Japan powers up electric car battery

by Mark Wilsey

Electric vehicles have not yet developed to the point that they represent a practical replacement for internal combustion-powered vehicles. However, this seems to be the next phase for individual vehicle transport, and efforts are under way to develop the technology needed to put large numbers of electric vehicles on the road.

At the 1991 Tokyo Motor Show, the Future Electric Vehicle (FEV), unveiled by Nissan, caused a stir. The advance embodied in the car was the low time required to recharge the battery. The battery will power the FEV for 100 miles, and then take only 15 minutes to recharge. "The time it takes for a cola," say FEV promoters.

The car signifies that with the right scientific commitment and capitalization, the electric car era may not be far off. On that count, U.S. automakers will be left in the dust unless there is economic emergency intervention. There is research into advanced electric cars in the United States, but no assurance that production can be carried to fruition.

There is a striking difference between the present crop of electric cars and those offered just a decade ago. Those of the past generation had the appeal of a golf cart, and their performance was not much better. Although some elements of these earlier efforts may carry over, the new generation of electric cars are a breed apart, built from the ground up with state-of-the-art technology.

Pressure for 'clean air'

The shift in attitude toward electric vehicles among automakers, from modest budgets for research to major commitment of resources for development, has been brought on by a number of factors.

The least of them is the pressure to meet the wave of new clean air regulations. A few years back, the Environmental Protection Agency, under provisions of the Clean Air Act, decreed that the air quality in the Los Angeles area must be brought up to standard by 2007. A recent ruling from the California Air Resources Board mandates that for all auto manufacturers planning to sell more than 5,000 cars in California, starting in 1998, 2% of those sales must be "zero-emission vehicles." This number goes to 5% in 2001, then jumps to 10% in 2003, or an estimated 100,000 cars a year.

But beyond all the new regulations—most of which originated from quarters wanting to strangle industry—there is the interest in technological advance for its own sake. In this regard, not only the battery-driven car, but hydrogen fuel is a prospect for the post-gasoline era. In an *EIR Quarterly Economic Report* for 1985, the state of research into hydrogen-powered automobiles was reviewed: "Researchers have been investigating ways of storing hydrogen, as a gas, in metal hydrides. In this system, the hydrogen is released when the temperature rises, such as in an automobile engine. For the system to be efficient, the density of the hydrogen in the hydride must be high. Otherwise, you are carrying around a lot of weight for a small amount of fuel.

"In Germany, liquid hydrogen-burning auto engines have been developed and are in use experimentally. For the consumer to 'tank up' with liquid hydrogen at his neighborhood filling station, a considerably safer and more complex station than operates today with gasoline, would have to be designed. In the United States, researchers at the University of Miami have completed work for the Department of Energy, which included building and testing 19 hydrogen-burning auto engines."

A quick recharge

The FEV rolled out by Nissan at the Tokyo Motor Show last October is a 2+2 (two adults, two children) coupe, designed for the "urban family." The big news is its battery, which can be recharged to 40% capacity in six minutes and 100% capacity in 15. Most other electric vehicles take 6-8 hours to recharge; some can be force-fed in an hour. The nickel-cadmium battery used in FEV achieves its feat by using new, stronger materials with reduced electrical resistance. The battery is thinner with increased surface area for greater heat dissipation.

Nissan has formed a consortium with Tokyo Electric Power Co., Japan Storage Battery Co., and Hokuto Denko Co. to study what systems and infrastructures are needed for expanded use of electric vehicles. Recharging stations could be located at auto dealers and supermarkets. Electric cars could facilitate extensive underground parking since design problems in tunnels and underground parking facilities are greatly eased by eliminating the fumes and smoke problem.

The GM 'impact'

Two years ago, on the eve of Earth Day, GM announced that it planned to put an electric car on the market by the mid-1990s. Current plans are to convert a Buick plant in Lansing, Michigan for electric car production, to be ready as early as 1993. The car GM unveiled was an electric-powered, two-seat sports coupe called Impact. It boasts an acceleration from 0 to 60 miles per hour in eight seconds, a top speed approaching 100 mph, has a range of 120 miles at 55 mph, and takes eight hours to recharge. It is designed to maximize aerodynamic efficiency, and has a drag coefficient of a little more than half that of most cars. It uses special tires with half the rolling resistance of conventional tires and yet maintains sufficient traction. Every effort has been made to minimize weight. Impact's body is made of composite materials and, to stretch energy economy, even a portion of the energy used in braking is recovered.

The Impact's powerplant is made up of two alternating current (AC) electric motors which provide 114 horsepower to the front wheels. The AC motors have twice the power output per pound than direct current (DC) electric motors. Two space-age power converters from Hughes Aircraft, a GM subsidiary, transforms the DC battery power into AC for the motors. This power comes from 32 ten-volt, lead-acid batteries that have been developed for high-energy storage. GM claims Impact's batteries will last 20,000 miles before they need replacing, which is estimated to cost about $2,000, and would have operating costs up to that of a standard car burning $2 a gallon gas.

There is some doubt as to whether these batteries will last that long. Lead-acid batteries do not hold up well to frequent rechargings, particularly if repeatedly run down to exhaustion. The advantages are that they are relatively cheap, readily available, and their manufacturing processes are well established.

To this end, GM last January joined with Ford and Chrysler to form the U.S. Advanced Battery Consortium (USABC). In addition to the Big Three, the Electric Power Research Insitute (EPRI) and the U.S. Department of Energy (DoE) have joined USABC. The deal with the DoE is a jointly funded, four-year $260 million research project to develop new batteries. At present, there are several possible options in battery technology. The "brass ring" would be a system that could power an electric vehicle for 300 miles on a charge and last 100,000 miles. At current research levels, it will be well into the next century before such a system is developed. Among the technologies that USABC is focusing on are the nickel-iron battery and the sodium-sulfur battery.

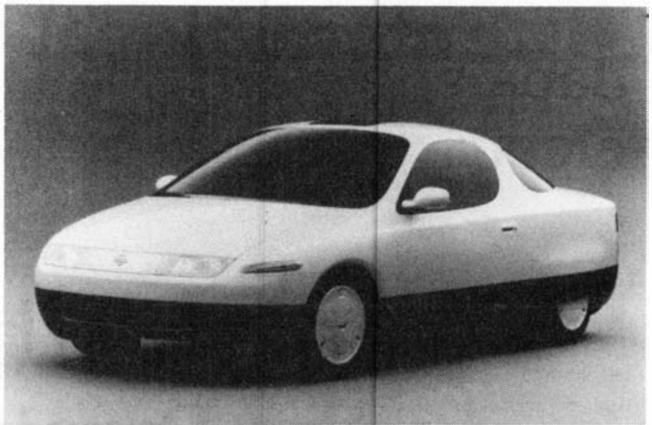
Nickel-iron batteries have been around since 1910. They are durable, hold up well to repeated recharging, and out-perform lead-acid batteries with 30-50% greater energy capacity and peak power. However, they give off hydrogen gas which must be vented and could be hazardous in confined areas. A certain water level needs to be maintained; if the battery goes dry it quits working, and nickel is somewhat expensive.

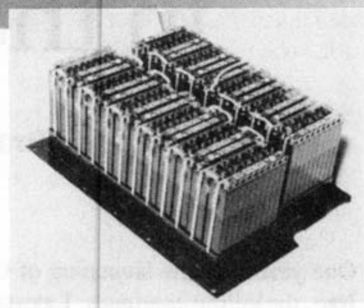
Sodium-sulfur batteries have 2-3 times greater energy storage and power than lead-acid batteries. Their big drawback is that they require a temperature in excess of 500°F to operate.

To provide an adequate power supply, Southern California Edison estimates that 1 million electric vehicles traveling 15,000 miles a year each could use 7.5 billion kilowatt-hours of electricity annually. EPRI figures that the country has enough off-peak generating capacity to support the overnight recharging needs of 50 million electric vehicles. But assumptions can change and greatly affect projections; electric vehicles may produce more demand for electricity than expected.

Vans, prototypes, and hybrids

Chrysler is testing an electric van, called TEVan, which is powered by 30 six-volt, nickel-iron batteries. Ford plans to produce a fleet of 70-100 electric Escort vans for evaluation which will feature sodium-sulfur batteries. GM also has an electric van project. Electric vans are thought to have a potential market in fleet sales.





Nissan's Future Electric Vehicle and its new battery, fully rechargable in 15 minutes.

Among European efforts, BMW has a prototype electric car, the BMW E-2, which uses sodium-sulfur batteries. Fiat has been selling its electric car, Panda, for two years now. Peugeot plans to add an electric car to its line; it already sells electric vans. Higher fuel prices in Europe make such cars more attractive than in the United States.

Another line of development is the hybrid electric vehicle, which uses a small gas engine to supplement its electric power and extend the range of the vehicle. Volkswagen's experimental hybrid car is called Chico. It uses a two-cylinder, fuel-injected engine in tandem with its electric motor and nickel-cadmium battery to boost its range to 250 miles. GM is working on a hybrid van, the HX-3, that uses an engine-generator to provide charge to the batteries to extend their discharge time.

Last September, a hybrid from Sweden, the LA301, was named the winner of the Los Angeles Electric Car Initiative, a competition intended to put 10,000 electric vehicles on the streets of Los Angeles by 1998. The manufacturer of the winning design is to receive $7 million to subsidize the vehicle's development. LA301 was developed by CleanAir Transport. It uses a 220-volt, lead-acid battery pack, a DC electric motor, and an auxiliary four-cylinder, 33-horsepower gas engine to give it a range of 150 miles and a top speed of 75 mph.