Health Impacts of Diesel PM Emissions: An Update

November 19, 2009

Sacramento, California

Air Resources Board

California Environmental Protection Agency

Presentation Overview

- Health effects of diesel PM
- Methodology for estimating premature deaths
- Control programs and PM trends

Health Effects of Diesel PM

- ARB and OEHHA evaluating diesel exhaust since 1989
- Listed as a toxic air contaminant in 1998
- Responsible for 70% of air toxics cancer risk
- Listing formed the basis of ARB's Diesel Risk Reduction Plan

Diesel PM Also Linked to Premature Death

- Diesel PM is a component of ambient PM2.5
- Ambient PM2.5 associated with many adverse health effects, including premature deaths
- Assumed diesel PM and PM2.5 have equal toxicity

Guest Speaker

- Professor Jonathan Samet, USC
  - Chair of U.S. EPA's Clean Air Scientific Advisory Committee
  - Chair of Department of Preventive Medicine at USC
  - Founding Director of Institute for Global Health at USC
  - Topic: Evidence for premature death from PM2.5 exposure

Presentation by Jonathan Samet

Placeholder (replace with your slides)

- Focus on epi data that show risk from PM2.5 exposure
  - NAAQS basis
  - Biological plausibility
  - total number of papers & funding commitment
  - uncertainties

  - 7 minute presentation

Presentation Overview

- Health effects of diesel PM
- Methodology for estimating premature deaths
- Control programs and PM trends

PM2.5 Exposure and Premature Death

Key Steps in ARB's Review of Health Literature

ARB Mortality Report

- 78 peer-reviewed publications
- No books or opinion pieces
- Included all U.S. studies through August 2008

Peer Review Evaluation

Advisors

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

UCOP Peer Reviewers

- 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

Additional Peer Reviewer

- Dr. Philip Hopke, Clarkson University

How Was ARB's Estimate Developed?

- Pooled estimates from independent panel of 12 leading experts
- Most weight given to American Cancer Society and Six Cities cohorts
  - Includes LA study with improved exposure methodology

Public Health Statements

- American Medical Association
  - "… AMA support efforts to significantly reduce particulate air pollution by reducing the amount of particulate matter from diesel sources …"
- American Heart Association
  - "… epidemiological studies conducted worldwide have shown a consistent, increased risk for cardiovascular events, including heart and stroke deaths, in relation to short- and long-term exposure to present-day concentrations of pollution, especially particulate matter."
- World Health Organization
  - "The effects of PM on health occur at levels of exposure currently being experienced by most urban and rural populations in both developed and developing countries. Chronic exposure to particles contributes to the risk of developing cardiovascular and respiratory diseases, as well as of lung cancer."

Quantified PM2.5 Health Effects

- Premature death
- Hospital admissions
  - –Respiratory illnesses
  - –Cardiovascular illnesses
- Acute bronchitis
- Asthma and other lower respiratory symptoms
- Minor restricted activity days
- Work loss days

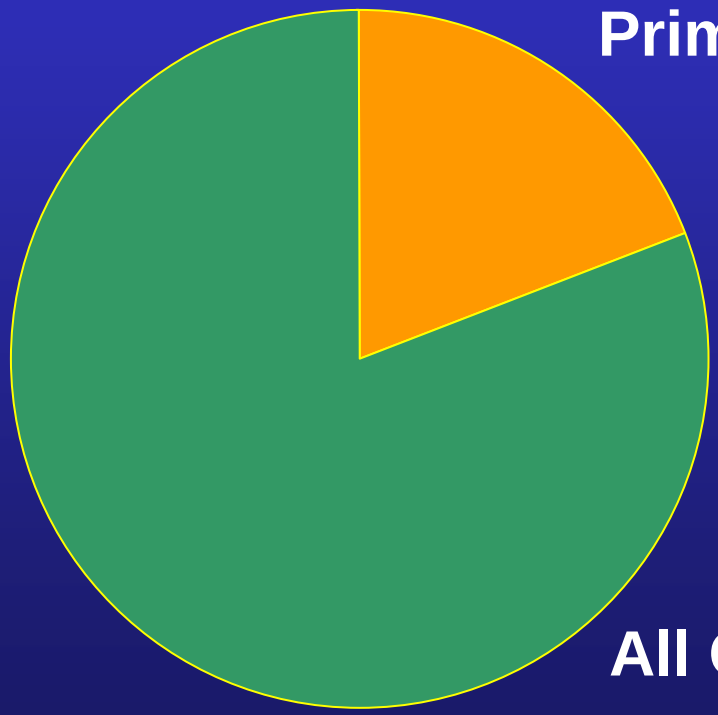
Additional PM2.5 Health Effects

- Non-fatal heart attacks
- Infant death
- Low birth weight, premature birth
- Emergency room visits for asthma
- Exacerbation of asthma
- Chronic bronchitis

PM Reductions Improve Public Health

- Steel mill closure in Utah Valley
  - Reduced hospital admissions and deaths with reduced exposure
- Life expectancy and PM2.5 levels in the United States
  - 0.61 year increase in life expectancy for every 10 $\mu g/m^3$ reduction
- Children's Health Study in California
  - Improved lung function growth in children moving from higher to lower pollution area

Risk from Diesel PM Exposure



Annual Statewide Diesel PM Health Impacts

Health Endpoint	Mean (cases)	Range (cases)
Mortality	3,500	1,000 – 6,400
Hospital Admissions, Cardiovascular	740	480 – 1,100
Hospital Admissions, Respiratory	390	190 – 600
Lower Respiratory Symptoms	56,000	22,000 – 90,000
Acute Bronchitis	4,700	0 – 10,000
Minor Restricted Activity Days	2,100,000	1,700,000 – 2,400,000
Work Loss Days	350,000	300,000 – 410,000

Year 2005 emission inventory

Presentation Overview

- Health effects of diesel PM
- Methodology for estimating premature deaths
- Control programs and PM trends

Progress: New Engines and Fuels

Major Task	Action	Adoption status
New engines	Truck standards reducing NOx/PM by 90% (2007-10)	Complete
	Off-road equipment engine standards reducing NOx/PM by 90% (2011-15)	Complete
	Locomotive/harbor craft standards (EPA)	Complete
Fuels	Ultra-low sulfur diesel, on- and off-road	Complete
	Ship auxiliary engines	Complete
In-use compliance/ enforcement	On-Board Diagnostics for heavy trucks	Complete
	In-use testing and recall program	Complete

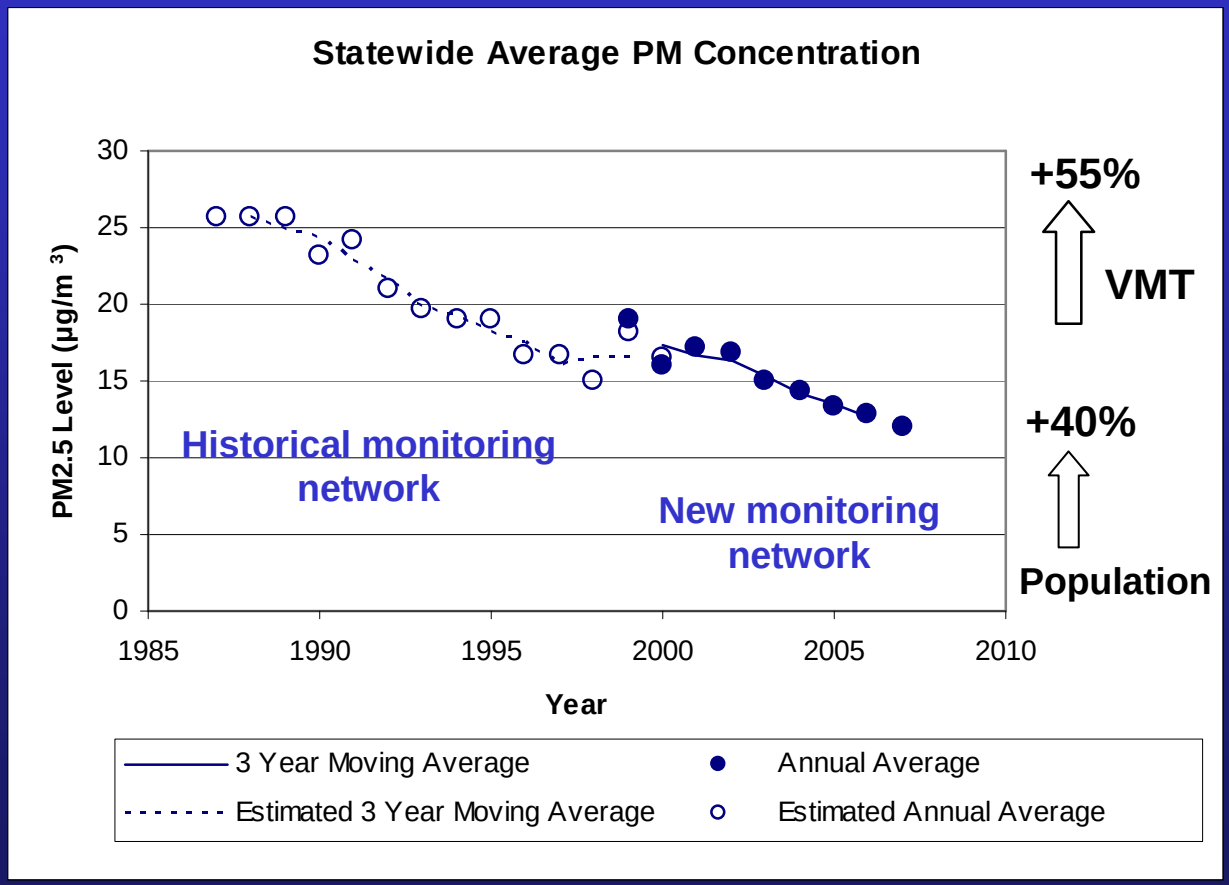
Progress: Existing Engines

Major Task	Action	% of PM	Cost (millions)	Adoption Status
Clean-up existing engines	Urban transit buses	<1	122	Complete
	Trash trucks	2	155	Complete
	Portable equipment	3	350-420	Complete
	Stationary engines	2	47	Complete
	Cargo handling equipment	<1	71	Complete
	Municipal fleets	<1	157	Complete

Progress: Existing Engines

Major Task	Action	% of PM	Cost (millions)	Adoption Status
Clean-up existing engines (cont.)	School buses	<1	200	Prop 1B
	TRUs	2	87-156	**Complete**
	Idling limits	1	Savings	**Complete**
	Stationary ag. engines	1	34-42	**Complete**
	Aux. engines OGV	3	165-171	**Complete**
	Port trucks, ships	9	400	Prop 1B
	Off-road non-ag.	30	3200	**Complete**
	Private trucks	37	5500	**Complete**
	Ag. equipment	8		2010

Trend in Statewide Annual PM2.5 Concentration



Additional PM Reductions Are Needed

- Reduce premature deaths
- Reduce diesel PM emissions by 85% by 2020
- SIP attainment in South Coast and San Joaquin Valley
- Attain increasingly tighter federal PM2.5 standards

Research to Address Remaining Issues

- U.S. EPA PM Centers
  - Ultrafine PM
  - Biological plausibility
  - Toxic components of PM
  - Pollutant mixtures
- CA-specific studies
  - California Teachers cohort
  - American Cancer Society cohort

PM2.5 Exposure