

EPA Diesel Update

2005 DEER Conference

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Air Quality

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Overview

- Implementation update on mobile source diesel programs
 - Tier 2 Light-duty Vehicles
 - Heavy-duty highway ULSD & 2007-2010 program
 - Let's talk about urea
 - Nonroad Diesel Tier 4
- EPA regulatory development priority
 - Diesel locomotive and marine engines
- National Clean Diesel Campaign



3 Milestone Environmental Programs

Tier 2 Light-duty Vehicles (1999)



2007/2010 Heavy-duty Highway Engines (2001)



Tier 4 Nonroad Diesels (2004)

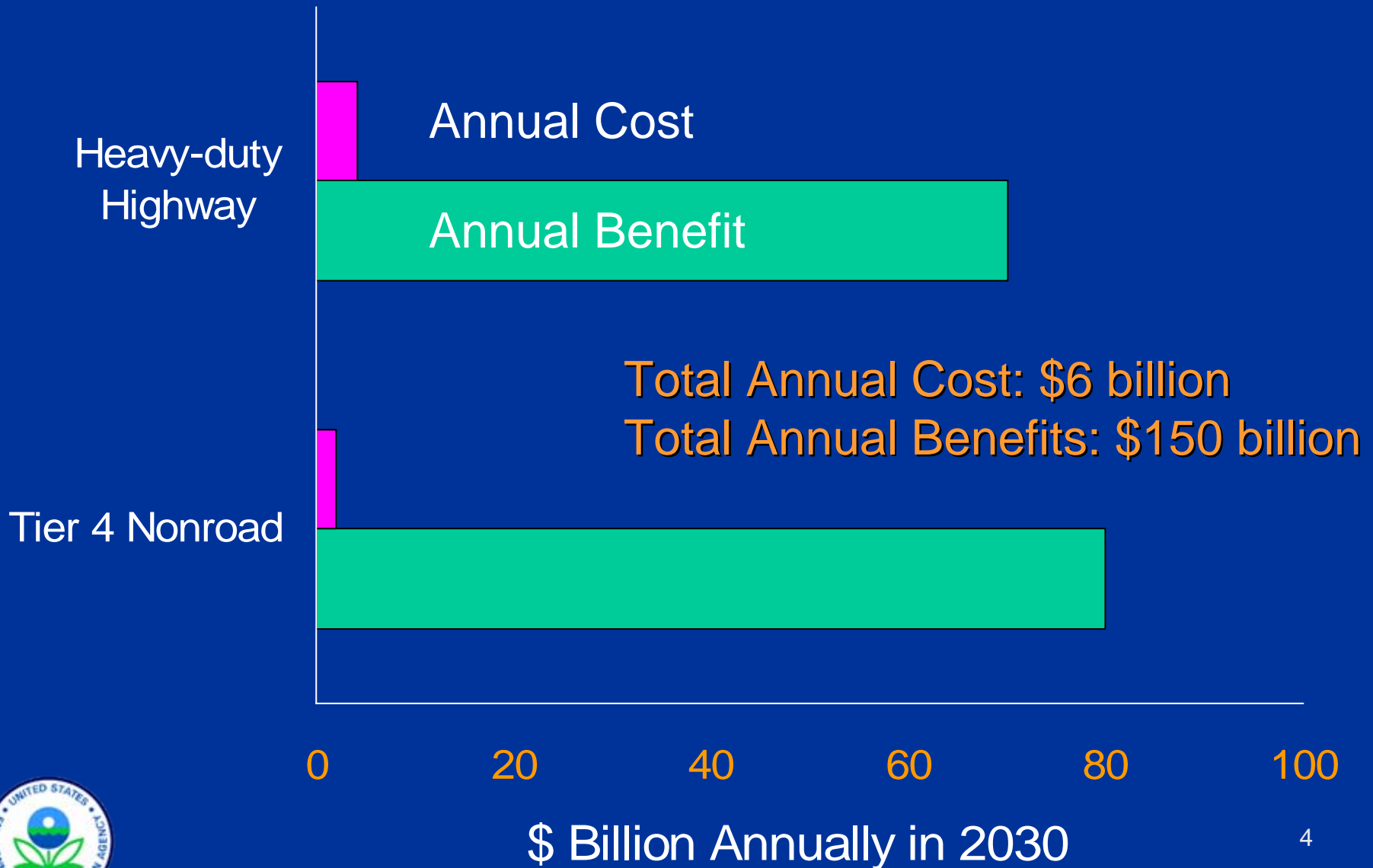


Much In Common--

- Systems approach— fuels and engines together
- Very large environmental benefits
- Responsive to needs of States to meet Clean Air goals
- Complex mix of stakeholders



Benefits of Clean Diesel are Substantial



Tier 2 Light-duty Diesels



Tier 2 Vehicle Program

- A landmark program that affects every new passenger car and every gallon of gasoline sold in U.S.
 - Implementation began January 2004
- For the first time:
 - Same set of emission standards applies to cars, SUVs, pickups, vans, and other large passenger vehicles
 - Vehicles and fuels are treated as a system
 - Standards apply to all light-duty vehicles, regardless of the fuel they burn (e.g., gasoline, diesel, alternative fuels)

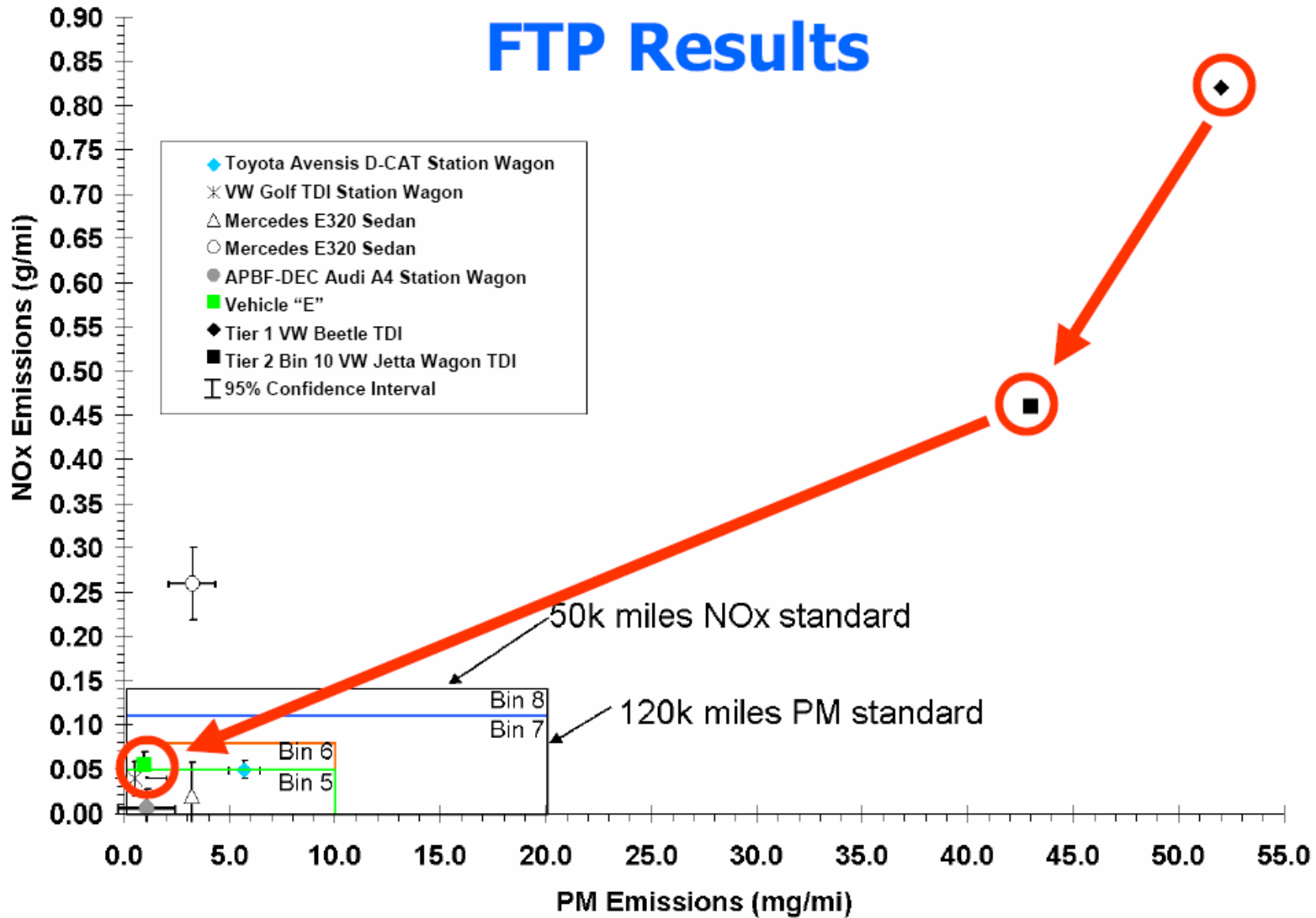


Prospects for Diesels in the U.S.

- European experience shows customer acceptance of modern diesel engines
 - Diesel vehicles have been available in Europe for many years
 - Diesel market penetration increased significantly coincidental with new diesel technologies
- Industry Optimistic for US Introduction of Tier 2 Diesels
 - Dr. Gerhard Schmidt, VP Research and Advanced Engineering Ford, *“Our target must be 50 state programs at LEV2/Bin 5.the prognosis is good, and we expect several diesel-powered light-duty vehicles to be offered in the US late in this decade.”*
 - Bernd Bohr, Chairman Bosch Automotive Sector, *“Our progress is so good, we are fundamentally convinced that we can exceed US norms.”*
- EPA Testing of LNT-equipped Tier 2 Prototype Vehicles



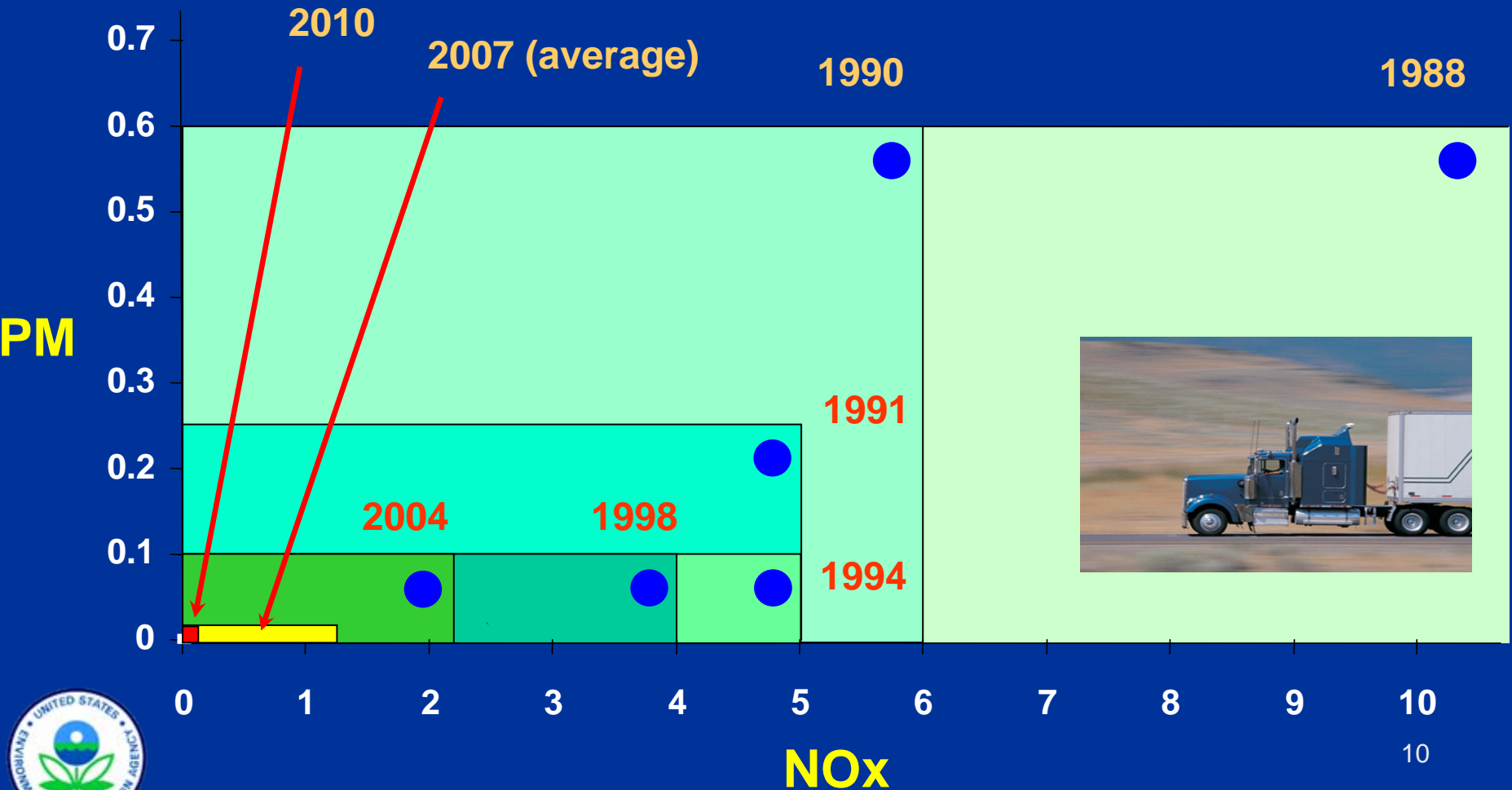
FTP Results



US EPA Heavy-duty 2007-2010 Program



Highway Heavy-duty Diesel Emission Standards (g/bhp-hr)



Progress Towards 2007 -- Engines



- **Manufacturers on track for 2007** using:
 - PM filters with active regeneration
 - Incremental improvements of 2004 technologies to meet 1.2 g/bhp-hr NO_x averaging standard
- **Customer fleet testing is occurring this year**
- **EPA will continue to monitor progress**
 - Regular progress update meetings with manufacturers
 - In past year many pre-certification meetings
 - Working with all manufacturers to ensure smooth implementation and certification processes for 2007



Trucking Industry Increasingly Confident

“Many environmental groups have been concerned that ATA will seek a delay in the implementation of the rule. I can tell you without reservation that ATA does not intend to challenge EPA’s diesel engine emission standards set to take effect on January 1, 2007 ...”

*-- Bill Graves, President, American Trucking Associations
November 17, 2004*



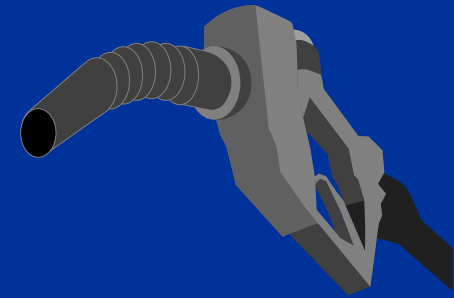
Progress Toward 2007: Fuels



- 2003, 2004 Refiner pre-compliance reports
 - ULSD will be produced...
 - On time
 - In sufficient quantity
 - Nationwide
 - 2005 Pre-compliance report data submitted in July
 - Data being analyzed now, EPA will release a summary report this fall
- Implementation Workshops
 - 2002, 2004, Again in November 2005



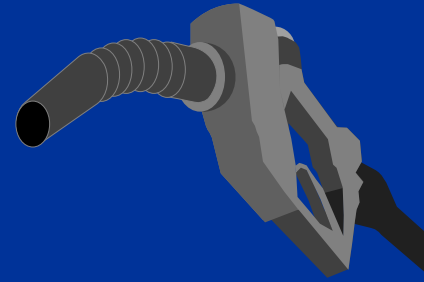
Progress Toward 2007: Fuels



- Series of meetings with Refiners, Pipelines, Terminals, and others in past year
- Refiners
 - Re-affirmation of pre-compliance reports
 - Refiners plans are on track
- Pipelines and Terminals
 - Engineering analysis essentially complete
 - Have already committed to some investments
 - Additional investment decisions are in process
 - Need to put in place recordkeeping/reporting processes for compliance obligations
- **Main Issues Highlighted**
 - Concern over sulfur testing uncertainty
 - Desire additional transition flexibility



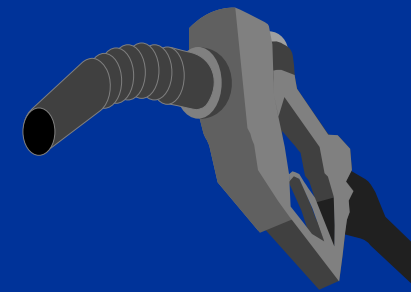
Sulfur Test Method Uncertainty



- Final rule allows a 2 ppm downstream test tolerance
- Industry is concerned that actual range of reproducibility may be greater
 - Recent ASTM results have been in the range of 3-5 ppm
 - However, this data is not reflective of 2006
 - Labs in the ASTM program were not qualified for measuring sulfur in the 15 ppm range for precision and accuracy
- EPA is conducting a Round-Robin test program
 - Qualified labs across the country
 - 131 labs qualified to participate, 152 instruments qualified
 - Samples were sent out in July and August
 - Report expected in early October on the results
- Based on the results, we will adjust the test tolerance accordingly



ULSD Transition Flexibility



- Considerable interest was expressed by the petroleum industry for additional flexibility to help smooth the initial transition to ULSD
- Many competing interests and challenges, not the least of which is to **protect the new engines and aftertreatment systems**
- EPA spent several months discussing the issue and potential solutions with:
 - Refiners, pipelines and terminals
 - Engine and vehicle manufacturers
 - States and environmental groups
- Proposed flexibility announced on May 25
- Transition flexibility:
 - No changes for refiners, still held to June 1, 2006
 - **45 day extension** for terminals and retailers to enable the system to flush from 500 to 15 ppm
 - **Completion by October 15 at retail**



Progress Toward 2010



- Rate of progress in developing technologies for 2010 NOx compliance is encouraging
- As with 2007, the range of potential technology options is expanding beyond what EPA projected in the 2001 final rule.
- For example:
 - Advanced combustion concepts (e.g., HCCI)
 - Lean NOx adsorbers
 - Selective catalytic reduction
 - Combination of advanced combustion at low loads and aftertreatment at high loads
- EPA expects most manufacturers will select 2010 technology path within the next 18 months



What is EPA's perspective on urea-SCR?



Would you like
some urea with
those fries?



Diesel doublespeak: Technology hits a wall

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DETROIT — Automakers are getting mixed messages from U.S. regulators about a controversial emissions technology that could be the key to unlocking diesel sales in North America.

Publicly, Environmental Protection Agency officials say they have no problem with the process, called urea injection. At least one automaker is planning to use the system as early as 2008.

But privately, the EPA officials tell automakers they don't like urea injection, which sprays ammonialike acid into the exhaust system to change NOx into harmless nitrogen and water. And the EPA is putting up roadblocks that automakers will have to get around before giving urea the green light.

Why the doublespeak?

news ANALYSIS

Pros and cons

Urea injection is a simple process that turns oxides of nitrogen emissions into harmless nitrogen and water. But the system has its critics. Here are some advantages and disadvantages.

ADVANTAGES

- Enables diesel engines to meet strict emissions standards
- Currently the lowest-cost, least-complex diesel emissions system
- Does not affect diesel engine performance or economy

DISADVANTAGES

- Requires a driver to refill a urea tank or the vehicle won't meet



What's Special About SCR?

Selective Catalytic Reduction is similar to other diesel emission control technologies in many ways--

- hardware is mounted in the exhaust stream
- relies on catalyst-enabled chemical reactions
- requires sophisticated electronic controllers
- can yield high reduction efficiencies, in excess of 90%

BUT...

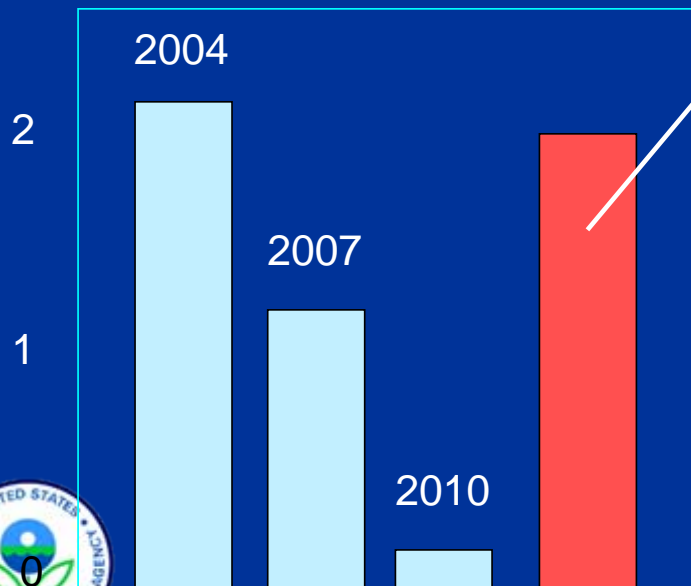


...there is one key difference:

SCR requires injection of a non-fuel reductant

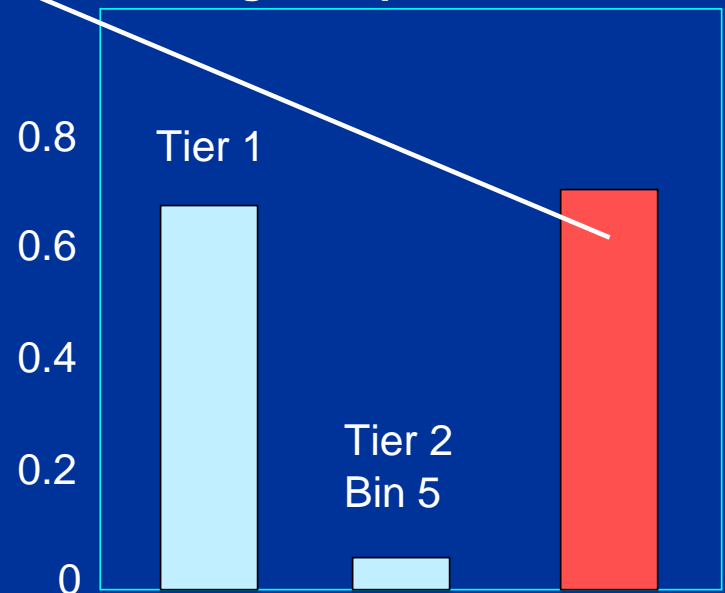
- typically urea-- an ammonia-based liquid
- efficiency drops to zero if not regularly replenished
- NOx could increase tenfold

Heavy-Duty NOx
grams per hp-hour



Potential
emissions
with 90%
SCR
system
without
urea

Light-Duty NOx
grams per mile



The Challenge for SCR In Regulatory Terms

- Urea will need to be replenished more often than the minimum allowable maintenance interval.
 - 150,000 miles for large HDVs
 - 100,000 miles for smaller HDVs and LDVs
- Shorter intervals can be approved if it can be shown that the maintenance will indeed be done and is technologically necessary.



The Challenge for SCR In Practical Terms

Regulatory challenges translate into 2 main objectives for manufacturers wishing to certify SCR diesels:

- Urea infrastructure--
 - Ensure that drivers will find SCR-quality urea wherever they need it.
- Vehicle compliance--
 - Ensure that vehicles will meet the standards in use (that drivers will not drive with empty urea tanks).

EPA has been consistent on these objectives since SCR was first discussed (heavy duty final rule, Jan. 2001).



The Urea Infrastructure Issue

- Main challenge will be widespread retail distribution
 - Especially in early years (modest urea volumes)
- Dealer and oil change locations not enough
 - Even if urea refill is tied to oil change intervals.
- Manufacturers will need to get commitments from major truck stop and/or service station chains to “fill in the map”.
- Containerized urea is a possible near-term solution.
- Co-fueling (automatic pumping of urea co-incident with fuel pumping) may be better for the long-term.



The Vehicle Compliance Issue

- Goal: engine/vehicle standards not exceeded due to lack of urea
- Audible & visible alarms when urea is running low are helpful but insufficient.
- May need some type of no-start mechanism as last resort.
 - Aim is robust design so that no-start is never triggered
- Some suggestions we've heard--
 - Vehicle won't start after refueling with low urea level
 - Vehicle fueling locked out if low urea level
- Also need way to detect if fluids other than urea are used (urea quality sensor, exhaust NOx sensor, ...).
- Tamper-proofing of all components is essential.
- Designed to work for the life of the vehicle.



A Roadmap To Success

- Waiting for certification applications to resolve these issues would be **too late** for all concerned.
- A better process is for manufacturers to **submit a plan** for how they would achieve the objectives.
 - Must include verifiable milestones along the way.
- Due to the importance of this issue, EPA would ask for **public comments** on the draft plan.
- Manufacturers following the plan could consider these **issues resolved** when they apply for certification.



Progress To Date

- Both heavy- and light-duty manufacturers have discussed concepts for draft plans with EPA and California ARB.
- **Heavy-duty:**
 - Extensive discussions regarding 2007 resulted in good progress, general agreement on principles & process.
 - Discussions were suspended in 2003 when product plans for 2007 (without SCR) were announced.
 - EMA has asked to start discussions this Fall focused on 2010.
- **Light-duty:**
 - Several meetings with the manufacturers over the past year to discuss plan elements.
 - Progress made on defining principles & process.



HD In-use Testing Program



- Announced in June 2005
- On-road, in-use HD diesel test program run by engine manufacturers
- Utilize onboard emissions measurement equipment
- Tests compliance with the not-to-exceed emissions std.
- Program phase-in from 2005-2008
 - Pilot program starts this year
 - PM emission measurement lags behind gaseous pollutants by one year
- Program developed jointly by EPA and CARB



HD On-board Diagnostics



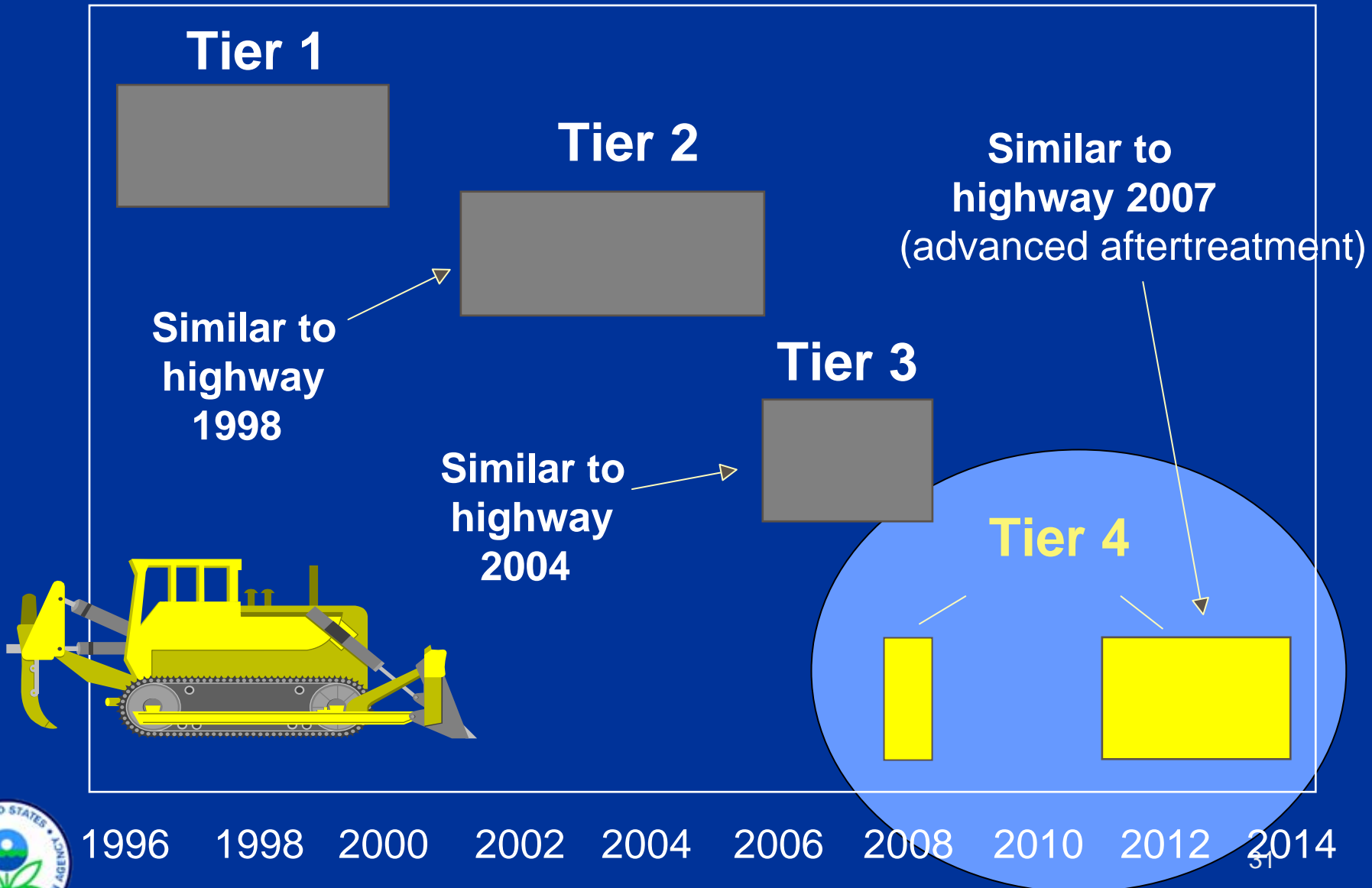
- EPA & California have worked with industry during the last two years to discuss technology and implementation issues
- We have worked towards the development of a nationwide program
- California Air Resources Board HD OBD Program
 - 2010 to 2016 program phase-in
 - Robust monitoring of emission control systems including diesel aftertreatment
- EPA proposal targeted for the end of this year



Nonroad Diesel Tier 4 Program



Phase-In of Nonroad Diesel Engine Programs



Distillate Fuels



home heating, etc 15%

not covered



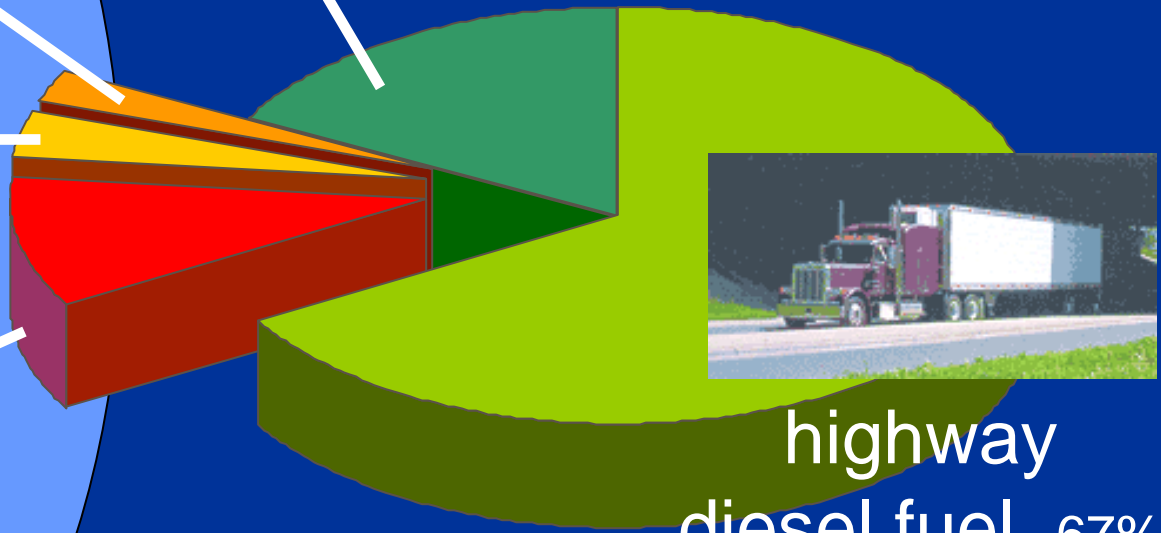
marine 2.6%



locomotive 3.2%



nonroad equipment
12%



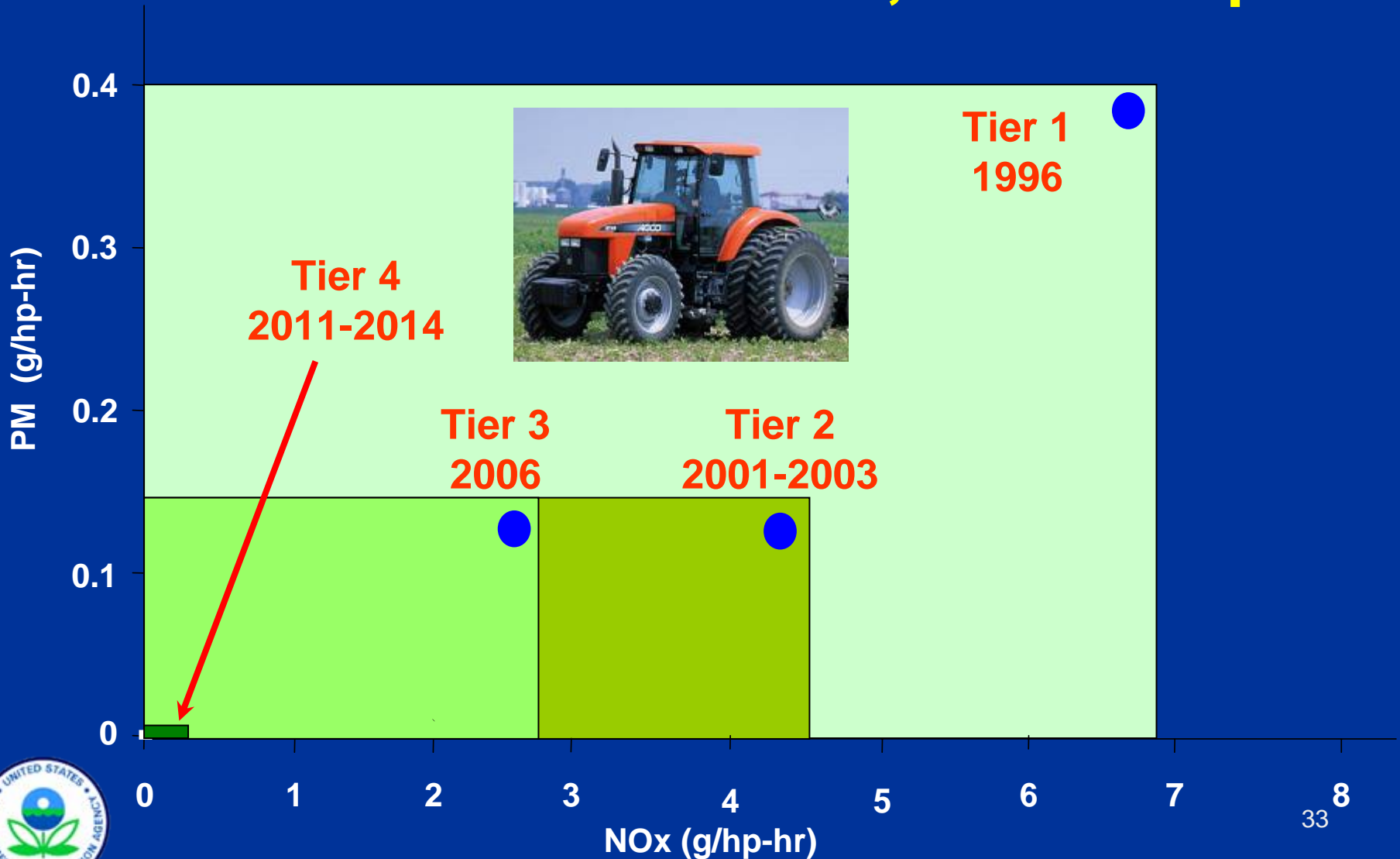
highway diesel fuel 67%

regulated since 1993

covered by the new program



Tier 4 Nonroad Diesel Emission Standards, 175-750 hp



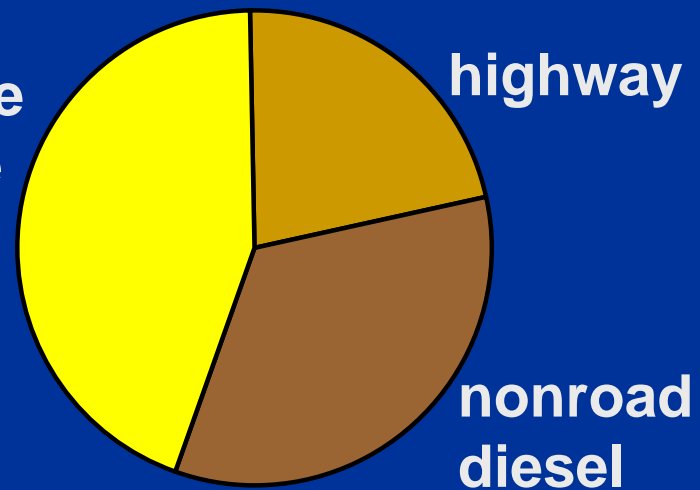
EPA Regulatory Development Priority - Diesel Locomotive & Marine Engines



Mobile Source Inventories in 2030

Diesel PM_{2.5}

locomotive & marine
45%



NOx

locomotive & marine
27%

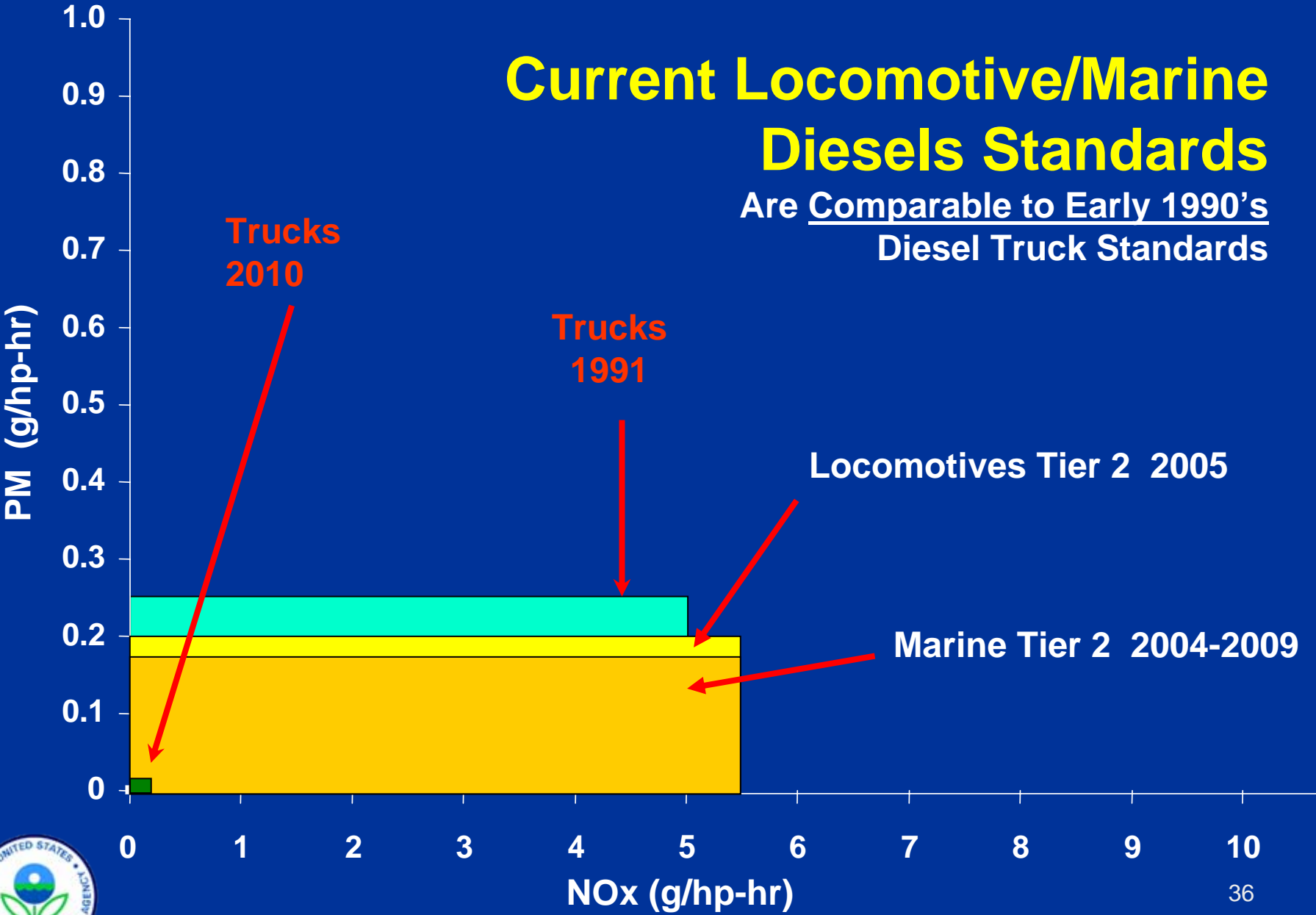


- Potential reductions on the order of:
 - ~25,000 tons/yr of PM
 - ~900,000 tons/yr of NOx
- Compares to nonroad rule reductions of:
 - ~129,000 tons/yr of PM
 - 738,000 tons/yr of NOx



Current Locomotive/Marine Diesels Standards

Are Comparable to Early 1990's Diesel Truck Standards



Future Locomotive & Marine Diesel Stds.

- Locomotive/marine diesel engines are a large source of diesel PM
- Nonroad Tier 4 rule
 - requires 15ppm fuel for loco/marine in 2012
- EPA proposal targeted for the spring of 2006



EPA's National Clean Diesel Campaign



National Clean Diesel Campaign: Overview

- Regulations for new engines & low sulfur diesel fuel
 - Light-duty Tier 2 passenger vehicles , Heavy-Duty Diesel Highway, Nonroad Diesel Engines
 - Upcoming standards for Marine/Locomotives
 - Sulfur Emission Control Area (SECA)
 - Ocean-going vessels
- Voluntary Programs to address diesel legacy fleet
 - Retrofit Program
 - Diesel exhaust catalysts, PM filters, engine modification technologies, cleaner fuels, idle reduction, etc...
 - SmartWay Transport Program
 - Idle reduction, tires, logistics, lubricants, aerodynamics, speed management, etc...



Voluntary Programs Strategy

- Regulations take time to implement and achieve their full benefit
- National Clean Diesel Campaign is a comprehensive strategy which includes stds. for new engines/vehicles and programs to address emissions from the existing fleet
- Sector-specific with geographic emphasis where appropriate (i.e., nonattainment area, rural & urban, sensitive populations)
- **Five sectors targeted:**
 - Ports
 - Construction
 - Freight
 - School buses
 - Agriculture

Objective: By 2014 reduce emissions from the approx 11 million diesel engines in the legacy fleet





EPA Funded Retrofit Projects

