

# EPA's New Program for Clean Nonroad Diesel Engines & Fuel



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U.S. EPA

Clean Air Act Advisory Committee Meeting

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# 3 Milestone EPA Programs



Tier 2 Light-Duty  
Vehicle Program



2007/2010 Heavy-Duty  
Highway Program

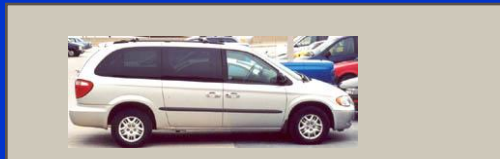


Tier 4 Nonroad  
Diesel Program



# Phase-In of New Mobile Source Programs

Light-duty  
Tier 2



*vehicles*



*gasoline*

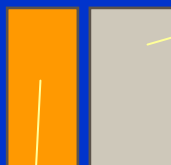
Heavy-duty  
highway

*diesel  
fuel*



*engines*

Nonroad  
Tier 4



*diesel fuel: 1st step*

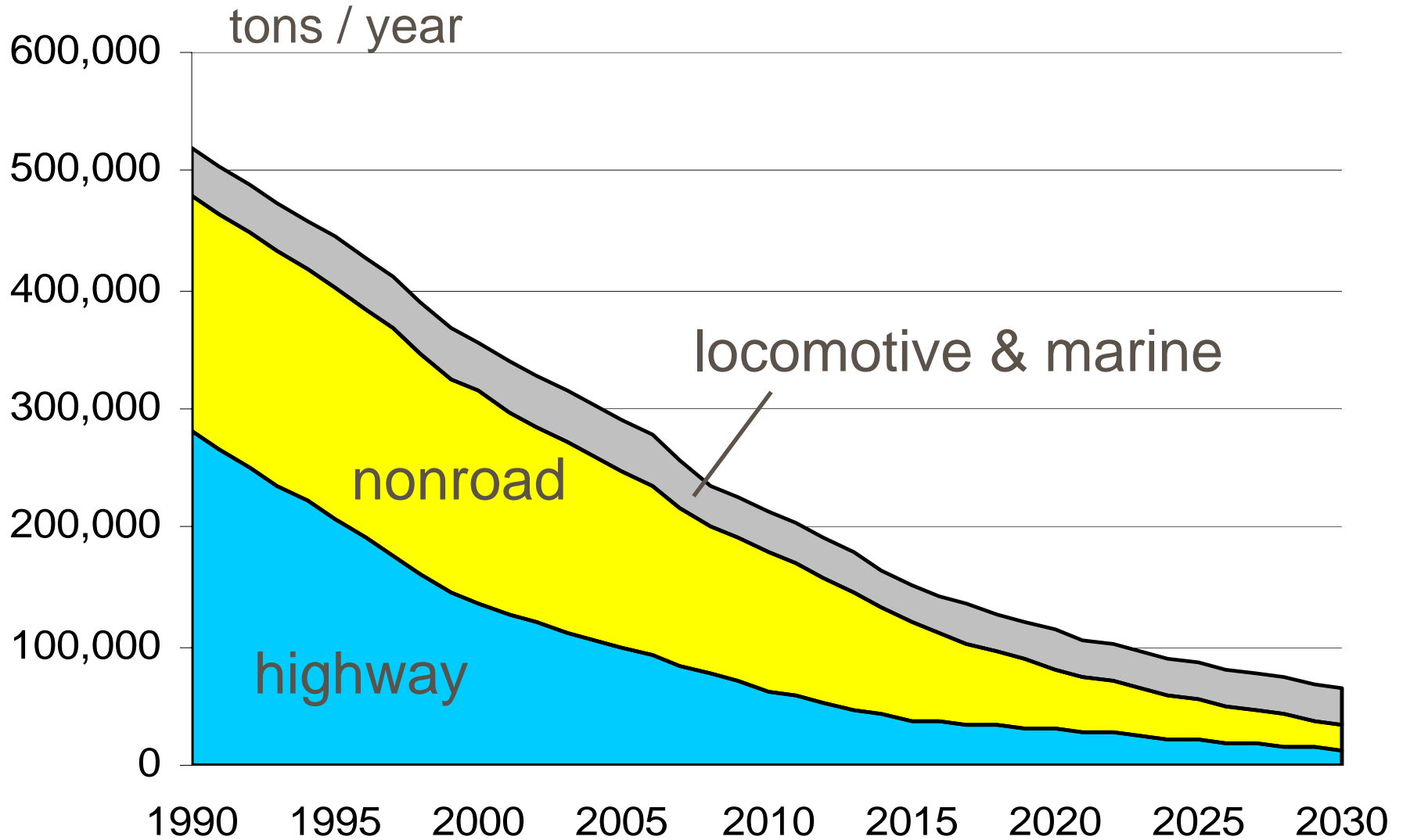
*2nd step*



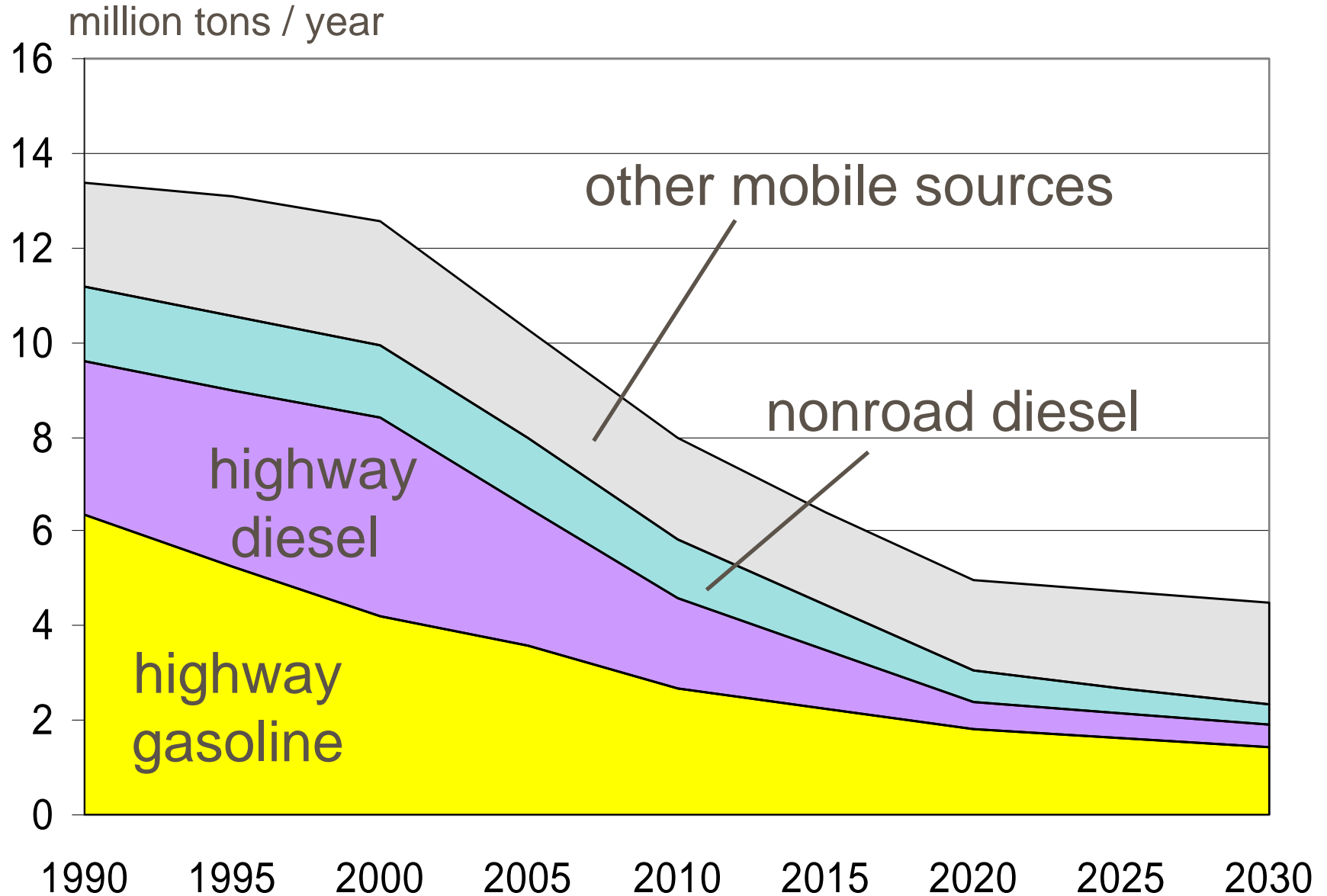
*engines*

2000 2002 2004 2006 2008 2010 2012 2014 2016

# Impact of Mobile Source Programs on Diesel PM<sub>2.5</sub>



# Impact of Mobile Source Programs on NOx Emissions



# Designing a Program to Control Nonroad Diesel Emissions Presented Some Challenges

- Engines vary from 3 to 3000 hp
- Used in thousands of machine models
- High hurdles for emissions controls--
  - Users demand rugged machines
  - Must work in extreme conditions
- Nonroad diesel fuel is currently unregulated
  - Has ~3000 ppm sulfur (10 x more than highway fuel)
  - Harms sulfur-sensitive control technologies



skid steer loader 80 hp



genset 20 hp

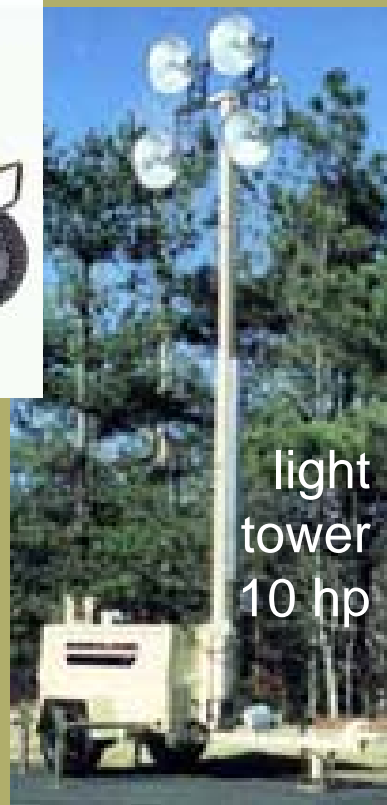


backhoe loader 80 hp

2WD tractor 130 hp



utility vehicle 18 hp



light tower 10 hp



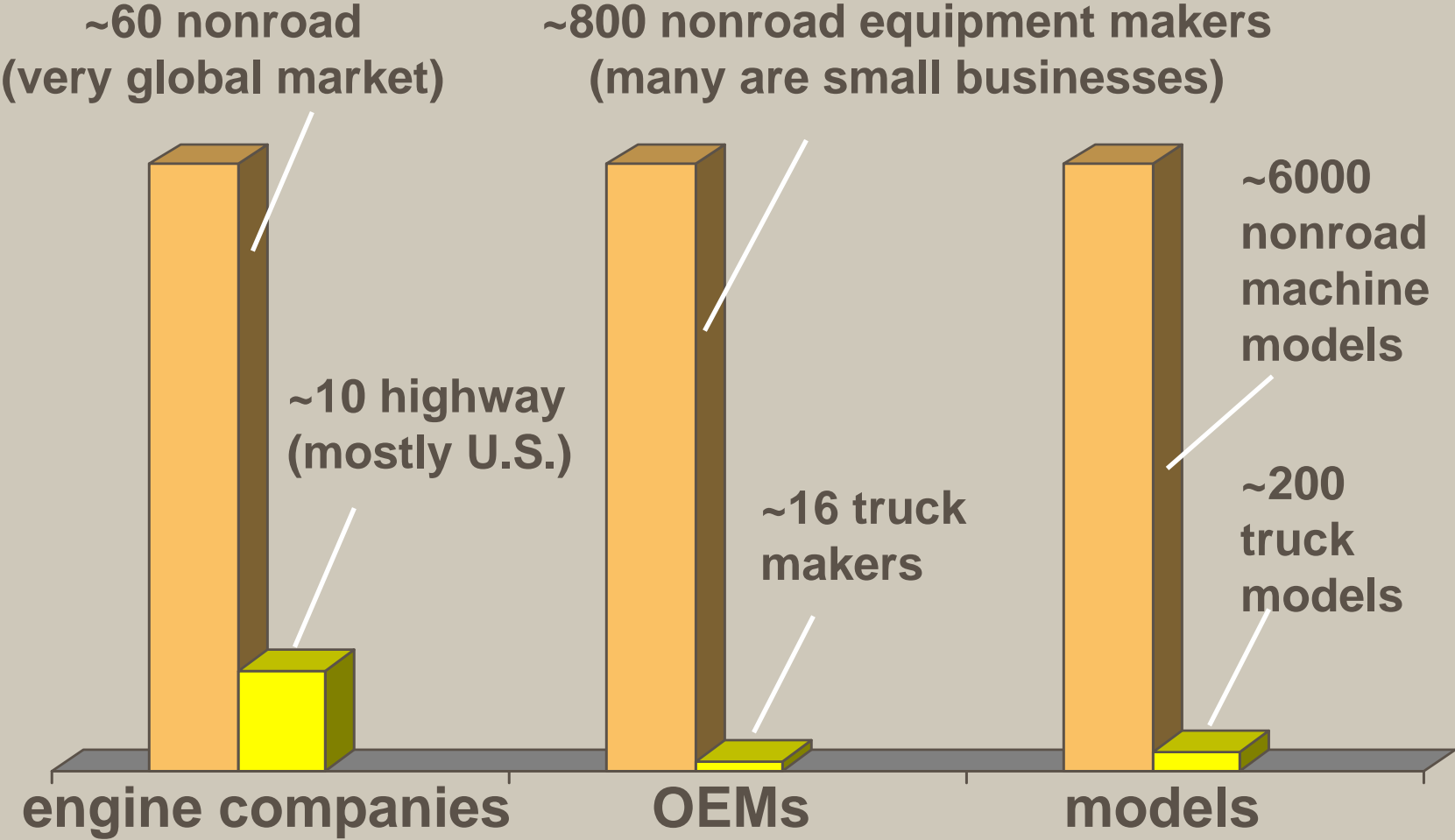
combine 285 hp

# Wide Range of Diesel Machines



off-highway truck 1000 hp

# Nonroad Diesel Industry is Very Diverse





# Program Considerations

- Treat the diesel fuel and engine as a system.
- Transfer advanced technology from 2007 highway program to nonroad applications.
- Get timely, large emission reductions to help States' attainment and maintenance plans.
- Provide 6-10 years lead time to deal with technical challenges and diversity of industries & products covered.
- Include flexibility provisions to minimize costs.
- Align with implementation of 2007 highway diesel program (put in place by EPA in 2001).

# Nonroad Diesels: An Effective Collaboration

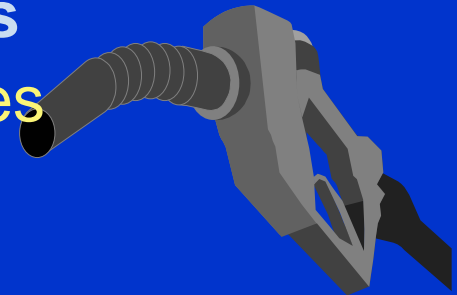
- Program success keyed to extensive outreach done by EPA with all stakeholder groups
  - State and local governments
  - Environmental and public health organizations
  - Engine and equipment manufacturers
  - Oil industry
  - Emissions control manufacturers
- Final rule has received widespread support

# A Systems Approach-- Fuel & Engines



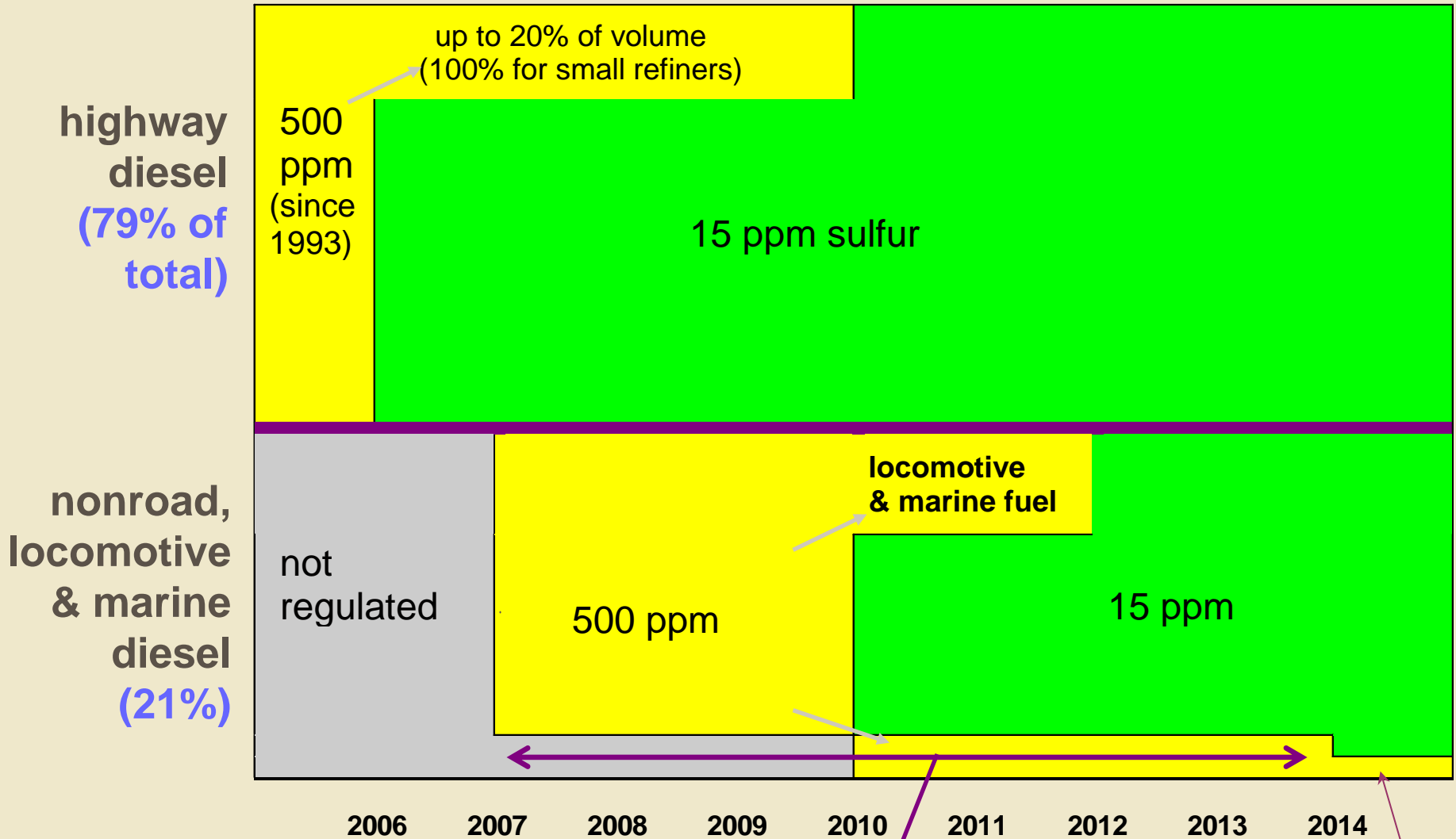
*Patterned after the 2007 highway diesel rule:*

- **Diesel aftertreatment**
  - Stringent new standards for NO<sub>x</sub> and PM
    - Reductions of >95% PM, ~90% NO<sub>x</sub>
  - Also new test requirements to ensure control in use
  
- **Fuel sulfur reduced to 15 ppm in 2 steps**
  - Enables the aftertreatment technologies
  - AND gets large immediate sulfate PM reductions from existing fleet
  - AND lowers engine maintenance costs
    - sulfur acidifies oil, corrodes engine parts
    - benefits owners of new *and old* equipment



# EPA Regulation of Diesel Fuel Sulfur

*Regulations apply June 1 at refinery, Aug 1 at terminal, Oct 1 at retailer*

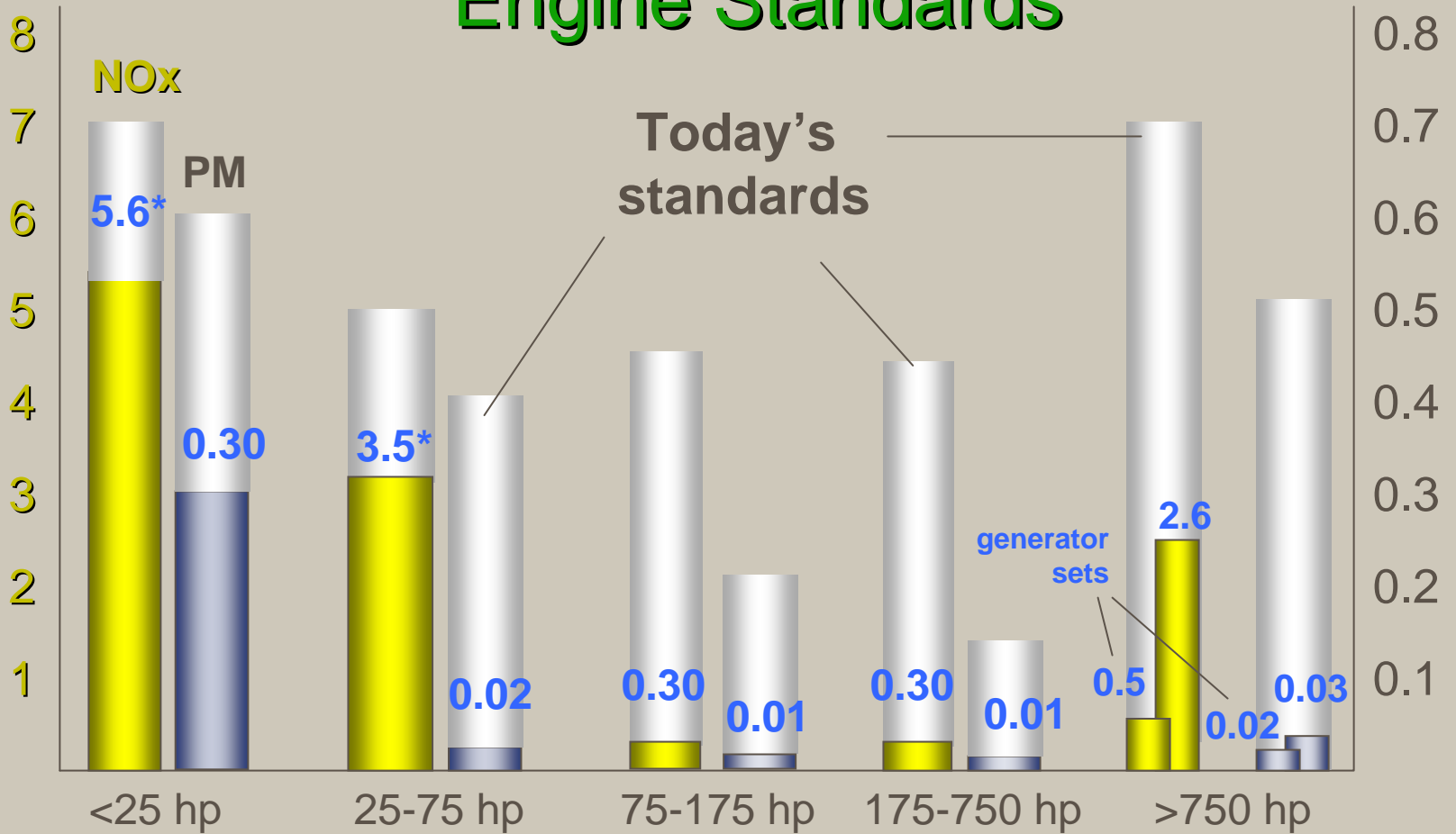


for transmix, small refiner fuel, and thru use of credits, except in Northeast & Alaska  
(expiration date not yet set for 500 ppm locomotive & marine transmix)

**NOx**  
(g/hp-hr)

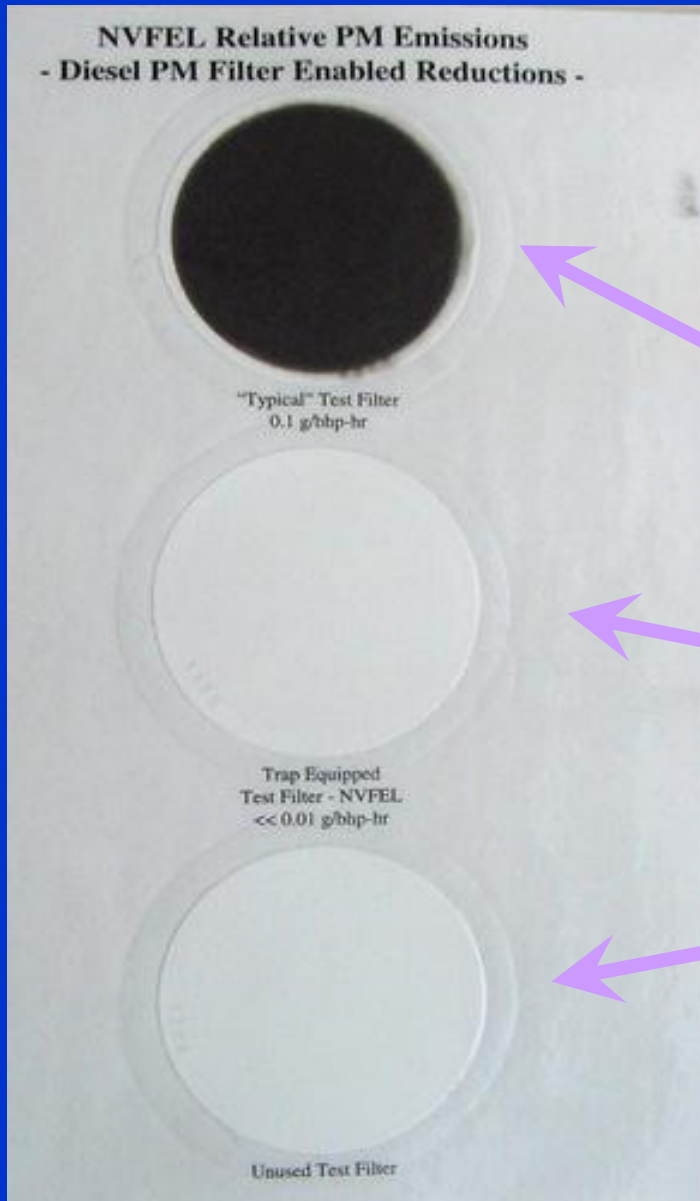
# Tier 4 Engine Standards

**PM**  
(g/hp-hr)



\* This is a combined NOx + hydrocarbon standard

**NVFEL Relative PM Emissions  
- Diesel PM Filter Enabled Reductions -**



A vivid demonstration of what this is all about

- Typical test filter – current standards
- Test filter – Tier 4 PM standards
- Unused test filter

# Cost Impacts

Vary with Engine Size and Equipment Application



	<b>Skid Steer Loader 33 hp</b>	<b>Backhoe 76 hp</b>	<b>Dozer 175 hp</b>	<b>Off-Highway Truck 1000 hp</b>
Long-term cost of meeting new standards	\$790	\$1200	\$2560	\$4670
Typical retail price of this equipment	\$20,000	\$49,000	\$238,000	\$840,000

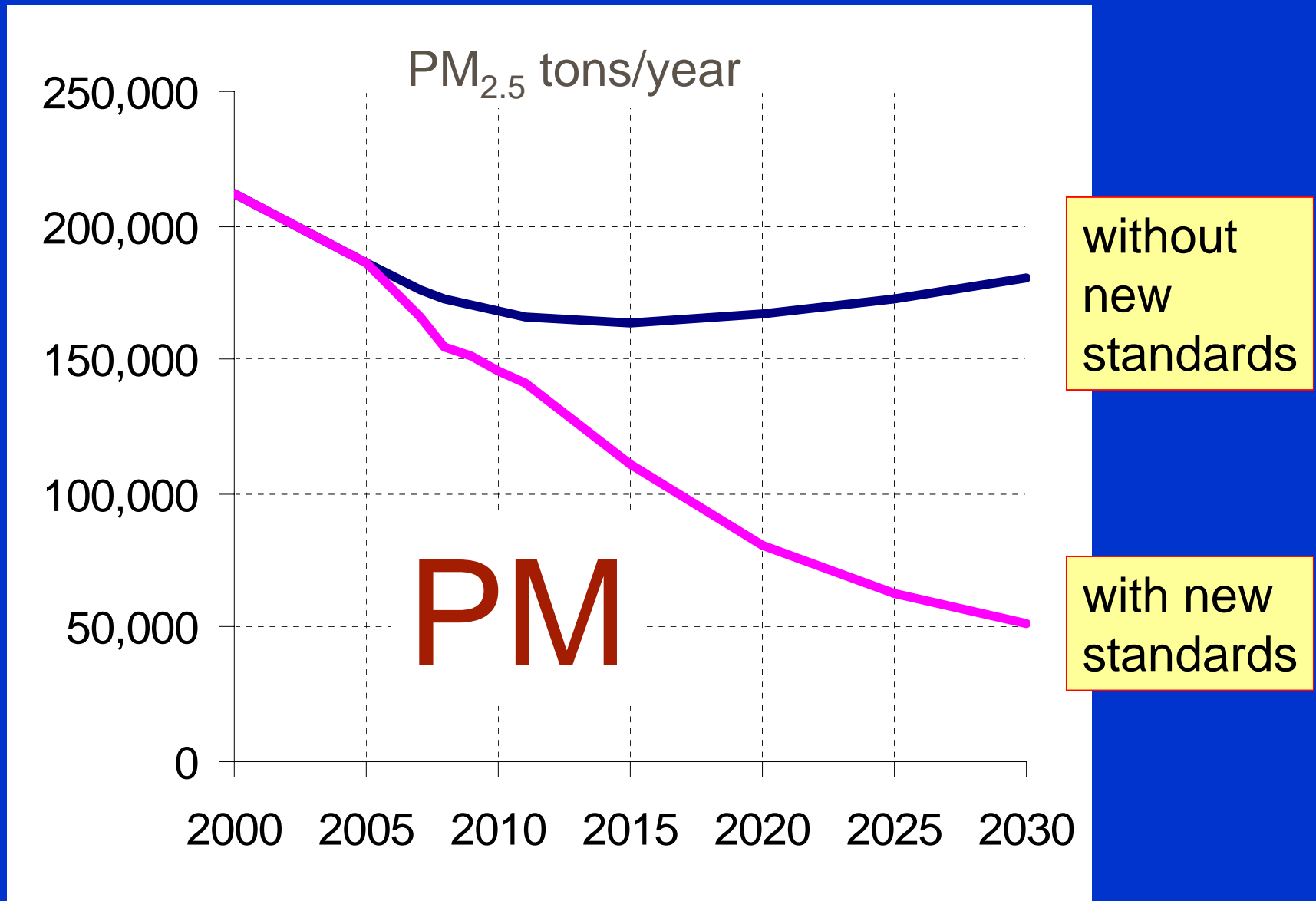


# Diesel Fuel Refiner, Distributor, & User Impacts

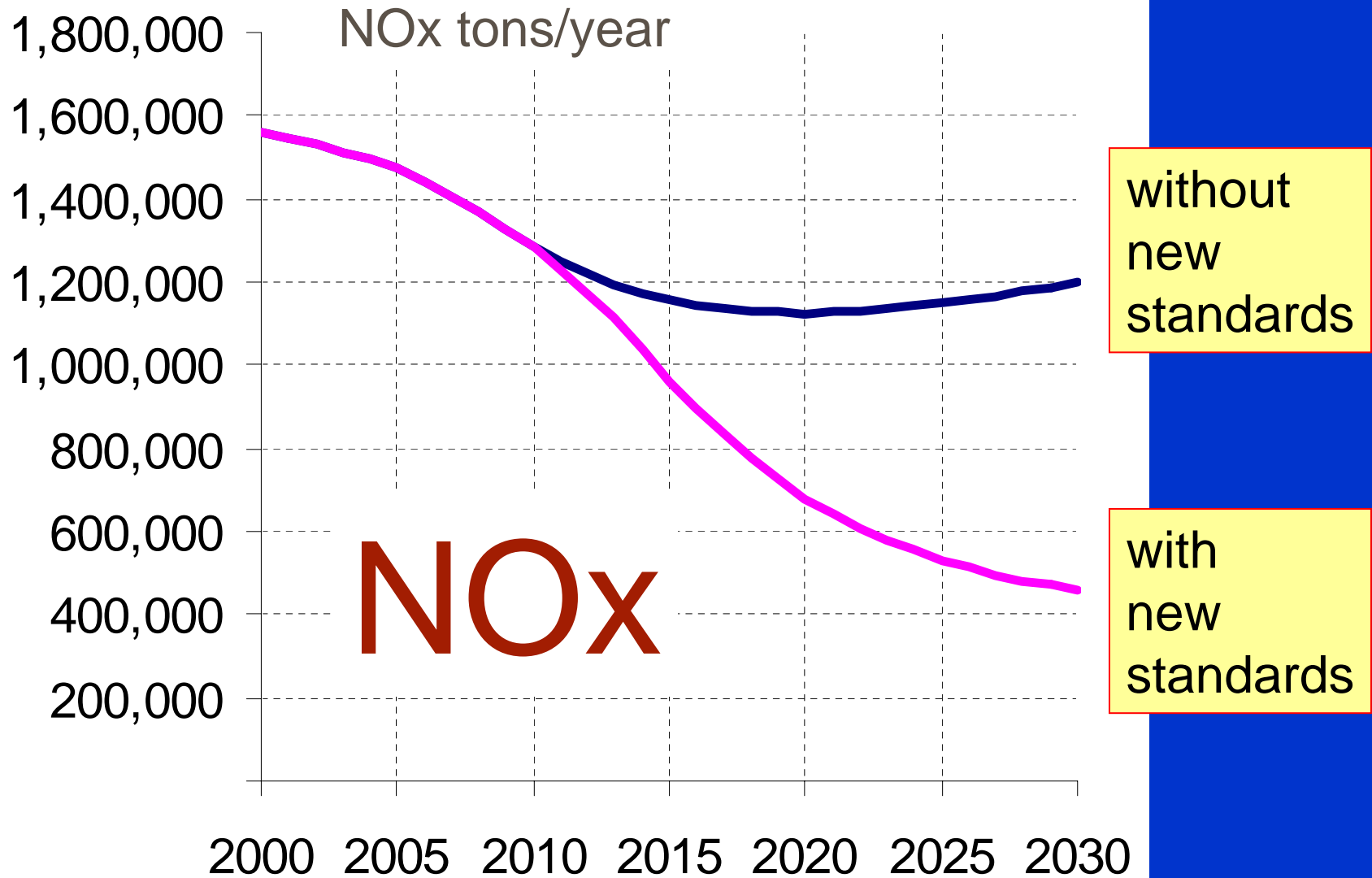


- Average fuel cost (refining & distribution): **6-7 ¢/gal**
- Maintenance savings to nonroad equipment owner from cleaner fuel: **~3 ¢/gal**
- Net consumer cost of fuel change: **3-4 ¢/gal**

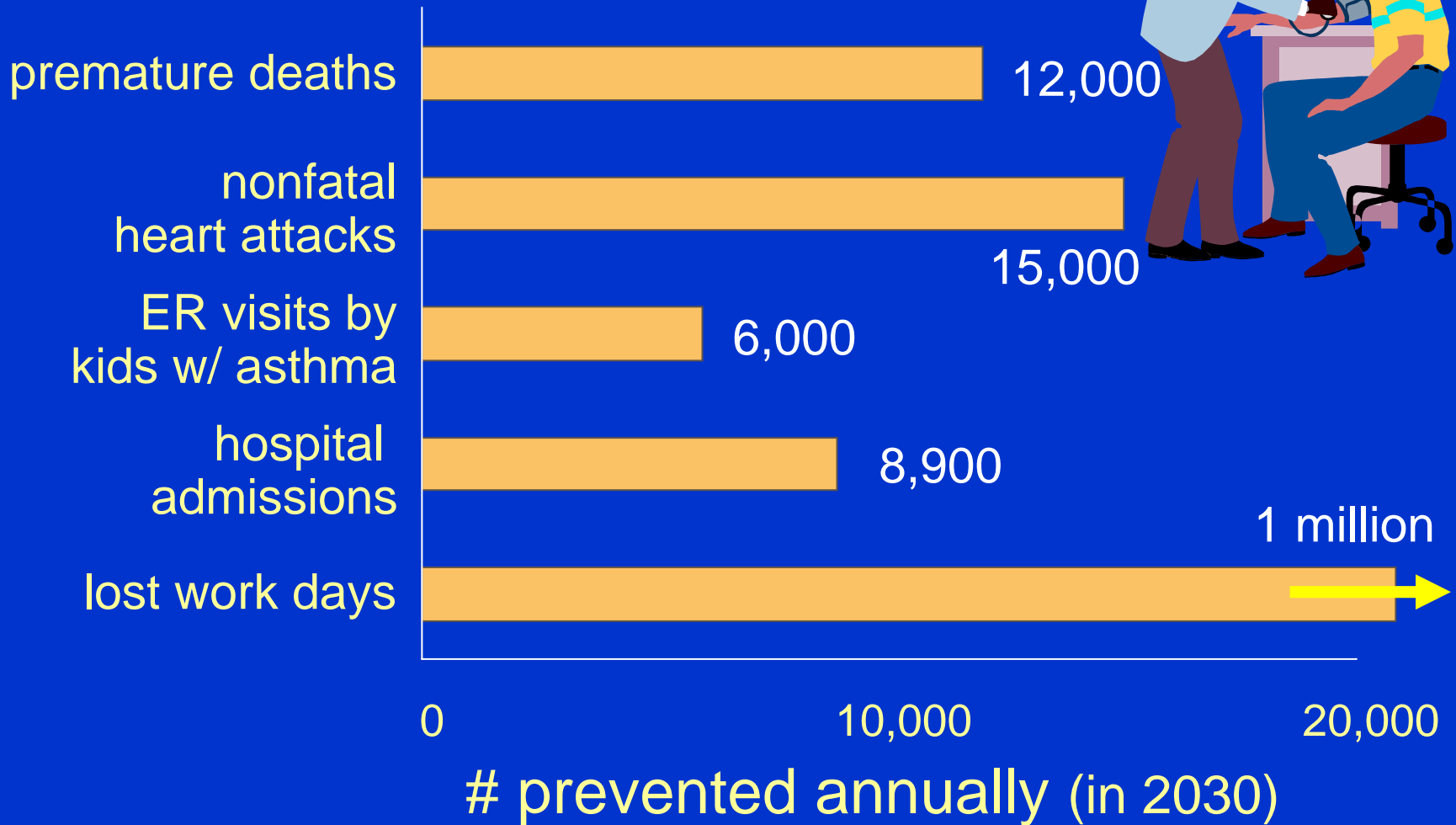
# Nationwide PM Reductions From Nonroad Diesels



# Nationwide NOx Reductions From Nonroad Diesels



# Nonroad Diesel Health Benefits



**\$80B annual benefits vs \$2B cost (in 2030)**

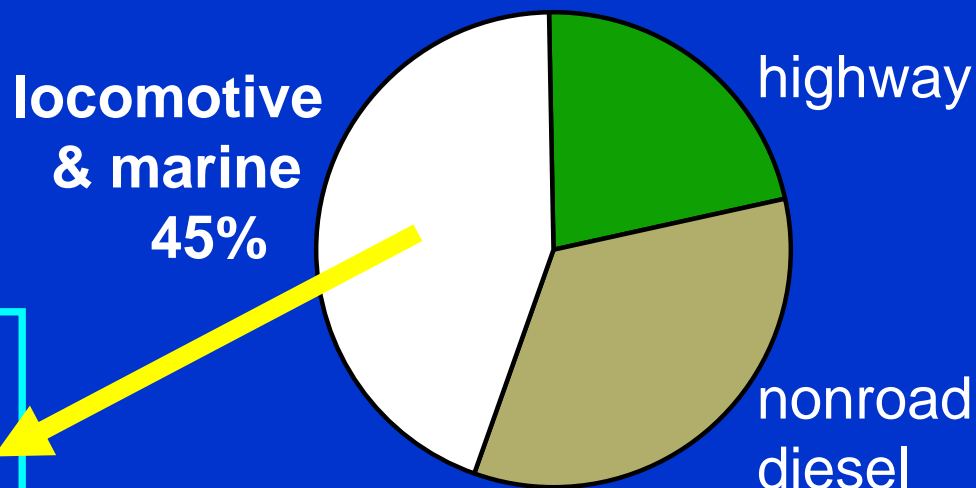
# Controlling Emissions From Locomotives and Marine Diesel Engines



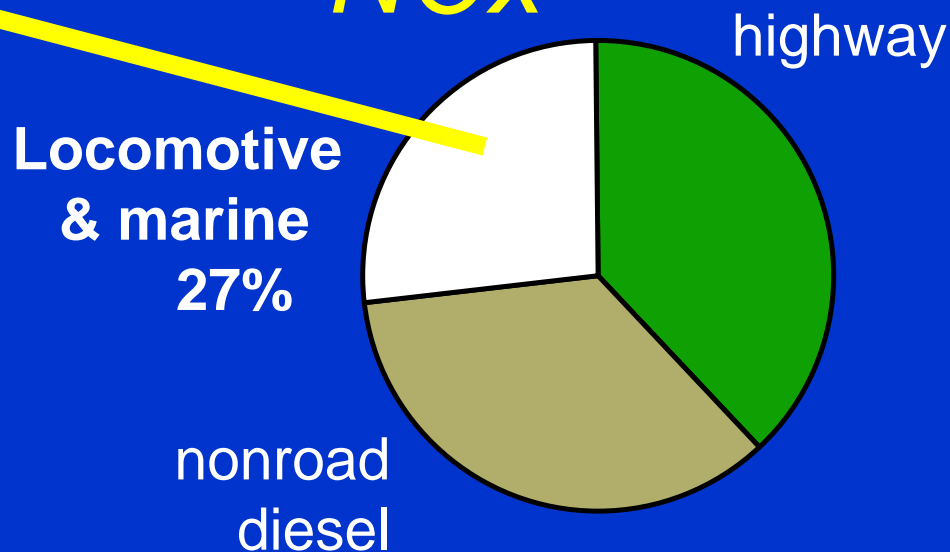
# Mobile Source Inventories in 2030

- Potential reductions on the order of:
  - ~25,000 tons/yr of PM
  - ~900,000 tons/yr of NO<sub>x</sub>
- Compares to nonroad rule reductions of:
  - ~129,000 tons/yr of PM
  - 738,000 tons/yr of NO<sub>x</sub>

## Diesel PM<sub>2.5</sub>



## NO<sub>x</sub>



# Locomotive & Marine Diesels Advance Notice

- Advance Notice signed May 11
  - Targets high-efficiency aftertreatment
  - as early as 2011
  - Patterned after highway and nonroad programs
  - Not ocean-going vessels (separate EPA action)
- Comment period open to end of August
- Starting to engage stakeholders in discussions
- Proposal planned for mid-2005