NAVISTAR-DRIVING EFFICIENCY WITH INTEGRATED TECHNOLOGY

Denny Mooney – Vice President, Navistar Global Engineering
Navistar History

1831: Cyrus McCormick invents mechanical reaper

1900s: International Harvester Company founded

1910s: School buses added to product line

1930s: First engine plant opens

1940s: Military vehicle production for war effort
Navistar History

1950s: IH enters off-highway truck business

1980s: Aerodynamics is the new buzz

1990s: Emphasis on visibility, comfort, efficiency

2000s: Hybrid vehicles, Navistar Defense, ProStar/LoneStar
Navistar Today: North America Focus, *Global Growth*

**North American Market Share Leader: Q3-2011 YTD**

<table>
<thead>
<tr>
<th>Category</th>
<th>Share</th>
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<tbody>
<tr>
<td>School Bus</td>
<td>48%</td>
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<td>Medium</td>
<td>40%</td>
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<td>Severe Service</td>
<td>34%</td>
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<td>Heavy</td>
<td>17%</td>
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- **School Bus/Combined Class 6-8 Market Share**
  - FY-2009: 27%
  - FY-2010: 35%
  - YTD-2011: 27%

**Combined Class 8 Market Share (Q3-2011): 21%**
Navistar Global Presence Today
Navistar Global Presence Today

One Common Theme
- Customers want fuel efficiency
- Governments / Society want low emissions
# Global Engines and Emission Capability

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## The Markets We Serve:

- United States
- Canada
- Brazil
- India
- Italy
- Korea
- Mexico
- China
- Russia
- Colombia
- Saudi Arabia
Navistar’s Technology Roadmap

Aerodynamic Innovation

2012 / 2013
- Advanced Aero Devices
- Tractor / Trailer Aerodynamics
- Body Modifications

Prime Path: In-cylinder Solution

Further Combustion Development
+ Alternative Technologies

30% Fuel Economy Improvement

2010
Emissions Compliance with:
- Advanced EGR
  - Fuel Economy Optimization
  - Aero Improvements
  - Hybrids
  - Electric Vehicles

2015
- Further Advanced Combustion
- Heat Recovery
- Multi-Stage Hybrid
- Next Generation Aerodynamics

Rolling Resistance
- 32%

Aerodynamic Drag
- 50%

Powertrain
- 18%
Where does the energy go?

- Engine losses dominate below 35 mph.
- Tires dominate between 35 and 55 mph.
- Aero dominates above 55 mph.
Main Contributors to Fuel Efficiency

Fuel Economy Impact
Class 8 On-Highway
at 65mph

- Rolling Resistance: 32%
- Aerodynamic Drag: 50%
- Powertrain: 18%

2% in Aero = 1% in Fuel Economy

Fuel Economy Impact
Medium-Duty Applications

- Rolling Resistance: 45%
- Aerodynamic Drag: 37%
- Powertrain: 18%

Heavy-Duty Line Haul

Medium/Vocational
Fuel Economy Focus Areas

- Aerodynamic Leadership
- Powertrain Efficiencies
- Total Vehicle Integration
- Driver: +/- 15%
- Driver Behavior

- Rolling Resistance 32%
- Aerodynamic Drag 50%
- Powertrain 18%

Aerodynamic
Drag
50%

Powertrain
18%

Driver: +/- 15%

Driver Behavior
Fuel Economy Focus: Aerodynamics

ProStar and ProStar+
• Among most aerodynamic, fuel-efficient Class 8 trucks ever built
• Innovative, Aero-focused Design
• Comprehensive Aero Testing at NASA Wind Tunnel
• Focus on A-pillar, bumpers, mirrors, fairings, skirts, and trailer integration
• Finalist for D.O.E. SuperTruck
Fuel Economy Focus: Powertrain Efficiencies

Advanced Fuel Injection Technology

Proprietary Combustion Bowl Design

Exhaust Gas Recirculation

Advanced Air Management

Electronic Engine Controller
Road Conditions / Driver Behavior

- Significant congestion 35 KPH average speed
- Significant overloading
- Driver behavior
US – China Road Systems / Traffic / Routes

• Similar road conditions and high-way system
• Aero - nose trucks?
Navistar Supertruck Program ---- Vehicle Technology

with DOE and Partners

Supertruck Concept

50% Improvement on tractor trailer fuel efficiency

Aero
Gap reduction
Aero Drop
Camera Mirrors

Hybrid
Dual-Mode Drive
Electrified
Accessories

Light Weight
SMART tandem axles
Composite cab, trailer
Wide base single tires

Driveline
SMART tandem axles
Composite cab, trailer
Wide base single tires
Navistar Supertruck Program ---- High Efficiency Engine

Pushing the Technology Boundary

Supertruck

Variable Valve Actuation

Adv Combustion & Feedback Control

2900 bar

Adv Combustion

2200 bar

Adv Control

Electric Turbocompounding

2010 Production

Multi stage Turbo

2-stage EGR Cooler

Adv Vehicle Cooling

Aftertreatment

Friction Reduction

Waste heat Recovery

Navistar Supertruck Program

High Efficiency Engine

Pushing the Technology Boundary

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Pushing the Technology Boundary

2010 Production

Multi stage Turbo

2-stage EGR Cooler

Adv Vehicle Cooling

Aftertreatment

Friction Reduction

Waste heat Recovery
• Customers demanding fuel efficiency
• Global push for low emissions
• DOE/Navistar/Suppliers driving affordable technology
  • Supertruck
  • EV eStar

Thank You