

EPA Heavy Duty Vehicle Emissions Program

Cheryl L. Bynum
Team Lead, Technology and Fuels
US EPA SmartWay Transport Partnership
ICCT/NESCCAF Workshop:
Improving Fuel Economy of Heavy Duty Fleets II
20 February 2008



Presentation Overview

- What is the Challenge?
- What is the Solution?
- SmartWay Phase I Test Program
- SmartWay Tractor-Trailer Trucks
- Phase II Test Program: SmartWay Truck Emissions Test Protocol
- Public Workshop
- Next Steps



What is the Challenge?



Climate Change Already Affecting the Planet: Arctic Ice Cap

- Mid-September 2007 Arctic sea ice cover is **39%** smaller than the 1979 to 2000 mid-September median
- Mid-September 2007 is **22%** smaller than mid-September 2005

Source: National Snow and Ice Data Center

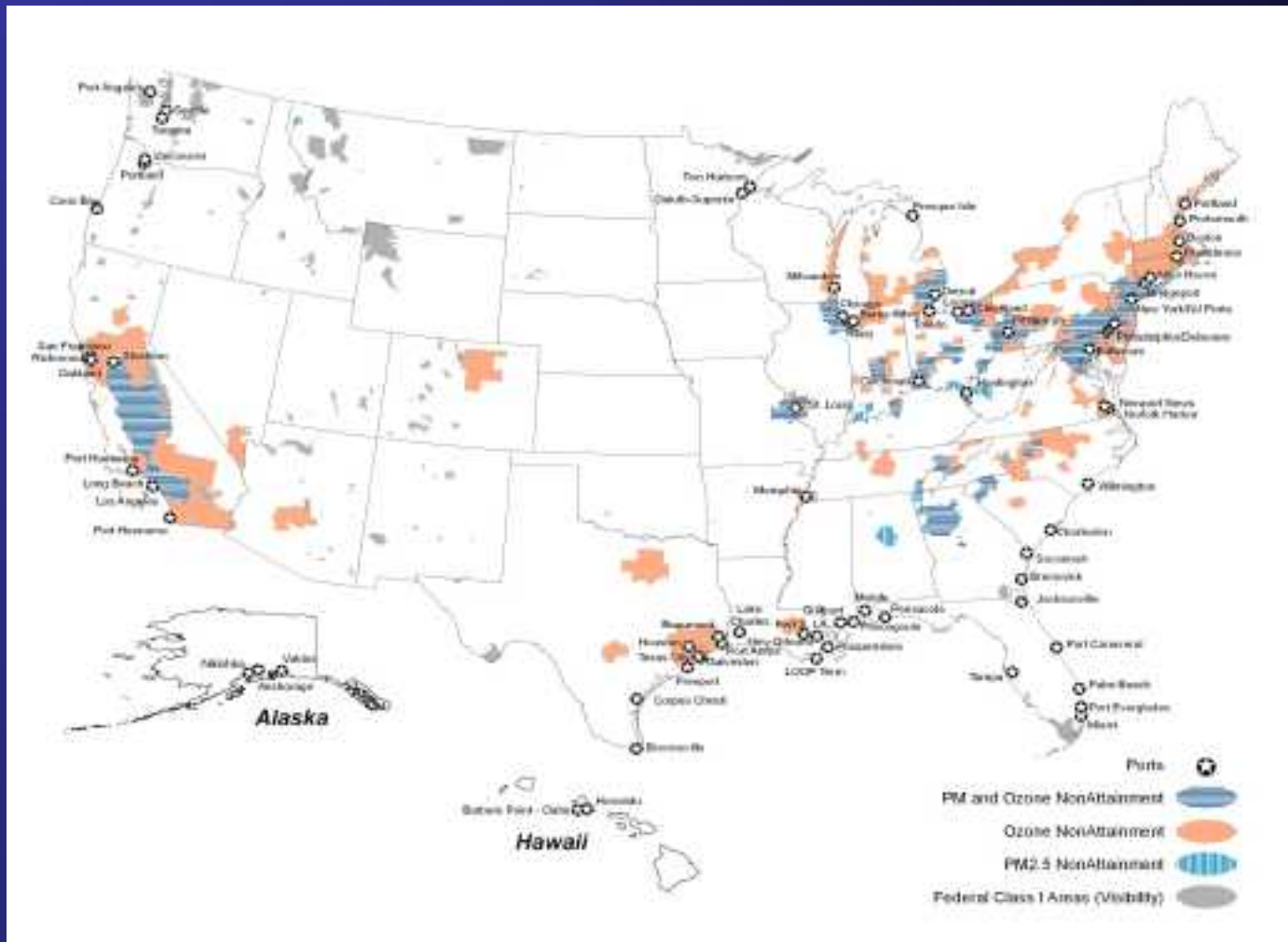


Freight Is a Significant Source of U.S. Greenhouse Gas Emissions

- The freight sector accounts for about 20% of US transport-related GHG emissions
- Carbon dioxide emissions from freight trucks increased by 69% from 1990-2005
- This is the largest emissions rate increase of any major transportation mode
 - Fuel efficiency relatively constant over this time period
 - ... While truck VMT increased by 51%

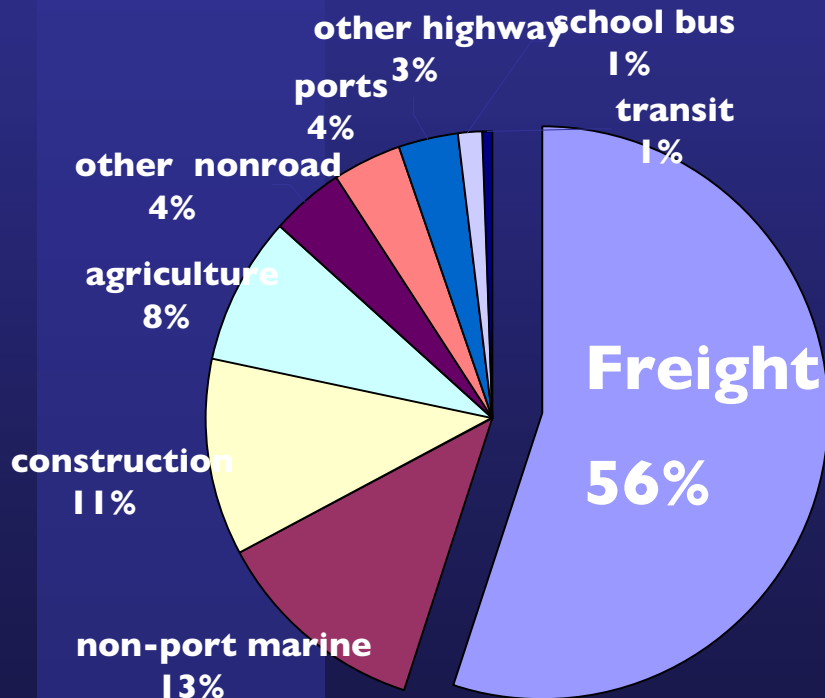


Large Portions of US Do Not Meet the National Ambient Air Quality Standards

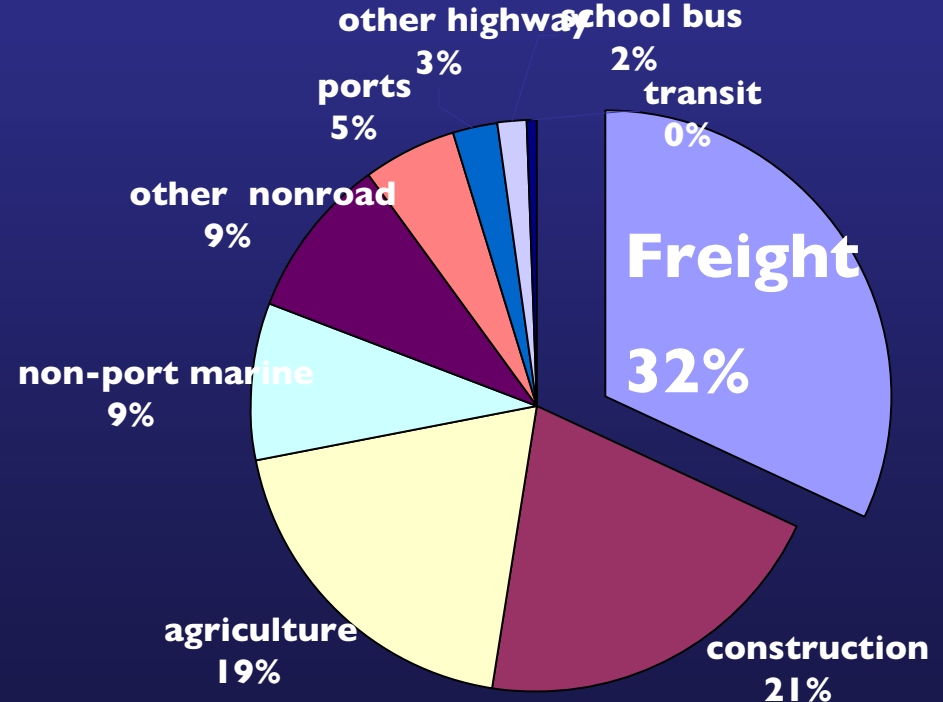


Freight Is a Significant Source of NO_x and PM Emissions

NO_x
(6.3 million tons)

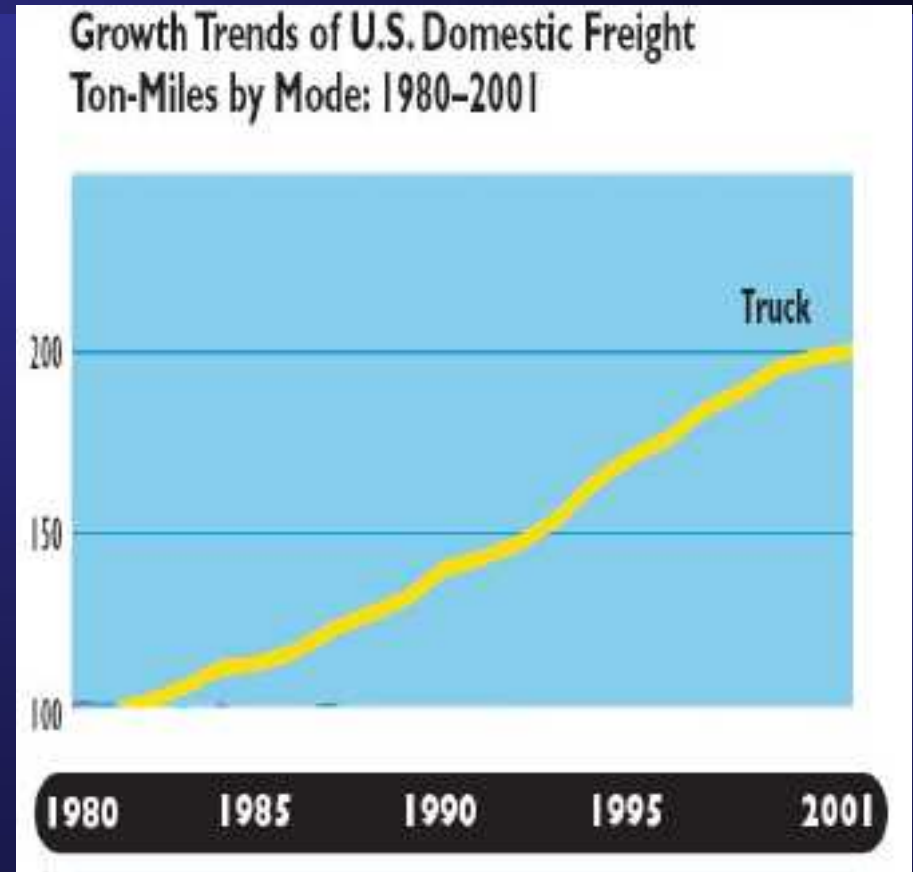
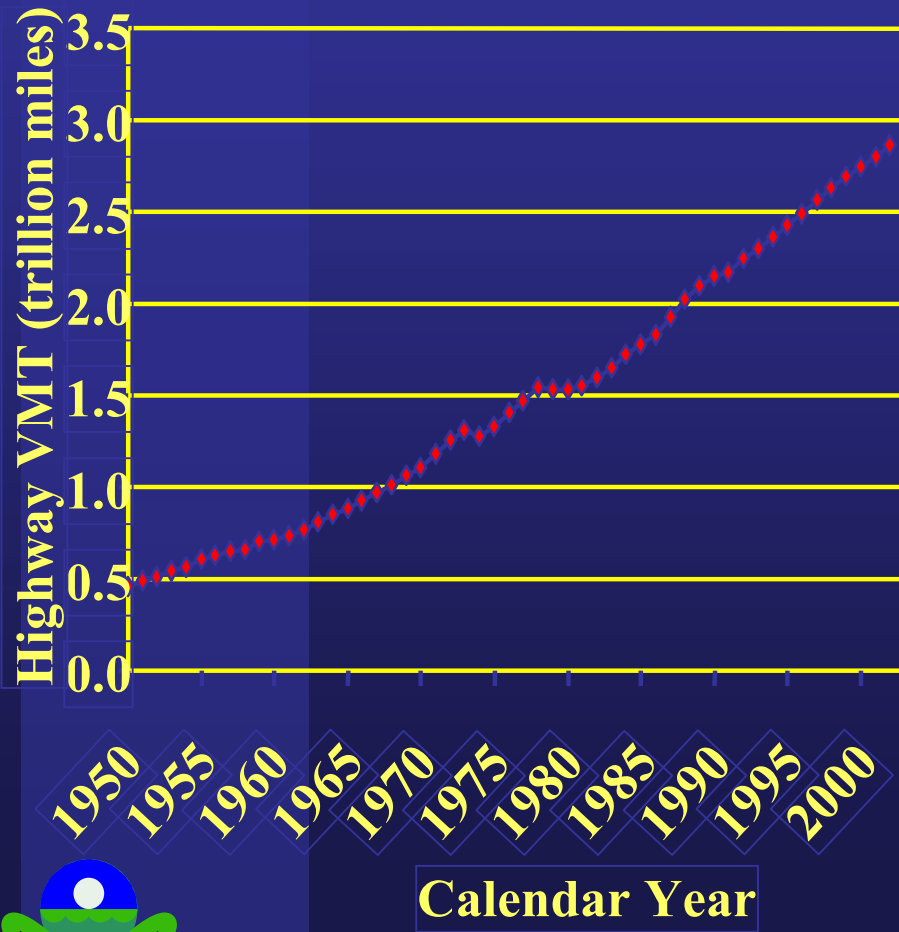


PM 2.5
(305,000 tons)



Mobile Source Diesel Emissions Inventory by Sector (2004)

Growth In Transportation Offsets Gains from Cleaner, More Efficient Vehicles



Source: U.S. Department of Transportation – Bureau of Transportation Statistics

What is the Solution?



EPA Regulatory Program: Mandating Cleaner New Vehicles

Tier 2 Light-Duty

final rule 1999

fully phased in 2009

Diesels held to same stringent standards as gasoline vehicles



Heavy-Duty Highway

sales 800,000 / yr

40B gallons / yr

final rule 2000

fully phased in 2010



Locomotive / Marine

sales 40,000/yr

(1,000 locomotives)

6B gallons / yr

proposal 2007

fully phased in 2017

Nonroad Diesel

sales over 650,000 / yr

12B gallons / yr

final rule 2004

fully phased in 2015



Clean Fuel/Engine Standards will Lead to Substantial Air Quality / Health Benefits

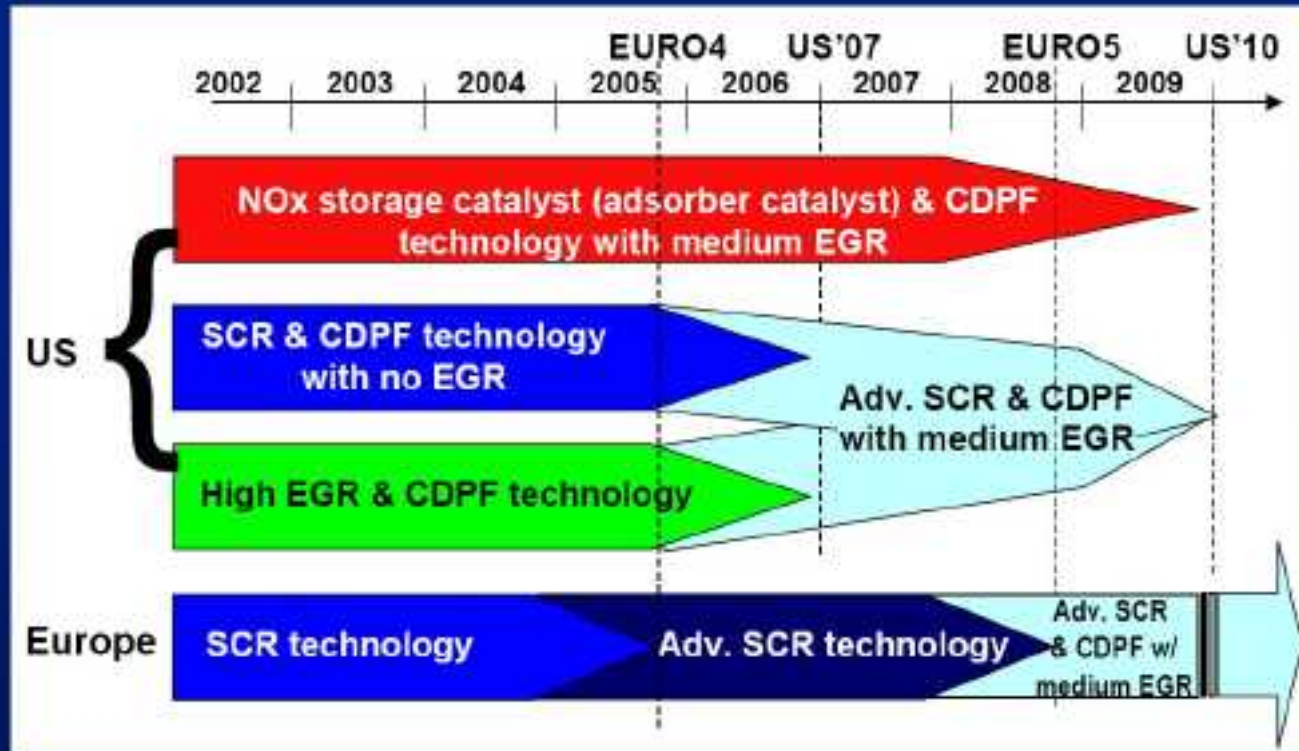
2030 Annual	Light-duty Tier 2	Heavy-duty 2007	Nonroad Diesel Tier4	Total
Cost	\$5 billion	\$4 billion	\$2 billion	\$11 billion
Benefits	\$25 billion	\$70 billion	\$80 billion	\$175 billion
Avoided Premature Mortality	4,300	8,300	12,000	24,600
Avoided Hospital Admission	3,000	7,100	8,900	19,000
Avoided Lost Work Days	0.7 million	1.5 million	1.0 million	3.2 million



Typical Technology Development Concepts to Meet US 2007/2010

Timelines of different emission strategies

DAIMLERCHRYSLER



EPA SmartWay Program: Accelerating Change Beyond Regulation

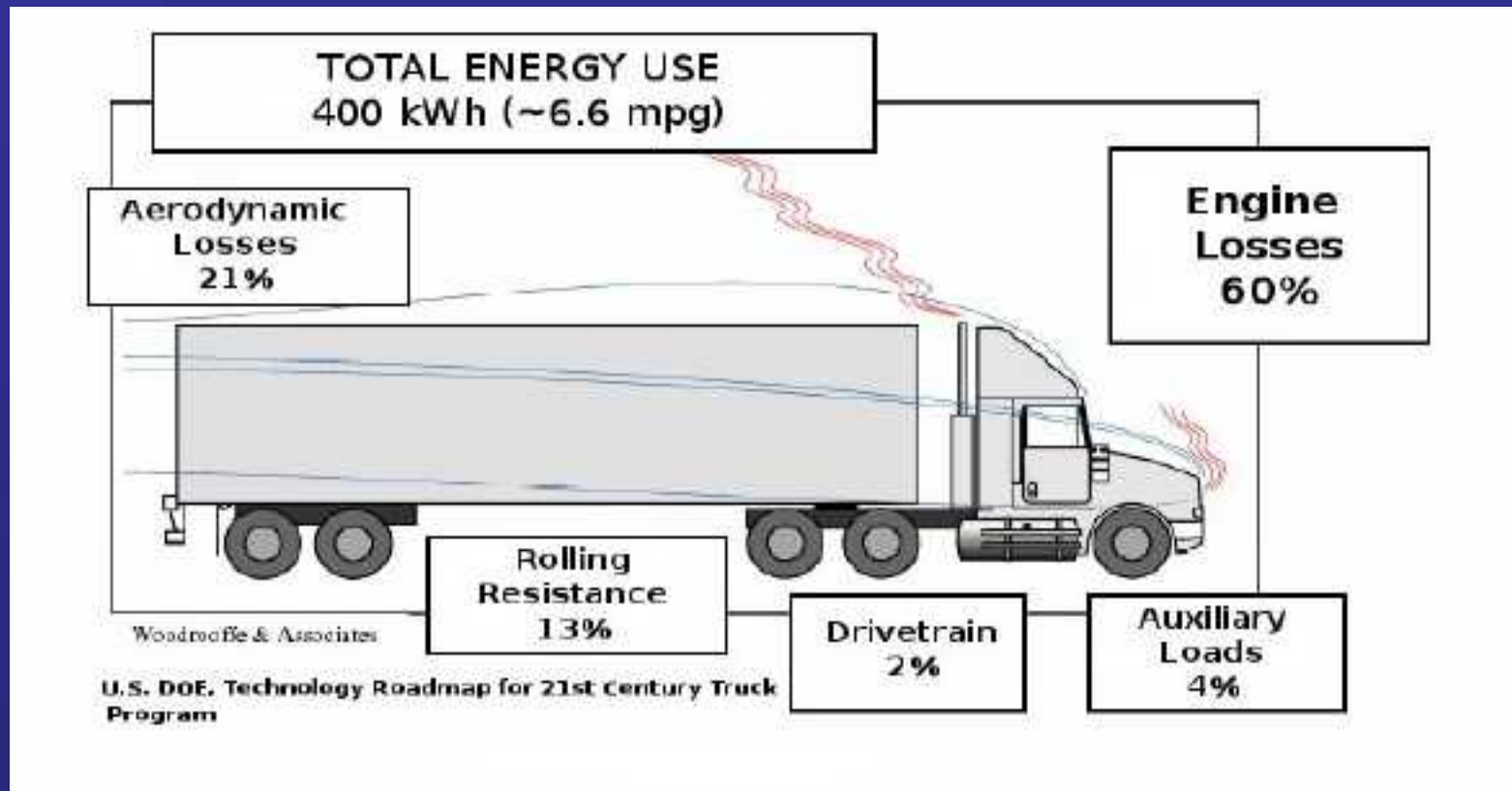
- **Nearly 700 SmartWay Partners**
- **Drive approximately 375,000 trucks**
- **Travel nearly 29 billion miles per year**
- **For current three-year commitments, on track to:**
 - **reduce greenhouse gas emissions by over 6 million metric tons of carbon dioxide**
 - **reduce 27,000 tons of NOx**
 - **reduce 845 tons PM**
 - **save over 545 million gallons of diesel fuel**
 - **save the trucking industry over \$2 billion ¹³ in annual fuel and maintenance costs.**



SmartWay Phase I Test Program



Our Goal: Reduce Emissions While Increasing Fuel Economy



EPA SmartWay Phase I Test

- Phase I (2004-2005)
 - ROVER PEMS
 - Mack cooled EGR engine & 2004 emission standards
 - Single wide tires (2 types), aluminum wheels, trailer aerodynamic fairings (front, side (2 types), rear)
- Phase II (2005-2006)
 - SEMTECH-D PEMS and portable fuel tank
 - Kenworth T600 with 2004 CAT ACERT engine and Freightliner FLD120 with 2000 DDC-60 engine
 - Single wide tires (2 types), aluminum wheels, trailer aerodynamic fairings (front, side - 2 types, rear - 2 types)

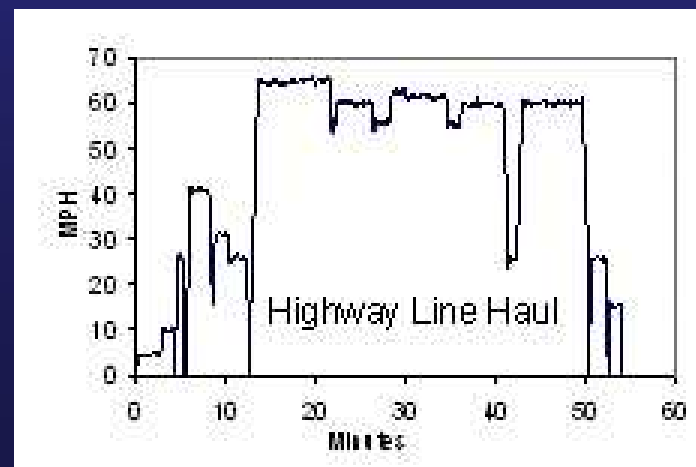
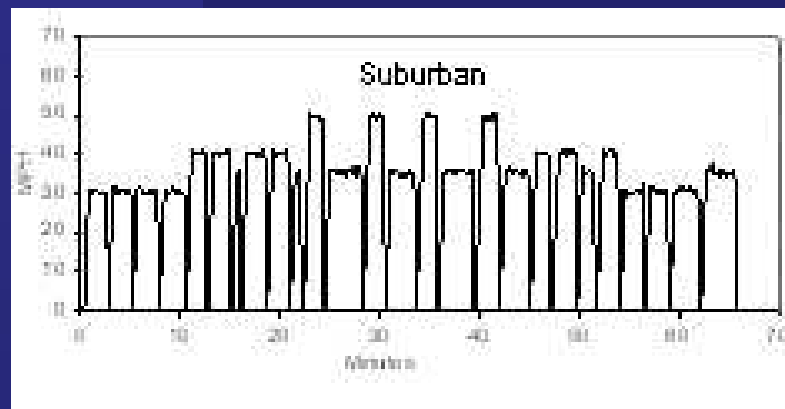
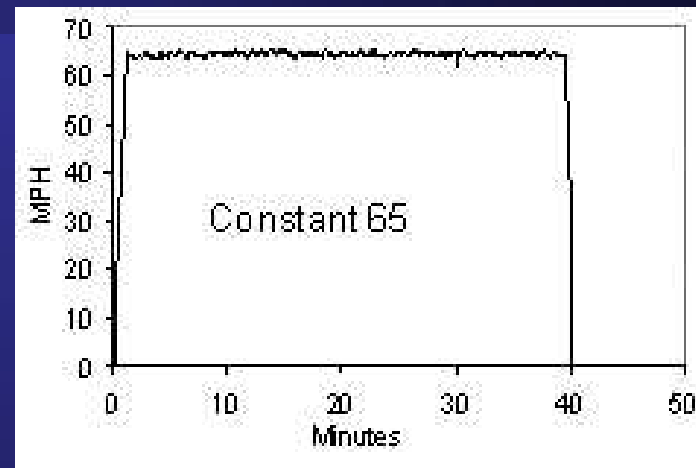
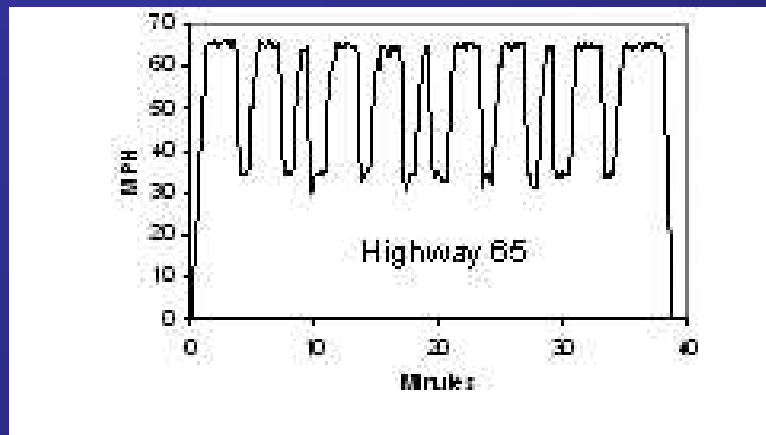


Phase I Test Method

- SAE J1321 (Joint TMC/SAE Fuel Consumption Test Procedure Type II)
 - Tests Control (C) and Test (T) truck
 - Fuel Consumption from gravimetric and carbon balance using portable fuel tank and PEMS
 - NOx Emissions from exhaust gas analyzers
- Several configurations of equipment
 - single wide tires with aluminum wheels and aerodynamic fairings (side, front, rear) on trailer
- Three common engine types
- Four different drive cycles



Phase I Drive Cycles



Phase I Test Program Results

- Demonstrated significant (10% or higher) per-mile reductions in fuel consumption and NOx emissions during highway-type operation
- Published three SAE papers
 - Available on EPA SmartWay web site:
 - <http://epa.gov/smartway/swresources.htm>
- New EPA SIP guidance for States to use fuel-saving truck retrofits to meet air quality standards
 - Available on EPA SIP and Conformity web site:
 - <http://www.epa.gov/otaq/stateresources/transconf/policy/420b07004.pdf>



SmartWay Tractor-Trailer Trucks



SmartWay Truck Specification

- **Meet or exceed 2007 engine cert requirements**
- **Aero profile high-roof sleeper cab with added aero features (bumper, mirror, tank fairing, side extenders, integrated roof fairing) (5+%)**
- **53' dry box van trailer**
- **Aerodynamic trailer fairings (skirts and tail or gap fairing) or demonstrate equivalent fuel savings (5%)**
- **Low rolling resistance tire models (3%)**
- **Capable of 8+ continuous hours idle reduction (6%)**
- **Aluminum wheels (optional)**



SmartWay Tractor-Trailers



**10% - 20%
more
efficient
Lower
emissions**



Outstanding Market Response

- **All six major truck OEMs offer at least one SmartWay tractor model (13 models to date)**
- **Four of the largest trailer OEMs offer SmartWay trailers**
- **Four tire manufacturers have at least one tire per axle position**
- **Three aerodynamic manufacturers offer fairings that meet the specification**
- **Dozens of APU and other idle reduction technologies meet specification**



Next Generation SmartWay Trucks

- **Initial SmartWay designation for line-haul combination tractor-trailer trucks**
 - Use more fuel than all other commercial truck classes, combined
- **Strong demand to expand to other applications**
- **Also need flexibility to assess technologies as they evolve over time**
 - Current specification, although based on test data, is design-based
- **EPA and stakeholders determined there is a need for a truck test that is objective, uniform and consistent**



Phase II Test Program: SmartWay Truck Emissions Test Protocol

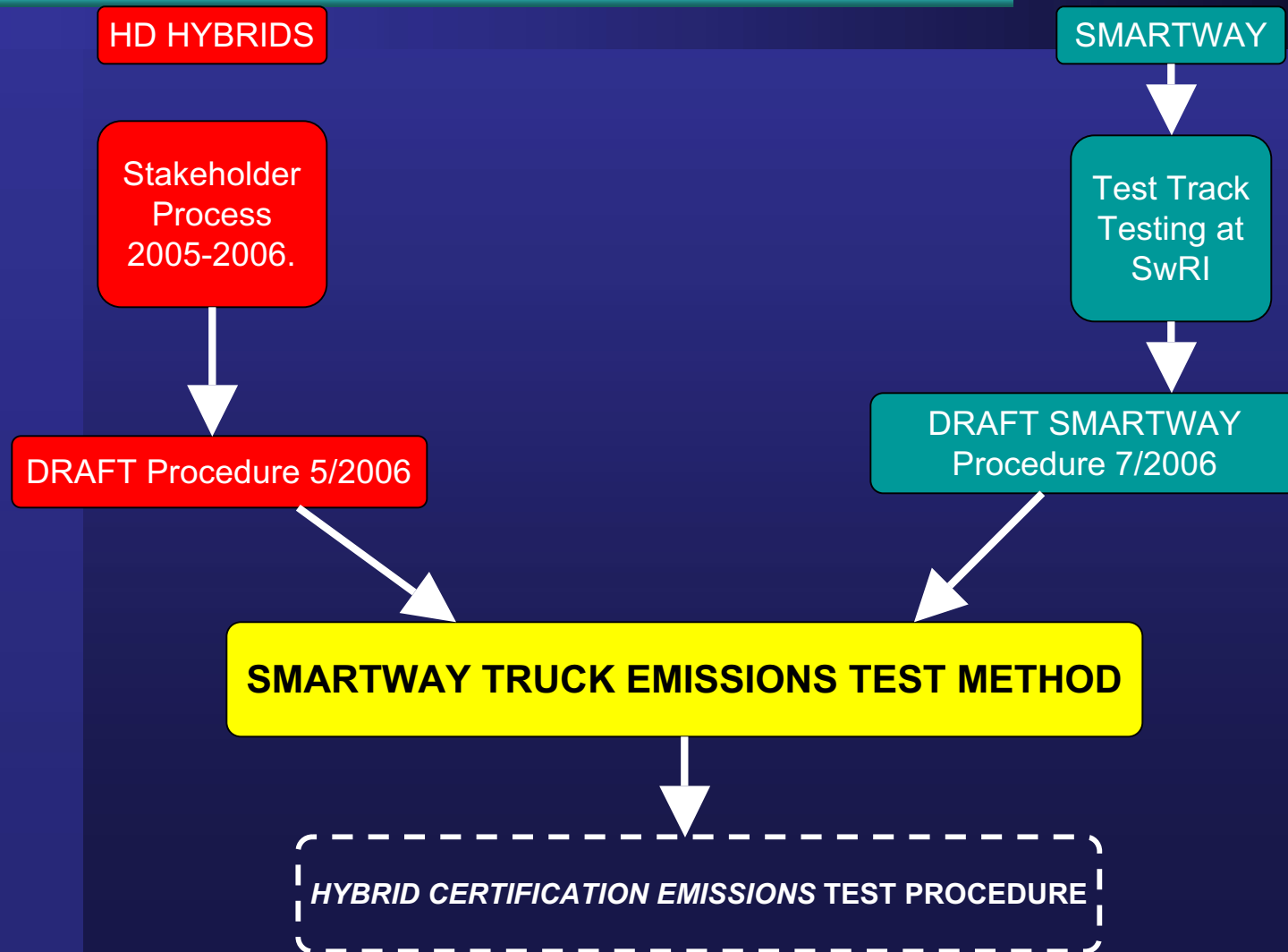


Context

- Industry, environmental groups, and EPA have common interest in developing a performance test for heavy vehicles
 - Current test methods not applicable (heavy duty engine, passenger vehicle) or insufficient (SAE and TMC test HD vehicle test methods)
- Design test to meet multiple aims
 - Provide the evaluation metric for next generation SmartWay trucks
 - Establish vehicle-based test that could lead toward hybrid truck certification
 - Offer end-users (fleets) an unbiased method to compare truck performance



Process

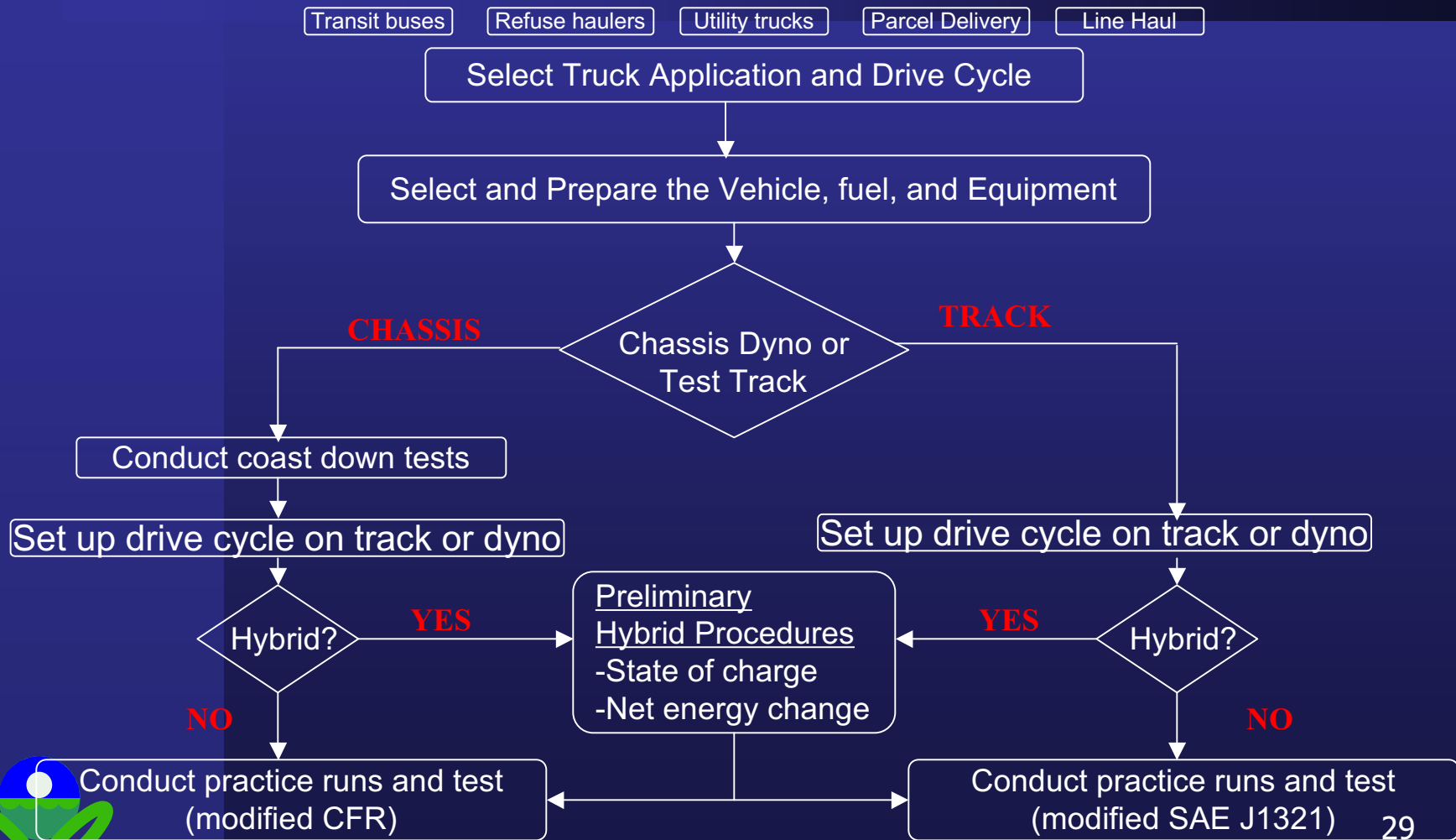


Scope

- Single Truck Test
 - Will measure FE in absolute (not relative) mpg or other metric (e.g., ton-mile/g; gallon/hr)
- Conduct on test track or chassis dynamometer
 - Track test modifies SAE J1321, "Joint TMC/SAE Fuel Consumption Test Procedure Type II," for heavy duty vehicles
 - Chassis test modifies EPA Optional Chassis Certification for diesel vehicles (CFR 40 Part 86, Subpart B and §86.1863-07) test procedure
- Can be used for all heavy duty trucks including hybrid
 - Added requirements for hybrid trucks



Flowchart



Draft Test Protocol

- Published on EPA SmartWay web site in November, 2007

<http://www.epa.gov/smartway/>



New!

SmartWay Truck Emissions Test Protocol

- Soliciting written comments by March 5 2008



Public Workshop



Public Workshop Logistics

- March 19 – 20, 2008
 - Washington, DC Hilton Embassy Row
- Details on web site

New! **SmartWay Truck Emissions Test Protocol**

Workshop Announcement:

SmartWay Truck Emissions Test Protocol Working Draft



- EPA will post agenda in near future
 - Seeking preliminary input from key stakeholders like ICCT/NESCCAF



Goals for Workshop

- Discuss potential benefits of test (SmartWay Truck, hybrid certification)
- Highlight outstanding technical areas
- Discuss written comments received to date
- Engage stakeholders in discussion of draft
- Establish working groups to resolve outstanding technical areas
 - Testing, data sharing and generation, modeling, analysis
- Invite stakeholder participation in working groups



Outstanding Technical Areas

- Representative drive cycles
- Representative load characterizations
 - Power draw per accessory
 - Accessory weighting per drive cycle
 - Must include PTO loads for vocational trucks (very important in HD hybrid designs)
- Testing, modeling and analysis to:
 - Verify drive cycles and refine test procedure
 - Quantify differences between chassis and track test (Initial protocol allows either method)
 - quantify differences between PEMS and lab equipment – underway
- Analysis to determine appropriate fuel efficiency metrics
 - Industry strongly favors a ton-mile which better captures the “work” HD vehicles do, and the benefits of hybrid designs
- Analysis to determine appropriate supplementary models
 - Must be accepted by government and industry; non-proprietary, accurate



Looking Forward



What's Next?

- Complete new “working version” of test (this year)
- Use “working version” to collaborate with stakeholders on testing, data sharing
- Use test data & stakeholder feedback to further refine test (1 – 2 years)
- Develop/adopt vehicle models to supplement testing
- Develop assessment methods for aerodynamic drag and tire rolling resistance
- Collect data for “baseline” input values for model
- Establish performance criteria for next-generation SmartWay trucks (2010)
 - Determine when to test, when to model
- Move toward vehicle-based hybrid certification



Questions? Thank You!

Cheryl L. Bynum
SmartWay Transport Partnership
734-214-4844
bynum.cheryl@epa.gov

