21st Century Truck Partnership Overview

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21st CENTURY TRUCK PARTNERSHIP

This presentation does not contain any proprietary or confidential information

Introduction

- The 21st Century Truck Partnership (21CTP) brings together government agencies (DOE, EPA, DOT,DOD) and heavy-duty industry members
- Common goals of making trucks and buses safer, cleaner, and more efficient
- In existence since 2000: major revision of vision, mission, and goals in 2003
- *VISION: Our nation's trucks and buses will safely and cost-effectively move larger volumes of freight and greater numbers of passengers and emit little or no pollution while dramatically reducing the dependency on foreign oil.*

Partnership Industry Members

Allison Transmission

DETROIT DIESEL CORPORATION

Mack

BAE SYSTEMS

EATON

NOVABUS

CATERPILLAR®

FREIGHTLINER LLC
A DaimlerChrysler Company

OSHKOSH

Honeywell

PACCAR

Cummins

INTERNATIONAL

VOLVO

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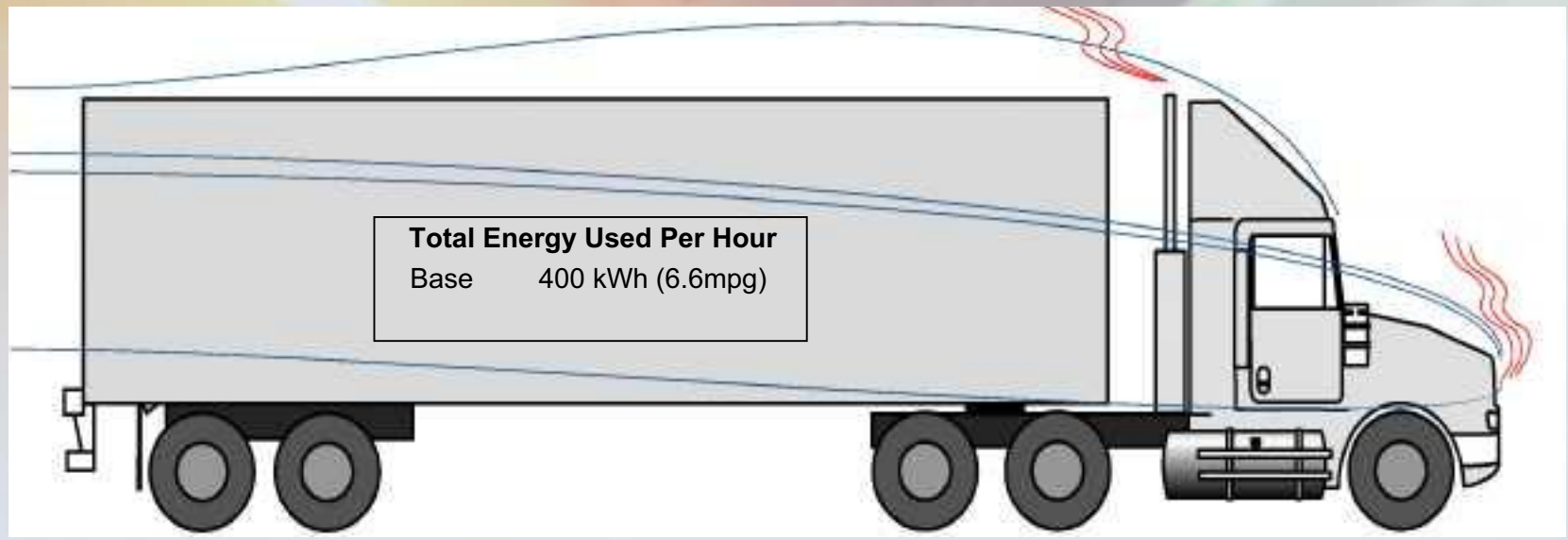
Partnership Deliverables

- Partnership outcomes
  - Public data on technologies provided in annual reports
  - Public demonstrations of technologies
  - Transfer of intellectual property to product development

- Benefits of partnership forum
  - Information on industry and government technology trends
  - One forum for approaching entire industry with issues
  - Information sharing on pre-competitive R&D among partners
  - Coordination of activities leverages available funding and avoids duplication of effort

Heavy Vehicle Energy Audit



Rolling Resistance	Drivetrain	Auxiliary loads	Aerodynamic Losses	Engine losses	Engine Efficiency
Base 51 kWh	Base 9 kWh	Base 15 kWh	Base 85 kWh	Base 240 kWh	40%

-20% RR –> -6% fuel

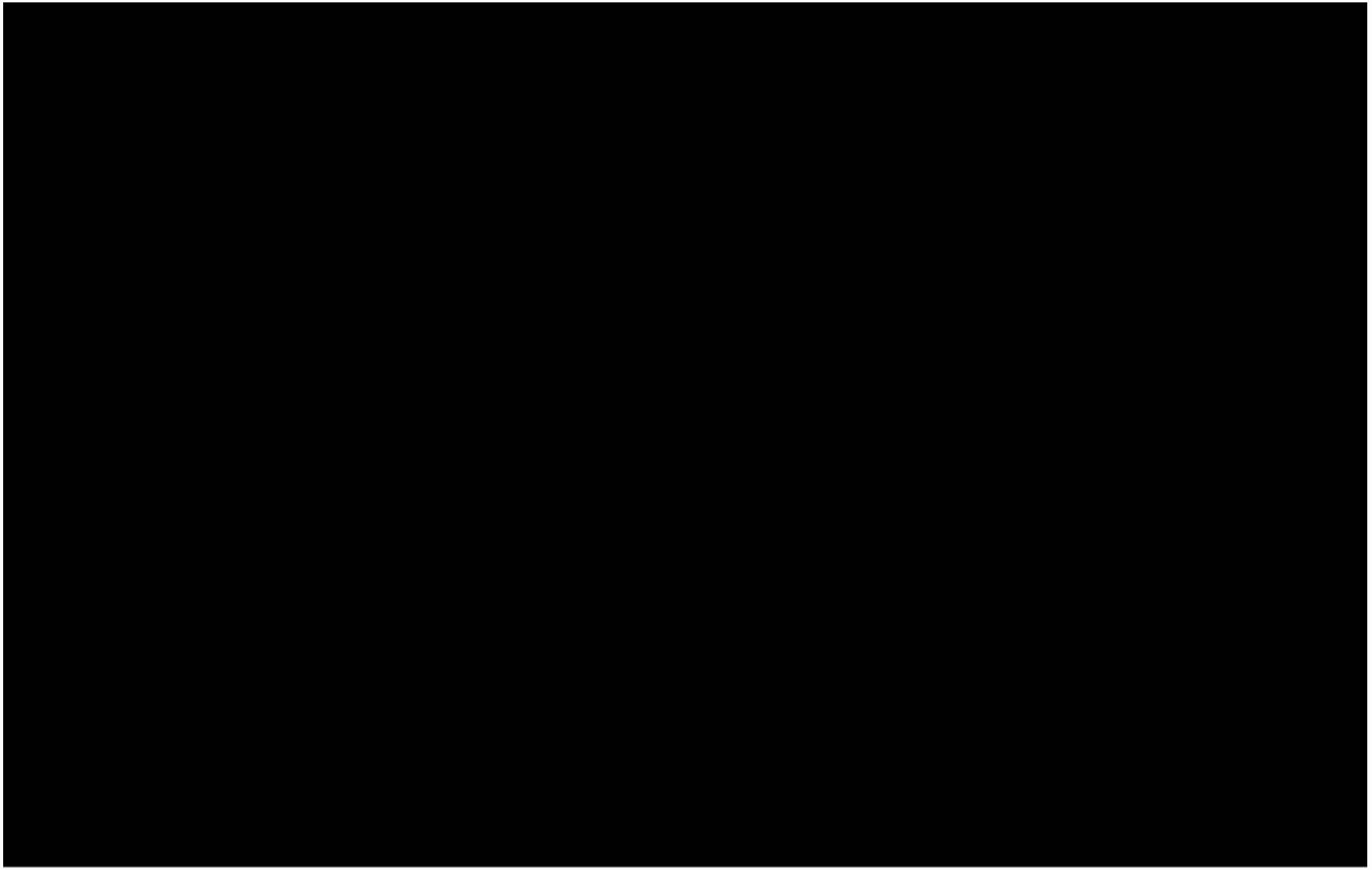
-20% Aero –> -11% fuel

-20% Engine –> -20% fuel

Pictorial representation of a Class 8 truck energy audit
80,000# GVW at a steady 65 mph

Source: 21st Century Truck Technical Roadmap – 2001

Range of Heavy Vehicle Technologies



Partnership Focus Areas

Technology goals focus on five key areas for heavy duty vehicles

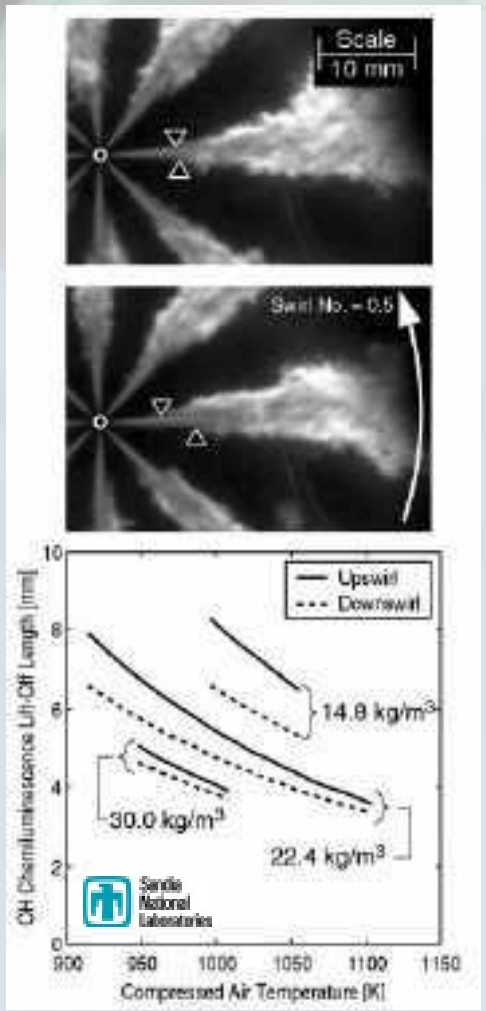
- Engine Systems
- Heavy-Duty Hybrids
- Parasitic Losses
- Idle Reduction
- Safety

Support Research, Development and Demonstration

Partnership Accomplishments: Engines

Improve Efficiency of Engine Systems

- Light duty diesel engine technology
  - Tier 2 Bin 3 demonstrated (exceeded Bin 5 goal)
  - Recent product announcement
- 2007 emissions compliant engines with
  - no/minimal fuel penalty
- 45-50 % system efficiency demonstration @ 2010 emissions
- HCCI combustion at commercial engine power density
- Program was a critical enabler for ultra low sulfur fuel
- Future Goal: 55% thermal efficiency technology demonstration



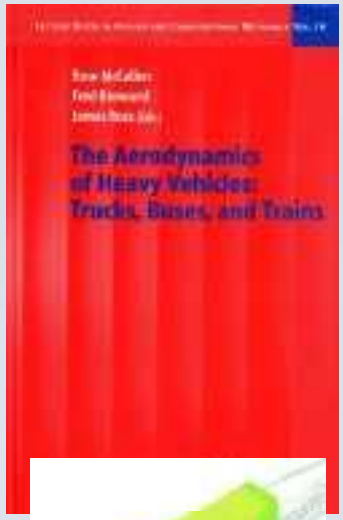
Partnership Accomplishments: Parasitic Losses

Reduce Parasitic Losses to Regain Horsepower in Class 8 Trucks

Aerodynamic Drag

- Consortium of Industry, National Laboratories and Universities
- Proven devices that exceeded 25% drag reduction
  - Wind tunnel, track, and road testing
  - Simulations
- Concepts developed/tested (15+ concepts evaluated)
  - Determine effectiveness and usability
- Engaged industry
  - Annual meetings, workshops
- Real-world aerodynamic development (TMA)
  - Wind tunnel and real world testing of aerodynamic devices
  - Demonstrated fuel efficiency improvements of up to 8% in SAE fuel economy testing

Representatives from (left to right) Freightliner, PACCAR, Kenworth, International, and Cummins at annual workshop



Emission Reduction Accomplishments

NOx [g/HP-hr]

2
3
5
8

Ford
GM
Mack DRIVEN
Cummins
Shell Global Solutions
OAK RIDGE National Laboratory
VOLVO
Lawrence Livermore National Laboratory
ExxonMobil
DAIMLERCHRYSLER
ConocoPhillips
Sandia National Laboratories
CATERPILLAR
Chevron
bp
Los Alamos NATIONAL LABORATORY
DETROIT DIESEL
ARGONNE NATIONAL LABORATORY
JOHN DEERE
MECA Technology Clean Air
Pacific Northwest National Laboratory ...delivering breakthrough science and technology
NREL National Renewable Energy Laboratory
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Summary

21st Century Truck Partnership has enabled

- A forum for government agencies and U.S. Industry to address important issues facing the Heavy Truck industry
- Industry input on prioritization and coordination of R&D investments for new technology development
- Information sharing on pre-competitive R&D among partners
- Provides industry the opportunity to evaluate and demonstrate higher risk technologies

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