

**NAVISTAR<sup>®</sup>**

TRUCK GROUP

# HTUF Conference 2009

## Navistar Hybrid Update

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*Tuesday 27 Oct. 2009*



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INTERNATIONAL DIESEL POWER

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**HYBRID**  
TECHNOLOGY

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# Hybrid Electric Vehicles

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HYBRID INNOVATION

Going Green  
WHILE SAVING SOME GREEN.

**DURA** *Star* HYBRID



The Only One  
The IC Plug-in  
Hybrid School Bus



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# Application Coverage Growing



## 23,500# to 40,000# GVW

### Base System

- Pickup & Delivery
- Landscape Dump
- Shuttle bus
- Beverage
- Stake flat
- Armored car
- **Tractor (55,000# GCW)**

### ePTO System

- Utility / Aerial Bucket
- Tree Trimmer / Crane
- Recovery Truck
- Road Patch Truck

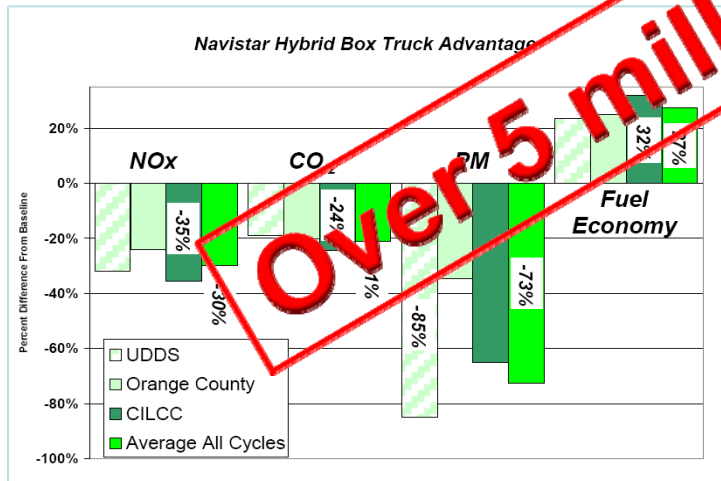
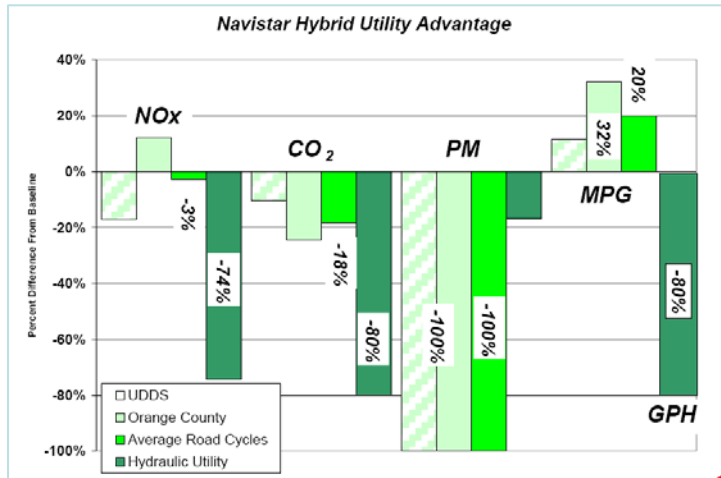


# Hybrid Electric Trucks

CARB Certified

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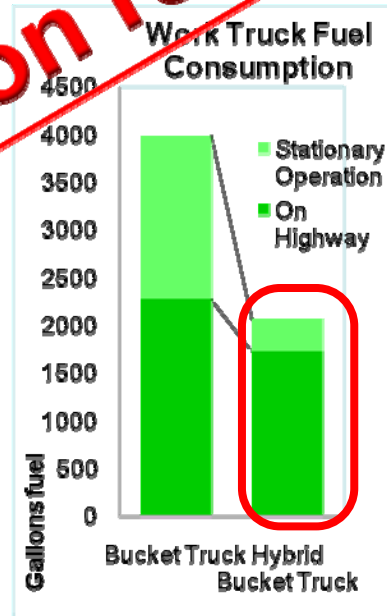
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## DuraStar and WorkStar

- Higher GVWR / tandem (6x4) applications
- ThermoKing Reefer Electrification demonstration and field test
- Digger Derrick / Snow Plow / Hazard Material
- Export Power / HVAC
- Higher hp engines

Over 5 million real world miles



80% reduction Stationary Operation  
20% reduction On Highway



# Hybrid Electric Trucks

**CARB Certified**


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## Hybrid IRS & CARB Certification

- MY2010 IRS certification received
- Improved IRS tax credit for DuraStar Hybrid delivery truck
- New IRS tax credits for DuraStar Beverage Tractor and WorkStar 7300 4x4.



	IMPORTANT VEHICLE INFORMATION VEHICLE MANUFACTURED BY NAVISTAR, INC.			
	CALIFORNIA HYBRID VEHICLE FAMILY 9NVXH0466HGB			
	MAXXFORCE DT ENGINE FAMILY 9NVXH0466AGB			
IMPORTANT EMISSION INFORMATION THIS HYBRID ELECTRIC DRIVE SYSTEM CONFORMS TO CALIFORNIA REGULATIONS APPLICABLE TO 2009 MODEL YEAR HEAVY DUTY DIESEL ENGINES				
CA HYBRID VEHICLE FAMILY EMISSION LIMIT (g/Bhp-hr)				
NOx	1.00	PART.	--	

CARB Certification label

Application	IRS	CARB
DuraStar Delivery	\$12,000	√
DuraStar 3200 Bus	\$12,000	√
DuraStar Utility	\$12,000	√
DuraStar Tractor	\$9,000	X
WorkStar 7300 4x4	\$9,000	X
DuraStar Refrigerated Truck	\$12,000	√
IC Bus – Plug-IN	\$12,000	√

**DURAStar**  
HYBRID



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# Leveraging Hybrid Capabilities

- Engine off Hybrid HVAC
  - Between seat mounting



- Engine off heating



- Exportable power
  - Drives AC loads from hybrid battery source
  - Output 120V & 208V single phase AC at 5 KW (6KW peak)
  - 3 individually GFCI protected 120 volt A/C duplex outlets
  - Up to 1½ hours 5KW operation on charged hybrid batteries (engine off)
  - Two part design enables flexible mounting

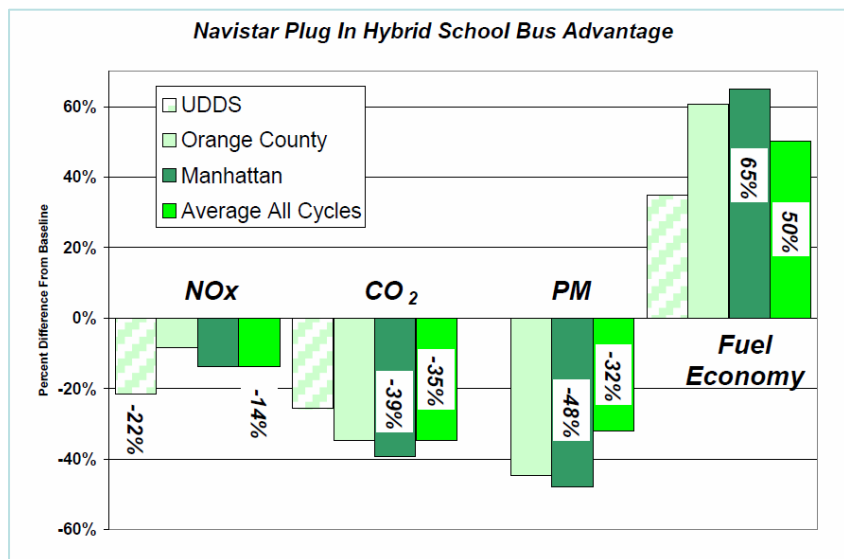


# Hybrid Electric School Buses

CARB Certified

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- Two hybrid systems available
  - Charge Depleting (PHEV)
  - Charge Sustaining
- Develop next generation of PHEV school bus under DOE grant
  - 30 miles of Engine-Off capability from one charge\*
  - 0-45 mph electric mode speed
  - Deploy 30 Next Gen school bus

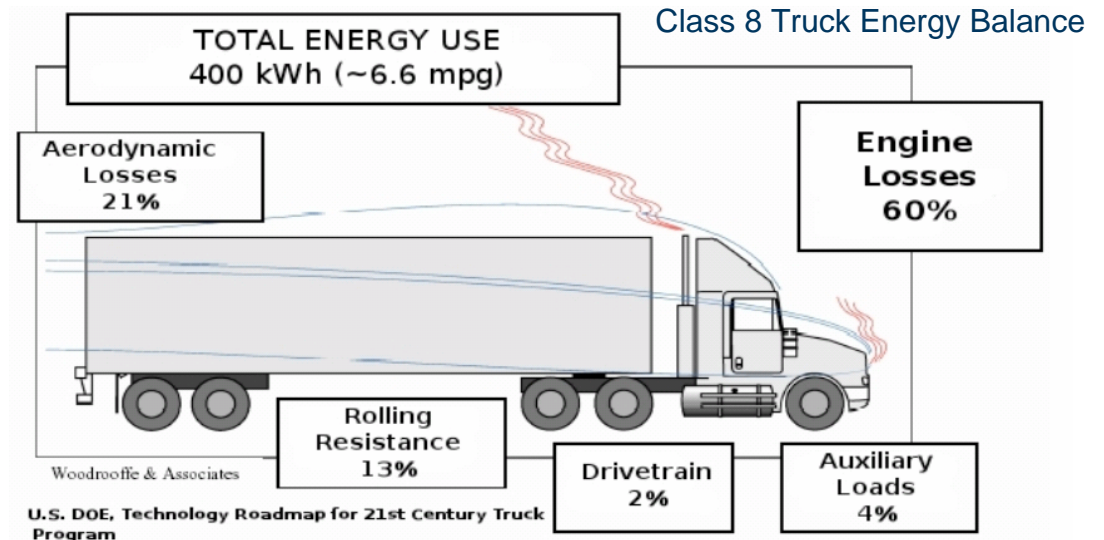
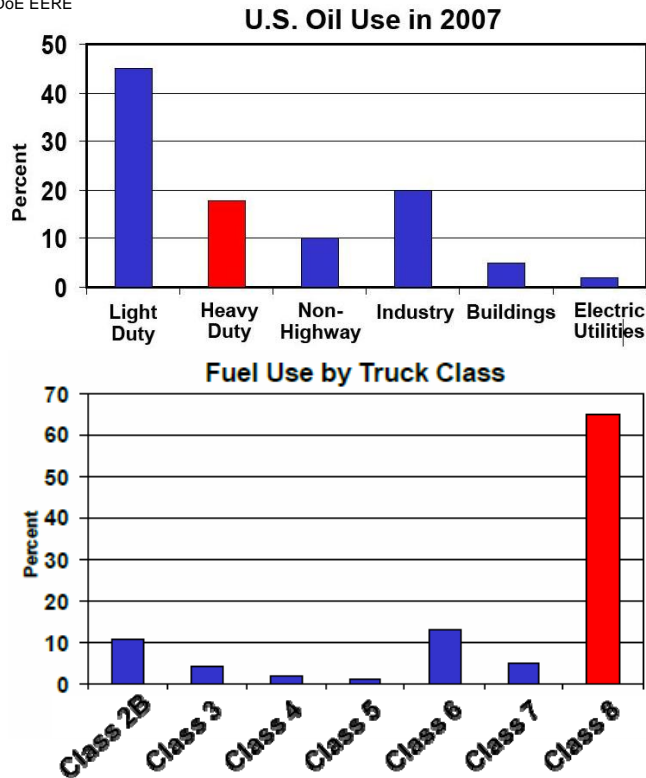


\* Measured on UDDS drive cycle



# Heavy Duty Hybrids

Source DoE EERE



Source: USDOE

**Class 8 Trucks consume more fuel than all other classes together**

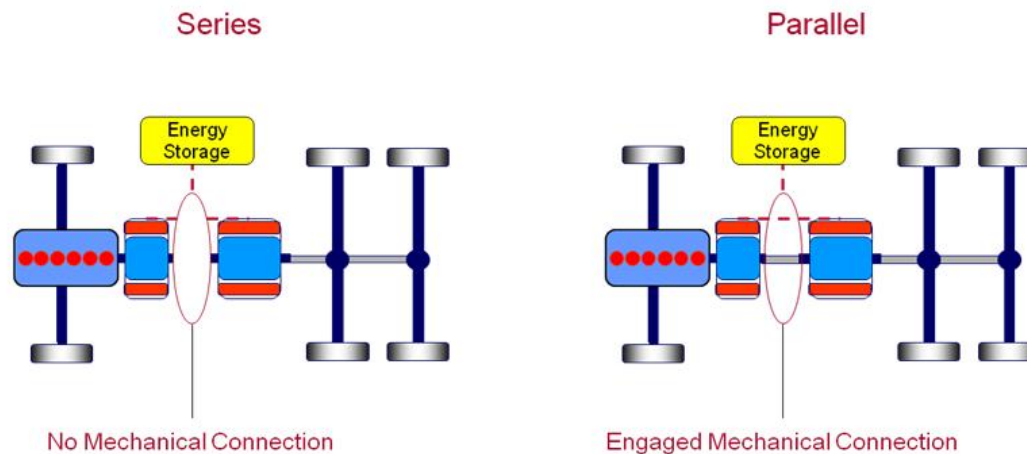
- Commercial Truck fuel efficiency regulation expected in 2016CY

**Efficiency improvement in Class 8 has high impact to society – DOE SuperTruck**



# Dual Mode Full Hybrid - Class 8 Gen I

- ArvinMeritor / Wal-Mart project with ProStar selected as vehicle platform
- Gen I 'Dual Mode' Hybrid system – no transmission
  - Both series and parallel architecture

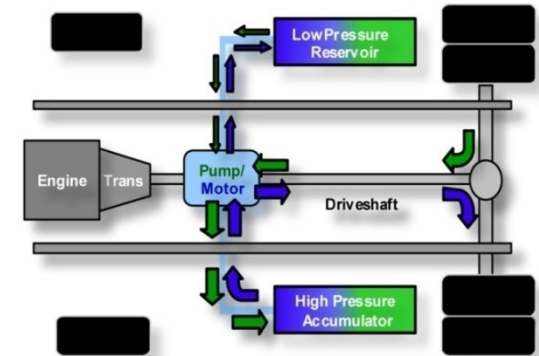


- Activities have now started on a Gen. 2 project to further develop the technology

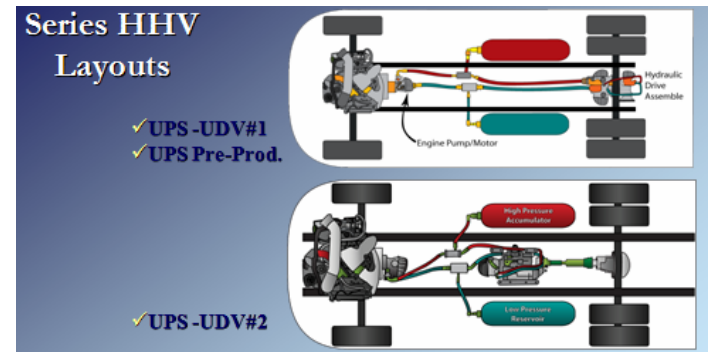


# Hydraulic Hybrid Vehicles

- Built a Navistar 7400 (285hp DT466) Demonstrator with Eaton Hydraulic Launch Assist
- Demonstrated FE improvements;
  - 23% in Econ Mode on EPA Refuse Cycle
  - 16% in Performance Mode on EPA Refuse Cycle
  - 4% route time (Productivity) improvement



- Four year Cooperative Research and Development Agreement (CRADA) with EPA including an annual technology license agreement
- Joint EPA / Eaton / Navistar program to build seven Workhorse field test vehicles for UPS
  - First two vehicles **delivered to UPS 28 Sept.**
  - Initial FE improvements close to 50%



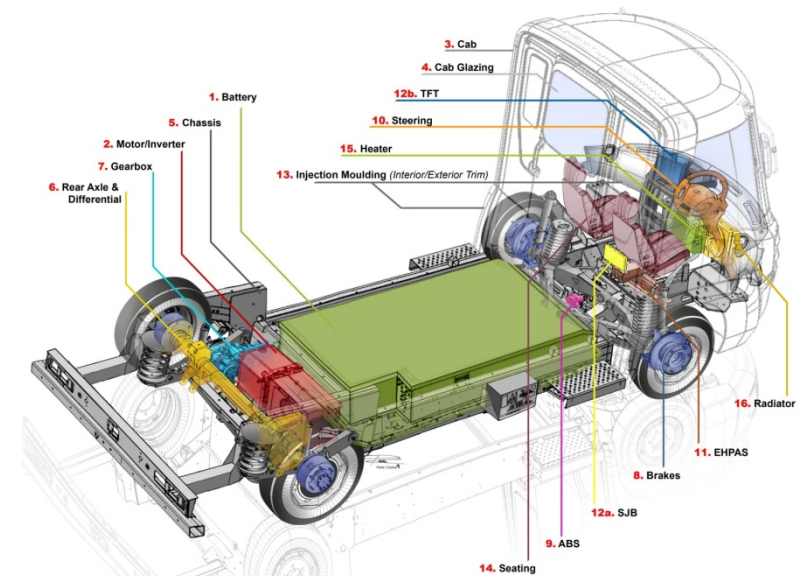
# Truck Hybridization – The Challenges

- Incremental system costs over non-Hybrid are extremely high
  - DuraStar Medium Duty Truck will pay back in 8-9yrs (at 30% FE improvement alone)
  - ePTO benefit improves payback
- EPA has no vehicle certification over 14,000# GVW (Class 3) limited to ‘engine only’
  - Only California ARB allows hybrid vehicle certification
    - ‘interim procedure’ not prime path
  - ‘engine only’ certification provides no regulatory competitive (i.e. lower emissions) solution
- HD Hybrid OBD must be in place by 2013 latest.
  - Current OBD regulations based on light duty passenger car hybrid experience
  - Heavy duty applications much different than light duty
- No foundation for certification means nothing to validate OBD against



# Electric Vehicle

- Designed and built as an all Electric Vehicle
  - it is not a hybrid!
- Vehicle uses a 75kW electric machine linked to a PRND clutch less transmission
  - delivering 221ftlb torque at wheels.
- Payload of 4,400lbs with 36 foot turning circle
- Maximum speed of 50mph (software governed) with 100 mile range
- WALK-IN, WALK-OUT cockpit with single rear door
- CARB Certification Expected Q1/2010



# The Future - What is Navistar Doing ?



- Total systems integration approach
  - critical to achieving these aggressive performance goals
- Proactive efforts with the EPA and ARB to Engine and Vehicle Certification processes
  - for fuel efficiency legislation, emission optimization and OBD
- Leading collaboration throughout the entire supply chain
  - OEMs, fleets, engines, suppliers, universities, labs
- Maximizing R&D funding to develop new technologies

