

21st Century Truck Partnership/SuperTruck Initiative

DOE Hydrogen and Fuel Cell Technical Advisory Committee



U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

Ken Howden
21CTP Director
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21st Century Truck Partnership Overview

The 21st Century Truck Partnership (21CTP) brings together four federal agencies (DOE, EPA, DOT, DOD) and fifteen heavy-duty OEM and supplier partners with the common goals of making trucks and buses safer, cleaner, and more efficient.

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.



21CTP Overview

MISSION: The 21st Century Truck Partnership (21CTP) provides analysis and information to the government and its industry partners concerning future research and development to ensure that the Nation's economically vital truck freight transportation system is affordable, efficient, energy secure, and sustainable with minimal impact to the environment and human health.

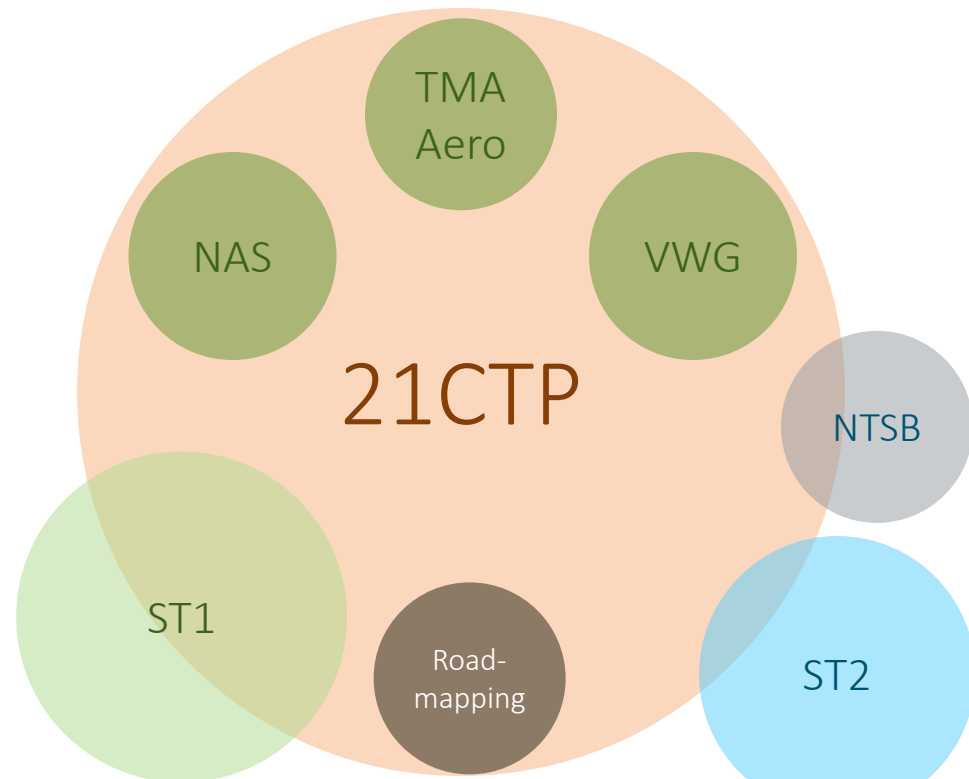
INDUSTRY MEMBERS

- Allison
- Cummins
- Daimler
- DENSO
- Eaton
- Ford
- Meritor
- Navistar
- Oshkosh
- PACCAR
- Volvo

GOVERNMENT MEMBERS

- US DOD
- US DOT
- US DOE
- US EPA

21CTP has served as framework for a number of commercial truck research concepts



Overview of Motivation for 21CTP

FUEL USE

- Projected to increase for trucks
- Need efficiency improvements

SALES

- Truck sales are cyclical
- Unpredictable corporate R&D funding

R&D

- HD similar to LD in % of revenue invested in R&D, but fewer total dollars invested

REGS

- Regulations impact all areas of trucking industry
- R&D investment to meet these regulations

NEED FOR
INVESTMENT IN
COLLABORATIVE
R&D FOR THE
TRUCKING
INDUSTRY



- Accelerate technology development
- Provide focus for R&D efforts
- Information exchange forum

Partnership Focus Areas

IC ENGINE POWERTRAINS

GOAL

Engine efficiency will approach 60%, with emissions levels moving toward zero while improving affordability



ELECTRIFIED POWERTRAINS

GOAL

Affordable and efficient electrified powertrains will be developed and optimized for diverse duty cycles via accelerated HPC methods and in-use data



FREIGHT OPERATIONAL EFFICIENCY

GOAL

Increased freight efficiency, mobility, and productivity will be achieved by exploiting connectivity and deep learning for MD/HD vehicles in the transportation system



SAFETY

GOAL

Synergistic benefits in technology for truck safety and efficiency will be discovered and implemented for greater productivity



VEHICLE POWER DEMANDS



Road loads and parasitics with potential for energy savings but activity is largely confined to industry space.

DRAFT – UNDER REVIEW

SuperTruck I Initiative

Origins: Concept for SuperTruck (vehicle-level technology demonstration for Class 8) first developed by 21CTP members

Vehicle
Goals

Demonstrate **50% Improvement** in Freight Efficiency versus 2009 Baseline Class 8 Tractor-Trailer

Engine
Goals

Demonstrate **50% brake thermal efficiency engine** in the SuperTruck vehicle

Show pathway to **55% brake thermal efficiency**

freight efficiency = tons of cargo x miles per gallon

Brake thermal efficiency = $\frac{\text{Net work out of the engine}}{\text{Fuel energy into the engine}}$


Scope of SuperTruck Research

- Engine / powertrain system
 - Improved in-cylinder combustion
 - Engine mechanics
 - Friction reduction
 - Downsizing
 - Downspeeding
 - Waste heat recovery (turbo-compounding and organic Rankine cycle)
 - Emission control
 - Materials
 - Electrification and intelligent control of accessories
 - Reduced ancillary loads
- Engine and vehicle controls
- Hybridization
- Drivetrain efficiency
 - Advanced transmissions automated manual (AMT), dual clutch, etc.
 - Axles
- Fuels (non-food feedstocks)
- Lubricants
- Aerodynamic drag reduction
- Rolling resistance reduction
- Weight reduction
- Idle / hotel load reduction

SuperTruck I Awards

- Awarded 2009-2011
- Cooperative R&D Agreement Awards:
 - Cummins Inc. with Peterbilt (ARRA Funded)
 - Daimler Trucks North America (ARRA Funded)
 - Volvo Trucks North America
 - Navistar, Inc.
- Total project funding:
 - DOE + Industry = \$260 Million
- Not intended for production but for development and demonstration.



 Daimler Trucks North America **VOLVO NAVISTAR®**

Benefits analysis conducted indicated a savings of 6 billion barrels of oil in 2050 (a 500:1 return on investment) for SuperTruck I !!!

SuperTruck Advances Are Being Commercialized

CUMMINS/PETERBILT



*Peterbilt EPIQ
Efficiency Package*



*Cummins X-Series 2017
Engines*

DAIMLER



*Freightliner Cascadia
Evolution Efficiency Package*

*International ProStar ES
Efficiency Package*



NAVISTAR

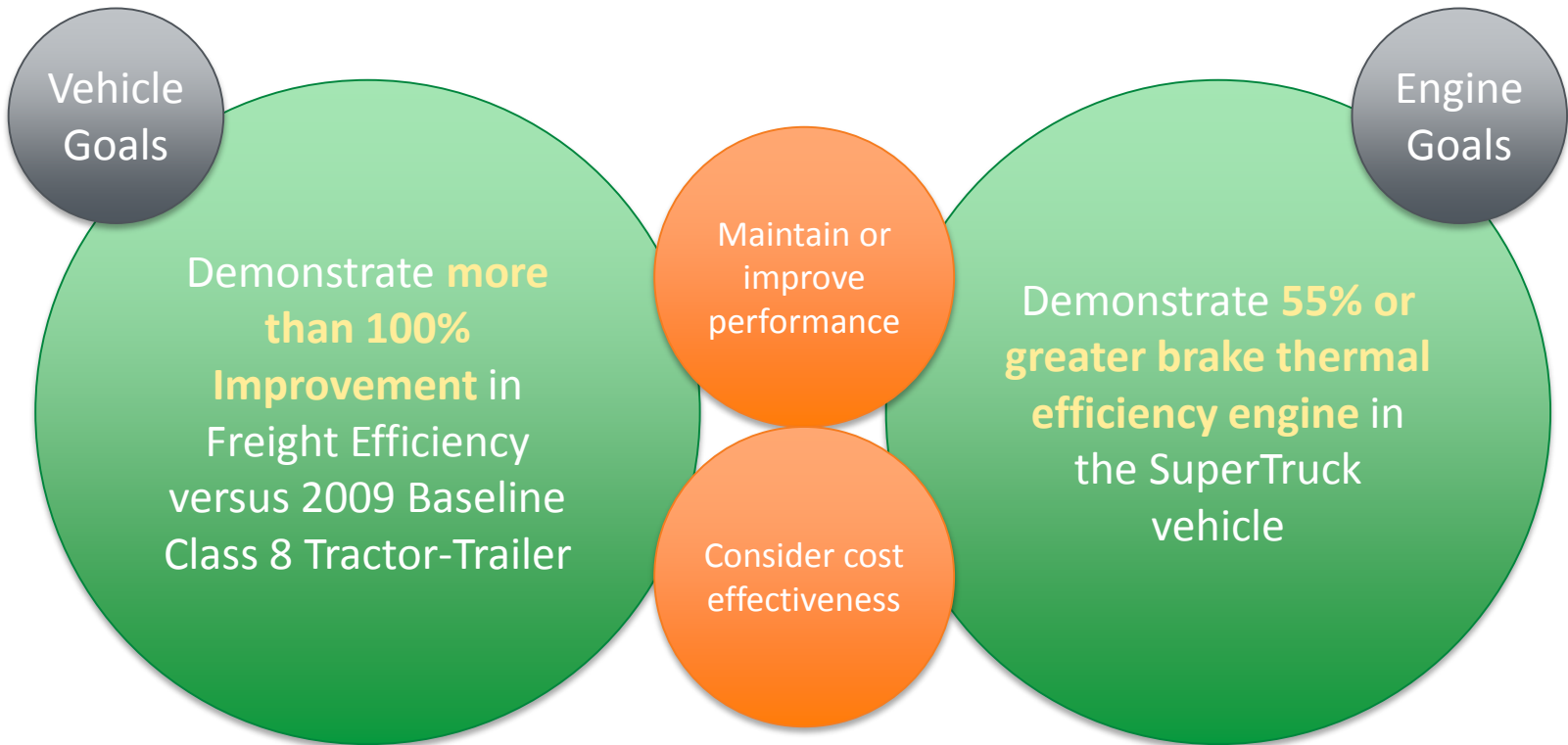
VOLVO

Volvo 2017 Engines



- ✓ Wave piston
- ✓ Turbo compounding
- ✓ Common rail fuel injection system

SuperTruck II Initiative (New)



SuperTruck I was 50% freight efficiency improvement

SuperTruck I was 50% brake thermal efficiency demonstration

Conclusions

- 21CTP serves as a forum for connecting key stakeholders in the commercial vehicle space in a pre-competitive manner to discuss common research needs
- SuperTruck I was highly successful – all teams exceeded the freight efficiency goal
- SuperTruck II represents an opportunity to build on the success and technology foundation of SuperTruck I
 - Goals that reach beyond those of SuperTruck I (freight efficiency and engine efficiency)
 - Teams identified areas for further efficiency gains
 - Additional focus on cost effectiveness is likely to bring technologies into SuperTruck II that are closer to commercial viability

Thank You!

Ken Howden

ken.howden@ee.doe.gov

Vehicle Technologies Office

Telephone: (202) 586-3631

Room 5G-030, EE-3V

1000 Independence Ave, SW

Washington, DC 20585

<http://www.energy.gov/eere/vehicles/vehicle-technologies-office-21st-century-truck>