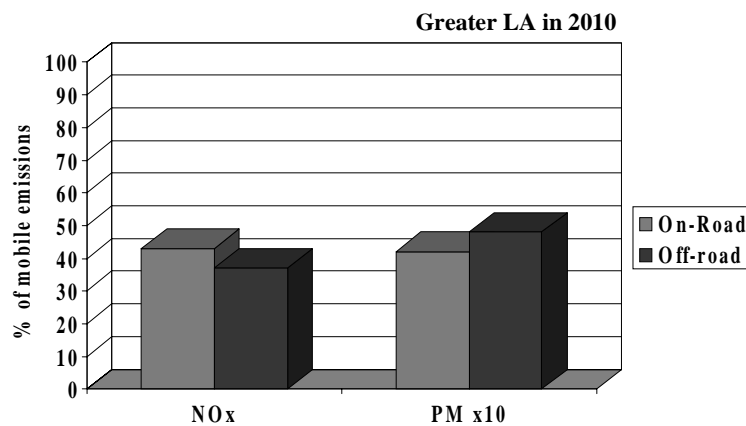


Reducing Emissions from Off-Road Engines

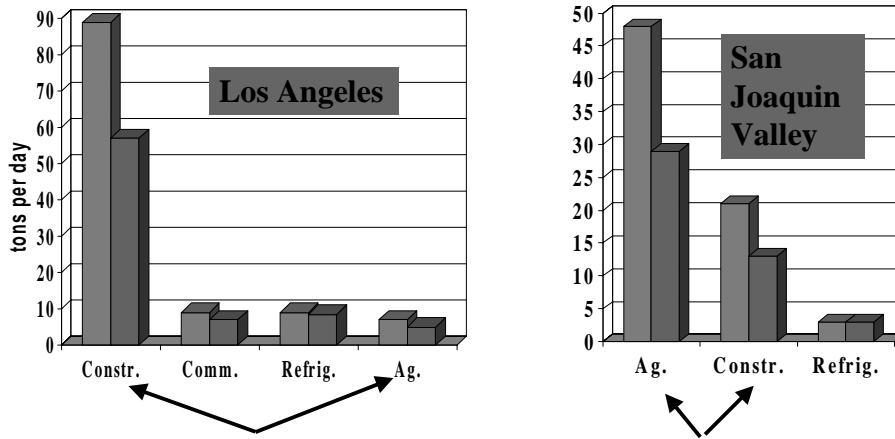
Tom Cackette, CARB

FACA - April 12, 2000

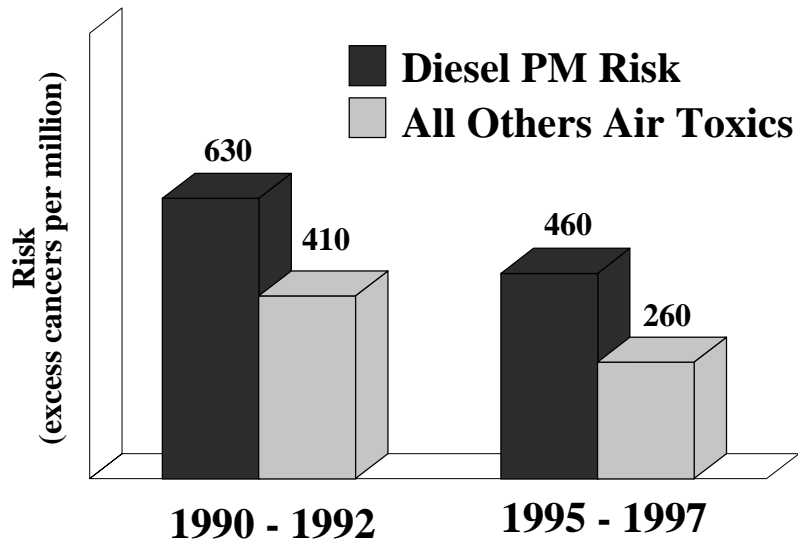
Off-Road Diesels are as Important as Trucks and Buses

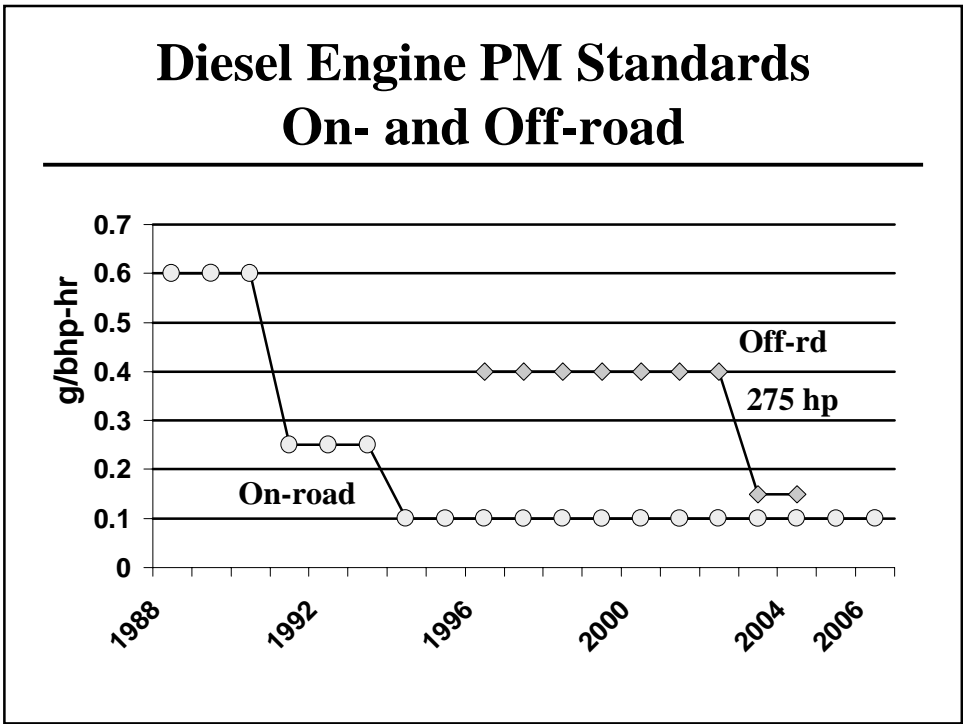
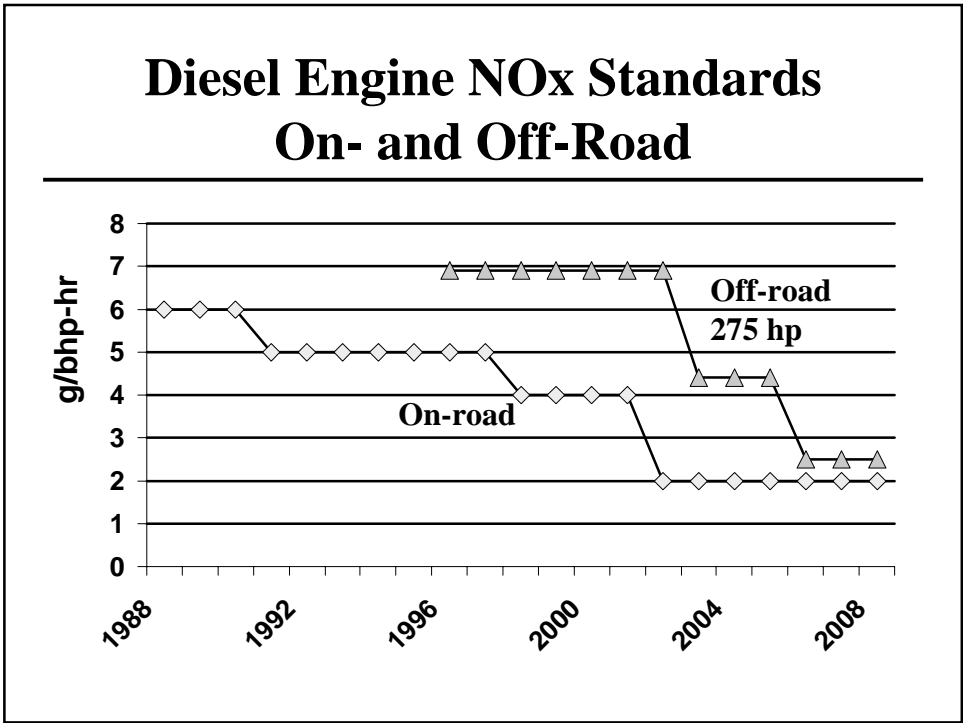


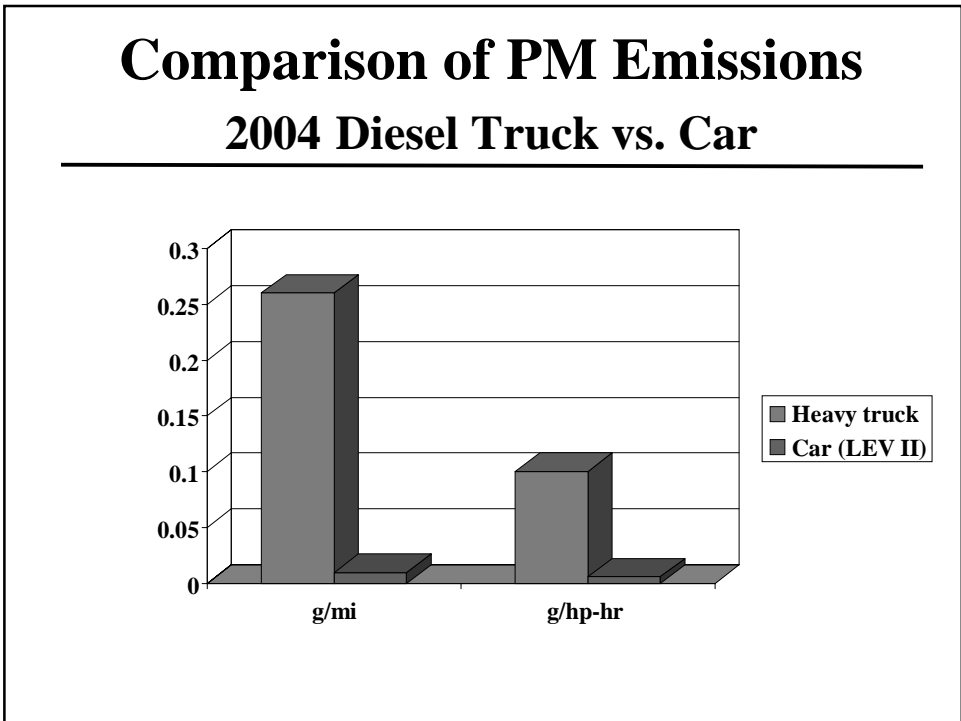
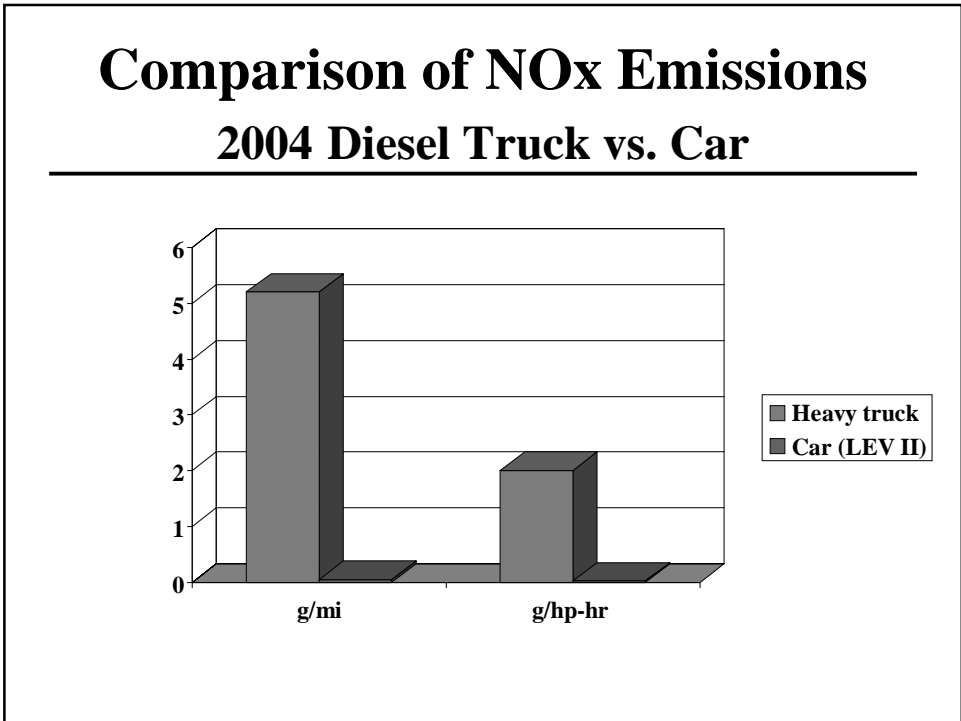
Both Construction and Ag Equipment are Important



Diesel PM Cancer Risk



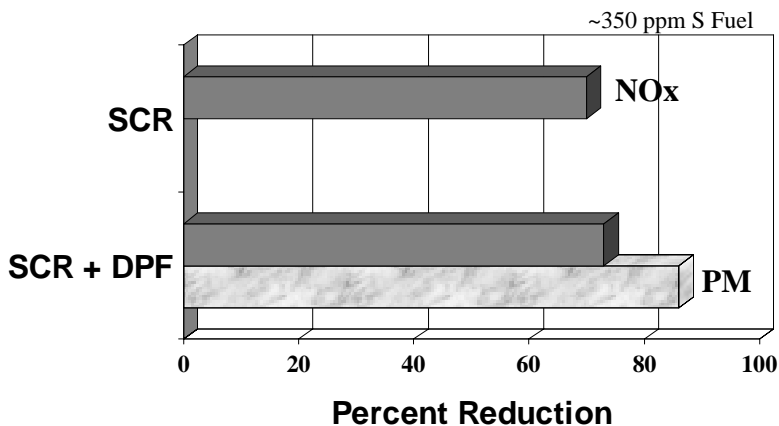




Opportunities for Lower Heavy Diesel Emissions

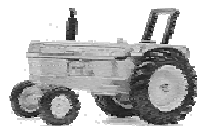
- Exhaust after-treatment
 - PM traps > 90% efficient
 - NOx catalysts 50-90% efficiency potential
- Cleaner diesel fuel
 - Very low sulfur enables after-treatment
- Alternative fuels/technologies
 - Natural gas
 - Hydrogen fuel cells

Selective Catalytic Reduction Reduces Emissions

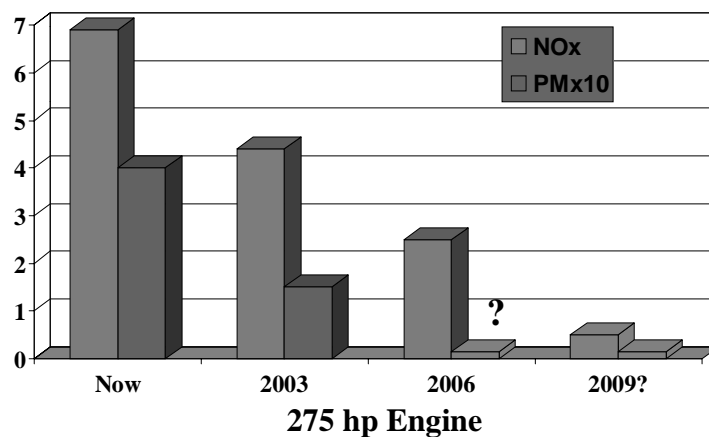


Non-road Diesel Engines Next Steps

- 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



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