California Global Warming Solutions Act of 2006 and Changing Composition of Air Pollution Emissions

Wolfgang F. Rogge

School of Engineering, UC Merced
## Pollutant Sources Investigated

<table>
<thead>
<tr>
<th>No.</th>
<th>Source Type</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cars</td>
<td>15</td>
<td>Roofing Tar Pot</td>
</tr>
<tr>
<td>2</td>
<td>Diesel Trucks</td>
<td>16</td>
<td>Restaurant Type Meat Cooking</td>
</tr>
<tr>
<td>3</td>
<td>Dual Fuel Power Cars</td>
<td>17</td>
<td>Residential Cooking for many Food Items</td>
</tr>
<tr>
<td>4</td>
<td>Traffic Tunnel (Pittsburgh)</td>
<td>18</td>
<td>Pine Logs burning in Fireplace</td>
</tr>
<tr>
<td>5</td>
<td>Urban Road Dust Pasadena</td>
<td>19</td>
<td>Oak Logs burning in Fireplace</td>
</tr>
<tr>
<td>6</td>
<td>Urban Road Dust Pittsburgh</td>
<td>20</td>
<td>Synthetic Logs burning in Fireplace</td>
</tr>
<tr>
<td>7</td>
<td>Urban Road Dust San Joaquin Valley, CA</td>
<td>21</td>
<td>Campfire burning of Pine Wood</td>
</tr>
<tr>
<td>8</td>
<td>Rural Road Dust San Joaquin Valley, CA</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Unpaved Road Dust San Joaquin Valley, CA</td>
<td>23</td>
<td>Thermal conversion of individual Biopolymers</td>
</tr>
<tr>
<td>10</td>
<td>Tire Wear Particles</td>
<td>24</td>
<td>Leaf Surface Abrasions for Los Angeles Vegetation</td>
</tr>
<tr>
<td>11</td>
<td>Brake Lining Dust</td>
<td>25</td>
<td>Leaf Surface Abrasion for Pittsburgh Vegetation</td>
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<tr>
<td>12</td>
<td>Natural Gas Home Appliances</td>
<td>26</td>
<td>Cigarette Smoke</td>
</tr>
<tr>
<td>13</td>
<td>Industrial Oil Boilers</td>
<td>27</td>
<td>Fugitive Dust from Feedlots and Dairy Farms for San Joaquin Valley</td>
</tr>
<tr>
<td>14</td>
<td>Coke-Oven</td>
<td>28</td>
<td>Fugitive Dust from Crop Fields for San Joaquin Valley</td>
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### Source Type Notes:
- **Cars**
- **Diesel Trucks**
- **Dual Fuel Power Cars**
- **Traffic Tunnel (Pittsburgh)**
- **Urban Road Dust**
- **Rural Road Dust**
- **Unpaved Road Dust**
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- **Fugitive Dust from Crop Fields for San Joaquin Valley**

### Pollutant Sources Studied:
- Cars
- Diesel Trucks
- Dual Fuel Power Cars
- Traffic Tunnel (Pittsburgh)
- Urban Road Dust
- Rural Road Dust
- Unpaved Road Dust
- Tire Wear Particles
- Brake Lining Dust
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- Industrial Oil Boilers
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- Cigarette Smoke
- Fugitive Dust from Feedlots and Dairy Farms for San Joaquin Valley
- Fugitive Dust from Crop Fields for San Joaquin Valley
Cooking Fuel and Organic Compound Emissions: Natural Gas vs. Electric Cooking

Pan-Frying (40)  Stir-Frying (8)  Sauteing (4)  Deep-Frying (6)  Oven-Roasting (4)  Oven-Broiling (12)  Oven-Baking (12)

- Alkanes
- Alkanoic Acids
- Alkenoic Acids
- Dicarboxylic Acids
- Alkanols
- Alkanals
- Alkan-2-ones
- Furans
- Lactones
- Amides
- Cholesterol
- PAH

EN-Gas/EN-Electric

Number of Experiments in ( )
# Ambient Air Quality Studies

<table>
<thead>
<tr>
<th>Location</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Los Angeles Area - 1982</td>
<td>Five Locations, sampled PM2.1 every 5&lt;sup&gt;th&lt;/sup&gt; day for an entire Calendar Year (Cass &amp; Gray) - 24hour-sampling</td>
</tr>
<tr>
<td>South Florida - 1996/97</td>
<td>Size-segregated PM, sampled every 5&lt;sup&gt;th&lt;/sup&gt; day for an entire Year - 24hour-sampling</td>
</tr>
<tr>
<td>Pittsburgh - 2001/02</td>
<td>Two Locations, sampled PM2.5 every 5&lt;sup&gt;th&lt;/sup&gt; day for more than 1 year plus intensive sampling campaigns</td>
</tr>
<tr>
<td>Baltimore - 2002/03</td>
<td>3-hourly PM2.5 sampling, three weeks in summer as well in winter</td>
</tr>
</tbody>
</table>
Baltimore: Vehicular Marker vs. Polycyclic Aromatic Hydrocarbons

Total PAHs (Phenanthrene to Coronene)

Hopanes

November 2002

February 2003
Air Pollution Modeling

- Los Angeles
- Pittsburgh
- Baltimore
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Examples:

Transportation - Substituting Fossil Fuels with Biofuels

Power Plants - Substituting Fossil Fuels with Agricultural/Forestry Biomass

Biogas Plants - Methane Generation

Are exhaust emissions less or more toxic?
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Examples: Goods Production/Industrial Processes

Are exhaust emissions less or more toxic?
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Examples: Methane Emission Factors for Dairy Cows vs. Beef Steers

Frank Mitloehner
UC Davis
California Global Warming Solutions

Examples: Changing Composition of Emissions

How does the atmospheric chemistry change and what impacts has it on human health and welfare?