Reducing Emissions from Off-Road Engines

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Off-Road Diesels are as Important as Trucks and Buses

Greater LA in 2010

<table>
<thead>
<tr>
<th></th>
<th>NOx</th>
<th>PM x10</th>
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<tbody>
<tr>
<td>On-Road</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>Off-road</td>
<td>30</td>
<td>40</td>
</tr>
</tbody>
</table>
Both Construction and Ag Equipment are Important

Diesel PM Cancer Risk

Diesel Engine NOx Standards
On- and Off-Road

Diesel Engine PM Standards
On- and Off-road
Comparison of NOx Emissions
2004 Diesel Truck vs. Car

Comparison of PM Emissions
2004 Diesel Truck vs. Car
Opportunities for Lower Heavy Diesel Emissions

- Exhaust after-treatment
  - PM traps > 90% efficient
  - NOx catalysts 50-90% efficiency potential
- Cleaner diesel fuel
  - Very low sulfur enables after-treatment
- Alternative fuels/technologies
  - Natural gas
  - Hydrogen fuel cells

Selective Catalytic Reduction Reduces Emissions

![Bar chart showing percent reduction in NOx and PM emissions with SCR and SCR + DPF technologies. ~350 ppm S Fuel.]
Non-road Diesel Engines

Next Steps

- Establish national PM standard: Tier 3
  - EPA 2001 technology review
  - Particulate filters feasible
- Establish national after-treatment-based NOx standards: Tier 4
- Clean diesel fuel nationwide for off-road
  - Enables after-treatment use

Countdown to Zero Emissions

275 hp Engine
**Some Important Considerations**

- **Maximum emission reductions**
  - Near zero emission target
  - Trucks, busses and off-road

- **Treat vehicle and fuel as a system**

- **Adequate time for implementation**
  - Engine/after-treatment technology
  - Truck/equipment modifications
  - Fuel reformulation

- **Nationwide application**

- **Market incentives for early introduction**