

CURRENT

Electric Transportation News From Southern California Edison

Special Electric Bus Issue

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Electric Bus Use: Growth Continues

Electric buses offer tremendous benefits to both their operators and riders: the buses produce no tailpipe emissions, helping to improve air quality; like all buses, they reduce traffic congestion, further contributing to emissions reductions; they operate quietly; and they use domestic fuel sources.

Santa Barbara Buses Top Million-Mile Mark

The Santa Barbara Metropolitan Transit District (MTD) recently was honored by the Electric Vehicle Association of the Americas (EVA) with an induction into the EVA's "Million-Mile Club"—designed for companies and organizations that have logged more than 1 million miles moving people with electric transportation.

The MTD introduced its first electric bus in January 1991, and today operates 27 battery-electric buses on several routes that serve both residents and tourists. According to the MTD, its electric bus system has logged more miles and hours of operation than any other in the United States.

At the EVA induction ceremony, Santa Barbara Mayor Marty Blum said, "For me, electric vehicle

transportation serves two purposes. . . it helps to protect the environment but also serves the needs we have in planning and developing our city infrastructure.

"De-emphasizing the automobile is just one way to approach our transportation needs and represents just a part of the puzzle," she added. "If we get them out of the car, we need to put them in something just as attractive. In Santa Barbara, that is why we say electric buses are a marketing strategy as much or perhaps more than just a way to clean up our air. Continuing the trend toward innovation in mass transit systems is another part of the community needs puzzle."

The ceremony took place at the start of a two-day EVA workshop on electric bus technologies, policies and markets. EVA Executive Director Kateri Callahan noted, "Santa Barbara, Calif. is



Besides all of this, riders love the electric buses. When Santa Barbara's Metropolitan Transit District – which operates one of the largest electric bus fleets in the nation – first introduced electric buses in the early 1990s, it discovered that passengers would pass up a diesel bus to wait for an attractive, user-friendly, clean, quiet electric one.

Today, according to the Electric Transit Vehicle Institute, more than 260 electric buses operate throughout the United States, providing a variety of customers with that same popular service. This issue of the Southern California Edison Electric Transportation Division's *Current* newsletter focuses on the latest in the electric bus industry, and new developments that promise to move the industry forward to an even brighter future.

Power it With **Electro-drive**

Check out the second Electric Transportation Industry Conference *Battery *Hybrid *Fuel Cell, taking place in Hollywood, Fla. from Dec. 10 – 13, 2002. Hosted by the Electric Vehicle Association of the Americas, the conference will feature plenary sessions with government, industry and academic leaders, in-depth tutorial sessions, displays of the latest technologies, and more. Get additional information at www.eticonference.com or www.evaa.org.

an ideal backdrop for this workshop since the MTD was one of the first transit districts in the U.S. to fully embrace electric buses."

Other members of the EVAA's Million-Mile Club include Southern California Edison, Georgia Power, the New York Power Authority, Southern Company, and the Swedish Ministry of Transport.

For additional information on the MTD's electric bus program, visit www.sbmtd.gov. Details on EVAA's Santa Barbara and other electric bus workshops are available at the "Bus Stop" section of www.evaa.org.



The Santa Barbara Metropolitan Transit District (MTD) gets inducted into the Electric Vehicle Association of the Americas' "Million-Mile Club" for logging more than 1 million miles moving people with electric transportation – in this case electric buses. MTD General Manager Gary Gleason (left) and Santa Barbara Mayor Marty Blum (center) receive the award from EVAA Executive Director Kateri Callahan.



Workshops Highlight Electric, Hybrid Buses

To ensure that business and community leaders understand as much as possible about electric and hybrid-electric bus technologies, infrastructure and markets, this year the Electric Vehicle Association of the Americas (EVAA) is holding four bus workshops across the nation, modeled after the successful "EV-Ready Community Market Launch Workshop" series conducted in 1995.

The first three workshops took place in Memphis, Tenn., Santa Barbara, Calif., and New York City. The final workshop will be held in Hollywood, Fla., in December in conjunction with the second Electric Transportation Industry Conference. EVAA is hosting the workshops as part of the two-year "Electric and Hybrid-Electric Bus Information Sharing and Technology Transfer Program" it has undertaken with the Electric Power Research Institute in partnership with the U.S. Department of Transportation.

Reports on and copies of presentations from the completed workshops are available at EVAA's Web site at www.evaa.org under the "Bus Stop" section.

Stingray Electric Bus Meets High Standards

Touting "the most practical pure-electric bus ever built," the Santa Barbara Electric Transportation Institute (SBETI) recently completed the prototype *Stingray* bus and delivered it to the Santa Barbara Metropolitan Transit District (MTD) to begin local service.

According to the SBETI, the 30-foot-long *Stingray*, with its Zebra Z5C sodium-nickel chloride batteries, travels 130 to 150 miles between charges in a typical urban transit cycle, plus one additional mile for every minute of mid-day opportunity charging. The low-floor bus carries 45 passengers total (seated and standing), plus accommodates two wheelchairs.

Griffith said that batteries account for 31 percent of maintenance costs for a typical electric bus. Because the *Stingray* uses the virtually maintenance-free Zebra batteries, he noted, the bus should achieve significant life cycle cost savings.

The SBETI was formed at the MTD several years ago to assist it with technology evaluations and developments related to electric buses. For the *Stingray*, the SBETI served as the prime contractor and performed the propulsion system design. The development team is progressing quickly toward the commercialization of the *Stingray* technology.

To learn more about the *Stingray*, call the SBETI at 805-568-0985.



The Stingray electric bus, developed by the Santa Barbara Electric Transportation Institute for operation in the Santa Barbara Metropolitan Transit District's fleet, uses state-of-the-art technology to provide superior reliability, performance and range.

SBETI President Paul Griffith said his organization relied on 12 years of operation and maintenance experience with electric buses to develop a product that addresses some concerns about electric bus technology in the areas of reliability, performance and preventative maintenance.

About the *Stingray*, Griffith noted, "We picked components and subsystems that promise to be reliable in service, and we have a performance level in terms of range that's probably twice that of any electric bus that's been made available to date.

"The *Stingray* has hill-climbing and acceleration capabilities equivalent to or better than those of a diesel bus, and the propulsion system is virtually maintenance free," he added.



Bus Manufacturers Roll Toward Future

Electric and hybrid-electric bus manufacturers express optimism about the future of their industry, pointing to the success of both electric and hybrid-electric buses in current on-road applications, and the promise of newer technologies with electro-drive as the common thread.

Current recently spoke to officials from Advanced Vehicle Systems, Inc. (AVS), Ebus, Inc. and Orion Bus Industries Ltd. to find out the latest news in their companies, and their perspectives on what the future holds for this form of transportation.

AVS

The nearly 10-year-old company, based in Chattanooga, Tenn., soon will build its 200th bus – the most electric and hybrid-electric buses built by any U.S. firm.

An AVS 22-foot hybrid-electric bus crosses the finish line at the 2002 Tour de Sol, an annual road rally competition featuring advanced, clean-fuel technology vehicles. The AVS bus captured the most innovative vehicle award in the 2002 event, plus first place in the heavy-duty vehicle category.



Over the past two years, the company primarily has delivered hybrid-electric buses (up to 38 feet long) that use the ultra-low-emission Capstone MicroTurbine™, though it recently received a contract from the New York Power Authority to provide the first all-electric buses that combine advanced lead-acid batteries with ultracapacitors. Electrochemical energy storage systems, ultracapacitors are designed to protect batteries from charge and discharge spikes, thus extending battery life, and also to allow for the more efficient capture of regenerative braking energy.

Besides being pleased with the success of the Capstone MicroTurbine in hybrid-electric bus applications, AVS President and Chief Executive Officer Rick Hitchcock noted, "We are excited about the prospect of combining power storage devices like ultracapacitors and flywheels with

readily available advanced lead-acid batteries. We think that combination will broaden the capabilities and attractiveness of all electric buses."

Looking ahead, Hitchcock said, "The challenge in this industry is to prove that electric and hybrid-electric vehicles can be cost-effective in order to dramatically increase the market. We already have proven that they are very clean and very efficient in terms of energy use. [Making them cost-effective] requires volume so that economies of scale will be available to apply to the critical components."

Ebus

Ebus' product line includes 22-foot electric and hybrid-electric trolley replicas, transit-style buses and open-air, all-electric shuttle buses. The 4-year-old, Downey, Calif.-based company has placed about 60 vehicles into service, including 10 that, through the Anaheim Transportation Network, this summer began shuttling passengers among the Anaheim Resort, Disneyland, California Adventure, Downtown Disney and the Anaheim Convention Center.

The company recently began developing hybrid-electric buses, also using the Capstone MicroTurbine with either diesel or propane, creating, as Ebus President and Chief Operating Officer Bill Webster Jr. said, "the quietest, cleanest heavy-duty engine available."

Webster noted that, in the past, transit agencies tended to define buses as 40-feet long. With opportunities now existing to use downtown shuttles and feeder buses, for example, to get people to and from transit stations, he added that agencies are looking more for smaller, quiet, neighborhood-friendly vehicles – an ideal application for electric technology.

"We're encouraged because there's a lot of activity going on," Webster said. "The whole world is waiting for fuel cells, and they'll be waiting a long time. When fuel cells become affordable and available we'll be right there. There are solutions available today that work great."



Ten Ebus electric shuttle buses like the one shown here currently transport passengers among various attractions in Anaheim, Calif., including Disneyland.

Orion, which builds diesel, natural gas and hybrid-electric buses, started off in the 1970s in the truck and repair business and eventually evolved into a major transit bus manufacturer. Based in Ontario, Canada, the company became part of DaimlerChrysler in 2000.

The 40-foot-long heavy-duty hybrid-electric buses built by Orion – including 10 that have operated in New York City since 1998 – have accumulated more than 600,000 miles of in-service experience. Stepping up its presence in the industry, Orion now is working on filling an order from MTA New York City Transit, an agency of the New York Metropolitan Transportation Authority, for 325 hybrid-electric buses that will run on regular transit routes.



A prototype Orion VII hybrid-electric bus, which Orion Bus Industries Ltd. currently is producing in high volume for use by New York City Transit, takes a test drive.

Orion Director of Sales Mark Brager said that hybrid-electric buses offer three key benefits compared to their diesel counterparts: fewer air emissions, reduced brake maintenance costs (due to their regenerative braking capability), and higher fuel efficiency.

"There are numerous technologies out there that have great promise for transit buses – and the common thread is electric drive," Brager said. "These technologies include bus rapid transit that allows opportunity charging, fuel cells, or a number of others. We saw the hybrid as a bridge technology that was ready to go five or six years ago, and we were able to get it into place. Users of that technology will be able to hone their skills for operating and maintaining electrically driven vehicles."

Brager added that the industry's key technical challenge remains battery energy storage, noting, "We are certainly working on and looking for novel solutions to the energy storage part of the equation."

For more information about AVS and Ebus, visit www.avsbus.com and www.ebus.com. For information on Orion, call 905-403-1111 or E-mail Sales@orionbus.com. Links to other electric bus and component manufacturers are available at www.etvi.org, and at www.evaa.org under the "Bus Stop" section.



Hybrid Buses Meet NY Project Goals

Data from two years of hybrid-electric bus operation in New York show that, as anticipated, these vehicles operate with greater efficiency and much lower emissions than diesel buses.

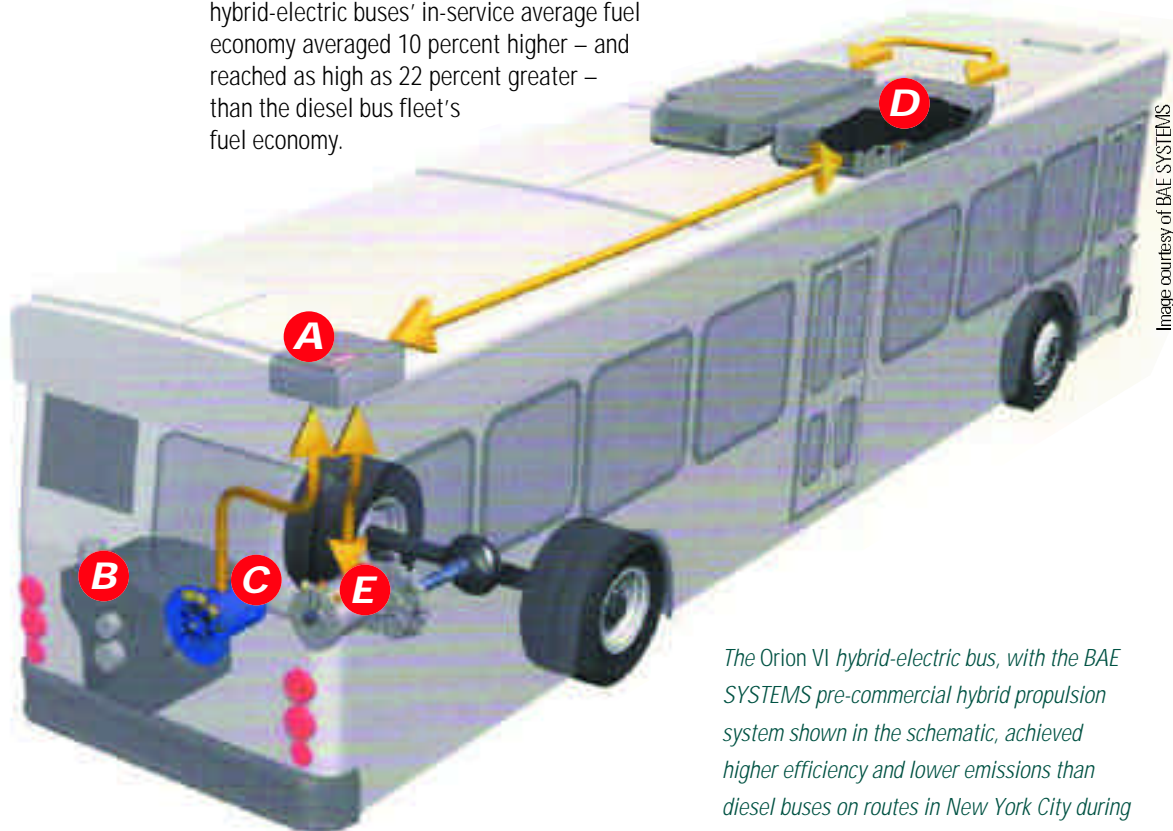
A U.S. Department of Energy research project, managed by the National Renewable Energy Laboratory, analyzed the operating costs, efficiency, emissions and overall performance of 10 Orion VI hybrid-electric buses, manufactured by Orion Bus Industries Ltd., and compared them to the performance of 14 conventional diesel transit buses between 1999 and 2001. MTA New York City Transit, part of the New York Metropolitan Transportation Authority, operated the vehicles.

Emissions testing on the central business district cycle indicated that the hybrid-electric buses, compared to modern diesel buses, produced 97 percent less carbon monoxide, 50 percent less particulate matter, 43 percent fewer hydrocarbons, and 36 percent fewer oxides of nitrogen. The hybrid-electric buses' in-service average fuel economy averaged 10 percent higher – and reached as high as 22 percent greater – than the diesel bus fleet's fuel economy.

The research project report does note that the hybrid-electric buses had higher operating costs than the diesel buses, but this was not unexpected for a pre-commercial introductory fleet. The report says that these costs should decline for the next generation of vehicles as the technology matures and repair technicians become more familiar with the advanced hybrid propulsion systems.

The hybrid-electric buses studied in this project use an ultra-low, sulfur-fuel-powered diesel engine to provide primary power to the traction motor and to recharge the batteries. The batteries offer supplemental power to the motor during acceleration and grade climbing.

To review the New York hybrid-electric bus project report, visit www.afdc.doe.gov/pdfs/nyct_diesel_hybrid_final.pdf. Information on other hybrid-electric bus projects is available through the Electric Transit Vehicle Institute at www.etvi.org under the "TDOT Project" section.



- A: Propulsion control system
- B: Diesel engine
- C: Traction generator
- D: Battery energy storage system
- E: Traction motor

The Orion VI hybrid-electric bus, with the BAE SYSTEMS pre-commercial hybrid propulsion system shown in the schematic, achieved higher efficiency and lower emissions than diesel buses on routes in New York City during a two-year research project monitored by the U.S. Department of Energy's National Renewable Energy Laboratory. BAE SYSTEMS currently is producing a commercial hybrid propulsion system for the Orion VII hybrid-electric bus, scheduled to begin running in New York in the near future.

Regulations Support Electric Bus Industry

Given the benefits of electric and hybrid-electric buses, activities on the federal, state and local levels continue to lead to the more widespread use of these clean-fuel transit vehicles.

The Transportation Equity Act for the 21st Century (TEA-21), implemented by the U.S. Department of Transportation, includes the Clean Fuels Formula Grant Program to assist public transit operators in purchasing and utilizing low-emission and alternative-fuel vehicles. Funding covers 80 percent of the cost of eligible projects, using a formula based on population, fleet size, bus passenger miles and the severity of the air quality problem in each project area. TEA-21 authorizes \$200 million for this program in 2003, with \$100 million of that guaranteed.

TEA-21 also features other emissions-reduction transportation programs, including the Congestion Mitigation and Air Quality Improvement Program (CMAQ), which allocates over \$1.4 billion in funding for 2003. Alternative-fuel buses often receive both Clean Fuels Formula Grant Program and CMAQ funds, dramatically reducing their incremental cost.

In addition, for private sector operators of shuttles with 20 or more passengers (such as hotel and rental car shuttles), the Internal Revenue Service provides a \$50,000 tax deduction, plus a \$100,000 per site tax deduction for clean-fuel infrastructure.

In state news, under California Air Resources Board (ARB) regulations, transit agencies that operate more than 200 buses must continue to move toward making 15 percent of their new buses zero-emission (meaning battery- or fuel cell-powered) by either January 2008 or January 2010 (depending on other emissions reductions strategies they implement).

The ARB also is working with the California Energy Commission and local air pollution control districts on the Lower-Emission School Bus Program, designed to reduce children's exposure to harmful air emissions by replacing 350 of the oldest, highest-polluting school buses in the state with new, cleaner diesel or alternative-fuel buses, and by paying for filters to reduce emissions from 2,000 existing diesel buses. The program also will provide funds to help develop alternative-fuel infrastructure as needed.

On the regional level, the South Coast Air Quality Management District (AQMD) has enacted several additional clean-fuel bus requirements. These regulations require public transit fleets (with 15 or more public transit vehicles), airport

fleet (i.e. hotel and parking lot shuttle) operators, and school bus fleets (with 15 or more buses) to utilize increasing numbers of alternative-fuel vehicles (in most cases) in the coming years.

Operators of full-size transit buses within the AQMD region (which covers Los Angeles and Orange counties, and parts of Riverside and San Bernardino counties) now have the opportunity to tap into co-funding for the purchase of alternative-fuel transit buses through the Mobile Source Air Pollution Reduction Review Committee. Information on the \$2-million Alternative-Fuel Transit Bus Program is available at www.msrtc-cleanair.org.

To find out more about the regulations and programs discussed in this article, visit www.fhwa.dot.gov/tea21, www.arb.ca.gov and www.aqmd.gov.



EV Tech Center Update

Expertise Applies to Electric Buses

With the electric and hybrid-electric bus industry continuing to grow, Southern California Edison's (SCE) Electric Vehicle (EV) Technical Center has put into place the procedures, equipment, and personnel training to allow it to properly evaluate electro-drive bus technology and make sure SCE can support the more widespread introduction of this clean-air transportation option.

The Tech Center, an independent testing and evaluation center with ISO 9001 certification, helps assess how increasing use of various electro-drive technology products – from on-road vehicles, including buses, to airport ground support equipment, to forklifts and more – will affect power quality and energy load management in SCE's system.

According to Tech Center Manager Juan Argueta, "As this [electric bus] segment grows and grows, we will be more involved. We will be there to evaluate the technology and make sure SCE will be ready to supply the buses with their fuel, which is electricity."

The Tech Center's electric bus involvement dates to the mid-1990s, when it worked with several organizations through the California Energy Commission's Transportation Energy Technologies Advancement Program on an electric school bus demonstration in the Goleta Union School District in California.

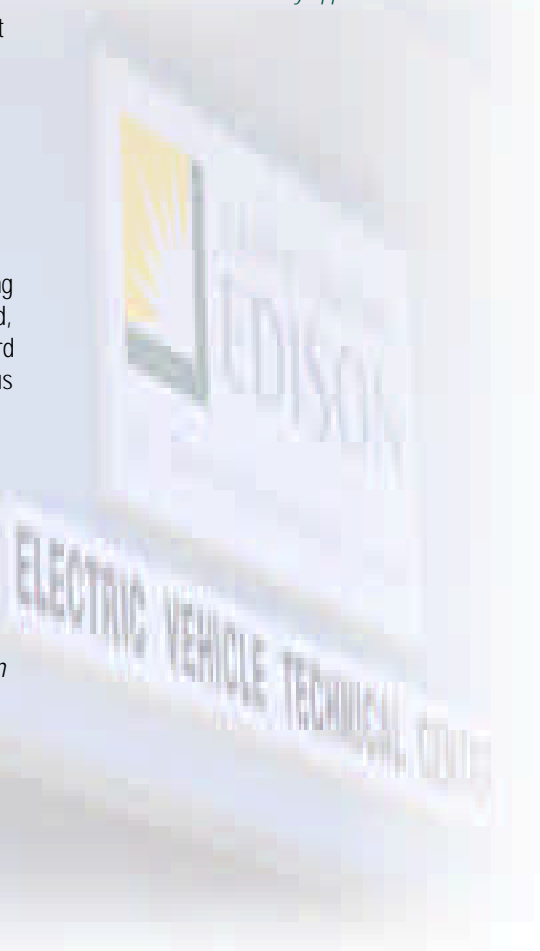
SCE's contributions to the project included providing batteries for the bus, installing a charging station at the school district's maintenance yard, and placing instrumentation on the bus to record data for one year. The project found that the bus worked well in running both the morning and afternoon routes, for a total of nearly 35 miles per day, on a single charge.

The Tech Center also served as the first U.S. entity to use the advanced Zebra Z5C sodium-nickel chloride batteries in an electric-powered vehicle (a sedan). The Santa Barbara Electric Transportation Institute selected these batteries for its new *Stingray* bus. (See story on page 3.)

To find out more about the Tech Center's capabilities, plus available testing and evaluation services, visit www.sce.com/electrodrive, or contact Juan Argueta at 909-469-0315 or Juan.Argueta@sce.com.



The procedures, equipment and trained personnel of SCE's EV Technical Center enable the facility to evaluate electric bus technology and determine how to manage the energy load created by the increasing use of electric buses in daily applications.



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