

Reducing Emissions from Diesel Trucks in California



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Faster Freight Cleaner Air 2006

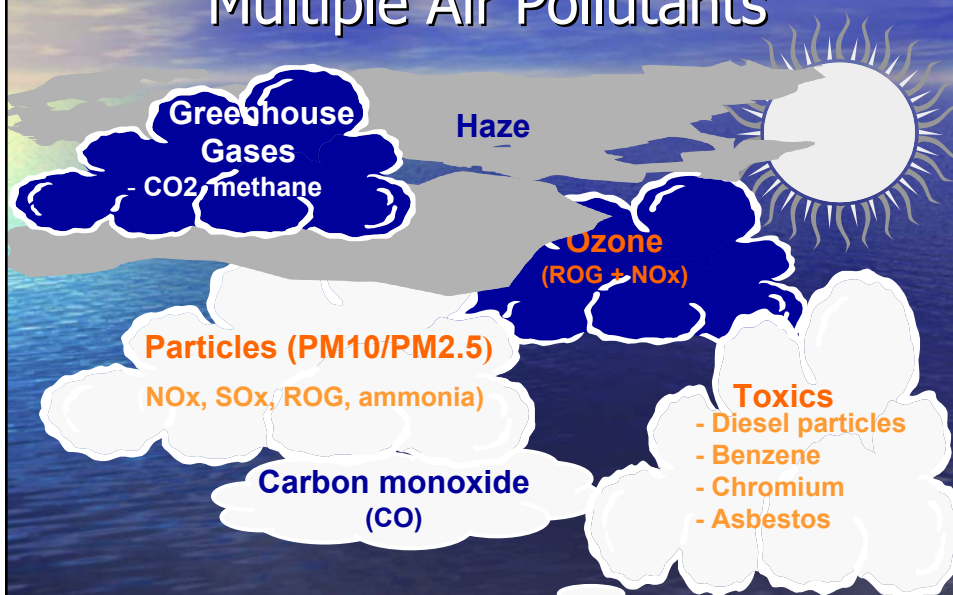
January 31, 2006 Long Beach

California Environmental Protection Agency



Air Resources Board

Diesel Engines Contribute to Multiple Air Pollutants

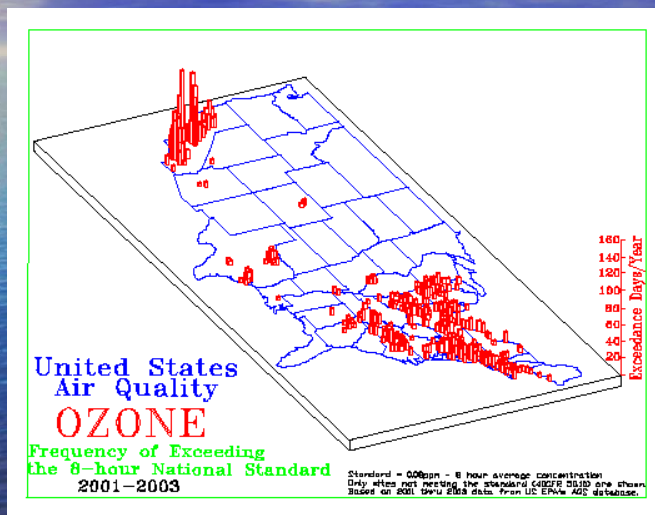


Diesel Pollutants

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

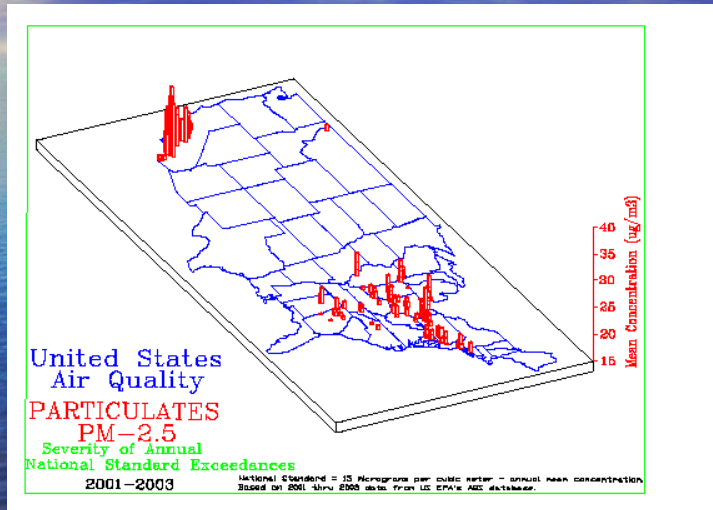
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Nationwide Ozone Exceedances



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Nationwide PM2.5 Levels



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Annual Health Impacts of Diesel Emissions in CA

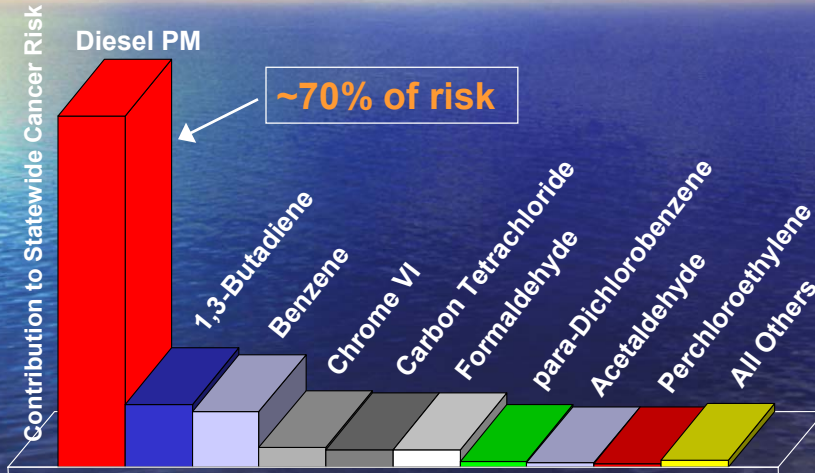


- 2,900 premature deaths¹
- 240,000 asthma attacks/
respiratory symptoms
- 600,000 lost work days

¹ Compare to 2000 homicides and 3700 car accident deaths annually

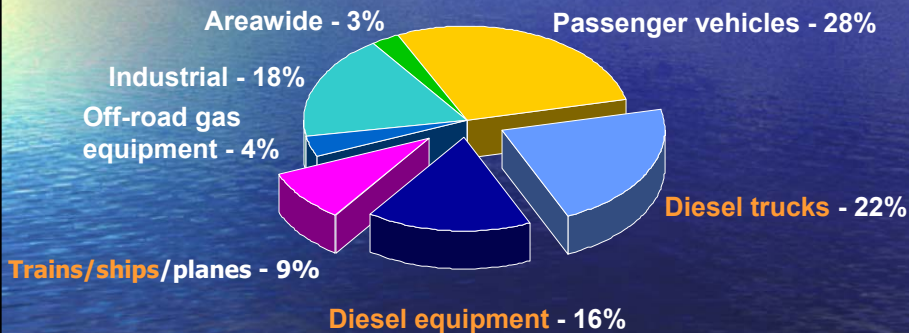
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Diesels Dominate Cancer Risk from Air Toxics



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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 N₂O, 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

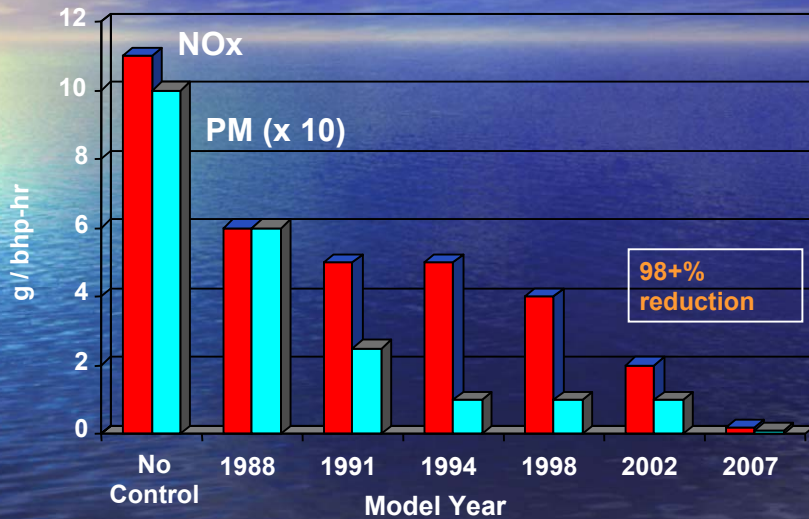
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Broader Planning Efforts

- 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



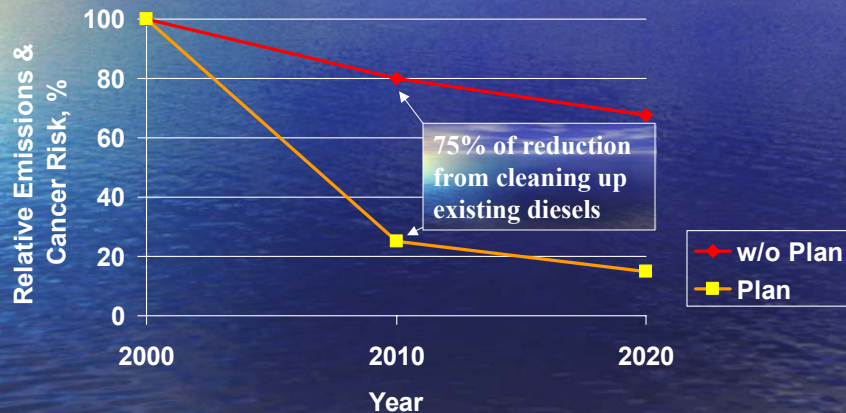
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Cleaner Fuels

- 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

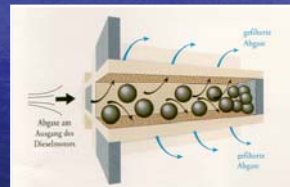
Operational controls:

- 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)

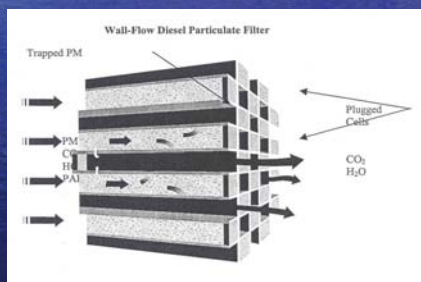
- A flow through device that consists of a canister containing a honeycomb-like structure or substrate
- The substrate has a large surface area that is coated with an active catalyst layer containing platinum or palladium



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Diesel Particulate Filters - Passive

- Filter traps particles
- Catalyst prior to filter or coated on filter
- Catalyst promotes NO₂ to "Regenerate" (burning accumulated PM)

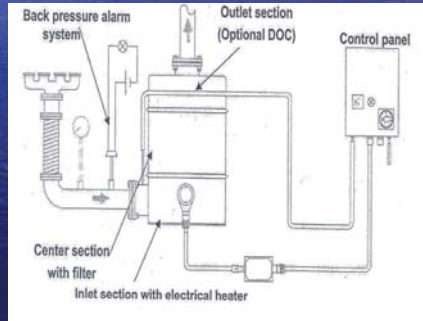


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Diesel Particulate Traps - Active

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

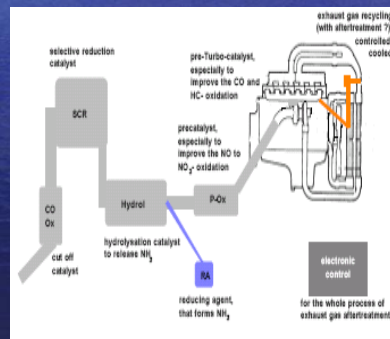
- Automatic
 - Fuel burner
 - Electrical heater
- Semi-automatic
 - Plug on-board unit into electrical grid
- Manual
 - Off-board regeneration



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Selective Catalytic Reduction (SCR)

- NO_x 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_x 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 ratio¹ > 4:1

¹ 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>

