



## Santa Clara BEEs Hit the Street

Mid-November saw the official launch of the city of Santa Clara, Calif.'s Breathe Easy Express (BEE) hybrid-electric buses. The trio of buses, of which only two are currently in operation while problems with the third are worked out, seat 31 passengers (including two wheelchairs).

Each bus utilizes 30-kw twin propane-fueled Capstone MicroTurbine Corp. (Chatsworth, Calif.) microturbines to generate electricity to charge batteries during operation. The microturbines "add additional miles" to each bus's nightly recharge.

The BEE program provides peak commute time shuttle service between the Santa Clara train station and various work sites south of Highway 101 in the city of Santa Clara.

Started by Silicon Valley Power (SVP), Santa Clara's municipal electric utility, the free bus service is operated by Serendipity Land Yachts Ltd. (Santa

Clara). The goal of the project, in addition to providing environmentally-friendly transportation, is to show off new electric technology, including hybrid-electric buses.

Depending on variables such as weather, speed, capacity of the batteries, performance of the driver, efficiency of the propulsion system, and terrain, the BEE buses can operate about 120 miles between nightly "deep charges" thanks to the microturbines continually recharging the buses' gelled lead-acid batteries. The batteries are expected to last over 800 charge and discharge cycles.

The buses also recharge the batteries during the braking process, utilizing regenerative braking. As an electric vehicle slows down, the motor turns into a generator, adding electricity to the batteries. A goal in regenerative braking is to stop as slowly as possible to maximize energy produced and

since it means stopping with as little use of the brakes as possible, it increases brake life.

As for the environment, the propane-fueled microturbine hybrid buses produce ultra-low emissions, significantly less nitrous oxide ( $\text{NO}_x$ ) and particulates than a diesel bus.

The California Air Resources Board has found that the propane microturbines emit 0.53 g/brake horsepower-hour (bhp) of  $\text{NO}_x$  while the typical "clean" diesel bus puts out 3.9 g/bhp-hour. In terms of particulates, they put out 0.0041 g/bhp-hour, as compared to a diesel bus's 0.04 g/bhp-hour.

AmeriGas Propane is the fuel provider. The BEE buses, with 48-gal. tanks, refuel at their home base, where the company had a 500-gal. tank and refueling equipment installed. A Serendipity spokeswoman said it expects to take delivery of fuel once a week or so once all of the buses are in operation.

The BEE buses are part of a Propane Education & Research Council-funded project to improve propane-powered microturbine performance headed by the ADEPT Group Inc. (Los Angeles). Capstone develops its microturbines but doesn't work on developing the fuel system, which means microturbine buyers have to work out such details, including troubleshooting problems. ADEPT has also looked at microturbine issues in Los Angeles and in Galveston, Texas. —Pete Ottman