ALPINE GEOPHYSICS

ENVIRON

Emission and Air Quality Trends Review 1999-2011

Illinois

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, NOx, SO_2, 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

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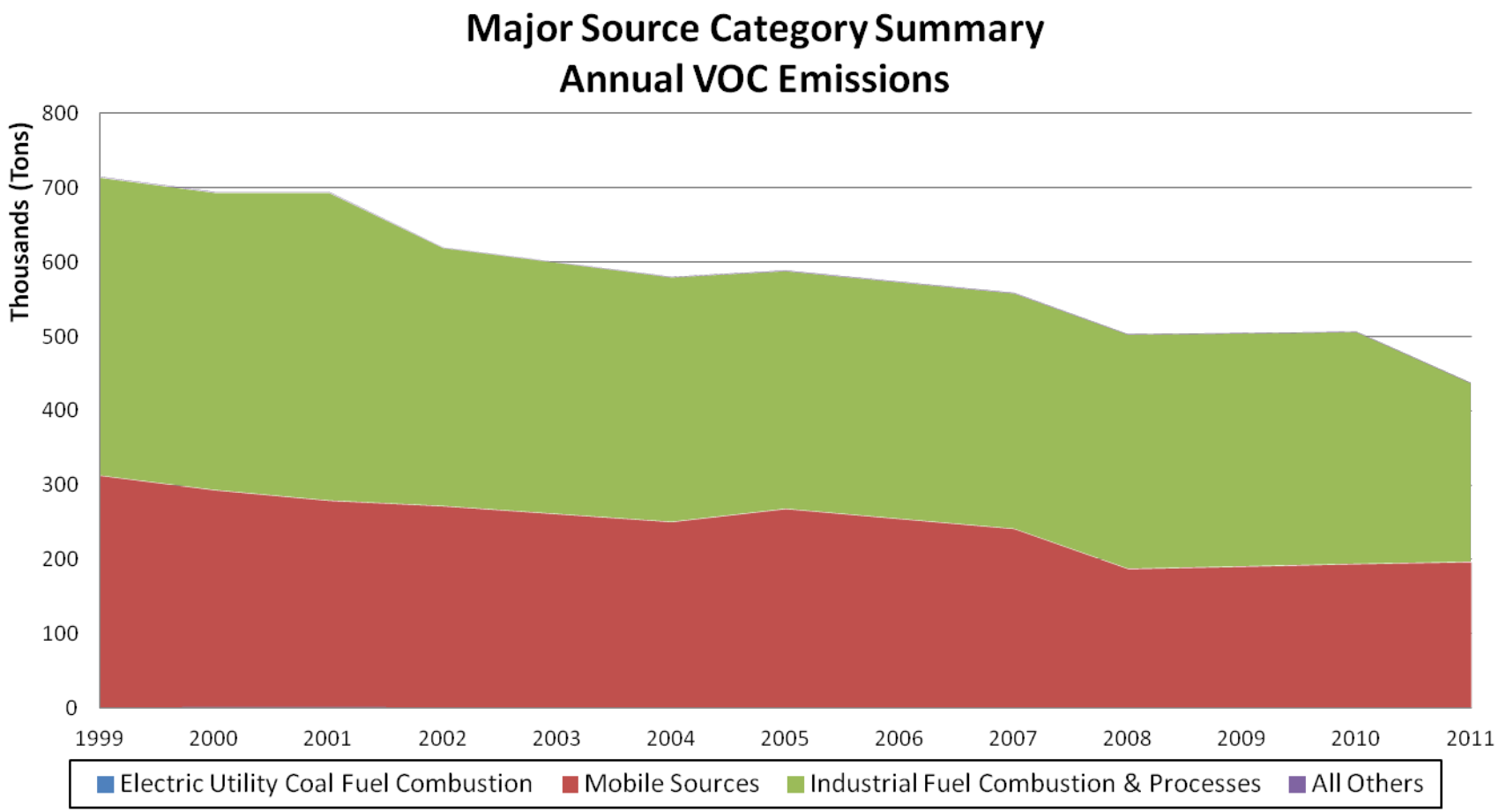
Illinois Emission Trends (VOC)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	1,146	1,819	1,476	1,282	1,244	1,351	1,293	1,231	1,276	1,430
Mobile Sources	311,520	277,282	259,546	266,706	253,212	239,719	185,791	189,098	192,405	194,995
Industrial Fuel Combustion & Processes	400,957	414,332	338,231	319,940	318,391	316,842	315,293	313,746	312,195	240,711
All Others	528	676	411	743	690	728	663	654	674	660
Total	**714,150**	**694,109**	**599,665**	**588,671**	**573,537**	**558,639**	**503,040**	**504,729**	**506,549**	**437,795**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	59%	29%	12%	9%	18%	13%	7%	11%	25%
Mobile Sources	0%	-11%	-17%	-14%	-19%	-23%	-40%	-39%	-38%	-37%
Industrial Fuel Combustion & Processes	0%	3%	-16%	-20%	-21%	-21%	-21%	-22%	-22%	-40%
All Others	0%	28%	-22%	41%	31%	38%	26%	24%	28%	25%
Total	**0%**	**-3%**	**-16%**	**-18%**	**-20%**	**-22%**	**-30%**	**-29%**	**-29%**	**-39%**

Illinois Emission Trends (VOC)



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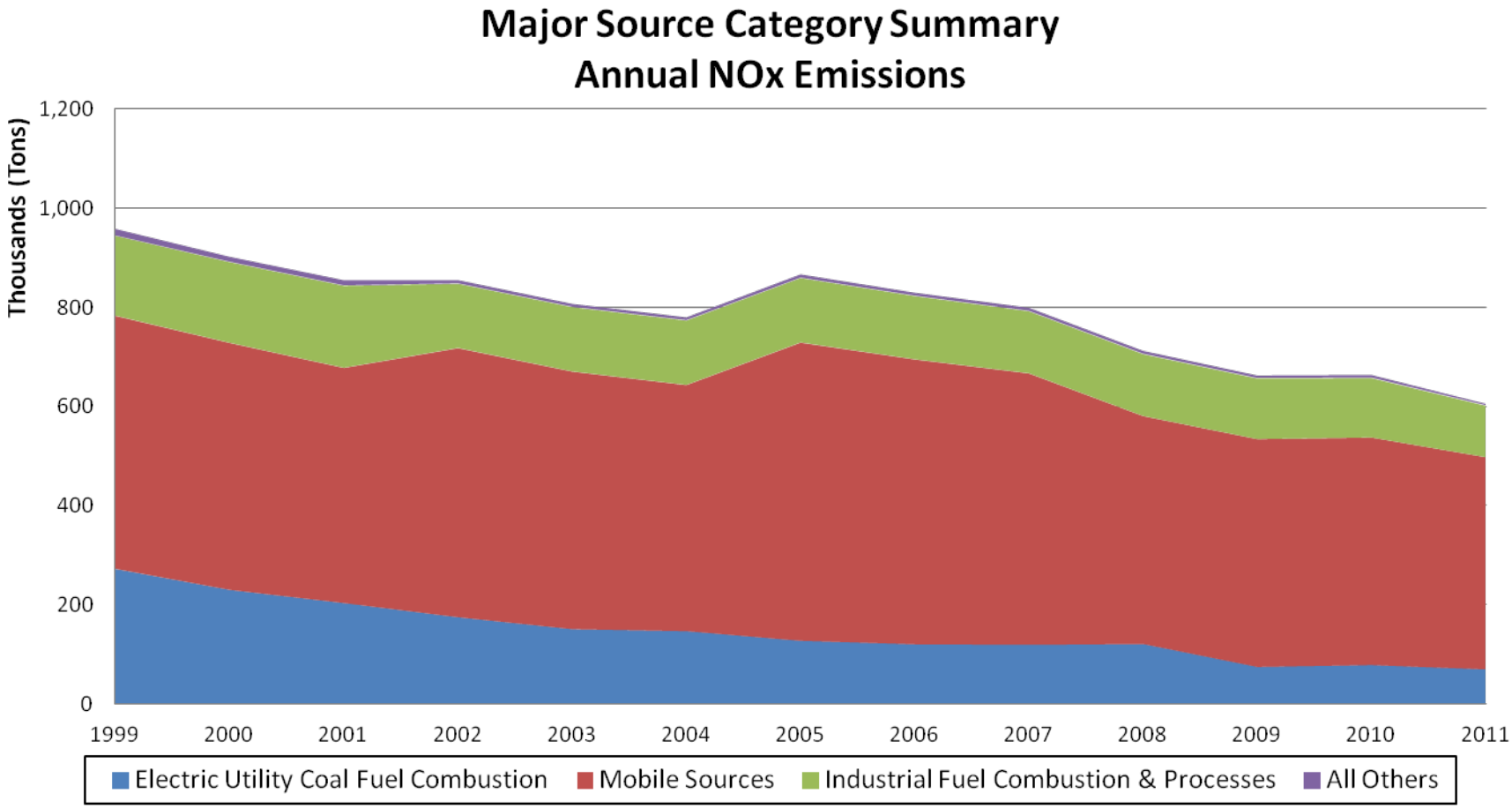
Illinois Emission Trends (NOx)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	273,025	203,911	151,077	127,568	120,626	119,462	121,130	74,854	78,542	69,818
Mobile Sources	510,646	474,838	520,202	602,187	575,168	548,149	460,314	459,967	459,619	428,648
Industrial Fuel Combustion & Processes	161,068	165,103	129,514	129,831	127,382	124,933	124,587	121,963	119,505	103,453
All Others	13,009	10,275	5,654	6,482	5,745	6,005	5,613	4,990	5,175	2,821
Total	**957,747**	**854,126**	**806,447**	**866,067**	**828,921**	**798,550**	**711,645**	**661,774**	**662,842**	**604,741**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-25%	-45%	-53%	-56%	-56%	-56%	-73%	-71%	-74%
Mobile Sources	0%	-7%	2%	18%	13%	7%	-10%	-10%	-10%	-16%
Industrial Fuel Combustion & Processes	0%	3%	-20%	-19%	-21%	-22%	-23%	-24%	-26%	-36%
All Others	0%	-21%	-57%	-50%	-56%	-54%	-57%	-62%	-60%	-78%
Total	**0%**	**-11%**	**-16%**	**-10%**	**-13%**	**-17%**	**-26%**	**-31%**	**-31%**	**-37%**

Illinois Emission Trends (NOx)



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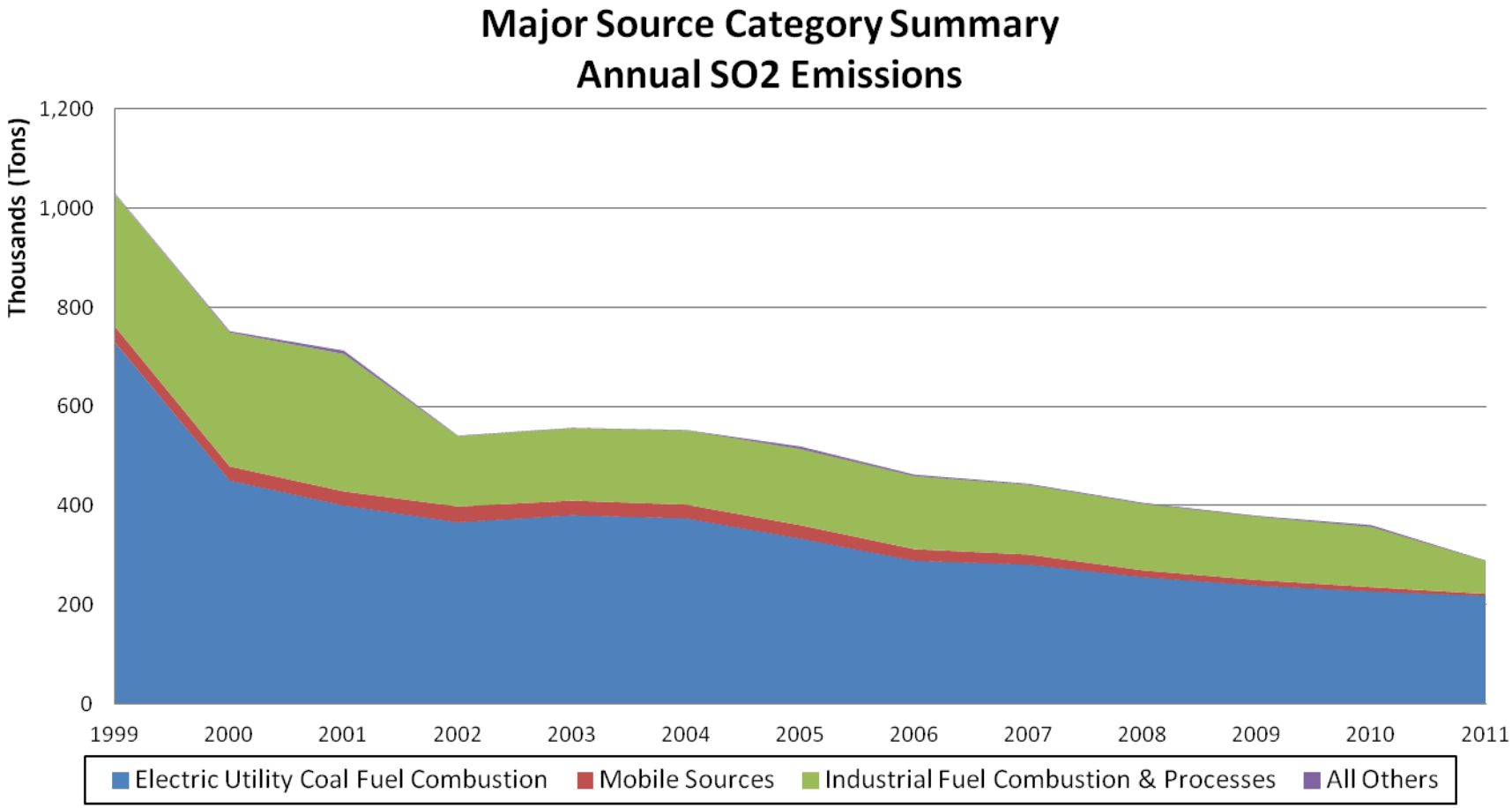
Illinois Emission Trends (SO_2)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	727,899	400,085	380,480	333,465	288,601	280,950	255,833	238,793	226,936	217,840
Mobile Sources	31,991	28,815	29,946	27,266	23,881	20,496	13,857	11,407	8,957	4,496
Industrial Fuel Combustion & Processes	266,471	276,929	145,758	153,744	147,354	140,963	134,575	128,207	121,797	66,665
All Others	1,633	6,578	715	4,922	2,833	1,885	1,785	1,267	3,367	639
Total	**1,027,994**	**712,406**	**556,900**	**519,398**	**462,669**	**444,294**	**406,050**	**379,674**	**361,056**	**289,641**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-45%	-48%	-54%	-60%	-61%	-65%	-67%	-69%	-70%
Mobile Sources	0%	-10%	-6%	-15%	-25%	-36%	-57%	-64%	-72%	-86%
Industrial Fuel Combustion & Processes	0%	4%	-45%	-42%	-45%	-47%	-49%	-52%	-54%	-75%
All Others	0%	303%	-56%	201%	74%	15%	9%	-22%	106%	-61%
Total	**0%**	**-31%**	**-46%**	**-49%**	**-55%**	**-57%**	**-61%**	**-63%**	**-65%**	**-72%**

Illinois Emission Trends (SO_2)



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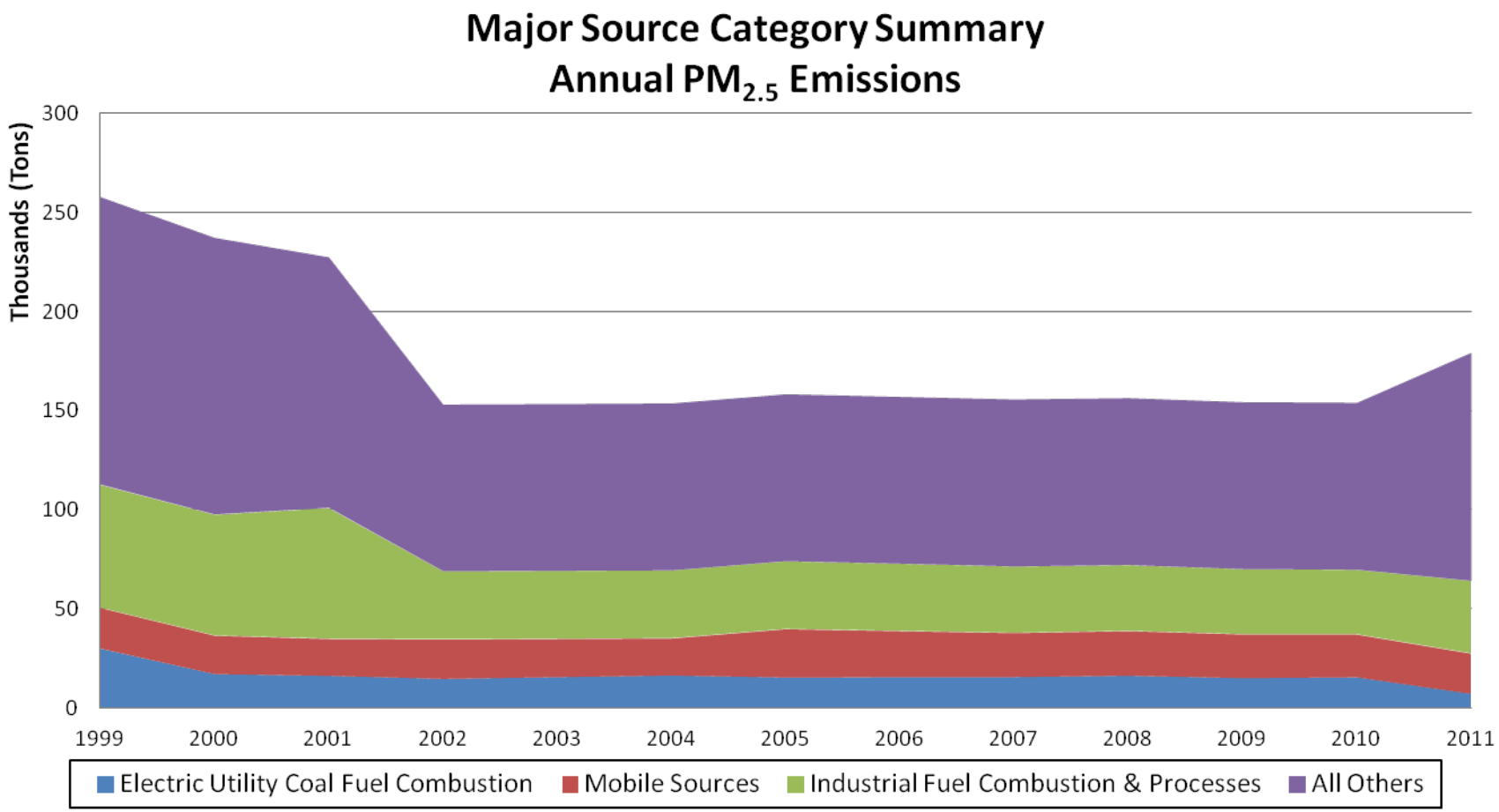
Illinois Emission Trends ($PM_{2.5}$)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	30,049	16,228	15,537	15,356	15,495	15,567	16,283	15,039	15,484	7,135
Mobile Sources	20,513	18,646	19,322	24,463	23,380	22,298	22,591	22,134	21,677	20,324
Industrial Fuel Combustion & Processes	62,247	66,186	34,337	34,247	33,918	33,588	33,260	32,934	32,602	36,724
All Others	145,020	126,383	84,153	84,199	84,188	84,189	84,192	84,189	84,190	115,020
Total	**257,829**	**227,442**	**153,349**	**158,265**	**156,981**	**155,642**	**156,326**	**154,295**	**153,952**	**179,203**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-46%	-48%	-49%	-48%	-48%	-46%	-50%	-48%	-76%
Mobile Sources	0%	-9%	-6%	19%	14%	9%	10%	8%	6%	-1%
Industrial Fuel Combustion & Processes	0%	6%	-45%	-45%	-46%	-46%	-47%	-47%	-48%	-41%
All Others	0%	-13%	-42%	-42%	-42%	-42%	-42%	-42%	-42%	-21%
Total	**0%**	**-12%**	**-41%**	**-39%**	**-39%**	**-40%**	**-39%**	**-40%**	**-40%**	**-30%**

Illinois Emission Trends ($PM_{2.5}$)



Emission Trends Summary

- All pollutants have decreased since 1999 in aggregate across Illinois
- NOx and SO2 from Electric Utility Fuel Combustion sources show significant decrease over time as a result of Acid Rain Program, NOx 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/m^3
- $PM_{2.5}$ 24-Hour
  - Annual 98th percentile of daily averages averaged over three consecutive years
  - Current standard = 35 ug/m^3

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

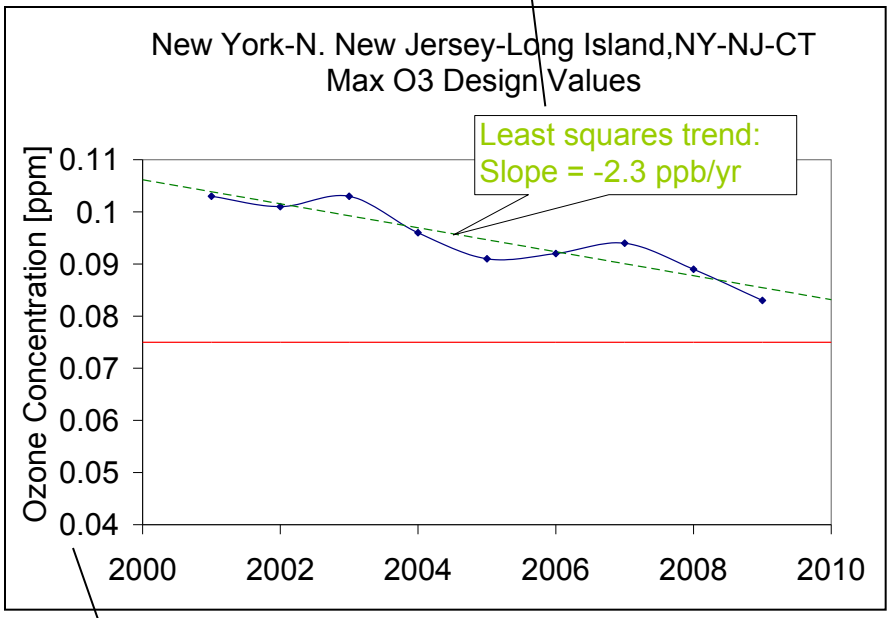
- O_3 design value (DV) for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
  - DV calculated using annual 4th highest daily max 8-hr averages and percent of valid observations, based on EPA data handling conventions
  - Data associated with exceptional events that 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

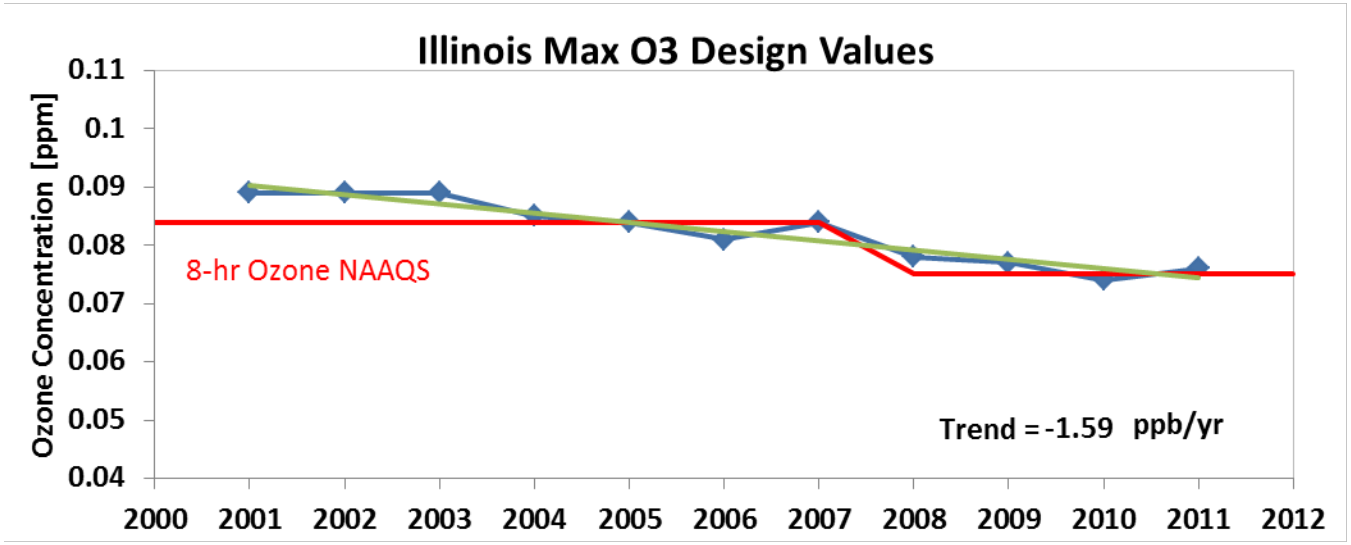
Trend in units of ppb/year

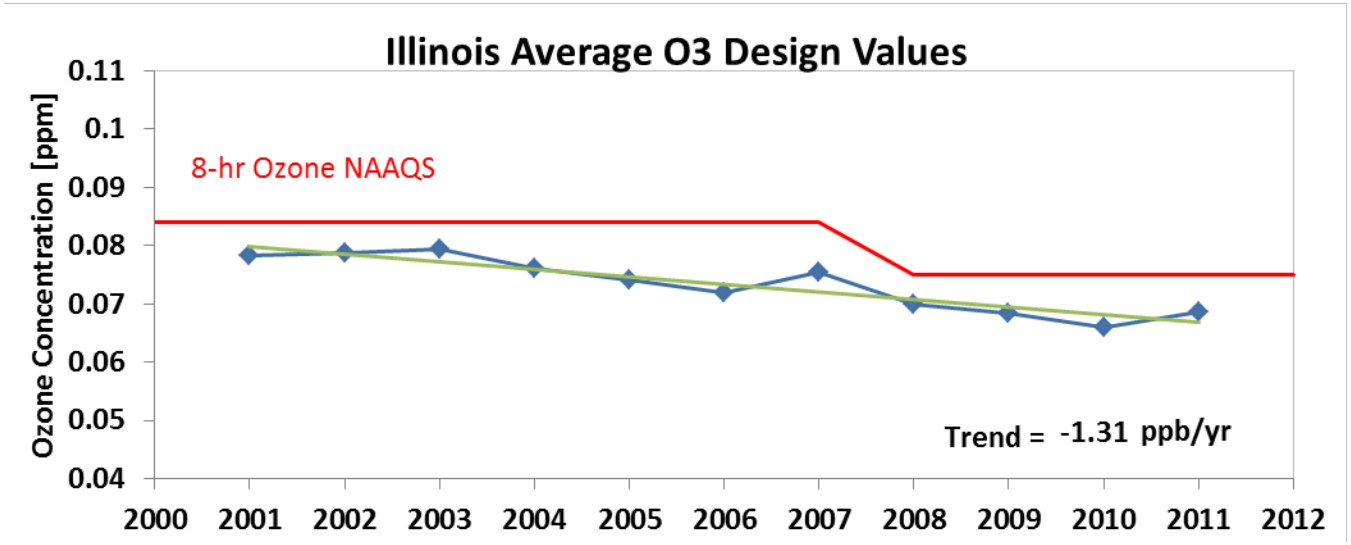


Scale in units of ppm

- 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 O_3 DVs and Trend





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Ozone Trends by Site in Illinois

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/ yr]
1701900044420101	Champaign, IL	N/A	-1.90
1703100014420101	Cook, IL	0.071	-0.72
1703100324420101	Cook, IL	0.072	-1.99
1703100644420101	Cook, IL	0.068	-0.81
1703100724420101	Cook, IL	N/A	-1.55
1703110034420102	Cook, IL	0.067	-1.16
1703116014420101	Cook, IL	0.069	-0.20
1703140024420101	Cook, IL	0.069	-0.53
1703142014420101	Cook, IL	0.072	-1.33
1703170024420101	Cook, IL	0.069	-2.11
1704360014420101	DuPage, IL	0.063	-1.06

Note: Only monitoring sites meeting data completeness criteria listed

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Ozone Trends by Site in Illinois

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
1704910014420102	Effingham, IL	0.068	-1.15
1708310014420101	Jersey, IL	0.072	-2.25
1708900054420101	Kane, IL	0.069	-1.25
1709710024420101	Lake, IL	N/A	-1.73
1709710074420101	Lake, IL	0.076	-1.05
1711100014420101	McHenry, IL	0.067	-2.13
1711320034420101	McLean, IL	0.068	-1.03
1711500134420101	Macon, IL	0.07	-0.86
1711700024420101	Macoupin, IL	0.07	-1.35
1711900084420101	Madison, IL	0.074	-1.49
1711910094420101	Madison, IL	0.076	-0.67

Note: Only monitoring sites meeting data completeness criteria listed

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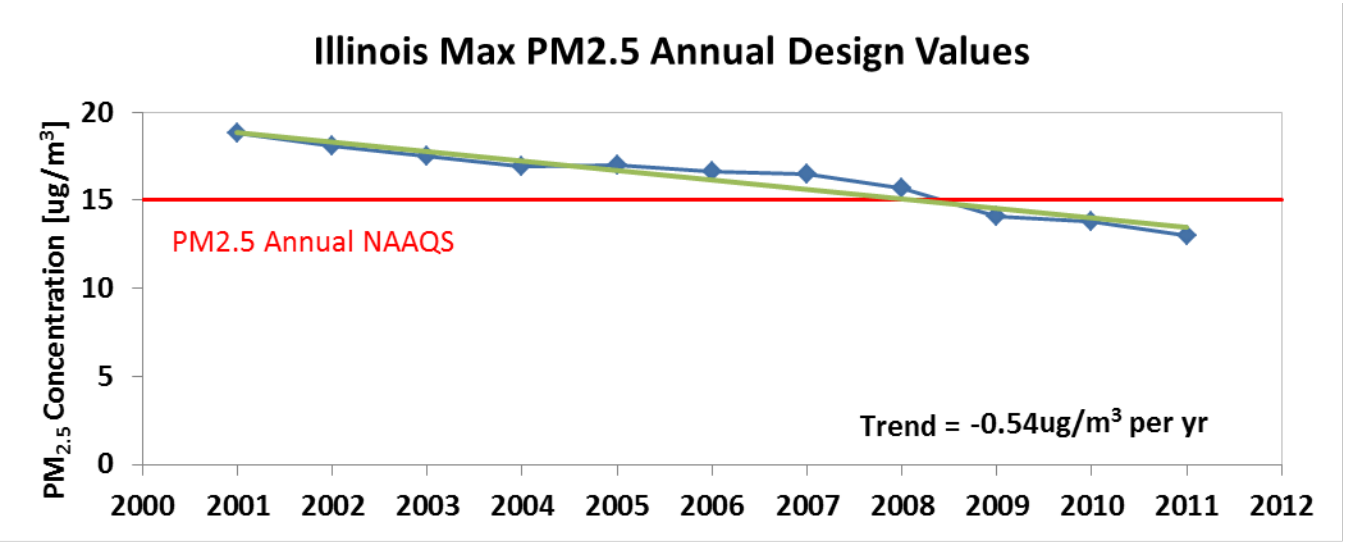
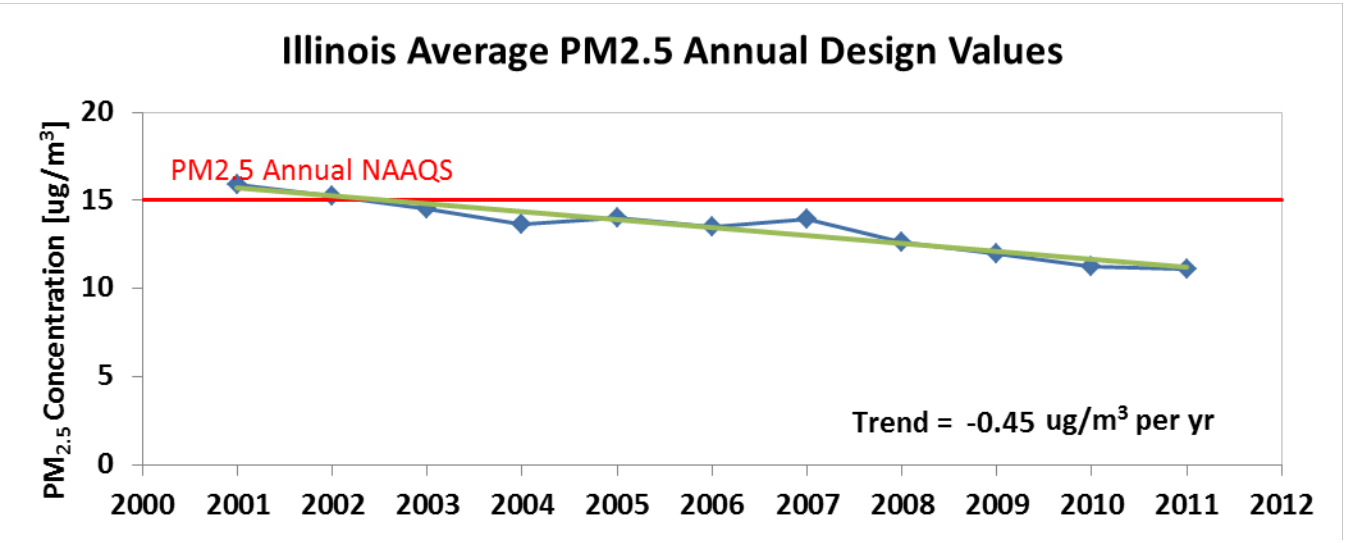
Ozone Trends by Site in Illinois

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
1711930074420101	Madison, IL	0.072	-1.11
1714300244420101	Peoria, IL	0.059	-1.51
1714310014420101	Peoria, IL	0.069	-1.05
1715700014420101	Randolph, IL	0.063	-1.61
1716130024420101	Rock Island, IL	0.056	-1.48
1716300104420102	St. Clair, IL	0.072	-1.59
1716700104420101	Sangamon, IL	N/A	-1.58
1719710114420101	Will, IL	0.063	-1.97
1720120014420101	Winnebago, IL	0.066	-1.06

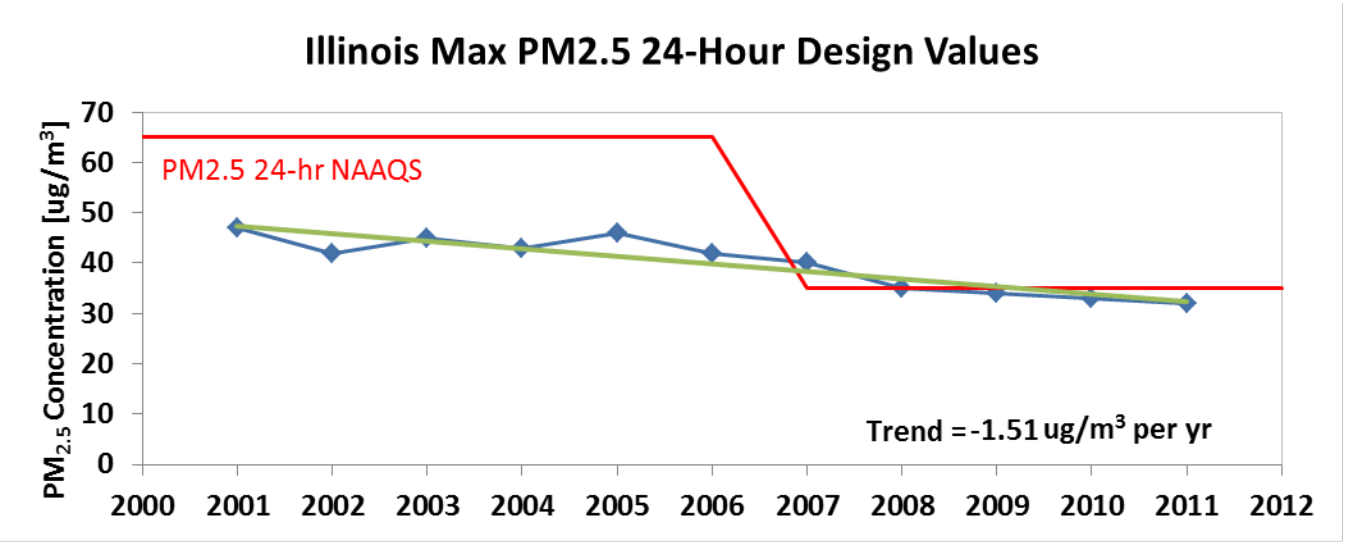
Note: Only monitoring sites meeting data completeness criteria listed

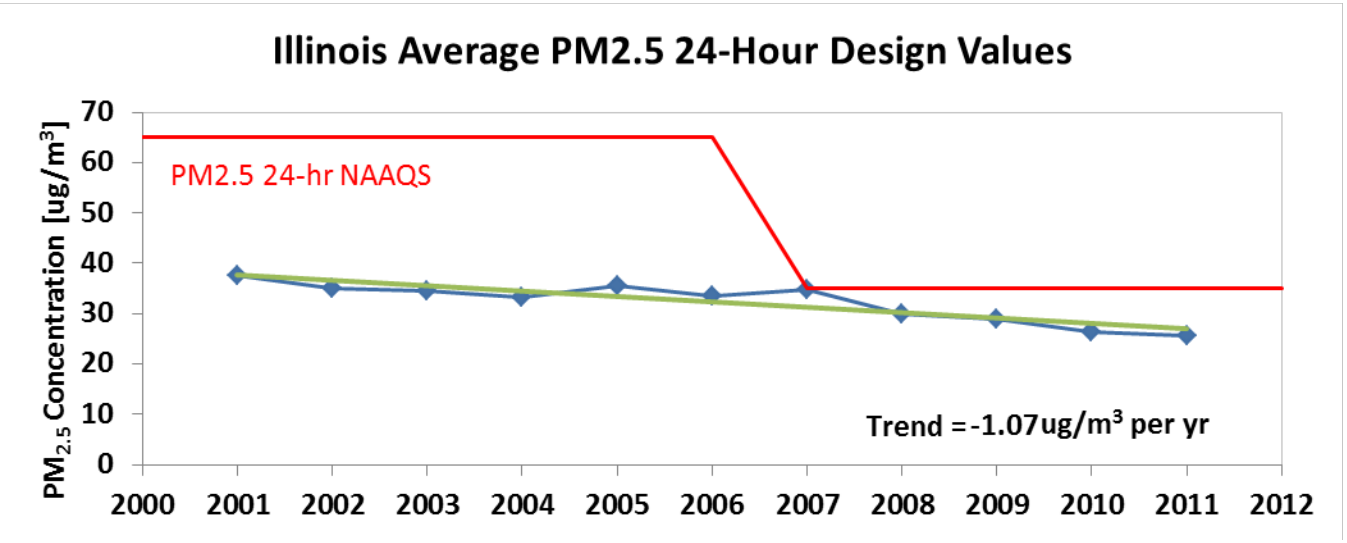
Max/Ave $PM_{2.5}$ Annual DVs and Trend





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





$PM_{2.5}$ Trends by Site in Illinois

		2009-2011 DV [ug/m³]		Trend [ug/m³ per year]	
Monitoring Site	**County**	**Annual**	**24-Hr**	**Annual DV**	**24-Hr DV**
170191001	Champaign	10.4	22	-0.26	-0.53
170310022	Cook	12.7	29	-0.47	-1.12
170310050	Cook	N/A	N/A	-0.59	-1.45
170310052	Cook	12.4	32	-0.63	-1.28
170310057	Cook	N/A	N/A	-0.49	-0.70
170310076	Cook	11.5	28	-0.54	-0.98
170311016	Cook	N/A	32	N/A	-1.51
170312001	Cook	11.6	26	-0.52	-1.25
170313301	Cook	11.6	30	-0.54	-0.92
170314007	Cook	10.7	27	-0.40	-1.15

Note: Only monitoring sites meeting data completeness criteria listed

$PM_{2.5}$ Trends by Site in Illinois

		2009-2011 DV [ug/m³]		Trend [ug/m³ per year]	
Monitoring Site	**County**	**Annual**	**24-Hr**	**Annual DV**	**24-Hr DV**
170314201	Cook	9.6	26	-0.47	-1.12
170434002	DuPage	10.7	25	-0.46	-0.80
170890003	Kane	10.2	27	-0.48	-0.64
170971007	Lake	N/A	N/A	-0.43	-0.82
170990007	LaSalle	N/A	N/A	N/A	-0.68
171110001	McHenry	10.0	26	-0.38	-0.92
171150013	Macon	11.6	23	-0.33	-1.17
171191007	Madison	13.0	27	-0.45	-1.38
171192009	Madison	11.7	22	-0.35	-1.42
171193007	Madison	11.8	24	-0.37	-1.12

Note: Only monitoring sites meeting data completeness criteria listed

$PM_{2.5}$ Trends by Site in Illinois

		2009-2011 DV [ug/m³]		Trend [ug/m³ per year]	
Monitoring Site	**County**	**Annual**	**24-Hr**	**Annual DV**	**24-Hr DV**
171430037	Peoria	11.3	26	-0.37	-0.97
171570001	Randolph	9.8	20	-0.31	-0.96
171613002	Rock Island	9.8	22	-0.33	-0.93
171630010	St. Clair	12.5	23	-0.49	-1.55
171634001	St. Clair	N/A	N/A	N/A	-1.32
171670012	Sangamon	10.9	25	-0.30	-1.00
171971002	Will	10.8	25	-0.46	-0.90
171971011	Will	9.7	23	-0.41	-0.64

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 Illinois

- O_3 and $PM_{2.5}$ design values have decreased since 1999 in all currently designated O_3 and $PM_{2.5}$ non-attainment areas in Illinois