



EPA's Rulemaking for Clean Diesel Locomotives



Don Kopinski, U.S. EPA
California ARB Locomotive Emissions Meeting
July 13, 2006

Reconciling the Diesel Engine With the Environment: A Comprehensive Approach

Highway



Tier 2
Light-duty
(1999)



2007/2010
Heavy-duty
(2001)

Common Aspects--

- Systems approach— fuel change enables clean technologies
- Large environmental benefits
- Responsive to needs of States to meet air quality goals
- Collaborative process

Nonroad



Tier 4 diesel (2004)

Locomotive/Marine



Key Elements of Current EPA Locomotive Program

Tier 0

(35%
NOx ↓)



new-built in 2001

rebUILds of locomotives built in 1973-2001



Tier 1

(50% NOx ↓)



new-built in 2002-2004

Tier 2

(60/50% NOx/PM ↓)



new-built in 2005+



Locomotive diesel fuel

500 ppm S fuel

15 ppm

2000

2002

2004

2006

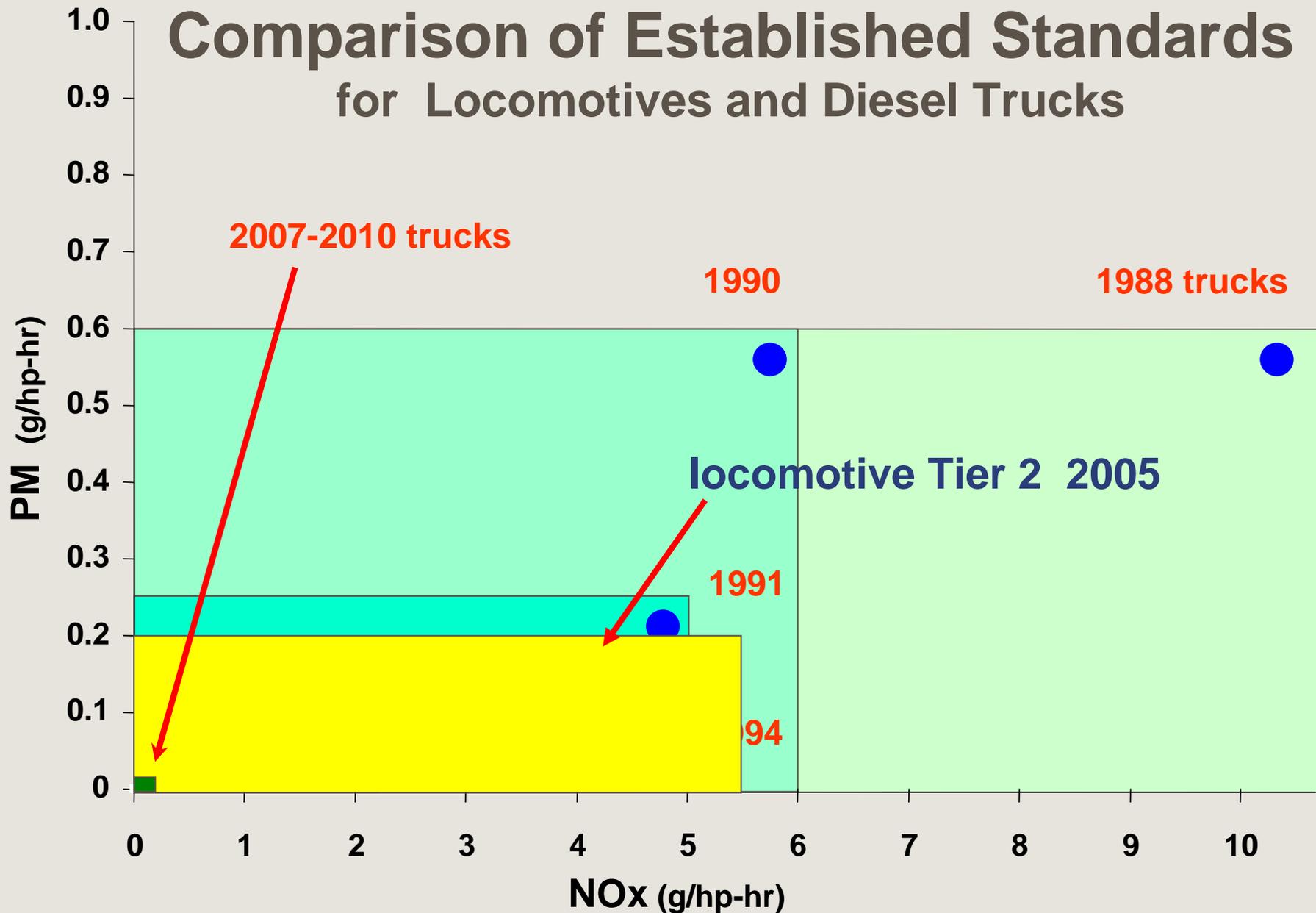
2008

2010

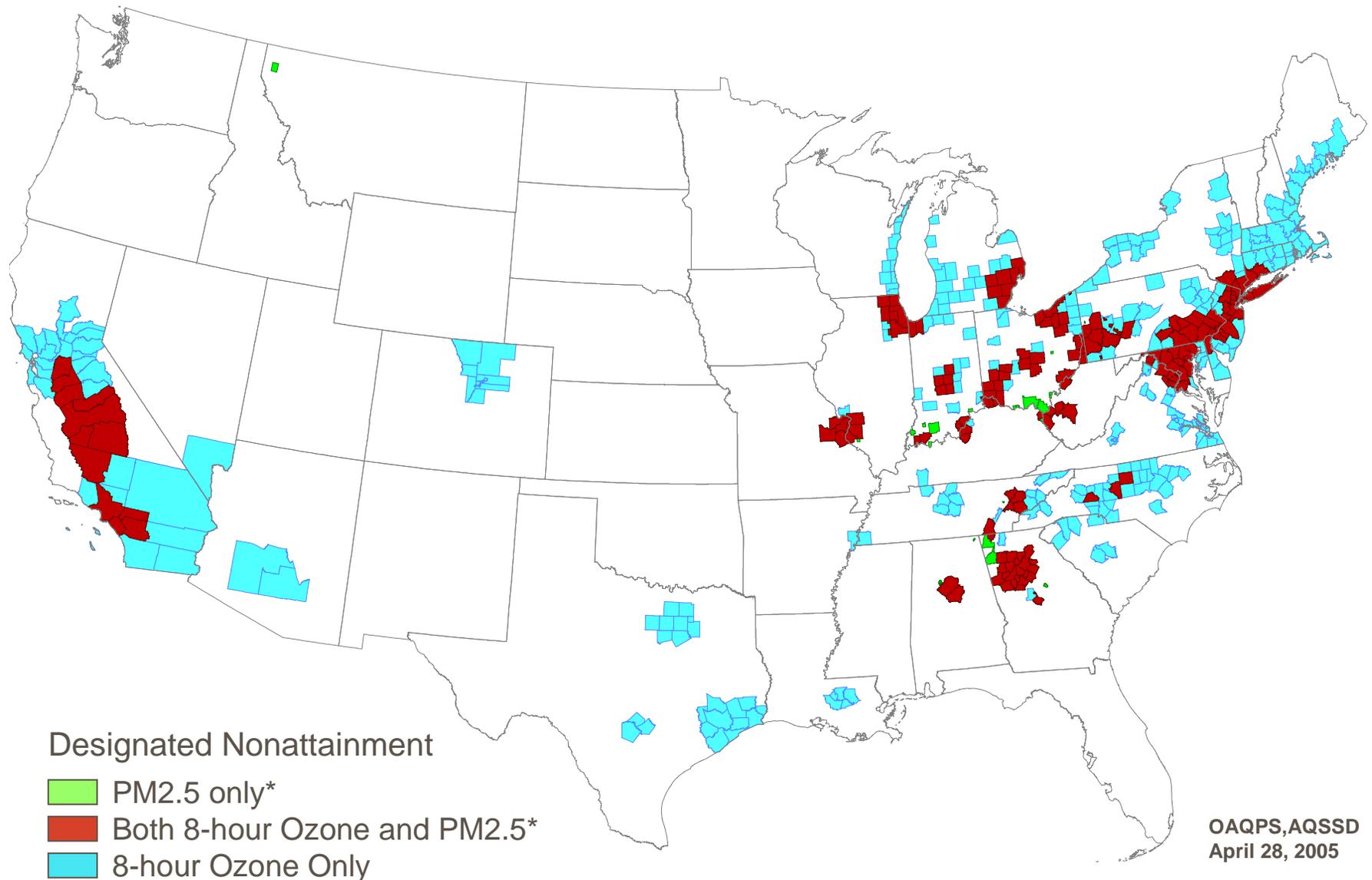
2012

2014

Comparison of Established Standards for Locomotives and Diesel Trucks



8-hour Ozone and PM2.5 Nonattainment Areas



* For PM2.5, the designated partial county areas are shown as actual boundaries designated.

22 PM2.5 Areas Projected to Not Attain by 2010

- Atlanta, GA
- Birmingham, AL
- Canton, OH
- Charleston, WV
- Chattanooga, TN-GA-AL
- Chicago, IL
- Cincinnati, OH-KY-IN
- Cleveland, OH
- Columbus, OH
- Detroit, MI
- Huntington-Ashland, WV-OH-KY
- Indianapolis, IN
- Knoxville, TN
- Libby, MT ?
- Los Angeles (South Coast), CA
- Louisville, KY-IN
- Macon, GA
- Pittsburgh (Liberty-Clairton), PA
- Rome, GA
- San Joaquin, CA
- St. Louis, MO-IL
- Steubenville-Weirton, OH-WV

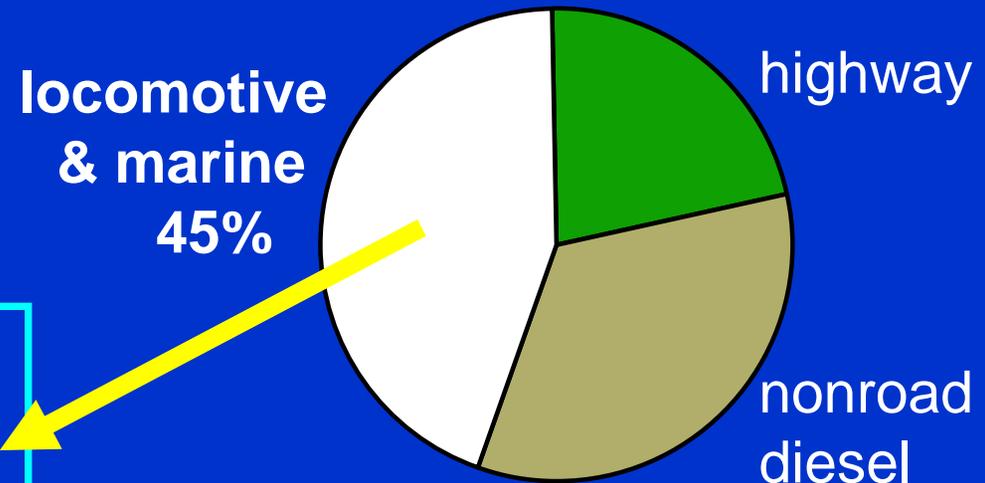
Total: 122 counties, 51 million population

Very close: New York, Philadelphia, Baltimore

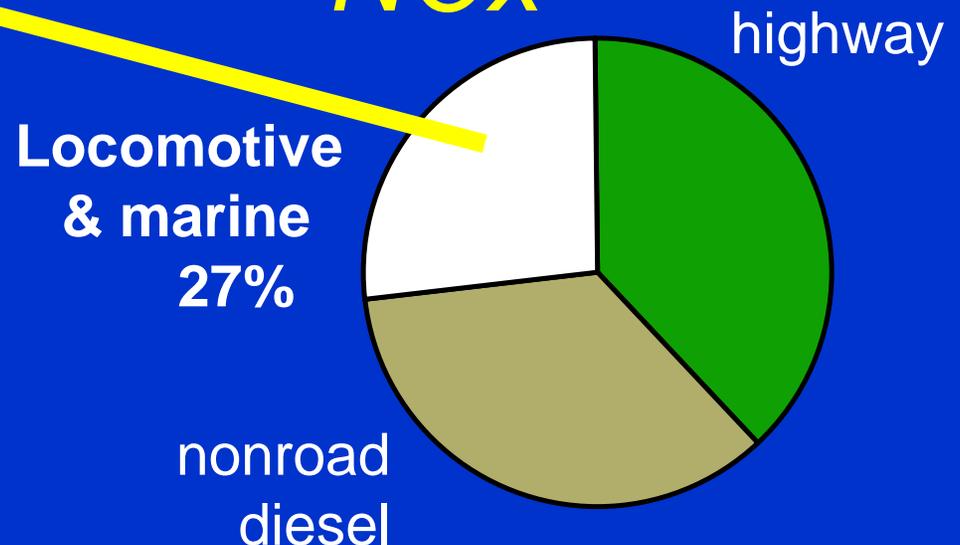
2030 Mobile Source Inventories from ANPRM Analysis

- Potential reductions on the order of:
 - ~25,000 tons/yr of PM
 - ~900,000 tons/yr of NOx
- Compares to nonroad rule reductions of:
 - ~129,000 tons/yr of PM
 - 738,000 tons/yr of NOx

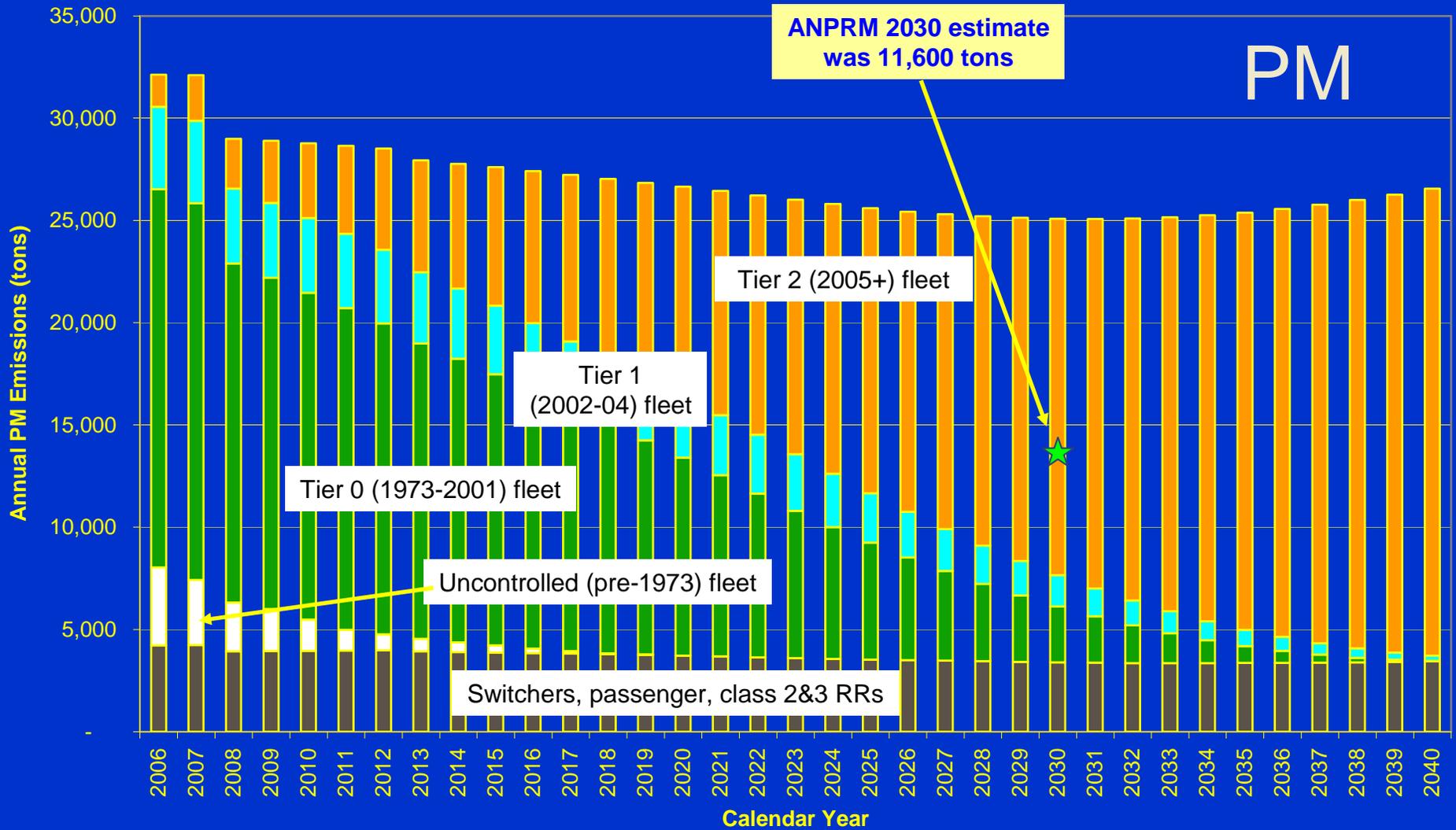
Diesel PM_{2.5}



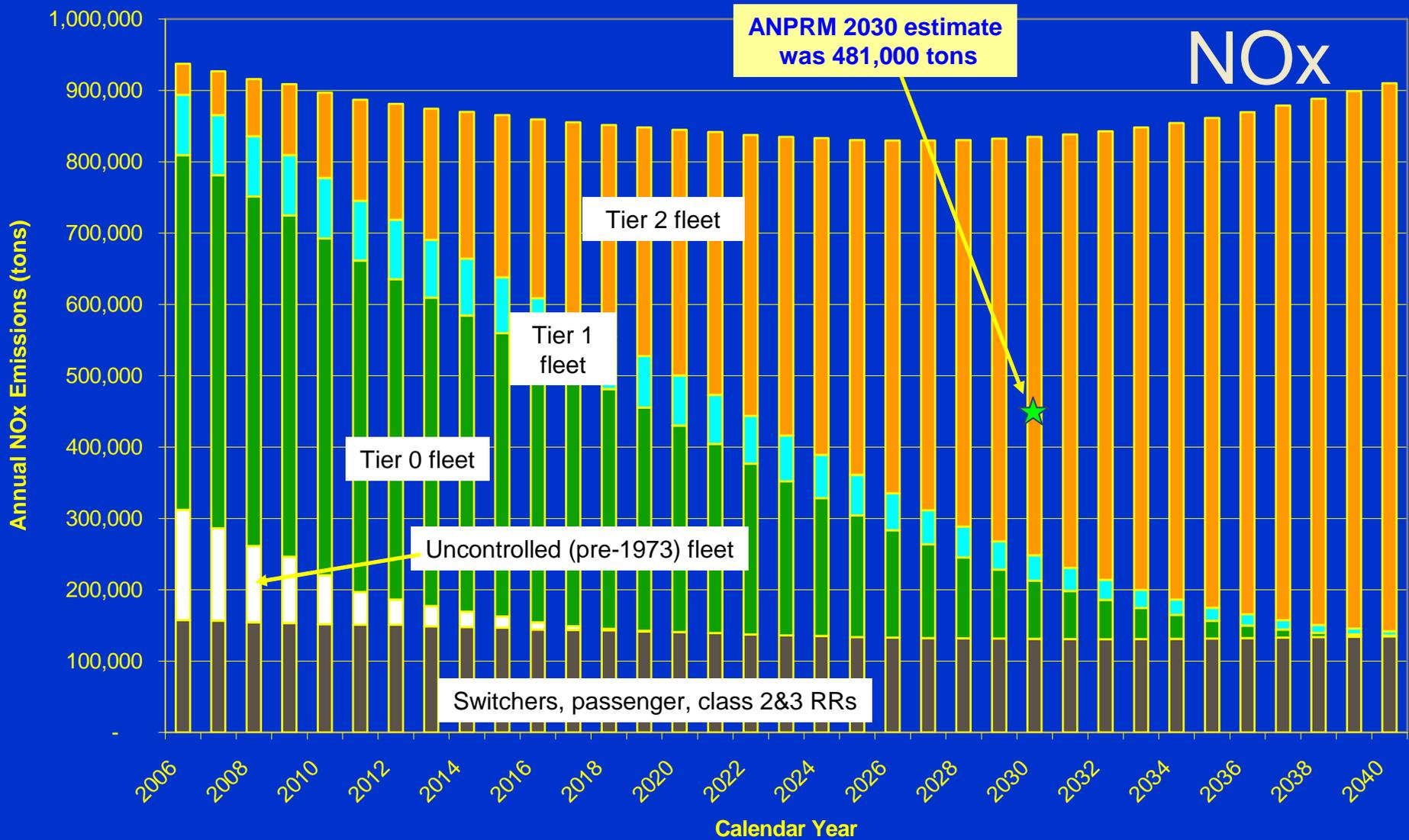
NOx



Locomotives: Draft Model Results

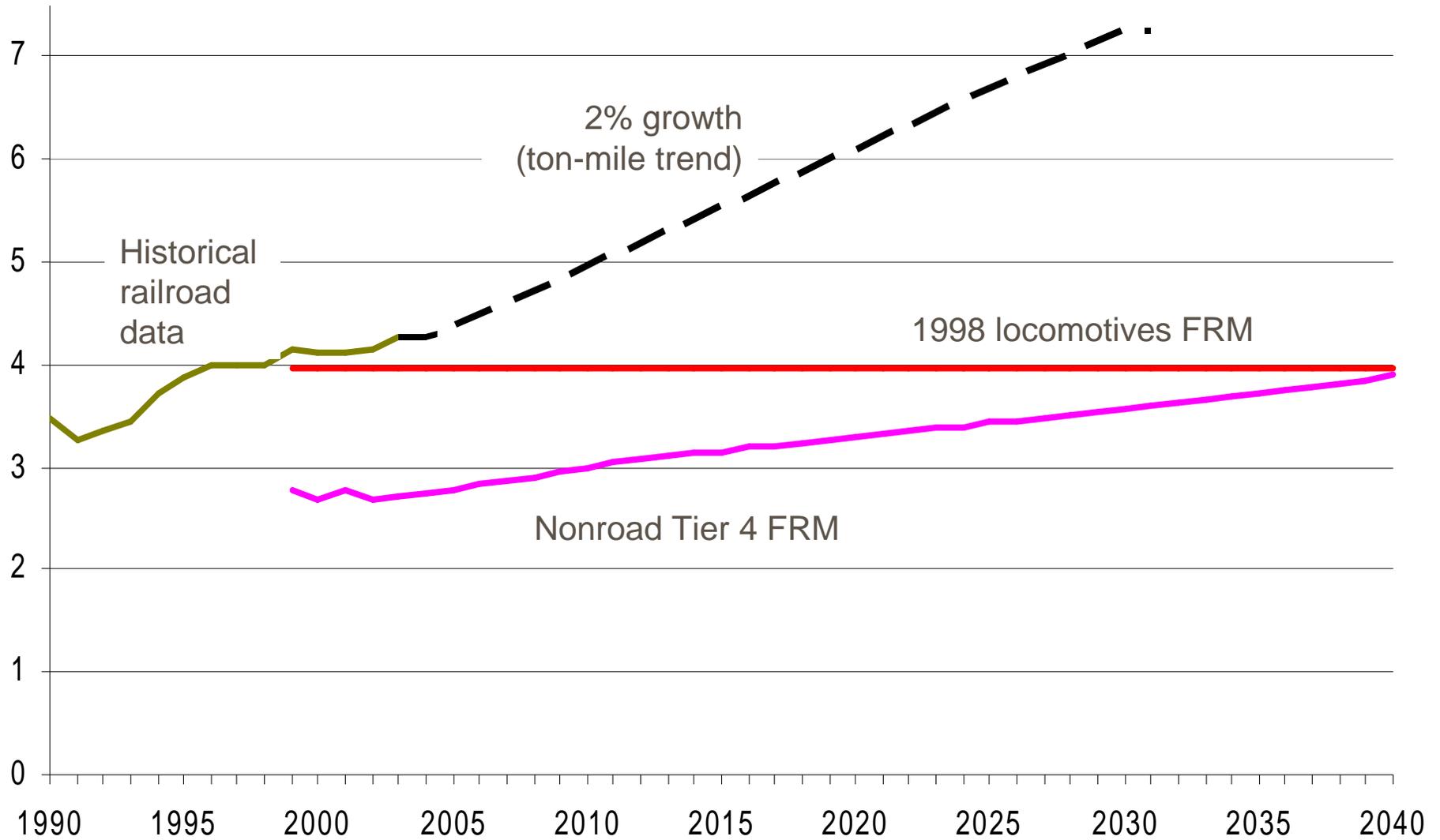


Locomotives: Draft Model Results



Fuel Consumption

(billion gallons/year)



Technology Opportunities

Newly built locomotives—

- Catalyzed PM filters
- High-efficiency NOx aftertreatment (e.g. urea SCR)
- Possibly engine-out reductions as an interim step

Existing locomotives—

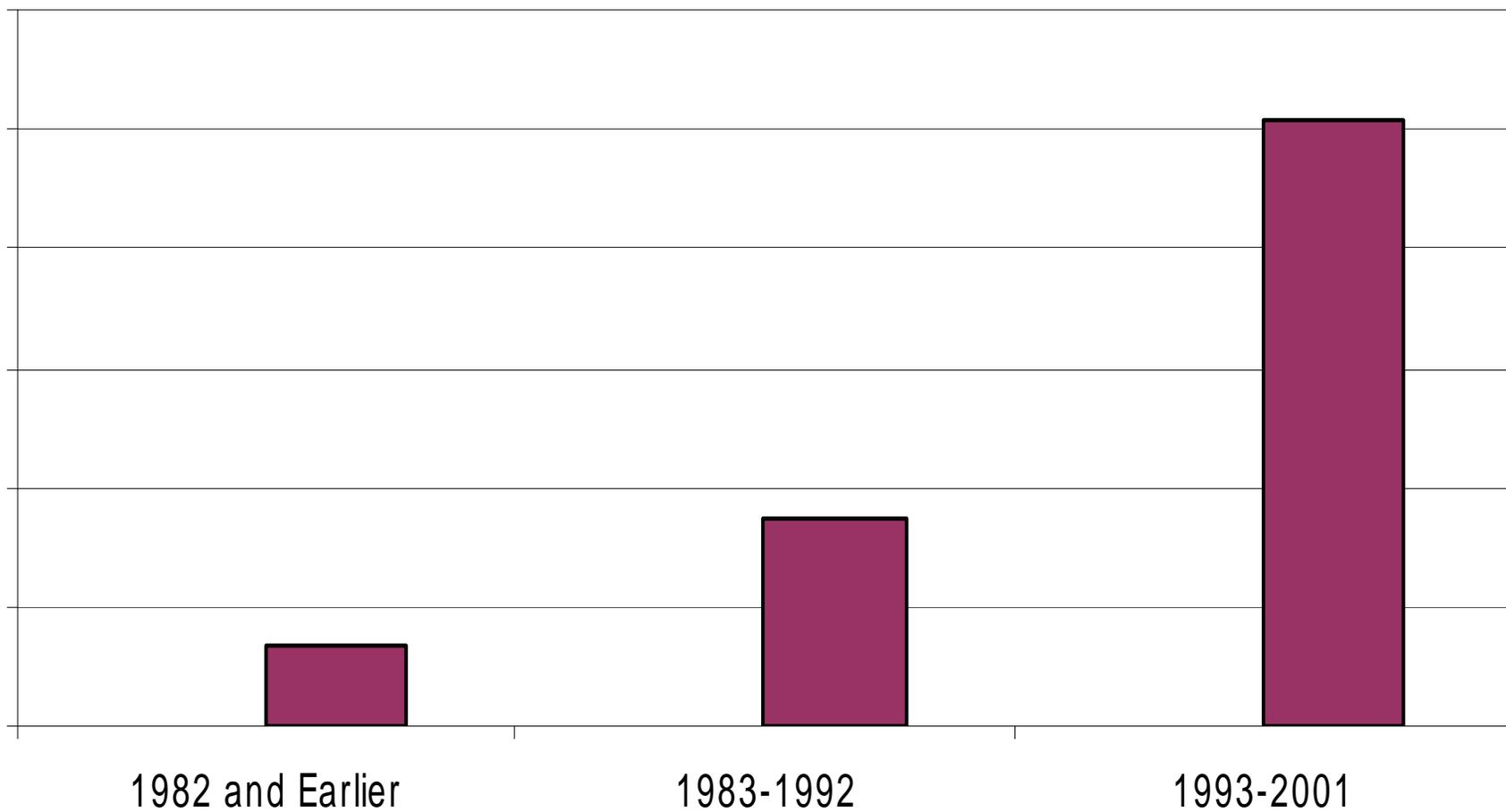
- Engine-based reductions on Tier 0, 1, 2 engines
- Installed at first major rebuild after program takes effect

Technology Challenges

- Space constraints
- Operation at lower temperature notches may hamper catalyst function
- Limited base of experience with aftertreatment for very large diesels
- Impact on RR operations
- Effective approach to switcher fleet
- Older locomotives— cost to upgrade vs remaining life

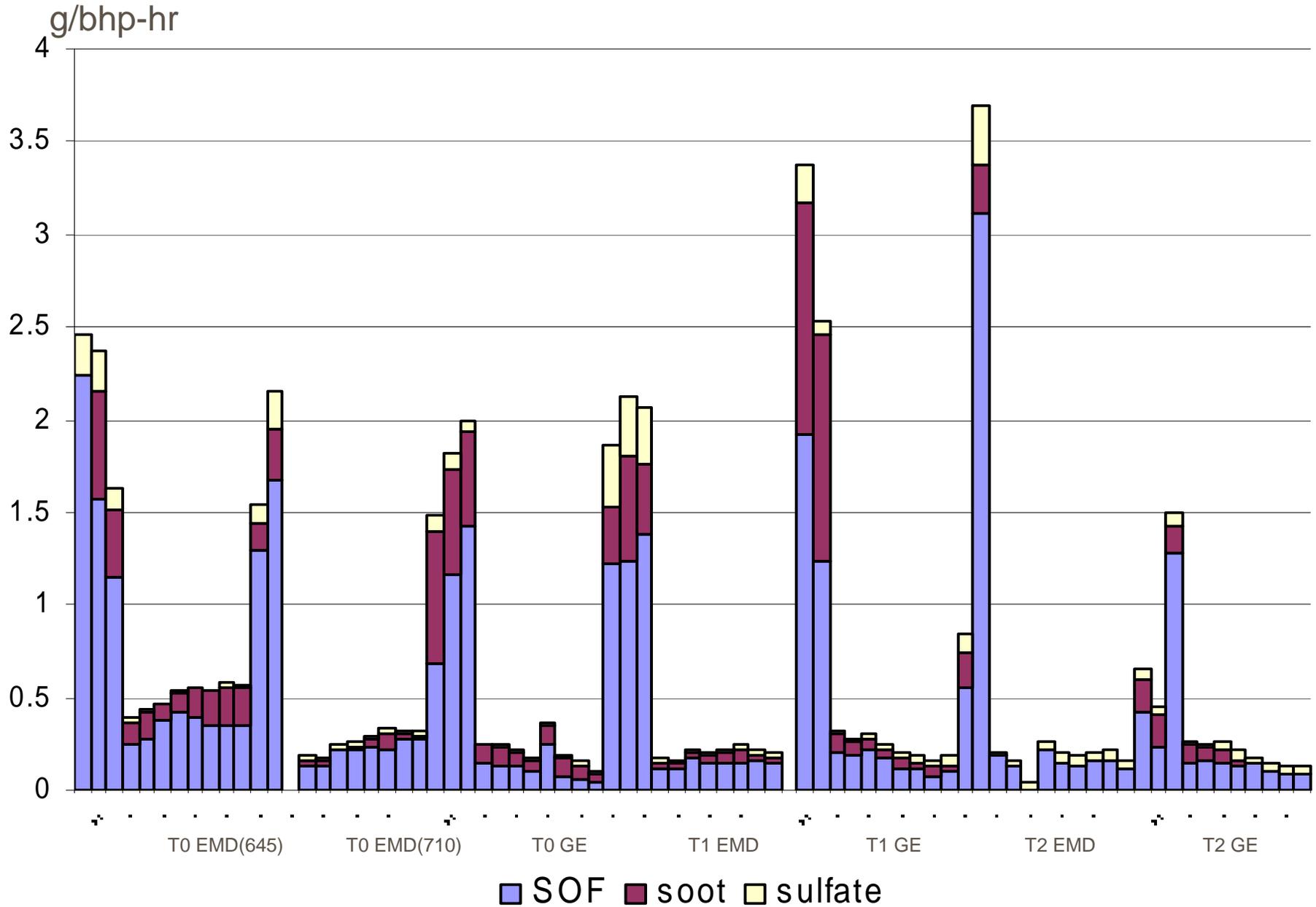
Opportunity for Updated Remanufactured Engine Standards

Relative Work Done by Tier 0 Fleet in 2010

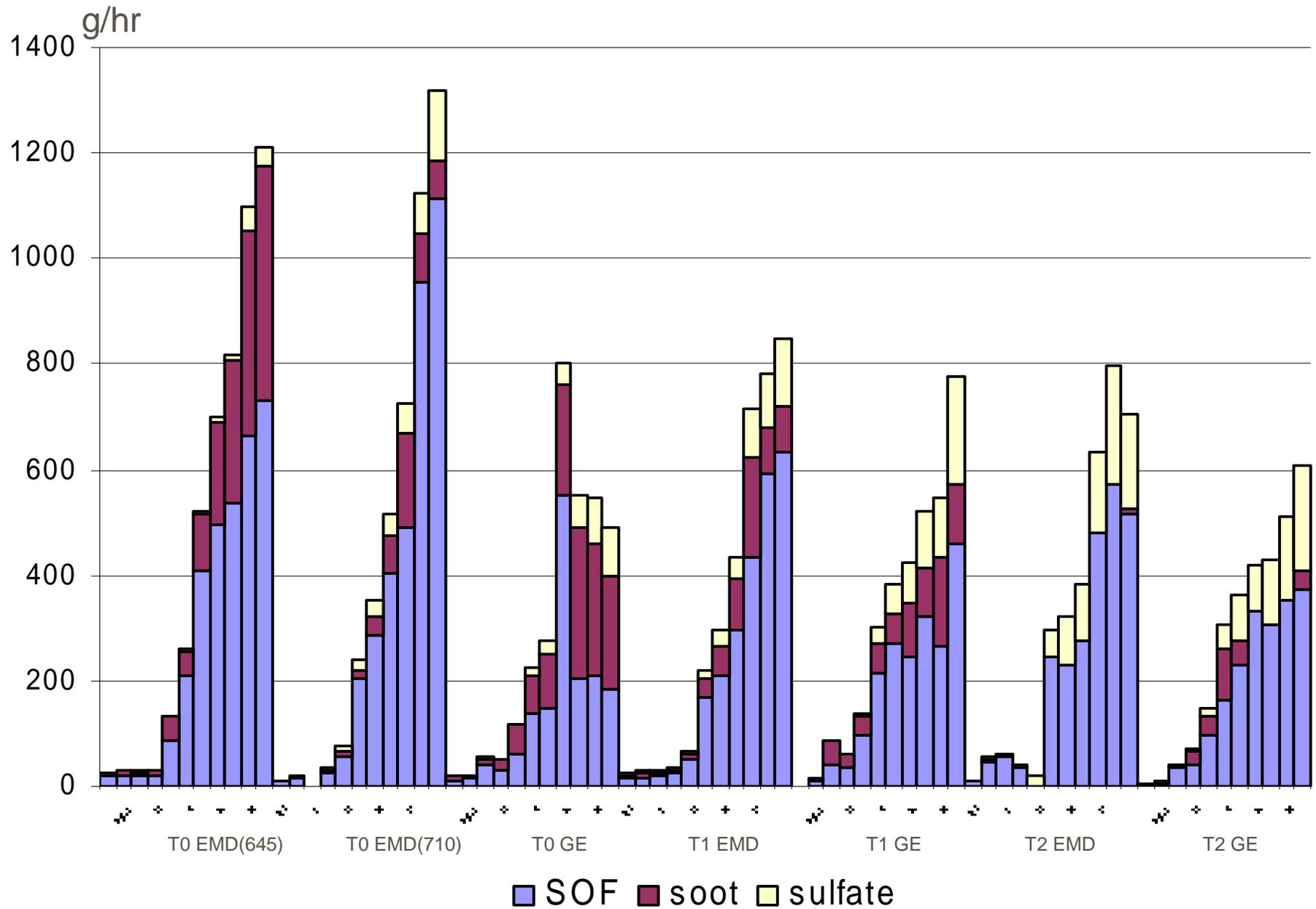




2005 In-Use Locomotive PM Test Data



2005 In-Use Locomotive PM Test Data



Locomotive Aftertreatment Demonstration

- **EPA contracted with Southwest Research to outfit a working locomotive with diesel oxidation catalysts (DOCs)**
 - Union Pacific provided the locomotive
 - EMD provided technical advice
 - DOCs and housings supplied by Miratech
 - Emissions testing in San Antonio completed in June
 - Will now be put in service for 6 months in California
 - Will then return to San Antonio for additional testing
- **Initial Results: >40% PM reduction; may improve some with further optimization.**

For More Information

- Don Kopinski
 - (734) 214-4229
 - kopinski.donald@epa.gov