



February 24, 2011

International Fuel Cell Bus Presentation



NAVC History

- NAVC established in 1993 as one of seven regional consortia under the DARPA Electric and Hybrid-Electric Vehicle Program
- Board of Directors appointed by eight Northeastern States, the City of New York, NESCAUM and The New England Governor's Conference
- Major Programs: DARPA, DOT, NIST, FTA as well as private foundation funding
- >\$121M programs funded since inception



History

Early Projects

Electric and Hybrid demonstration projects throughout the Northeast covering every New England State

Reports

- Future Wheels 1 & 2
- 100k downloads each

Successes

Numerous deployments including hybrid bus deployments in New York City and...



Citivan

NAVC funded a start-up called Solectria under EV/HEV

- Designed, Funded and Managed Citivan project
- Precursor to Azure - Ford Transit Connect Electric Van



TPI Composite Bus

NAVC funded and managed the TPI composite bus

- First all composite bus
- Acquired by NABI and precursor to the CompoBus



Bus Projects

- Hybrid Analysis For New York City Transit
- TCRP (Transit Cooperative Research Program) Report on Hybrid Buses
- Hybrid Working Group led to adoption of SAE J2711
- Northeast Clean Bus Committee
- Electric Bluebird School Bus
- Portland: Six electric buses deployed as part of three year program
- MassPort: Testing of natural gas, electric, and hybrid-electric buses



Projects with United Technologies

DARPA - Agreement MDA972-94-2-0005

- 1994 “Demo: Flywheel Surge Power Unit”
- 2001 “UPS Fuel Cell Hybrid 21,000 lbs. GVW Delivery Van”

RSPA - Agreement DTRS56-99-T-0015

- 2002 “Development and Fabrication of a PEM Fuel Cell Power Plant for Heavy Duty Vehicle Operations”
- 2002 “Drive Line Development Team and Industry Work Group”
- 2002 “Route Ready’ Fuel Cell Component Testing”

FTA NFCBP - Agreement FTA-MA-04-7002

- Present: “Nutmeg Program”



NAVC/NFCBP - UTC

UTC Power - “Nutmeg Program”

Program Goals

Manufacture and operate 4 fuel cell buses; gather critical performance data which will lead to improved durability, reliability, and reduced capital costs

Elements of Plan

- Procure hybrid buses through a bus supplier
- Develop technology intended to increase durability of the fuel cell system
- Integrate the latest fuel cell power system into 4 buses and deploy the buses at CT Transit for revenue operation
- Instrument the buses to gather data on operation
- Work with other transit agencies to allow buses to be operated in alternate locations



NAVC/NFCBP - UTC

UTC Power - “Nutmeg Program”

Project Partners

ORGANIZATION	ROLE	FUNCTION
UTC Power	Technology Lead	Coordinate program, provide fuel-cell power system and fuel cell technology
CT DOT and CT Transit	Transit Operator	Operates buses within Connecticut
Van Hool NV	Bus Manufacturer	Fabricates and integrates hybrid buses
Other Transit Agencies TBD	Transit Operator	Will operate in transit service in areas outside of CT



NAVC/NFCBP - GE

GE Global Research - “Light-Weight Fuel Cell Hybrid Bus”

Program Goals

Develop a lightweight hybrid fuel cell bus using a 75 kw fuel cell with an advanced drive system by GE incorporating Sodium energy and Li-ion batteries. The bus will be demonstrated in service with CDTA.

Elements of Plan

- Trade Study and System Design
- Investigate advanced Sodium Battery development, traction control and energy management systems.
- Create a “mule” vehicle to validate model predictions and system designs
- Develop a light-weight hybrid fuel-cell bus that will be demonstrated in-service



NAVC/NFCBP - Nuvera

Nuvera Fuel Cells - “MA Hydrogen Fuel Cell Powered Bus Fleet”

- Fuel Cell Bus at Logan International Airport
- Hydrogen Refueling Station at Logan Airport

Program Goals

The Massachusetts program seeks to demonstrate a “Total Transit Solution” (TTS) consisting of one fuel cell bus and one natural-gas-based hydrogen refueling station at Logan International Airport in Boston, MA

Elements of Plan

- Fuel Cell Engineer, Build and Test
- Powertrain Engineer and Production
- Bus Integration and Test
- H2 Station Design, Eng., & Installation
- In service Operation



NAVC/NFCBP - Nuvera

Nuvera Fuel Cells - “MA Hydrogen Fuel Cell Powered Bus Fleet”

Project Partners

- | | |
|----------------------------|--|
| - Nuvera Fuel Cells | Supplier of FC engine & H2 refueling station |
| - Massport | Bus operator (via Paul Revere Transportation) |
| - BAE Systems | Bus supplier, vehicle integrator and onsite support |
| - Fiat/Evotech | Design & Build Fuel Cell Engine |
| - AVSG
station | Permitting , installation, and operation of the H2 refueling |
| - National Grid | Natural gas supplier |
| - MBTA | Project advisor and technical support |

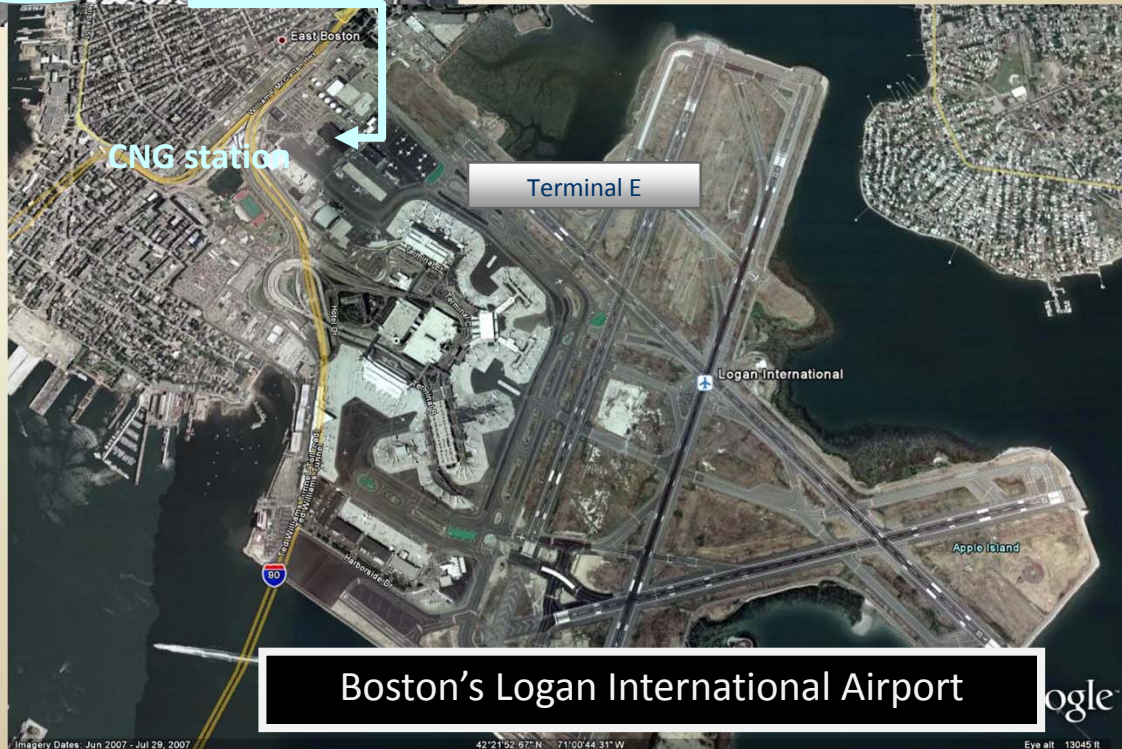


NAVC/NFCBP - Nuvera

PowerTap Hydrogen Refueling Station Location



- Hydrogen Station to be co-located with existing CNG station run by AVSG
- Completed site survey
- Met with MassPort agencies regarding permits and safety
- Bus to run on airport route(s)



Boston's Logan International Airport



Future Projects

NAVC continues to diversify by exploring other alternative fuel sources in the Northeast Region with an emphasis on the enormous natural gas deposits developed in the last five years in the Northeast



Thank You!

Questions?

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