PROGRAM OVERVIEW

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

- Cooperative Agreement signed December 22\textsuperscript{nd}, 2004
- Program duration: 2004 - 2009
- Partners: DaimlerChrysler, BP America, DTE Energy, NextEnergy

- Total budget: $88.8 M
  (50% federal share / 50% industry share)
- Planned budget for pre-award: $6,757,601
- Planned budget for 2005: $36,155,547

Barriers and Problems Encountered

- Vehicles
  - Install and enable Fleet Data Acquisition system
    - Sophisticated equipment and data collecting software/hardware
    - Frequent installations and upgrades provide “learning curve”

- Hydrogen Refueling Infrastructure / Maintenance and Training Facilities
  - Complex Relationships: Sub-recipient Contracts encounter difficulties in governmental and corporate policies and legalities
  - Establishment of Ecosystems: Service, Maintenance, Testing, and Hydrogen Infrastructure facilities endure delaying permitting and site approval processes

- Codes and Standards
  - Assurance of safe vehicle and infrastructure operations (ie. Permits, local regulations)
The main focus of the ongoing DOE Fleet Validation and Demonstration Project is to identify the technology status of:
- the fuel cell powered vehicles (OEMs) and
- the hydrogen infrastructure (energy companies and suppliers).

The program is about data collection and evaluation.

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Units</th>
<th>2009 Performance Target</th>
<th>2015 Performance Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Cell Stack Durability</td>
<td>Hours</td>
<td>2000</td>
<td>5000</td>
</tr>
<tr>
<td>Range</td>
<td>Miles</td>
<td>250</td>
<td>300</td>
</tr>
<tr>
<td>Hydrogen Cost at station; On- or Off-site Production</td>
<td>$/kg of H2</td>
<td>$3.00</td>
<td>$1.50</td>
</tr>
</tbody>
</table>

“To meet the goals of the project, the following 2008 performance measures are presented as targets to verify progress towards the 2015 performance targets and are the subject of this Solicitation. The 2015 performance measures will be the subject of subsequent phases.”

–Solicitation DE-PS36-03GO93010
OBJECTIVES

2005 Program Objectives

2005 will focus on the deployment of 30 fuel cell vehicles with complete data acquisition and reporting systems while the hydrogen infrastructure is beginning development.

- To ensure the safe installation of hydrogen fueling stations, fuel cell maintenance and service facilities, and the safe operation of all fuel cell vehicles
  - Emergency response plans including training
- To record, collect, report, and analyze data for the continuing improvement of performance and fueling goals
  - Timely and consistent reporting of raw data to NREL
- To communicate the technology advancements (vehicle and infrastructure)
  - Customer and community interaction and acceptance studies
- To maintain a high standard of program management and responsibility to all partners involved in the DOE Fleet Validation Program
  - Continued communication and development of Program Team Organization and Goals
APPROACH

- Fuel Cell Vehicle Deployment and Operation
  - Deploy the vehicles to three different ecosystems
    - Cold Climate – Southeast Michigan
    - Mild Climate – Northern California
    - Warm Climate – Southern California
  - Maintain continued customer operation
    - Day-to-day operation in various driving patterns
  - Collect statistically relevant data using automatic FDA data acquisition system
    - Customer friendly system that allows for engineer analysis for technology improvement

- Hydrogen Infrastructure
  - Install the necessary infrastructure to support the vehicles
  - Test infrastructure deployment across a metropolitan area
  - Evaluate technologies which have the potential to achieve the USDOE hydrogen cost targets

- Safety and Health
  - Properly address safety issues to improve perception and feasibility of hydrogen and fuel cell utilization

Create a broad database to evaluate status quo of Fuel Cell Vehicles and Hydrogen as alternative fuel.
APPRAOCH

- Launch of 30 FC vehicles in 3 regions
- Build-up of 7 Hydrogen fueling stations
- Generation of performance data
- Technology Improvement
- Codes & Standards / Safety & Health
- Customer Acceptance and Approval

<table>
<thead>
<tr>
<th>Vehicle Operation Plan</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>in Northern California</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>in Southern California</td>
<td>9</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>in Michigan</td>
<td>5</td>
<td></td>
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<tr>
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<td></td>
</tr>
</tbody>
</table>

Existing fueling stations

DCX & BP fueling stations

Number of vehicles
Vehicle Production and Operation:

- 30 Fuel Cell Vehicles (within the DOE program) are ready for operation
- 10 F-Cells are currently in internal qualification processes
- 18 F-Cells and 2 Fuel Cell Sprinter vans are currently operating in the U.S.
- 2 vehicles are being operated by UPS
- Positive feedback received
## TECHNICAL DATA

### F-Cell
**Mercedes Benz A-Class**

<table>
<thead>
<tr>
<th>Technical Data</th>
<th>Fuel Cell System</th>
<th>Fuel</th>
<th>Traction Battery</th>
<th>Vehicle</th>
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<tr>
<td><strong>Fuel Cell System</strong></td>
<td>PEM, 72 kW (97hp)</td>
<td>Compressed Hydrogen (350 bar / 5000 psi)</td>
<td>NiMH, air cooled Capacity: 6.5Ah</td>
<td>Max. speed: 87 mph Range: 100 miles</td>
</tr>
<tr>
<td><strong>Fuel</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
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<tr>
<td><strong>Vehicle</strong></td>
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### Fuel Cell Sprinter II (US)

<table>
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<td>PEM, 72 kW (97hp)</td>
<td>Compressed Hydrogen (350 bar / 5000 psi)</td>
<td>NiMH, air cooled Capacity: 6.5Ah</td>
<td>Max. speed: 80 mph Range: 155 miles</td>
</tr>
<tr>
<td><strong>Fuel</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Traction Battery</strong></td>
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<tr>
<td><strong>Vehicle</strong></td>
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### UPS F-Cell Operation
**May 2003 - March 2005**

### UPS Sprinter Operation
**October 2004 - April 2005**

- **First Sprinter** since Oct. 2004
- **Second Sprinter** since Nov. 2004
DaimlerChrysler Engineers and Technicians Provide:

- Hotline Service
- Failure analysis, Troubleshooting
- Data Analysis
- Feedback to Development
- Special on-site FCS repairs
- Local service personnel training
- Software updates, „running changes“
- Documentation
On-Board System:
Recording of fuel cell system and vehicle parameters

30 Fuel Cell vehicles have been equipped with FDA systems

Off-Board System:
Local Servers and Central Storage of fleet data

Central File Server in Nabern, Germany

Local file servers are being installed at all workshop locations

On-Board Computer:
- 600MHz Embedded system
- GPS
- CAN-Bus
- Mass storage

On-Board System:
- Integrated with existing navigation unit
- Powerflow display
- Technician displays
Vehicle Data Reporting

- Central file server and webpage set-up and operational
- First fleet data set has been provided to NREL
  - Four CDs/DVDs delivered from November 2004 through February 2005
- Data files from daily vehicle operation
- Constructive discussion with NREL regarding data format and reporting process
HYDROGEN INFRASTRUCTURE

Southeast Michigan

DTE Energy / BP Hydrogen Technology Park in Southfield, MI
- Technical data
  - Hydrogen produced by electrolysis
  - Vehicle Capacity: 15 kg Hydrogen per day
- Operation of Fueling station
  - Opening ceremony October 19th, 2004
  - Both DaimlerChrysler and Ford have already used the station
  - DaimlerChrysler customer will use consistently

EPA Hydrogen Fueling Station in Ann Arbor, MI (outside of DOE program)
- DaimlerChrysler customer fleet at UPS (F-Cell and Sprinter) fuel at the station on a regular basis

BP is undergoing negotiations with NextEnergy to build a hydrogen station
HYDROGEN INFRASTRUCTURE

Northern California
BP Mobile Hydrogen Refueler in Sacramento and in San Francisco Bay Area
- Technical data
  - 5,000 psi Dispenser
  - Usable capacity: 110 kg Hydrogen
- Fueling station
  - No Fuel Cell Vehicle operation at DaimlerChrysler customers until refueler in place
  - Mobile refueler will be delivered to the CaFCP in West Sacramento in April, 2005
  - BP finalizing agreement with CaFCP to allow refueling at West Sacramento facility

BP has identified sites and negotiations are underway for hydrogen stations in Sacramento and San Francisco (suppliers of equipment and technology evaluated for permanent stations)

Southern California
SCAQMD Fueling Station in Diamond Bar (outside of the DOE program)
- DaimlerChrysler customer fleet at UPS in Ontario, CA
  - Fueling on a regular basis

LAX Fueling Station (outside of DOE program)
- Dedicated October 22nd, 2004

BP is evaluating potential sites for a permanent station in Los Angeles area (suppliers of equipment and technology evaluated for permanent stations)
SAFETY PLAN

Project Safety Plan
Correlated with individual fueling station, local government, and corporate standards
Cooperative efforts with energy partners in progress

- FMEA
- Risk Mitigation
- Site Acceptance Testing
- Emergency Response Plans
- Standard Operating Procedures (Maintenance plans, operational manuals)
- Training and Education (customer training, vehicle service)
CUSTOMER ACCEPTANCE STUDY

Kick-Off Meeting:
February 2nd, 2005

Core question:
- What can be learned for future development and marketing of alternative drive train vehicles out of first user experiences with F-Cells?

Deliverables:
- "It is critical to understand the customer expectation and acceptance of fuel cell vehicles." (SOW)
- Customer Expectations
- Market Analysis
- Business Environment Trends

Main components in 2005

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<td>Modification of IA test tool used in Germany. Built upon Future scenario work and first results of market analysis (steps 1 and 2).</td>
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Publications and Presentations

DOE Signing Ceremony

March, 29th, 2005

- Media Coverage by CNN, CNBC, and ABC
- Other Coverage
  - USA Today
  - Michigan Radio
  - AP
  - Bloomberg
  - Business Week
  - Business Week TV
  - Auto Tech
  - Detroit Free Press
  - The Toronto Star
FUTURE WORK

Plans for 2005

- **Fuel Cell Vehicle**
  - Deliver remaining vehicles to customers in Michigan and California
  - Fully establish the data acquisition system
    - Begin analysis of performance data to meet DOE targets
- **Hydrogen Infrastructure**
  - Install and utilize two mobile refuelers in California
  - Continue site preparation and permitting process for four stationary hydrogen refueling stations (two in Northern California, one in Southern California, and one in Michigan)
- **Safety**
  - Maintain project safety through continued FMEA updates, vehicle and infrastructure training, education, and emergency response drills, emergency responders training
- **Communications and Customer Relations**
  - Communicate technology advancements to press and public and perform extensive customer acceptance studies
Supplemental Slides
The most significant hydrogen hazard associated with this project is:

Hydrogen Release in a maintenance garage due to fire

Our approach to deal with this hazard is:

- Safety Measures:
  - Vehicles are not to be driven into the workshop with hydrogen if there are integrity concerns (such as warning lights in dashboard)
  - Conventional Building Code: Fire Suppression System
  - Fire & Smoke detection connected to hydrogen mitigation system
  - Hydrogen Leak Detection and Mitigation System at every DaimlerChrysler maintenance Facility
Air Products Mobile Hydrogen Refueler in California
CUSTUMER ACCEPTANCE STUDY

Basic Concepts and Methods

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<th>2005</th>
<th>2006</th>
<th>2007</th>
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<td><strong>Phase 1:</strong> Preparatory &amp; Future Scenarios</td>
<td><strong>Phase 2:</strong> Empirical Studies I</td>
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