Emission and Air Quality Trends Review

Wyoming

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

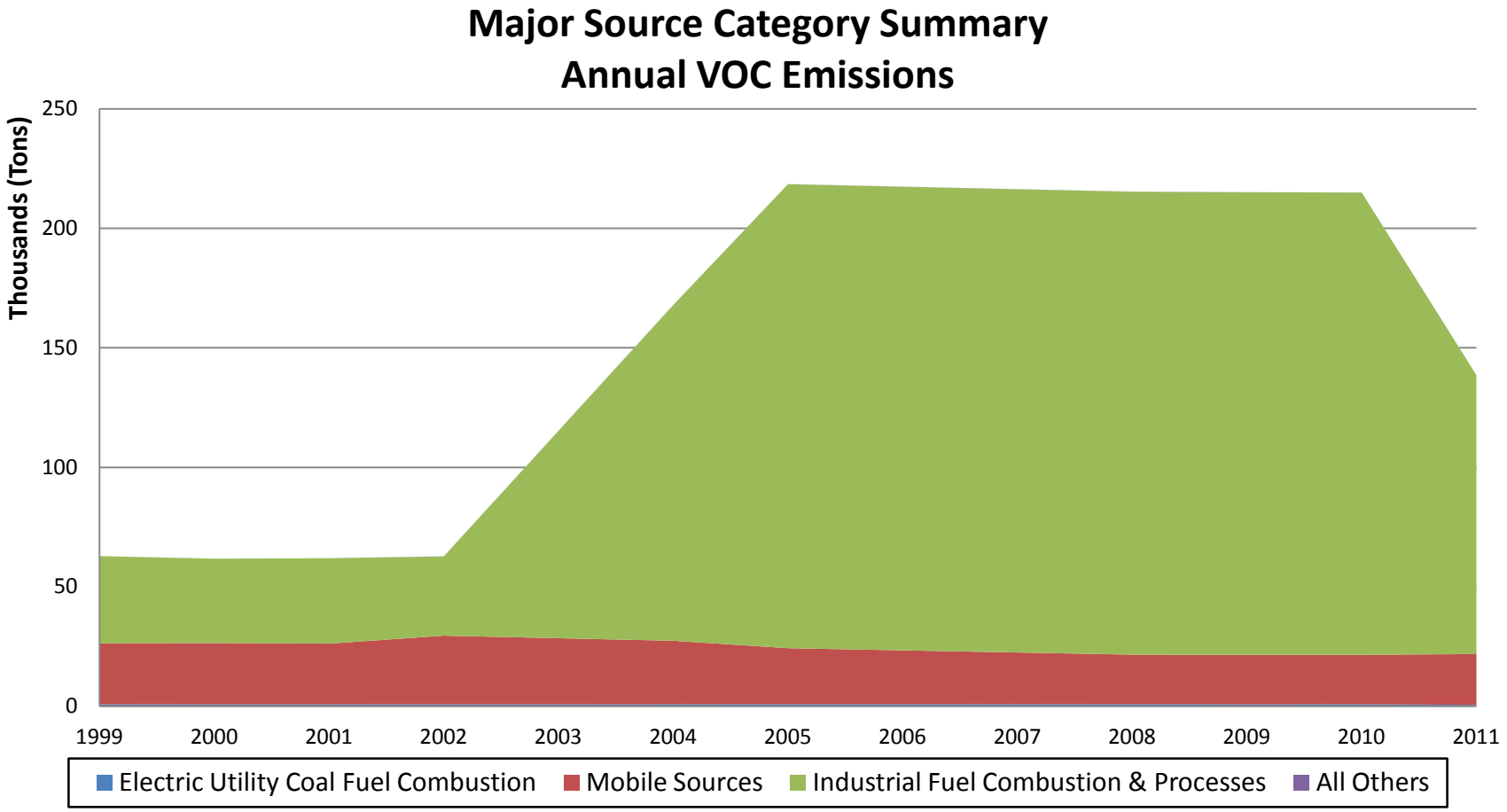
- Negative values indicate decrease in emissions, positive values indicate an increase

Wyoming Emission Trends (VOC)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	825	797	808	858	854	865	872	820	842	569
Mobile Sources	25,530	25,403	27,654	23,447	22,535	21,623	20,711	20,704	20,696	21,250
Industrial Fuel Combustion & Processes	36,478	35,768	86,824	194,174	194,029	193,883	193,738	193,592	193,447	116,755
All Others	4	4	47	41	40	40	34	30	26	0
Total	**62,836**	**61,971**	**115,333**	**218,520**	**217,458**	**216,412**	**215,355**	**215,145**	**215,010**	**138,574**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-3%	-2%	4%	4%	5%	6%	-1%	2%	-31%
Mobile Sources	0%	0%	8%	-8%	-12%	-15%	-19%	-19%	-19%	-17%
Industrial Fuel Combustion & Processes	0%	-2%	138%	432%	432%	432%	431%	431%	430%	220%
All Others	0%	2%	1066%	897%	881%	889%	725%	630%	527%	-96%
Total	**0%**	**-1%**	**84%**	**248%**	**246%**	**244%**	**243%**	**242%**	**242%**	**121%**

Wyoming Emission Trends (VOC)

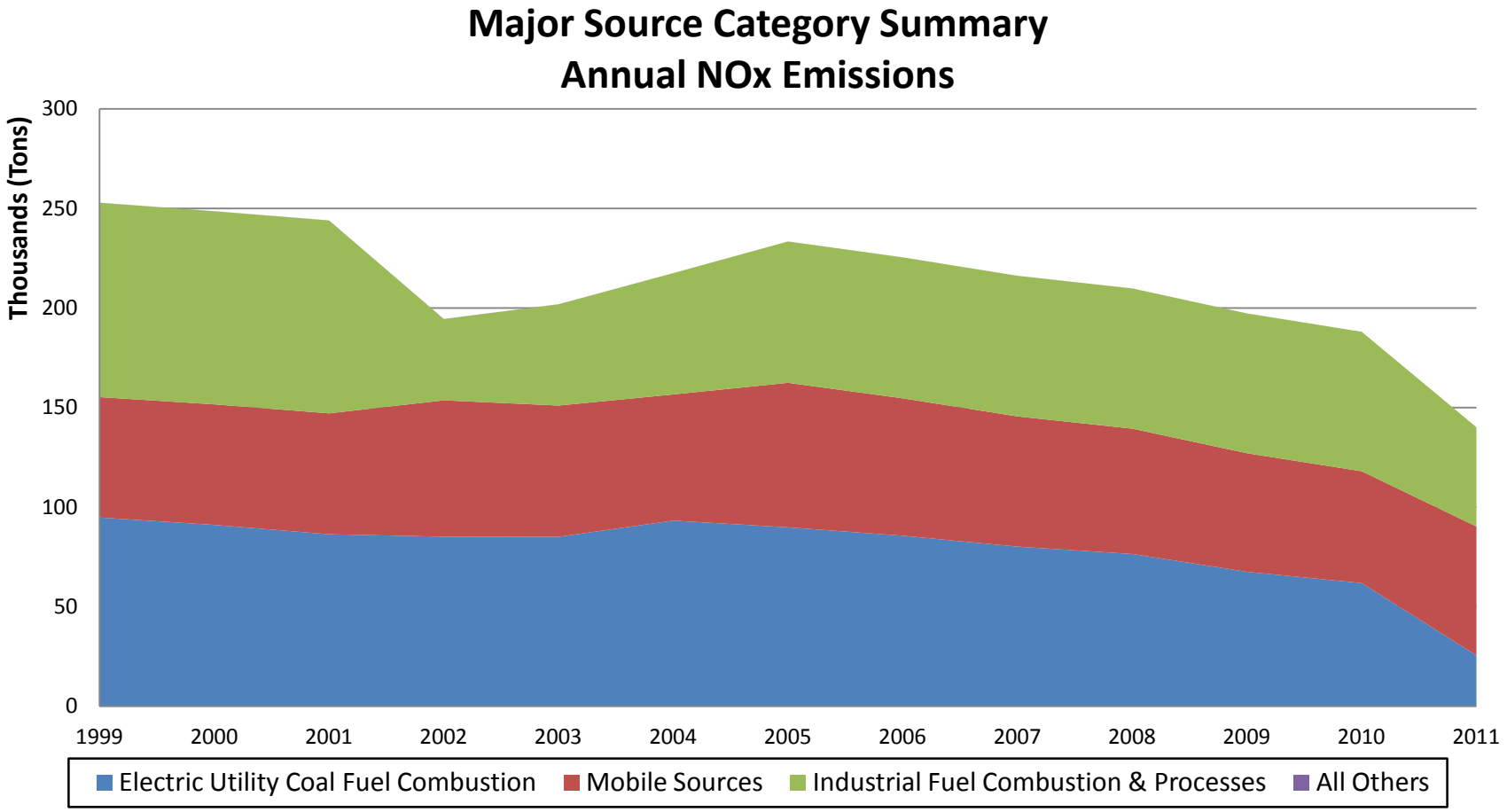


Wyoming Emission Trends (NOx)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	94,810	86,399	85,099	89,859	85,652	80,172	76,488	67,524	61,869	25,559
Mobile Sources	60,451	60,704	65,912	72,579	68,990	65,401	62,935	59,549	56,163	64,703
Industrial Fuel Combustion & Processes	97,596	96,848	50,844	70,975	70,786	70,596	70,407	70,217	70,028	49,863
All Others	39	40	49	16	21	25	17	8	4	5
Total	**252,896**	**243,991**	**201,904**	**233,429**	**225,449**	**216,194**	**209,846**	**197,298**	**188,064**	**140,129**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-9%	-10%	-5%	-10%	-15%	-19%	-29%	-35%	-73%
Mobile Sources	0%	0%	9%	20%	14%	8%	4%	-1%	-7%	7%
Industrial Fuel Combustion & Processes	0%	-1%	-48%	-27%	-27%	-28%	-28%	-28%	-28%	-49%
All Others	0%	2%	24%	-60%	-46%	-35%	-58%	-81%	-89%	-87%
Total	**0%**	**-4%**	**-20%**	**-8%**	**-11%**	**-15%**	**-17%**	**-22%**	**-26%**	**-45%**

Wyoming Emission Trends (NOx)

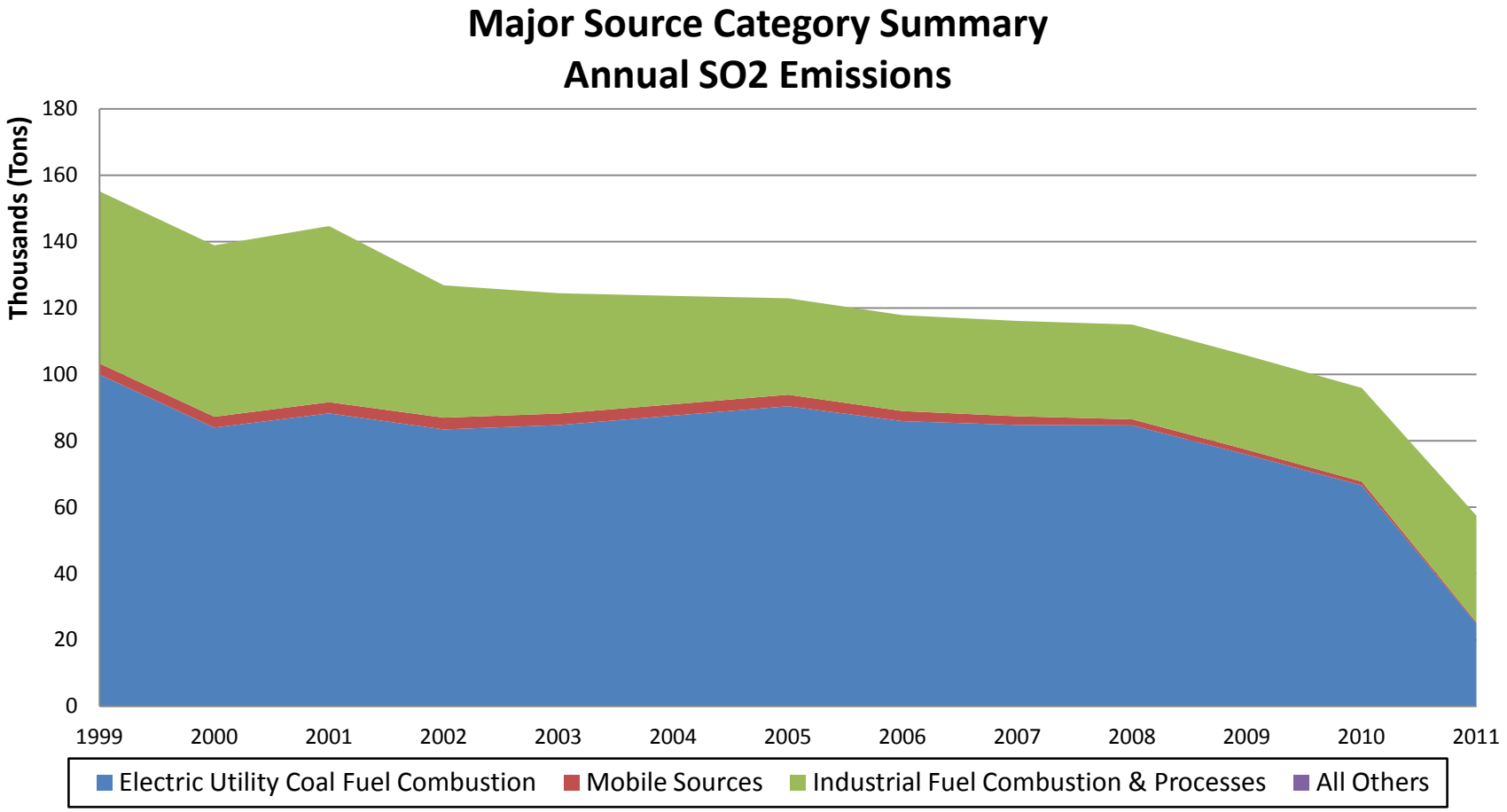


Wyoming Emission Trends (SO_2)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	99,931	88,255	84,717	90,404	85,907	84,771	84,627	75,807	66,574	24,945
Mobile Sources	3,342	3,384	3,481	3,484	3,049	2,614	1,837	1,486	1,135	407
Industrial Fuel Combustion & Processes	51,869	53,053	36,257	29,046	28,881	28,716	28,550	28,385	28,220	32,089
All Others	1	1	3	2	2	2	1	1	1	0
Total	**155,144**	**144,692**	**124,459**	**122,937**	**117,839**	**116,103**	**115,016**	**105,679**	**95,929**	**57,441**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-12%	-15%	-10%	-14%	-15%	-15%	-24%	-33%	-75%
Mobile Sources	0%	1%	4%	4%	-9%	-22%	-45%	-56%	-66%	-88%
Industrial Fuel Combustion & Processes	0%	2%	-30%	-44%	-44%	-45%	-45%	-45%	-46%	-38%
All Others	0%	1%	341%	197%	167%	139%	88%	48%	5%	-93%
Total	**0%**	**-7%**	**-20%**	**-21%**	**-24%**	**-25%**	**-26%**	**-32%**	**-38%**	**-63%**

Wyoming Emission Trends (SO_2)

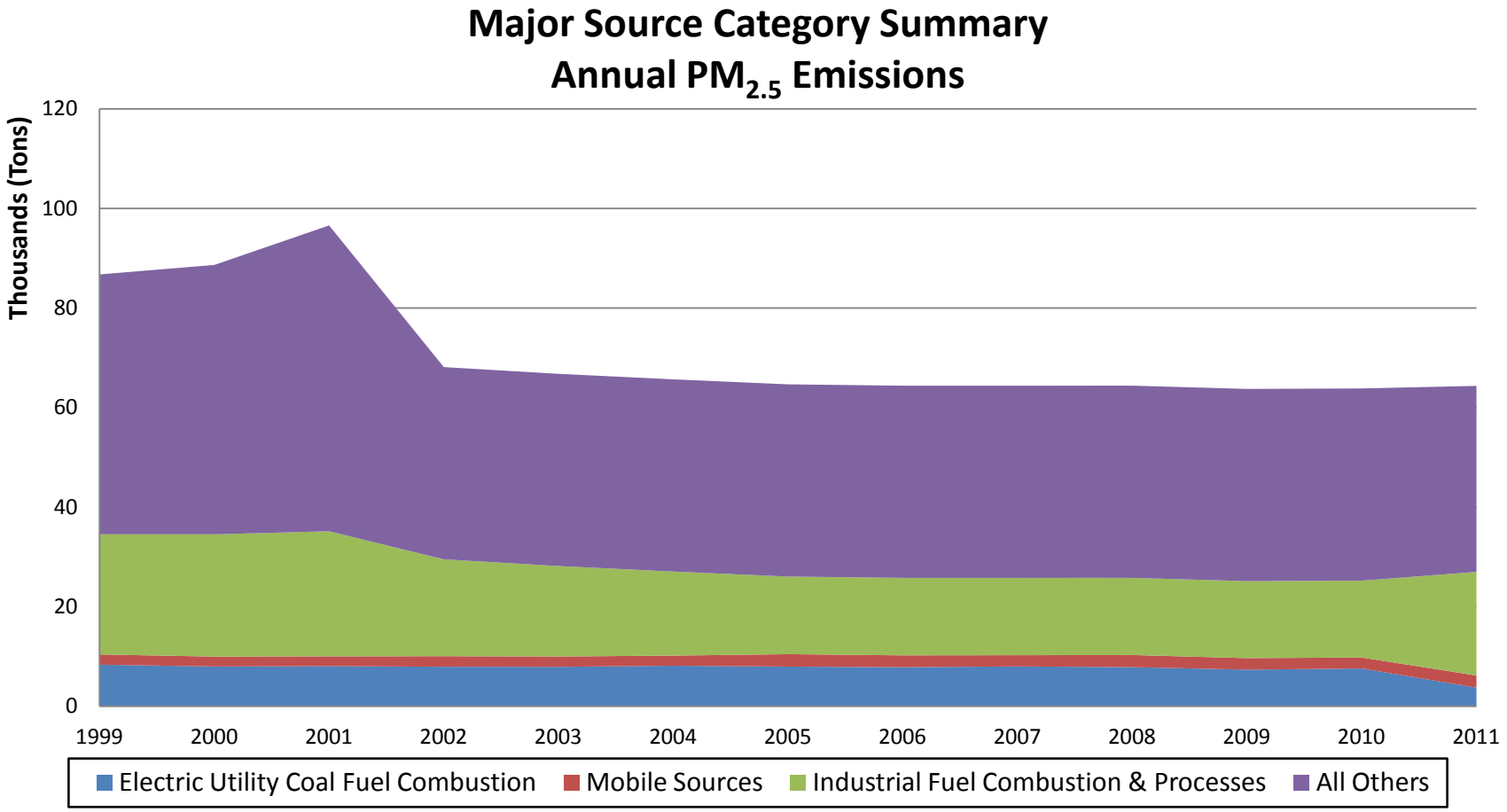


Wyoming Emission Trends ($PM_{2.5}$)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	8,356	8,064	7,920	7,966	7,851	8,003	7,859	7,353	7,595	3,740
Mobile Sources	2,054	1,963	2,075	2,499	2,378	2,256	2,436	2,317	2,199	2,447
Industrial Fuel Combustion & Processes	24,125	25,125	18,172	15,591	15,560	15,529	15,498	15,468	15,437	20,806
All Others	52,210	61,434	38,608	38,608	38,608	38,608	38,608	38,608	38,608	37,366
Total	**86,744**	**96,587**	**66,776**	**64,664**	**64,396**	**64,396**	**64,401**	**63,745**	**63,838**	**64,359**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-3%	-5%	-5%	-6%	-4%	-6%	-12%	-9%	-55%
Mobile Sources	0%	-4%	1%	22%	16%	10%	19%	13%	7%	19%
Industrial Fuel Combustion & Processes	0%	4%	-25%	-35%	-36%	-36%	-36%	-36%	-36%	-14%
All Others	0%	18%	-26%	-26%	-26%	-26%	-26%	-26%	-26%	-28%
Total	**0%**	**11%**	**-23%**	**-25%**	**-26%**	**-26%**	**-26%**	**-27%**	**-26%**	**-26%**

Wyoming Emission Trends ($PM_{2.5}$)



Emission Trends Summary

- All pollutants with the exception of VOC have decreased since 1999 in aggregate across Wyoming
  - VOC increases largely due to Industrial Processes
- 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

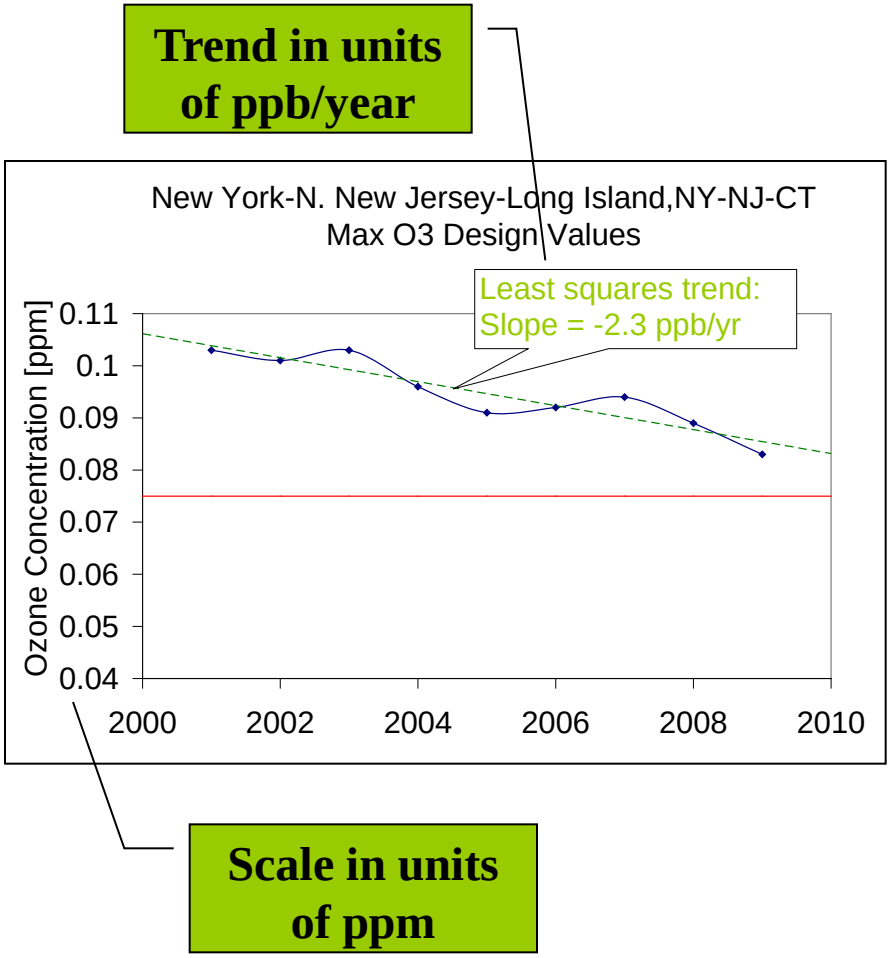
Data Handling Procedures

- 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

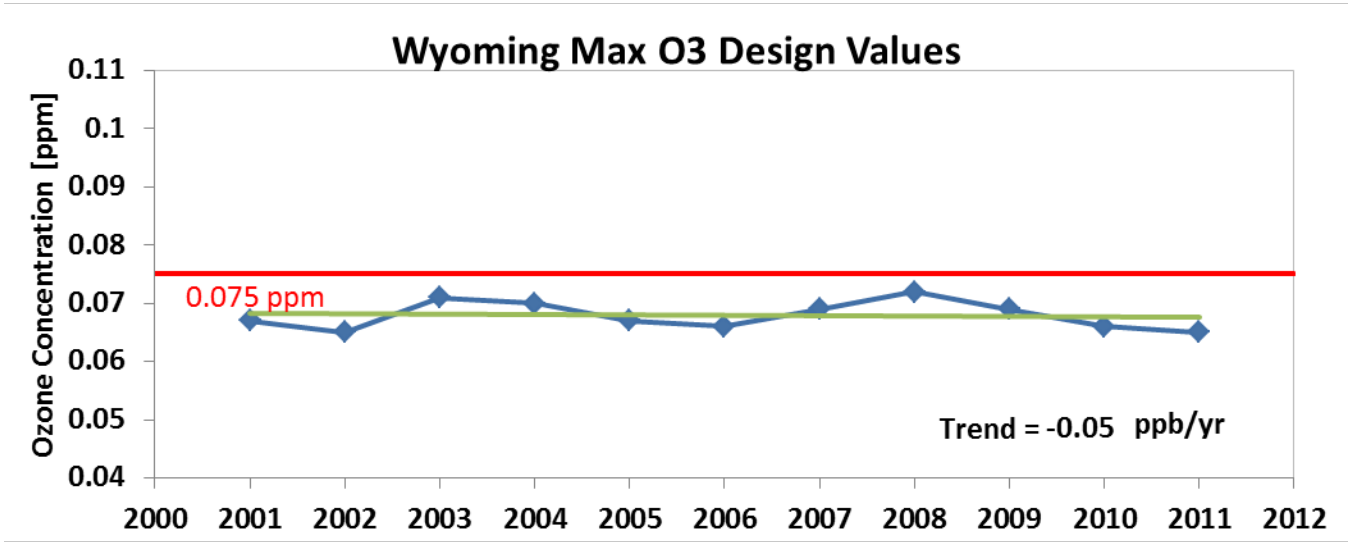
- Annual $PM_{2.5}$ DV and 24-hr $PM_{2.5}$ DV for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
  - DV calculations based on EPA data handling conventions
  - Data extracted from monitors that have a non-regulatory monitoring type are omitted
  - Selection of trend sites require valid DV in 9 out of 11 three-year periods between 1999 and 2011

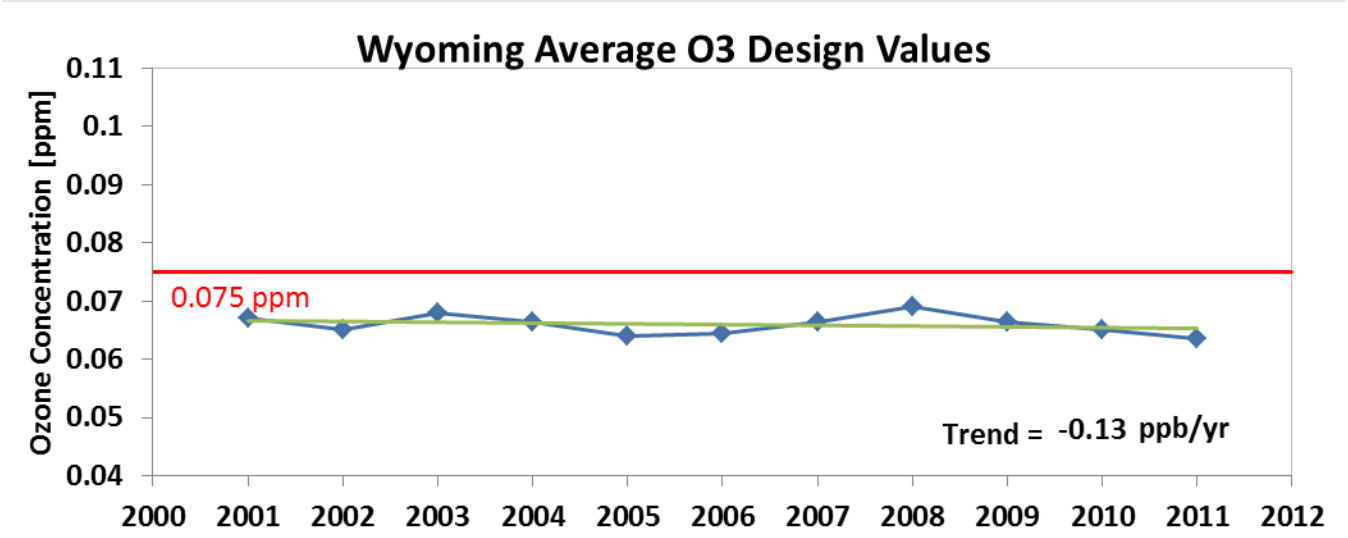
Trend Calculation



- 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



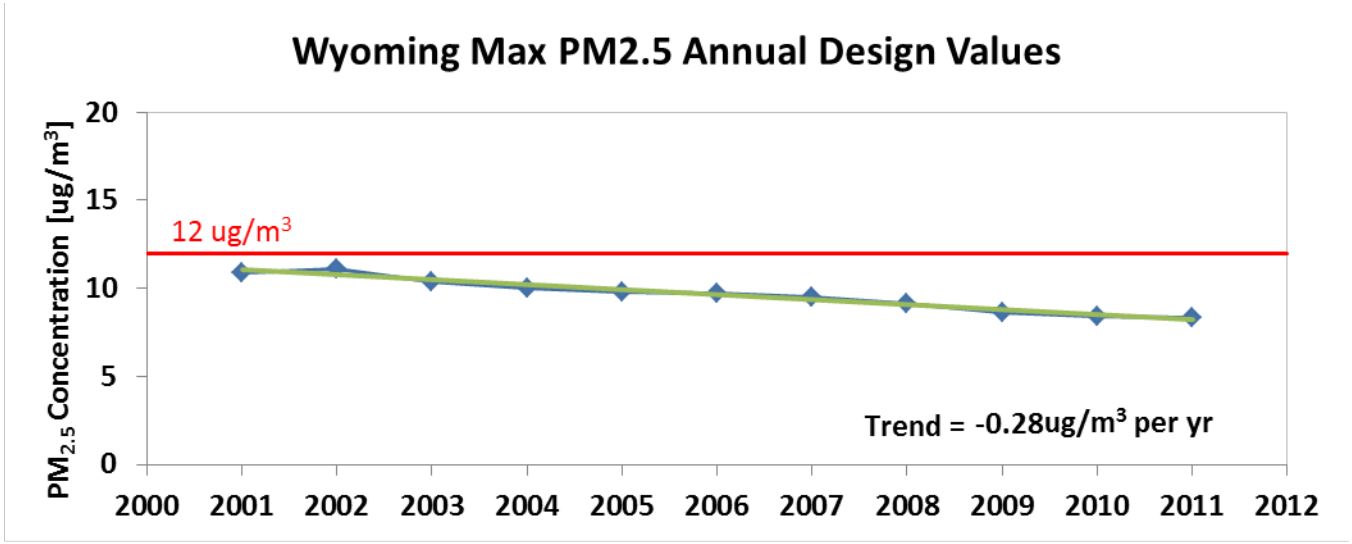


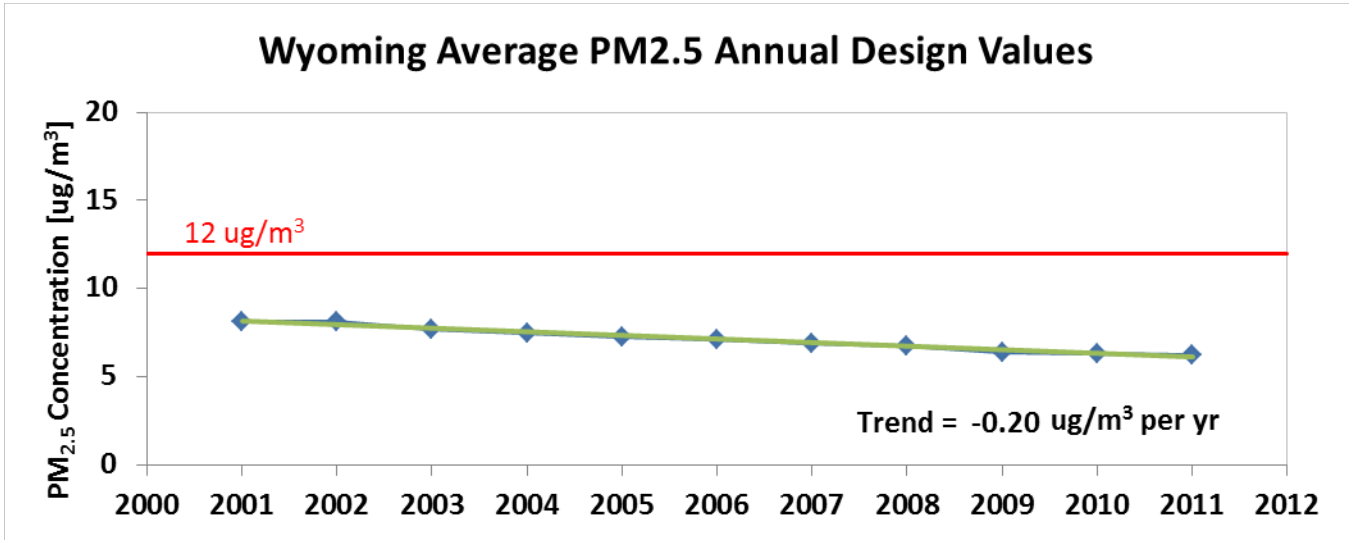
Ozone Trends by Site in Wyoming

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
5600501234420101	Campbell, WY	0.062	-0.63
5603910114420101	Teton, WY	0.065	-0.07

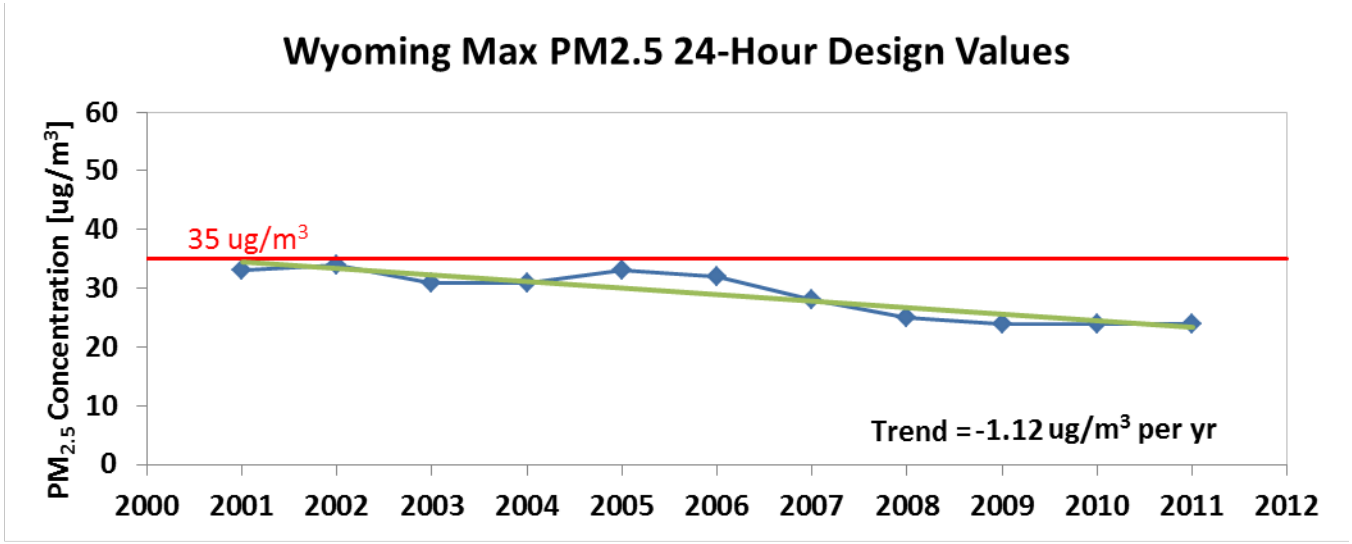
Note: Only monitoring sites meeting data completeness criteria listed

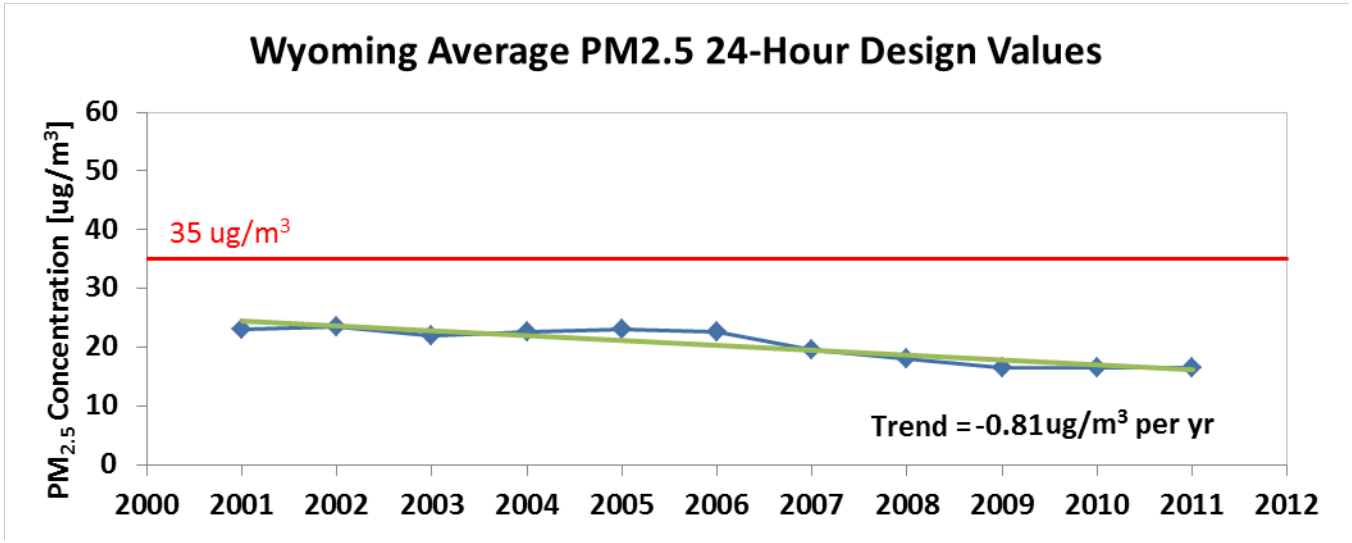
Max/Ave $PM_{2.5}$ Annual DVs and Trend





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





$PM_{2.5}$ Trends by Site in Wyoming

		2009-2011 DV [ug/m³]		Trend [ug/m³ per year]	
Monitoring Site	County	Annual	24-Hr	Annual DV	24-Hr DV
560210001	Laramie	4.1	9	-0.12	-0.51
560330002	Sheridan	8.3	24	-0.28	-1.12

Note: Only monitoring sites meeting data completeness criteria listed

Air Quality Trends Summary

- Based on data from two monitoring stations separately for O_3 and for $PM_{2.5}$, average O_3 design values have remained steady and average $PM_{2.5}$ design values have decreased since 1999 in Wyoming.
- There are no currently designated O_3 and $PM_{2.5}$ non-attainment areas in Wyoming in which monitoring data met the 1999–2011 trends completeness criteria. Additional O_3 or $PM_{2.5}$ non-attainment areas in Wyoming in which monitoring data did not meet the 1999–2011 trends completeness criteria include:
  - Upper Green River Basin Area, WY (Ozone)