HYDROGEN TO THE HIGHWAYS
Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project
Mercedes-Benz
Research & Development North America, Inc.
Ronald Grasman: Daimler AG
May 13, 2011
# Program Overview

## Timeline
- Project Start Date: 01/07/04
- Project End Date: 12/31/11*  
- Percent Complete: 90%

## Partners
- Daimler  
- MBUSA  
- DTE Energy  
- NextEnergy

## Budget
- $76.4M Total Project Funding  
  - $38.2M Federal Share  
  - $38.2M Industry Share  
- $5.1M FY05 Funding  
- $6.3M FY06 Funding  
- $7.6M FY07 Funding
- $5.2M FY08 Funding  
- $3.0M FY09 Funding  
- $3.9M FY10 Funding

## Barriers
- A. Vehicles  
- B. Storage  
- C. Hydrogen Refueling Infrastructure  
- D. Maintenance and Training Facilities  
- E. Codes and Standards

* Project extended in 09/2009 & 10/2010 for a total of 2 years
Relevance

- Address barriers to move toward technology readiness
- Align the Mercedes goals with DOE’s Hydrogen Program objective

<table>
<thead>
<tr>
<th>DOE Barriers</th>
<th>Mercedes Teams’ Project Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. FCV Performance and Durability Data</td>
<td>• Record, collect and report data from fuel cell vehicles and hydrogen fueling stations to validate DOE performance targets</td>
</tr>
<tr>
<td>B. Hydrogen Storage</td>
<td></td>
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<tr>
<td>C. H₂ Refueling Infrastructure Available Data</td>
<td></td>
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<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>2009</th>
<th>2015</th>
</tr>
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<tbody>
<tr>
<td>Fuel Cell Stack Durability</td>
<td>2000 hours</td>
<td>5000 hours</td>
</tr>
<tr>
<td>Vehicle Range</td>
<td>250+ miles</td>
<td>300+ miles</td>
</tr>
<tr>
<td>Hydrogen Cost at Station</td>
<td>$3/gge</td>
<td>$2-4/gge (2020)</td>
</tr>
</tbody>
</table>

| D. Maintenance and Training Facilities | | |
| E. Codes and Standards | | |
| | • Demonstrate the safe installation and operation of service facilities |
| | • Continuously update safety manuals and provide training |
| | • Participate in various working groups to ensure continuous progress |
Objectives

Program Objectives

- Collect data to evaluate the technology status of FCV and H₂ infrastructure

2010/11 Objectives

- Maintain and finalize the smooth operation of Gen I fuel cell vehicles with on-going service, maintenance and customer support
- Begin customer operations of production-level Gen II vehicles
- Maintain the high quality of technical vehicle & H₂ data reporting to NREL/DOE
- Operate DTE hydrogen fueling station and maintain project safety
Approach: Technical

- Operate Gen-I and Gen II vehicles under real world condition to monitor DOE performance targets
  - Install and maintain data acquisition system that collects vehicle and hydrogen fueling data
  - Establish maintenance and service facilities to support FCV operations
    - Set up initial fueling network to support FCV fleet
    - Support codes and standards activities
## Approach: Milestones

### Alignment Between the Workplan/Milestones of DOE and Team

![Technology Validation R&D Milestone Chart](image)

#### 2009-2011 DOE Targets
- Validate 2,000 hours FCV durability
- Validate cold start

<table>
<thead>
<tr>
<th>Team's Task</th>
<th>DOE Target</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>% Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gen I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>- Gen I Operation/Data Submission</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
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<tr>
<td>- 70MPa Vehicles Upgrade and Operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
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<tr>
<td><strong>Gen II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Fuel Cell Stack System Durability Test &amp; Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>- Gen II FDA System Upgrade</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
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<tr>
<td>- Internally Operate Vehicles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10%</td>
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<tr>
<td>- Externally Operate Vehicles</td>
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</table>
Accomplishments and Progress
Technical Advancements of Daimler’s Fuel Cell Vehicles

A-Class F-CELL

2004

B-Class F-CELL

2010

Range
+150%

Mileage
+15%

Durability
+100%

Size
(FC-system)
-40%

Power
+30%

Top Speed
+21%
Accomplishments and Progress
External Operations

Submitted over 110 CDs to Demonstrate that FCVs are on Track to be Commercially Viable by 2015

Gen I A-Class

• Successfully completed 7 years of external operations of Gen I vehicles (5 years past the original target date)
• Decommissioned last Gen I FCV 12/2010
• Achieved 2,000 hour stack durability

Gen II B-Class

• First 3 vehicles delivered 2010
• Achieved 250 mile range
• Tested Gen II fleet in temperatures ranging from -30°C (Sweden) to 50°C (Death Valley)
• Validated cold-start capability down to -17°C, while reaching 50% of max. power within 30 seconds
• Promising initial results show fuel cell stack durability will meet 2015 DOE target using on-road data
• High initial customer satisfaction
Accomplishments and Progress
Gen-II External Operations

Transitioning FCV Activities from an R&D to a Mainstream Commercial Activity

- Training Facilities
- Warranty Department
- Customer Assistance Center
- Parts & Distribution Center
- Vehicle Preparation Center
- Sales Processes
- Roadside Assistance
Accomplishments and Progress
Gen-II External Operations

Dealer Activities Mirror “Normal Processes” Except for Customer Selection

- Customer visit
- Test drive
- Training
- Lease/financial documentation
- Service activities
Accomplishments and Progress
Gen-II External Operations

Real World Operations Begin with Fueling Training and Customer Handover at Dealership

<table>
<thead>
<tr>
<th>GEN II CUSTOMER OPERATIONS</th>
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<tbody>
<tr>
<td>2010</td>
</tr>
<tr>
<td>Q4</td>
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<tr>
<td>------</td>
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<tr>
<td>1</td>
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<tr>
<td>5</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>17</td>
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B-Class F-Cell Deployment
Accomplishments and Progress
Gen-II External Operations

Submitting Raw Data from B-Class F-CELL World Drive 2011

- 125 days
- 14 countries
- Approximately 19,000 miles
- 3 Gen II FCVs
Accomplishments and Progress
Gen II Deployment

Preparing for Fueling Infrastructure

- Recommending station specifications, site locations, supplier qualification guidelines and providing joint OEM commitment letters to CEC/ARB.
- Collaborated with other OEMs to coordinate locations of future fueling stations
- Number of stations projects is increasing, however number of present operational and public stations is the limiting factor for customer selection

2010 Projection

- Q1 2010: UC Irvine, Torrance, CSU LA, Harbor City
- Q2 2010: Fountain Valley, Newport Beach
- Q3 2010: Burbank
- Q4 2010: UCLA

2011 Projection

- Q1 2011: Culver City, Harbor City
- Q2 2011: UC Irvine, UC Irvine, Torrance, Q2 2011
- Q3 2011: CSU LA, Newport Beach, UCLA
- Q4 2011: Santa Monica, West LA, Beverly Hills, Hawthorne, Hermosa Beach, North Irvine, Laguna Niguel, Diamond Bar

Station| Opening Date
---|---
UC Irvine| Operational
Culver City| Operational
Torrance| Q2 2011
Fountain Valley| Q2/Q3 2011
Newport Beach| Q3 2011
CSU LA| Q2 2011
Harbor City| Q2 2011
UCLA| 2012
Santa Monica| 2012
West LA| 2012
Beverly Hills| 2012
Hawthorne| 2012
Hermosa Beach| 2012
North Irvine| 2012
Laguna Niguel| 2012
Diamond Bar| 2012
Accomplishments and Progress
Infrastructure

DTE Energy Continuing Operations

- Technical Data:
  - Hydrogen produced by electrolysis
  - Storage capacity of 140 kg
  - Capable of dispensing 35 kg/day at 350 bar

- Accomplishments:
  - In operation for 7 years
  - Cold weather areas
  - Community outreach
  - New electrolyzer & dispenser installed winter of 2008-2009
  - Testing equipment reliability in cold weather location.

Visitors from: Romania, Kosovo, Estonia, State Dept. & Montenegro
U.S. Department of State International Visitor Leadership Program
# Accomplishments and Progress

## Codes and Standards

Continual progress in the development of appropriate Codes and Standards, updating hydrogen stakeholders of current and future directions to pave the way to FCV commercialization.

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<thead>
<tr>
<th>ISO Working Groups</th>
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<tr>
<td>• ISO DIS 17268</td>
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<td>• ISO DIS 14687</td>
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<table>
<thead>
<tr>
<th>SAE Working Groups</th>
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<tr>
<td>• J2600</td>
</tr>
<tr>
<td>• J2719</td>
</tr>
<tr>
<td>• J2578</td>
</tr>
<tr>
<td>• J2579</td>
</tr>
<tr>
<td>• Vehicle Battery Standards Committee</td>
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<tr>
<th>NextEnergy</th>
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<tbody>
<tr>
<td>• NFPA 2</td>
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<tr>
<td>• Database</td>
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<tr>
<td>• Conferences</td>
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- Held annual H\textsubscript{2} Codes & Standards (C&S) Conference in 9/21/2010
- Voting member of NFPA2
  - Intended to provide clarity to the infrastructure design process and to streamline permitting
- H\textsubscript{2} Permitting Officials & Station databases posted live on NextEnergy Website
  - Offered to DOE as a tool to identify H\textsubscript{2} AHJs in Michigan and to the H\textsubscript{2} industry to voluntarily catalog installed infrastructure world-wide data
Accomplishments and Progress
Public, Industry and Media Outreach

Participated in outreach activities to educate the public, encourage government support and raise awareness about the Team’s commitment to the technology.

- Alt Car Expo
- LA Auto Show / NHA
- SCAQMD High School Expo
- OC Journalist Drive
- U.S. Tennis Open
Collaboration

Thanks to our Project Partners

DAIMLER
Subrecipient
• Gen I and II fuel cell vehicle development and testing
• Program Management
• Data collection

Mercedes-Benz (USA)
Subrecipient
• Deployment of hydrogen fuel cell vehicles

Prime Recipient
• Partner to DOE
• Consortia leader

DTE Energy
Subrecipient
• Operations of hydrogen fueling station in the harsh weather condition of Michigan

Subrecipient
• Permitting database
• Establishment of annual conference
• Participation in NFPA2
### Summary

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<tbody>
<tr>
<td></td>
<td>• Maintained smooth operations of the DTE station</td>
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<td></td>
<td>• Worked with CEC/ARB and other OEMs to prepare fueling infrastructure</td>
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<td></td>
<td>• Finalized Gen I operations and deployed Gen II F-Cells to external customers</td>
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<td></td>
<td>• Transitioned fuel cell vehicle activities from R&amp;D to mainstream commercial efforts</td>
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<tr>
<td></td>
<td>• Participated in various working groups to ensure continuous progress with regards to Codes and Standards</td>
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<td></td>
<td>• Continued data collection, analysis and reporting</td>
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Future Work

• Maintain and finalize smooth operation of Gen II FCVs
• Submit final report
• Continue the development and transition to commercialization of hydrogen fuel cell vehicles
The Learning Hydrogen Demonstration Project (2004-2011)

Thank You

To be continued ...
The story is not over...
The story is not over...