The Particulate Matter and Ozone NAAQS

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Fine and Coarse PM

Fine particles ($PM_{2.5}$)

Combustion, gases to particles

Major sources:

- Coal, oil, gasoline, diesel, wood combustion;
- Transformation of SOx NOx, organic gases;
- High temperature industrial processes (smelters, steel mills); and
- Forest fires.

Lifetime days to weeks, regional distribution over urban scale to 1000s of km

Coarse particles ($PM_{10-2.5}$)

Crushing, grinding, dust

Major sources:

- Resuspension of dust tracked onto roads;
- Suspension from disturbed soil (farms, mines, unpaved roads);
- Construction/demolition; and
- Biological sources.

Lifetime of hours to days, distribution up to 100s km

History of the PM NAAQS

Year	Indicator	Ave. Time	Level[a]	Form
1971	TSP	24-hour	260 µg/m^3 (primary) 150 µg/m^3 (secondary)	Not to be exceeded more than once per year
		Annual	75 µg/m^3 (primary)	Annual average
1987	PM_{10}	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over a 3-year period
		Annual	50 µg/m^3	Annual arithmetic mean, averaged over 3 years
1997	**$PM_{2.5}$**	**24-hour**	**65 µg/m^3**	98th percentile, averaged over 3 years
		Annual	**15 µg/m^3**	Annual arithmetic mean, averaged over 3 years
	PM_{10}	24-hour	150 µg/m3	Initially promulgated 99th percentile, averaged over 3 years; when 1997 standards were vacated, the form of 1987 standards remained in place (not to be exceeded more than once per year on average over a 3-year period)
		Annual	50 µg/m3	Annual arithmetic mean, averaged over 3 years
2006	**$PM_{2.5}$**	**24-hour**	**35 µg/m^3**	98th percentile, averaged over 3 years
		Annual	**15 µg/m^3**	Annual arithmetic mean, averaged over 3 years
	PM_{10}	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over a 3-year period

- First established in 1971.
- Not revised until 1987, and indicator changed from TSP to PM_{10} (¼ of a grain of salt).
- Ten years later, added a standard for $PM_{2.5}$ and retained but slightly revised standards for PM_{10} (intended to regulate "inhalable coarse particles" from 2.5 to 10 micrometers).
- The 2006 standards lowered the 24-hour $PM_{2.5}$ standard to 35 µg/m^3, but retained the annual standard. The 24-hour PM_{10} standard was retained, but the annual PM_{10} standard was revoked.

Current PM NAAQS Review

Final Integrated Science Assessment (ISA)	December 2009
Final Risk Assessment (RA)	June 2010
Final Urban-Focused Visibility Assessment (UFVA)	July 2010
Public Comment Period for Second Draft Policy Assessment (PA)	August 16, 2010 (Extended to August 30 for Chapter 4)
Final Policy Assessment (PA)	September 2010 (Not final yet)
Proposed Rule	February 2011
Final Rule	October 2011

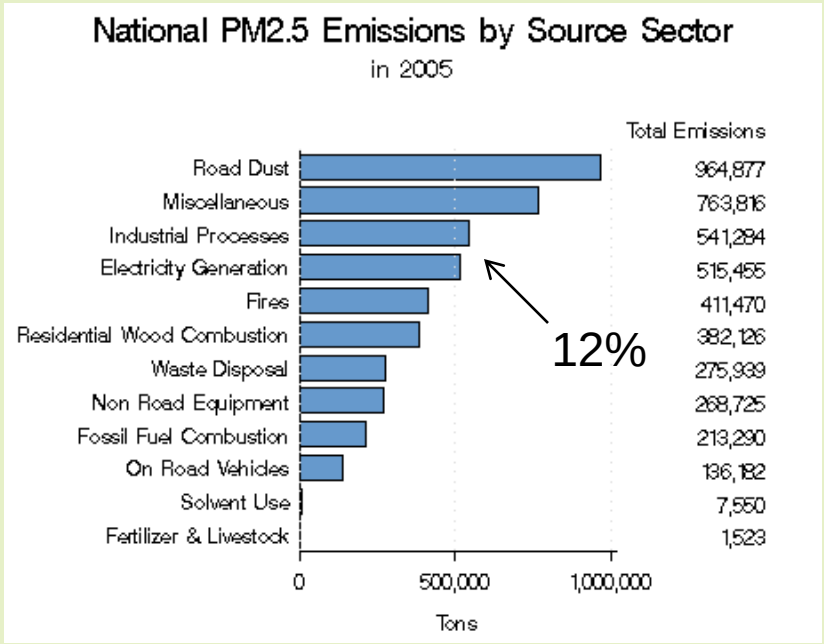
The PM Policy Assessment- 2nd Draft

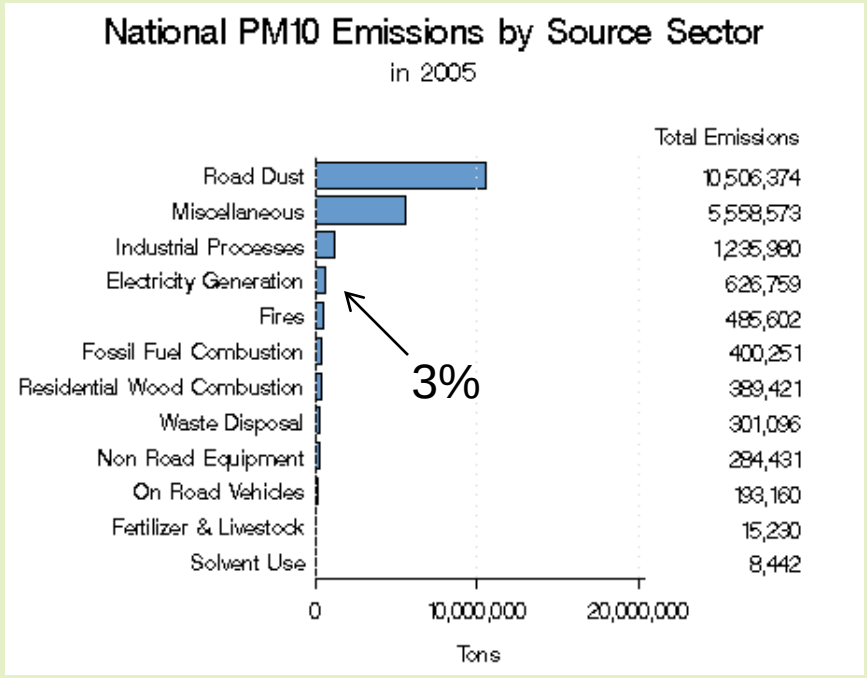
- Integrates evaluation of results from the ISA (evidence-based data) and from the RA (risk-based data).
- Recommends annual $PM_{2.5}$ concentrations in the range between 11 $\mu g/m^3$ (as precautionary level) and 13 $\mu g/m^3$ (a level just below that reported in select health effect studies).
- Recommends a 24-hr $PM_{2.5}$ between 30 $\mu g/m^3$ and 35 $\mu g/m^3$.
- Recommends lowering the PM_{10} standard to be between 65 $\mu g/m^3$ and 85 $\mu g/m^3$, and change the form of the standard to be a 98^{th} percentile.

Issues Associated with Recommendations Presented in the Policy Assessment

- US EPA continues to rely heavily on epidemiological studies of associations between ambient PM concentrations and various mortality and morbidity health outcomes to support lowering the $PM_{2.5}$ and PM_{10} standards.
- Evidence of effects is uncertain due to confounding factors, results that vary with different model specifications, heterogeneity in PM concentrations and health effects, and measurement exposure error.
- Regardless, US EPA in the policy assessment is making recommendations to lower the standard based on air quality distributions at monitoring sites, not on the health effects literature.
- Recommendations for the 24-hr standard are based on having a "controlling" annual standard and a 24-hr standard that would provide additional protection.

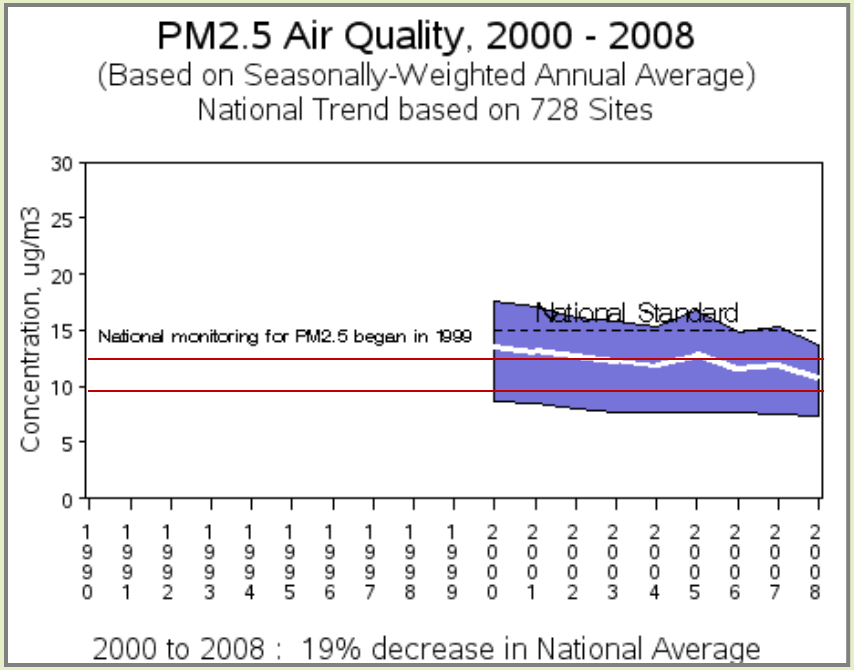
$PM_{2.5}$ Emissions from Different Sources (2005)



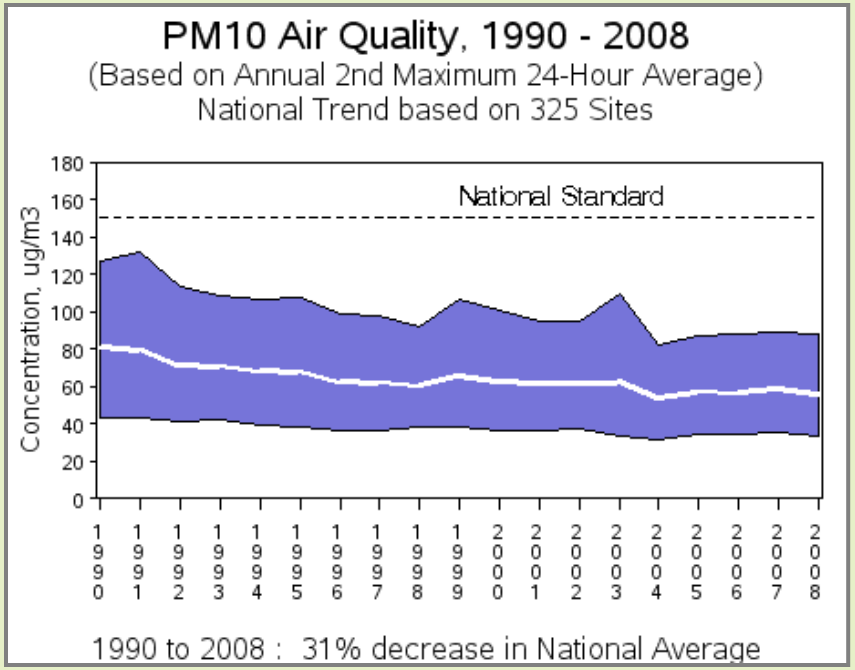


Source: http://www.epa.gov/air/emissions/pm.htm

PM Air Quality Trends



Large implications to lowering the annual $PM_{2.5}$ standard – as many sites would be out of compliance!



PM_{10} standard changes may also have an impact on power plants

Source: http://www.epa.gov/airtrends/pm.html

History of the Ozone NAAQS

Year	Indicator	Ave. Time	Level[a]	Form
1971	Photochemical oxidants	1-hour	0.08 ppm	Not to be exceeded more than once per year
1979	O_3	1-hour	0.12 ppm	Not to be exceeded more than once per year
1997	O_3	8-hour	0.08 ppm	Annual fourth-highest daily maximum, averaged over 3 years
2008	O_3	8-hour	0.075 ppm	Annual fourth-highest daily maximum, averaged over 3 years

[a] *Levels are identical for primary and secondary ozone standards*

- First established in 1971.
- First revision in 1979, when indicator changed from photochemical oxidants to ozone and the standards increased.
- In 1997, the standards changed form and were lowered to 0.08 ppm.
- The most recent revision in 2008 lowered the standards to 0.075 ppm, but this revision is currently under reconsideration.

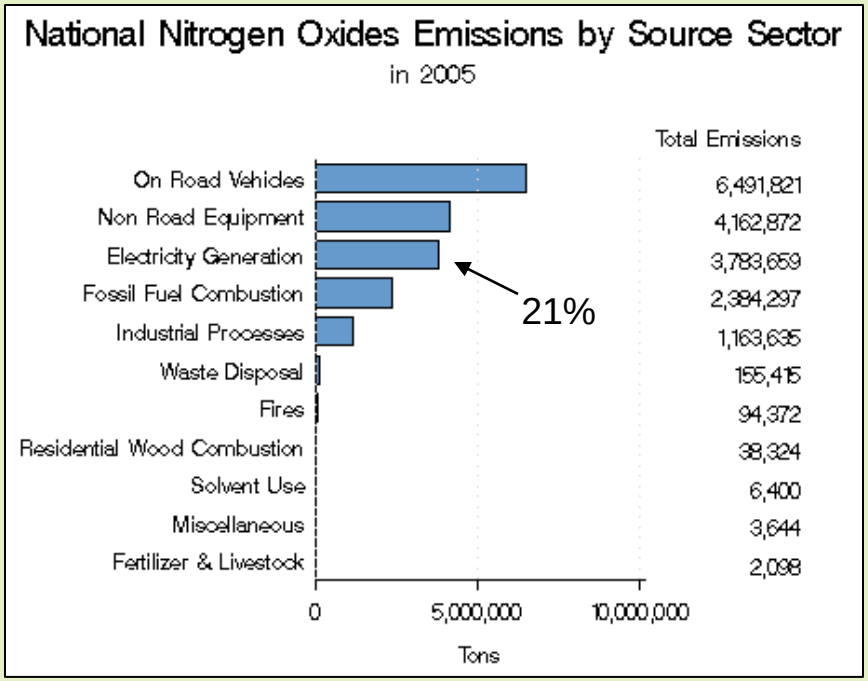
Reconsideration of the 2008 Ozone NAAQS

- In 2009, the US EPA Administrator re-evaluated the same scientific data used as the basis for the 2008 NAAQS, which was set under a different Administration, and decided to initiate a reconsideration of the standard.
- **In Sept 2010, US EPA proposed new primary and secondary ozone standards:**
  - The 8-hour primary standard should be lowered from 0.075 ppm to within the range of 0.06 – 0.07 ppm.
  - The secondary standard should be a cumulative, seasonal standard expressed as an annual index of the sum of weighted hourly concentrations, cumulated over 12 hours/day during the consecutive 3-month period within the ozone season with the maximum ozone index value, set within the range of 0.7 – 15 ppm-hours.
- US EPA has not issued their decision for reconsideration
- New review of ozone standards has begun, ISA to be released soon

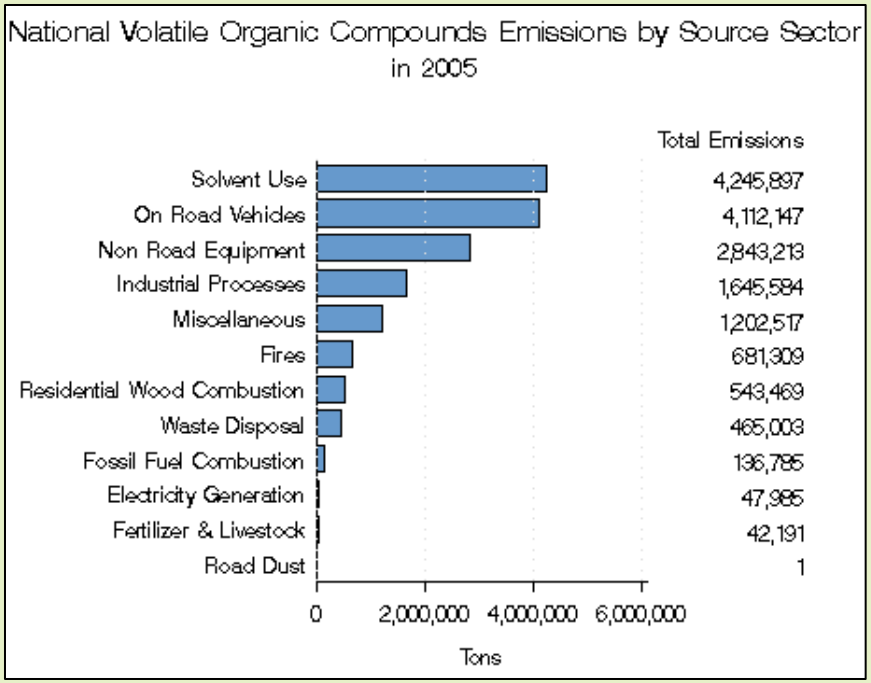
Issues Associated with the Reconsideration of the 2008 Ozone NAAQS

- US EPA placed greater emphasis on an exposure study of lung function that did not show adverse effects at ozone levels below 0.08 ppm (Adams 2002, 2006).
- US EPA used inappropriate statistics to re-analyze this study and concluded that effects on lung function were observed at 0.06 ppm ozone.
- US EPA did not consider that the small effects observed on lung function were not adverse.
- Epidemiological studies relied on by US EPA were subject to major methodological limitations and do not support adverse effects below the 2008 standard.

Emissions of Ozone Precursors from Different Sources

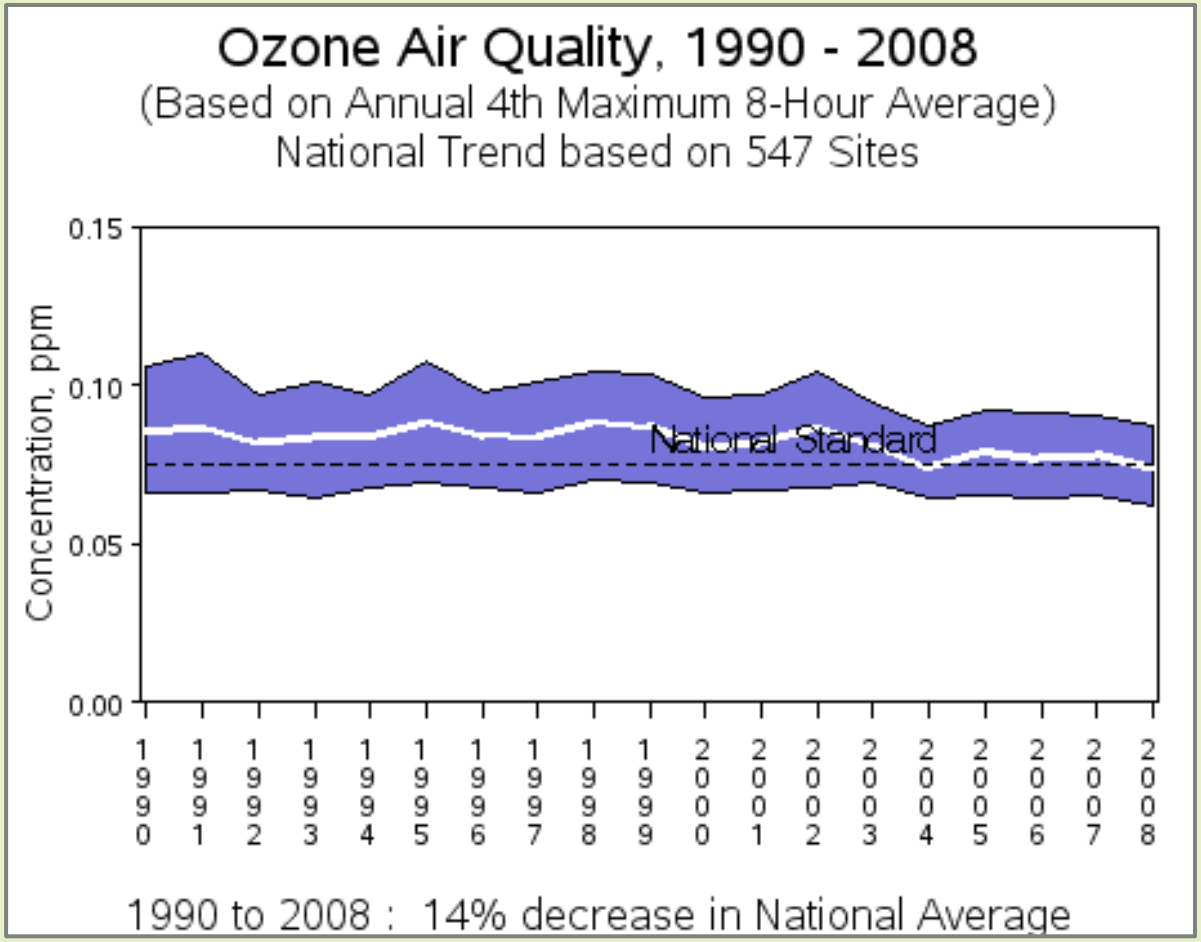


Source: http://www.epa.gov/air/emissions/nox.htm



Source: http://www.epa.gov/air/emissions/voc.htm

Ozone Air Quality Trends



Source: http://www.epa.gov/airtrends/ozone.html

Conclusions

- About 10% of monitoring sites are currently out of compliance with the $PM_{2.5}$ standard. A lower standard would bring many more out of compliance. As a major contributor to emissions, this will significantly impact power plants. It is less certain how changes to the PM_{10} standard will impact power plants.

- For ozone, many monitoring sites are currently out of compliance. Further reductions will bring many more out of compliance. As a major contributor to NOx emissions, this will have significant implications for power plants.