

# DAIMLERCHRYSLER

## HYDROGEN TO THE HIGHWAYS

### **Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project**

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April 22<sup>nd</sup>, 2005

This presentation does not contain any proprietary or confidential information

Project ID #:  
TV9



## PROGRAM OVERVIEW

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

- Cooperative Agreement signed December 22<sup>nd</sup>, 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)





# OBJECTIVES

## Overall Program Objectives

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**

Performance Measure	Units	2009 Performance Target	2015 Performance Target
Fuel Cell Stack Durability	Hours	2000	5000
Range	Miles	250	300
Hydrogen Cost at station; On- or Off-site Production	\$/kg of H2	\$3.00	\$1.50

“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

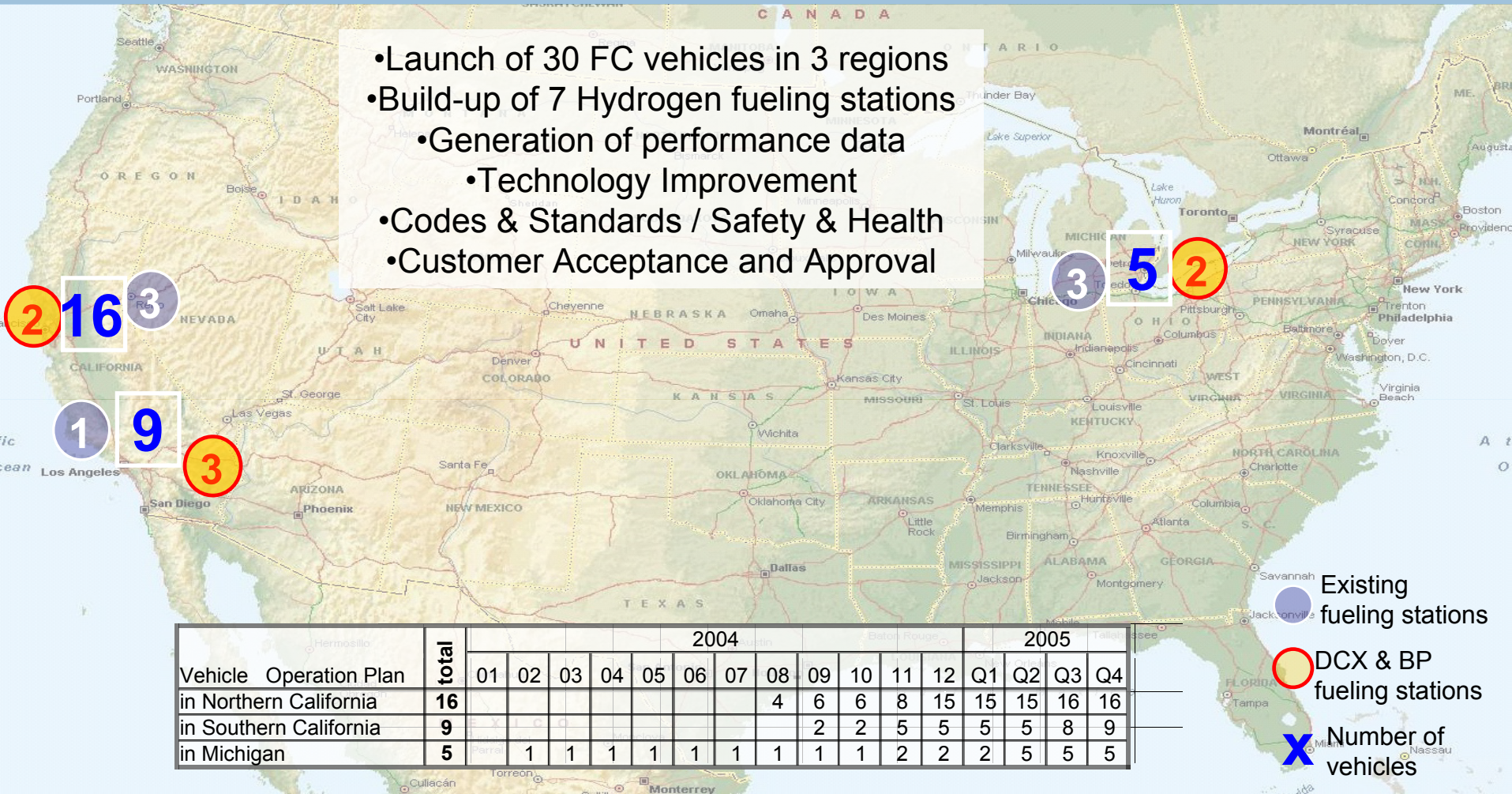
***Create a broad database to evaluate status quo of Fuel Cell Vehicles and Hydrogen as alternative fuel.***





# APPROACH

- 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





## TECHNICAL ACCOMPLISHMENTS

### 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

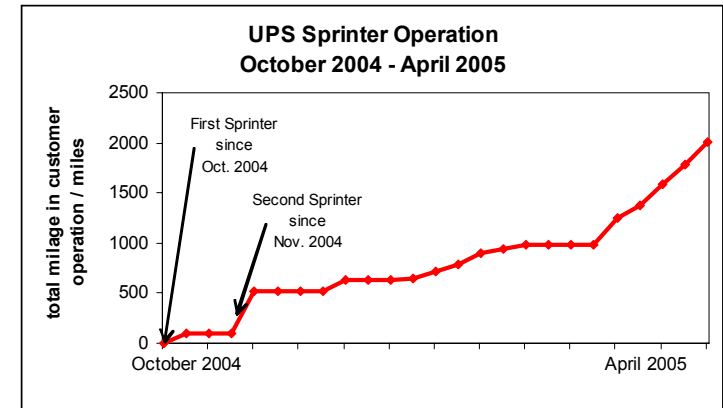
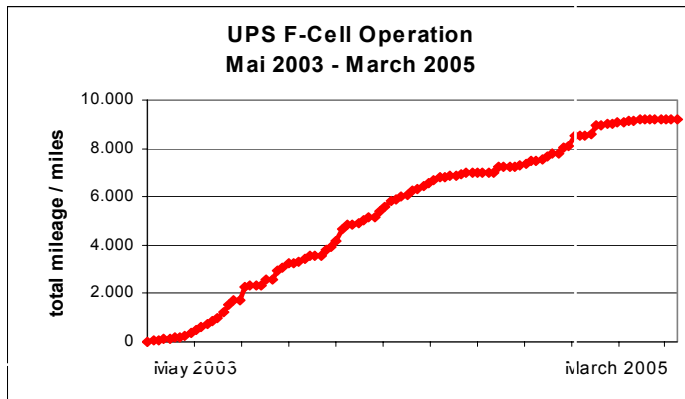


Technical Data	
Fuel Cell System	PEM, 72 kW (97hp)
Fuel	Compressed Hydrogen (350 bar / 5000 psi)
Traction Battery	NiMH, air cooled Capacity: 6.5Ah
Vehicle	Max. speed: 87 mph Range: 100 miles

## Fuel Cell Sprinter II (US)



Technical Data	
Fuel Cell System	PEM, 72 kW (97hp)
Fuel	Compressed Hydrogen (350 bar / 5000 psi)
Traction Battery	NiMH, air cooled Capacity: 6.5Ah
Vehicle	Max. speed: 80 mph Range: 155 miles







# FUEL CELL VEHICLES SERVICE FACILITIES



Service Facility at CaFCP  
West Sacramento



Service Facility at MBUSA  
Emissions Lab in Ann Arbor



Service Facility at MBUSA  
Emissions Lab in Long Beach



## 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





# DATA COLLECTION

**On-Board System:**  
Recording of fuel cell system  
and vehicle parameters

30 Fuel Cell vehicles have been equipped with  
FDA systems



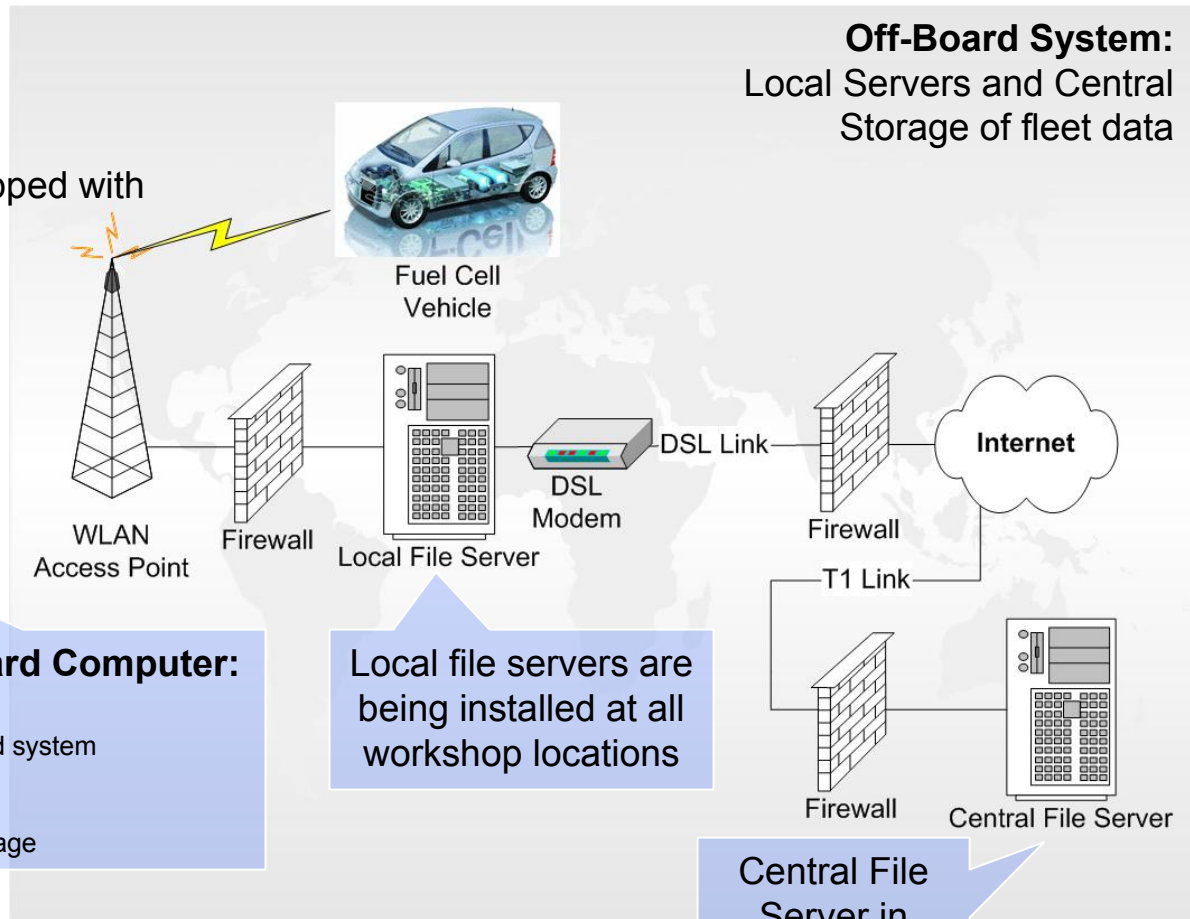
**On-Board Computer:**

- 600MHz
- Embedded system
- GPS
- CAN-Bus
- Mass storage

**On-Board System:**

- Integrated with existing navigation unit
- Powerflow display
- Technician displays

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

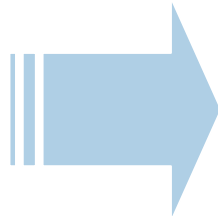




# DATA COLLECTION

## 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



**DaimlerChrysler F-Cell - Fleet Data Acquisition (FDA)**

Christof Nitsche | Abmelden | 10.03.2005 | English

**Ausgewählte Ereignisse**

Suchen Sie nach interessanten Ereignissen. Alle Suchkriterien sind optional.

**Suchbedingungen**

Trigger:

Lokaler Server:

Fahrzeug:

**DaimlerChrysler F-Cell - Fleet Data Acquisition (FDA)**

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**Statistik Datenübertragung**

Die folgenden Diagramme stellen die von den lokalen Servern empfangenen Datenmengen dar.

**Gesamtes Übertragungsvolumen [MBytes]**

Location	Volume [MBytes]
Ann Arbor	~200
Berlin	~200
Long Beach	~100
Nabern	~10000
Sacramento	~5000
Tokyo	~1000



# 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 19<sup>th</sup>, 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 22<sup>nd</sup>, 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 2<sup>nd</sup>, 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

	Title	Content	Comments
1	In-depth interviews with F-Cell partner organization (main contact person)	<ul style="list-style-type: none"> <li>• Semi-structured about motivation, usage of vehicle, expectations</li> <li>• Organizational profile</li> <li>• Working basis for future research activities</li> </ul>	STRG Palo Alto only
2	Market analysis of innovation and new technology	<ul style="list-style-type: none"> <li>• Learn about peoples view on new technology within established products</li> <li>• T.b.d. (group discussion likely)</li> </ul>	In co-operation with UC Berkeley
3	Future scenarios	<ul style="list-style-type: none"> <li>• Future business environment scenarios for fuel cell vehicles (identification of key factors; regulation, fuel prices)</li> </ul>	Update of Market Diffusion Scenarios through 2020 (1998)
4	Information Acceleration (IA)	<ul style="list-style-type: none"> <li>• Modification of IA test tool used in Germany</li> <li>• Built upon Future scenario work and first results of market analysis (steps 1 and 2)</li> </ul>	In co-operation with UC Berkeley





# COMMUNICATIONS

## Publications and Presentations

### DOE Signing Ceremony

March, 29<sup>th</sup>, 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





## SUPPORT

# Supplemental Slides



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## HYDROGEN SAFETY

### 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



# HYDROGEN INFRASTRUCTURE

## Air Products Mobile Hydrogen Refueler in California



Technical Data Sheet



**EQUIPMENT: AIR PRODUCTS HYDROGEN FUELER**

Design Parameters	Specification	Units of Measure
Service Pressure	6900	PSIG
Total Capacity	150	kg
Usable capacity @ 5,000 psig dispensing	110	kg
Dispensing Pressures	5,000 (standard) 3,600 (optional, not included)	PSIG
Trailer Length	27	FEET
Trailer Width	8	FEET
Total Weight	~42,000	LBS.
Utilities Required	None	

**DISPENSER DETAILS:**

Item	Details
Vehicle Interface	SAE J2600 Compliant, Drive away / Breakaway Protection
Wireless Telemetry	Standard
Vehicle Interface	Per Califormax Fuel Cell Partnership I/O Standard Revision 6
Fill Types	California Fuel Cell Partnership Compliant – Type3 Standard, Type 1 Optional
Fill Method	PLC Automated Eight Tube Cascade
User Interface	Controlled Personnel Access

**EQUIPMENT DETAILS:**

Description	Material	Details/Comments
Storage Vessels	Carbon Steel	Per DOT requirements
Valves	Stainless Steel	Per ASME B31.3
Relief Vent	Stainless Steel	Minimum 8' above grade
Pressure Relief Devices	Stainless Steel	Per ASME B31.3 and DOT

**SITE REQUIREMENTS:**

Item	Details
Foundations Required	None – Can be sited on Macadam Surfaces, but need support for landing gear
Electrical	None – Self Contained Power
Water	None Required
Phone	None – Wireless Communications included
Grounding Rod	Required when not parked on concrete
Siting Distances	Per NFPA 50A – See Air Products for Site Evaluation

**TRANSPORTATION REQUIREMENTS:**

Item	Details
CFR 49	Compliant
Transport Requirements	Commercial Drivers License with Hazmat Certification
Hitch Requirements	Fifth Wheel, Dual Axle Tractor

**AIR PRODUCTS ADDITIONAL SERVICES**

- HYDROGEN REPLENISHMENT
- DELIVERY AND PICKUP
- USAGE TRACKING
- KNOWHOW® HYDROGEN SAFETY TRAINING





# CUSTOMER ACCEPTANCE STUDY

## Basic Concepts and Methods

2005	2006	2007	2008
<b>Phase 1:</b> <i>Preparatory &amp; Future Scenarios</i>	<b>Phase 2:</b> <i>Empirical Studies I</i> <b>Phase 3:</b> <i>Mid-project Results &amp; Integration</i>	<b>Phase 3:</b> <i>Mid-project Results &amp; Integration</i> <b>Phase 4:</b> <i>Empirical Studies II</i>	<b>Phase 5:</b> <i>Final Analyses &amp; Outlook</i>

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