

# **Review of the California Ambient Air Quality Standards for Particulate Matter and Sulfates**

**June 20, 2002**



**Air Resources Board**



**Office of Environmental  
Health Hazard Assessment**

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**California Environmental Protection Agency**

# Purpose of Standards Review

- **Ensure State standards provide adequate protection of public health**
- **Base State standards on best available information on health effects**
- **Comply with Children's Environmental Health Protection Act (SB 25, Escutia, 1999)**

# Results of the 2000 Standards Prioritization Process

## 1<sup>st</sup> Priority

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- **PM10 (including sulfates)**
- **Ozone**
- **Nitrogen dioxide**

From Staff Report entitled "Adequacy of California Ambient Air Quality Standards: Children's Environmental Health Protection Act," December 2000.

# **Why We Are Concerned About Particles**

- **Significant health effects including premature death and cardiorespiratory disease**
- **Compelling body of evidence**
- **Vulnerable groups include infants & children, asthmatics, the elderly, and those with pre-existing heart or lung disease**
- **High exposures in California**
- **Substantial health benefits from lowering PM levels**

# Standards Review Process

Nov. 2001

Draft Report

Public

AQAC

public comment period

Public Workshops

AQAC Public Meetings

May 2002

Final Staff Report

Public Workshops

45-day public comment period

June 2002

Board Hearing



# **Environmental Justice Considerations**

- **PM standards set public health goal for all communities statewide**
- **Outreach efforts included townhall meetings**
- **Health impacts on vulnerable populations considered in the standard setting process**
- **EJ will be considered in prioritizing and evaluating measures to reduce PM**
- **Communities with higher exposure will see greater relative benefits from implementation**

# **Recent Developments Affecting Short-term Air Pollution Studies**

- Problem with statistical software package used in recent short-term studies**
- ARB and OEHHA staff determined long-term exposure estimates not affected**
- Some short-term studies need reanalysis**

# Recommendations for PM Standards

## Annual Standards:

- Reduce PM10 annual-average standard from 30 to 20 mg/m<sup>3</sup>
- Add PM2.5 annual-average standard of 12 mg/m<sup>3</sup>

## 24-Hour Standards:

- Continue review of 24-hour standards  
(Current PM10 24-hour standard of 50 mg/m<sup>3</sup> remains in effect)

## Sulfates Standard:

- Retain 24-hour standard of 25 mg/m<sup>3</sup>
- Establish alternate monitoring method

# Recommendations for Monitoring Methods

- **Adopt existing Federal Reference Methods (FRMs) for PM10**
- **Adopt existing FRM for PM2.5**
- **Designate continuous methods as acceptable for PM10 and PM2.5**
- **Replace TSP-based sulfate method with PM10-based sulfate method**

# Existing and Proposed Annual-Average Standards for PM

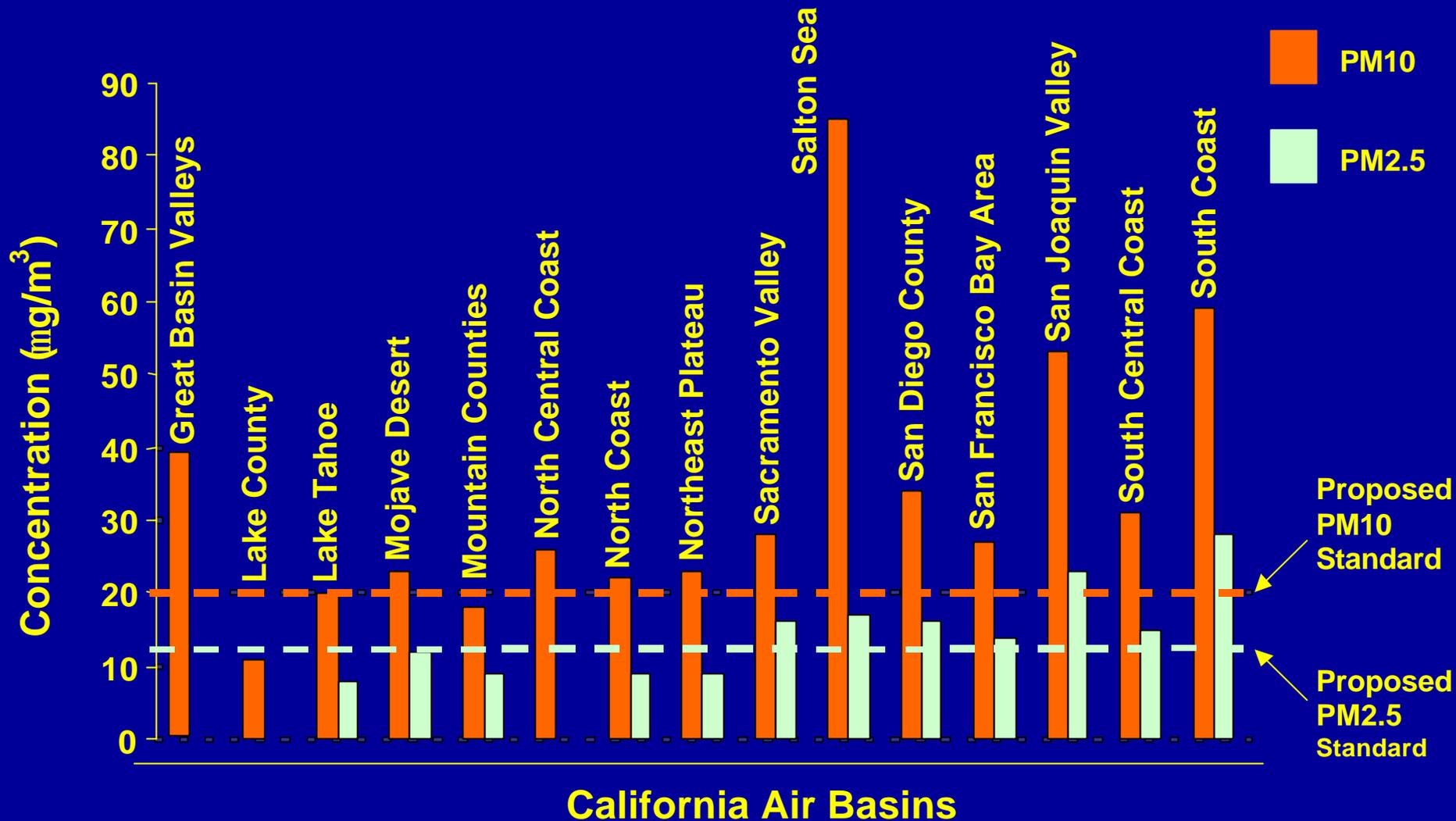
Year Adopted		PM10 ( $\mu\text{g}/\text{m}^3$ )	PM2.5
1983	California (current)	30	--
1997	USEPA	50(40-50)*	15 (12.5 -20)*
1999	EU (2005)**	40	--
1999	EU (2010)**	20	--
2000	UK	40	--
2002	California (proposed)	<b>20</b>	<b>12</b>

\* Ranges based on staff recommendation, USEPA 1996

\*\* Attainment target date; 2010 goal subject to review

# PM10 and PM2.5 by Air Basin

## 2000 Annual Average



# Expected Health Benefits from Attaining Proposed Standards

Meeting the proposed annual-average PM standards would prevent about:

- 6,500 deaths per year
- 32,000 cases of bronchitis in children (ages 8 to 12)
- 340,000 asthma attacks
- 2.8 million lost work days
- Thousands of cardiovascular and respiratory hospitalizations among those older than 65

# **Why Move Forward with Annual Standards?**

- Long-term studies not affected by statistical software issue**
- High level of PM exposure in most of California**
- Studies provide conclusive evidence of significant health effects from PM exposure**

# **Scientific Rationale for Annual Standard Recommendations**

# **PM Standards Based Mainly on Epidemiological Data**

- **Represent real-world exposures and health outcomes**
- **Can examine different population segments (e.g. children, asthmatics, elderly)**
- **For gaseous pollutants, air quality standards based in part on controlled exposure studies**
- **Since PM composition is complex, epidemiological studies are more relevant**

# **Vast Body of Evidence Relating Health Effects to PM Exposure**

- Since last PM review (1983), hundreds of studies published on health effects of exposure to PM10 and PM2.5**
- Evidence of mortality and morbidity linked to increases in exposures to PM10 and PM2.5 in over 200 cities**
- Effects associated with both short- and long-term exposures at current ambient concentrations**

# Studies of Long-term Exposure and Life Expectancy

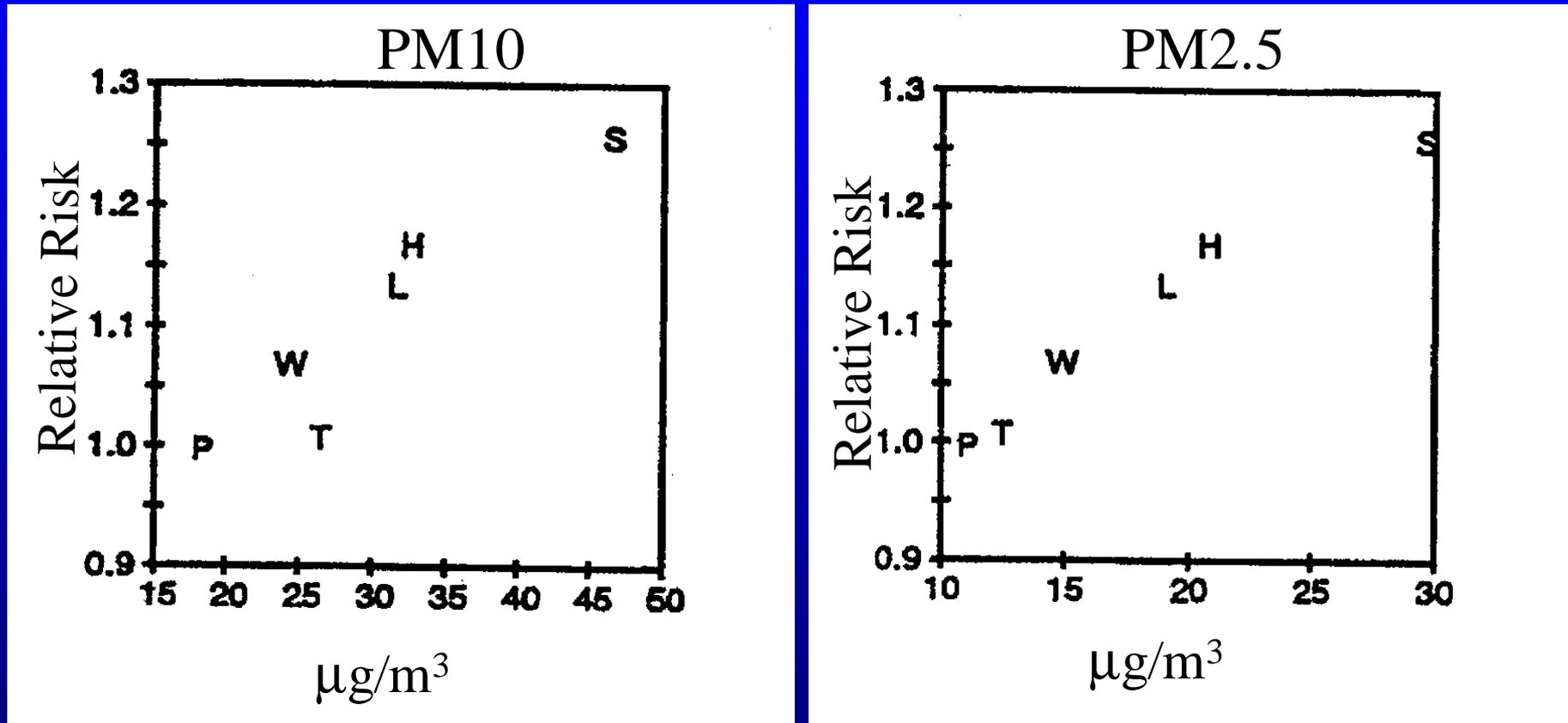
- **Several studies (Harvard 6-Cities, American Cancer Society, AHSMOG) have prospectively examined effects of long-term exposure to PM10, sulfates, and/or PM2.5**
- **Study subjects followed up to 16 years**
- **Analyses control for individual-level risk factors for mortality (e.g., age, gender, weight, tobacco and alcohol use, occupational exposure)**

# Harvard Six-Cities Study

*(New England Journal of Medicine, 1993)*

- Over 8,000 adults followed for up to 16 years
- Pollution monitors set up specifically for this study
- Associations reported between both PM<sub>2.5</sub> and PM<sub>10</sub> and deaths from heart and lung disease

# Mortality Risks and Long-term PM Exposure In the Six-Cities Study



# **American Cancer Society (ACS) Study Results**

- Involved roughly 550,000 individuals in 151 cities, followed for up to 7 years (Pope et al., 1995)**
- Associations observed between PM<sub>2.5</sub> and sulfate and both cardiopulmonary mortality and lung cancer**
- Results imply significant reduction in life expectancy. Between the least and most polluted cities (24 mg/m<sup>3</sup> PM<sub>2.5</sub>), the average pollution-associated decrease in life expectancy was about 1.5 years.**

# Re-analysis and Updating of Studies

- **Funded by Health Effects Institute, Canadian researchers re-analyzed data from Six-Cities and ACS studies**
- **Extensive additional analysis confirmed associations with PM, considering additional individual and city-wide variables**
- **Update of ACS study (Pope et al., 2002) confirmed earlier findings using 16 years of follow-up, accounting for dietary and other variables**

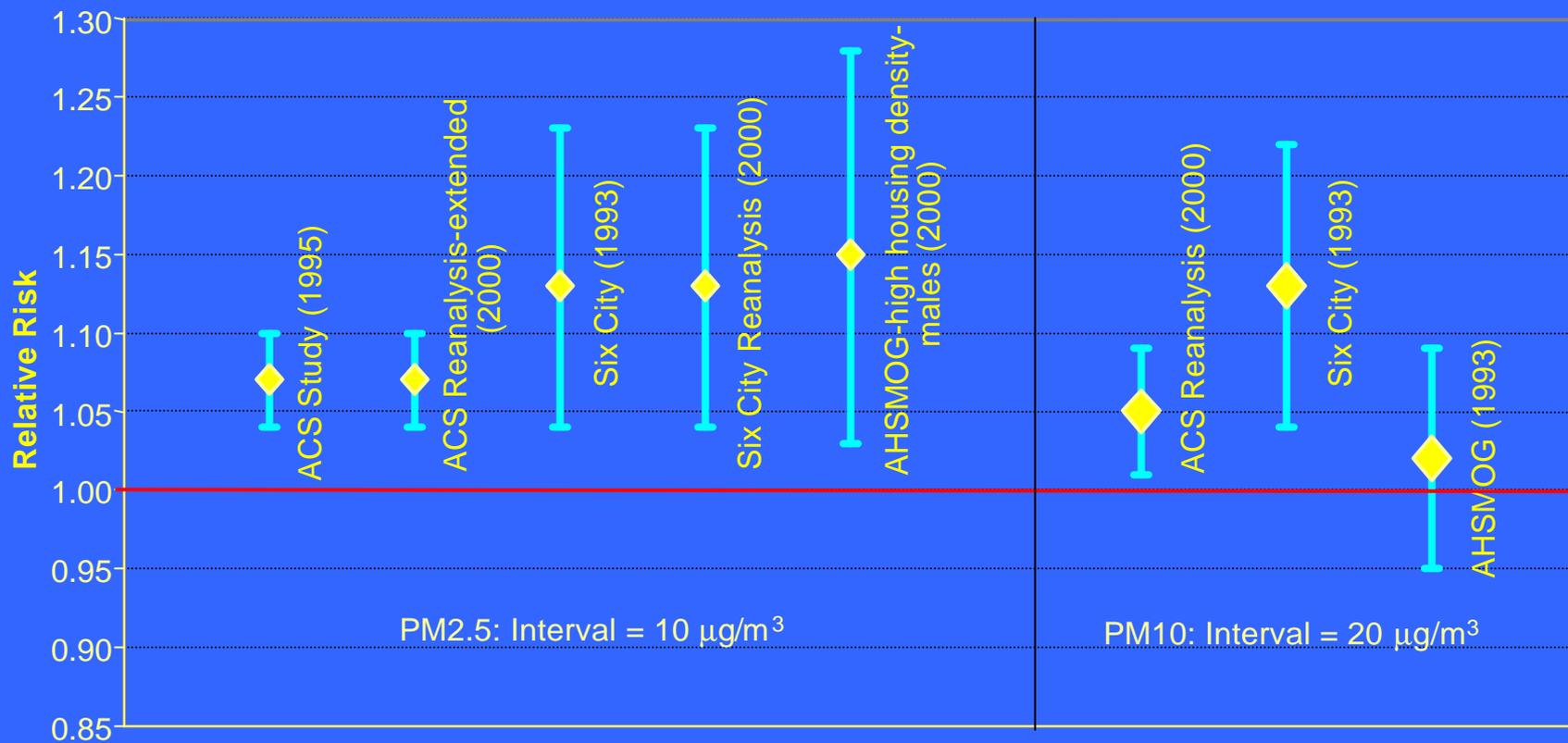
# Conclusions of HEI Review Committee

**“Overall, the reanalyses assured the quality of the original data, replicated the original results, and tested those results against alternative risk models and analytic approaches without substantially altering the original findings of an association between indicators of particulate matter air pollution and mortality.”**

# **Long-term PM Exposure Also Affects Morbidity in Children**

- Increased risk of bronchitis and chronic cough in children related to long-term exposure to PM10**
- PM exposure during pregnancy reported to be associated with low birth weight, premature birth, and birth defects**
- Over a 4-year period, PM10, PM2.5, coarse particles, acid vapors, and NO<sub>2</sub> were associated with reduced lung function growth in Children's Health Study**

# Comparison of Studies of Chronic Exposure and Mortality



# **Rationale for Annual-Average Standards**

- Several large studies suggest significant health effects associated with chronic PM exposure**
- Long-term exposure has large impact on mortality**
- PM<sub>2.5</sub> generally has different sources, indoor penetration, and lung deposition patterns than PM<sub>10</sub>**

# **Rationale for Annual-Average Standards (cont'd)**

- **Lowering annual-average PM10 and adding PM2.5 annual-average standard will reduce entire PM distribution and long-term exposures**
- **Proposed standards are below concentrations at which adverse health effects have consistently been observed**

# **Decreasing Annual Average PM Levels Will Reduce Peak Daily Concentrations as Well**

- **Reducing PM distributions will reduce both mortality and morbidity, including:**
  - **Heart attacks and arrhythmias**
  - **Hospital admissions and ER visits**
  - **Asthma attacks and other respiratory symptoms**
  - **Lost work and school days**

# Summary of Public Comments

- **Over 1,400 letters of general support from individuals**
- **73 more detailed comments received, mostly supportive**
  - 17 comments express opposition to one or more aspects of review process or proposals
- **Major comments**
  - Insufficient review time
  - Recent statistical issues undermine all studies and therefore all recommendations should be delayed
  - Economic impacts of future controls not considered
  - Standards are too lenient

# Summary of Recommendations

- **Update annual standard for PM10**
- **Establish annual standard for PM2.5**
- **Revise monitoring methods**

# **Expected Annual Health Benefits of Attaining Proposed Standards**

**We have the ability to prevent...**

- 6,500 premature deaths**
- Thousands of CV and respiratory hospitalizations**
- 32,000 cases of bronchitis in children**
- 340,000 asthma attacks**
- 2.8 million lost work days**