Emission and Air Quality Trends Review

South Dakota

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, 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

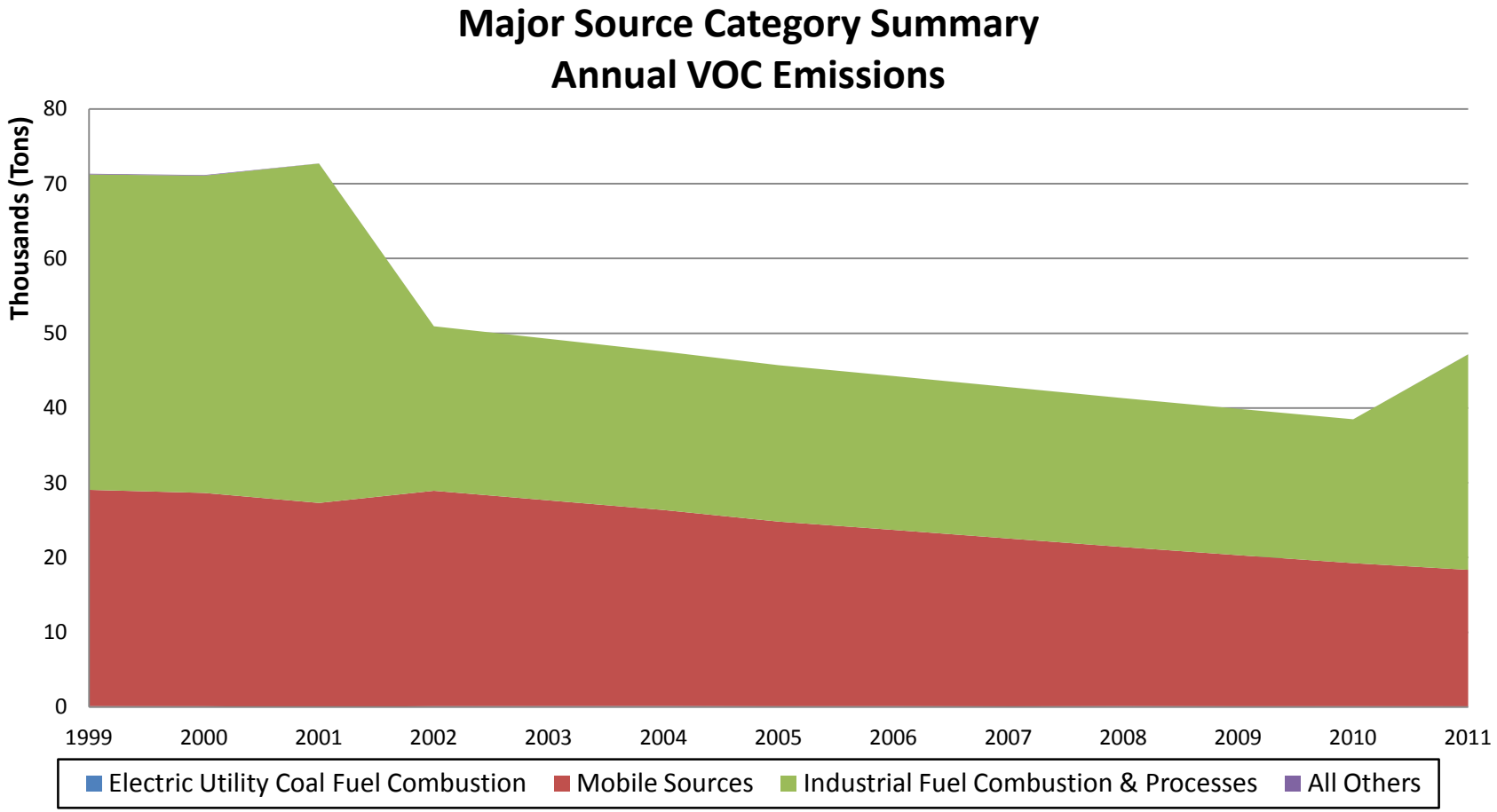
- Negative values indicate decrease in emissions, positive values indicate an increase

South Dakota Emission Trends (VOC)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	116	13	120	103	114	89	119	101	106	94
Mobile Sources	28,938	27,291	27,524	24,703	23,581	22,458	21,283	20,213	19,143	18,264
Industrial Fuel Combustion & Processes	42,194	45,400	21,605	20,918	20,583	20,248	19,913	19,578	19,243	28,818
All Others	94	14	1	2	2	4	2	1	1	13
Total	**71,342**	**72,717**	**49,250**	**45,726**	**44,280**	**42,799**	**41,317**	**39,893**	**38,493**	**47,189**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-89%	4%	-11%	-2%	-23%	3%	-13%	-8%	-19%
Mobile Sources	0%	-6%	-5%	-15%	-19%	-22%	-26%	-30%	-34%	-37%
Industrial Fuel Combustion & Processes	0%	8%	-49%	-50%	-51%	-52%	-53%	-54%	-54%	-32%
All Others	0%	-86%	-99%	-98%	-97%	-96%	-98%	-99%	-99%	-86%
Total	**0%**	**2%**	**-31%**	**-36%**	**-38%**	**-40%**	**-42%**	**-44%**	**-46%**	**-34%**

South Dakota Emission Trends (VOC)

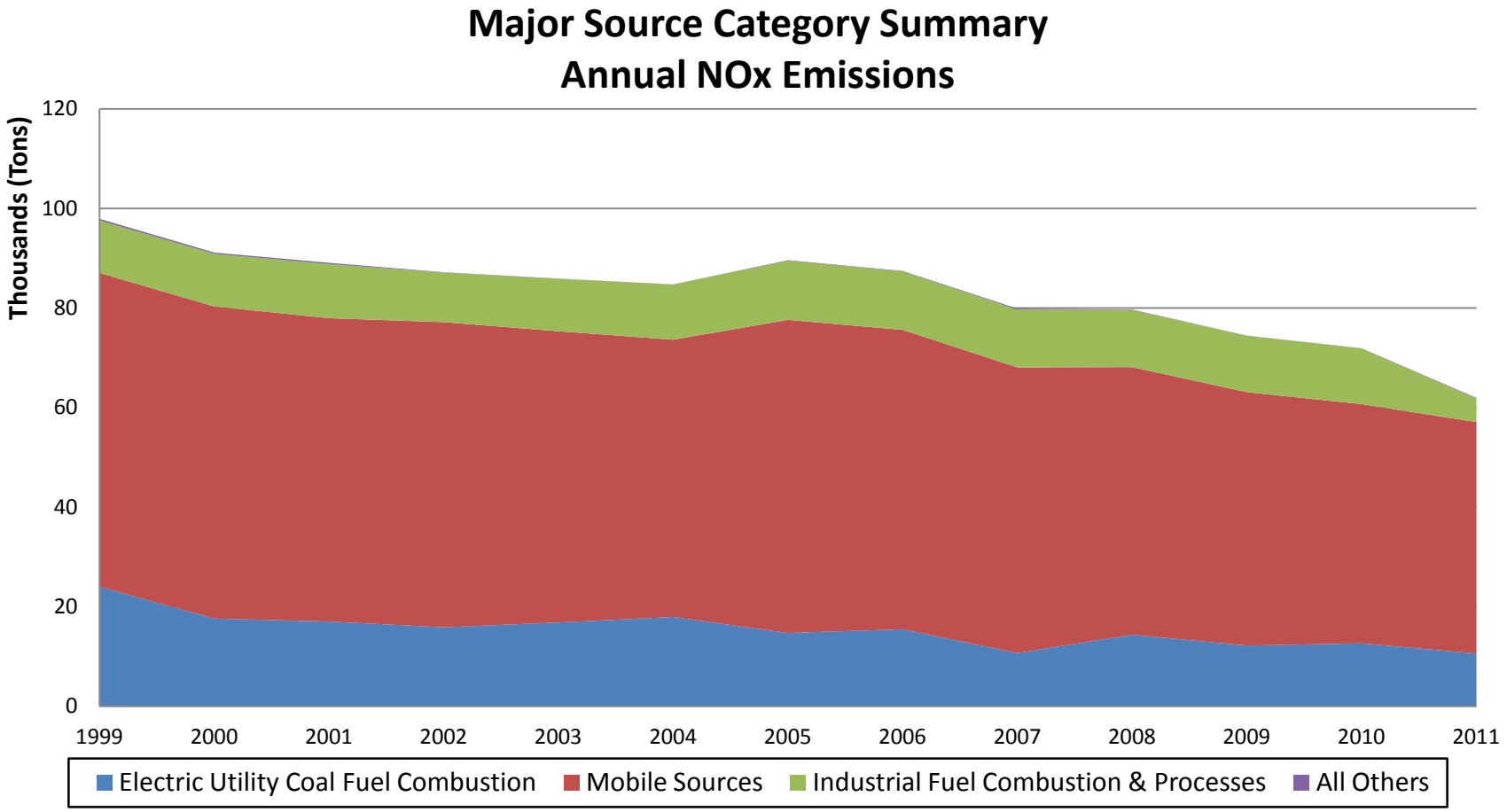


South Dakota Emission Trends (NOx)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	23,991	17,025	16,838	14,721	15,459	10,678	14,369	12,203	12,640	10,589
Mobile Sources	63,054	60,928	58,490	62,897	60,143	57,389	53,748	50,894	48,040	46,492
Industrial Fuel Combustion & Processes	10,516	10,873	10,525	11,888	11,748	11,609	11,470	11,330	11,191	4,743
All Others	344	253	52	101	92	197	98	30	47	126
Total	**97,905**	**89,080**	**85,904**	**89,607**	**87,442**	**79,873**	**79,685**	**74,458**	**71,917**	**61,950**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-29%	-30%	-39%	-36%	-55%	-40%	-49%	-47%	-56%
Mobile Sources	0%	-3%	-7%	0%	-5%	-9%	-15%	-19%	-24%	-26%
Industrial Fuel Combustion & Processes	0%	3%	0%	13%	12%	10%	9%	8%	6%	-55%
All Others	0%	-26%	-85%	-71%	-73%	-43%	-72%	-91%	-86%	-63%
Total	**0%**	**-9%**	**-12%**	**-8%**	**-11%**	**-18%**	**-19%**	**-24%**	**-27%**	**-37%**

South Dakota Emission Trends (NOx)

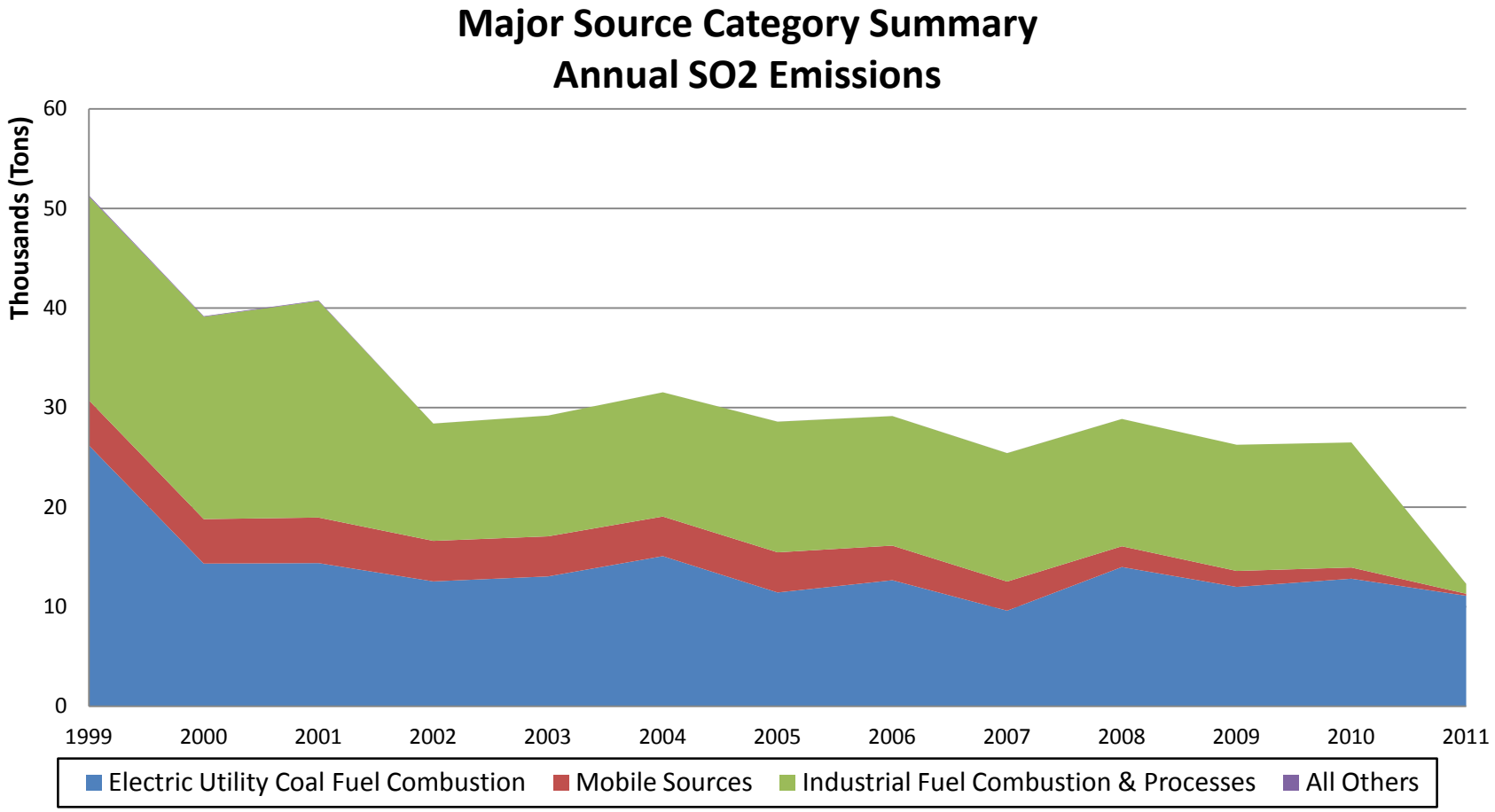


South Dakota Emission Trends (SO_2)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	26,189	14,378	13,043	11,428	12,659	9,604	13,985	11,987	12,813	11,101
Mobile Sources	4,530	4,577	4,025	4,032	3,477	2,922	2,086	1,605	1,124	198
Industrial Fuel Combustion & Processes	20,469	21,754	12,128	13,122	13,010	12,897	12,784	12,671	12,559	987
All Others	113	60	3	7	4	8	3	1	1	14
Total	**51,302**	**40,769**	**29,199**	**28,589**	**29,149**	**25,430**	**28,858**	**26,265**	**26,497**	**12,301**

	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%	-50%	-56%	-52%	-63%	-47%	-54%	-51%	-58%
Mobile Sources	0%	1%	-11%	-11%	-23%	-36%	-54%	-65%	-75%	-96%
Industrial Fuel Combustion & Processes	0%	6%	-41%	-36%	-36%	-37%	-38%	-38%	-39%	-95%
All Others	0%	-47%	-97%	-94%	-97%	-93%	-97%	-99%	-99%	-87%
Total	**0%**	**-21%**	**-43%**	**-44%**	**-43%**	**-50%**	**-44%**	**-49%**	**-48%**	**-76%**

South Dakota Emission Trends (SO_2)

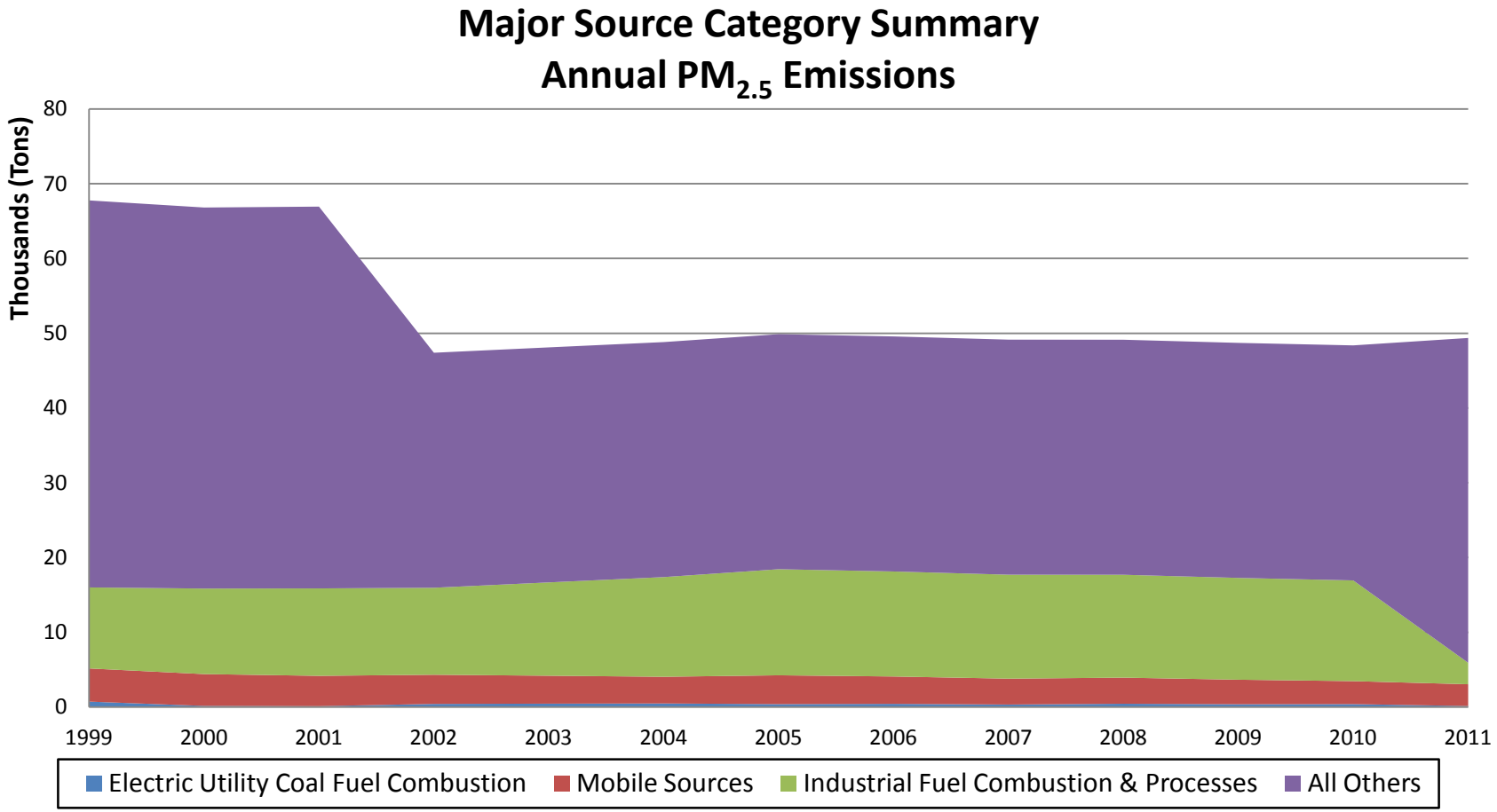


South Dakota Emission Trends ($PM_{2.5}$)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	726	115	453	389	426	333	441	374	391	130
Mobile Sources	4,438	4,060	3,736	3,857	3,660	3,464	3,491	3,283	3,074	2,917
Industrial Fuel Combustion & Processes	10,837	11,696	12,485	14,191	14,048	13,904	13,761	13,617	13,474	2,875
All Others	51,770	51,071	31,438	31,440	31,441	31,444	31,441	31,438	31,439	43,448
Total	**67,771**	**66,941**	**48,111**	**49,877**	**49,576**	**49,146**	**49,134**	**48,712**	**48,378**	**49,370**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-84%	-38%	-46%	-41%	-54%	-39%	-48%	-46%	-82%
Mobile Sources	0%	-9%	-16%	-13%	-18%	-22%	-21%	-26%	-31%	-34%
Industrial Fuel Combustion & Processes	0%	8%	15%	31%	30%	28%	27%	26%	24%	-73%
All Others	0%	-1%	-39%	-39%	-39%	-39%	-39%	-39%	-39%	-16%
Total	**0%**	**-1%**	**-29%**	**-26%**	**-27%**	**-27%**	**-28%**	**-28%**	**-29%**	**-27%**

South Dakota Emission Trends ($PM_{2.5}$)



Emission Trends Summary

- All pollutants have decreased since 1999 in aggregate across South Dakota
- NOx 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/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

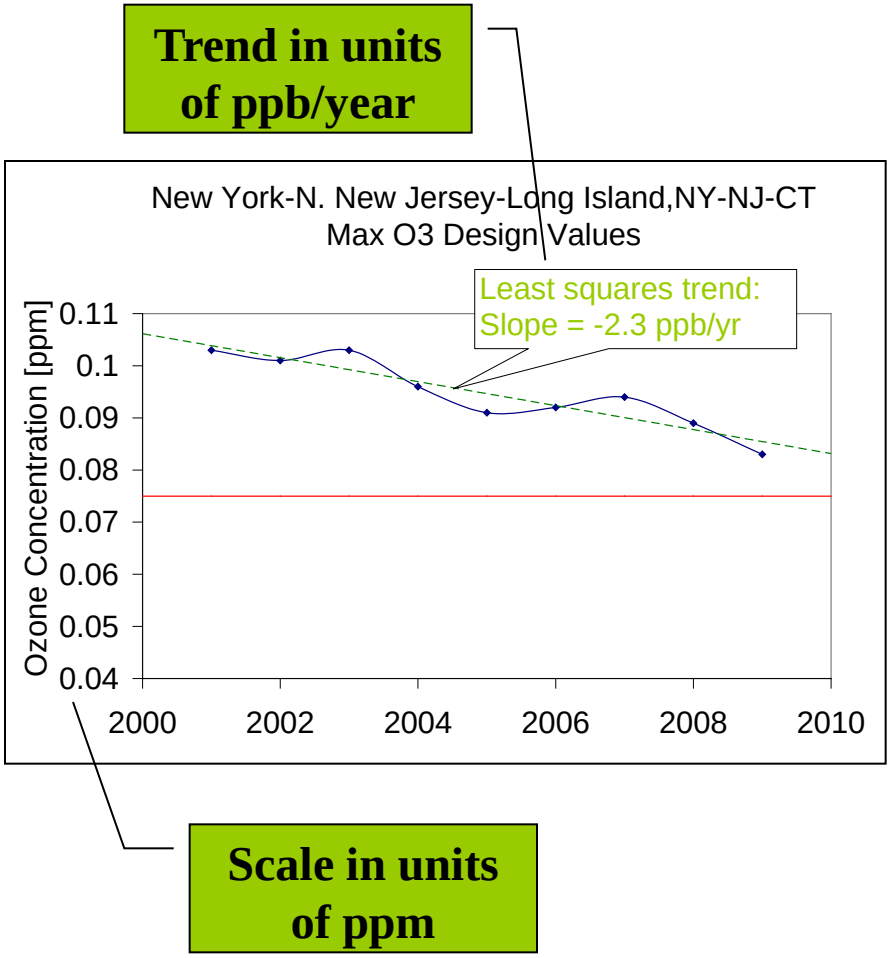
Data Handling Procedures

- 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

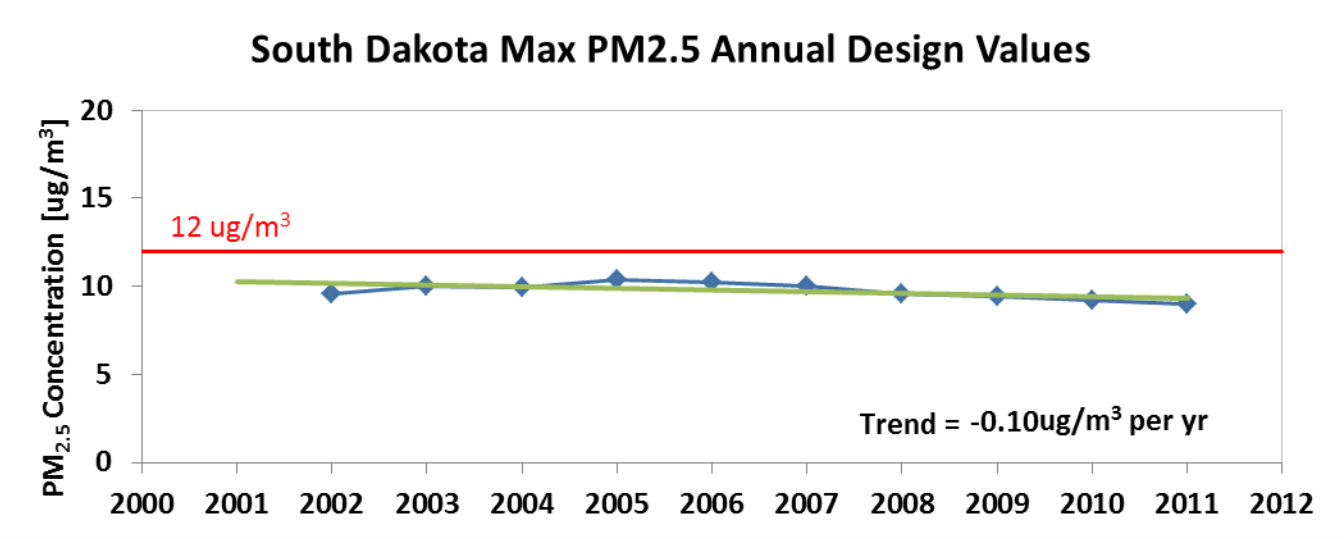


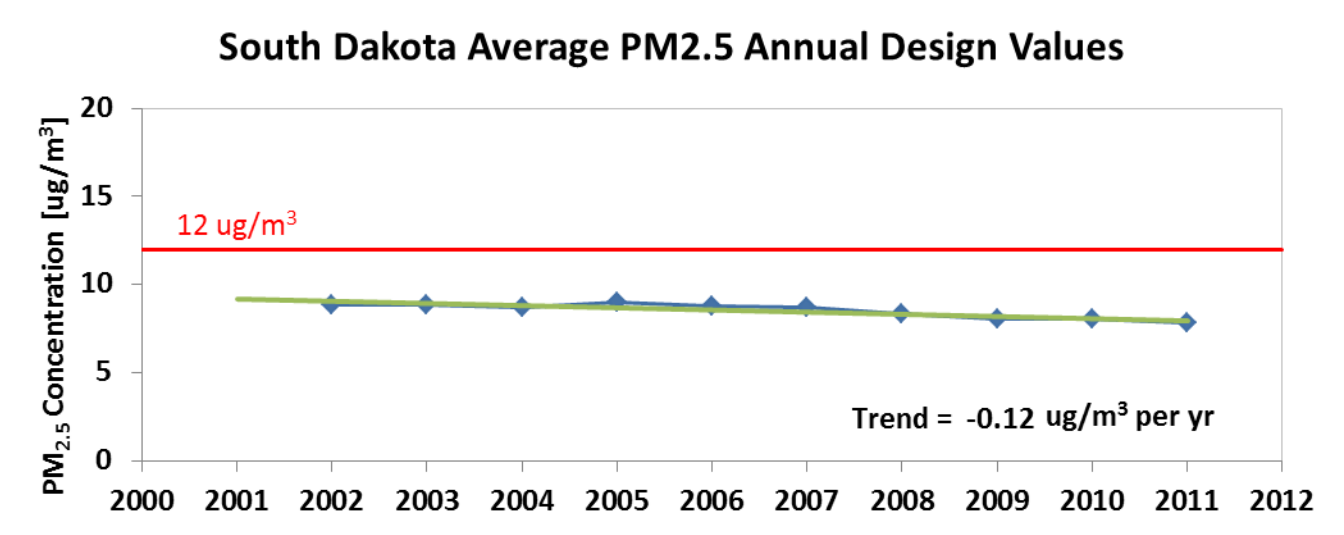
- Trends based on linear least squares fit to rolling three year design values (DVs)
- Negative trend indicates improving air quality
- DVs based on each 3-year period: 1999-2001, 2000-2002, … 2009-2011
- Notes
  - On plots, DVs are for three year period ending in year shown (i.e., 2009-2011 DV plotted 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

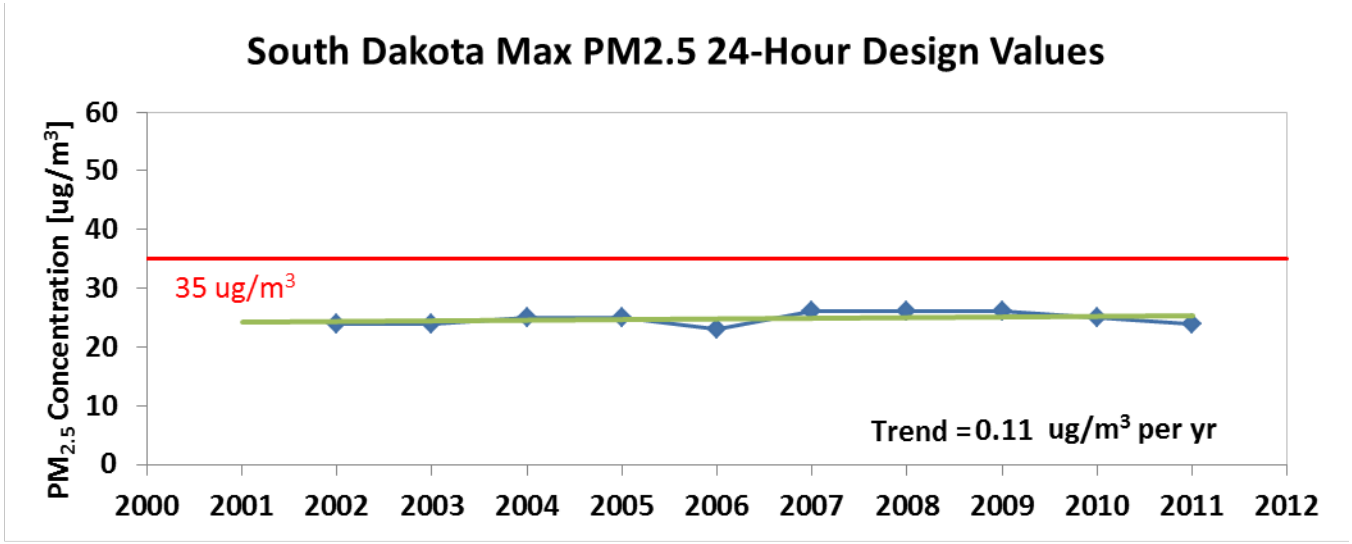
Note: No ozone monitoring sites in South Dakota meet the data completeness requirements established for this analysis and therefore no trends are presented.

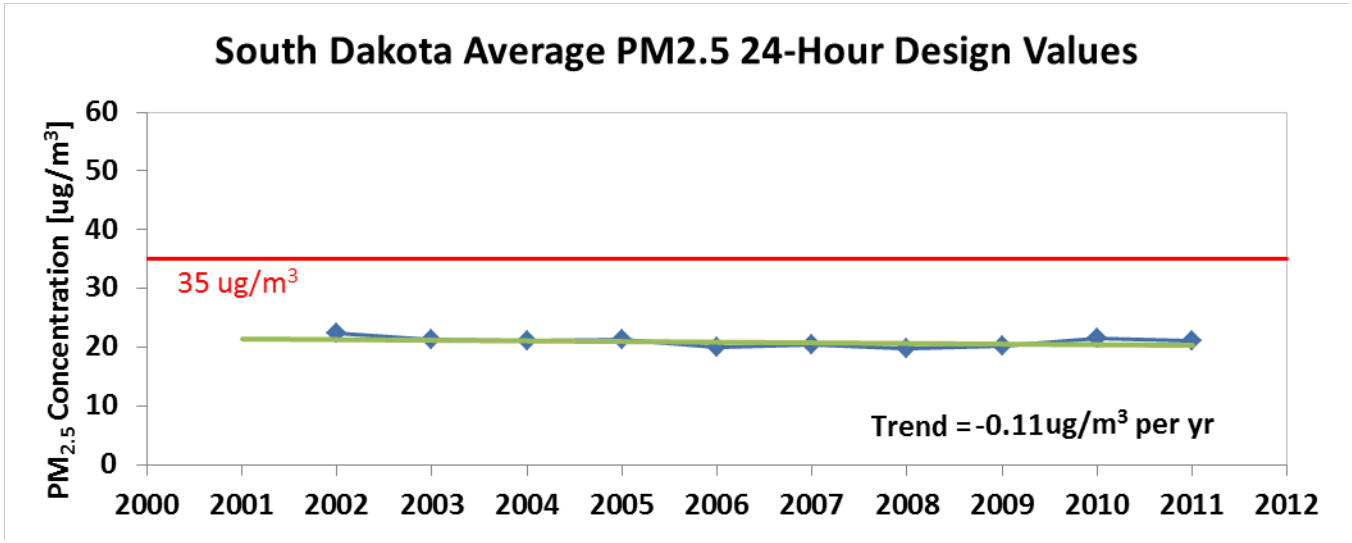
Max/Ave $PM_{2.5}$ Annual DVs and Trend





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





$PM_{2.5}$ Trends by Site in South Dakota

		2009-2011 DV [ug/m³]		Trend [ug/m³ per year]	
Monitoring Site	County	Annual	24-Hr	Annual DV	24-Hr DV
460110002	Brookings	8.4	23	-0.15	-0.27
460130003	Brown	8.0	22	-0.04	0.25
460990006	Minnehaha	9.0	24	-0.10	0.28
461031001	Pennington	5.9	15	-0.18	-0.46

Note: Only monitoring sites meeting data completeness criteria listed

Air Quality Trends Summary

- Average annual $PM_{2.5}$ design values have decreased slightly since 2000 in South Dakota whereas average 24-hr $PM_{2.5}$ design values have remained steady since 2000 (incomplete data in 1999).

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