

# Reducing Emissions from Diesel Trucks in California



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Faster Freight Cleaner Air 2006

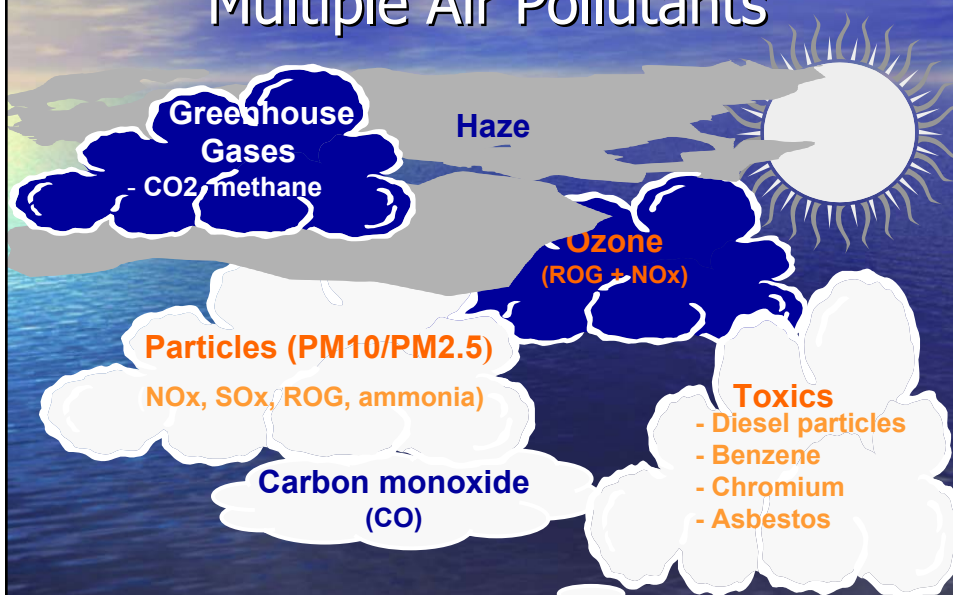
January 31, 2006 Long Beach

California Environmental Protection Agency



Air Resources Board

## Diesel Engines Contribute to Multiple Air Pollutants

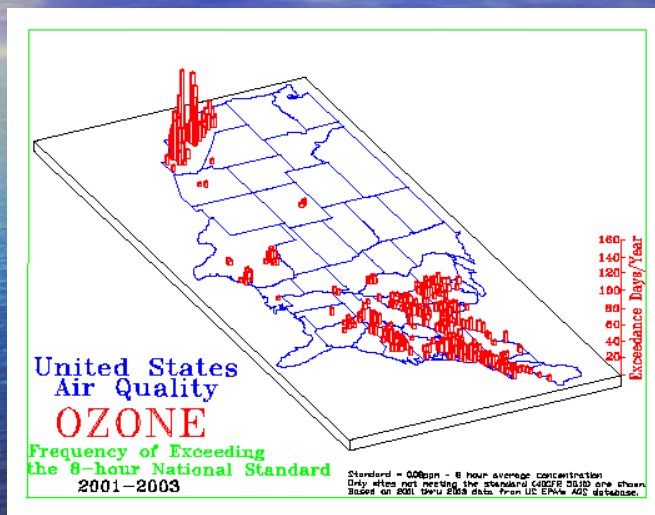


# Diesel Pollutants

- Directly emitted fine particles ('soot')
  - $PM_{2.5}$
  - Carcinogenic
- Oxides of Nitrogen (NOx)
  - Forms ozone
  - Forms particulate nitrates ( $PM_{2.5}$ )

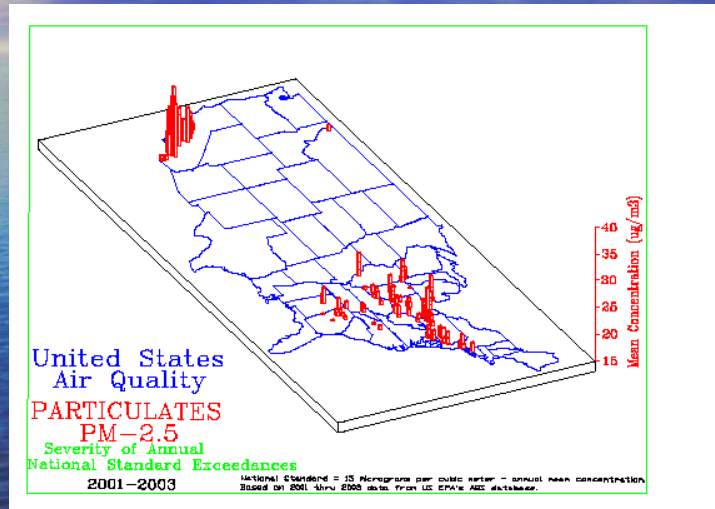
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# Nationwide Ozone Exceedances



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# Nationwide PM2.5 Levels



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# Annual Health Impacts of Diesel Emissions in CA

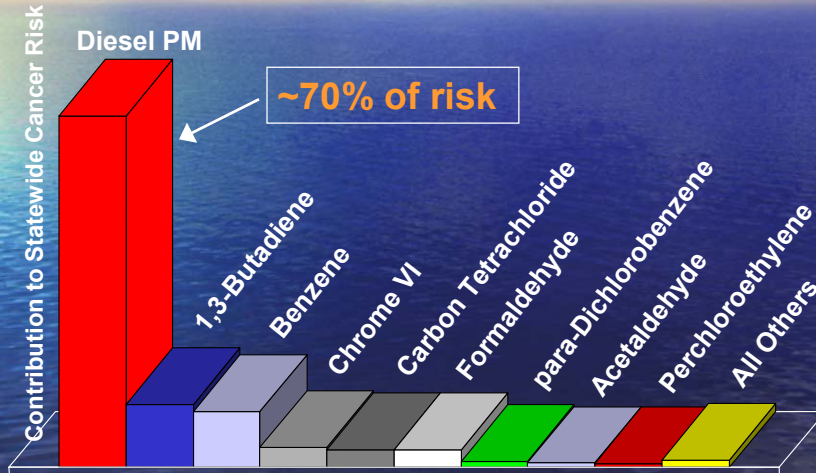


- 2,900 premature deaths<sup>1</sup>
- 240,000 asthma attacks/  
respiratory symptoms
- 600,000 lost work days

<sup>1</sup> Compare to 2000 homicides and 3700 car  
accident deaths annually

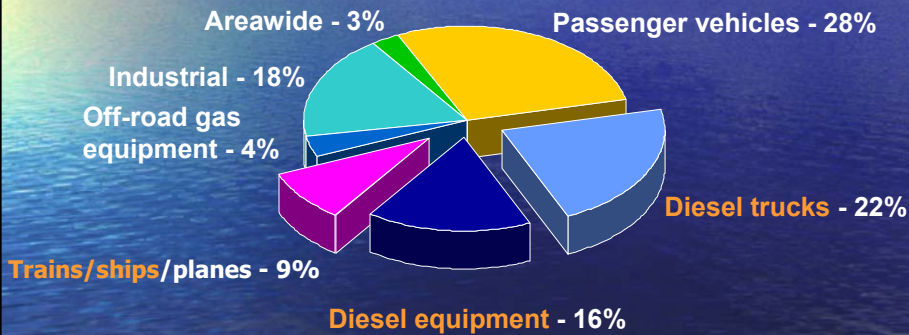
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# Diesels Dominate Cancer Risk from Air Toxics



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# Diesels Account for Nearly Half of NOx Emissions



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## Diesel Trucks and Climate Change

- Heavy-duty diesel trucks contribute 8-10 percent of carbon dioxide emissions
- Also contribute N<sub>2</sub>O, methane, HFCs
- Truck measures included in draft Climate Action Team Report to Governor and Legislature



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## ARB Control Priorities

- Reduce diesel risk
- Cut community exposure to air pollution
- Attain health standards for ozone and particulate matter
- Meet the Governor's Environmental Action Plan goals

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## Diesel Risk Reduction Plan

- Adopted 2000
  - 75 percent risk reduction by 2010
  - 85 percent risk reduction by 2020
- Four Strategies:
  - Stringent new engine standards
  - Cleaner diesel fuel (<15 ppm sulfur)
  - Ensure in-use emissions compliance
  - Aggressive emission reductions from in-use engines

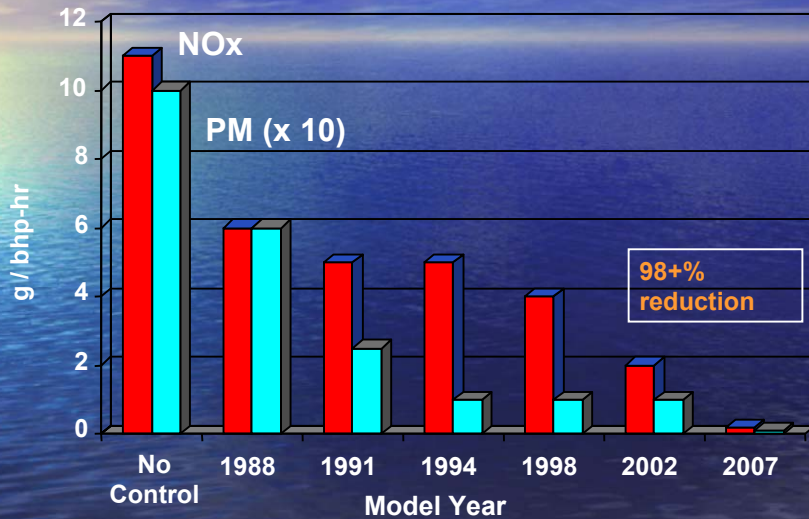
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## Broader Planning Efforts

- Goods Movement Emission Reduction Plan
  - Initial Draft out for public review
  - Final Draft due March 2006
  - Board Adoption Spring 2006
- State Implementation Plan Updates
  - 8-hour Ozone in mid-2007
  - PM2.5 in early 2008

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## Emission Standards for New Heavy-Duty Diesel Trucks



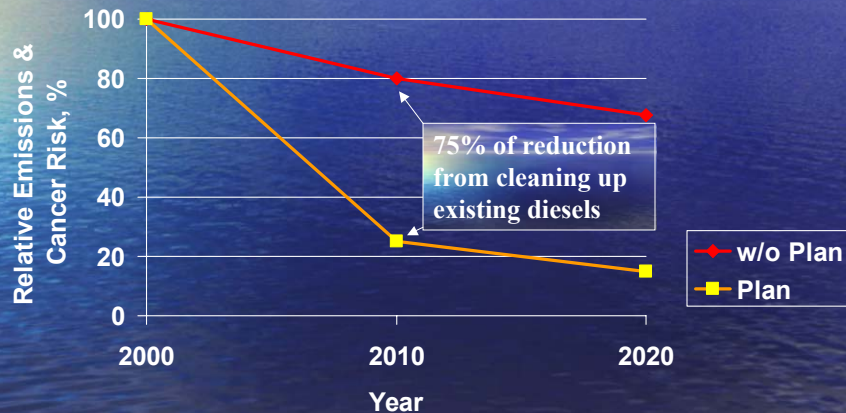
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## Cleaner Fuels

- Current California diesel fuel limits aromatics content to reduce NOx
- ARB requires 15 ppm sulfur diesel fuel for on-road engines, off-road equipment, and stationary engines starting in 2006

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## Importance of Cleaning Up Existing Diesels



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## Reducing Emissions from Existing Engines

- In-use controls - ensure engines operate as cleanly as possible
- Fleet rules - modernize fleets through accelerated replacement, repower, and retrofit

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# In-Use Controls for Heavy-Duty Vehicles

## *Maintaining emission levels in-use:*

- Roadside Smoke Inspection Program
- Software upgrade (chip reflash)
- On-board diagnostic program
- In-use compliance test program

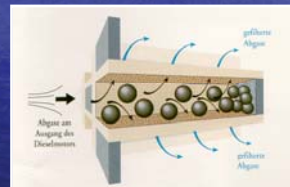
## *Operational controls:*

- Idling limits

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# Fleet Rules to Clean Up Existing Engines

- Retrofit mid-aged engines
  - Filters 85% PM ↓
  - Catalysts 25% PM ↓
  - Other 50% PM ↓ typical
- Replace older engines
  - Re-power
  - New vehicle
- Provide several years to comply



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## Compliance Flexibility

- Additional Time to Repower Engine if Verified Retrofit Controls are Not Available
- Special Provisions for Smaller Fleets
- Special Provisions for Very Low Usage Fleets
- Early Compliance Credit

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## Diesel Retrofit Emission Control Technologies

### Exhaust Gas Aftertreatment

- Diesel Oxidation Catalyst
- Diesel Particulate Filter – Passive
- Diesel Particulate Filter - Active
- Lean NOx Catalyst
- Selective Catalytic Reduction
- NOx Adsorbers
- Crankcase Filter
- Exhaust Gas Recirculation

### Fuel Based Technologies

- Alternative Diesel Fuels - Emulsions
- Alternative Diesel Fuels - Biodiesel
- Alternative Diesel Fuels - Gas to Liquids
- Fuel Additives

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## Diesel Oxidation Catalyst (DOC)

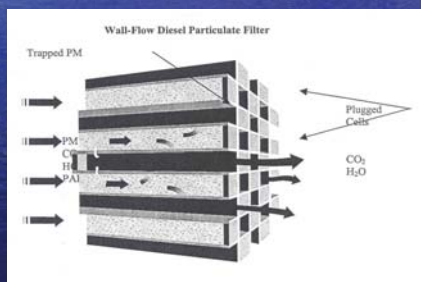
- A flow through device that consists of a canister containing a honeycomb-like structure or substrate
- The substrate has a large surface area that is coated with an active catalyst layer containing platinum or palladium



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## Diesel Particulate Filters - Passive

- Filter traps particles
- Catalyst prior to filter or coated on filter
- Catalyst promotes NO<sub>2</sub> to "Regenerate" (burning accumulated PM)

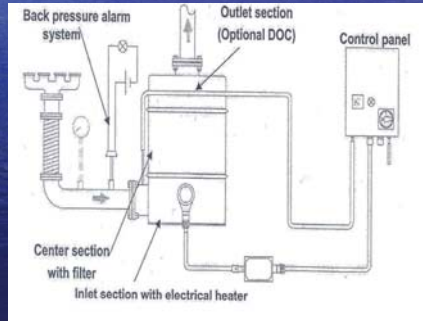


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# Diesel Particulate Traps - Active

Thermal energy is supplied to the filter to facilitate the oxidation of soot

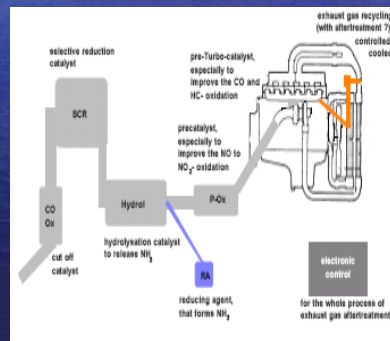
- Automatic
  - Fuel burner
  - Electrical heater
- Semi-automatic
  - Plug on-board unit into electrical grid
- Manual
  - Off-board regeneration



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# Selective Catalytic Reduction (SCR)

- NO<sub>x</sub> reacts with ammonia or urea that is injected into the flue gas stream before the catalyst
- Used commercially for many years with stationary diesel engine and marine applications
- Only catalyst technology to meet future NO<sub>x</sub> emission standards for new engines



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## Verified PM Retrofit Technologies

- ARB has adopted regulations for verifying diesel emission control technologies
- Systems verified to date:
  - 9 Level 1 systems ( $\geq$  25% PM reduction)
  - 4 Level 2 systems ( $\geq$  50% PM reduction)
  - 12 Level 3 systems ( $\geq$  85% PM reduction)
- Reciprocity agreement with U.S. EPA for emission testing and verification levels

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## Fleet Rules for Existing Engines Adopted Rules

- ✓ Public transit buses - *adopted 2000*
- ✓ School bus idling - *adopted 2002*
- ✓ Refuse vehicles - *adopted 2003*
- ✓ Transportation refrigeration units - *adopted 2004*
- ✓ Diesel truck idling - *adopted 2004, 2005*
- ✓ Transit Fleet Vehicles - *adopted 2005*
- ✓ Locomotive/harbor craft fuel - *adopted 2004*

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# Recently Adopted Rules

- December 2005
  - Public agency/utility on-road fleets
  - Port/rail cargo handling equipment
  - Ship auxiliary engine fuel



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# Regulations Under Development

- 2006/07
  - On-road private fleets
  - Off-road public/private fleets
  - Harbor craft
  - Stationary agricultural engines
  - Agricultural off-road engines



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## Experience With Retrofits

|               | # of Retrofits |
|---------------|----------------|
| Transit buses | ~1000          |
| Trash trucks  | >1000          |
| School buses  | >2000          |



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## Cost of PM Retrofit Devices

- Passive filter \$10,000
- Active filter \$14,000
- Flow through filter \$5,000
- Catalyst \$2,000
  
- Benefit to Cost ratio<sup>1</sup> > 4:1

<sup>1</sup> Based on trash truck rule

## Incentives: Carl Moyer Program

- Grants to fund incremental cost to install modern engines or retrofit devices
- \$154 million spent over 6 years
  - 5000 engines cleaned up
  - Cost effective - \$6000/ton NOx
- New on-going funding beginning 2005
  - \$140 million/year
  - PM retrofits and vehicle scrap now eligible

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## Port Truck Modernization

- Older trucks serving California ports hurt nearby communities
- Goods Movement Plan proposes replacing pre-2003 trucks and retrofitting pre-2007 trucks with diesel particulate filters.
  - Substantial PM and NOx reductions
  - State support to limit cost to truck owners
    - Bond measure proposed

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## Federal Government Role

- One-fourth of trucks operating in CA are registered out of state
- New engine standards will make all new trucks substantially cleaner
- Federal incentive funds would help clean the in-use fleet
  - U.S. EPA grants to date have contributed \$1 million.
  - Congress has authorized up to \$200 million per year for National Clean Diesel Campaign.

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## Summary

- Diesel trucks are a significant contributor to air pollution in California
- Multiple programs are underway to cut truck emissions and health risk
- Both regulations and incentive programs are needed to achieve healthful air

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## For Further Information

- General Information:  
<http://www.arb.ca.gov/diesel/dieselrrp.htm>
- Verifications:  
<http://www.arb.ca.gov/diesel/verdev/verdev.htm>
- Diesel Mobile Programs:  
<http://www.arb.ca.gov/diesel/mobile.htm>
- Carl Moyer Program  
<http://www.arb.ca.gov/msprog/moyer/moyer.htm>
- Lower-Emission School Bus Program  
<http://www.arb.ca.gov/msprog/schoolbus/schoolbus.htm>

