

Emission and Air Quality Trends Review

Indiana

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

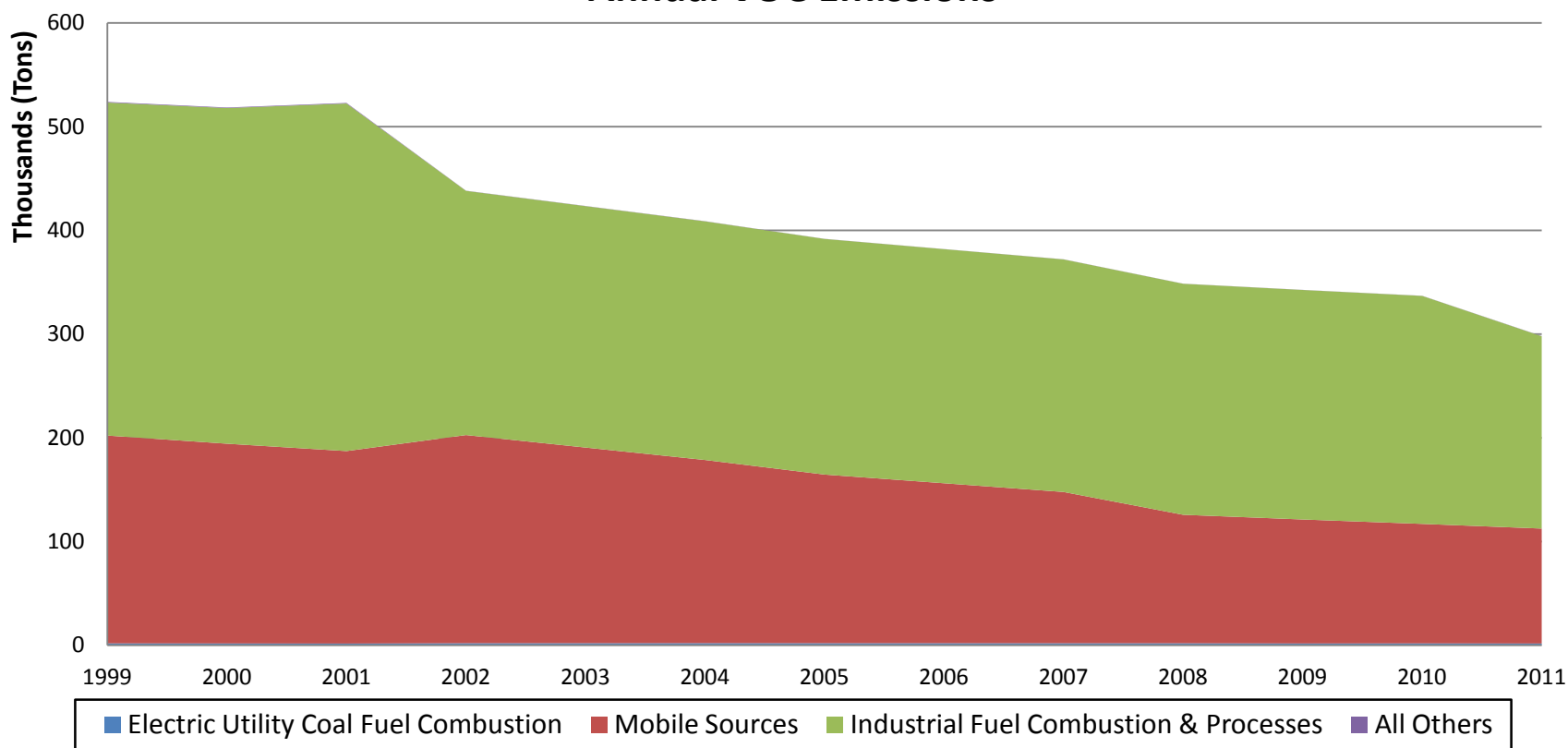
Indiana Emission Trends (VOC)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	1,822	1,625	1,956	1,952	1,950	1,912	1,903	1,711	1,795	1,669
Mobile Sources	200,333	185,579	188,651	162,616	154,235	145,855	123,883	119,548	115,213	110,816
Industrial Fuel Combustion & Processes	321,092	335,121	232,751	227,167	225,693	224,218	222,744	221,270	219,796	185,452
All Others	616	550	160	108	96	109	98	96	122	169
Total	523,862	522,875	423,517	391,842	381,974	372,095	348,628	342,624	336,926	298,106

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	-11%	7%	7%	7%	5%	4%	-6%	-1%	-8%
Mobile Sources	0%	-7%	-6%	-19%	-23%	-27%	-38%	-40%	-42%	-45%
Industrial Fuel Combustion & Processes	0%	4%	-28%	-29%	-30%	-30%	-31%	-31%	-32%	-42%
All Others	0%	-11%	-74%	-83%	-84%	-82%	-84%	-84%	-80%	-73%
Total	0%	0%	-19%	-25%	-27%	-29%	-33%	-35%	-36%	-43%

Indiana Emission Trends (VOC)

**Major Source Category Summary
Annual VOC Emissions**



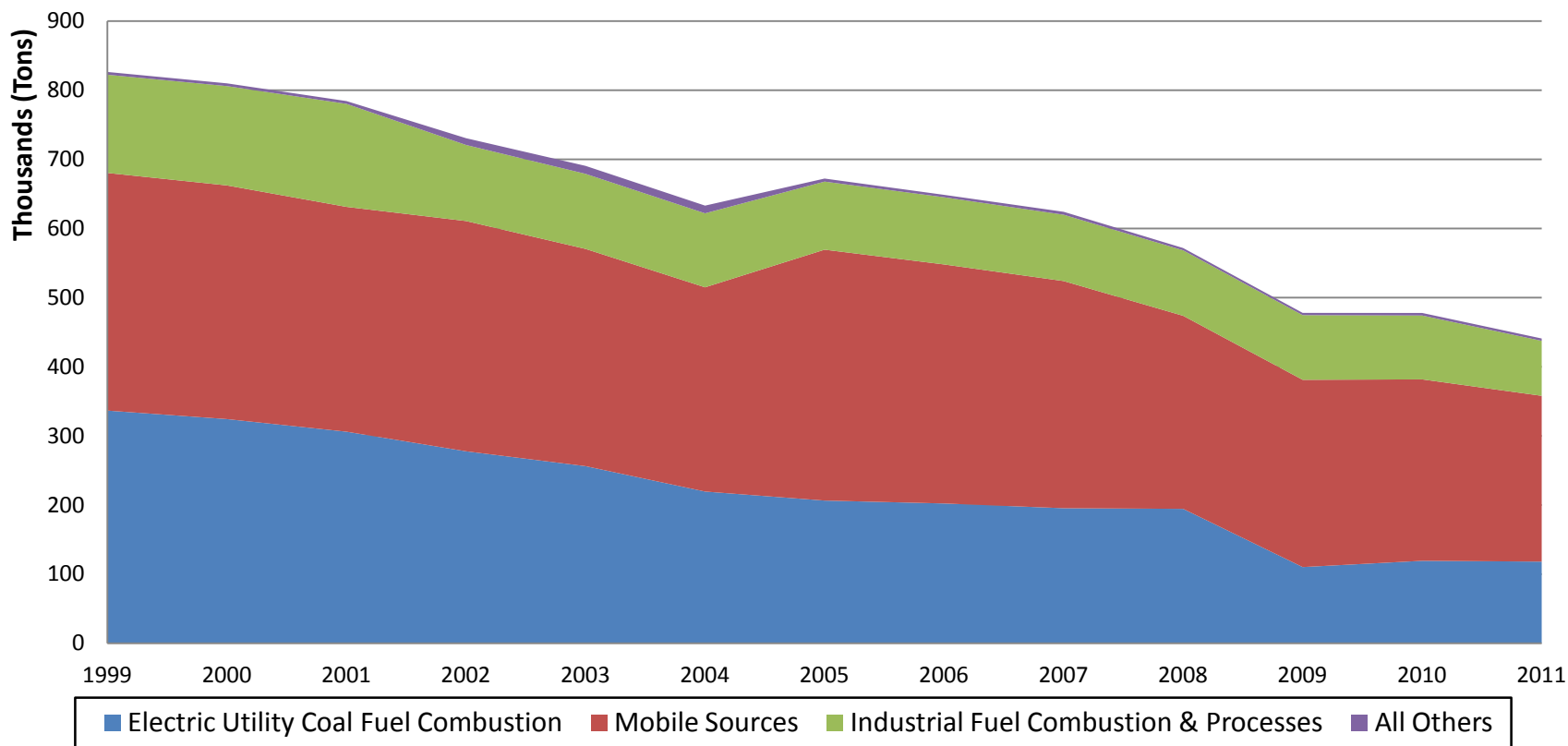
Indiana Emission Trends (NO_x)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	336,563	306,039	256,204	206,422	202,204	195,345	194,441	110,233	119,272	118,114
Mobile Sources	343,743	325,205	314,224	362,905	345,751	328,596	279,259	270,846	262,432	239,832
Industrial Fuel Combustion & Processes	142,074	148,992	108,599	98,470	97,191	95,930	94,708	93,541	92,388	79,511
All Others	4,012	4,032	11,510	4,405	3,484	4,247	3,291	3,276	3,693	3,377
Total	826,392	784,268	690,537	672,203	648,630	624,119	571,699	477,896	477,786	440,835

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	-9%	-24%	-39%	-40%	-42%	-42%	-67%	-65%	-65%
Mobile Sources	0%	-5%	-9%	6%	1%	-4%	-19%	-21%	-24%	-30%
Industrial Fuel Combustion & Processes	0%	5%	-24%	-31%	-32%	-32%	-33%	-34%	-35%	-44%
All Others	0%	1%	187%	10%	-13%	6%	-18%	-18%	-8%	-16%
Total	0%	-5%	-16%	-19%	-22%	-24%	-31%	-42%	-42%	-47%

Indiana Emission Trends (NO_x)

**Major Source Category Summary
Annual NO_x Emissions**



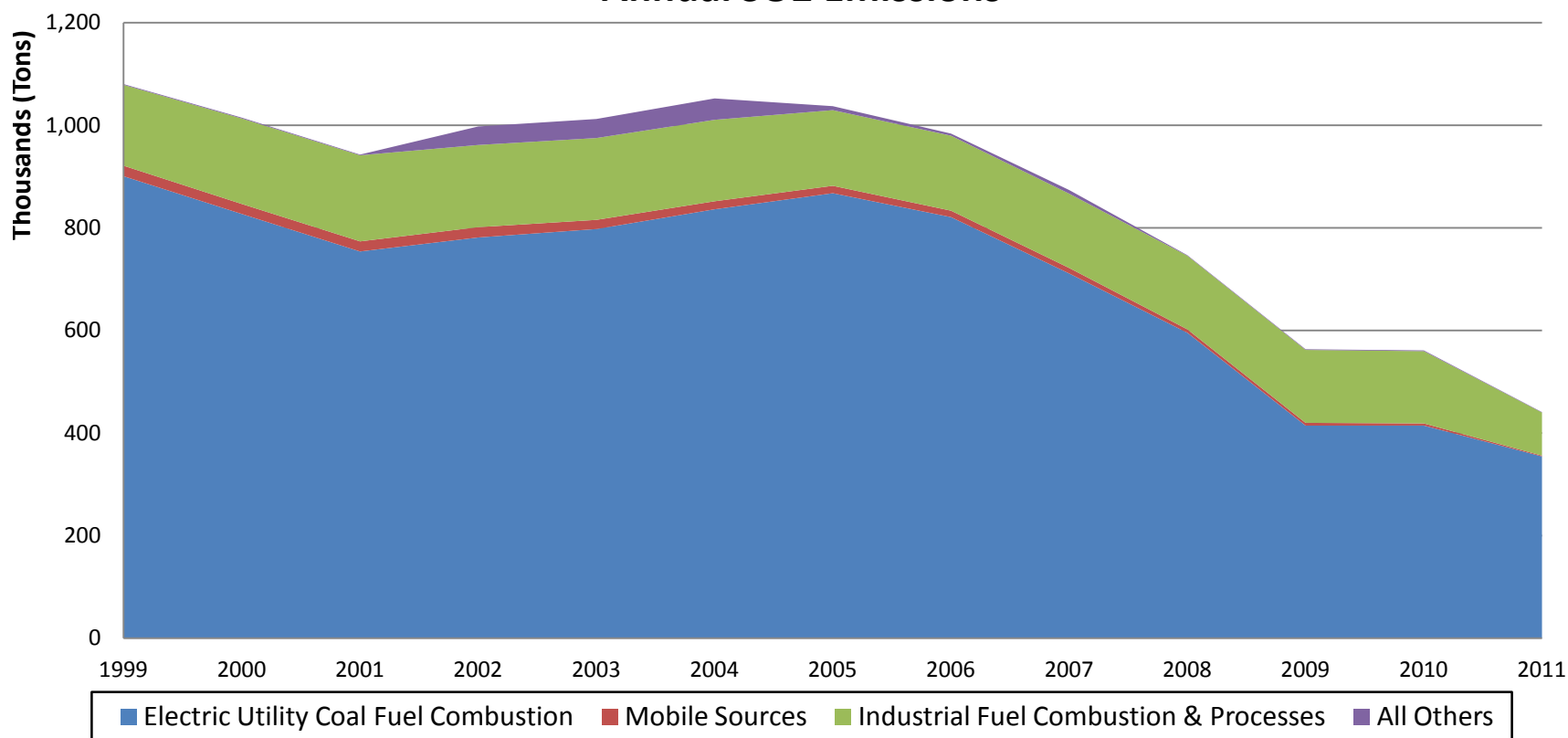
Indiana Emission Trends (SO₂)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	900,605	753,946	797,688	867,541	820,899	711,034	595,423	414,424	414,535	354,405
Mobile Sources	20,507	19,673	17,883	14,434	12,591	10,747	6,668	5,425	4,183	1,628
Industrial Fuel Combustion & Processes	157,681	167,864	159,534	147,507	146,178	144,839	143,521	142,223	140,926	83,961
All Others	1,418	1,343	37,144	7,718	4,098	7,065	1,056	1,262	1,465	789
Total	1,080,210	942,825	1,012,248	1,037,199	983,765	873,685	746,667	563,334	561,110	440,784

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	-16%	-11%	-4%	-9%	-21%	-34%	-54%	-54%	-61%
Mobile Sources	0%	-4%	-13%	-30%	-39%	-48%	-67%	-74%	-80%	-92%
Industrial Fuel Combustion & Processes	0%	6%	1%	-6%	-7%	-8%	-9%	-10%	-11%	-47%
All Others	0%	-5%	2520%	444%	189%	398%	-26%	-11%	3%	-44%
Total	0%	-13%	-6%	-4%	-9%	-19%	-31%	-48%	-48%	-59%

Indiana Emission Trends (SO₂)

**Major Source Category Summary
Annual SO₂ Emissions**



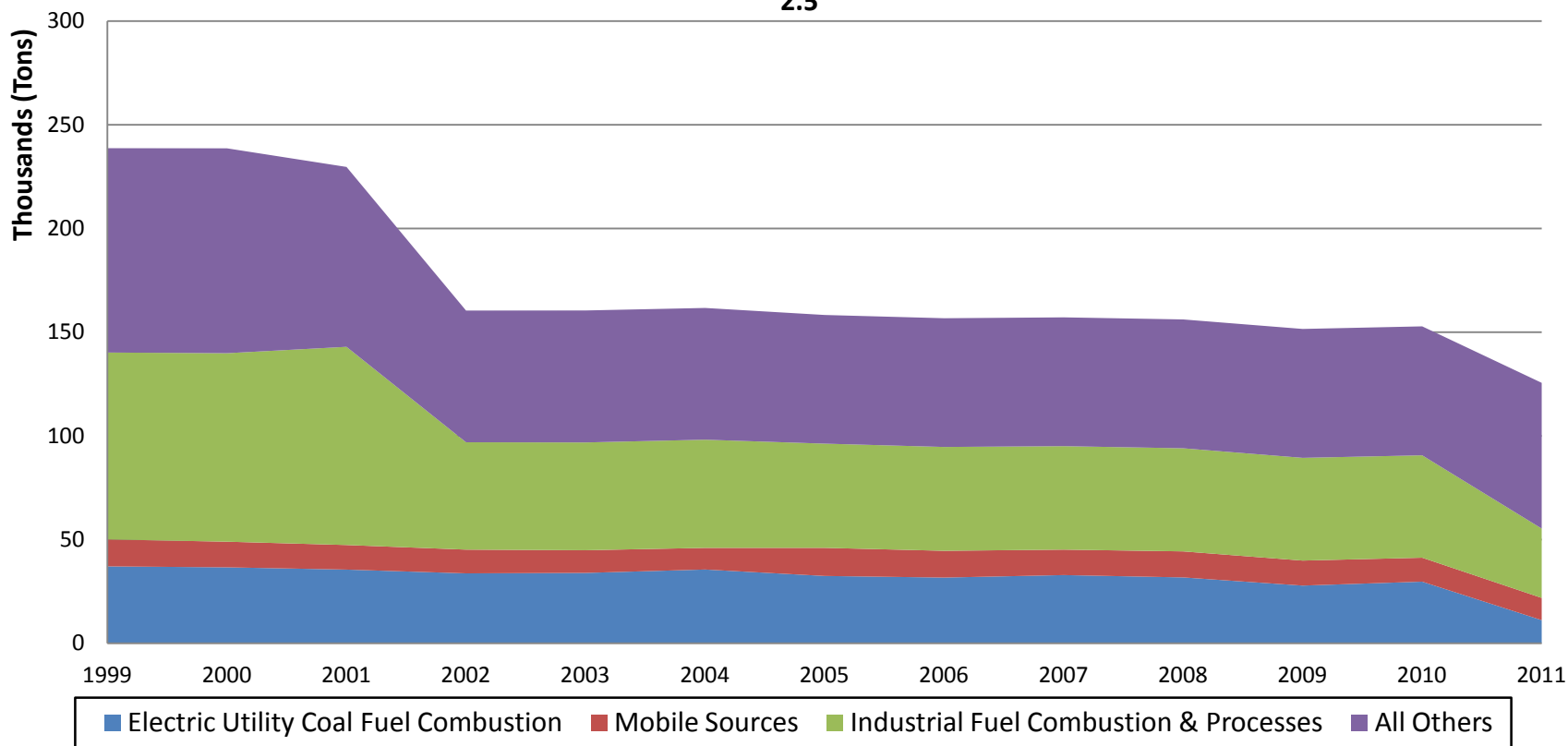
Indiana Emission Trends (PM_{2.5})

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	37,068	35,523	33,920	32,453	31,671	32,875	31,746	27,808	29,702	11,156
Mobile Sources	12,994	11,848	10,935	13,548	12,911	12,274	12,556	12,057	11,558	10,714
Industrial Fuel Combustion & Processes	90,115	95,557	51,969	50,244	50,068	49,891	49,714	49,537	49,360	33,436
All Others	98,528	86,741	63,638	62,043	62,066	62,099	62,122	62,150	62,183	70,261
Total	238,706	229,669	160,463	158,288	156,715	157,138	156,138	151,551	152,803	125,566

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%	-8%	-12%	-15%	-11%	-14%	-25%	-20%	-70%
Mobile Sources	0%	-9%	-16%	4%	-1%	-6%	-3%	-7%	-11%	-18%
Industrial Fuel Combustion & Processes	0%	6%	-42%	-44%	-44%	-45%	-45%	-45%	-45%	-63%
All Others	0%	-12%	-35%	-37%	-37%	-37%	-37%	-37%	-37%	-29%
Total	0%	-4%	-33%	-34%	-34%	-34%	-35%	-37%	-36%	-47%

Indiana 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 Indiana
- ❑ 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

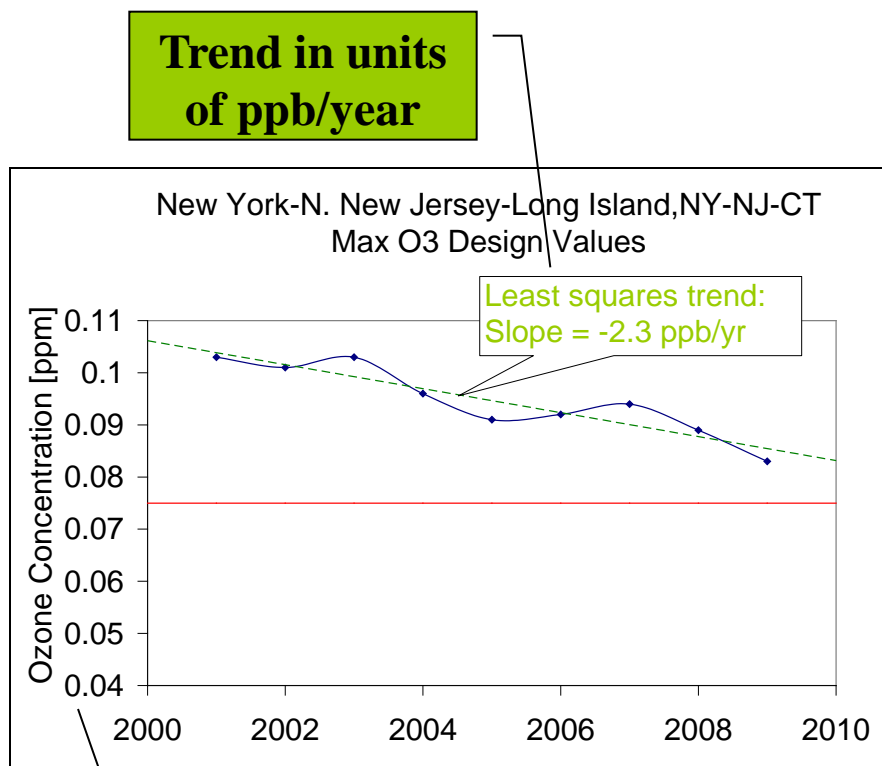
Data Handling Procedures

- ❑ 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

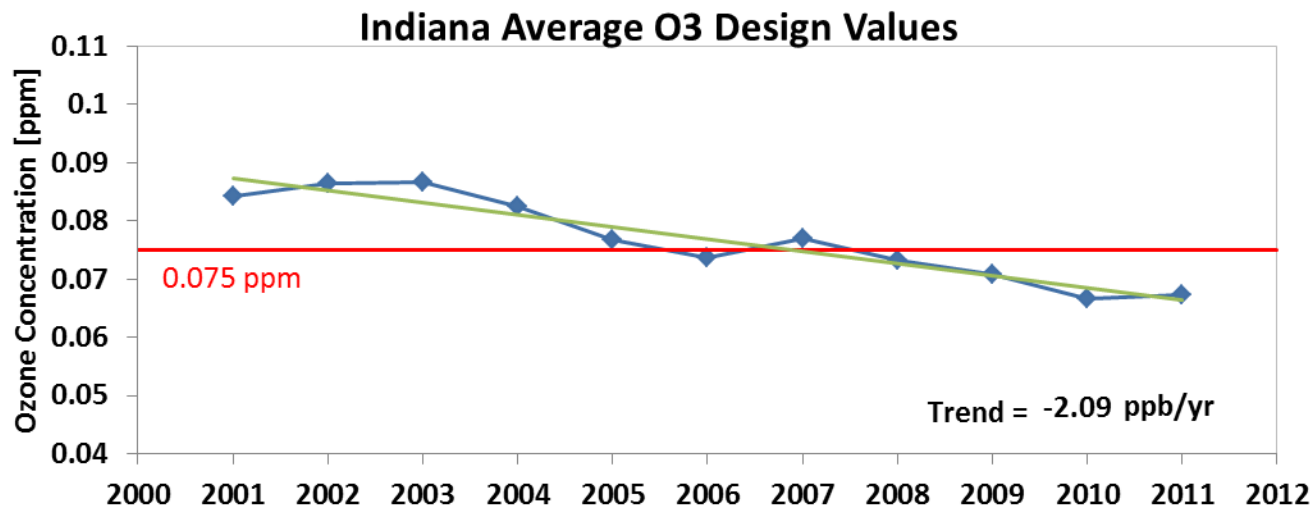
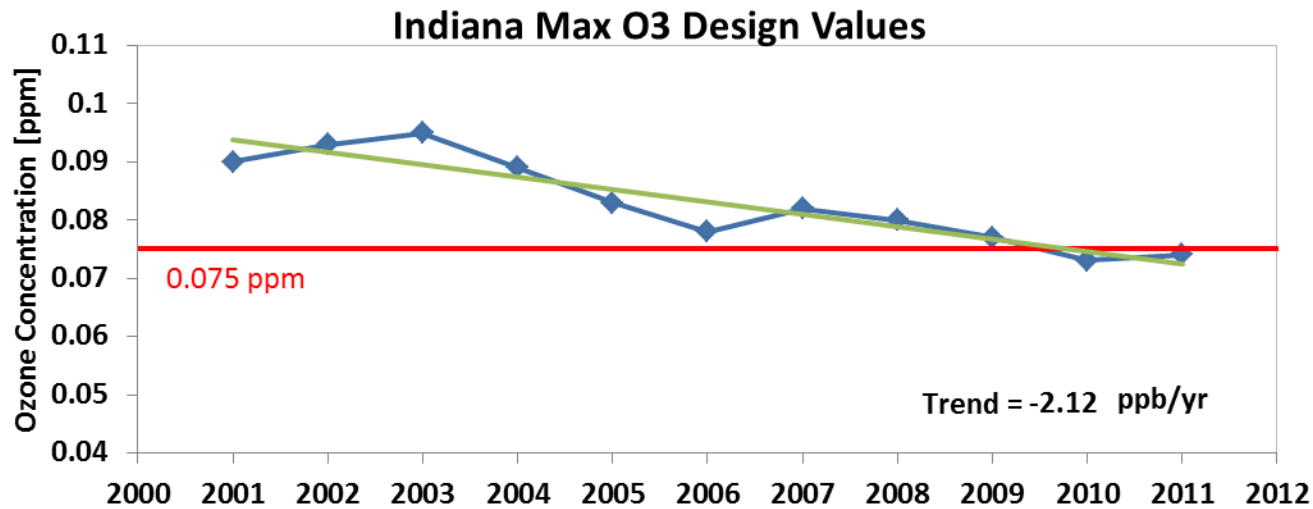
- Annual $PM_{2.5}$ DV and 24-hr $PM_{2.5}$ DV for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
 - DV calculations based on EPA data handling conventions
 - Data extracted from monitors that have a non-regulatory monitoring type are omitted
 - Selection of trend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

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
1800300024420101	Allen, IN	0.066	-2.59
1800300044420101	Allen, IN	0.068	-1.70
1801100014420101	Boone, IN	0.07	-2.14
1803500104420101	Delaware, IN	0.068	-2.58
1804310044420101	Floyd, IN	0.071	-1.45
1805500014420101	Greene, IN	N/A	-2.15
1805900034420101	Hancock, IN	0.069	-2.46
1806300044420101	Hendricks, IN	0.068	-2.13
1806900024420101	Huntington, IN	0.064	-2.69
1807100014420101	Jackson, IN	0.066	-2.10
1808100024420101	Johnson, IN	0.069	-1.92

Note: Only monitoring sites meeting data completeness criteria listed

Ozone Trends by Site in Indiana

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
1808900224420101	Lake, IN	0.062	-2.00
1808920084420101	Lake, IN	0.068	-2.63
1809100054420101	La Porte, IN	0.072	-2.63
1809100104420101	La Porte, IN	0.066	-2.01
1809500104420101	Madison, IN	0.066	-3.01
1809700504420101	Marion, IN	0.074	-1.86
1809700574420101	Marion, IN	0.067	-1.97
1809700734420101	Marion, IN	0.068	-2.50
1810900054420101	Morgan, IN	0.068	-2.02
1812700244420101	Porter, IN	0.067	-2.38
1812700264420101	Porter, IN	0.062	-2.58

Note: Only monitoring sites meeting data completeness criteria listed

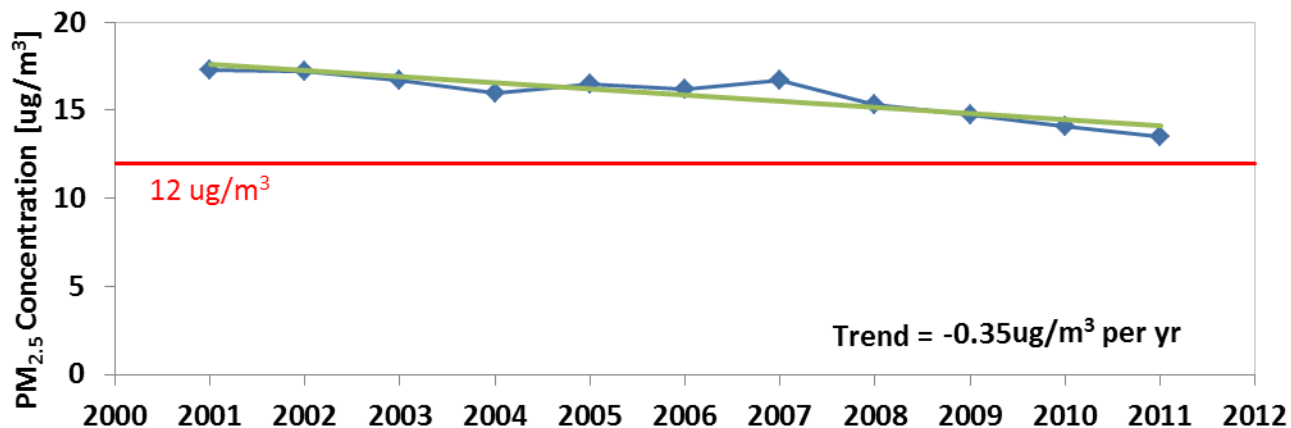
Ozone Trends by Site in Indiana

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
1812900034420101	Posey, IN	0.07	-1.99
1814100104420101	St. Joseph, IN	0.061	-2.51
1814110074420101	St. Joseph, IN	0.064	-2.79
1814500014420101	Shelby, IN	0.072	-2.59
1816300124420101	Vanderburgh, IN	N/A	-1.20
1816300134420101	Vanderburgh, IN	0.07	-0.45
1816700184420101	Vigo, IN	0.062	-1.80
1816700244420101	Vigo, IN	0.064	-2.92
1817300084420101	Warrick, IN	0.069	-1.15
1817300094420101	Warrick, IN	0.068	-1.54

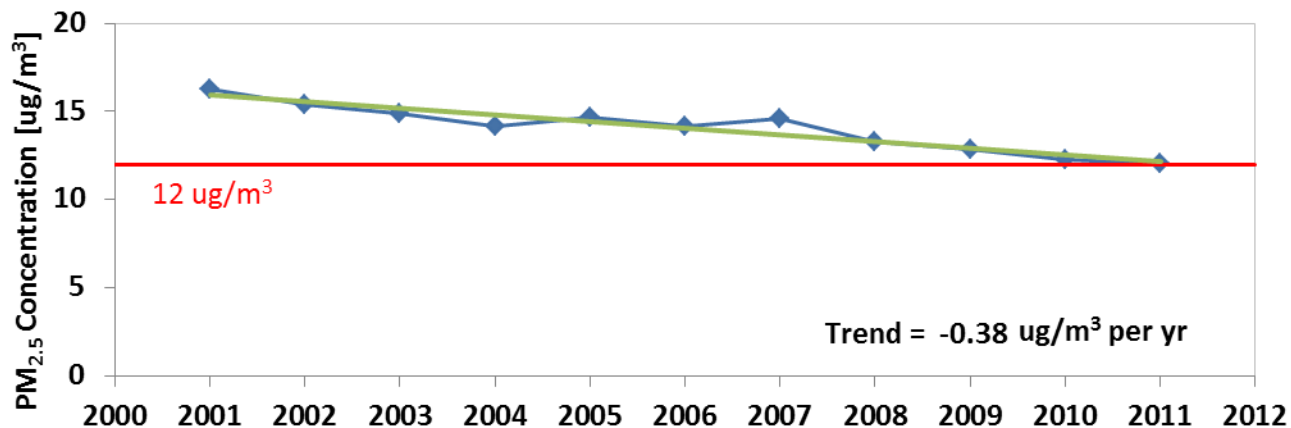
Note: Only monitoring sites meeting data completeness criteria listed

Max/Ave PM_{2.5} Annual DVs and Trend

Indiana Max PM_{2.5} Annual Design Values

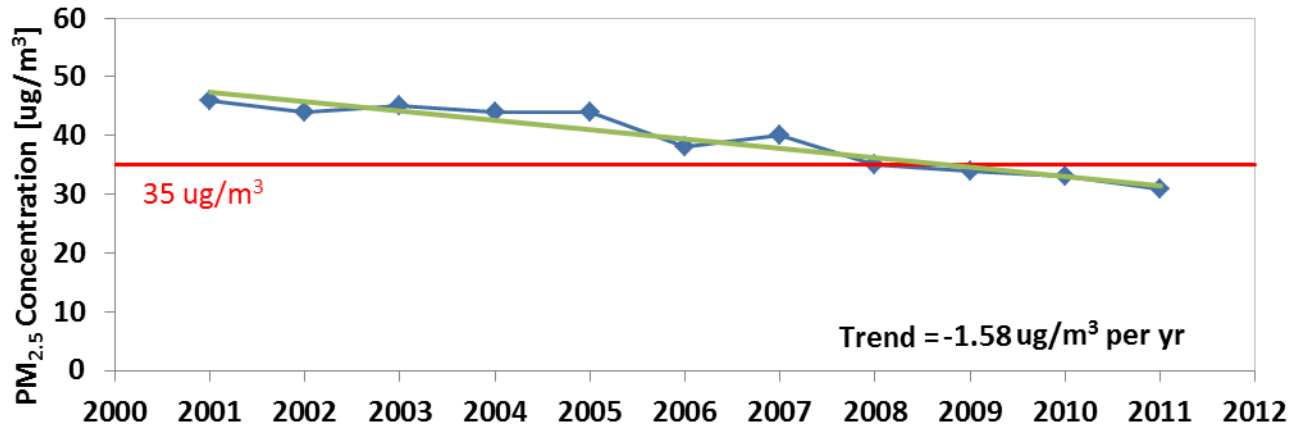


Indiana Average PM_{2.5} Annual Design Values

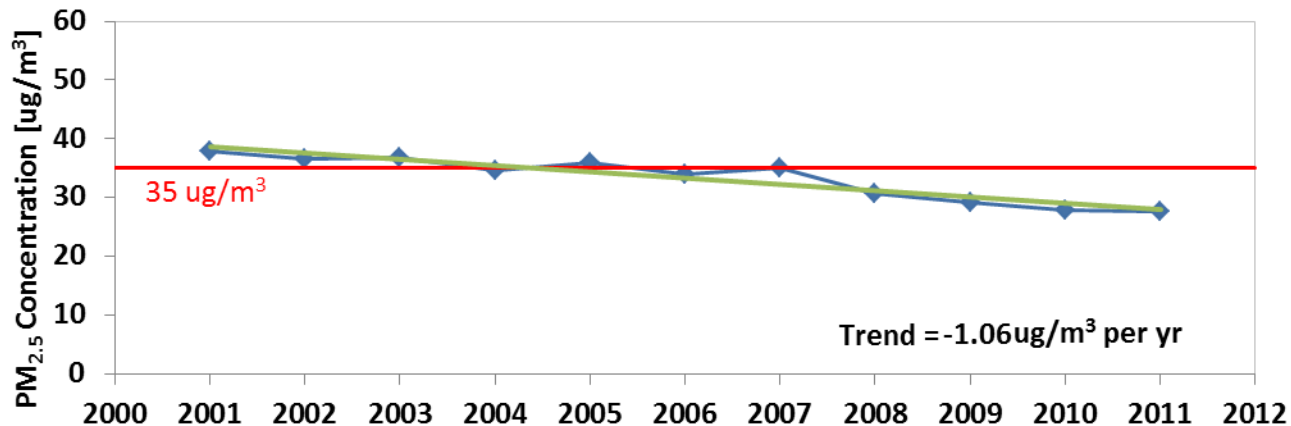


Max/Ave PM_{2.5} 24-Hour DVs and Trend

Indiana Max PM_{2.5} 24-Hour Design Values



Indiana Average PM_{2.5} 24-Hour Design Values



PM_{2.5} Trends by Site in Indiana

Monitoring Site	County	2009-2011 DV [ug/m ³]		Trend [ug/m ³ per year]	
		Annual	24-Hr	Annual DV	24-Hr DV
180030004	Allen	11.0	26	-0.41	-0.73
180190006	Clark	13.5	28	-0.33	-1.32
180350006	Delaware	N/A	26	N/A	-1.03
180431004	Floyd	12.3	26	-0.31	-1.20
180670003	Howard	11.6	26	-0.41	-0.92
180830004	Knox	N/A	26	N/A	-1.48
180890006	Lake	11.7	27	-0.40	-1.12
180890022	Lake	N/A	31	N/A	-1.85
180890026	Lake	N/A	31	N/A	-1.06
180892010	Lake	11.1	27	-0.44	-1.06

Note: Only monitoring sites meeting data completeness criteria listed

PM_{2.5} Trends by Site in Indiana

Monitoring Site	County	2009-2011 DV [ug/m ³]		Trend [ug/m ³ per year]	
		Annual	24-Hr	Annual DV	24-Hr DV
180910011	LaPorte	10.2	N/A	-0.37	N/A
180970043	Marion	N/A	30	N/A	-0.74
180970078	Marion	12.4	28	-0.44	-0.95
180970081	Marion	13.1	N/A	-0.35	N/A
180970083	Marion	13.0	30	-0.43	-0.89
181270024	Porter	11.1	27	-0.31	-0.66
181470009	Spencer	12.4	27	-0.28	-0.73
181630016	Vanderburgh	12.7	28	-0.38	-1.33
181670018	Vigo	12.4	27	-0.29	-1.25
181670023	Vigo	N/A	N/A	-0.18	-0.92

Note: Only monitoring sites meeting data completeness criteria listed

Air Quality Trends Summary

- Average O₃ and PM_{2.5} design values have decreased since 1999 in Indiana
- O₃ and PM_{2.5} design values have decreased since 1999 in all currently designated O₃ and PM_{2.5} non-attainment areas in Indiana