On-Road Heavy-Duty Diesel
In-Use Vehicle
Emissions Control Measure

Workgroup Meeting
July 18, 2006

California Environmental Protection Agency
Air Resources Board

Overview

• Background
• Updated emissions inventory
• Segmentation of the industry
• Characterization of vehicle trips
• Interstate trucks and buses
• Quality of data sources
• Adopted control measures
• Emission Control Technologies
• Concepts for consideration/Issues to Address

Why Control Diesel Exhaust

• Annual health impacts of diesel emissions
  – 2,900 premature deaths
  – 2,500 cases of chronic bronchitis
  – 600,000 lost work days
  – 3.2 million minor restricted activity days
• By comparison
  – 3,289 deaths from car accidents
  – 2,084 homicides

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– 600,000 lost work days
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– 3,289 deaths from car accidents
– 2,084 homicides
Diesel PM Contribution to Risk

![Pie chart showing contributions of different pollutants to PM emissions.]

- Diesel Exhaust PM10 (70%)
- 1,3 Butadiene (10%)
- Benzene (8%)
- Carbon Tetrachloride (4%)
- Formaldehyde (3%)
- Hexavalent Chromium (2%)
- All Others (3%)

2005 PM Emissions
Heavy-Duty Diesel Vehicles

- 1965 - 1987: 23%
- 1988 - 1990: 21%
- 1991 - 1993: 9%
- 1994 - 2005: 47%

Total ~ 23 tons per day

1. Greater than 14,000 lbs GVWR
Source: Air Resources Board EMFAC Draft Working Model

2005 NOx Emissions
Heavy Duty Diesel Vehicles

- 1965-1987: 7%
- 1988-1990: 7%
- 1991-1993: 10%
- 1994-2005: 76%

Total ~ 450 tons per day

1. Greater than 14,000 lbs GVWR
Source: Air Resources Board EMFAC Draft Working Model
### 2005 Vehicle Miles Traveled Heavy-Duty Diesel Vehicles

<table>
<thead>
<tr>
<th>Year</th>
<th>Miles Traveled</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965 - 1987</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>1988 - 1990</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>1991 - 1993</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>1994 - 2005</td>
<td>80%</td>
<td>Greater than 30,000,000 miles/day</td>
</tr>
</tbody>
</table>

1. Greater than 14,000 lbs GVWR

Source: Air Resources Board EMFAC Draft Working Model

### 2005 Population Heavy-Duty Diesel Vehicles

<table>
<thead>
<tr>
<th>Year</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965 - 1987</td>
<td>15%</td>
</tr>
<tr>
<td>1988 - 1990</td>
<td>11%</td>
</tr>
<tr>
<td>1991 - 1993</td>
<td>9%</td>
</tr>
<tr>
<td>1994 - 2005</td>
<td>65%</td>
</tr>
</tbody>
</table>

314,000 Vehicles

1. Greater than 14,000 lbs GVWR

Source: Air Resources Board EMFAC Draft Working Model

### On-Road Private Fleets

<table>
<thead>
<tr>
<th>Business Type</th>
<th>Percent of Fleet</th>
</tr>
</thead>
<tbody>
<tr>
<td>For Hire Transportation or Warehousing</td>
<td>38%</td>
</tr>
<tr>
<td>Construction</td>
<td>14%</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>10%</td>
</tr>
<tr>
<td>Agriculture, Forestry, Fishing, or Hunting</td>
<td>9%</td>
</tr>
<tr>
<td>Vehicle Leasing or Rental</td>
<td>8%</td>
</tr>
<tr>
<td>Waste Management, Landscaping</td>
<td>6%</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>6%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>5%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>5%</td>
</tr>
<tr>
<td>Accommodation or Food Services</td>
<td>2%</td>
</tr>
<tr>
<td>Other</td>
<td>2%</td>
</tr>
</tbody>
</table>

Source: California 2002 Economic Census, Vehicle Inventory and Use Survey; U.S. Department of Commerce, U.S. Census Bureau
Body Types for Trucks
Greater than 10,000 lbs (Excludes Truck-Tractors)


Range of Operation of Trucks Greater than 10,000 lbs

*Off-road, not reported, or not applicable

Annual Miles Traveled (Trucks > 10,000 lbs)

Interstate and Mexican Trucking

- Subject to Heavy Duty Vehicle Roadside Inspection Program (over 133,000 total inspections since 1998)
- ARB conducts roadside inspections in cooperation with CHP.
  - Vehicle Code Section 2813 gives the California Highway Patrol authority to pull over vehicles.
- Out of state trucks would be subject to in-use vehicle particulate matter control measure
  - Health effects of emissions not different than in state vehicles
  - Should be treated equitably with in state vehicles
  - Enforcement similar to current roadside inspection program

Expected Changes to Mexican Truck Travel in California

- 1995 – USDOT Moratorium on Mexican trucks
  - Can only travel in US border commercial zone
  - Mostly 5 – 20 miles inside U.S.
- 2001 – President Bush determined NAFTA should be fully implemented (Mexican trucks should not be restricted)
  - FMCSA developed registration process to allow Mexican trucks to drive in the U.S.
  - Implementation delayed by lawsuit to determine if EIR is required
  - U.S. Supreme Court concludes that no EIR is required

ARB Emissions Model (EMFAC)

- Sources of data
  - DMV
  - CalTrans
  - Regional Council of Governments (COGs)
  - University Studies
- Currently being revised to included updated information on diesel emission factors
Adopted ARB Diesel PM Measures

- Public transit fleet rule (2000)
- School buses
  - Low emission school bus program (2000)
  - Idling restrictions (2002)
- Portable engines (2004)

Future ARB Diesel PM Control Measures (2006/2007)

- Off-road mobile equipment
- On-road private fleets
- Harbor craft
- Stationary agricultural engines
- Off-road agricultural engines
Solid Waste Collection Vehicle Control Measure Status

- Required best available controls for 1988 to 2002 model year engines by early 2005
- Number of retrofits exceeded projections
  - 35% in compliance (only 10% required)
    - 22% installed Level 3 devices
    - 24% using cleanest engines available (0.01 g/bhp-hr)
- Cost-effectiveness
  - $67 per pound per year for 2004 - 2020

Public Fleets ATCM Implementation Schedule

<table>
<thead>
<tr>
<th>Group</th>
<th>Engine MY</th>
<th>% of Group to use BACT</th>
<th>Compliance Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1960 – 1987</td>
<td>20, 60, 100</td>
<td>12/31/07, 12/31/09, 12/31/11</td>
</tr>
<tr>
<td>2</td>
<td>1988 – 2002</td>
<td>20, 60, 100</td>
<td>12/31/06, 12/31/08, 12/31/10</td>
</tr>
<tr>
<td>3</td>
<td>2003 – 2006</td>
<td>50, 100</td>
<td>12/31/09, 12/31/10</td>
</tr>
</tbody>
</table>

Diesel PM Control Options for Existing Fleets

Verified PM Retrofit Technologies

• ARB verifies effectiveness of emissions control technology
• Currently 25 PM diesel emission control systems verified (5 for off-road)
  – Level 1 (25% reduction) - 9 systems
  – Level 2 (50% reduction) - 4 systems
  – Level 3 (>85% reduction) - 12 systems
• Memorandum of Agreement with U.S. EPA for emission testing and verification levels

PM Reduction From Existing Vehicles

<table>
<thead>
<tr>
<th>Control Strategy</th>
<th>PM Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhaust Filter</td>
<td>85%</td>
</tr>
<tr>
<td>Exhaust Catalysts</td>
<td>25%</td>
</tr>
<tr>
<td>Re-power with newer engine</td>
<td>20% to 90%</td>
</tr>
<tr>
<td>New vehicle</td>
<td>90%</td>
</tr>
<tr>
<td>Other (typical)</td>
<td>10% to 50%</td>
</tr>
</tbody>
</table>
  – Engine modifications
  – Fuel additives
  – Alternative diesel fuel derivatives

Retrofit Technology Estimated Costs

<table>
<thead>
<tr>
<th>Device</th>
<th>Prices Obtained</th>
<th>Most Common</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPF (Passive)</td>
<td>$5,000 - $10,000</td>
<td>$7,000</td>
</tr>
<tr>
<td>DPF (Active)</td>
<td>$15,000 - $20,000</td>
<td>$18,000</td>
</tr>
<tr>
<td>Crankcase Filter</td>
<td>$450 - $700</td>
<td>$450</td>
</tr>
<tr>
<td>DOC</td>
<td>$500 to $2,000</td>
<td>$900</td>
</tr>
</tbody>
</table>

Sources:
- U.S. EPA, Reducing Emissions from the Legacy Diesel Fleet, April 2006
- MECA, Retrofitting Emission Controls On Diesel-Powered Vehicles, April 2006
- Clean Air Act Advisory Committee, Recommendations for Reducing Emissions from the Legacy Diesel Fleet, April 2006
How Best to Reduce Emissions?
- Require retrofit of all 6 year old vehicles
- Require all 13-year old and older vehicles to be retired
- Restrict older trucks from large population centers
- Require older trucks to be phased out
- Require all trucks to pass an annual emissions "physical"
- Require sellers to apply retrofits upon sale
- Require retrofits by body type
- Require retrofits by business type

How to Phase in Emission Control Options?
- Require retrofits all at once
- Phase-in BACT by model year
  - Mechanical controls
  - Electronic controls
- Phase-in BACT by engine technology
- Phase-in BACT by emissions standards
  - 1991-1993; 0.25 PM & 5.0 NOx
  - 1994-1998; 0.1 PM
  - 1998-2002; 0.1 PM & 4.0 NOx
  - 2003-2006; 0.1 PM & 2.5 NOx

Other Issues to Address
- Interstate trucks and Mexican trucks
- Characterization of the fleet
- Technical feasibility (duty cycle)
- Cost/ benefits
- Competitive disadvantages
- Implementation schedule
- Flexibility
- Enforcement
<table>
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<th>On-Road Heavy Duty Diesel PM Control Measure Schedule</th>
</tr>
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<tbody>
<tr>
<td>• First public workshop series</td>
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<tr>
<td>– Sacramento, April 5; El Monte, April 12; and Fresno, April 13</td>
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<tr>
<td>• Workgroup meetings</td>
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<td>– Next meeting in Fall</td>
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<tr>
<td>• Second public workshop</td>
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<td>– Discuss regulatory concepts (late Summer)</td>
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<tr>
<td>• Third public workshop</td>
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<td>• Formal Board consideration in mid-2007</td>
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