



CENTER FOR TRANSPORTATION
AND THE ENVIRONMENT

Hydrogen Fueling Infrastructure and Fuel Cell Bus Demonstration Program in Columbia, SC

Fuel Cell Seminar
November 18, 2009
Palm Springs, CA

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Agenda

- Background
- Fuel Cell Bus Project
- Hydrogen Fueling Station Project
- Results So Far
- Lessons Learned



Background

Fuel Cell Bus Project

- An Initiative of FTA's National Fuel Cell Bus Program

Hydrogen Fueling Station Project

- An initiative of the Greater Columbia Fuel Cell Challenge



Common Goal: Technology Development



Bus Project



Fuel Cell Bus Team



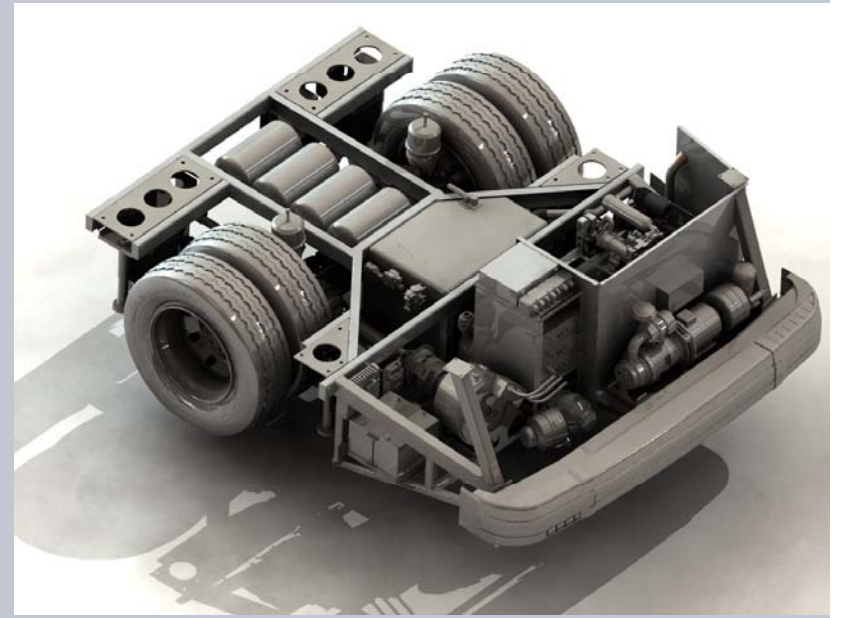
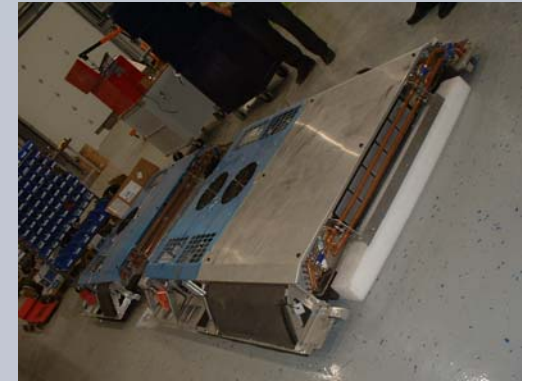
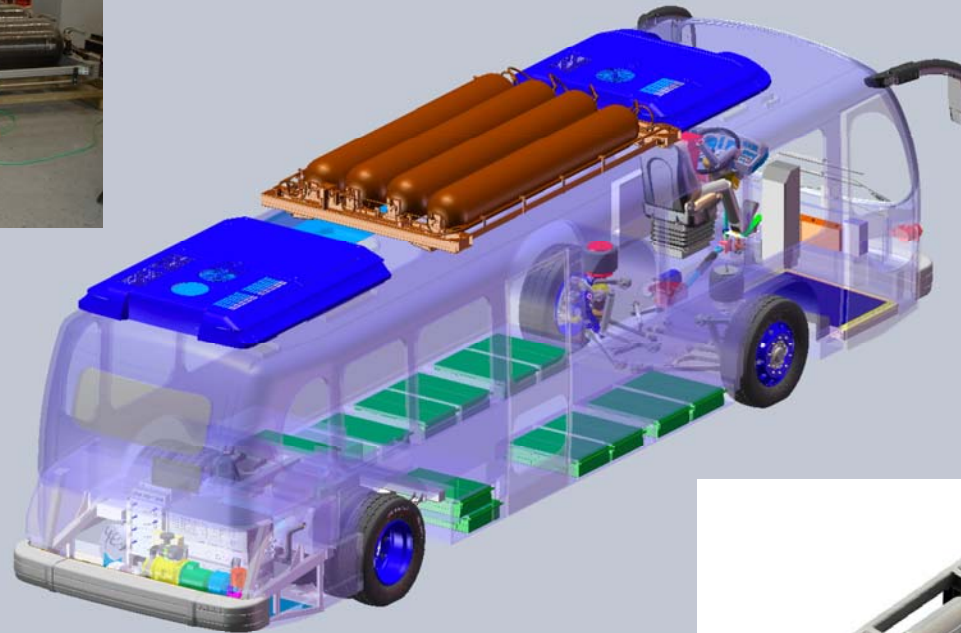
U.S. Department
of Transportation
**Federal Transit
Administration**



PROTERRA
EXCELLENCE IN BUILDINGS FROM GLOBAL TRANSPORTATION



Innovative Design

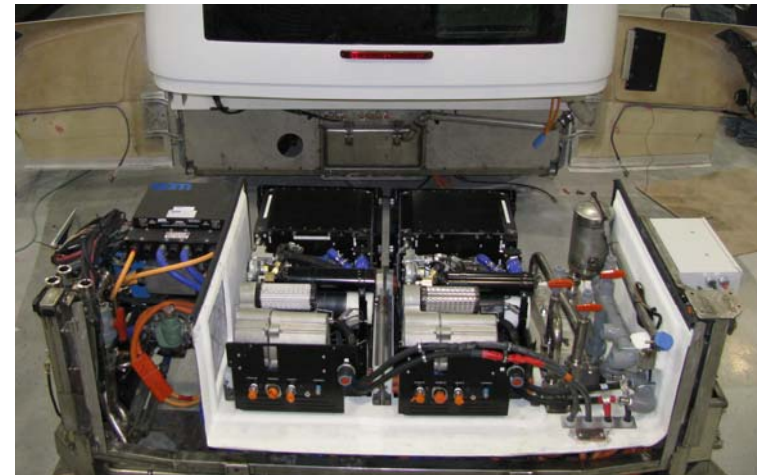


Bus Tour



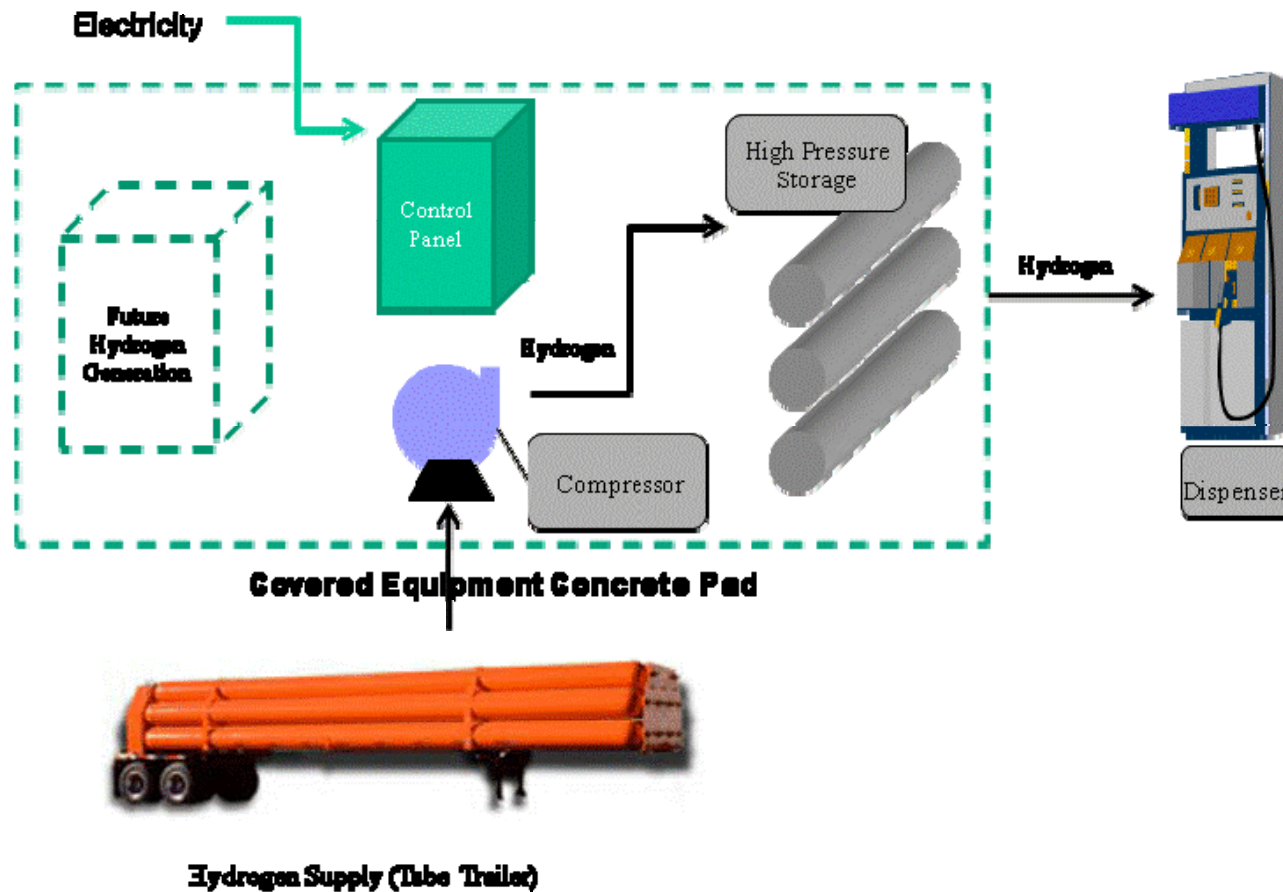
Fuel Cell Bus Specs

Top Speed	55 mph
Battery Capacity	55 kWh @ 350 volts
Range (battery + Hydrogen)	300 miles
Range (battery only)	40 miles
Fuel Consumption	1.1 kg/hr
On-board Capacity	29 kg @ 5,000 psi
Length	35'
Curb Weight	27,000 lbs
Capacity	37 seated
Fuel Cell	Two 16 kW PEM
Drive Motor	Permanent Magnet 150 kW
Body Construction	Hybrid Composite



Fueling Station Project

Integrated Hydrogen Supply System



Fueling Station Team

- South Carolina Research Authority
 - Gas Technology Institute
 - Greenfield Compression
 - University of South Carolina
 - CTE
-
- The Boudreaux Group
 - Mashburn Construction



Fueling Station Specifications

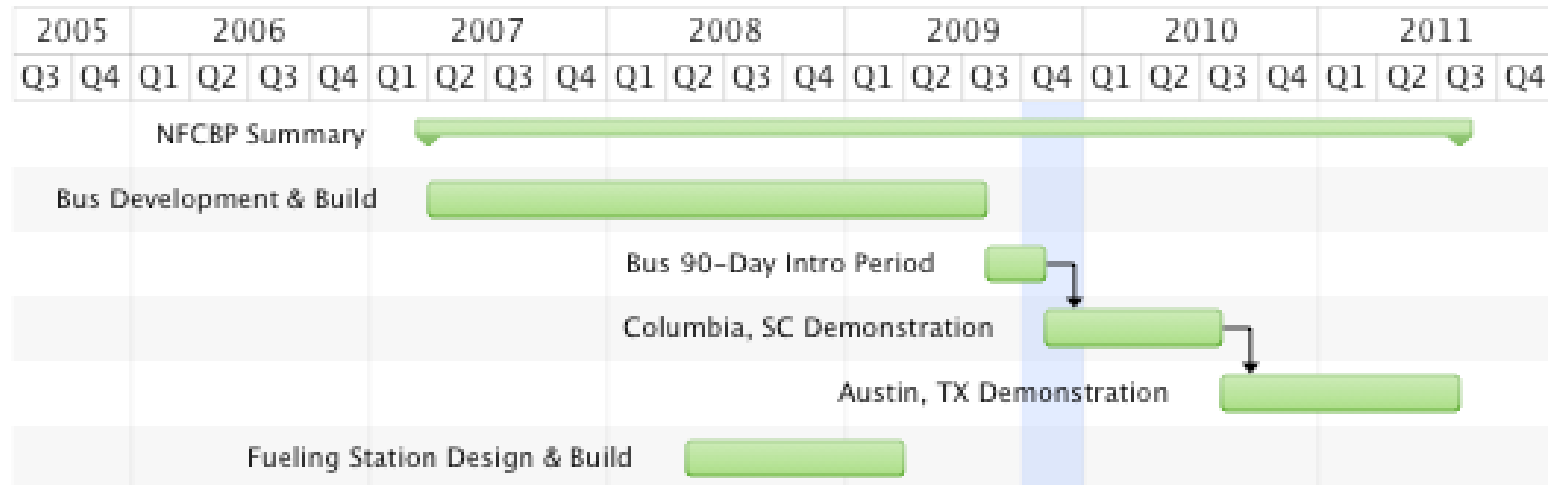
- 66 kg storage capacity with daily maximum capacity 120 kg per day
- 7,000 psi max storage with 5000 psi dispensing
- Remote operation and monitoring capability
- Fast-fill non-communication based dispensing
- Passenger vehicle fueling under 5 minutes
- Conforms to all building and safety codes
- Designed for expansion to on-site generation capabilities
- Quiet operation – less than 65 dB at 20 feet
- Future flexibility possible for multiple fuels



Fueling Station Completion



Combined Schedule



Status and 90-Day Introductory Period

- Bus Delivered to Columbia on August 7, 2009
- Intro Period
 - Bus Familiarization
 - Acceptance Testing
 - Public Events
 - Route Verification
 - Data Collection Process Validation
 - Charging/Fueling Process Validation
 - Training - Driver and Maintenance
 - Titling, Licensing, Leasing, Insuring
 - Shadow Service
 - Setting Expectations
 - Establishing System Safety Plan



Demonstration Stats (as of 11/18/09)

	Refueling time		Hubmeter	Fuel Station	Bus Tank Pressure		Dispensing Rate	# Fueling Events
	<i>min</i>	<i>sec</i>		H2 Dispensed	Before	After		
	<i>min</i>	<i>sec</i>	<i>miles</i>	<i>kg</i>	<i>psi</i>	<i>psi</i>	<i>kg/min</i>	
Total:	280	25	805.0	159.1				18
Average:	15	35		8.4	2650.0	4185.0	0.5	



Bus Maintenance



Early Results - Altoona Testing

Route/Duty Cycle	Battery Only Fuel Economy (diesel equivalent)	Projected Fuel Cell Hybrid Fuel Economy
Central Business District	21.35 mpg	11.39 mpg
Arterial	17.55 mpg	9.36 mpg
Commuter	29.23 mpg	15.59 mpg

- *At Seated Load Weight (37 Passengers)*
- *Full Fast Charge In Around 10 Minutes*



Challenges & Successes

FUELING STATION

- Challenges
 - Scoping
 - Lack of Vehicles to Fill & Shakedown System
- Success Strategies
 - Clear Expectations
 - Common Project Management with Vehicle Side
 - Event Driver
 - Flexibility of Team and Stakeholders
 - Reliable Team

FUEL CELL BUS

- Challenges
 - Innovative Technology
 - First Article
 - Setting Expectations
- Success Strategies
 - Motivated Bus Developer
 - Flexibility of Team and Stakeholders
 - Purpose Built
 - Experienced Team
 - Parallel Activity Scheduling



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Questions?

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