Adverse Health Effects of Diesel Particle Air Pollution

An Overview for the DEM Clean Diesel Workshops

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“Reducing emissions from diesel engines is one of the most important air quality challenges facing the country. Even with EPA’s more stringent heavy-duty highway and nonroad engine standards set to take effect of the next decade and clean up new engines, millions of diesel engines already in use will continue to emit large amounts of nitrogen oxides, particulate matter and air toxics, which contribute to serious public health problems. These emissions are linked to thousands of premature deaths, hundreds of thousands of asthma attacks, millions of lost work days, and numerous other health impacts every year (EPA).”

http://www.epa.gov/diesel
Public Health Risk

Source: http://www.catf.us
Diesel Emissions

• **Gaseous Pollutants**
  – Carbon Monoxide
  – Nitrogen Oxides
  – Sulfur Dioxide
  – Ozone

• **Particulate Matter Pollutants**
  – Directly emitted (soot, black carbon)
  – Created as a result of transformation i.e. sulfur dioxide to sulfate
  – PM 10, PM 2.5, Ultra-Fine Particles
In a study of small particle deposition in the respiratory system, particles at 2.4 microns have (around the size of diesel PM 2.5 particles) increased lung deposition (bottom) compared to larger 5 micron particles (top).
Studying Deposition of Medical Aerosols

$^{133}$Xe Equilibrium Scan, Conventional SVN (Above); Aero-Eclipse BAN (Below)

Respiratory Care 2005;50(9):1152/Journal of Aerosol Med 2001
High Levels of Diesel Exhaust inside Trains, Transit Buses and School Buses

Transit Bus

Commuter Train
Acute Particle Pollution Exposure

- Irritation to the eyes, nose throat and lungs
- Neurological effects such as lightheadedness
- Cough
- Exacerbate asthma and difficulty breathing

Asthma Prevalence by Age
United States, 1980-1994

Source: National Health Survey, 1980-1994
Chronic Particle Pollution Exposure

- Decreased lung function
- Development of chronic bronchitis
- Irregular heartbeat
- Nonfatal heart attacks
- Premature death in people with heart or lung disease
- Bladder Cancer
- Heart Disease
- Nervous System Impairment
- Stroke
- DNA Damage
Sensitive Populations

- Children
- Elderly
- Truck drivers, bus drivers, dock workers, railroad workers, construction workers

- A 1999 study published by the American Journal of Public Health concluded that workers exposed to diesel exhaust have a 47% higher risk of lung cancers relative to unexposed workers.
OCCUPATIONAL EXPOSURE

• Railway Workers
  – Workers in jobs with diesel exhaust exposure had a 2.5 increase of COPD mortality relative to those in unexposed jobs
  – An association between diesel exhaust exposure and lung cancer mortality was reported in a study of 55,000 US railroad workers
  – Nervous system impairment

• Trucking Industry Workers
  – A 2007 Harvard study of 54,000 workers in the trucking industry found a higher risk of in heart disease in the trucking industry compared to the general population
    • 49% higher for drivers
    • 32% higher for dock workers
    • 34% higher for shop workers

• All Diesel-Related Industry Workers
  – 50% increased risk of colon cancer in men related to diesel engine emissions exposure
  – 47% higher risk of lung cancers relative to unexposed workers
  – Premature death due to heart and lung disease
  – Risk of blood clots and stroke more than double within 2 hours exposure to high levels of fine particulates
  – Many studies link asthma, allergic sensitization, respiratory infections, and chronic bronchitis to exposure to diesel particles
## Nationwide Health Impact of Diesel Fine Particles

**Annual Cases in the U.S., 2010**

<table>
<thead>
<tr>
<th>Health Impact</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature Deaths</td>
<td>21,000</td>
</tr>
<tr>
<td>Lung Cancer Deaths</td>
<td>3,000</td>
</tr>
<tr>
<td>Hospital Admissions</td>
<td>15,000</td>
</tr>
<tr>
<td>ED Visits for Asthma</td>
<td>15,000</td>
</tr>
<tr>
<td>Asthma Attacks</td>
<td>410,000</td>
</tr>
<tr>
<td>Chronic Bronchitis</td>
<td>12,000</td>
</tr>
<tr>
<td>Non-fatal Heart Attacks</td>
<td>27,000</td>
</tr>
<tr>
<td>Work Loss Days</td>
<td>2,400,000</td>
</tr>
<tr>
<td>Restricted Activity Days</td>
<td>14,000,000</td>
</tr>
</tbody>
</table>

CATF Study
Local Impact: Rhode Islanders Suffer from Diesel Pollution Each Year

Premature deaths as a result of exposure to particulate matter: 50
Heart attacks: 80
Asthma attacks: 900
Child respiratory problems: 1,400
Missed days of work: 5,500

-Providence County ranks among the worst six percent of all counties in the United States for health impacts from diesel pollution. The average lifetime cancer risk from diesel soot for Providence County residents is 330 times higher than the acceptable risk level determined by the United States Environmental Protection Agency. Other Rhode Island Counties rank, at best, in the worst twenty percent.

-Rhode Island has the 5th highest asthma rate in the country and the 3rd highest in the Northeast.

-Those living in urban centers are affected most severely from exposure to
Solutions

• Action
  – Anti-Idling
  – Retrofitting Existing Engines
  – Replacing vehicles with 2007 or newer engine models
  – Cleaner Fuels

• Process
  – Local Level Government Action
  – State and County Clean Diesel Programs
  – Private Company Investment

Retrofit filters used in conjunction with ultra-low sulfur fuel can reduce 90% of fine particulate matter pollution; a cheaper diesel oxidation catalyst (DOC) can cut 20%. “Uncontrolled” means the engine operates to the standard for the year in which it was sold (in this example, MY1996) absent any modifications to the engine or after-treatment emission controls.
Questions?

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