

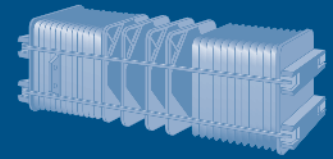
# FUEL CELL BUS DEMONSTRATION PROJECTS

Hydrogen, Fuel Cells & Infrastructure Technologies Program



U.S. Department of Energy  
**Energy Efficiency and Renewable Energy**

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## SunLine Expands Horizons with Fuel Cell Bus Demo

### SUNLINE TRANSIT AGENCY

is a joint powers authority that provides public transit and community services to California's Coachella Valley. Headquartered in Thousand Palms, California, SunLine's service area encompasses more than 1,100 square miles and includes nine member cities (Desert Hot Springs, Palm Springs, Cathedral City, Rancho Mirage, Palm Desert, Indian Wells, La Quinta, Indio, and Coachella), as well as Riverside County. The agency's fleet covers 12 routes and serves 320,000 permanent residents and 3.4 million tourists annually.

In December 2005, SunLine placed a prototype hybrid fuel cell transit bus in revenue service. SunLine's prototype vehicle was purchased as part of a four-bus procurement by Alameda-Contra Costa Transit District (AC Transit), based in Oakland, California. AC Transit has three buses in demonstration in its service area. The hot, dry desert environment in SunLine's territory will help further testing of the performance of fuel cell buses in multiple climates.

**SUNLINE WAS AN EARLY ADOPTER** of alternative fuels for bus operations. In 1994, it converted its entire bus fleet to compressed natural gas (CNG). The agency's fleet currently includes 48 full-size transit buses (40-foot), five mid-size transit buses (29-foot), 23 paratransit vehicles, and 35 light- and medium-duty support vehicles—all of which operate on CNG (a few operate on a blend of CNG and hydrogen).

Since the early 1990s, SunLine has pursued an aggressive course to build a fleet of clean fuel vehicles. After replacing its fleet with CNG buses, SunLine has continued to look for ways to further reduce or eliminate emissions. The agency has participated in many projects to evaluate advanced technologies, including buses that run on a hydrogen/CNG blend, fuel cells, and hybrid hydrogen internal combustion engines. Because of the experience gained by testing prototype fuel cell buses, SunLine is uniquely qualified to demonstrate these advanced buses.

The prototype fuel cell bus in service at SunLine is the result of a collaboration between UTC Power, ISE Corporation, and



This fuel cell bus is being demonstrated at SunLine Transit Agency.

NREL/PIX 14396

Van Hool. The bus uses a fuel cell power system manufactured by UTC Power in a hybrid electric drive system designed by ISE. The original design of the Van Hool A330 transit bus chassis was redesigned to integrate the fuel cell system. The bus has a low floor from front to back and three doors for easy passenger boarding.

### ISE's HYBRID SYSTEM is

a series configuration, meaning the powerplant is not mechanically coupled to the drive axle. The powerplant and energy storage system work together to provide electricity to two electric drive motors, which are coupled to the driveline through a combining gearbox. When the bus needs extra power, the powerplant and energy storage provide power to the drive motors. When the power requirements of the bus are low, the powerplant provides power and recharges the energy storage system.

The hybrid system is also capable of regenerative braking, which captures the energy typically expended during braking and uses it to recharge the energy storage system. Each component of the propulsion system is carefully controlled through an ISE-developed operating system.

ISE designed the system to be flexible. Depending on a client's needs, a variety of powerplants and energy storage



NREL/PIX 14395

A natural gas autothermal reformer by HyRadix produces hydrogen for the fuel cell bus at SunLine.

## SUNLINE FUEL CELL BUS FACTS

Bus Chassis	Van Hool, A330 Fuel Cell
Model Year	2005
Length/Width/Height	40 ft/102 in/11 ft, 5 in
GVWR/Curb Weight	43,240 lb/36,000 lb
Passenger Capacity	30 seated (or 26 seated, plus two wheelchairs), 18 standing
Drive System	ISE ThunderVolt® hybrid drive system
Electric Propulsion	Siemens ELFA Drive; two AC induction motors, 85 kW each (170 kW total)
Powerplant	UTC Power PureMotion™ 120, PEM fuel cell system, 120 kW continuous power
Accessories	Electrically driven for air, heating, and air conditioning
Fuel/Storage	Gaseous hydrogen, 50 kg at 5,000 psi, type III tanks by SCI
Energy Storage	ZEBRA® (nickel sodium chloride), three modules, 32 kW (95 kW total), 53 kWh storage
Brakes	Regenerative braking, four-wheel disc brakes
Range	250-300 miles
Emissions	Zero

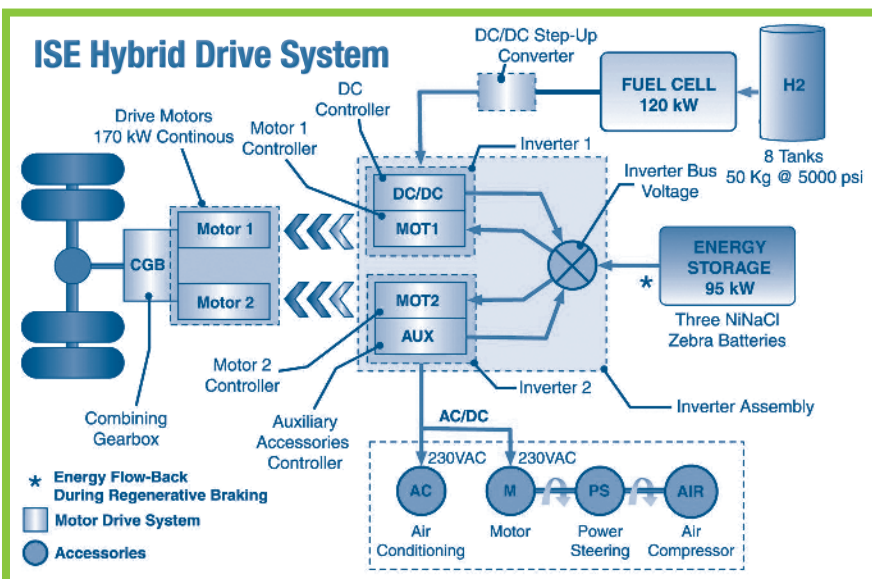
options can be integrated into the system. The bus at SunLine has a fuel cell powerplant and three ZEBRA® (sodium nickel chloride) batteries.

The primary power source for the hybrid system is UTC Power's PureMotion™ 120 kW proton exchange membrane (PEM) fuel cell system. UTC Power's fuel cells operate at near-ambient pressure, which eliminates the need for a compressor. This not only increases the efficiency of the system but results in a quieter operation.

**SUNLINE IS CURRENTLY COLLABORATING** with the U.S. Department of Energy's (DOE) Hydrogen, Fuel Cells & Infrastructure Technologies (HFCIT) Program on the evaluation of the fuel cell bus. The agency will run the bus in revenue service for at least two years. During this time, DOE's National Renewable Energy Laboratory (NREL) will collect and analyze performance and operations data.

This evaluation is one of several DOE projects that supports the research and development of highly efficient, low- or zero-emission fuel cell power systems and is consistent with HFCIT Program goals. Information gathered during the demonstration will help researchers assess the status of the technology and aid fleets in making informed purchase decisions.

Results will also be fed back into the research and development process to focus future resources, as appropriate.



### SunLine Partners

SunLine has the support of several partners in the demonstration. They include:

- Funding partners: Federal Transit Administration, California Air Resources Board (CARB)
- Demonstration partners: AC Transit and Golden Gate Bridge, Highway, and Transportation District
- Technology partners: ISE (hybrid propulsion system), UTC Power (fuel cell), Van Hool (bus chassis), HyRadix (natural gas reformer)
- Technical evaluation partner: NREL

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### Web Sites

**SunLine:** [www.sunline.org](http://www.sunline.org)  
**ISE:** [www.isecorp.com](http://www.isecorp.com)  
**UTC Power:** [www.utcpower.com](http://www.utcpower.com)  
**Van Hool:** [www.vanhool.com](http://www.vanhool.com)  
**DOE:** [www.eere.energy.gov/hydrogenandfuelcells](http://www.eere.energy.gov/hydrogenandfuelcells)  
**NREL:** [www.nrel.gov/vehiclesandfuels/fleettest](http://www.nrel.gov/vehiclesandfuels/fleettest)  
**CARB:** [www.arb.ca.gov/homepage.htm](http://www.arb.ca.gov/homepage.htm)  
**California Fuel Cell Partnership:** [www.ca4cp.org](http://www.ca4cp.org)

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### For more information contact:

**EERE Information Center**  
1-877-EERE-INF (1-877-337-3463)  
[www.eere.energy.gov](http://www.eere.energy.gov)

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