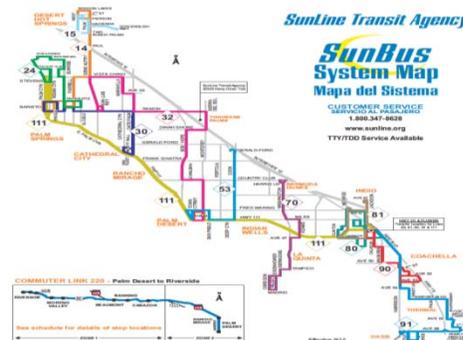




## THE STATE OF THE AGENCY

### SunLine Facts:

- Operates eleven routes.
- Provides service in an area of 1,120 square miles.
- SunLine is the consolidated transportation service agency in the Coachella Valley.
- Serves over 4.5 million riders in the Valley.





### MISSION STATEMENT

*To provide environmentally conscious public transportation services and alternative fuel solutions to meet the mobility needs of the Coachella Valley.*

### AGENCY GOALS

- To provide dynamic organizational leadership and change consistent with the growth of the Transit Agency.
- To continue the advancement of innovative transportation and alternative fuel technologies.
- To provide leadership for the region's mobility needs.
- To provide high quality transportation services that are safe, efficient and effective.



## LEADERS IN ALTERNATIVE FUEL TECHNOLOGY Early & Current Hydrogen Projects



1<sup>st</sup> Generation



2<sup>nd</sup> Generation



3<sup>rd</sup> Generation



4<sup>th</sup> Generation



5<sup>th</sup> Generation



6<sup>th</sup> Generation



7<sup>th</sup> Generation

***SunLine's Seven Generation Hydrogen fueled buses have traveled over a half a million miles serving our customers in the Coachella Valley!***



**6<sup>th</sup> Generation**  
**Advanced Tech New Flyer Ballard ISE Fuel Cell Bus**

- Accumulated > 65,000 miles on vehicle to date
- New Flyer/ H40 LFR
- Fuel Cell/ Ballard FC velocity HD 6 150 kW
- Hybrid Sys/ Siemens ELFA hybrid-electric hybrid drive integrated by Bluways/ISE
- Lessons learned
- Loss of technology partners
- Proprietary software not available
- The need for technician training



 **8<sup>th</sup> Generation**   
**American Fuel Cell Bus Project**



**Project Start-up and Mitigations for Early Issues**



# AFCB Overview



- AFCB delivered to SunLine Transit in November 8, 2011.
- Bus Unveiling event hosted by SunLine on Nov. 14, 2011
- Bus Entered Service in December 2011
- Data Collected by SunLine transit and delivered to NREL
- Data “clean point” established starting March, 2012
- Through Feb, 2013, American Fuel Cell bus **averaged 85% Availability against a target of 85%, over the same period the CNG reference fleet averaged 76% available.**

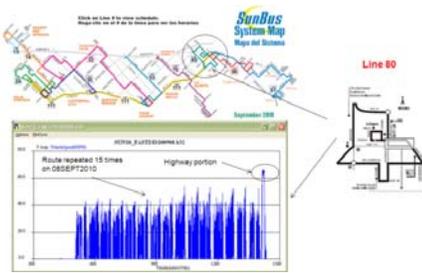





## What was done differently



- Complete “Hardware in the Loop” Integration in a Fuel Cell Systems Integration Laboratory (FC SIL).
- Permitted full integration and testing of fuel cell powered propulsion and accessory systems up to rated power.
- Integrated with dynamometer setup, allowed verification of vehicle system performance prior to integration on the vehicle
- Tested and optimized power and energy control algorithms for the American Fuel Cell Bus under real operating conditions





Fuel Cell System Integration Lab – Control Center BAE New York



Dynamometer Test Cell BAE New York



Fuel Cell in Test BAE New York

Results: No faults during 500+ mile pre-delivery testing  
 Bus able to go straight into service with very little “tweaking” - accelerated maturity



## American Fuel Cell Bus

### Start up and Corrective Actions for Early Issues



Date	Description	Solution
Dec. 2011	Hydrogen Storage System control valve leak	Replaced Faulty valve, Performed failure investigation: random defect, no systemic or latent issues expected in other valves
Dec. 2011	Hybrid Traction Batteries depleted after lengthy bus troubleshooting with accessories running and FC off	Added battery state of charge protection to prevent complete discharge when Fuel Cell is not running
Jan. 2012	Fuel Cell Hydrogen Recirculation Blower fault.	Replaced Blower - Warranty
Feb. 2012	Air Compressor motor tripping ground faults	Motor wet from bus wash water – replaced motor with Totally Enclosed Fan Cooled version
Mar. 2012 Apr. 2012	Fuel Cell ventilation filter clogging / vent fan intermittent	Replaced filter, discovered / corrected fan blade interference. Filter eventually upgraded to improved design and filter inlet "snorkeled" to cleaner air intake location.
June 2012	Air Compressor breaker tripping	Upgraded breaker to motor rated circuit protector
July 2012	Rear door exhibiting erratic operation. Air Conditioner compressor tubing failure. Bus taken out of service for extensive inspection at EIDorado.	Failed door sensor replaced. Door operation fixed and verified. Compressor not properly secured in AC unit, caused fatigue on tubing. Repaired tubing, secured compressor and recharged system. Other non critical upgrades performed by BAE Systems.

The Majority of issues were related to a new vehicle introduction and not Fuel Cell, Propulsion or Power Electronics

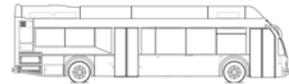
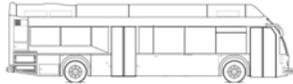
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## Preliminary Outcomes of the SunLine AFCBus


- The BAE Systems / EIDorado National Fuel Cell Bus has proven to be a dependable bus
  - The fuel cell bus was ready for service when delivered (very little tweaking and tuning) – Worked right out of the box
  - The bus went right into full-time service on SunLine’s most visible and demanding routes (the 27 mile long route 111)
  - Drivers fell in love with the bus
  - Passengers liked it too, preferring to ride on the FC bus
  - Transit Agency Technicians and Maintainers found it to be very maintainable
  - The cost to operate is somewhat higher than conventional buses however, this bus has clearly extended the trend in reduced operating cost for zero-emission, hydrogen technology.
  - Top down bottom up commitment from Agency to be successful and sustain this new technologies.
- 10



Coming Soon 8<sup>th</sup> Generation  
American Fuel Cell Buses



- FTA Awards of Funding to SunLine for Two Additional American Fuel Cell Buses!
- Secured FTA TIGGER funding in the amount of \$4.8 million for two additional buses to promote commercialization.
- Highly innovative, zero-emission fuel cell buses expected to play critical role in future of transit.
- Buses to be in service in 2<sup>nd</sup> quarter 2014.



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**American Fuel Cell Bus**