Particulate Matter

Use of scientific information in establishing US National Ambient Air Quality Standards

Presentation for
Panel Discussion on use of science in setting PM Standards
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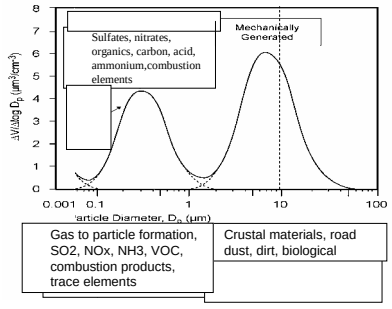
National Ambient Air Quality Standards

- Standards are to be based on the latest scientific criteria
- Standards are to protect public health with an adequate margin of safety and to protect against adverse effects on public welfare
- Four major components of standards that determine degree of protection:
  - **Indicator**: e.g., PM_{10}, $PM_{2.5}$, O_3, SO_2
  - **Averaging Time**: e.g., 1-hr, 24-hr, annual average
  - **Form**: e.g., number of exceedances, percentile, mean
  - **Level**: e.g., 15 µg/m^3

History of PM NAAQS

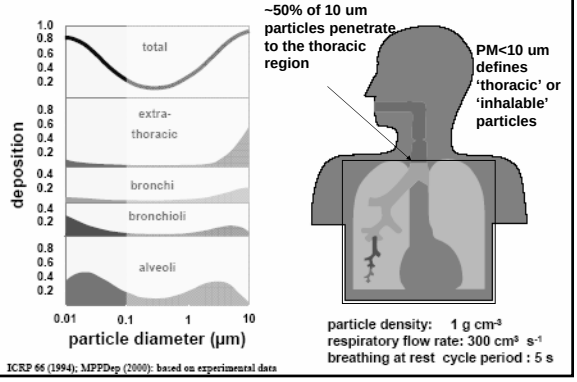
- **1971** – EPA promulgates NAAQS for "total suspended particulate" (particles smaller than ~25-45 µm in diameter)
- **1987** – EPA revises PM NAAQS, changing the indicator from TSP to PM_{10} to focus on "inhalable" particles (< 10 µm)
- **1997** – EPA revises PM NAAQS to focus separately on the "fine" and "coarse" fractions of PM_{10}
  - New standards established for "fine" particles < 2.5 µm in diameter ($PM_{2.5}$)
  - PM_{10} standards retained to focus on "coarse fraction" (particles between 2.5 and 10 µm in diameter)
- **2006** – Complete review/revision of PM NAAQS (process underway)

1976- 87 The First PM NAAQS Review

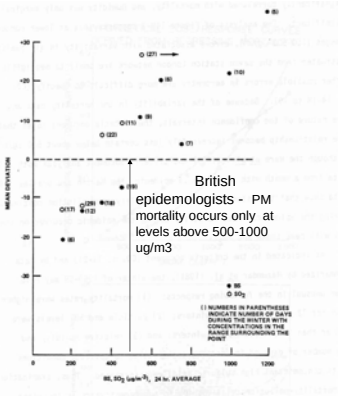


➓ Major advances in understanding particle distributions

Particle Dosimetry Defined PM_{10} Indicator



ICRP 66 (1994); MPPDep (2000): based on experimental data

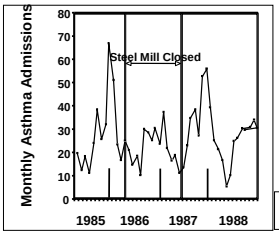


Levels for NAAQS

- A new look at London episodes
- Schwartz and Marcus apply modern econometric statistical tools
- No evidence of obvious thresholds
- Some suggestion of independent PM effect
- 24 hour level set at lowest level in London episode data, some US, Dutch data, indicator differences noted
- Annual level based on US studies

1988-94 – Important new epidemiology

- Schwartz et al. daily mortality in 10 cities
- Harvard 6, 24 cities long-term studies
- Pope work in Utah Valley
- Pope et al. prospective cohort study
- Thurston hospital admission
- Follow-up studies of cause, morbidity, reanalyses
- Most studies use PM10, some fine particle indicators, components
  - Pope (ACS) study uses sulfate data and 50 city PM2.5 from IP Network established for first review

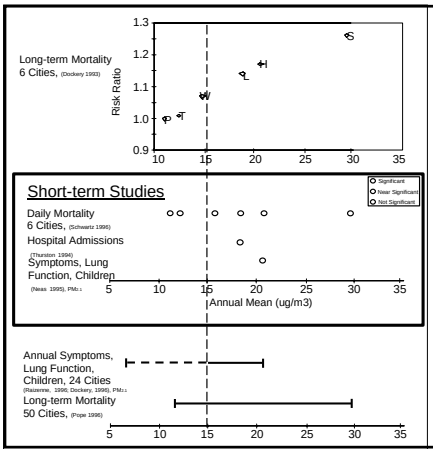


Pope showed health outcomes tracking steel mills closure and PM levels.

1993- 97 Second PM NAAQS Review

Standard Component	1987 US NAAQS	1997 Standard Revisions
Particle Indicator	PM-10	PM2.5 (keep PM-10)
Averaging Times	24-hr, annual AM	24-hr, annual AM
24-hour Primary Level	150 ug/m3	65 ug/m3
Annual Primary Level	50 ug/m3	15 ug/m3
Form	Statistical	98th percentile, 3 yr avg
Secondary Standard(s)	Same as primary	Same as primary

- Epi studies increasingly find effects at levels meeting PM10
- Litigation to accelerate review, subsequent litigation lasted 5 years, to the Supreme Court delayed implementation
- An explosion of research and monitoring began during the review, continuing through NAS panel, current programs.
- CASAC recommends indicators, diverse views on levels



Basis for annual level is daily plus long-term

•Basis for PM2.5 – atmospheric sciences

Key Scientific Issues in 1993-7

- Results determined by statistical model
  - Controversy over data in long-term cohorts
- Confounding by non-pollutant variables
  - Weather, temperature
  - Infectious diseases, personal factors, e.g. smoking
- Confounding by other pollutants
  - Outdoor
  - Personal exposure vs. ambient monitor
- Biological plausibility
  - Who is dying?
  - By what mechanisms can low PM levels cause death?
  - Controlled studies of specific particles not supportive in quantitative sense
  - If death, what evidence for morbidity?
- If real, deaths may be only days premature

➓ 2005 – Research and monitoring stimulated by this review has made advances in all of these areas

Timeline for PM NAAQS Review

- Consent agreement
  - PM Criteria Document
    - final in October 2004
  - PM Staff Paper milestones
    - January 31, 2005 - release of second draft Staff Paper (done)
    - April, 2005 - CASAC meeting to review second draft Staff Paper
    - June 30, 2005 - final Staff Paper
  - FR notices signed
    - proposal - December 20, 2005
    - final rule - September 27, 2006
  - Web address for Staff Papers: http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_cr_sp.html

2005 Staff Approach to primary $PM_{2.5}$ standards review… evidence-based considerations

	Annual standard	24-hour standard
Long-term exposure studies	▪ *Evidence-based* assessment of protection from effects related to long-term exposures	
Short-term exposure studies	▪ *Evidence-based* assessment of protection from effects related to short-term exposures	▪ *Evidence-based* assessment of protection from effects related to short-term exposures

2005 Staff Approach to primary $PM_{2.5}$ standards review… risk-based considerations

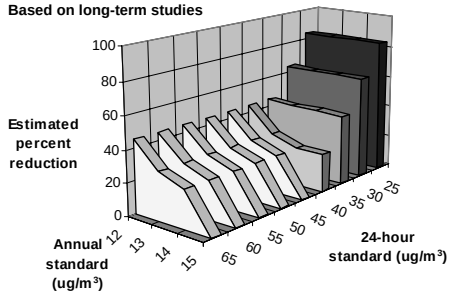
	Annual standard	24-hour standard
Long-term exposure studies	▪ *Evidence-based* assessment of protection from effects related to long-term exposures ▪ *Risk-based* assessment of extent to which alternative suites of standards would likely reduce estimated risks from long-term exposures	
Short-term exposure studies	▪ *Evidence-based* assessment of protection from effects related to short-term exposures ▪ *Risk-based* assessment of extent to which alternative suites of standards would likely reduce estimated risks from short-term exposures	▪ *Evidence-based* assessment of protection from effects related to short-term exposures

Risk-based Assessment in 5 Cities

Philadelphia [540 (190-940) deaths/yr]

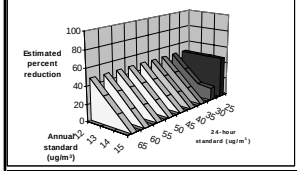
Residual risk just attaining current NAAQS

Based on long-term studies

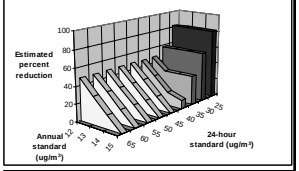


Risk-based Assessment in 5 Cities

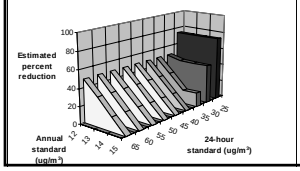
Detroit [520 (180-910) deaths/yr]



Pittsburgh [400 (140-700) deaths/yr]



Los Angeles [1500 (530-2600) deaths/yr]



St. Louis [600 (210-1000) deaths/yr]