

HYDROGEN TO THE HIGHWAYS

Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project

Mercedes-Benz

Research & Development North America, Inc.

Ronald Grasman: Daimler AG

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DAIMLER

NEXTENERGY
Economic Security through Energy Diversity



Mercedes-Benz

Project #: TV004

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Program Overview

US Dept. of Energy Fuel Cell Vehicle and Infrastructure Cooperative Program

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

DOE Barriers	Mercedes Teams' Project Goal												
A. FCV Performance and Durability Data B. Hydrogen Storage C. H ₂ Refueling Infrastructure Available Data	<ul style="list-style-type: none">Record, collect and report data from fuel cell vehicles and hydrogen fueling stations to validate DOE performance targets <table><tr><th>Performance Measure</th><th>2009</th><th>2015</th></tr><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></table>	Performance Measure	2009	2015	Fuel Cell Stack Durability	2000 hours	5000 hours	Vehicle Range	250+ miles	300+ miles	Hydrogen Cost at Station	\$3/gge	\$2-4/gge (2020)
Performance Measure	2009	2015											
Fuel Cell Stack Durability	2000 hours	5000 hours											
Vehicle Range	250+ miles	300+ miles											
Hydrogen Cost at Station	\$3/gge	\$2-4/gge (2020)											
D. Maintenance and Training Facilities	<ul style="list-style-type: none">Demonstrate the safe installation and operation of service facilitiesContinuously update safety manuals and provide training												
E. Codes and Standards	<ul style="list-style-type: none">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



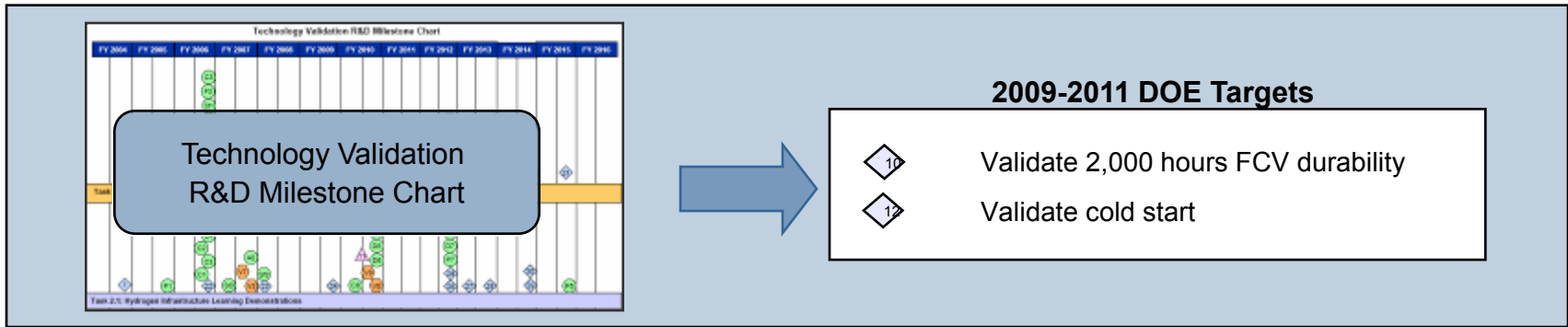
Approach: Technical

- 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



Team's Task	DOE Target	2009	2010	2011	% Complete
• Gen I					
– Gen I Operation/Data Submission					100%
– 70MPa Vehicles Upgrade and Operation					100%
• Gen II					
– Fuel Cell Stack System Durability Test & Analysis					100%
– Gen II FDA System Upgrade					100%
– Internally Operate Vehicles					100%
– Externally Operate Vehicles					10%

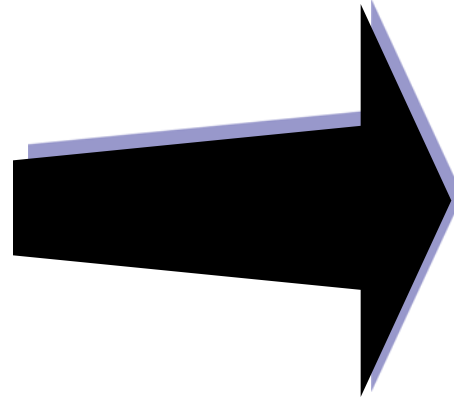
Accomplishments and Progress

Technical Advancements of Daimler's Fuel Cell Vehicles

A-Class F-CELL



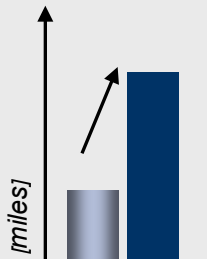
B-Class F-CELL



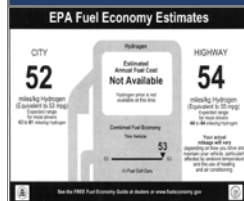
Range



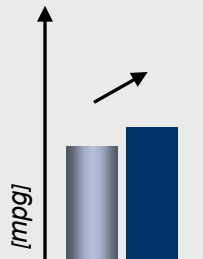
+150%



Mileage



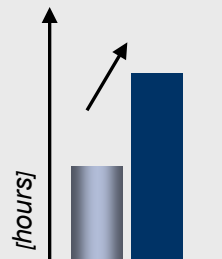
+15%



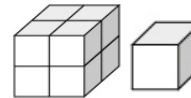
Durability



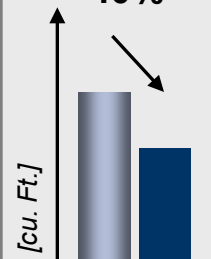
+100%



Size



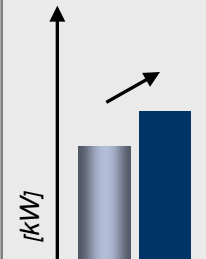
(FC-system)
-40%



Power



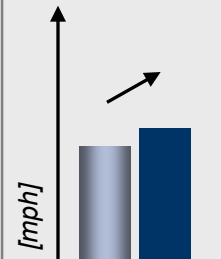
+30%



Top Speed



+21%



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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



Accomplishments and Progress

Gen-II External Operations

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



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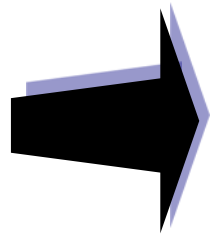
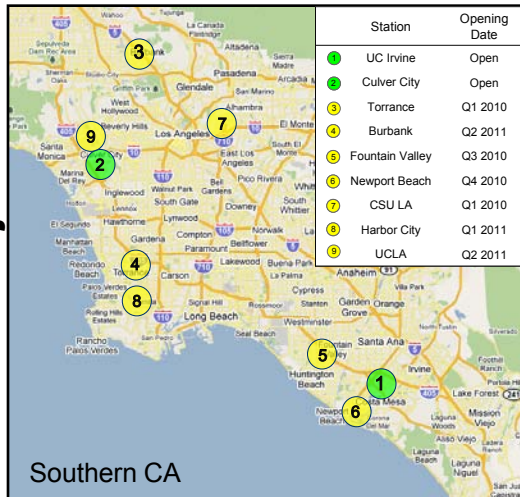
Accomplishments and Progress

Gen II Deployment

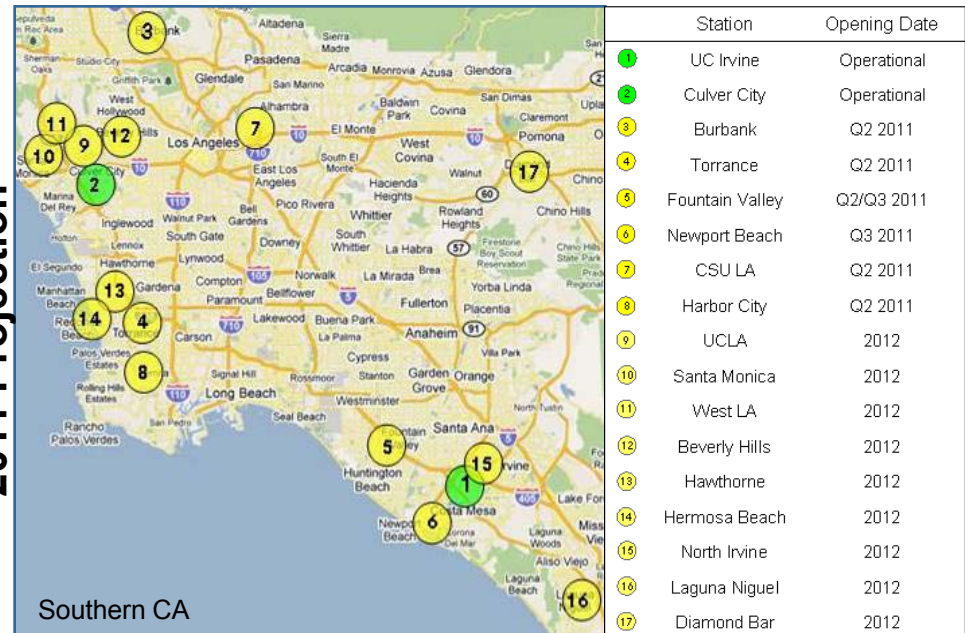
Preparing for Fueling Infrastructure

- 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



2011 Projection



Accomplishments and Progress

Infrastructure

DTE Energy Continuing Operations



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

- 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.

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.

ISO Working Groups	
• ISO DIS 17268	• ISO DIS 14687

SAE Working Groups	
• J2600	• J2719
• J2578	• J2579
• Vehicle Battery Standards Committee	

NextEnergy		
• NFPA 2	• Database	• Conferences
<ul style="list-style-type: none"> • Held annual H₂ Codes & Standards (C&S) Conference in 9/21/2010 • Voting member of NFPA2 <ul style="list-style-type: none"> – Intended to provide clarity to the infrastructure design process and to streamline permitting • H₂ Permitting Officials & Station databases posted live on NextEnergy Website <ul style="list-style-type: none"> – Offered to DOE as a tool to identify H₂ AHJs in Michigan and to the H₂ 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



SCAQMD High School Expo



LA Auto Show / NHA



OC Journalist Drive



U.S. Tennis Open



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Collaboration

Thanks to our Project Partners



DAIMLER **Subrecipient**

- Gen I and II fuel cell vehicle development and testing
- Program Management
- Data collection



Subrecipient

- Deployment of hydrogen fuel cell vehicles

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Research & Development North America, Inc.

Prime Recipient

- Partner to DOE
- Consortia leader

DTE Energy



Subrecipient

- Operations of hydrogen fueling station in the harsh weather condition of Michigan

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Subrecipient

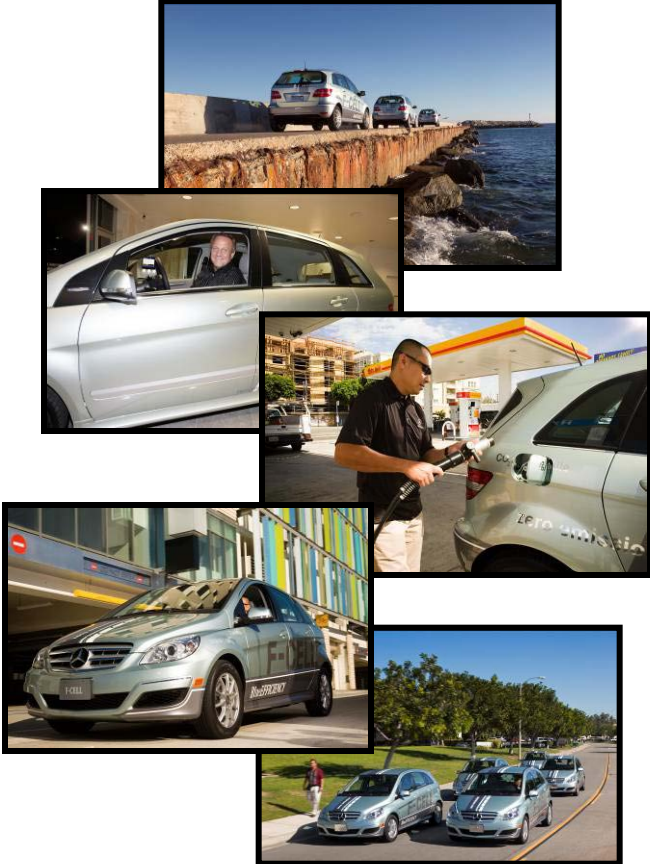
- Permitting database
- Establishment of annual conference
- Participation in NFPA2



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Summary

	<ul style="list-style-type: none">• Maintained smooth operations of the DTE station• Worked with CEC/ARB and other OEMs to prepare fueling infrastructure
	<ul style="list-style-type: none">• Finalized Gen I operations and deployed Gen II F-Cells to external customers• Transitioned fuel cell vehicle activities from R&D to mainstream commercial efforts
	<ul style="list-style-type: none">• Participated in various working groups to ensure continuous progress with regards to Codes and Standards
	<ul style="list-style-type: none">• Continued data collection, analysis and reporting

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



DTE Energy



NEXTEnergy



To be continued ...



The story is not over...

The story is not over...

