Overview

Timeline
• Project Start = 10/1/04
• Project End = 9/30/11
(Project is in Phase 2 vehicle demonstration with Technology Insertion element “in process” with 10 baseline and 10 Technology Insertion FCEVs)
• Percent complete: 94%

Budget
• Total project funding
  – $38.7 M DOE share
  – $38.7 M GM share
• Funding received in FY10: $4.2 Million
• Funding for FY11: $4.6 Million

Barriers
• Vehicles
  – Vehicle range and fuel cell (FC) durability
• Hydrogen Fueling Infrastructure
  – $H2/gge
• Maintenance and Training Facilities

Gen 2 Partners - 2010
Vehicle operators
• Project Driveway customers and drivers
• U.S. Postal Service
  (Operated 2 vehicles to deliver mail)
• City of White Plains, NY
• University of California at Irvine
• Department of Sanitation – New York City
• Port Authority of NY and NJ
• Monroe County, NY
• Air Products and Chemicals, Inc., PA
Relevance

Program Objective

• General Motors worked with energy partner Shell Hydrogen to deploy a system of hydrogen fuel cell electric vehicles integrated with a hydrogen fueling infrastructure to operate under real world conditions
  – Demonstrate progressive generations of fuel cell system technology
  – Demonstrate multiple approaches to hydrogen generation and delivery for vehicle fueling
  – Collect and report operating data

Past Year Objectives – Execute next generation of fuel cell technology

• Work with vehicle operators to obtain hours and data
• Collect, analyze, report data from program vehicles and fueling locations
• Operate and maintain fueling stations and provide data
• Start FCS accelerated durability testing

Current Year Objective

• Operate Technology Insertion and Baseline vehicle fleets
• Operate FCS accelerated durability testing
• Collect, analyze, report data from Technology Insertion and Baseline vehicles and accelerated durability testing
Approach

Demonstrate fuel cell electric vehicles
  • Deploy fuel cell electric vehicles (FCEVs) in various terrains, driving conditions, and climates including cold weather
  • Demonstrate two generations of fuel cell technology
    – Insert Technology with recent advances to test Gen2 learnings

Operate hydrogen stations for public fueling
  • Install and operate total of eight fueling stations on East and West coasts
  • Explore hydrogen generation/delivery options such as electrolysis

Focus on accumulating durability hours
  • More intensive operation of vehicle fleet
  • Work with commercial customers
  • FCS accelerated durability testing

Generate and report data required under the Program
  • Capture vehicle on-road and dynamometer test data
  • Capture hydrogen infrastructure production/fueling data

Evaluate Vehicle performance against Targets
  • Vehicle range, stack durability, cold weather performance
Technical Accomplishments and Progress

Vehicle and Fueling Station Implementation

- Benning Rd
- Santa Monica, Ardsley, White Plains
- JFK, Bronx, Culver City
- LA
- Station Commissioned
- Station Closed

Number of Vehicles

Gen1
Gen2
Tech Insertion

2005
2006
2007
2008
2009
2010
2011
Objective: Collect and Report operating data

- Across three generations of vehicles, 23% of the miles are from Technology Insertion vehicles
Objective: Demonstrate FC vehicles under real-world conditions

Continue Long-Term Testing of Project Driveway Vehicles
- Over 100 Chevrolet Equinox Fuel Cell Electric vehicles
  - 20 Program vehicles 3+ years old with 40-50K miles
- Launched in late 2007 continuing through 2011
- Markets with diverse climates and conditions:
  - Southern California
  - Washington, D.C.
  - Greater New York City metropolitan area

2010 Focus/Accomplishments
- Accumulated significant mileage/hours on vehicles
- Worked with commercial/fleet customers
- Stack durability data confidence increased
- Technology Insertion – data on new controls/materials
Objective: Vehicle Range and Fuel Cell Stack Durability

Stack Durability improves as successive iterations mitigate failures

- Failure Mode A
- Failure Mode B
- Failure Mode C
Technical Accomplishments and Progress

Objective: Demonstrate progressive generations of fuel cell system technology

Gen2 Technology Insertion
- Advanced hardware, diagnostics and software controls developed from Gen2 learnings are implemented in the Gen2 Technology Insertion vehicles.

FCS accelerated durability testing
- Stressors
  - Reduce stack damage caused by vehicle startup/shutdown
  - Reduce effects of voltage cycling on stack
  - Remove stack contaminants
  - Humidity control
- Assess Improvement
  - Test various material sets for durability
  - Testing of new hardware, components and controls algorithm other than stack
Objective: Cold Weather Performance

- Vehicles in the eastern region performed 2,913 starts at ambient temperature less than 0°C without any issues.

- GM Vehicles exhibited very fast cold start/driveaway times under sub-freezing temperatures.
Technical Accomplishments and Progress

Objective: Demonstrate multiple approaches to hydrogen generation and delivery for vehicle refueling

- www.sustainability.rit.edu/csm.html
  “Analysis of FC Equinox and Green Hydrogen”
- Video emphasis on renewable pathway in use (play video here) tv005_stottler_slide_11.wmv
Technical Accomplishments and Progress

Objective: Demonstrate multiple approaches to hydrogen generation and delivery for vehicle refueling

- First agreements to purchase fuel “by the kilogram”
- Launching new relationships with H2 stations outside original project stations
  - Rochester Institute of Technology
  - Town of Hempstead, NY
  - SunHydro, Wallingford, CT
Collaboration

- Individual “retail” customers
- Fuel providers/suppliers/infrastructure equipment
  - Air Liquide (dispensing equipment)
  - Air Products
  - Praxair (“Green Hydrogen”)
- State/university collaborations
  - UCI
  - CaFCP
  - RIT
- NREL (methodology development)
- Business-to-Business fleet Applications
  - Port Authority of New York and New Jersey (siting of fuel dispensing)
  - Air Products and Chemicals, Inc. (vehicle outreach and station utilization)
- Agencies
  - U.S. Department of Defense (Army, Navy/Marines, USAF)
    - Launching Hawaii demonstrations
  - U.S. Postal Service (>1 million pieces of mail in Gen2)
  - Department of Energy
  - D.C. Department of Transportation
- Influential
  - Various WDC dignitaries, policy makers and celebrities
Proposed Future Work - 2011

- Accumulate as much vehicle Fuel Cell Stack durability data as possible during the remainder of the program.
- Complete FCS Accelerated Durability testing.
- Conduct End-of-Program dynamometer testing.
- Complete Final Technical Report
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Program learnings moving us towards
Commercial product

Equinox

Commercial