EPA Mobile Source Rule Update

2003 Diesel Engine Emission Reduction Conference

US EPA Office of Transportation and Air Quality

August 24, 2003

Presentation Overview

- 2007 Highway Heavy-duty Diesel Program Highlights
- Emission Performance of Advanced Technology Light-duty Diesels
- EPA Nonroad Diesel Proposal

2007 Highway Diesel Program

- Applies stringent NOx and PM standards to heavy-duty engines and vehicles
  - Technology-neutral standards
  - 90%+ emission reductions-- gasoline-like levels
  - 100% PM standard in 2007 model year
  - Phase-in of NOx standards 2007-2010
  - Incentives for early technology introduction
- Reduces diesel fuel sulfur levels nationwide
  - Enables use of aftertreatment technology
  - Highway diesel fuel sulfur cap of 15 ppm by Sept 1, 2006
  - Voluntary temporary compliance option 2006-2010
  - Hardship provisions, small refiner options

Heavy-duty 2007:
Long-term Costs and Benefits

- Compliance costs
  - Estimated at $1200-1900 per engine (near-term costs ~ 2x higher)
  - 4-5 cents per gallon fuel, partially off-set by maintenance savings of ~ 1 cent per gallon
  - Total costs are $4.3 billion/year
- Health benefits

The program will prevent annually:

  - Over 8,300 premature deaths
  - Over 750,000 respiratory illnesses 1.5 million lost work days
  - 2.6 million tons of NOx, 110,000 tons of PM, and 17,000 tons of toxic pollutants
- Monetized benefits: $70 billion/year

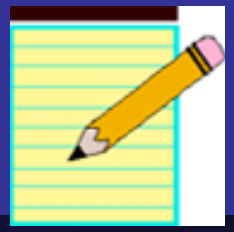
Heavy-duty 2007:
Tracking Progress

- EPA undertaking a number of steps to ensure program goals are met:
  - Technology progress reviews
  - Company visits
  - In-house engine and systems testing
  - Participation in external test programs
  - 2002 Clean Diesel Independent Review
  - Refinery pre-compliance reports
  - Implementation workshops

Progress Toward 2007:
Engine Status

- 2002 → 2003
  - Focus has shifted from R&D programs to product development
- Engine companies have reached or are approaching technology down-select
  - Most companies have multiple technology paths capable of achieving 2007 standards
    - NOx control options being considered include engine-out, NOx adsorber, urea-SCR
  - Companies preparing for formal gate reviews to choose final 2007 package
    - Most companies will make decision in 4th quarter 2003 or 1st quarter 2004

Progress Toward 2007:
Fuel Status



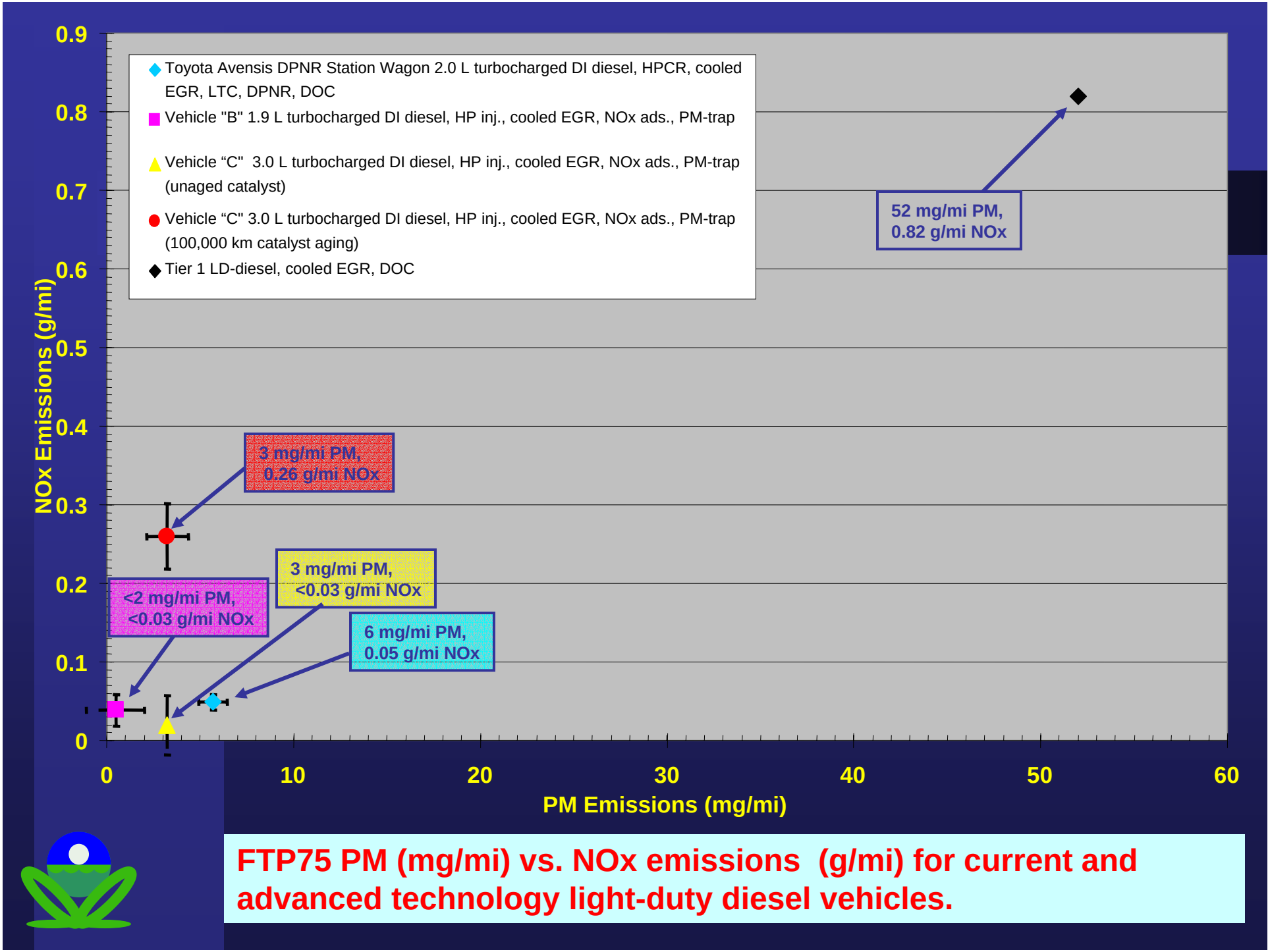
- Refiner/Importer Pre-Compliance Reports
  - Annual pre-compliance reports due June 1, 2003-05
- Industry is On Target to Comply with 15ppm Fuel Requirements
- 15 ppm Fuel Will be Widely Available
  - Over 95% of highway diesel fuel volume produced in 2006 is projected to meet the 15 ppm sulfur standard
- Highway Diesel Fuel Supply Will be Sufficient
  - Refiners/Importers plans are in line with projected demand — highway diesel fuel supply will be sufficient
- EPA will summarize the results and publish a report soon

EPA Light-duty Diesel Testing

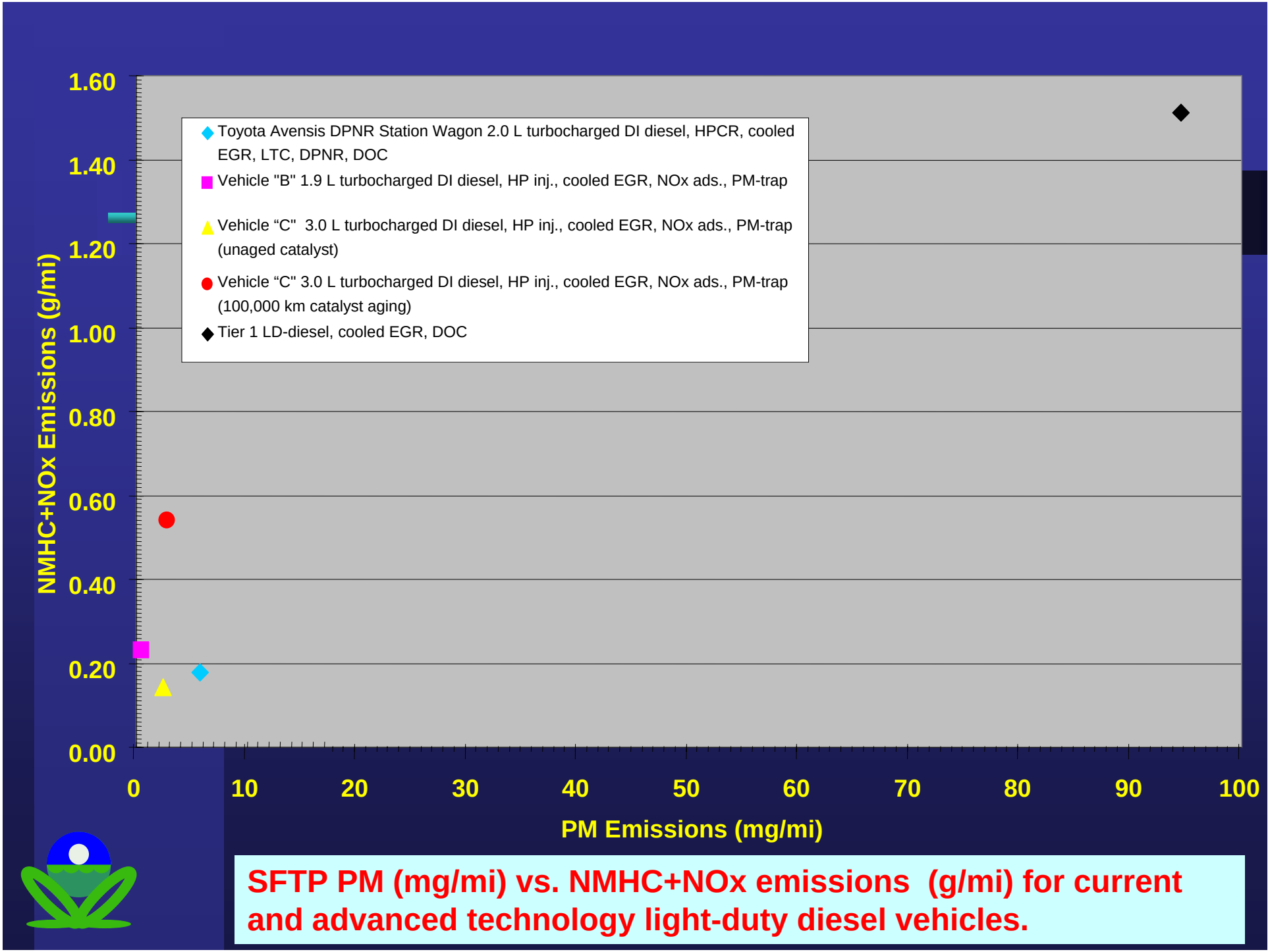
- Investigation of advanced diesel technology
  - Testing of prototypes and pre-production vehicles from a number of LD manufs.
  - Gauge progress towards compliance with Light-Duty Tier 2 Standards
  - Gauge progress on NOx control technology
  - Will continue to publish results in technical papers

Light-duty Diesels:
Vehicles Tested

	Vehicle-A (Toyota Avensis *DPNR*)	**Vehicle-B**	**Vehicle-C**
Vehicle Type:	Small station wagon	Small station wagon	Mid-size car
Power Transmission:	Front-drive, 5-speed manual transmission	Front-drive, 5-speed manual transmission	Rear-drive, 5-speed automatic transmission
Engine:	2 L, 4-cyl. Turbocharged, charge-air-cooled DI Diesel w/DOHC, 4 valves/cyl.	~2 L, 4-cyl. Turbocharged, charge-air-cooled DI Diesel w/DOHC, 4 valves/cyl.	~3 L, 6-cyl. Turbocharged, charge-air-cooled DI Diesel w/DOHC, 4 valves/cyl.
Power/Torque Rating:	81 kW @ 4000 rpm 250 Nm @ 2000 rpm	N/A	N/A
Fuel System:	Denso HPCR	N/A	HPCR
Emission Control Systems:	DPNR system, cooled EGR,	NOx adsorption catalyst, PM-trap, diesel oxidation catalyst	NOx adsorption catalyst, PM-trap, diesel oxidation catalyst
Catalyst Volume:	DPNR: 2.8 L DOC: 2.0 L	N/A	N/A
Inertia Weight (as tested):	1590 kg	1530 kg	1930 kg



FTP75 PM (mg/mi) vs. NOx emissions (g/mi) for current and advanced technology light-duty diesel vehicles.



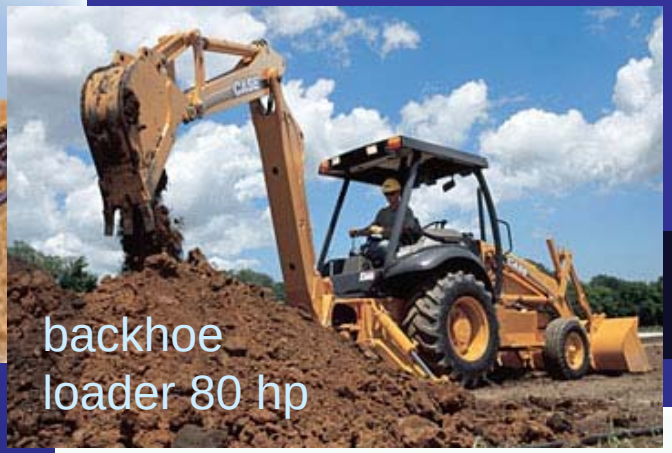
SFTP PM (mg/mi) vs. NMHC+NOx emissions (g/mi) for current and advanced technology light-duty diesel vehicles.

Light-duty Diesels:
Conclusions

- Very low emissions demonstrated
  - Approaching Tier 2 Bin 5 standards
- NOx performance degradation with vehicle "C" was observed for the aged exhaust emission control system
  - Fixed NOx regeneration may have contributed to degradation
- Within the next year additional testing of prototypes from several additional manufs.

2WD tractor
130 hp

combine 285 hp



backhoe
loader 80 hp

trencher
50 hp

utility vehicle
18 hp

skid steer
loader
80 hp

light
tower 10
hp

genset
20 hp

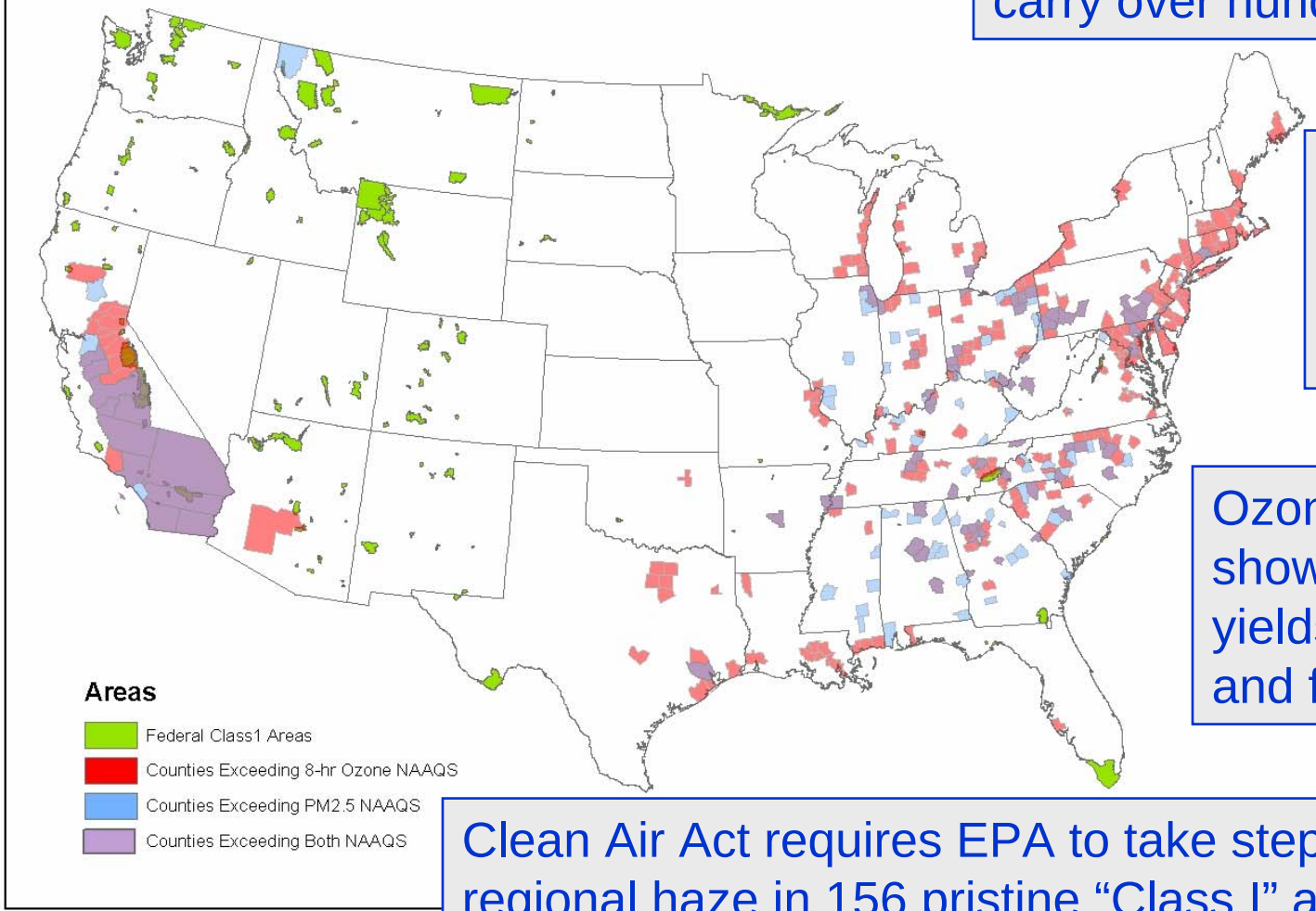
mini-track
loader
20 hp

off-highway truck
1000 hp

Widespread Need for Air Pollution Reductions

127 million people live in 353 counties that exceed the air quality standard for ozone or fine PM, or both

Fine particles from diesel exhaust can remain in the atmosphere for weeks, and carry over hundreds of miles

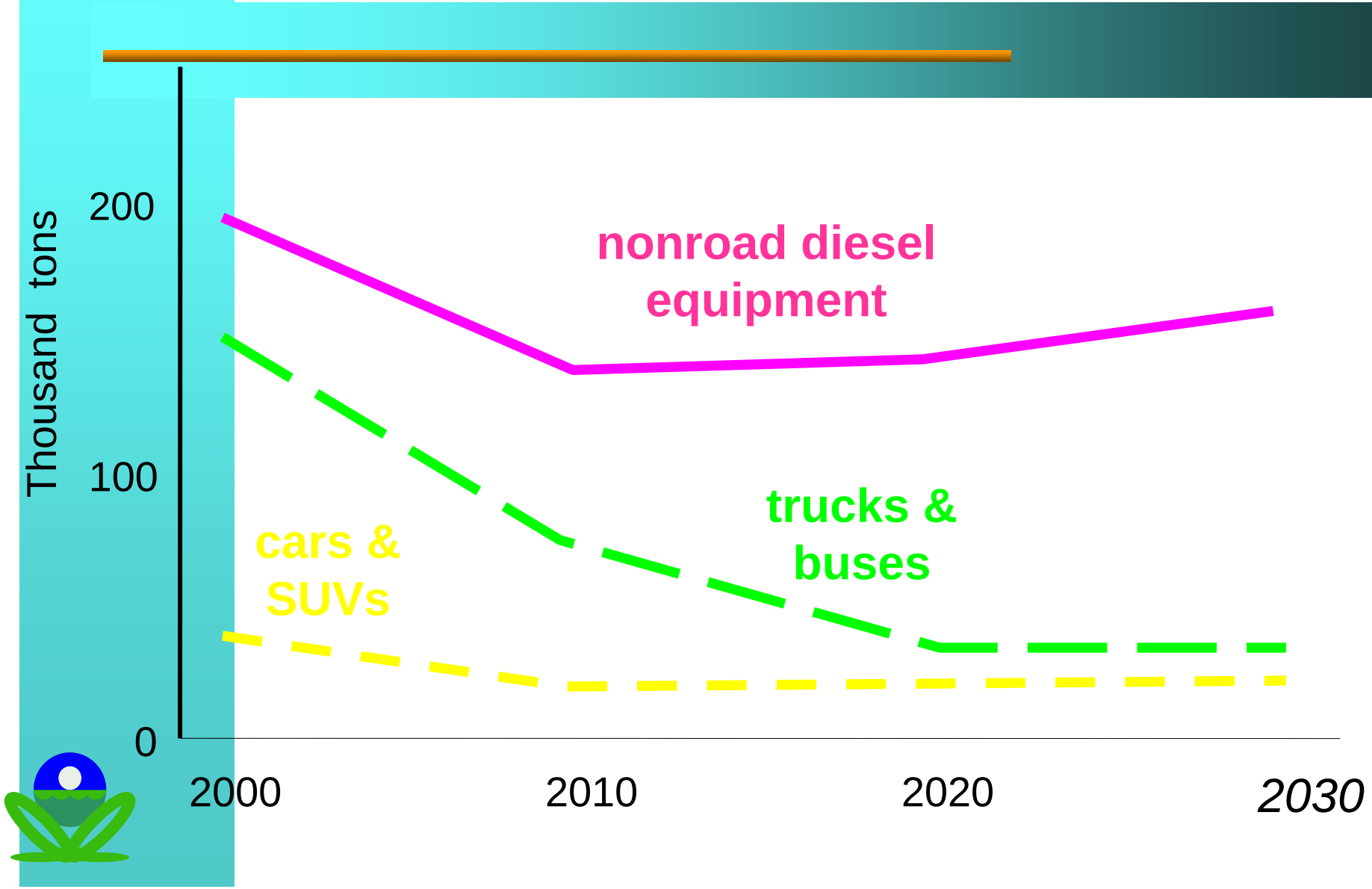


Diesel exhaust is likely to be carcinogenic to humans

Ozone has been shown to reduce yields of vegetables and field crops

Clean Air Act requires EPA to take steps to remedy regional haze in 156 pristine “Class I” areas

Mobile Source PM



Nonroad Proposal Overview

- A systems approach of reducing nonroad fuel sulfur levels to enable advanced emission control technology
- 500 ppm maximum sulfur nonroad, locomotive and marine diesel fuel in 2007
- 15 ppm nonroad fuel in 2010
- Engine standards representing reductions of >95% PM and ~90% NOx
  - Standards phase in starting in 2008, fully phased in by 2014
  - Expect similar technologies that will be used on highway engines
- Enhanced testing requirements to ensure in-use emissions reductions
- Program will prevent 9,600 premature deaths; 16,000 nonfatal heart attacks; & nearly 1 million lost work days on an annual basis in 2030
- Total annual benefits exceed $80 billion/year in 2030, annual costs less than $2 billion/year

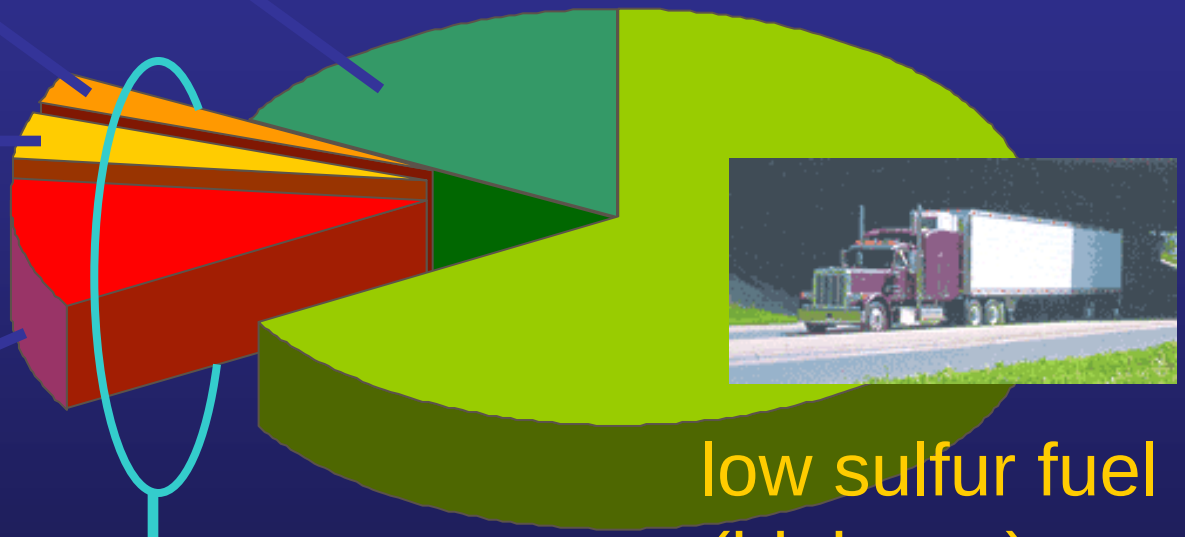
Distillate Fuels

home heating, etc 17%
not covered

marine 2.5%

locomotive 3.5%

nonroad equipment 10%



low sulfur fuel (highway) 67%
regulated since 1993

covered by the proposal

For More Information…

- 2007 Highway Diesel Rule:
  - http://www.epa.gov/otaq/diesel.htm
- Light-duty Diesel Testing:
  - SAE Paper 2002-01-2877 (Toyota vehicle only)
- Nonroad Diesel Proposal:
  - Copy of proposal and supporting documents are available from:
    www.epa.gov/nonroad/
- Specific questions:
  - Bill Charmley (734) 214-4466
  - e-mail at charmley.william@epa.gov