

Emission and Air Quality Trends Review 1999-2011

Kansas

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

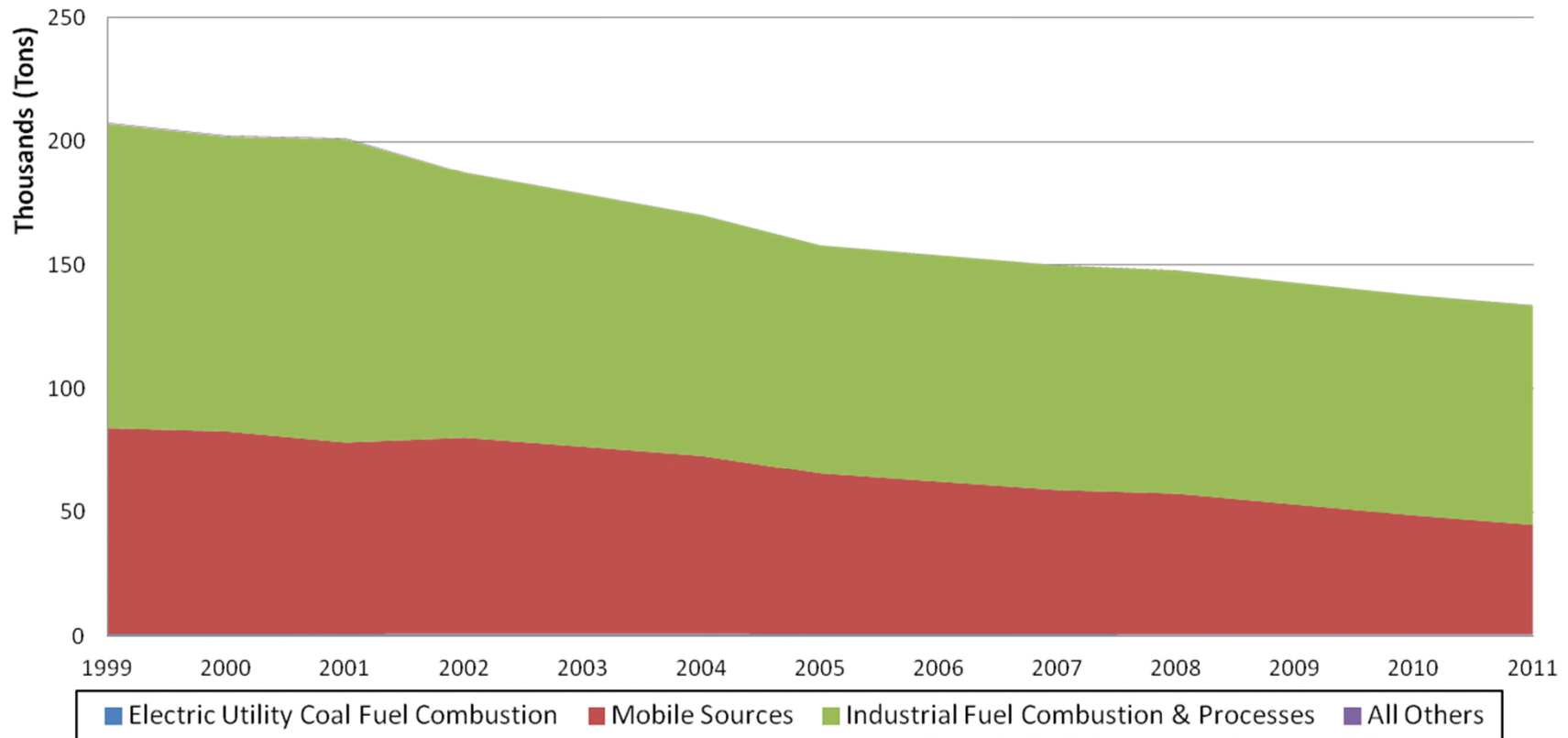
Kansas Emission Trends (VOC)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	658	658	780	615	608	638	581	567	577	623
Mobile Sources	83,590	77,769	75,960	65,109	61,695	58,280	56,879	52,490	48,101	44,244
Industrial Fuel Combustion & Processes	123,116	122,730	101,979	92,184	91,587	90,990	90,393	89,797	89,200	88,955
All Others	242	257	88	64	59	64	58	56	47	93
Total	207,605	201,414	178,808	157,971	153,949	149,972	147,912	142,910	137,924	133,915

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%	19%	-7%	-8%	-3%	-12%	-14%	-12%	-5%
Mobile Sources	0%	-7%	-9%	-22%	-26%	-30%	-32%	-37%	-42%	-47%
Industrial Fuel Combustion & Processes	0%	0%	-17%	-25%	-26%	-26%	-27%	-27%	-28%	-28%
All Others	0%	6%	-64%	-74%	-76%	-74%	-76%	-77%	-81%	-61%
Total	0%	-3%	-14%	-24%	-26%	-28%	-29%	-31%	-34%	-35%

Kansas Emission Trends (VOC)

**Major Source Category Summary
Annual VOC Emissions**



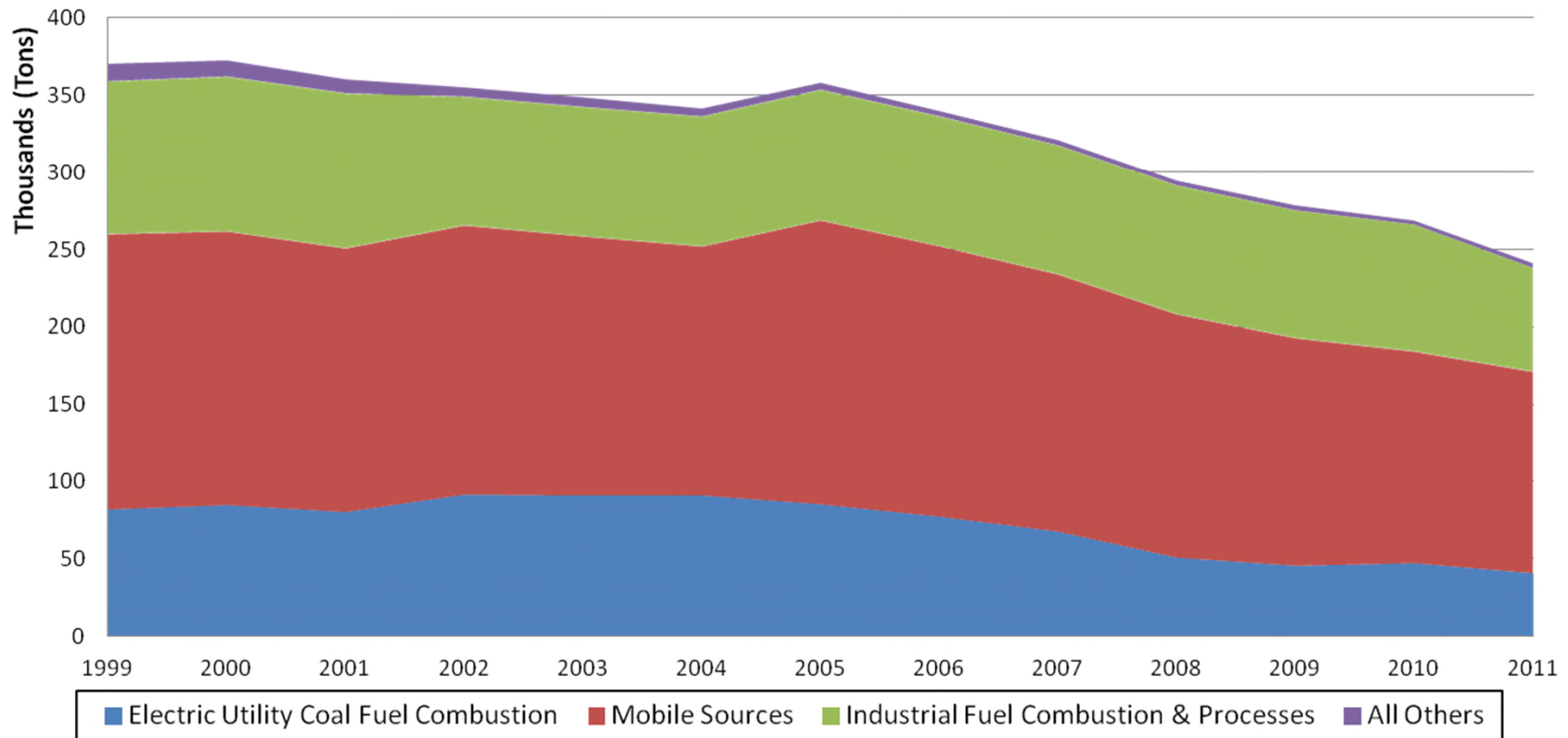
Kansas Emission Trends (NO_x)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	81,529	79,838	90,614	84,889	76,866	67,229	50,424	45,177	46,841	40,323
Mobile Sources	178,453	170,911	167,885	183,904	175,326	166,748	157,794	147,527	137,260	130,694
Industrial Fuel Combustion & Processes	99,266	100,696	84,088	84,963	84,348	83,732	83,115	82,498	81,884	66,968
All Others	11,209	8,947	6,091	4,404	3,282	3,202	2,967	3,059	2,442	2,939
Total	370,457	360,391	348,678	358,160	339,822	320,910	294,300	278,261	268,427	240,924

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%	11%	4%	-6%	-18%	-38%	-45%	-43%	-51%
Mobile Sources	0%	-4%	-6%	3%	-2%	-7%	-12%	-17%	-23%	-27%
Industrial Fuel Combustion & Processes	0%	1%	-15%	-14%	-15%	-16%	-16%	-17%	-18%	-33%
All Others	0%	-20%	-46%	-61%	-71%	-71%	-74%	-73%	-78%	-74%
Total	0%	-3%	-6%	-3%	-8%	-13%	-21%	-25%	-28%	-35%

Kansas Emission Trends (NO_x)

Major Source Category Summary
Annual NO_x Emissions



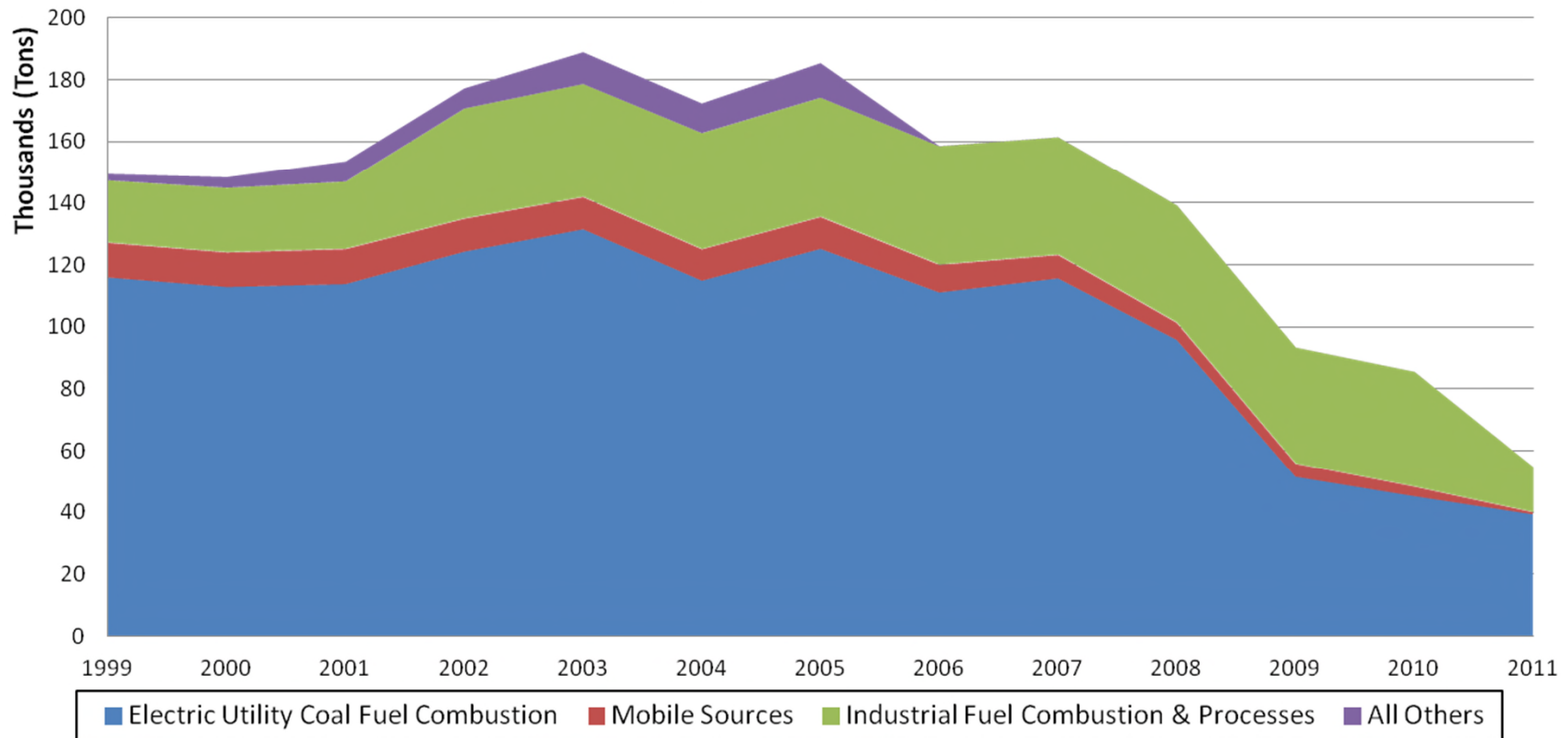
Kansas Emission Trends (SO₂)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	116,065	113,932	131,652	125,321	111,220	115,779	95,916	51,581	45,279	39,375
Mobile Sources	11,205	11,323	10,387	10,287	8,929	7,569	5,543	4,331	3,119	712
Industrial Fuel Combustion & Processes	20,046	21,685	36,677	38,689	38,375	38,061	37,748	37,434	37,120	14,608
All Others	2,095	6,574	10,306	11,198	60	50	43	37	31	35
Total	149,410	153,514	189,022	185,495	158,584	161,459	139,250	93,383	85,549	54,730

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%	13%	8%	-4%	0%	-17%	-56%	-61%	-66%
Mobile Sources	0%	1%	-7%	-8%	-20%	-32%	-51%	-61%	-72%	-94%
Industrial Fuel Combustion & Processes	0%	8%	83%	93%	91%	90%	88%	87%	85%	-27%
All Others	0%	214%	392%	435%	-97%	-98%	-98%	-98%	-99%	-98%
Total	0%	3%	27%	24%	6%	8%	-7%	-37%	-43%	-63%

Kansas Emission Trends (SO₂)

**Major Source Category Summary
Annual SO₂ Emissions**



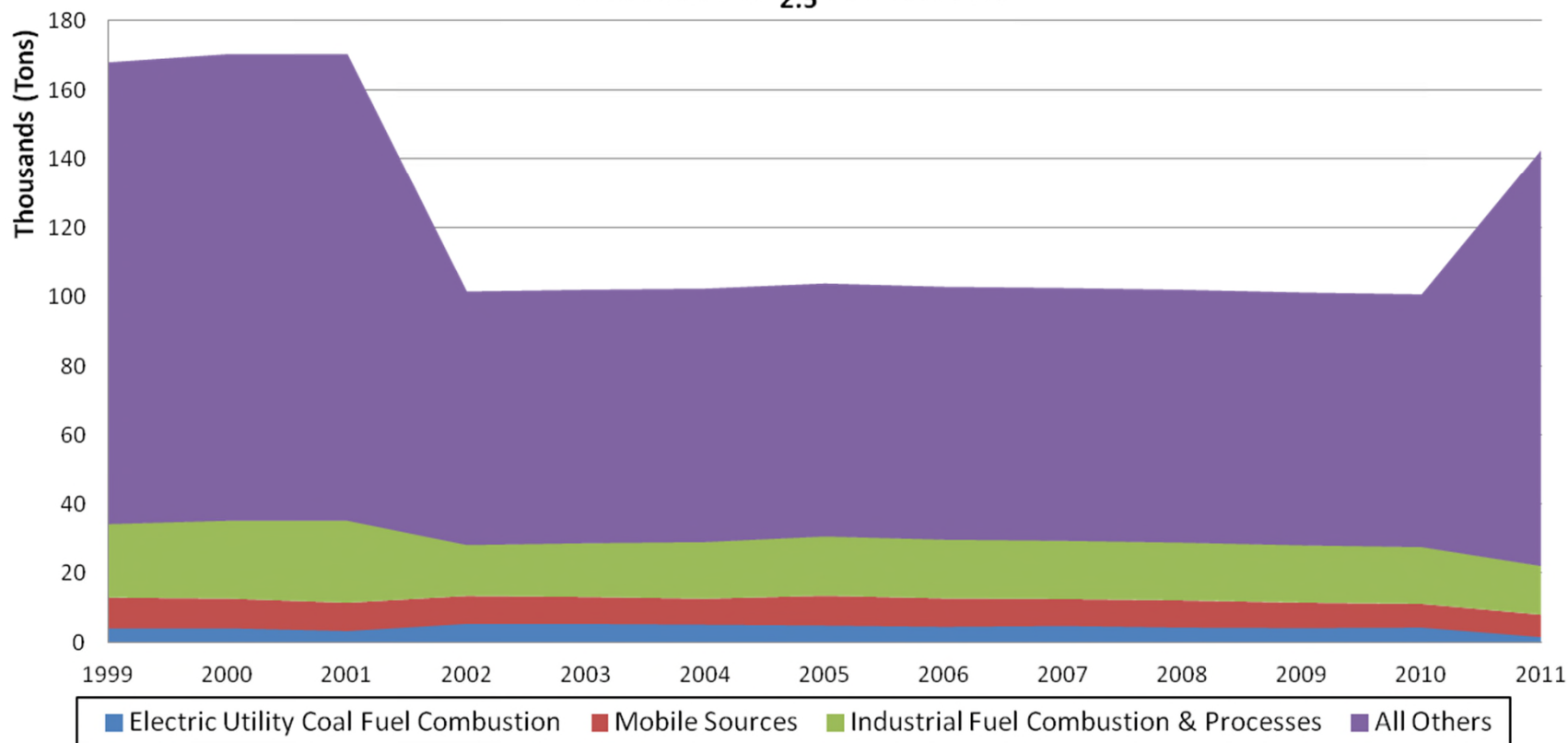
Kansas Emission Trends (PM_{2.5})

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	4,170	3,444	5,490	5,013	4,661	4,909	4,447	4,303	4,432	1,695
Mobile Sources	8,852	8,128	7,725	8,561	8,137	7,712	7,785	7,298	6,811	6,442
Industrial Fuel Combustion & Processes	21,282	23,701	15,586	17,160	17,015	16,869	16,724	16,579	16,433	14,062
All Others	133,637	135,056	73,302	73,159	73,109	73,105	73,117	73,107	73,084	120,287
Total	167,941	170,328	102,103	103,894	102,921	102,595	102,073	101,286	100,760	142,485

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	-17%	32%	20%	12%	18%	7%	3%	6%	-59%
Mobile Sources	0%	-8%	-13%	-3%	-8%	-13%	-12%	-18%	-23%	-27%
Industrial Fuel Combustion & Processes	0%	11%	-27%	-19%	-20%	-21%	-21%	-22%	-23%	-34%
All Others	0%	1%	-45%	-45%	-45%	-45%	-45%	-45%	-45%	-10%
Total	0%	1%	-39%	-38%	-39%	-39%	-39%	-40%	-40%	-15%

Kansas 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 Kansas
- NOx and SO2 from Electric Utility Fuel Combustion sources show decrease over time
- 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

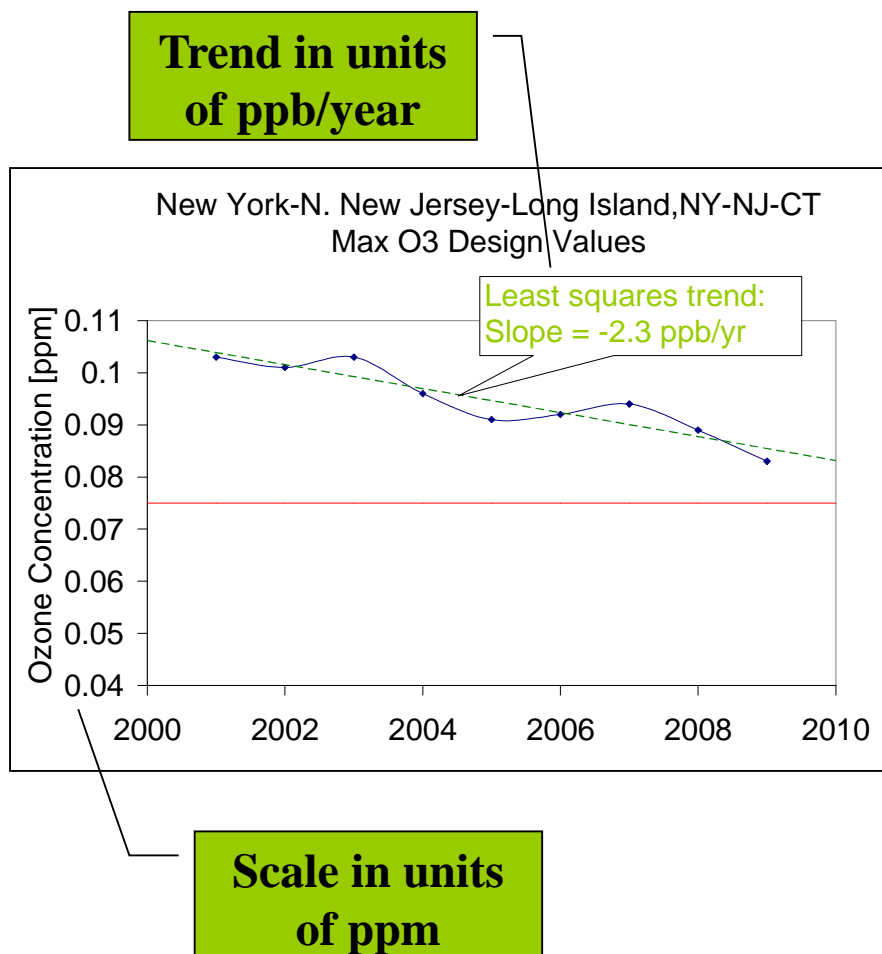
Data Handling Procedures

- 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

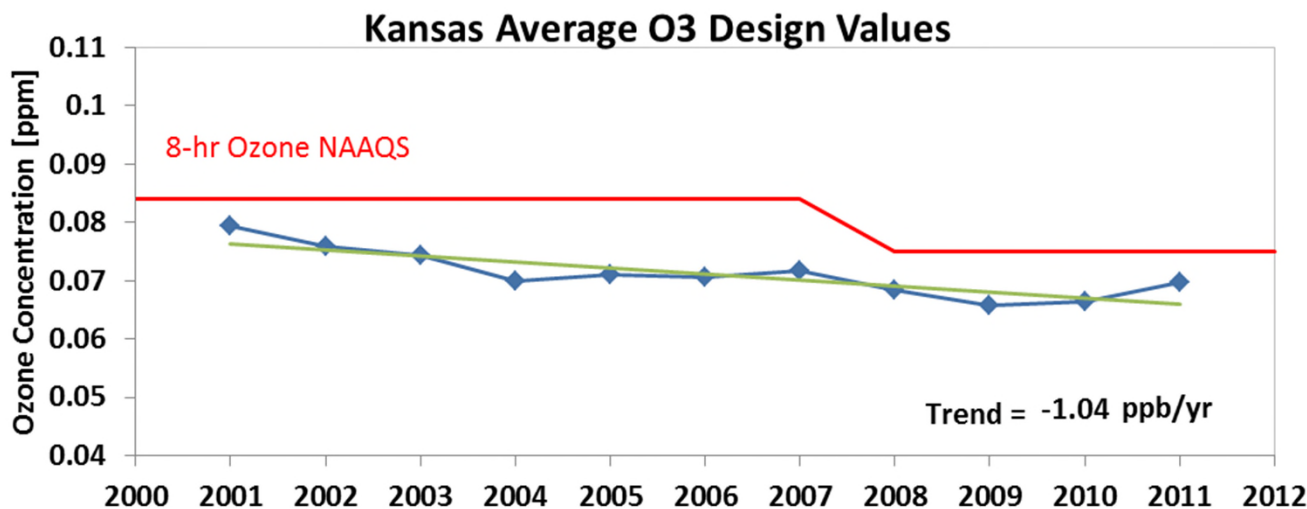
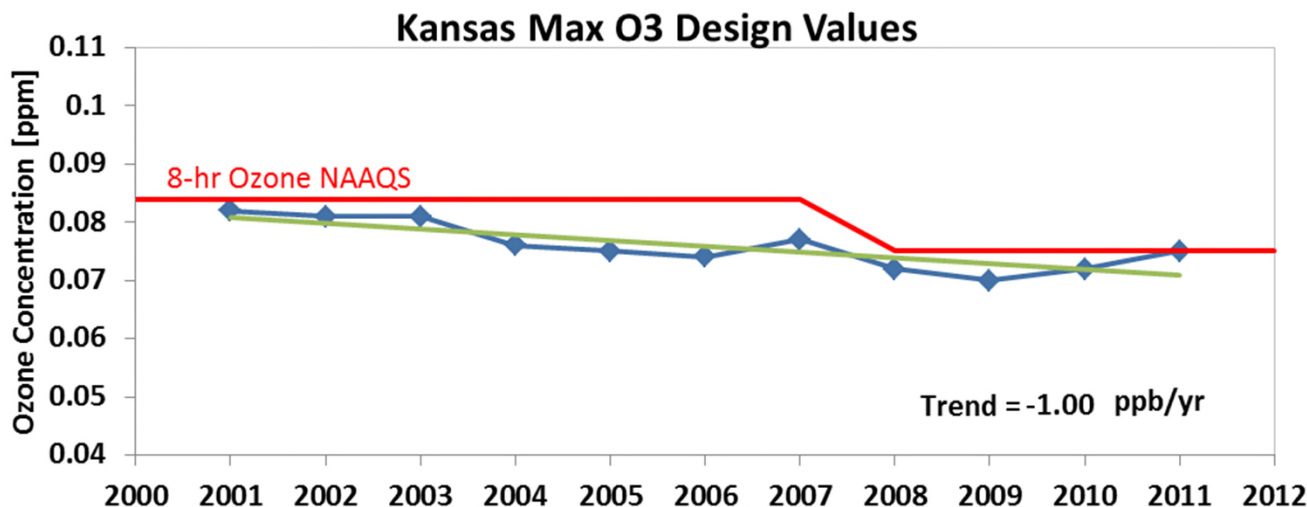
- Annual PM_{2.5} DV and 24-hr PM_{2.5} DV for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
 - DV calculations based on EPA data handling conventions
 - Data extracted from monitors that have a non-regulatory monitoring type are omitted
 - Selection of trend sites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



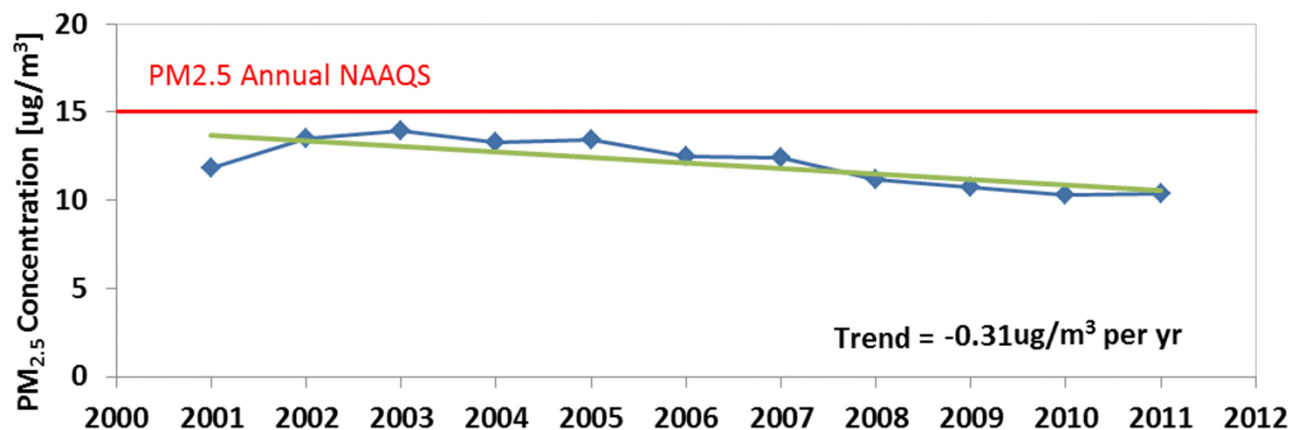
Ozone Trends by Site in Kansas

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
2010700024420101	Linn, KS	0.067	-1.32
2017300014420101	Sedgwick, KS	N/A	-1.27
2017300104420101	Sedgwick, KS	0.075	-1.25
2019100024420101	Sumner, KS	0.075	-0.71
2019500014420101	Trego, KS	0.071	0.63
2020900214420101	Wyandotte, KS	0.06	-2.07

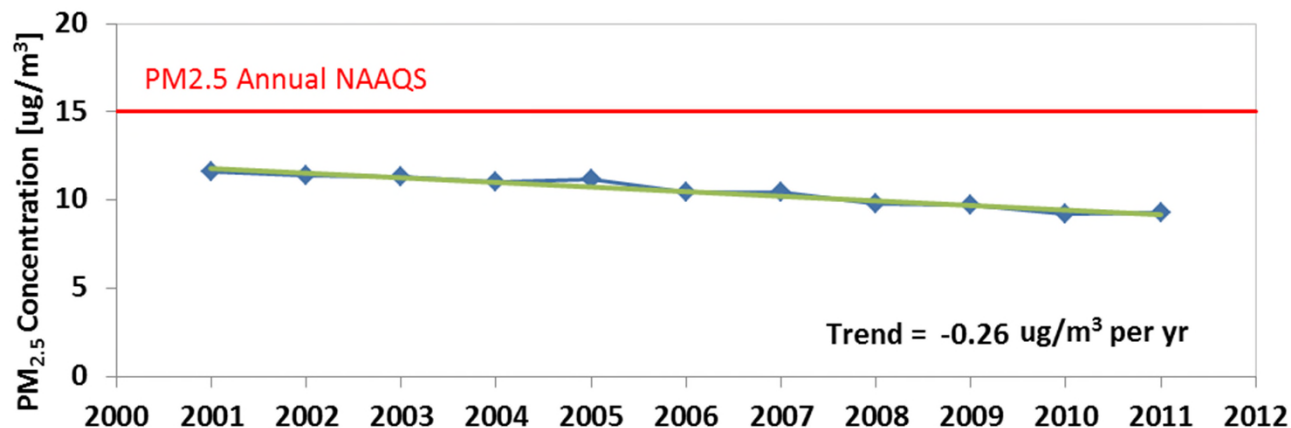
Note: Only monitoring sites meeting data completeness criteria listed

Max/Ave PM_{2.5} Annual DVs and Trend

Kansas Max PM_{2.5} Annual Design Values

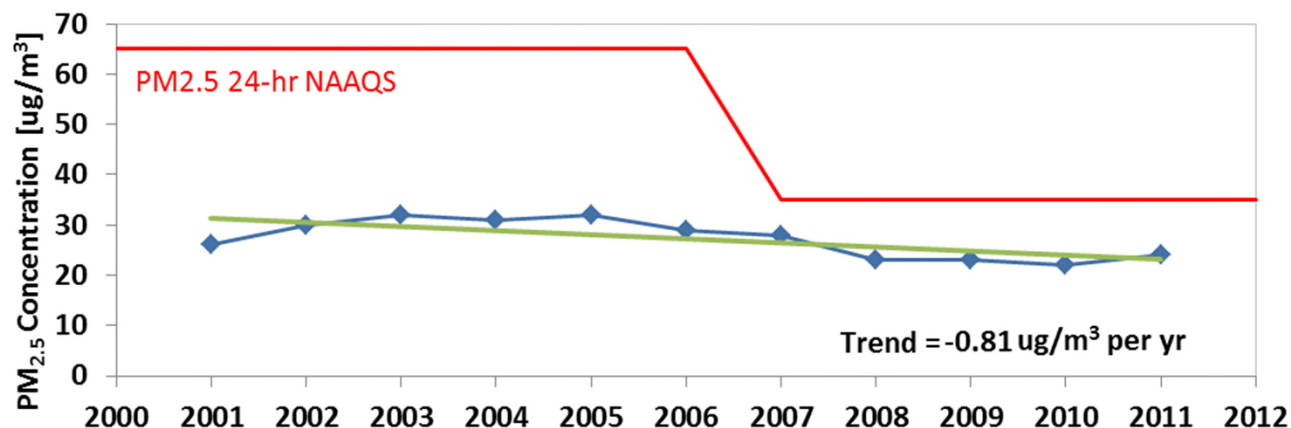


Kansas Average PM_{2.5} Annual Design Values

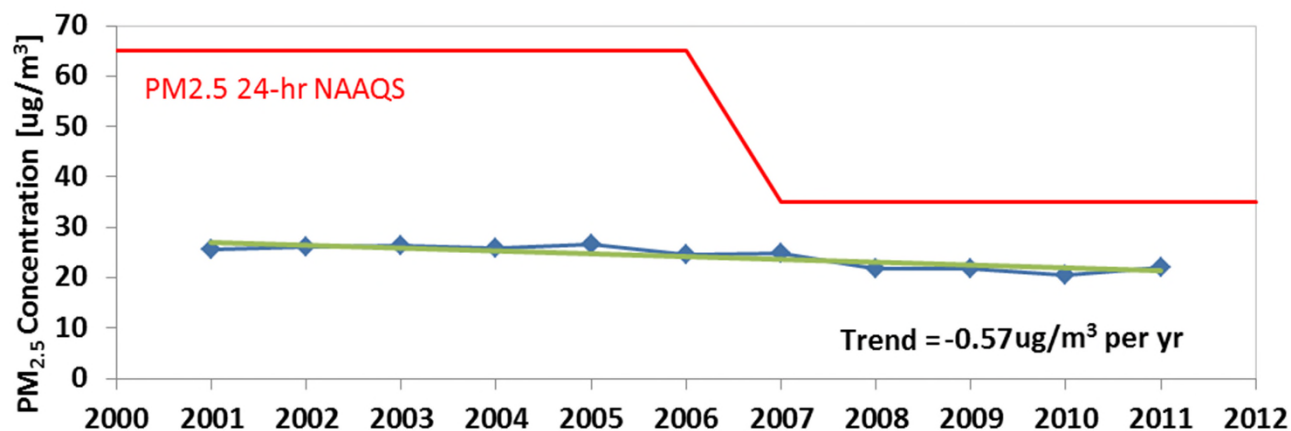


Max/Ave PM_{2.5} 24-Hour DVs and Trend

Kansas Max PM_{2.5} 24-Hour Design Values



Kansas Average PM_{2.5} 24-Hour Design Values



PM_{2.5} Trends by Site in Kansas

Monitoring Site	County	2009-2011 DV [ug/m ³]		Trend [ug/m ³ per year]	
		Annual	24-Hr	Annual DV	24-Hr DV
201070002	Linn	9.4	22	-0.17	-0.45
201730008	Sedgwick	9.1	22	-0.28	-0.58
201730009	Sedgwick	9.1	22	-0.26	-0.52
201730010	Sedgwick	8.9	21	-0.29	-0.65
201910002	Sumner	8.6	21	-0.22	-0.35
202090021	Wyandotte	10.4	24	-0.44	-1.19

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