United States Department of Energy

April, 2011

Vehicle Technologies Program

Patrick B. Davis, Program Manager
We are Highly Dependent on Oil

• Transportation is responsible for 2/3 of our petroleum usage

• On-Road vehicles responsible for ~80% of transportation petroleum usage

U.S. Transportation Fuel Share (2009)

- Petroleum: 94%
- Natural Gas: 3%
- Biomass: 3%
Goal: 1 Million Electric Vehicles by 2015

“With more research and incentives, we can break our dependence on oil with biofuels, and become the first country to have a million electric vehicles on the road by 2015”

- President Barack Obama, 2011 State of the Union
Goal: 1 Million Electric Vehicles by 2015

• DOE Report on capacity to reach one million vehicles by 2015 released February 8, 2011.
• Key findings
  – Manufacturers already have plans for cumulative U.S. production capacity in the range of 1.2 million electric vehicles by 2015
  – This doesn’t include vehicles from at least half a dozen manufacturers who have not announced production capacities
  – Consumer acceptance, existing R&D and policy measures are important to reaching the goal
Reaching 1 Million EVs by 2015

1 Million EVs by 2015

- Electric Drive R&D, Battery Cost Reduction
- 2016 CAFE Standards
- ATVM Loan Program
- ARRA Manufacturing Facilities
- Tax Incentives
- Charging Infrastructure
What’s Different This Time?

- Urgency of Energy and Environmental Challenges
- Battery Technology
- CAFE standards post 2016

Answer:

- Early 1900s
- 1970s
- 1990s
- 2011
DOE Battery Innovation, Market Acceptance and Cost Reduction

- 1990’s → Nickel Metal Hydride (NiMH) batteries enable commercial introduction of HEVs
- 2000 – 2010’s → Li-ion batteries enable next generation HEVs, PHEVs and EVs (Volt)
- Future → Next Generation Chemistry with 3x energy density: Li(metal) battery

Plug-In Hybrid Battery Cost on Track to Meet 2015 Goal of $300/kWhr

<table>
<thead>
<tr>
<th>Year</th>
<th>Battery Cost, $/kWhr</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>$1,300</td>
</tr>
<tr>
<td>2010</td>
<td>$800</td>
</tr>
<tr>
<td>2012</td>
<td>$500</td>
</tr>
<tr>
<td>2015</td>
<td>$300</td>
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Battery Module Construction
Recovery Act: $2.0 Billion
Manufacturing Supporting Electric Drive

$1.5 Billion in funding to accelerate the manufacturing and deployment of the next generation of U.S. batteries

$500 Million in funding for electric-drive components manufacturing

President Obama at Compact Power in Holland, MI

Vice-President Biden at Dow-Kokam
Creating an Electric Drive Vehicle Manufacturing Base

Integrated Supply Chain

Material Suppliers → Cell Manufacturer → Battery Assembler → End User

12 Awards

9 Awards

10 Awards

Electric Drive Component
Outlook for Battery Cost and EV Production Capacity

On Track to Meet Administration’s Goal of 1 Million EVs by 2015

<table>
<thead>
<tr>
<th>Year</th>
<th>Battery Cost ($ per kWh)</th>
<th>Battery Production Capacity (10 kWh packs)</th>
<th>Vehicle Production Capacity (announced, cumulative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>$1,000-$1,200</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2009</td>
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</tr>
<tr>
<td>2010</td>
<td>$700-$950</td>
<td>50,000</td>
<td>45,600</td>
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<tr>
<td>2011</td>
<td>Goal = $500</td>
<td>150,000</td>
<td>223,200</td>
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<tr>
<td>2012</td>
<td>Goal = $500</td>
<td>144,000</td>
<td>486,200</td>
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<td>2013</td>
<td>Goal = $300</td>
<td>500,000</td>
<td>854,200</td>
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<tr>
<td>2014</td>
<td>Goal = $300</td>
<td>488,000</td>
<td>1,222,200</td>
</tr>
</tbody>
</table>
| 2015 | Goal = $300              | 9.88 MkWh per year production capacity in 2015 | >7.7 MkWh per year capacity demand in 2015

9.88 MkWh per year production capacity in 2015

>7.7 MkWh per year capacity demand in 2015
Build out of Charging Infrastructure

Key Today: Home Charging

- Need to get the cost and installation process right. Currently a significant barrier

Public Charging

- Expensive if not well utilized
- Expansive to fully cover full driving patterns

Ideally need market pull to determine public infrastructure build out

- PHEV’s are key to help initiate market pull for public infrastructure
The largest-ever U.S. deployment of electric-drive vehicles and charging infrastructure

- Deployment of 13,000 electric-drive vehicles, including light-duty, medium-duty, and heavy-duty passenger and commercial vehicles
- Installation of over 22,000 Level 2 charging sites at residential, commercial, and public locations and 350 (500VDC) Fast Chargers
- Collection of detailed operational data from vehicles and charging infrastructure

10 Grants to establish comprehensive educational and outreach programs focused on electric-drive vehicles

- Funding of the first programs to educate first responders and emergency personnel in how to deal with accidents involving EVs and PHEVs
Transportation Electrification Data Collection

• **Charge event data:**
  – Connect, start charge, end charge, and disconnect times
  – Average power (kW), max peak power (kW), total energy (kWh), and rolling 15 minute average peak power (kW)
  – Charger ID, event ID, and date/time stamp

• **Driving event data:**
  – Data recorded for each key on/key off event
  – Event Type (key on/off), date/time stamp
  – Vehicle ID, Odometer, GPS location
  – Battery SOC, Liquid Fuel consumption
Data Collection Plan

• Data will be collected by INL and NREL
• Data Analysis and Reporting will focus on:
  – Vehicle and charger performance, efficiency, and utilization
  – Charging patterns and public charging use
  – Impact of various rate structures on charging habits
  – Impact of vehicle charging on electric grid
• Report dissemination:
  – Internet based starting this spring
  – Fact Sheet reporting will commence end Q2 FY 2011
  – Annual Utilization / impacts reports beginning late 2011
• Raw vehicle and infrastructure data will not be available
  – Considered “Generated Data with Delivery Restrictions”
  – Raw data will not be delivered to DOE in any format
On January 26, 2011 Vice-President Biden announced a $200M program to help cities establish charging infrastructure (FY12 Budget Request):

- Establish a comprehensive infrastructure plan
- Encourage locally-based public and private sector collaboration
- Leverage federal resources
- Streamline building permit approval and installation procedures.
- Initial build-out of the infrastructure.
President Announces Clean Fleets Partnership

- The Clean Fleets Partnership - working with national vehicle fleet operators to reduce petroleum consumption.
- Charter members: AT&T, FedEx, PepsiCo, UPS and Verizon -- five of the nation’s 10 largest national fleets operating more than 275,000 vehicles.
Contact Information

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