2012 DOE Vehicle Technologies Program Review Presentation
Advanced Vehicle Electrification
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Navistar
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Project ID # ARRAVT069
This presentation does not contain any proprietary, confidential, or otherwise restricted information
### Overview

#### Timeline
- Start - Oct 1\(^{st}\), 2009
- Finish - Oct 31\(^{st}\), 2014
- 44% Complete through Dec, 2011

#### Barriers
- Immature supply chain
- Original / foreign platform reliability issues
- Aligning vehicle requirements vs customer cost/range expectations
- EVSE compatibility with various suppliers due to spec interpretations

#### Budget
- Dept of Energy cost share $39,200,000
- Navistar cost share $39,858,466
- DoE funding received through Dec 2011, $7,202,694

#### Partner
- DOE (NREL) analysis of fleet data
- Suppliers
- Initial customers
- ELC (Electrification Leadership Council)
Objective and Relevance

The overall objective of this project is to manufacture and distribute a zero tailpipe emission light-duty commercial electric vehicles (EV) in the United States. Navistar shall deploy at least 950 commercial medium duty EVs in the U.S. market.

• Specific objectives include;
  • Demonstrate EV technology for commercial applications
  • Demonstrate reliability in diverse locations
  • Address customers needs to achieve mass market penetration

• This project is creating and sustaining American jobs in support of the ARRA initiatives.

• Estimates are that each vehicle will reduce carbon emission by at least 10 tons per annum, compared to ICE vehicle. This equates to 1250 gallons of fuel per annum

• EV Project has a positive impact on technology development, barriers are being improved
## Approach - Milestones

<table>
<thead>
<tr>
<th>Month/Year</th>
<th>Milestone or Go/No-Go Decision</th>
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<tbody>
<tr>
<td>Oct-2010 / Complete</td>
<td>Milestone: Complete transition to CKD (complete knockdown) units, with increased US manufacturing content. Due to component availability and pre-ordered product, this milestone slipped to 5/2011.</td>
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<td>Aug-2011 / Complete</td>
<td>Milestone: Complete launch of Model Year 2012. Enhanced; heating, air-conditioning, motor, charger, and battery pack</td>
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<td>Sep-2011 / Complete</td>
<td>Milestone: Chartered the development of next generation EV2 for integration into another existing platform</td>
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<td>Mar-2012 / Planned</td>
<td>Milestone: Program approval of next generation EV2. Critical systems concepts approved</td>
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<tr>
<td>Jun-2013 / Planned</td>
<td>Milestone; Job 1, program launch, of next generation EV2 integrated into existing platform.</td>
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Approach - Tasks

• Transfer existing technologies and product from overseas to a domestic manufacturing location
• High voltage architecture was revised to ensure compliance with US Grant performance targets
• Complete homologation of systems and sub-systems to ensure compliance with DOT (Department of Transport) requirements
• Charter and staff product development teams to upgrade and launch EV generation 1, and improve key systems for development and launch of EV generation 2
• Develop alignments with Gen 1 customer base, and utilize feedback to improve and enhance Gen 2
• Organize industry, governmental, and educational institutions stakeholders into Electrification Leadership Council to promote adoption and infrastructure of EVs
Technical Accomplishments

• Prior Accomplishments
  – Vehicle meets FMVSS requirements
  – 80 kW battery pack integrated (to achieve 100 mile range objective)
  – On board charger integrated
  – EPA and CARB certified for on road use
  – Launched initial product May, 2010

• 2011 Accomplishments
  – Generation 1 EV
    – FRP battery pack enclosure
    – Locally sourced charger integrated allowing improved charging time and serviceability
    – Air conditioning option available
    – Enhanced windshield defrost / demist to allow for expanded geographic locations
    – Continued vehicle life durability testing
Technical Accomplishments

• 2011 Accomplishments (cont)
  – Generation 1 (cont)
    – EMC susceptibility further improved during redesign of Battery enclosure and Charger Management Systems
    – Implemented J1772 architecture into charger
    – Vehicle and systems Operating Temperature range increased to -20 to 50 C
    – Park pawl robustness improved
• Staffed EV Generation 2 program with product development team
Technical Accomplishments

• EV Generation 2
  – 100 mile range with increased GVW and Payload
  – Modular battery pack configurations to allow for reduced cost option
  – Increased maximum speed
  – Common platform to minimize product cost
  – Evaluated for driver ergonomics
  – Design protected for alternative product offerings
Collaboration

- Reporting of deployed vehicle performance data to the DOE (NREL)
- Leveraging DOE partners
  - High voltage battery pack manufacturer
  - EVSE options for customers
- Strategic alignment with body builder for integrated truck / body
- Initial customer(s) key to continuous enhancement of gen1 and defining requirements for gen 2
- Developing relationships via the Electrified Leadership Council;
  - Utility
  - Local suppliers / User Industry
  - Local and state governments
Future Work

- Continuous localization and sourcing
- Launch generation 2 summer 2013
- 2013 and out
  - Continue cost reduction initiatives
  - Integrate electrified drive train into alternative platforms
- Achieve General Services Administration (GSA) certification for Generation 1 product to increase vehicle sales
Future Work

Existing customer demands supported by PD will result in volume growth

- **Alternative GVWR’s**
- **Navistar common platforms**
- **Modularized Battery, Improved Propulsion Sys**
- **eStar van, FMVSS, CMVSS, reliability & stabilization**

2011 2012 2013 2014 2015

**ADDITIONAL CUSTOMERS**

Product, market development AND cost reduction required to grow the EV business
Summary

- US homologation generation 1 completed
- Product launched May 2010
- MY2012, enhanced version of generation 1 launched Sep 2011
- Technical challenges remain
  - Cost reduction of energy storage system
  - Vehicle range matched to customer wants
  - Availability of charging stations for utilization by commercial vehicles.
  - Electric grid support for large fleets (long term)