

HYDROGEN TO THE HIGHWAYS

Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project



CHRYSLER

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DAIMLER

NEXTENERGY
Economic Security through Energy Diversity



Mercedes-Benz



Project ID#: tv_04_grasman

This presentation does not contain any proprietary, confidential, or otherwise restricted information

Program Objectives

- Record, collect and report data from fuel cell vehicles and hydrogen fueling stations to validate 2009 DOE performance targets:
 - Fuel cell stack durability: 2,000 hours
 - Vehicle range: 250 miles
 - Hydrogen cost at station: \$3.00/GGE
- Demonstrate the safe installation and operation of service facilities
- Raise public awareness of hydrogen technology
- Develop Codes and Standards and implement rigorous safety processes



Program Overview

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

Timeline

- Project Start Date: 01/07/04
- Project End Date: 09/30/09
- Percent Complete: 90%

Partners

- Chrysler
- Daimler
- MBUSA
- BP America
- DTE Energy
- NextEnergy

Budget

- \$88.8M Total Project Funding
 - \$44.4M Federal Share
 - \$44.4M Industry Share
- \$5.1M FY05 Funding
- \$6.3M FY06 Funding
- \$7.6M FY07 Funding
- \$5.2M FY08 Funding

Barriers

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

Approach

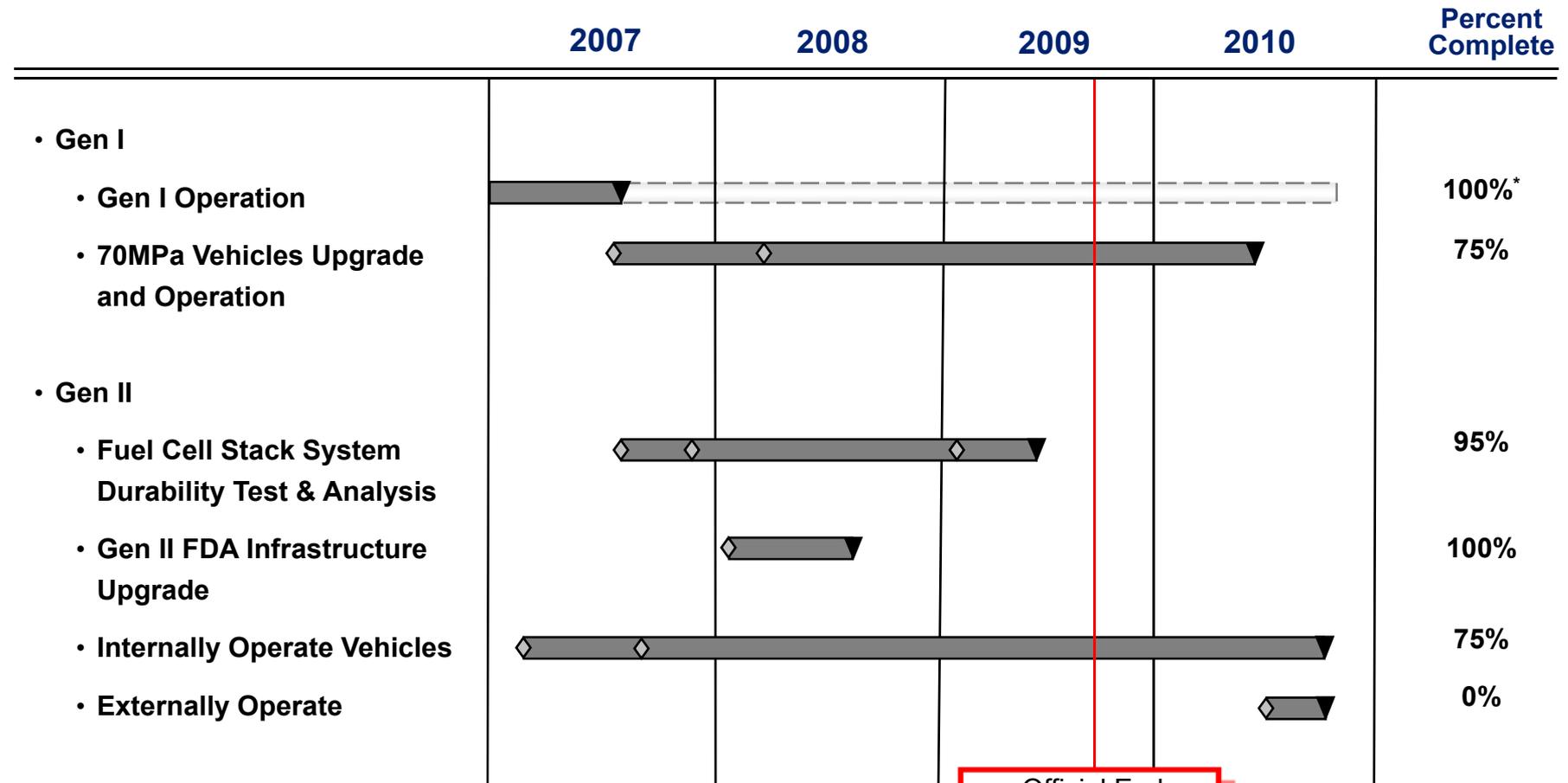
- Operate Gen-I and Gen II vehicles under real world condition to monitor 2009 performance targets
- Install and maintain data acquisition system that automatically collects vehicle data
- Establish initial fueling network to support FCV fleet
- Align the Chrysler Team's outreach activities with the education goals of the DOE
- Support codes and standards activities



2008/09 Objectives

- Fuel Cell Vehicles
 - Maintain smooth operation of Gen I vehicles
 - Finalize development and begin operations of 70MPa fuel tank upgrade
 - Complete lifetime test of Gen II fuel cell stack system
 - Begin internal operations of Gen II vehicles
- Hydrogen Infrastructure
 - Complete site development of City of Burbank station
 - Continue operations of PG&E and LAX stations as agreed by partners
 - Maintain operations of DTE and NextEnergy hydrogen fueling stations
- Safety and Data Reporting
 - Maintain project safety
 - Complete safety and risk assessment activities with the construction of new 70MPa Burbank station
 - Maintain the high quality of data reporting structure
- Outreach/Media Events
 - Raise public knowledge of hydrogen technology and demonstration projects

Milestones



Official End Date

*Gen I vehicle operation achieved and exceeded

Accomplishments and Progress Gen-I Operations



- Continuing mileage accumulation through customer operations in 2009 with vehicles in service for over 5 years
- Submitted over 85 DVD's of raw data to NREL
- Embraced DOE's "lighthouse" vision by relocating primary workshop from West Sacramento to Long Beach
 - (Service center in Palo Alto remains for Northern California customers)

Accomplishments and Progress

Gen-I Operations

Operated Gen I vehicles with optimized 70MPa tank systems and CPU software upgrade



Deployed F-Cell to NREL (Golden, Colorado) for Advanced Technology Fleet Effort



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Accomplishments and Progress Transition to Gen II Technology



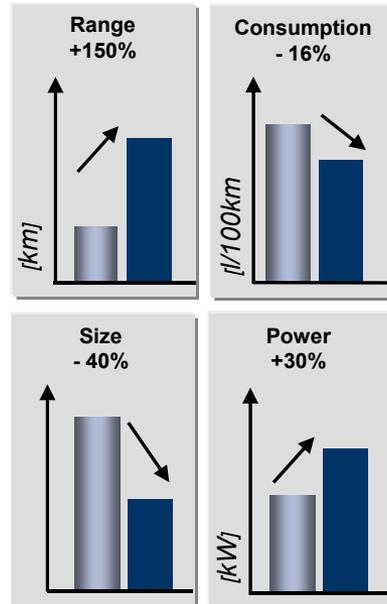
Next generation of the fuel cell-power train:

- Higher stack lifetime (>2000h)
- Increased power
- Higher reliability
- Freeze start ability
- Li-Ion Battery



A-Class F-Cell

Technical Data	
Vehicle Type	Mercedes-Benz A-Class
Fuel Cell System	PEM, 72 kW (97 hp)
Engine	Engine Output (Continuous / Peak): 45 kW / 65 kW (87hp) Max. Torque: 210 Nm
Fuel	Hydrogen (35 MPa / 5,000 psi)
Range	105 miles (170 km / NEDC)
Top Speed	88 mph (140 km/h)
Battery	NiMh



B-Class F-Cell

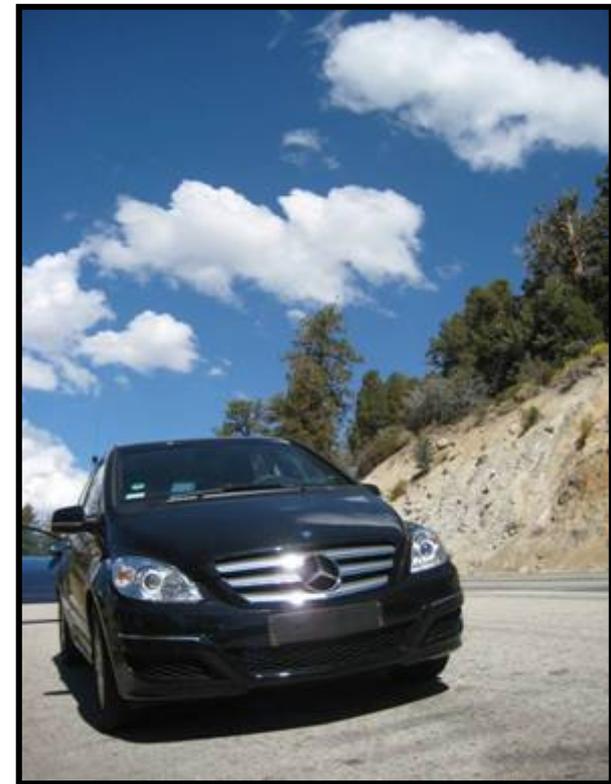
Technical Data	
Vehicle Type	Mercedes-Benz B-Class
Fuel Cell System	PEM, 80 kW (108 hp)
Engine	IPT Engine Output (Continuous/ Peak) 70kW / 100kW (136hp) Max. Torque: 320 Nm
Fuel	Hydrogen (70 MPa / 10,000 psi)
Range	250 miles (400 km)
Top Speed	106 mph (170 km/h)
Battery	Li-Ion



Accomplishments and Progress

Gen-II Technical Accomplishments

- Completed durability testing on Gen-II fuel cell stack system to support 2009 DOE target
- Developed, optimized and tested Gen II start/stop algorithm to further improve fuel economy and start-up time of fuel cell system
- Completed vehicle dynamometer testing to verify fuel economy and range

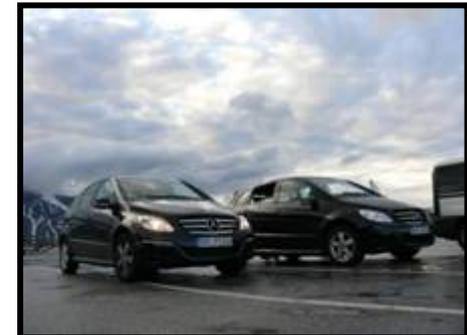


Accomplishments and Progress

Gen-II Technical Accomplishments



- Internally operated Gen II pre-production vehicles
 - Hot weather conditions
 - Cold start capability
- Submitted Gen II raw data for NREL analysis to validate 2008 milestone



Accomplishments and Progress

Codes and Standards

Daimler participated in various working groups to ensure continuous progress with regards to Codes and Standards

- J2578 - Recommended Practice for General Fuel Cell Vehicle Safety
 - Revised version published January 2009
- J2579 - Technical Information Report for Fuel Systems in Fuel Cell and Other H2 Vehicles
 - Revised version published January 2009
- J2601 - Fueling Protocols for Gaseous Hydrogen Surface Vehicles
 - Final draft sent out for review, ballot targeted for May 2009
- J2719 - Information Report on the Development of H2 Quality Guideline for Fuel Cell Vehicles
 - Proposal to change reporting units of particle sampling and particulate size requirements
 - Letter (draft) to be sent to NIST
- FMVSS 305
 - Expected to be finalized in 2009
 - J1766 will be revised to reflect the content of the final rule
- Database (NextEnergy)
 - Hydrogen Permitting Officials database posted to live NextEnergy Center website
 - Intended to be used as future DOE tool to identify H2 AHJs in Michigan
- Annual Conference (NextEnergy)
 - Slated for Fall 2009
 - Focus on current industry efforts toward C&S development



SAE International



Accomplishments and Progress

Safety

- Emergency responder training at NextEnergy
- Joint table top exercise
- No safety incident

- Project Fleet Vehicle Incident Management Plan
- Palo Alto Service Facility

- Risk assessment and HAZOP activities for 70MPa station in Burbank, CA



Accomplishments and Progress

Public, Political & Industry Outreach

Public Outreach



H2 Road Tour



Conference Exhibitions



Accomplishments and Progress Infrastructure

- **Southern California: Burbank**

- Status: Construction complete
- Technical Data:
 - On-site SMR hydrogen production; 108 kg/day capacity
 - 352 kg storage capacity
 - 60 Hp 70MPa compressor
 - Dual pressure dispenser
 - H2 truck off-loading
 - Operational video monitoring
- Hydrogen Delivery: 35 and 70 MPa
- Site Utilization:
 - Planned as an open site for all OEMs with a supply agreement
 - Burbank will use 10-15kg/day of hydrogen for fuel cell bus
 - Burbank and Daimler/Chrysler will have priority of supply
 - 70 MPa cars must have communication capabilities for complete fill



Accomplishments and Progress Infrastructure

- **Southern California: Burbank
(Continued)**

- Start-Up Issues:

- Reformer had start up issues that delayed commissioning
- New infrared 70MPa interface needed developing; Now operational

- Going Forward:

- Open site and start 70MPa filling
- Open site to other OEM's
- Learn what reformer and 700 bar operations require
- Transfer BP ownership to City of Burbank September 2009 after funding found



Accomplishments and Progress

Infrastructure



- **Michigan: DTE Energy**
 - Technical Data:
 - Hydrogen produced by electrolysis
 - Storage capacity of 140 kg
 - Capable of dispensing 15 kg/day
 - Accomplishments:
 - Operational since 2004
 - Cold weather areas
 - Community outreach
 - New electrolyzer & dispenser installed winter of 2008-2009

Accomplishments and Progress Infrastructure

- **Southern California: LAX (non-DOE)**

- Technical Data: Hydrogen produced by on-site electrolysis; Capacity of about 25 kg/day
- Accomplishments: In operations since early 2006; Serving a number of Daimler/Chrysler vehicles on a regular basis, and other OEM's (Ford, Toyota, Honda, etc.) vehicles; Site remained available beyond 2008 although BP transferred responsibilities



- **Michigan: Next Energy**

- Technical Data: Hydrogen produced by remote SMR; Usable capacity of 50 kg; 10-15 kg/day
- Accomplishments: Only one of a small number of stations in cold weather areas; Additional station training given to Michigan inspectors; Fueling agreement signed with GM to fuel vehicles



Critical Infrastructure Next Steps

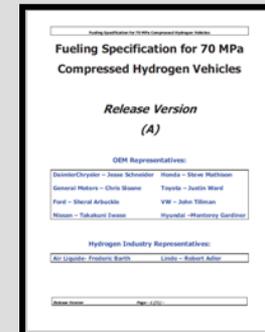
Further station deployment must be made to support future vehicle fleets

- Funding essential for infrastructure build-up
- 40 stations needed in Los Angeles area by 2010

- Coordination with DOE and State agencies

- Needs of all fleets
- NextEnergy Release A document

- Fuel cost reduction



Future Work

- Prepare for next generation demonstrations
- Work with DOE to ensure existing hydrogen stations remain open and available
- Finalize decision and plan for project extension
- Maintain smooth operation of Gen I fuel cell vehicles with on-going service, maintenance and customer support
- Continue internal operations of Gen II vehicles
- Maintain the high quality of technical vehicle and infrastructure data reporting to NREL/DOE
- Pursue novel approaches toward outreach and media events to raise public knowledge of hydrogen technology and demonstration projects

Conclusion



- Completed construction of City of Burbank 70MPa station.
- Installed new electrolyzer & dispenser at DTE Station
- Internally operated Gen II pre-production vehicles
- Upgraded and operated vehicles with 70MPa tank system and new CPU software
- Continued mileage accumulation of Gen I vehicles
- Relocated service facility to support of DOE's "lighthouse" vision
- Continued data collection, analysis and reporting