F.V.E.A.A. NEWSLETTER

June/July 1993

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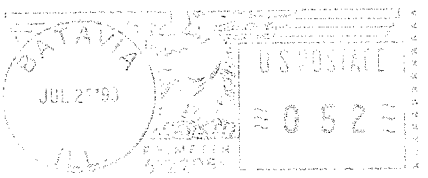
NEXT MEETING

August 20th @ 7:30pm
College of Dupage
Student Resource Center
Room 1046
Use Lambert Rd. En ot 7 at the Southeast corner of 22nd & Lambert
bers are always welcome!

MEMBERSHIP INFORMATION

Membership to the Fox Valley Electric Auto Association is open to the public. Anyone interested in electric vehicles or electric transportation are encouraged to join. The cost to join is $15 per year from November to November. If joining in the middle of the year the cost is $1.25 for every month remaining til November of that year. The cost for new members joining is $3.75.

Fox Valley Electric Auto Association
336 McKee Street
Batavia, IL 60510



First Class

John Emde

6542 Fairmount Avenue
Downers Grove, IL 60516
USA

ADDRESS
CORRECTION
REQUESTED

PRESEZ

Saturday August 21, 1993 is the date set for an all day symposium and demonstration of electric vehicles at the College of Dupage, Bldg K. This symposium is being jointly sponsored by FVEAA and the Illinois Solar Energy Association.

The antique auto owners association contacted us to explore the possibility of FVEAA displaying 5 or 6 electric vehicles at their 7th annual display in Naperville on Labor day weekend. This is part of Naperville's Last fling celebration which attracts over 100,000 people. This would be a one day display at the Martin Mitchel museum site. This approach will be discussed at our July meeting.

Featured speaker for the August meeting will be Mike Rogers of Packer Engineering who will discuss the "Station Car" as proposed by Metra.

At our May 21, 1993 meeting, a poll was taken to determine what members did not have our name identification badge with the FVEAA logo. At least 12 members do not have the badge. Paul Harris will contact the source and present day cost so we can process an order for those who do not have an identification badge.

Ken Woods

Editor's Note

Apparently there are a number of electric vehicles for sale by club members. We encourage you to send in the pertinent information to the newsletter so that it may be published.

Summer Event Flyer

You will find a copy of the Summer Event flyer in your newsletter. Please make copies and distribute to as many people as you know that would be interested. Your promotional efforts are greatly appriciated.

MINUTES OF JUNE 18, 1993 FVEAA MEETING

The meeting at the College of DuPage was called to order by President Woods at 7:44 PM. Eleven members and one guest were present.

Treasurer Corel reported $ 2055.36 in the savings account and $ 1247.53 in the checking account. His report was unaminously approved.

Secretary Shafer announced that Doug Marsh is the Registered Representative for the FVEAA according to the Secretary of State's Office. The membership voted unaminously to continue Doug in that position.

President Woods announced that tonight's speaker, Mike Rogers from Packer Engineering, was unable to appear and will be scheduled for the July meeting. The topic will be development of the "Town Car".

President Woods announced that the Summer event is tentatively scheduled for the College of DuPage on Saturday, August 21 from 10AM-4PM. Speakers will be invited.

John Ahern's nephew has acquired John's FIAT and drove it to the meeting. He intends to use it regularly.

Jerry Mitchell has acquired Harry Kampfert's FIAT and will upgrade the system. He is looking for a 26-spline coupler.

President Woods reported on his attendance at the New England EV & solar car race. There were 3-4 commercial conversions of Geo Metro's exhibited. The selling prices ranged from $ 20k to $ 60k for a car equipped with Nicad batteries and having a 184 mile range. The race contained an entry with a Zn-Br battery that achieved a 144 mile range. There were fewer solar-electric cars this time than any of the 4 previous events, probably due to the Texas-Minnesota race for solar cars later this year. Only about 100 spectators were at the race finish in Vermont. Slides and photos of the vehicles were shown.

The meeting was adjourned at 9:30 PM, in time for members to watch the second half of the Chicago Bull's playoff game.

Submitted by

William H Shafer
Secretary

June/July 993 Want Ads

1981 VW DIESEL RABBIT AVAILABLE FOR CONVERSION

Guest Richard Ray, an architect and member of the Illinois Solar Energy Association announced at the April meeting that he had a 1981 diesel VW Rabbit with over 100k miles that developed a bad engine which would require about $ 3000 to replace. He is willing to sell the car for $ 150 or donate it to a FVEAA member willing to undertake a conversion project. Anyone interested should call him soon at (708) 447-1899.

This is the second VW diesel Rabbit that developed engine trouble which has been brought to the attention of the FVEAA. Wonder if there is a failure pattern ?

WANTED

A used electric corded or cordless push mower. Preferable working. Contact Doug Marsh (708) 879-8008

Electric Car & Solar Summer Event

The Fox Valley Electric Auto Auto Association and the Illinois Solar Energy Society are jointly sponsoring a one day event of talks and exhibitions. The date is August 21st at the College of Dupage in parking lot M and the student resource center.

The schedule talks are as follows:

10:00am	Welcome to the Event
10:15am	Electric Car - A useful and necessary transportation tool for the the Chicago area.
11:00am	Photovoltaics - A cost effective electrical source in most parts of the world.
12:00noon	Lunch Break
1:00pm	Building your own electric car (converting a Mazda RX7)
2:00pm	Electric Supply for electric car Commonwealth Edison - Role of Nuclear energy in transportation.
3:00pm	Electric Supply for electric car - Role of Solar Energy in transportation.
4:00pm	The current state of the electric vehicle industry

Electric sports cars ready for Florida streets

By William R. Diem
AUTOMOTIVE NEWS

Two dozen Florida dealers hope to begin selling a new electric city sports car next year, says the company that will build them.

The Tropica, a $10,000 two-seater, will be built by Renaissance Cars Inc. in Palm Bay, Fla.

The first 50 units are slated for delivery to dealers by the end of the year.

A utility version with a small pickup bed also will be produced, priced at about $12,000, company officials said.

Robert Beaumont, company president, has a track record in electric cars.

Beaumont sold 2,200 CitiCars in the early 1970s after the OPEC oil embargo made gasoline a big issue.

While Renaissance was not formed until 1989, it claims the CitiCar's heritage, said Dennis Kaiser, general sales manager.

"We have built and sold more electric cars than anyone in the world," he said.

"We have 20 years of experience and knowledge in the EV industry."

The Renaissance Tropica will use lead-acid batteries from Trojan Battery Co.

The car develops 53 horsepower with dual DC motors powering the rear wheels.

Renaissance developed its own electronic controller.

The Tropica, said Kaiser, "will travel up to 65 mph; it zips right along, and it will go 60 to 80 miles on a charge."

"We now have something that is feasible for a city commuter," he said. "You zip right along with traffic."

The CitiCar project foundered when the gasoline crisis ended. Although some CitiCars are still on the road, their performance was limited.

"We were not able to obtain more than a 35- to 40-mile range," said Kaiser.

"That just barely makes an average person's daily mileage. The top speed was 37 or 38 mph, not fast enough."

Spectrum Companies Receives Grant for Electric Vehicle Controller Development

Spectrum Companies Int'l Ltd. of Batavia Illinois was awarded $15,000 by the Valley Industrial Association for the development a microprocessor based electric vehicle controller. Fox Valley Electric Auto Association members Richard Marsh and Doug Marsh are the engineering team that will head up the development. The project is to be completed by June of 1994.

The controller is to provide greatly enhanced electric vehicle performance by increasing battery performance and life, better motor control and greatly enhanced user instrumentation.

Lowering the high cost of electric cars

By Matthew L. Wald
N.Y. TIMES NEWS SERVICE

Almost everybody likes the idea of clean, quiet electric cars, but at today's relatively high prices — from the mid $20,000s for a small car to $100,000 for a mini-van — almost nobody buys them. So they remain impossible to mass-produce, which means that prices stay high.

Now, a new analysis has concluded that the impasse could be broken if federal and state governments would commit themselves to large-scale purchases of the vehicles, an idea that some federal officials cautiously agree has merit.

The study, scheduled for release Monday by the Center for the Biology of Natural Systems at Queens College in New York City, calls on federal, state and local governments to purchase 200,000 vehicles a year, or about 80 percent of the cars and light-duty trucks that they now order per year.

An order of that size would lead to lower prices over all, according to the authors, who said that "this gridlock can be broken with no direct cost to taxpayers."

Barry Commoner, who directed the study, said that if the government entered the vehicle market in a big way and caused the price to fall, "we're not talking about a subsidy, but simply an economic motivation."

While electric cars have far less range — from 50 miles between charges to perhaps 800 — than gasoline-powered vehicles, most cars in the federal fleet do not travel more than 50 to 100 miles a day, Commoner said.

The main force behind electric vehicles is air pollution, and its reduction. Electric vehicles are pollution-free at the point of use. Electricity production creates some pollution, but power-plant smokestacks are more easily controlled than auto tail pipes, and can be located hundreds of miles from population centers.

President Clinton has been seeking to stimulate production of "alternative fuel vehicles," including those running on compressed natural gas, methanol and propane. In April, the president signed an executive order requiring the federal government to buy nearly 34,000 such vehicles during the next three years, or 11,000 more than the number specified in the Energy Policy Act of 1992.

But officials of the General Services Administration, which actually buys the vehicles, and of the Energy Department, which provides the difference in cost between traditional and alternative-fuel vehicles, say they prefer buying natural gas- and methanol-powered cars because their price premium is far smaller than for electric cars.

William T. Rivers, an official at the GSA's fleet management division who is responsible for buying alternative-fueled vehicles, said Congress had appropriated $18 million for the extra costs of buying 11,250 alternative-fueled vehicles next year. That comes to $1,600 a vehicle. The added cost of some alternative cars falls well within that margin.

'The technology is not quite at the point where they're worth being mass-produced.'

KENNETH F. BARBER
Energy Department

A Dodge Spirit that can run on methanol or gasoline costs $721 more than a gasoline-only model, Rivers said, while a Chevrolet Lumina or Ford Taurus that can run on methanol or ethanol carries no price premium.

In contrast, he said, electric mini-vans sold by Ford and Chrysler cost more than $100,000 each. For example, Rivers said one mini-van that sells for $15,000 in the gasoline-powered version costs $115,000 for the electric model.

Buying electric vehicles would require a substantial subsidy, Rivers said, one that must be shared with methanol and natural gas vehicles. "Right now the only mechanism we have to get the vehicles is that the Department of Energy receives an appropriation from Congress under the Energy Policy Act," he said, referring to a provision of the 1992 law that is supposed to reduce dependence on oil.

Still, creating demand is not solely a federal concern, nor one likely to be left to it. California air pollution regulators, who traditionally set standards that become models for national rules, have established a program that will require 2 percent of each auto manufacturer's in-state sales in 1998 to come from electrics, rising to 10 percent in the early years of the next century.

Gary Mauro, the Texas Land commissioner who was named by Clinton as chairman of the federal Fleet Conversion Task Force, said his group would try to work with state governments and private-sector fleet purchasers to stimulate demand for electric cars, with an eye to bringing down costs.

The problem, he said, was scale. For example, not counting postal vehicles, the federal government owns about 558,000 light-duty vehicles, too small a fleet to require 200,000 new vehicles a year.

In addition, Mauro said, it was wrong to think that electric vehicles would work in all situations; with the limited energy in their batteries, they could not perform adequately in areas where heat or air-conditioning requirements were high.

Other people are skeptical for other reaso "The technology is not quite at the point wh they're worth being mass-produced," said Kenneth F. Barber, director of the Electric and Hybrid Propulsion Division at the Energy Department.

The average passenger car in the GSA fleet travels 13,000 miles a year, the agency said. That comes to 50 miles a weekday. Some, obviously, travel far more than 50 miles in a day, but proponents of electric cars say a motor pool could employ many vehicles with a 50-mile range.

Commoner and a co-author at Queens College, Mark Cohen, said they thought costs would fall sharply after the first few hundred thousand electric vehicles were ordered. They based their projections in part on studies of the gasoline auto industry in its nascent years; the price of an average car fell by more than two-thirds between 1907 and 1915, the authors said, because of the "learning curve" inherent in mass production.

Still, in the case of electric cars, mass production would not lower the price of batteries; it might even drive the price up, because demand could rise faster than production capacity, experts have said.

But mass production would lower the cost of assembling the components, Commoner argued. "Most of the value added that goes into the car is the assembly," he said.

At this point, the American auto industry the ability to deliver electric vehicles only in ited numbers. The new electric mini-vans, for example, are not widely available in dealer showrooms, except in some parts of California, although they can be ordered.

But within three or four years, if demand mounted, automakers could gear up to produce any number of electric vehicles. In the interim, electric vehicles are readily available from small assemblers, which buy cars from manufacturers, take out the engines and reconfigure them.

Electric-car producers say that even modest increases in demand would drive down the cost of some components. For example, Solectria Corp. of Arlington, Mass., sells a converted Geo Metro with an electronic controller, which regulates the flow of energy between the alternating-current recharging plug, the direct-current batteries and the alternating current electric motor.

The controller, in a box the size of a videocassette recorder, costs about $5,000 because it must be built by hand, Arvind V. Rajan, Solectria's vice president for marketing and planning, said. With automated production, he said, the price would drop rapidly.

Solectria's least expensive car model sells for $26,000; the company has sold 40 of them in the last two years. If it could sell 10,000 vehicles a year, Rajan said, the price would be about $10,000 each.

The Calstart consortium

Many eyes are on an enterprising attempt to solve the 'peace problem' by creating an electric vehicle industry in California

One of the most ambitious—and problematic—defense conversion endeavors to date can be found in an abandoned aircraft plant near the Burbank, CA, airport. There, in a 14 500-square-meter facility donated by Lockheed Corp., a private consortium called Calstart is working to create an electric vehicle industry that it hopes will utilize the engineers and other specialists idled by the aerospace industry's eight-year decline.

The goals are ambitious: a raft of sophisticated aerospace technologies harnessed for the commercial marketplace; government-industry partnerships spurring economic growth; and 55 000 new jobs by the end of the decade. In the year since its debut, Calstart has made great progress.

"We are ahead of schedule on almost every front," said Mike Gage, a former deputy mayor of Los Angeles, who recently took over command of the enterprise from Lon Bell, one of its founders.

HIGH-TECH JUDO. Calstart hopes to succeed by taking advantage of a factor that is usually cited as a weakness of California's economy—the state's stringent environmental regulations. Those regulations require, among other things, that, starting in 1998, 2 percent of all vehicles under 1700 kg sold in California—about 40 000 cars—must produce zero tailpipe emissions. The 2 percent figure rises to 5 percent just three years later, and to 10 percent, equal to 200 000 cars, by 2003.

So far, the consortium has secured almost US $20 million in funding—$14 million from industry backers and the remainder from Federal and state grants. It has already produced a showcase electric vehicle, or SEV, which has made the rounds of the big automobile shows [Fig. 1], and it has sponsored the production of an electric bus for in-city trips in the seaside community of Santa Barbara [Fig. 2].

Yet, just six people form Calstart's salaried staff. Another 75 or so are in residence, representing member companies participating in the consortium.

Within the beige walls of its headquarters, Calstart is busy on a variety of nuts-and-bolts chores. Across California, the Los Angeles Department of Water and Power has installed 80 of a planned 140 electric vehicle (EV) charging stations, the key infrastructure element needed to make EVs viable. Most have been placed in public garages, parking lots, and corporate motor pools. Training videos also are being prepared to educate police and fire personnel on procedures for dealing with accidents involving battery-powered cars.

But while there are high hopes for this first-of-its-kind grouping of more than 40 high-tech corporations, utilities, unions, universities, and government agencies, Calstart faces an array of daunting obstacles and numerous skeptics.

For Calstart to reach its goal of 55 000 new jobs by the year 2000, it will have to capture a third of the world market in EV components. By the early years of the next century, that market will comprise annual production of about 800 000 EVs, Gage estimates. Although program officials say California's existing cadre of sophisticated aerospace designers give it a leg up in that effort, it will face numerous competitors. After all, the top auto makers in Europe, Japan, and the United States are saddled with excess plant and labor capacity.

AGAINST THE FLOW. At a time when manufacturers are fleeing California's costly, regulation-ridden business climate, it is difficult to see why the advanced transportation industry should be immune. Earlier this year, concern over the state's economic prospects grew so serious that Governor Pete Wilson convened an economic summit in Los Angeles. High-level corporate and political figures came from across the state to find some way to stem the hemorrhage of manufacturing jobs.

Industry's complaints by now are familiar. California's tough air-quality regulations boost costs and slow business decisions. The state's workers' compensation system has earned national notoriety as a symbol of abuse and waste. And state political leaders until recently have appeared indifferent to the business community's concerns.

Said Richard Dore, a Hughes Aircraft Co. spokesman: "[The EV] industry has the potential to generate a lot of jobs. The question is where the jobs are going to be. But you have to be realistic. It's unlikely that will happen in California."

A 1989 plant-location study conducted for one California aerospace contractor found that the state was a far more costly place to do business than alternative sites. Average hourly wages and benefits were $17.38, compared with less than $12 for nine of 10 other states surveyed. Including administrative and overhead costs, California totaled $43.42 per hour, nearly 20 percent higher than sites in Utah and Arizona, according to the Los Angeles County Aerospace Task Force. General Motors Corp., which closed its Van Nuys car plant several months ago, said it cost almost $700 more to produce a car in California than in the Midwest.

> To create 55 000 more jobs by the year 2000, Calstart will have to capture a third of the world market in EV components

Electric vehicle industry supporters recognize the problem and believe legislative relief from Sacramento will be needed. "Unless we do something about these problems, then everything else is just wishful thinking," said Malcolm Currie, an EV backer who moved parts of Hughes Aircraft to 17 other states when he was chairman of the defense electronics giant in the 1980s.

Currie, who stepped down from Hughes' top job in March 1992, has joined with two other principals in setting up Electric Vehicles Corp., which plans to take over some or all of the Van Nuys auto plant shuttered by GM. This veteran scientist, who helped pioneer some of the U.S. military's most advanced radars, satellites, and weaponry, appears genuinely excited about prospects for converting aging gas guzzlers into EVs in the old GM plant. "I see electric vehicles as a burgeoning new industry and I want to be a part of it," he said. "I am working twice as hard as I ever have."

David Lynch Contributing Editor

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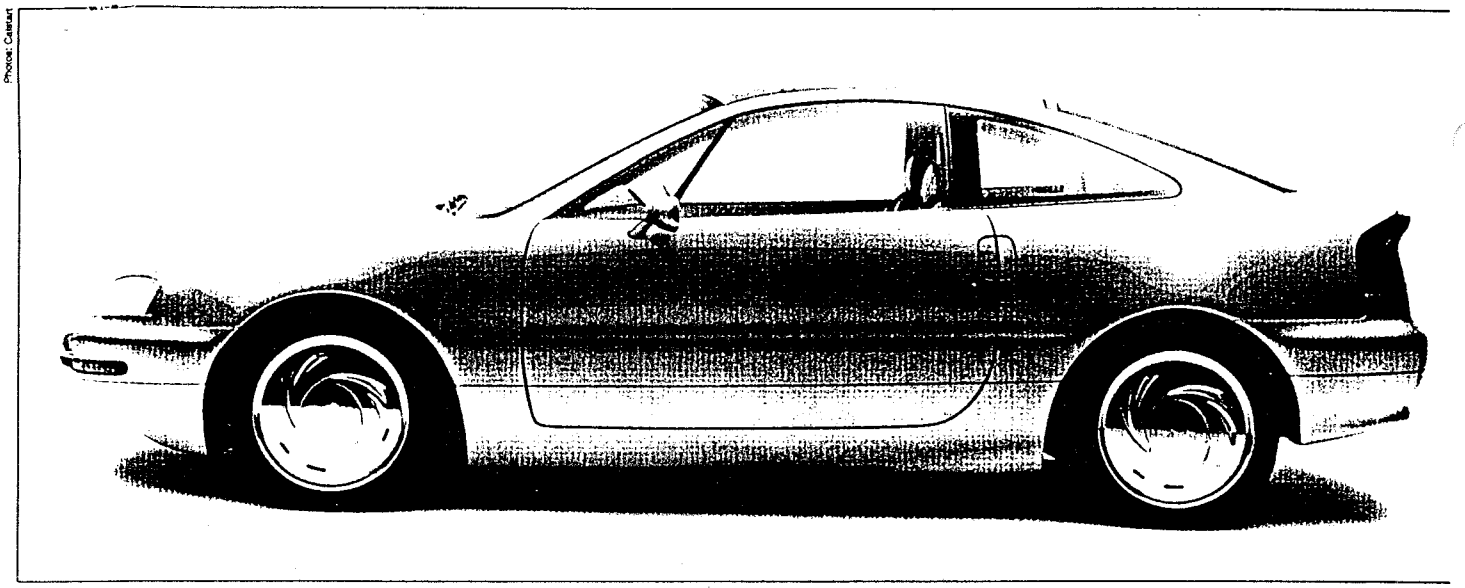
Photos: Calstart



[1] Calstart's Showcase Electric Vehicle (SEV) weighs 1200 kg, of which 380 kg is accounted for by its deep-discharge lead-acid battery. The car has a range of 160 km for stop-and-go driving. Its Peltier-effect heating and cooling system cuts its climate-control budget by a factor of five.

[2] This Calstart-sponsored 30-passenger electric bus has a range of 115 km and a top speed of 55 km/h. The vehicle is built by Bus Manufacturing USA Inc., Goleta, CA. The Santa Barbara Municipal Transit District has found its operating costs to be below those of diesel buses—even when battery replacement is taken into account.

At GM, which has placed its own electric car project on hold, executives are politely incredulous. "We are just shaking our head wondering how they are going to do all that and make a profit," said Robert Wragg, who represents GM's electric vehicle program in California.

Still, California's high costs are offset to some degree by an impressive technological infrastructure. First-rate universities, a network of advanced research facilities, and a dense cluster of aerospace suppliers stretching across the lower third of the state all make the state attractive for new high-tech ventures, Calstart's proponents say. Likewise, California is where the market for EVs will most probably get started, fueled by environmental legislation. Calstart supporters acknowledge they will need help to develop an electric vehicle industry in the state. Tax credits for consumers who purchase electric cars, as well as investment credits for companies trying to compete, are vital.

BOND ISSUE. In March, three state senators introduced an eight-part legislative package that would authorize a $100 million "clean transportation" bond measure to fund EV research and development, offer consumers rebates for purchasing EVs, and set up EV charging stations, as well as providing a range of other services.

But others are calling for bolder steps. "There needs to be a tremendous design effort from a national perspective," said Lou Kiefer of the International Association of Machinists and Aerospace Workers, which is backing Calstart. "It's going to take a moonshot effort."

High prices are expected to be the initial obstacle to widespread consumer acceptance for EVs. California residents already are eligible for a 10 percent subsidy in the form of a Federal tax credit plus a separate $1000 state tax credit on the purchase of an electric car valued up to $40 000. Gage would like the state credit to be $5000—a goal he considers achievable, given the environmental and economic pluses of a home-grown EV industry.

What Calstart is seeking is an EV in-

dustry cluster in Los Angeles, no less identifiable and self-contained than other economic groupings in Silicon Valley, Pittsburgh, Detroit, New York City, and elsewhere. According to a May 1991 study by the University of California, Los Angeles, "The goal of policies to encourage early location in Southern California is to attempt to lock the region in as the first comer in a large-scale electric vehicle industry."

Proponents say an EV industry is likely to emerge first through the efforts of small, second-tier high-tech companies that will supply components to the Big Three car makers. Some in Detroit believe Calstart's ultimate aim is production of an entire car to compete with GM, Ford, and Chrysler. But consortium officials deny that is the case.

Operating as a clearinghouse for information and technical interchange, Calstart intends to act as a catalyst in speeding commercialization of surplus aerospace expertise. Several aerospace companies—Hughes, Aerojet General, ITT Cannon, and Dowty Aerospace in Los Angeles—are working with Calstart, conscientiously attempting to merchandise the state's rich harvest of aerospace technologies.

MILITARY CONNECTION. As if to make the point, consortium brochures show an SR-71 spy plane metamorphosing into the Calstart showcase electric vehicle. "We want to take advantage of the huge investment in defense and aerospace in this state," said Gage. "We want to tap the intellectual capital."

Since World War II, when Detroit's auto plants were among the first to shift to production of war materiel for the Allies, a synergy has existed between the auto and defense industries. But the nature of that relationship has changed in recent years.

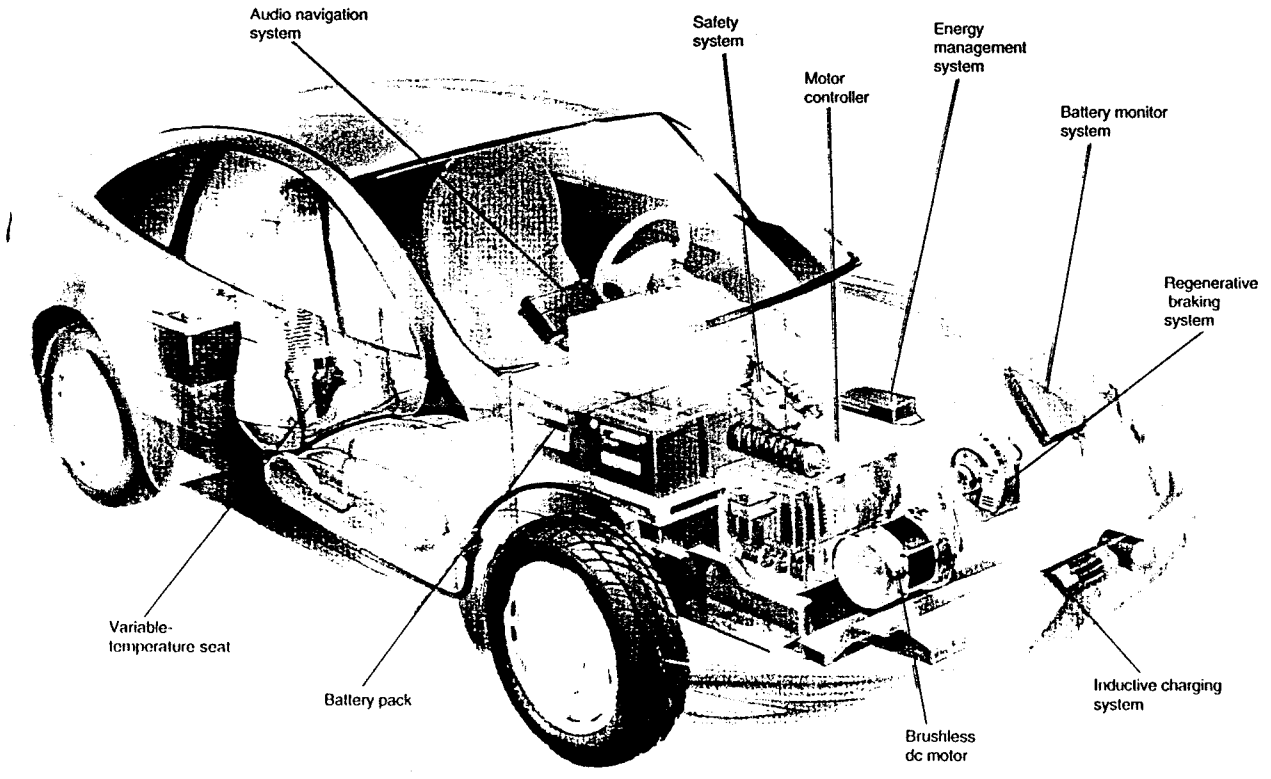
Now Calstart is betting that an EV industry will have more in common with the high-tech end of California's aerospace sector than with the conventional auto components churned out by the Big Three. Advanced materials, lightweight design, electronics, and energy storage devices are areas in which the consortium perceives opportunity.

At Hughes Aircraft, engineers have made steady progress with prototypes of the chargers consumers will use to charge their EV batteries. One year ago, early models were operating at 6 kW. Hughes recently demonstrated a 25-kW model to corporate parent General Motors. By year's end, 100 kW is the target, with fully "productionized" 25-kW models outfitted to accept credit card purchases entering mass production, according to Hughes' program manager Troy Nestor.

Indeed, through its corporate links with GM, Hughes already boasts an excellent track record of transferring defense technology to civilian applications. In the late 1980s, Hughes adapted a head-up display it had developed for Air Force fighter aircraft for use in GM's passenger cars. The version Hughes sold the Pentagon cost almost $400 000. But after years of painstaking development, the company produced a stripped-down commercial model that GM offered consumers for $150, according to former Hughes executive Currie.

Throughout Calstart's prototype operation, aerospace experience is producing mini-breakthroughs. The passenger seats in the showcase electric vehicle, for example, are individually heated and cooled using Peltier junction technology originally developed for the sidewinder missile. By simply reversing the polarity of the current flowing through the Peltier junctions, the system switches from heating to cooling. The technique increases the efficiency of the vehicle's climate control system by concentrating its effects in the automobile's seats, directly heating and cooling the passengers, while expending only a little energy on the passenger compartment itself [Fig. 3].

According to Lon Bell, now president of Amerigon Inc., Monrovia, CA, which designed the system, a little heated air blowing



Source: Calstart

[3] The showcase electric vehicle serves as a test bed for a wide variety of innovations, some of which may benefit conventionally powered vehicles. For example, its variable-temperature seats can cool passengers with only 20 percent of the usual energy expenditure. (It can also heat them very efficiently, a boon to EVs but not to conventional vehicles, which are warmed at essentially no cost by waste engine heat.) Similarly, its audio navigation system "speaks" replies to spoken requests for help in reaching destinations, so that the driver may operate the system without taking her eyes off the road. After calculating the best route, the system instructs the driver to follow that route, one leg at a time, complete with distances to be covered and estimates of the time required.

out o the vents, combined with heating of the seats, combines a high degree of passenger comfort with a great saving of energy. For cooling, he told *IEEE Spectrum*, the technique has so far proved less satisfactory. Some passengers find it quite acceptable; others, less so.

REALITY CHECK. But whether the emerging ties between some aerospace companies and Calstart suggests dramatic new employment opportunities for excess aerospace engineers, managers, and production workers remains in doubt. The sheer scale of the aerospace downturn is likely to swamp Calstart's efforts—or any single conversion strategy, for that matter. By one estimate, 60 000 aerospace jobs disappeared in California between 1986 and 1991. Another 50 000 will be gone by year end, with tens of thousands more to follow.

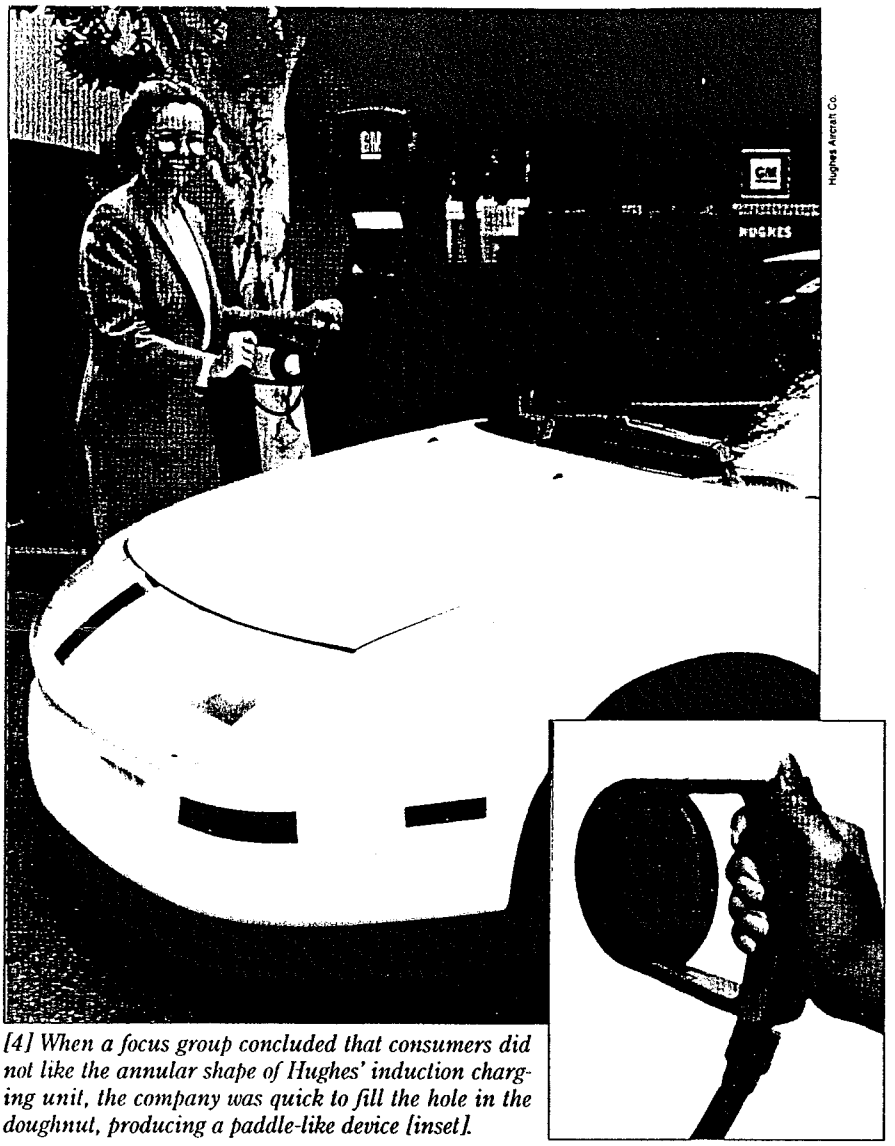
Against that employment drain, Calstart's 55 000-job goal—while ambitious for a fledgling industry—offers little immediate hope for many. Doubts have been raised as to whether EV production will require anything like the number of jobs forecast. Before General Motors pulled the plug on its Impact electric vehicle late last year, it had drawn up plans to add just 250 jobs to its Lansing, MI, facility to support production for tens of thousands of Impacts, according to Robert Wragg.

Moreover, even if Calstart reaches its goal five to seven years from now, that still begs the question of what happens to aerospace engineers in the interim. Some experts foresee a slow drain of California's engineering talent to other locales. "The scale of the solution doesn't fit the scale of the problem," said Robert Paulson, who tracks the aerospace industry for McKinsey & Co. in Los Angeles. "It's [minute] compared to the layoffs in California."

Calstart's current training efforts are targeted more at positioning existing companies to compete for EV work than at equipping laid-off workers with new skills. The 30 aerospace veterans now being trained by Calstart in the ways of the auto industry all have jobs with Los Angeles-area aerospace companies and Calstart sponsors Dowty, Group IX Systems, and Amerigon.

At the end of the three-month program, the trainees will fan out into their companies and train their co-workers in the rigorous demands of the commercial marketplace. Said Josh Newman, who directs Calstart's training: "We are working with the companies themselves who are interested in making this transition. We are not interested in training people who are unemployed."

ATTITUDE ADJUSTMENT. In working for the automotive industry, aerospace engineers will be facing a big adjustment. The low-volume, high-cost world of defense work could not be further removed from the dog-eat-dog world of commercial automobile manufacturing. The highly formalized government procurement process revolves around inch-



[4] When a focus group concluded that consumers did not like the annular shape of Hughes' induction charging unit, the company was quick to fill the hole in the doughnut, producing a paddle-like device [inset].

thick contract solicitations that draw similarly dense responses from industry.

In contrast, the high-volume commercial market is much less structured, and its main emphasis is on minimizing costs. Experts differ on how rough the transition will be, but all agree that retraining of aerospace industry personnel will be needed—for middle managers as well as engineers.

Since Calstart is deliberately trying to make use of aerospace technology, the key problem for program engineers is not acquiring new technical skills but learning marketing know-how. Hughes has tried to address this issue by inviting engineers working on its battery charger to attend consumer focus groups. "At first, I was afraid none of them would attend," said Troy Nestor, Hughes' program manager. "In the end, I had to turn some away."

The Hughes teams received an early lesson in the difficulty of predicting consumer response when they tested a doughnut-shaped, handheld charger. Consumers almost uniformly said that the device, which represented the ideal engineering solution, felt flimsy. Hughes responded by filling in the doughnut's hole, producing a paddle-like charger, with which customers felt more comfortable [Fig. 4].

Gage pointed out that Calstart cannot be the sole solution to California's conversion challenge. He envisions a host of similar consortia promoting new state industrial clusters in environmental technologies, state-of-the-art media, and telecommunications. A conscious goal of those working to reorient the battered and bruised Golden State economy is to avoid previous generations' excessive vulnerability to downturns in a single industry. California would "be better off with a more diversified base," Gage said.

Seemingly, the skeptics are having little impact on Currie or Gage or the other Calstart enthusiasts. After a chance meeting at a recent Los Angeles luncheon, Gage is hoping for a visit from Transportation Secretary Federico F. Pena later this year. But most of all, he is looking forward to the day his services and those of Calstart are no longer needed.

Said Gage: "My goal is to put Calstart out of business by the year 2000." ◆

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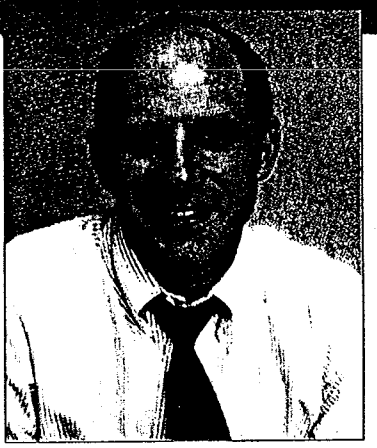
MIXED-SIGNAL DESIGN Stephan Ohr

The "big beasts"—semiconductors for electric cars



I would be seriously remiss if I didn't devote one column this year to some of the "big beast" semiconductors—those carrying hundreds of amps and volts—that are coming out of development. Devices like Harris' newly introduced MOS-controlled thyristor (MCT) and insulated gate bipolar transistors (IGBTs) from Motorola and Ixys are meant to serve a market in which few computer designers will participate, but one that may impact all of us within the next decade—environmentally safe electric vehicles. The semiconductors will handle up to 1200 V and 300 A, are efficient enough to be packaged in plastic and often sell in quantity for less than $50.

As digital designers, we tend to be enamored with the tight packing densities provided by submicron digital CMOS. Even those involved with mixed-signal design are doing most of their work with 10- or 12-V bipolar parts (perhaps nothing greater than a 40-V breakdown) or 3.0-μm linear CMOS. Even those working on power supplies (an increasingly smaller portion of the engineering community) are dealing with TO-220-packaged MOSFET transistors capable of delivering 4 or 5 A at 100 V. It may be highly unusual, then, for designers to be involved with "monster" power devices, although data provided by the World Semiconductor Trade Statistics association suggests that it's an attention-getting area. "Discrete" devices (transistors and diodes), for example, accounted for $15.8 billion in semiconductor sales in 1991, and will grow to $19.5 billion by 1997—21 percent of the $92.7 billion world semiconductor market.

What seems to be driving the development of monster devices is the prospect of battery-powered electric cars. Auto industry analysts have projected that, by 2003, consumers will be buying as many as two million electric cars a year in the United States. While Detroit seems to place electric cars in the same category as hydrogen- or ethanol-powered vehicles—powered by environmentally safe alternative fuels—electronic engineers view electric cars as the most safe, practical and economically viable. My conjecture that Detroit may replace the Pentagon as the technology driver for mixed-signal device development (see *Computer Design*, Dec 1992, p 132) may seem overly optimistic, especially as General Motors, under economic pressure, scales back its development schedule for its Impact electric car. All the U.S. automakers, as well as Japanese and European manufacturers, have on-going development projects and have demonstrated prototype vehicles at engineering and automotive trade shows.

Three-phase motors

The power plants in EVs (electric vehicles) are mechanically simpler than the internal combustion engines and mechanical gear trains that power today's cars. The two big elements in EVs are three-phase induction motors and big batteries. In GM's Impact EV, for example, the conventional lead-acid batteries weigh close to 900 lbs. EVs promoted by Ford use sodium-sulfur (NaS) batteries, which are said to have twice the capacity of lead-acid batteries. The Ford's Ecostar battery has a peak rating of 58 kW (when it delivers 77 hp) and a maximum continuous rating of 35 kW (47 hp). Nissan's experimental FEV (future electric vehicle) has dual 20-kW NiCad batteries. (The set weighs approximately 444 lbs, according to Nissan literature.)

The advantage of three-phase induction motors is that their speed and torque can be controlled electronically, simplifying gear train requirements. "A 75- to 100-hp electric car probably has better acceleration than a gas-powered vehicle," declares Ralph Locher, a senior applications engineer at Ixys in San Jose, CA. "The hard part is getting them up to speed. Then they kind of loaf along after that." (GM's Impact, for example, goes from 0 to 60 mph in 8 s.)

Indeed, improving the efficiency of the electrical power train—not necessarily to improve the performance and handling of the vehicle, but to preserve battery life (and make it easier to recharge)—is the major direction for EV research. (The range of the EV prototypes is approximately 100 miles on a single charge.) For semiconductor manufacturers, the requirement is for highly efficient power converter devices that deliver current from the battery to the motor—as well as battery charging systems.

A three-phase motor is essentially a commutator,

New battery may give electric cars a needed boost

Longer range, more power expected with new technology

By Mary Gooderham
TORONTO GLOBE AND MAIL

A battery has been developed that could finally put viable electric cars on the road, according to the current issue of the journal Science.

The battery will power electric vehicles for about 250 miles on one charge and be cost-competitive with gasoline-powered engines, says the article.

The nickel metal hydride battery was developed by a company in Troy, Mich., and is already used in consumer electronics items. It is expected to have more than double the range as well as five times the life expectancy of conventional batteries used in electrically powered vehicles.

"A battery that has more energy and is cheaper, non-toxic, disposable and maintenance free is a fact," said John Ross, a professor of chemistry at Stanford University, one of the authors of the report.

Use of electric vehicles — a legislated requirement for the future in several parts of the United States, including California — is expected to have a significant effect on urban air quality and national energy dependence.

However, the Achilles' heel of electric vehicles is the weight, relative energy efficiency and other performance limitations of the rechargeable batteries that are necessary to collect, store and release electric power.

The article, written by Ross and two representatives of the Ovonic Battery Co. Ltd., found that the nickel metal hydride battery overcomes many of the limitations of current battery technologies. It says that the battery will improve the energy density, power, life, tolerance to abuse, charging capability, maintenance and environmental friendliness of the electric car.

"The performance of electric cars is going to be so good we believe that consumers are not only going to buy them just for pollution reasons but because they'll be high-performance cars," said Subhash Dhar, president of Ovonic, a division of Energy Conversion Devices Inc.

Dhar said that current lead-acid batteries — the technology used in electric vehicles such as the Impact car proposed by General Motors — have a range of only 125 miles for a battery that weighs almost 900 pounds.

Lead-acid batteries also take from two to eight hours to recharge, are made from toxic materials, and deteriorate to the point where they must be replaced after about 20,000 miles, Dhar said.

Nickel-cadmium batteries, used in a number of consumer products and proposed for an electric car to be made by Nissan, have about the same range as lead-acid, and cadmium is a carcinogen, although the batteries will recharge in a matter of minutes.

A nickel metal hydride battery weighing the same amount is expected to go about 250 miles, recharge in a hour or less and last about 99,000 miles before replacement, and is made of non-toxic materials.

The United States Advanced Battery Consortium, a research group made up of the three major automobile manufacturing companies working to develop technology for use in electric cars, has endorsed the nickel metal battery system. Dhar said that it could be ready for use in cars in the next couple of years.

A battery with a range of 250 miles is expected to cost close to $5,000. Dhar said that, over time, the battery would mean a vast saving over the cost of internal combustion engines. He said the cost of gas and maintenance in today's cars is 22 to 27 cents a mile, while the cost of an nickel metal battery car car would be 10 cents a mile or less.

$128 million has been spent on battery R&D

Since its foundation in early 1991, the U.S. Advanced Battery Consortium has negotiated $128 million in research and development contracts.

Long-term, the consortium has focused on lithium battery technologies, which could give electric cars the range of a gasoline car. Battery makers W.R. Grace & Co. and Delco Remy/Valence are working on lithium polymer, and Saft Nife is working on lithium iron disulfide.

Midterm, the consortium has signed contracts with Ovonic Battery Co. and Saft Nife for nickel-metal hydride batteries.

In addition, it has $19 million in research contracts with five government laboratories studying all those technologies as well as sodium sulfur and sodium nickel chloride.

Sodium nickel chloride, like sodium sulfur, is a high-temperature battery.

Time running out for Big 3 to decide how to combine efforts on electric car

By Jim Henry
CRAIN NEWS SERVICE

NEW YORK — Time is running out for the Big 3 to decide how far they're willing to cooperate with each other in building battery-powered cars.

Arv Mueller, vice president and general manager of engineering and design operations for General Motors, said that alone or together, American automakers must firm up their electric-car programs by the end of this year to make the 1998 deadline to start phasing in zero-emission vehicles in California.

Time is so short, costs are so high and the threat of a Japanese breakthrough is so great that the Big 3 might share the same products, Mueller said.

"If we were to produce the same car, it would certainly reduce the development and production costs," he said.

That would require an unprecedented degree of cooperation among GM, Ford Motor Co. and Chrysler Corp. And the U.S. government would have to relax anti-monopoly laws to permit such a Big 3 joint venture.

Mueller suggested last week the government might go along, if the Big 3 can convince Uncle Sam that a joint venture is the only way U.S. makers can meet the deadline.

U.S. government help will also be needed to create market demand for electric vehicles, such as sales to government fleets, Mueller said.

Time is short, Mueller emphasized. For instance, if GM is to build a production version of its battery-powered Impact commuter car, it will have to start finalizing the design this summer, he said.

GM put the Impact on hold last December, and started exploring the possibility of an electric-car joint venture under the umbrella of the Big 3's United States Council for Automotive Research. USCAR is best known for a $250 million consortium that's trying to develop a better battery for electric cars.

Mueller said there are three basic alternatives for electric-car cooperation:

- The Big 3 can build entirely separate vehicles.
- They can share components.
- Or they can share entire vehicles.

Meet the Press: A Guide for the EV Owner

by Shari Prange

One of the first things you will discover as an EV owner is that an electric car is an instant ticket to local fame. You will find yourself stopped by strangers in parking lots, speaking to the Rotary Club, driving politicians in parades, and invited to participate in Concours d' Elegance. You will also find yourself talking to reporters.

One of the next things you will discover is that the story the reporter files usually isn't nearly as enthusiastic about EVs as you are. In fact, the more important the venue for the story, the more likely that it will come out downright negative. "Electric cars can't. . . not yet. . .still limited."

Knowing that you are an ambassador for EVs, and facing a skeptical world, here are some things you can do to improve the results.

Choose your forum. Not all publicity is good. If you are invited to participate in an eighty mile "Clean Air Race" as the only electric among a pack of methanol and CNG cars, and you know you will limp in dead last if at all, don't go "just to show the flag". The flag doesn't show well dragging in the dust. Don't participate in events you know will make your car look bad by comparison.

Prepare your car. Even club rallies, which are events within the EV "family", attract a lot of general public and some media. Be sure your car is as clean and professional looking as you can possibly make it. If the paint is old, there are products to buff it up. At least wash and vacuum it. Clean the battery terminals. Take a few minutes to tie wrap wires tidily out of the way.

Above all, do not give rides to reporters if your car is not fully charged, or not up to snuff for any other reason. Too often, major media have ridden in undercharged or ailing cars and written about the pathetic performance. Don't give them another opportunity.

Accentuate the positive. As they say, nobody notices planes that land safely, only the ones that crash. Likewise, nobody notices all the miles of reliable EV driving, only the one time you walked home. Even among ourselves, problems stick in our minds.

The media and general public already have negatives about EVs in their heads: EVs are small, weird-looking, slow, have short ranges, and are likely to run out of juice and leave you stranded. Don't feed these stereotypes. Before you open your mouth, remember the doctor's principle: "First, do no harm."

Don't tell the reporter about the time you goofed and had to walk home. Don't tell them how much extra effort you take to plan your routes carefully. (Is it really that much more effort?) Don't tell them you worry about having enough juice. These are the things they will blow up into headlines.

There are only about a dozen questions that everyone asks, but the same facts can be given in different ways. Practice answers that are stated in a positive way. No sentence should start out, "An electric car can't. . ." or "With an electric car, you have to . . ."

Emphasize "normal". If your car is a Citicar, or a home- built chassis, or a souped up race car with batteries everywhere, be sure the media and the public know that this is an unusual car. If possible, try to have a friend with a very ordinary-looking electric sedan included in the interview. The world in general already knows electric cars can be weird. Most of the world is put off by weird. They need to know electrics can be normal, too.

Give information bites. Reporters are looking for brief, clear quotes to use. Have some of your favorites ready. A single clear sentence will be quoted, maybe even highlighted. A lengthy discourse of run-on sentences will be condensed and edited by the reporter, if used at all. Any time the reporter edits you, your statements get farther from what you intended to say. Practice a few snappy quotes.

Have printed handouts. Send them away with something in writing they can refer to later. Keep literature in your car at all times, for surprise interviews in parking lots. You can get brochures from the EAA, or "EV Fact Sheets" from Electro Automotive, or you can type up and copy a page of info about your own car.

When talking to the public or press, try to get inside the head of your audience. Try to dissolve their fears and surprise them with positive facts that will get them excited. Listen to what you're saying from their perspective, and see if it sounds positive or negative. Don't dwell on ideas of limits or handicaps, or anything that implies that people will have to make major sacrifices in their lives to own an electric.

We are all missionaries for electrics in a world of automotive pagans. A sermon of joy is going to make more converts than one of chastity, poverty, and obedience. So go forth and preach the gospel.

Positive vs. Negative EV Facts

The same information can be delivered in different ways, with different results. Is the glass half full, or half empty? The following are samples of different ways to convey the same facts about electric cars.

Range

Negative. Electric cars have short ranges. The average is only 60 - 80 miles, and some of the poorer ones get only 30 miles. Only a few of the best can get even 100 miles.

Positive. Ninety percent of the cars in America travel less than 25 miles a day, and even the worst electrics can do that. Most well-made modern conversions can do two or three times that, and the high-performance cars can do 100 miles or more.

Speed

Negative. Electric cars aren't as fast as gas cars.

Positive. Most well-made modern conversions can reach top speeds of 50 - 60 mph, and the high performance cars can get up to 80 - 90 mph.

(continued on next page)

Meet the Press

(continued from previous page)

Charging

Negative. Electric cars are inconvenient to refuel, because you can't just pull up to a corner gas station. Also, they take a long time to charge--as much as twelve hours.

Positive. Electric cars are easy to charge. Just plug into a regular 110 v outlet. Most people don't use up a full charge in a day. Instead of finding a gas station, waiting in line, and wrestling a smelly pump, you simply plug in at home at night, and the car is ready in the morning. Many people drive ten or so miles to work, plug in all day, and have a full charge when they leave.

Running Out Of Electricity

Negative. What happens if you run out of juice before you get home? Most electric car owners have tow bars for rescues.

Positive. When a gas car runs out of gas, it stops dead, right now. An electric will simply start to slow down gradually over a period of several miles. If you finally must pull off the road, you can park for ten minutes, and the batteries will regain some charge just by resting. You can then drive a couple more miles, and rest again if need be. Try that with an empty gas tank!

Long Trips

Negative. You can't take long trips in an electric car.

Positive. An electric car is not intended for long trips, just as a microwave oven is not intended for frying foods or baking angel food cakes. Most people who have a microwave also have a conventional oven. Most households in America have more than one car. For long trips, take the other car.

Cost

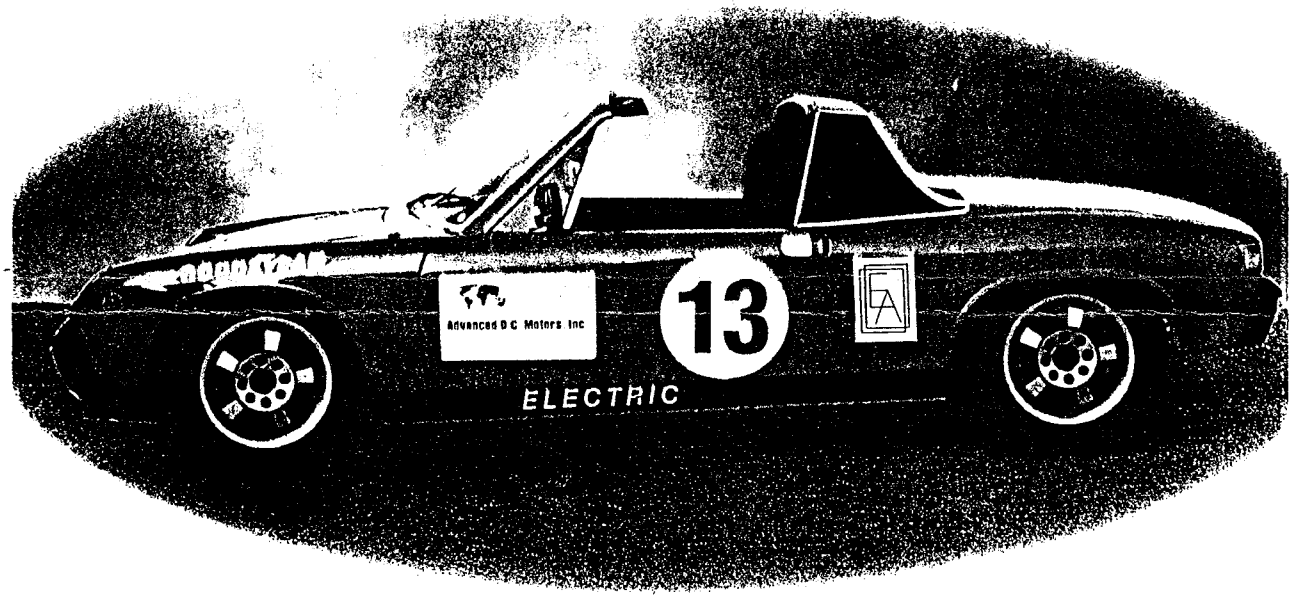
Negative. It's expensive to buy or convert a car, and to replace the batteries when they need it.

Positive. An electric car is very cheap to operate. Even including replacing the batteries every three to four years, it still costs only about a third as much as a gas car. That's because there are no tune-ups, oil changes, mufflers, starters, water pumps, radiators, etc. And how do you place a dollar value on all the time you save not taking the car to the shop?

These are just a few examples of ways to answer the most common questions in a positive way. Think up your own positive answers to questions, and have them ready when people ask.

I FEEL THIS INFORMATION IS VERY IMPORTANT. PLEASE REPRINT IT IN YOUR NEWSLETTER, OR MAKE IT AVAILABLE TO EV HOBBYISTS IN ANY WAY YOU HAVE AVAILABLE. THANKS!

MYTH-SHATTERING ELECTRIC PORSCHE!



MYTH: Electric cars are slow.
FACT: This electric car has a top speed of 90 mph.

MYTH: Electric cars are stodgy.
FACT: This is an electric *sports* car.

MYTH: Electric cars have no power.
FACT: This electric car lives 1400 feet up a mountain--and makes that climb daily.

MYTH: Electric cars have a limited range.
FACT: This electric car can travel more than 125 miles on a single charge.

MYTH: A fast, powerful, long-range electric sports car must use exotic new technology and cost a fortune.
FACT: This electric car was built with off-the-shelf components, and the conversion parts cost less than $8,000.

PHOENIX, MARCH 6, 1993--An electric Porsche rolled onto Phoenix International Raceway to shatter myths about electric cars. The common misconception is that economical electric cars must be gutless and boring, and exciting high performance electric cars must be astronomically expensive. This 914 Porsche soundly refutes that fallacy.

The sports car was converted by owner Ron Rasmussen, using affordable, reliable, off-the-shelf components, and the car is his daily commuter. Yet it is also a fully competitive electric stock car racer. With several other successful races behind it, Rasmussen is setting his sights on the 1993 APS Solar & Electric 500.

The car has been the subject of numerous articles, and was featured in a videotape. A custom Porsche 914 conversion kit based on this car is anticipated for release in late 1993.

SPECS:

DONOR CAR:	1974 914 Porsche
TRANSMISSION:	5 Speed
MOTOR:	Advanced DC 9" Series Brush DC 20 HP Continuous
CONTROLLER:	Curtis/PMC 1221 MOSFET PWM Chopper
BATTERIES:	US Battery 6 Volt Deep Cycle Lead Acid 120 Volt Pack
BATTERY BOXES:	Polyprolylene
TIRES:	Goodyear Invicta GL
CHARGER:	K & W 110 Volt Transformerless
OTHER COMPONENTS:	Sevcon DC/DC Convertor Heinemann DC Circuit Breaker Buss Fusible Links Westach Gauges Empro Shunt Albright Main Contactor Heavy-Duty Rear Springs & Front Torsion Bars
CURB WEIGHT:	3,500 lbs.

RACE TEAM:

TECHNICAL CAPTAIN:	Michael Brown
STRATEGY CAPTAIN:	Dan Sullivan
OWNER/DRIVER:	Ron Rasmussen
COMPONENTS:	Deluxe Kit From Electro Automotive
SPONSORS:	Electro Automotive Advanced DC Motors U. S. Battery Curtis/PMC Goodyear

RACE CREDITS:

1992 APS SOLAR & ELECTRIC 500:
"B" STOCK SPRINT RACE:
3rd Place
"B" STOCK ENDURANCE RACE:
2nd Place
1992 SOLAR ENERGY EXPO & RALLY:
AMERICAN COMMUTER CLASS:
2nd Place
1992 ELECTRIC GRAND PRIX:
COMMUTER CLASS:
2nd Place

VIDEO AVAILABLE

"Porsche 914 Components Packaging Tour" (30 min., $30.00 + $3.00 shipping) Get a guided up-close tour of this exciting electric car, led by its builder, Ron Rasmussen, and kit supplier and conversion authority Mike Brown. Available from Electro Automotive, POB 1113, Felton, CA 95018. Check/VISA/M

ABOUT ELECTRO AUTOMOTIVE:

Electro Automotive, in business since 1979, is the oldest and largest retail supplier of electric conversion components for a wide variety of cars & small trucks. Electro Automotive also offers consulting & training, videos & books, including the definitive step-by-step conversion manual, Convert It, by conversion authority Michael Brown.

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