Revised Estimates of Premature Death Associated with PM2.5 Exposures in California

May 22, 2008
Fresno, California
Overview

- Background on ARB’s health impacts analysis
- Updated methodology
- New estimates of premature deaths
- Next steps
ARB’s Health Impacts Analysis

- Estimate health impacts associated with public exposures to ambient levels of ozone and PM
- Estimate benefits associated with proposed diesel PM regulations to reduce emissions
- Board requested update in light of new studies emerging since 2002
Key Steps in ARB’s Update of Estimates

1. U.S. EPA’s Review of Literature
2. Draft Report
3. Peer Review
4. Board Briefing
5. Public Workshop
6. Final Report

Public comment period
Advisors

- Dr. Jonathan Levy, Harvard University
- Dr. Bart Ostro, Office of Environmental Health Hazard Assessment
- Dr. Arden Pope, Brigham Young University
Peer Review Evaluation

- Dr. Jeffrey R. Brook, Environment Canada
- Dr. Mark D. Eisner, UC San Francisco
- Dr. Richard C. Flagan, California Institute of Technology
- Dr. Alan E. Hubbard, UC Berkeley
- Dr. Joel D. Kaufman, University of Washington
- Dr. Joel D. Schwartz, Harvard University
Proposed Revisions to the Methodology

- New estimate of PM2.5-premature death relationship
- Health impacts associated with exposures below the annual standard of 12 µg/m³
Basis of Updated Methodology

- New information from major health studies
  - American Cancer Society (2005)
  - The Adventist Health Study of Smog (2005)
  - Women’s Health Initiative (2004, 2007)
  - Veterans Administration (2003, 2006)
  - Eleven California Counties (2005)
  - Cystic Fibrosis Foundation (2004)

- U.S. EPA: experts’ reviews and interpretations of literature
Summary of Results from Key Studies

Relative Risk of Premature Death from PM2.5 Exposure

Best estimate and uncertainty range

% Change in Risk per 10 µg/m³ Increase in PM2.5

-5

0

5

10

15

20

25

30

35

ACS (2002)

ACS, Los Angeles (2005)


AHSMOG, males only (2000)

VA, extended (2005)
Revised Concentration-Response Relationship in Our Draft Report

• On average: 10% increased risk of premature death per 10 µg/m³ increase in long-term PM2.5 exposures
  – Current estimate is 6%

• 90 percent uncertainty interval: 3% to 20%
Other Analyses Consistent with Our Estimate of Increased Risk

• Results from U.S. EPA’s reviews of literature statistically treated in various ways
• Results from actual major cohort studies
• European experts convened to survey interpretations of the literature
Statewide PM2.5 Exposures
1987-2006

Statewide Average PM Concentration

Level in µg / m³

Year

Historical monitoring network
New monitoring network

3 Year Moving Average
Annual Average
Estimated 3 Year Moving Average
Estimated Annual Average
PM2.5 Exposures
1987, 1999, and 2006
Premature Deaths Avoided Due to Ambient PM2.5 Reductions

- Since 1999, annual average PM2.5 levels decreased 30% statewide
- Deaths avoided due to year-to-year reduction in PM2.5 from 1999 to 2006: 14,000 deaths*

*Uncertainty interval: 4,300 to 25,000 deaths.
Proposed Revisions to the Methodology

- Update PM2.5-premature death relationship
- Use new estimate of ambient PM2.5 concentration based on 2004/05/06 monitoring data
- Estimate health impacts associated with exposures below the annual standard of 12 μg/m³
Levels at Which the Risk for Premature Death Can Be Quantified

- Literature suggests increased premature death occurs at levels well below 12 µg/m³.
- New approach uses a range of levels:
  - 7 µg/m³: lowest level measured in American Cancer Society studies
  - 2.5 µg/m³: background level in California
Revised Estimates of Premature Deaths Associated with Ambient PM2.5

• About 14,000 to 24,000* premature deaths annually are estimated to be associated with long-term exposures to PM2.5

• A majority of the impacts occur in
  – South Coast
  – San Joaquin Valley
  – San Francisco Bay

*Uncertainty interval: 4,300 to 41,000 deaths.
New Estimates of Premature Deaths Associated with Diesel PM

• Updated the methodology by considering the relation between ambient NO\textsubscript{X} and diesel PM concentrations
• Based on new relationship, about 3,900* premature deaths were associated with primary diesel PM emissions in 2000
  – Previous estimate was 2,200 deaths

*Uncertainty interval: 1,200 to 7,100 deaths.
## Summary of Proposed Revisions

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<thead>
<tr>
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<th>Current</th>
<th>Proposed</th>
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<tbody>
<tr>
<td>Increased Risk per 10 µg/m³</td>
<td>6%</td>
<td>10%</td>
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<tr>
<td>Lowest level of effect</td>
<td>12 µg/m³</td>
<td>Range of 7 to 2.5 µg/m³</td>
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<td>Air quality data</td>
<td>Year 1999/2000</td>
<td>Year 2004-06</td>
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<tr>
<td>Annual premature deaths (Ambient PM)</td>
<td>8,200</td>
<td>14,000 to 24,000</td>
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<td>Premature deaths in 2000 (primary diesel PM)</td>
<td>2,200</td>
<td>3,900</td>
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Uses of New Methodology

• Use new findings for future health impacts analysis
• Consider this information in next review of ambient air quality standards
## Timeline for Completion of Staff Report

<table>
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<tr>
<th>Date</th>
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<tbody>
<tr>
<td>May 22, 2008</td>
<td>Draft report* released at Board briefing</td>
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<tr>
<td>June 2008</td>
<td>Public workshop</td>
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<tr>
<td>July 2008</td>
<td>Public comment period ends</td>
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<tr>
<td>August 2008</td>
<td>Final staff report released</td>
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*Draft report available at: [http://www.arb.ca.gov/research/health/pm-mort/pm-mort.htm](http://www.arb.ca.gov/research/health/pm-mort/pm-mort.htm)