Electric Auto Association

CURRENT EVENTS

JUNE '96 | Promoting the use of electric vehicles since 1967 | VOL 28 No. 6

Doing It By Eyeball

By Sparkz

EV types come in two main flavors these days. There are the safe and sane folk who see the EV as the sensible eco-alternative to infernal combustion. Then there are guys who probably deserve a membership in the Society for the Liberation of Smoke from Semiconductors and Motors. (SLSSM). Folks to whom safe and sane is an anathema. Like Ed Rannberg.

If you see a 320 volt drag bike blasting down the drag strip or an EV Streamliner rocketing close to 200 mph on the Bonneville salt flats, chances are that Ed's around. At events such as the recent Phoenix APS race Ed can often be located by tracing the source of that fountain of sparks lighting up the night. In his presence, 48 go-kart motor commutators think they have transformed into meteors and behave accordingly. He is a motorhead and an old-time drag racer who firmly believes that if you didn't break it, you didn't drive it hard enough

Shoving the Limits

But there is far more to Mr. Rannberg than making things light up and go bang. He builds vehicles that not only push the limits; they shove 'em right over the edge. He is arguably the fastest human on (non-rail) electric wheels. His drag bike set an EV quarter-mile record that hasn't yet been beat. Last year at Bonneville, the Streamliner set an unofficial EV landspeed record of 188 mph, topping the GM Impact's official 187. Unofficial because it was one direction only — something broke before he could run the other way. He has a lot of respect for the Impact landspeed team. "They took a stock EV,

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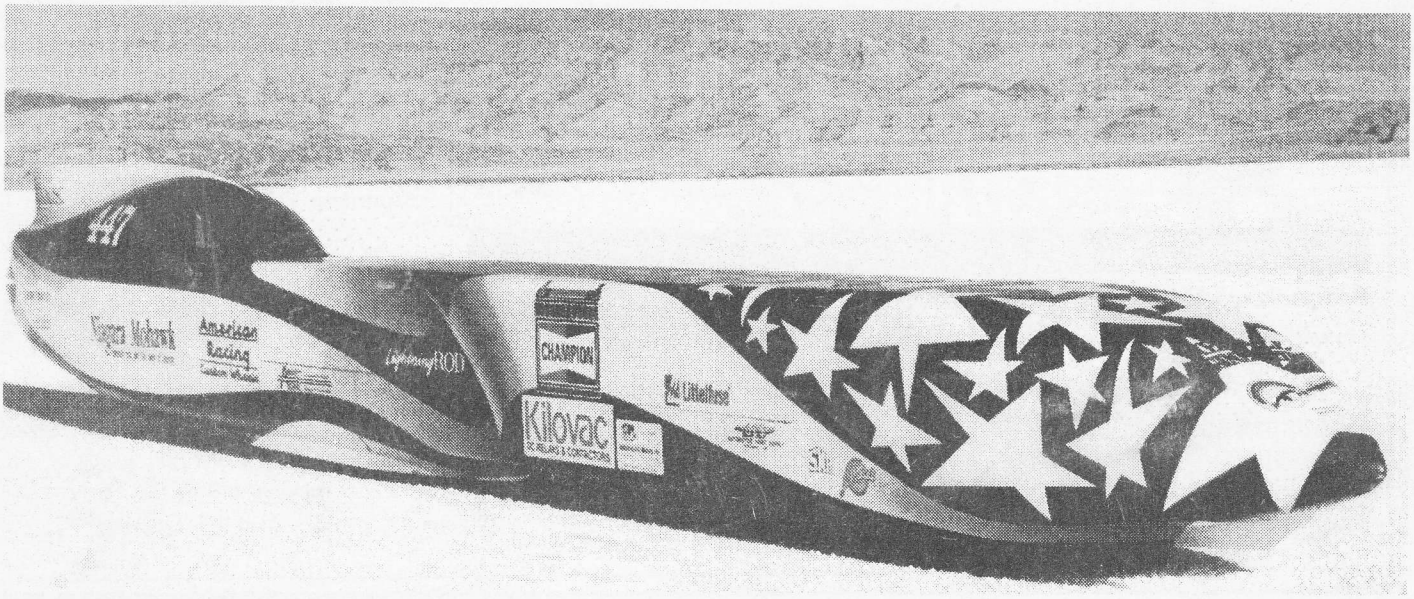

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Ed Rannberg's EV and Landspeed Record Attempt Streamliner

Photo credit — Eyeball Engineering

CURRENT EVENTS STAFF

Managing Editor
Clare Bell
271 Molina Drive
Santa Cruz, CA 95060
Tele: (408) 469-9185
Fax: (408) 469-3714

Contributing Authors
Sparkz
North Bay EAA Chapter
Bruce Parmenter

News In Brief
Ruth Shipley

Calendar of Events
Anna Cornell

Photography Credits
Ed Rannberg

Advertising/Design/Printing
Susan A. Hollis (PCTEK)
Fax: (408) 374-8750
18297 Baylor Avenue
Saratoga, CA 95070

Article Submissions
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Mountain View, CA 94040

Grime and Punishment

by Clare Bell

I'll let these stories speak for themselves, then I'll comment. The first was adapted from Ruth Shipley's News in Brief file, which she prepares from the Environmental Information Network (EIN) newsbriefs (see pp. 16-17). The second is from the America Online Reuters New Updates . I'm running them in the editorial section since I felt it was appropriate. —CB

Sierra Club Levels Anti-EV Charges

At the prompting of the Sierra Club, the US Justice Department has started an investigation into allegations that the automobile and petroleum industries have conspired to impede the development of EVs and low-emission vehicles. Among the claims being made by the environmental group are allegations that automobile and petroleum industry interests have colluded to manufacture substandard EVs and pushed battery development researchers to work on unachievable new technologies. The Sierra Club also claims that battery technology breakthrough news has been stifled, state legislators have been coerced into working against the passage of EV statutes and utility companies have been thwarted in their attempts to develop the infrastructure needed to support widespread EV use.

(from Ruth Shipley, News in Brief stories. Source - Automotive News: 4/1)

US Probes Gas Price Hikes

The Justice Department is investigating whether unlawful price fixing is behind the recent steep rise in gas prices. Gas costs at the pump are at the highest level since the Persian Gulf War. The department's anti-trust division has assembled a five member task force to probe the issue, which has become yet another battlefront as we head into November elections. The announcement follows President Clinton's order that the Energy Department start selling $227 M in oil from government stockpiles in order to knock down gasoline prices.

Source: America Online Reuters News Updates

The PayOff

Scarcely a month has gone by since the oil company PR firms and front groups delivered a decapitated California ZEV on a silver plate to their clients. And in that month gasoline prices have risen, in some cases close to the $2 a gallon mark ($1.89 for premium in San Francisco.) I confess that the change caught me by surprise, since I had been using my electric 914 as my daily driver. My last gas purchase had been about $1.32 a gallon for mid-grade. Yesterday, for a trip to San Mateo, I paid $1.55/gal. for the plain unleaded.

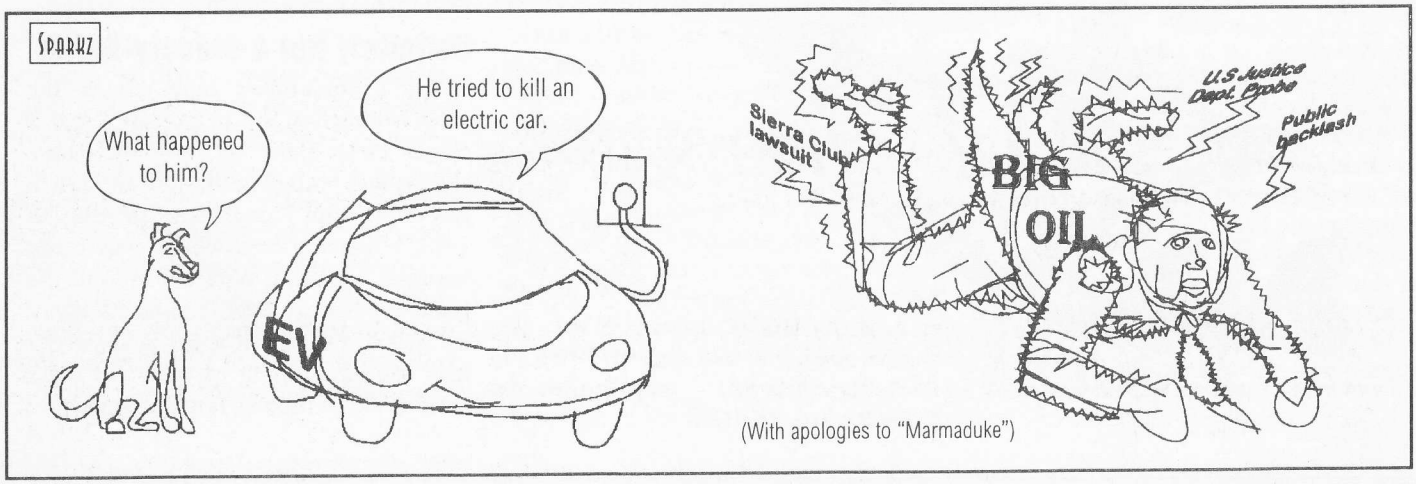
Coincidental, isn't it? Right. Blow that one out the tailpipe.

All of you folks (non-EAA members, of course) who worked against the CA ZEV mandate, this is your reward. Now that the petro-guys figure that they can just bury the guillotined corpse and with it any chance of competition, they've got themselves a captive audience. All you who just let the latest bit of slick from the petro-purveyors just drift on by, now you have the privilege of being thanked through the tank. For being saved from the evils of hidden taxes and the perils of dilute electrolyte, not to mention any possible shocks to the conscience, you grateful souls now pay a tithe to those who've made it possible. For those few who tried to stop the juggernaut and lost, the price hike is more salt in stinging wounds. If it is any consolation, the folks at CAHT, Woodward and McDowell, WSPA et al are also forking it over (though not as great a percentage of their incomes as those of us in the lower brackets). Unless they get their gas gratis.

Could this essay possibly be construed as criticism? Goodness, perish the thought!

Go right on jacking up those prices, guys. Just like heroin producers, you've got a helplessly captive market. I'm sure no-one can possibly think of an alternative to the gasoline "fix".

Go on and reel 'em in. They're hooked. —CB



(With apologies to "Marmaduke")

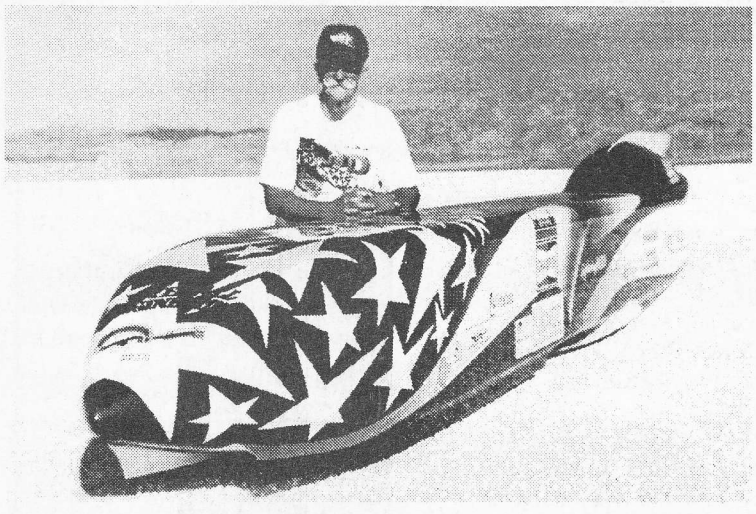
Eyeball

Continued from page 1

modified it a little and got it up to 187. That's impressive." Coming from one who knows, those words are praise indeed.

Now that the Italian Bertoni EV has broken 190 mph, Ed and his EV land-rocket are ready to do it again. This time he'll be going up to Bonneville with the similarly audacious Rod Wilde of Wilde Evolutions, who sincerely believes that he can throw that Taurus of his right through the 200 mph barrier. If guts and gumption suffice, he may well do it. If the salt flat conditions are right for Ed's Streamliner and everything holds together, chances are that Rannberg will succeed.

With a laid-back Montana gravel twang and a waxed and twirled blond handlebar mustache that could have belonged to Buffalo Bill Cody (or Snidely Whiplash), Ed is as smooth and easy as sippin' whisky. He's got a sly sense of humor and an ability to charm your socks off, even if you're wearing hiking boots. As for the firewater, he must put it in his batteries, judging from the way his EVs perform. He's a sharp cookie, a self-made, self-starter, who didn't let his eighth grade education slow him down. Challenging a two-year college equivalency degree test, he passed it with no sweat. His company name, Eyeball Engineering, reflects his philosophy, which is git out there and DO it. Though his name for a micrometer is "a fancied-up C-clamp", he's got a solid grounding in automotive and EV engineering. He has built many an adapter plate and converted many a car.



Ed and his Streamliner at Bonneville Salt Flats, He also pilots it.

One of Ed's better-kept secrets is that he built Joe LaStella's 450-mile-on-a-charge Geo Metro. Eyeball just did the car ; La Stella never told Ed what kind of batteries he intended to put in it, Rannberg says, adding that the Metro was a great little car. Ed also did the adapter plate and hung the motor in the first BAT Ford Ranger.

Ed understands the American love for things automotive, being a salt flat and drag racer from 'way back. . Quoting his long-time friend, Leo Schatzl, a Southern California EV builder (who has "gone on to that great EV Rally in the Sky."), Rannberg observed, "If you're American, you do the most important things in your life in a car. You were probably conceived in one and you'll take that last ride in one."

Definitely Not a Grocery-Getter

Ed's Streamliner may not be the most impractical EV in existence, but it comes close. Since its long wheelbase chassis was built to go straight and fast, it has only about 7 degrees of steering. In 1993, when the Streamliner was being honored by being paraded around the track at Phoenix International Raceway, Ed had to figure out if the landspeeder had enough turning capacity for the 1 mile oval. Definitely not the vehicle to

BE A PART OF THE STATE OF THE ART

Ed Rannberg, 63, of Eyeball Engineering in Fontana, CA, has been building electric vehicles for over 20 years. He is one of the Electric Vehicle Association of Southern California's 5 founding members. Ed's projects have spanned a wide range of vehicle types from 4-wheeled sedans to 3-wheeled saddled vehicles to high-speed 11-second drag bikes.

In September of '92, Ed decided to proceed with an electric streamliner, using "off the shelf" components and the experience he had gained the Eyeball way. Eleven months later, the vehicle stood ready to demonstrate American ingenuity and workmanship by resetting the then-current EV land speed record of 183 mph (GM EV1 in 1994) to above 200 mph.

In September 1994, Lightning Rod made several test passes of five miles of the 10-mile Bonneville Salt Flats at speeds in excess of 180 mph on three-quarters of its available power source. In 1995, the vehicle hit 188 mph going one direction. It will return to the salt in Spring 1996 when conditions permit, to reset the most recent 190 + mph record (Italian Bertoni EV in 1995) once again.

Individuals or organizations interested in being part of this adventure are encouraged to contact Eric Luebben at (714) 855-2814 or Ed Rannberg at Eyeball Engineering at (909) 829-2011. Or write to: Lightning Rod, 17 Hammond, Suite 409, Irvine, CA 92718.

take to the supermarket. For the purpose of debunking the "EV-as-gutless-wonder" propaganda, it's the most practical thing around..

A Hosed Motor

So, what got this motorhead from Missoula, Montana started on EVs? Serendipity and a mistreated Renault R-10.His daughter was driving the 1968 Renault one day when it overheated. This car is a rear-engine model with the radiator stashed back in a corner of the engine compartment. The oil filler cap is located in the middle of the engine, is far more accessible, and is easily mistaken for the radiator cap. It was and she did. "She stuck the hose right where you are supposed to add oil. Filled it full of water." Ed recollected during a telephone interview with CE's editor. "Well, I'd been thinking about building an electric..."

In the 1960's, he was working for Kaiser Steel, which was a 10 minute drive away. Yanking the drowned engine, he installed an aircraft starter-generator, 36 volts worth of batteries, and a mechanical J-bar controller, which worked by successively shorting out a set of voltage-dividing resistors and doing series/parallel switching. The Renault became Ed's daily driver to Kaiser Steel, who installed a charging plug for him. "I'd charge it, then go the 10 miles to work. It took 20 minutes each way and drained the poor beast completely ; I had to charge it hard overnight." Adding a variable belt drive doubled the Renault's range, however Ed went on to do other modifications to the car. "I've tried everything; voltage tapping, series/parallel switching, you name it." Once you build your first EV, you're hooked," Ed adds, and he was. Though the Renault's resistive switching worked, it was horribly inefficient, since the voltage-dividing resistors took half the current supplied by the batteries. The other half went to the motor. To Ed and pioneering EVers like him, the first electronic controllers made an unbelievable difference. It took modern EVs from backyard toys to serious contenders in the transportation arena.

LIGHTNING ROD" SPECIFICATIONS

Electric Bonneville Streamliner Vehicle

Body/Chassis	Builder	Arivett Brothers
	Chassis:	4140 Chrome-moly tubing
	Body:	Aluminum
Dimensions	Wheelbase:	117 in.
	Length:	24.4 ft.
	Width:	26 in. Nose tapers to 23 in. at canopy
	Height:	37 in. at tip of tail
	Weight:	2700 lb.
	Aerodynamic Drag:	0.131 Cd
Motor Type:	Advanced DC Motors Series-wound	
	Horsepower:	100 hp @ 3000 RPM
	Torque:	250 ft-lbs @ 1000 Amps
Performance	Performance:	0 to 200 MPH
	Top Speed	Estimated 200 MPH +
Electronics	MOSFET Controller	Curtis PMC 400 V 1000 A.
	Contactors:	Kilovac Single Pole "Bubbas"
Batteries	Type:	GNB Champion sealed recombinant lead-acid
	Quantity:	26 in series for 312 V DC
	Capacity:	240,000 watts (240 kilowatts) for 90 sec.
Drivetrain	Type:	62 mm Gates rubber belts 1:1 primary, 2.1:1 secondary, SPE floating hubs, Summers Brothers' 15 in. axle
	Steering:	Rack-and-pinion, 7 degrees lock-to-lock

Wilde Eyeballs?

Ed and Eyeball recently hooked up with Rod Wilde and Bob Rickard of Wilde Evolutions. They'll be doing a joint catalog featuring EV performance components. As part of the partnership, Eyeball may move to Oklahoma, where Wilde has a building. They'll keep their sites in Jerome, AZ and Seattle, WA

Currently, Ed is converting several cars from Russia and the Ukraine. "We sent over an Advanced DC motor and an empty 6V battery box and they used it for their design." The cars will take advantage of the 6V to 8V battery swap upgrade first described by Ken Koch, KTA Services, Inc., and now becoming popular. Originally designed for an 84 V pack; the substitution will take them to 112V, which, Ed says, will make these lightweight vehicles "really get with the program".

In the Works

Ed is re-thinking the present high-voltage, low-current EV design using the series-wound motor. After studying a pickup truck that used 72 volts from two parallel packs and a 550-amp Curtis to run a compound series/shunt motor, he began exploring the use of a compound series-shunt motor coupled with increased use of higher gears. Not only is regen easier to implement in the compound rather than the series, he points out, but the slower-revving compound

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CAUTION!

Ford EVs — Check Ignition Switches

An ignition switch fire hazard warning for 1984-1993 Ford cars, trucks and minivans may affect EVs built from those vehicles. Likely EV donors that have experienced fires include the Ford Escort, F-series trucks, Aerostar minivan and Mustang sports car. Conversion candidates that have the switch, but for which no fires have been reported include the Lynx, EXP, and Capri . Vehicles that do NOT have the switch are Ford Taurus, Mercury Sable and Ford Probe (made with Mazda)

Other Ford products that either have experienced fires or that have the switch are the Lincoln Town Car, Crown Victoria, and Lincoln Continental.

An internal Ford memo states that the deterioration of a plastic barrier between terminals in the ignition switch could cause an internal electrical short. According to documents filed with NHTSA, 820 switch-caused fires have occurred in the US. In some cases, fires ignited even with the vehicle parked and shut off. In Canada, Ford recalled 248,000 vehicles in late 1995, following 260 reports of fire or smoke from ignition switches. Fire in one parked Canadian Ford vehicle spread to the garage and house.

A new switch that puts more distance between the terminals has been in production since 1992. Replacement costs anywhere from $50 to $100. Ford will replace the switch without charge.

It might not be a bad idea to equip these Ford-based EVs with an auxiliary battery disconnect on the positive side, so that power can be quickly cut to the ignition switch, or keep a cable cutter (with insulated handles) in the glovebox.

An even better idea is to check and replace these switches at your first opportunity!

At the time of the Canadian fires in 1995, Ford said that it was looking into switch problems on 1989-1991 models. However an internal Ford memo dated Feb. 16, 1995 notes that nearly all of the company's; 1984 to 1993 models use the hazardous switch. According to the memo, which was obtained by the Associated Press, "There was a potential for adverse publicity at the time. One wonders why Ford did not just shift over to using the new switch in 1992 and avoid fires in the subsequent models.
— CB

Check or replace the ignition switch in the following 1984-93 Ford-based EVs

- Ford Escort, Mercury Lynx
- Aerostar (includes EcoStar) minivan
- F-series trucks
- Late-model Mustangs
- EXP
- Capri

Ford-based EVs that are OK

- Probe
- Taurus
- Sable
- Early Mustangs

What to do if you see smoke or fire from your EV's ignition switch.

- Stop the vehicle safely (if driving) BEFORE turning off the ignition. (You don't want to lock your steering column!)
- Get everyone out.
- Turn off the ignition switch.
- IF IT IS SAFE TO DO SO, disconnect main pack power (EPO)
- Disconnect ignition switch power at the auxiliary battery or DC/DC converter. Cut a wire, remove a terminal or pull a fuse if you have to.
- Use a fire extinguisher rated for electrical fires. DO NOT use water!

Eyeball

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motor is a better match to a gearbox designed for an ICE engine. Most EV conversions rarely get above third gear. Another idea is the use of multi-paralleled battery strings. The traditional 6-volt batteries have appreciable voltage sag when you draw heavy currents. The combination of two or three paralleled Group 30 12-volts holds up a lot better voltage-wise. The reason for this lies in the non-linear battery discharge curves. By splitting a load between two batteries, you don't just improve the current capacity of each by half, you improve it by more than half. Three does even better. Voltage stays up longer even under heavy current demand.

Supercaps and a 6,000 Amp Controller?

High-tech-wise, Rannberg's present interest is supercapacitors. Supercaps, which are huge capacitors with (comparatively) long time constants, would be ideal for short-distance high-power-burst applications such as EV drag racing. If an EV dragster used light supercapacitors instead of batteries, and refueled from a trackside dump-charge pack, it could blow the doors off anything ICE-y, up to and including the top-fuelers. The problem is how to control the kilo-amp currents that supercaps can deliver — anything other than a huge knife-switch gets fried. Traditional silicon is not going to do the job, but there are some devices being developed for utility grid power control that could handle it. In a way, the situation with a supercap-driven EV parallels the situation with the battery-driven EV before the first Willey controller appeared, Rannberg points out. Successful development such a supercap controller could result in the same flowering of EV technology as that which resulted in our present high-performance EVs.

Anyone game to build such a beast? We're probably talking 6,000-7,000 amp switching capability. The first commercial devices are becoming available (check out IEEE Spectrum, Nov. '95). If you do, call Ed Rannberg

Zeroing Out Pollution: The Promise of Fuel-Cell Vehicles

by Jason Mark, Union of Concerned Scientists

On the eve of automobile industry's centennial, recent developments in fuel vehicle technology suggest that we may be on the threshold of a moor change in the way we drive. By virtue of their high efficiency, zero emissions and non-petroleum fuels, fuel cells can help mitigate the negative side effects that have accompanied motor vehicle travel over the past century. A new 50-page report from the Union of Concerned Scientists demonstrates that:

- The fuel cell car of the future promises to be 98-100% cleaner than today's vehicles.
- In Los Angeles and New York City, the estimated economic value of zeroing out pollution with fuel cell vehicles is $4,3000-8,3000 per car over its lifetime.
- When running on renewable fuels, fuel cell cars reduce emissions of heat-tapping gases by 85-100%. By 2025, fuel cells can cut oil use from autos and small trucks by one-third, saving nearly twice as much oil as we currently import from the Persian Gulf.
- A mature fuel cell vehicle will be capable of traveling 250-400 miles before refueling, accelerating from 0-60 miles per hour in less than 12 seconds, and achieving 70-80 miles per gallon. Mass-produced vehicles may eventually cost only $1,000-3,000 more than conventional cars.
- Fuel cell vehicles are on a rapid pace towards development, but capturing the large benefits of this technology requires stepping up development today to overcome the remaining technical cost and infrastructure hurdles.

The full report includes detailed estimate of the energy and environmental benefits of fuel cell vehicles as well as a review of fuel cell operating characteristics and the current efforts to develop this technology. Written for the policy analyst, interested layperson, and technical reader,, Zeroing Out Pollution outlines the promise that fuel cell vehicles hold for transforming transportation into sustainable travel for the 21st century.

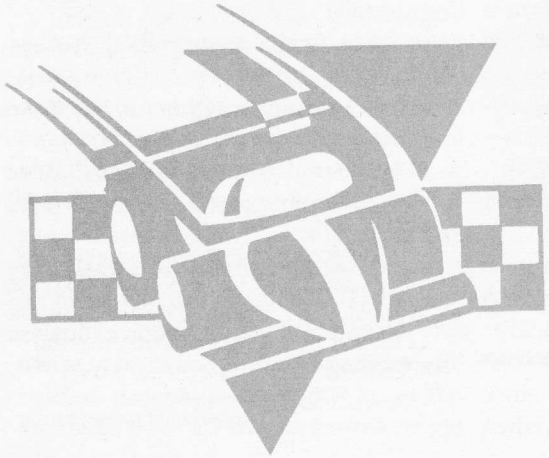
Access: Union of Concerned Scientists, Publications, Two Brattle Square Cambridge, MA 02238-9105 Tel. 617-547-5552.

For a copy of the full report, please send $7.20 for printing fees and shipping to UCS.

Funding for EV Race Teams?

by Bob Wing, EV Consultant

There might be funding for 1997 Phoenix teams through the Energy Foundation in San Francisco, CA. You need to be set up as a 501(c) (3) non profit to be eligible to apply for a grant. I think you might apply for a grant of $30-40,000 toward next years race car, possibly give the car, if it is street stock, to the Energy Foundation when you are through racing it.



Ask for the 1995 annual report, just issued. It has an essay by Hal Harvey, Exec Director on "Solving Early Market problems for EVs", several articles on EV and green fleets, list of and short description of awards given for the last three years, grant application form, applications due 12 weeks before Board Meeting held during first week of June, Nov. and March.

They have just moved to the Presidio to a building the Tides Foundation has leased for low cost non profit corporations to rent. Tides and Energy often co-sponsor grants.

Ph 415-561-6700, fax 561 6709, energyfund@ef.org, http://www.ef.org. They will mail copies of the annual report on request

Bob Wing, West Coast Editor EVNews, EV Consultant, Phone: 415/669-7402 Fax: 415/669-7407. Internet: bobwing@nbn.com or POB 277, Inverness, CA 94937-0277

Editor's note: EAA is set up as a 501(c) California nonprofit corporation. Chapters might benefit from such grants.

EV Design Analysis: Suspension

by North Bay EAA

This article was written to help the EV conversion designer in building safer conversions. To that end we discuss in general how an EV's suspension affects its safety, give a complete procedure for analyzing the effect of conversion on suspension and include hard-to-find information needed for the evaluation. We hope that this will make at least one EV conversion a little safer.

When you consider the safety of a vehicle, several items come to mind:

- Braking distance — Is it excessive?
- Handling Does controlling the vehicle require a lot of effort? Does the vehicle dip and sway while cornering, braking, or just cruising?

These are not the only valid safety considerations, but they do have a common factor; the vehicle's suspension. As well as making the passengers more comfortable, suspension also strongly influences braking characteristics, handling, stability and steering.

Suspension Basics

What is the primary task of suspension? To keep the tires on the road. Without enough road contact, a car can't steer or brake. Suspension adjusts to the dynamic forces of acceleration, braking and cornering in such a manner that the driver can maintain control of the car. This is what a vehicle's "handling" means.

A suspension system is a set of springs and/or struts plus shock absorbers located between the chassis and axles; usually at least one spring or strut per wheel. The spring does the work of absorbing impacts; the shock absorber or damper reduces ("damps") the spring's oscillation. Although we will not go into suspension theory in this article, the bibliography has excellent references on it.

Having established that suspension is key to a vehicle's safety, how do we apply this to EV conversions? In remaking a ICE car into an EV, we remove and add parts, thus altering parameters, such as weight distribution. Doing so may make demands that the manufacturer's original design can't meet. We will look at vehicle characteristics that influence suspension design, both in the original vehicle and the resulting EV conversion. By doing so, we can see what suspension modifications the EV will need. Ideally they will be minimal, however that is not usually the case.

Front to Rear Weight Distribution

The front-to-rear distribution of weight on an EV's axles influences what changes need to be made to suspension components. Hopefully, you will be able to calculate the new Gross Vehicle Weight (GVW) during the design phase rather than after completion, The actual calculations are simple.

You need basic information about your vehicle, namely:

* Curb weight (Wc)
* Max. payload
* Gross vehicle weight (GVW)
* Length of wheelbase (Lwb)
* Percentage of weight on the front axle (%GFAW)

(GFAW is Gross Front Axle Weight, GRAW is Gross Rear Axle Weight)

Getting this data is not difficult. It requires only a quick trip to the library to look at back issues of Consumer Reports or similar publication (although CR did not report maximum payload prior to 1975.) If not available, maximum payload can be calculated as the difference between curb weight Wc and GVW. GVW is located on the driver's door panel.

Front-to-rear weight distribution is expressed as a ratio of percentages, (e.g. 53/47) or of actual weights (1673/1327)

In the first case, %GFAW = W1%* 100/(W1% + W2%) or , since W1%+W2% will always equal 100 when dealing with two parts of a whole, %GFAW= W1%, so %GFAW = 0.53.

In the second case, %GFAW= W1*100/(W1+W2), or, in the second example, 0.55.

Start the analysis by determing the vehicle's center of gravity with reference to the origin (the rear axle).:

Lcg(orig) = Lwb * % GFAW (1)

Next, calculate the effect of every item removed or added during conversion You do this by making up two separate lists, one for all items added; a second for all items removed. Each list needs four columns. Column 1 for each list will be a description of each item, column 2, its weight in lb. or kg. If an item's weight is not known, it can be estimated using Table 1; multiply the appropriate factor by the curb weight, Wc and enter the result in column.2. In column 3, indicate each item's position in the vehicle relative to the rear axle in inches or meters (see Fig 1 for an example). Items in front of the rear axle are considered positive, those behind are considered negative. A calculated value for each, the moment arm, goes in column 4. Moment arm, M, is determined as:

M = W * L (2)

where W is the weight of an item, and L is the item's position relative to the vehicle's rear axle.

Complete each list. All information is necessary for each item being added or removed.

When finished, compute the following:

Wr = Sum weights of all items removed

Wa= Sum weights of all items added

Mr= Sum moment-arms of all items removed

Ma= Sum moment-arms of all items added

Example: Sample portion of analysis for existing EV.

continued on next page

Make: Mazda
Model: RX-3
Gross Vehicle Weight (GVW): 2804 lb
Curb Weight (Wc): 2124 lb
Wheelbase (Lwb): 91"
Front to rear weight ratio: 58/42

Determine %GFAW. In this case we have a weight ratio instead of actual weights.

%GFAW = %W1 = 0.58

Compute vehicle center of gravity with reference to origin, using equation (1):

Lcg = Lwb * % GFAW = 91 in. * 0.58 = 52.78 in.

Calculate the moment-arm of the original center of gravity (cg) using equation (2)

M = W * L

Mcg (orig) = Wc(orig) * Lcg(orig) = 2124 lb. * 52.78 in. = 112147.2 lb.-in.

Now make the two lists. Use equation (2) to compute moment-arms

Continuing the analysis:

Calculate the new curb weight and its associated moment-arm:

Wc (new)=Wc(orig) + (Wa-Wr) (4)

Example: More calculations for the Mazda

From equations (4) and (5)

Wc (new) = Wc(orig) + Wa - Wr
2124 lb. + 1155 lb. - 522.5 lb. = 2756.5 lb.

Mc(new) = Mc(orig) + Ma - Mr
= 112147.2 lb.-in. + 34825 lb.-in. - 4268.5 lb.-in = 142703.7 lb.-in

Since the operating weight will include driver, passengers and cargo, determine the maximum GVW of the converted vehicle. Estimate the max. payload by assuming a passenger weight of 150 lb. and a cargo weight of 100 lb. or less. For each passenger and each anticipated mass of cargo, find its relative position relative to the rear axle. Calculate its moment-arm using equation (2).

Once payload is determined and moment arms for payload items are calculated, sum payload weights to get Wp and sum payload moment-arms to get Mp.

TABLE 1

A. Items being removed from Mazda:

Item description	Weight (W in lb.)	Relative position (L in inches).	Moment-arm (M in lb.-inches)
Engine	81.6 @	99	3154.4
Radiator	8.5 @	112	952
Exhaust	29.7 @	-10	-297
Gas tank	23.4 @	-5	-117
Coolant	8.4 @	112	940.8
Gasoline	96.7 @	-5	483.5
Oil	7.2 @	-99	712.8
Spare tire	29. 7 @	-20	594
	Wr = 522.5 lb.		Mr = 4268.5 lb.-in.

Note: weights derived from factors in Table 1

B. Items being added

Item description (W in lb.)	Weight (L in inches).	Relative position (M in lb.-inches)	Moment-arm
Motor (Prestolite)	105	99	10395.0
Battery 1	65	106	6890
Battery 2	65	104	6760
Battery 3	65	96	6240
Battery 4	65	94	6110
Controller	15	100	1395
Charger	25	100	2500
Acc. Battery	15	100	1500
Battery racks, etc	65	99	6435
Battery pack1	325	-15	-4875
Battery pack2	325	-25	-8125
Battery box	20	-20	- 400
Wa = 1155 lb.			Ma = 34825 lb.-in.

TABLE 2

Payload evaluation (Mazda)

Payload (front seat)	Wpf = 300 lb.	Lpf = 41 in.	Mpf = 12300 lb.-in.
Payload (rear seat)	Wpr = 150 lb.	Lpr = 15 in.	Mpr = 2250 lb.-in
Totals	Wp = 450 lb.		Mp = 14550 lb.-in.

Now compute:

GVW (new) = Wc (new) + Wp (6)

Mcg (new) = Mc (new) + Mp (7)

Lcg (new) = Mcg (new) / GVW (new) (8)

% GFAW (new) = (Lcg (new)/ Lwb) *100 (9)

Example (Mazda):

Determine the new GVW, new moment arm, new cg. and new percent-

continued on page 10

EV Design Analysis: Suspension

continued from page 9

age of weight on front axle, (%GFAW). From (6),(7),(8) and (9)

GVW(new) = 2756.5 lb. + 450 lb. = 3206.5 lb.

Mcg (new) = 142703.7 lb.-in. + 14550 lb.-in. = 157253.7 lb.-in.

Lcg(new) = 157253.7 lb.-in /3206.5 lb. = 49.04 in.

%GFAW(new) = (49.04 in. / 91 in.) * 100 = 53.8

Now compute a new weight distribution parameter, the percentage of vehicle weight on rear axle or % GRAW:

% GRAW = 100 -%GFAW (10)

GFAW(new)= (11)

(%GFAW(new)/100) * GVW(new)

GRAW(new)= (12)

GVW(new) - GFAW(new)

GFAW(orig) = (13)

(%GVW(orig)/100) * GVW (orig)

GRAW (orig) = (14)

GVW (orig) - GFAW(orig)

Changes in weight distribution are:

dGVW = (15)

GVW(new)-GVW(orig)

dGFAW= (16)

GFAW(new)-GFAW(orig)

dGRAW= (17)

GRAW(new)- GRAW(orig).

Percentage increase in weights are:

% increase in GVW = (18)

GVW(new)/GVW(orig)

% increase in GFAW= (19)

GFAW(new)/GFAW(orig)

% increase in GRAW= (20)

GRAW(new)/GRAW(orig)

Example: (Mazda)

Calculate front and rear axle parameters from (10)-(20)

%GRAW(new) = 100 - 53.8 = 46.2

GFAW(new) = (53.8/100) * 3206.5 lb. = 1728 lb.

GRAW (new) = 3206 lb. - 1728 lb. = 1478.5 lb.

GFAW(orig) = (58/100) * 2804 lb. = 1626.3 lb.

GRAW(orig) = 2804 lb. - 1626.3 lb. = 1177.7 lb.

Changes in those parameters are:

dGVW = 3206.5 lb. - 2804 lb. = 402.5 lb.

dGFAW = 1728 lb. - 1626.3 lb. = 101.7 lb.

dGRAW = 1478.5 lb. - 1177.7 lb. = 300.8 lb.

% increase in GVW= 3206.5 lb./ 2804 lb. = 1.14 or 114%

% increase in GFAW = 1728 lb. / 1626 lb. = 1.06 or 106%

% increase in GRAW = 1478.5 lb. / 1177.7 lb. = 1.25 or 125%

Now that we've determined the parameters that affect the suspension and, in turn, the vehicle's steering, handling and braking, we can determine what modifications are needed for each system in the EV.

If ALL of the % increases in the above parameters are between 90-100%, the conversion is well within engineering safety margins and doesn't need any modifications.

This is seldom the case, so the conversion might have some problems. We'll deal with them in Part 2.

About this paper

A few years ago, the North Bay EAA members debated how to determine how safe an EV conversion really was. At the time nothing was resolved. We did recognize that there might be a serious safety concern if the builder exceeded the original gross vehicle weight. People suggested many ideas for making the vehicle safe again, but they came away with the sense that these were just qualitative guesses. In response to that lack, North Bay Chapter decided to investigate this issue as a chapter project.

This report turned up in the files that CE inherited from its previous editor. It must have been submitted and deserves publication. There was no author listed, so I am crediting North Bay EAA as a whole.

—CB

TABLE 3

Factors for estimating weight of original vehicle components and fluids

Item	Factor	Fluid	Unit weight
Original engine	0.15	Gasoline	6.2 lb./gal
Gas tank	0.111	Coolant	2.1 lb./qt
Radiator	0.004	Oil	1.8 lb./qt
Spare tire	0.014		
Rear seat	0.111		

1. How Your Car Works, Sam Jully, Popular Science Books, New York, NY, 1974

2.Chilton's Guide to Brakes, Steering and Suspension, Chilton Books, Radnor, PA, 1985

3.The Complete handbook of Front Wheel Drive Cars, Jan P. Norbye, Tab Books, Blue Ridge Summit, PA, 1979

4.EV Engineering Guide Book: Electric Vehicle Conversion for the 1980's, Paul R. Shipps, 3E Vehicles, San Diego, CA 1981

5. Consumer Reports, many issues from Mar. 1973 through July 1987, specially the April issues. Consumers Union, Mt. Vernon, NY.

6. Car and Driver, "Reading the Rubber," Sept. 1982, p. 41

7. Motor Trend, "Technologue: Active Suspension", Jan 1987, p. 100

8. Popular Science, "Air Lift for Cars", May 1983, p.11

9. Popular Science, "Gas-charged Shocks", Apr. 1983, p. 122

Goodyear Tire and Rubber Co. "G-Metric Radials, Brochure No. 862-918-506 Aug 1983.

Performance EV specs

by Rich Brown

Many of you have offered advice and components to me in my quest to build a performance EV. It kind of boils down to a couple of choices, at least without going to a custom motor and controller, which would take TLC (Truck Loads of Cash). Here's what I've gotten so far.

1. Mazda RX-7 body. Fairly lightweight rear-wheel drive (no torque steer) with lots of places to put batteries. The RX-7 also has lots of aftermarket performance and body parts available. Lots of these cars were made from 1979-1985 and you can pick one up for a song.

2. Motor - 9" Advanced DC. Can take higher voltage and current. Don't know where to find a better motor for my EV unless I pay a lot more for a custom motor with a custom controller. Suggestions welcome.

3. Controller- A.) Curtis, Zappi or Auburn Scientific controller with a controller bypass contactor (s) for the rare faster acceleration. Let the motor control how much current it draws from the batteries. B.) two Auburn Scientific Kodiak controllers with a Battery Blaster system delivering 1200 A max., A3 terminal on motor.

I think I would rather just have one high-voltage/amperage controller, but I haven't seen any available. Any offers to build one?

4. Battery pack - Hawker Genesis 12 V. Two parallel strings of 156 V to 180 V with battery management such as the Wilde Evolutions product. The Genesis battery has about the same energy as the 5 SHP, but seems to be able to deliver more amps with less damage and potentially can deliver better life. The Genesis pack will weight about 200 lb. less than the equivalent 5 SHP pack.

This car would need to go 18-36 miles between charges (don't know if I could charge at work or not). Not too much high amp acceleration if I want to make it home.

That's the basics for my high performance EV. The total cost is about $11-$12K for the controller bypass method and more for the Battery Blaster method.(not sure how much). That leaves me a little extra to fool around with.

Any comments, suggestion or flaming are welcome. I've learned a lot from the members of this list and the EAA people I've talked to. I know the above specs may be a tiny bit out on the edge, but I just don't want to drive a 96 V Escort with a 400 A Curtis. It's just not me.

Rich Brown, San Jose.

San Jose Earth Day Report

by Bruce Parmenter

The EV-ers had been contacted, maps faxed to participants, details given to the City Electrician about charging outlets needed. The committed EVs were coming on Saturday 4/20/96 between 8-8:30 AM.

Preparations for this Earth Day were long and intensive. Itís funny how, in the last few days, things get hot and heavy. I knew this and took the final two days before the EVent off, not only to recoup from an awful head cold, but to prepare for the worst. Being a good boy, I stayed in bed most of the time, only peeking out of the covers in the evening to access the fax at work (thus getting the final items done).

The Friday before the EVent, I went down to Parkside Hall to check on the preparations and see if there were any last minute details that needed to be resolved (sniff, sniff, AH-chooo!).

Yup, only one electrician had been assigned that night, and there was a major "Jay Leno"activity happening on Sunday, so the electrician was politically pulled away, leaving half of the work undone. Power panels and drops were in place. Power was available but it was in Industrial format. I needed the pigtail adaptor cables (L6-20 to NEMA 6-20, L14 to NEMA 5-20, etc.). The electrician was supposed to work on that task .

So, the rest I had gained previously was blown away by staying up very late on Friday night, organizing the available power for the higher priority EVs that had committed to come in the morning (an EVangel's job sometimes means no sleep). I built the most needed adaptors, leaving them partially open for the electrician to check in the morning.

I then dashed home late, loaded my EV with the needed materials; parking cones, literature, posters, etc. and tried to get some sleep for 4 hours. I awoke, got to the Hall to continue the work, and was happy to find the electrician there to help me.

At 8 AM the EVs started rolling in (during the same time that the Scoutmasters were parking in the driveway, trying to unload. I had to bull-horn them OUTTA THERE (much to their chagrin).

By 9-9:30 AM, the majority of the EVs were in and charging nicely. I was surprised to find some EVs that had been invited that I wasn't notified about, but it turned out well, since we had plenty of room and power for everyone.

We had many EVs from around the Bay Area, including:

A Mazda sedan at 120V using 12 EV batteries. This car was built in Santa Cruz for a 90-year-old gentleman who drove it from Palo Alto. He was having a ball driving electric in his new EV (I hope I'm that sharp at that age.)

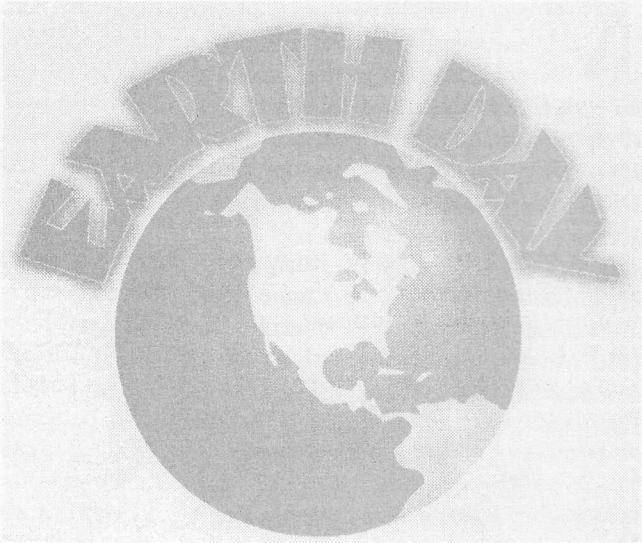
Don Bright (with the help of Mike Slominski) brought plenty of ZAP! Ebikes. AND a gorgeous, sleek and sexy white Tropica (Don will have more on how you can get your hands on these later.).

A surprise visit by the Trans2 representative, displaying their EV.

Many local EAA chapter members attended.

EAA San Francisco

- John Newell, Jet/Ford Escort, using the Stan Skokan 3.3kW charger
- Peter Barnes in his VW truck, 120 V
- Mike Slominski in his VW Rabbit, 120 V



EAA Silicon Valley

- Will Beckett, '92 S-10 Blazer, 120 V, using an Auburn Scientific Kodiak controller, Stan Skokan 3.3kW charger
- Chuck Olson in his 132V Saab (an EV old-timer who just keeps on going)
- Herman Gyr , Solar Electric Escort, 108 V.

EAA San Jose (home team)

- Don Gilllis, with both his 914 Porsche at 120 V
- Don's Grumman Postal Van at 96 V
- Marc Fontana, VW Rabbit (just back from a business trip in time for the fun).
- Bob Lombardi, Bradley GT, a T-top gullwing door design.
- Bob Mueller brought his 96 V Le Car for giving rides
- Bruce Parmenter, '85 Blazer, 120 V

There was a College Solar Racecar display outside the building, attracting passers-by to see more inside.

Glen Evan of the City of San Jose had arranged for a local TV station, KNTV Channel 11 to do an interview. At about

10 AM, we lined Will Beckett up for it, since he is the soft-spoken pro with the media. About 30 min. later they were done, gone and out of there, but Will thought it went well (great EV coverage for the cause). KNTV broadcast a 15 sec. clip of the interview on their 6PM News. While the video focused on the EAA Rally Awards on Will's dash while the announcer briefly segued in by saying, "and if you are having concerns about higher gas prices, you will like to hear this, (insert sound of Will's Blazer running). Electric cars can help with that."

Not exactly how we might have chosen to present ourselves, but the visibility was there.

Many members of the public were amazed at all the EVs present. They stuck around for the rides we gave from 11 AM to 2 PM, filling out the needed City waiver forms. The ride vehicles were Don's Porsche, Willís Blazer, Bob's LeCar and Bruce's Blazer (I spent most of my time using the bullhorn to alert the public to their EV ride options, then, at the end, I gave rides.)

My thanks to all who came and my greatest thanks to Glen Evan of San Jose Beautiful for working so hard with the City of San Jose.

In view of the response of the other Bay Area EAA chapters, we are now getting ready to attend their up and coming EVents: notably SFBEAR, on May 4th —BP

Bruce Parmenter , EVvangel, EV List BB Editor, email, BruceDP@aol.com. Fax 408-746-5368. San Jose EAA Chapter Website - http://members.aol.com/sjea

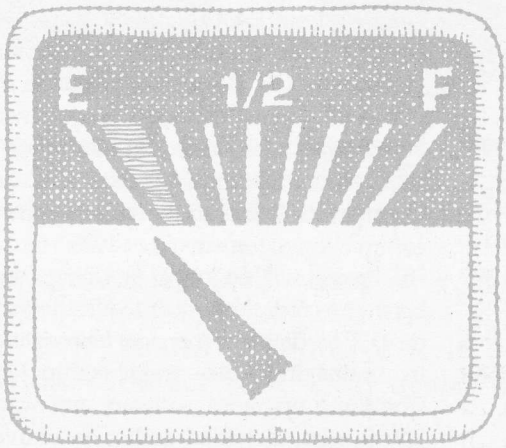
Earth Wins, You Win

For every $1000 you spend on gasoline, driving the EV1 could save you $717.

On a global scale, the estimated cost of cleaning up the pollution from an ICE car is $17,000. Using an EV1 could save the planet that cost.

(Thanks to John Newell)

How Far Can You Go On A Dollar? Electric - 353 % Further than Gas



32 Miles

Geo Storm, manual shift
$1.13/gal. 36 mpg hwy.

75 Miles

Impact-Day charging
Normal utility rates
$0.12/kwhr, 124m=13.7 kwhr

113 Miles

Impact - Overnight charging
Off-peak utility rates
$0.08/kwhr, 124 m=13.7 kwhr

And, as you can tell, that was before the recent gas price hike (Thanks to John Newel)

Board Briefs

from minutes taken by Peter Barnes

The meeting was called to order by Chair Skokan at 10:45 at his residence, 1020 Parkwood Way, Redwood City, CA

A quorum of members was deemed present by the Chair. Present Z. Skokan, T. Cygan, P. Barnes. Board member C. Bell arrived at 12:00 noon. Absent: B. Brooks, M. Slominski, A. Cornell, H. Bell, G. Gless, K. Koch, S. Lough. No other EAA members or visitors were present.

Chair Skokan announced that Vice-Chair, B. Brooks had announced his resignation from the Board with regrets. Resignation to be completed by April 30.

Agenda for meeting was presented. T. Cygan moved for acceptance,

Committee Reports

Internet - Inquiry requesting information on starting a chapter in West VA was received by T. Cygan. He will send contact information to H. Bell.

Chair Skokan received a mail inquiry from Prescott, AZ on chapter formation. It will be followed up by H. Bell.

Finance - Mike Slominski asked the Board for a review and comments on his yearly letter to chapters that accompanies one of his rebate checks.

Letter to Governor and CA Air Resources Board (CARB) expressing EAA interest in maintaining California Zero Emission Vehicle Mandate and timetable in place.

* John Newell - sent a letter as EAA Chairman Emeritus on Dec. 18, 1995

* C. Bell made presentation to the Air Board at the Dec. , 1995 CARB meeting in Sacramento.

* P. Barnes - Sent letter for the EAA Board to CARB and Gov. Wilson on Mar. 6, 1996 and a reply was received on Mar. 20 citing market experience, inability to match ICE mileage, and battery technology as reasons that Evs are impractical (see p. 18).

Current Events - C. Bell

April issue is running late due to Phoenix race involvement. Concerns were expressed about picking up issue from printer and mailing, as B. Brooks had this responsibility.

Concerns about reviewing Calendar Section for content and accuracy. Discussion noted a need for additional help in final proofing the entire Current Events.

Clare Bell moved that the Current Events editor, through contacts with Silicon Valley, SF Peninsula, and San Jose, will seek an additional proofreader to enhance CE and provide editorial backup/assistance. Passed unanimously by those present and their proxies.

B. Brooks' departure means that the mailing list, mailing labels, and mailing of CE will need a new person. B. Brooks indicated that he will help and seek replacement.

T. Cygan agreed to talk with Bruce about maintenance of the membership list.

-Editor's phone # in CE is getting general inquiries about EAA and Evs that should end up elsewhere in the EAA organization. Discussion of how to redirect these inquiries away from the editor. Redirect to EAA 800 number? Use of less burdened Board member? Electronic inquiry bank? Dedicated PC to electronically respond to phone calls via fax? C. Bell suggested a machine/computer aided by rotating response from EAA members (Board and chapters) for routine and non-routine inquiries to CE, Board and even the 800 number. T. Cygan will look into equipment. Board input is requested on new ways to respond to public inquiries about EAA.

Committees - No need to make changes in committee assignments from 1995.

- B. Brooks will no longer be doing membership records. Volunteer request to go in next CE for database manager for assistance in managing the membership list. Computer upgrades, software and warm EV fuzzies provided (other incentives, weekend with EV "Black Magic, T-shirts).

Radio-newspaper advertising - Memo from M. Slominski

Discussion - Good goal, costs are reasonable, but Board would like specific proposal - who, when, what would be focus. All Board members are requested to provide input to M. Slominski on specific thoughts in his proposal and especially on how the concept might be used by EAA chapters and members nationally. Suggestion that M. Slominski work with C. Bell to develop scenario/script and public service announcement that could be provided to chapters . C Bell will seek an article for CE on EAA advertising from M. Slominski.

Monthly budget report -Income from dues is down $2,600 (about 1/2 normal) Expenses were $1,600 below budget.

Future Activities

Tour de Sol - P. Barnes presented plans to attend NESEA's Tour de Sol from NY City to the Mall in Washington, DC. He discussed the advantages of EAA involvement, efforts planned for membership recruiting, and made a request to the Board for support.

C. Bell moved to approve P. Barnes as EAA representative at Tour de Sol, authorize $75 for display permit to help produce EAA flyer, to provide loans to Don Gillis as appropriate to budget for EAA store items, and to arrange special response to EAA #800/

Board requests pictures and story from Tour de Sol for Current Events

Other Business

C. Bell - Would like to produce EV Buyers' Guide. Discussion expressed concerns regarding copyright, ownership of name, intentions of present BG editor Terpstra. Charging station directory was discussed as a possible alternate project.

More EcoElectric News ! !

Desert Lightning™

EcoElectric's electric pickup is now in series production. It features COLD, efficient air-conditioning, power steering, optional automatic transmission, and tested, reliable DC technology.

EcoElectric Corporation
P.O. Box 85247 • Tucson AZ 85754
602-770-9444 • Fax 602-770-9908
Email: ecoelec@primenet.com

Northeastern U.S. Dealership
Blue Sky Motors

Announcing the appointment of our dealer for the Northeastern U.S. Headquartered in Greenwich, Connecticut, Blue Sky Motors will handle vehicle sales, assembly, and service.

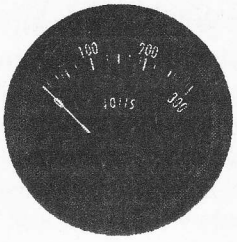
Blue Sky Motors
200 Greenwich Ave., 3rd Floor • Greenwich CT 06830
203-661-7747 • Fax 203-661-6558
Email: fw@ix.netcom.com

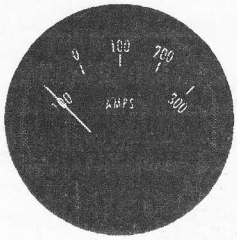
INTERNET

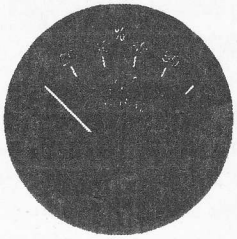
World Wide Web Home Page: *http://www.primenet.com/~ecoelec*
Desert Lightning Information: *http://www.primenet.com/~ecoparts/desert.html*
On-line Components Catalog: *http://www.primenet.com/~ecoparts*

ECOELECTRIC COMPONENTS SALES are now handled by email and the World Wide Web.
Visit our on-line components catalog at ***http://www.primenet.com/~ecoparts***
Our on-line parts sales manager will be happy to answer components questions by email at ***ecoparts@primenet.com***

ELECTRIC VEHICLE INSTRUMENTS







Analog Instruments to Monitor

- VOLTAGE
- AMPERAGE
- BATTERY TEMP.
- MOTOR TEMP.
- VEHICLE SPEED

High quality instruments for electric vehicles are available in a number of scale ranges, included expanded scale voltmeters for *fuel quantity*. Voltage and temperature instruments may be ordered with a optional *solid-state super bright warning light feature* which will warn of a battery "LOW FUEL" or a "HIGH TEMPERATURE" condition. Instruments are available in 2" & 3" round automotive style case made of MIL-SPEC nylon. Contact your local dealer or the factory for ranges available.

WESTACH INSTRUMENTS 1944 - 1994 50th ANNIVERSARY

WESTBERG MFG. INC.

3400 Westach Way, Sonoma, CA 95476 U.S.A. Phone (707) 938-2121/Fax (707) 938-4968

News in Brief

News in Brief is compiled by Ruth M. Shipley from information supplied by Environmental Information Networks. If reprinted, please credit Ruth Shipley and CE.

Hydro-Quebec Invests in Lithium Batteries

Osaka, Japan, is soon to be the home of a new ACEP lithium-polymer battery plant courtesy of an agreement between Hydro-Quebec and Yuasa Battery Co., of Japan. ACEP Inc., was founded in 1990 by Hydro-Quebec and Yuasa to pool their research findings on lithium-polymer batteries. Hydro-Quebec will invest C$3.8 million, 25 percent of the new company's total initial capital of C$15 million. The agreement provides for a second plant to be constructed in Quebec within the next five years to satisfy growing demand for the batteries in North America. While Yuasa will concentrate on developing small batteries in the new Osaka plant, expected to be completed in mid-1996, Hydro-Quebec will develop large batteries intended mainly for EVs.
(PRNEWSWIRE: 3/25)

Hyundai Makes EV Improvements

Korea's Hyundai Motor Company has announced that it has made improvements to its Excel electric automobile that rival some gasoline-powered automobiles in terms of speed and acceleration. The company has upgraded the Excel electric model, introduced in 1993, into what is now the new Accent electric model. The new Accent is capable of reaching speeds of 140 kilometers-per-hour (nearly 87 mph), and has a range of 390 kilometers (almost 250 miles) on a single charge. Developers said the car can reach a speed of 100 kilometers-per-hour (just over 60 miles-per-hour) in 15 seconds. The new Accent electric car features nickel-metal-hydride battery technology. Hyundai also made improvements to the old Excel's driving gear efficiency, and made some parts and components lighter.
(KOREA ECONOMIC DAILY: 3/25)

Rocketdyne Selected for EMB Demo

Rocketdyne, a division of Rockwell International, recently was selected by the Advanced Research Projects Agency (ARPA) and CALSTART to lead an electromechanical battery (EMB) technology demonstration program. The program will test Rocketdyne's patented flywheel containment system on a titanium flywheel. The project is intended to move EMB technology a step closer to commercialization. EMBs have several advantages over conventional battery systems for an equivalent amount of stored energy: they are lighter, more space efficient, require less maintenance, have a longer service life and cost less. Rocketdyne has been working on flywheel storage as a viable power source since the mid-1970s and has developed the technology into a direct-drive EMB.
(CALSTART CONNECTION: Mar 96)

CALSTART Announces Web Site

CALSTART, California's advanced transportation consortium, is making information on electric, hybrid electric and natural gas vehicles available for worldwide consumption via a new Internet web site. The site can be found at http://www.calstart.org. The consortium will draw on its industry network of more than 185 participating companies and organizations to update the site twice daily with EV and transportation industry news and resources. The site offers CALSTART's "Advanced Transportation Yellow Pages," a comprehensive directory of companies and organizations, including a list of nationwide vehicle manufacturers and suppliers. The site also includes information about all CALSTART activities, news releases, fact sheets and product photos. It also includes a discussion group area and links to other key industry web sites.
(CALSTART RELEASE: 4/2)

Powercell Unveils Zinc-Flow Battery

The Powercell Corporation, of Cambridge, MA, has developed a zinc-flow advanced battery for use in an EV designed by Daewoo Motor Company, a Korean automaker. Powercell, a developer of batteries for EVs and electric utilities, has been working since last fall with Daewoo on an electric car project using the automaker's light-weight two-passenger car. The car will reportedly have a range of 200 to 250 miles using the Powercell battery and cost about $15,000, according to Daewoo. The two companies expect the car to be available for purchase in the 1997 model year. However, the research and development venture has not yet resulted in a firm contract for the mass-production of the zinc-flow battery. Powercell currently is producing experimental models of its battery in Australia.
(BOSTON GLOBE: 4/2)

EV1 Will Use Inductive Chargers

General Motors will use Magne-Charge's inductive technology to charge the batteries in its upcoming EV1 and Chevrolet S-10 Pickup EV. Beginning this fall, GM will market the EV1 through its Saturn dealers in Southern California and Arizona. The system is being tested in GM's nationwide, two-year PrEView Drive Program. The ongoing program has taken place in nine cities across the US and has logged over 350,000 test miles. The charger meets all safety features and is expected to be extremely reliable. Since it is off-board, it won't contribute to the mass of the vehicle, which should increase the car's range. "Our PrEView test drive participants have told us they are extremely satisfied with the

system." said Robert Purcell, Jr., executive director of GM Advance Technology Vehicles.
(PRNEWSWIRE: 4/4)

Electrosource, Lockheed Martin Team Up

Lockheed Martin Control Systems has agreed to develop a high-performance, cost-effective HEV system that will use the Horizon battery being developed concurrently by Electrosource. The batteries in the HEV system are used to supplement the small internal combustion engine during instances of high power demand, such as for hill climbing, rapid acceleration and passing. This arrangement allows the hybrid electric engine to run at a constant speed, minimizing emissions and maximizing fuel efficiency. "We anticipate superior performance from HEVs when compared to today's automobiles," said William Craven, director of Electrosource motive power programs. For more information, contact Robin Roberson of Electrosource at 512-445-6606 or Jim Vallela of Lockheed at 607-770-2637.
(PRNEWSWIRE: 4/9)

Honda Acquires Interest in Ovonic

Honda Motor Co. recently became a shareholder in Ovonic Battery Company by acquiring an interest in the Energy Conversion Devices (ECD) subsidiary. Honda, which recently announced it will enter the EV market in 1997, has been evaluating the Ovonic battery technology as part of its ongoing EV development program. "We are pleased to have an automotive industry leader, Honda, join us as a partner as we prepare to manufacture production NiMH batteries for EVs at our GM Ovonic Joint Manufacturing Venture," said Stanford Ovshinsky, president and CEO of ECD. Ovonic currently licenses its proprietary nickel metal hydride (NiMH) battery technology to consumer battery manufacturers world-wide. For more information, contact Stanford Ovshinsky or Robert Stempel, at 810-280-1900.
(OVONIC RELEASE: 4/10)

Five Major Automakers Will Sell EVs

Honda and Toyota have joined Ford, Chrysler and General Motors in announcing plans to begin marketing EVs. At press conferences held recently in Southern California, Honda unveiled an all-new battery-powered car it will begin selling in California next spring, and Toyota showed the battery-powered 4-door RAV4 sport utility vehicle it will start selling in the second half of 1997. GM has unveiled the EV1, which will be marketed this fall in Southern California and Arizona. Chevrolet has announced it will sell its S-Series EV pickup truck next year, and Chrysler will have its electric EPIC minivan on the market by the end of 1997. Ford says it will begin selling electric Ranger pickups, first through a qualified vehicle modifier later this year, then as a production model next year.
(EVAA RELEASE: 4/10)

EV Makers to Use NiMH Batteries

General Motors, Honda Motor Co. Ltd. and Toyota Motor Corp. all have taken a step ahead of their competitors by building EVs with nickel-metal hydride batteries. According to Honda and Toyota, test vehicles with the new batteries averaged more than 120 miles between charges, twice the range of lead-acid batteries. The Japanese electronics firm Matsushita and Ovonic Battery Co. may supply the batteries for the Honda EV and Toyota RAV4 EV, which will be targeted at the California market. "We are delighted," said Ovonic Chairman Robert Stempel. "We are targeting the end of the year or early 1997 to have some production volume."
(AUTOMOTIVE NEWS: 4/15)

Solectria's Force Gets New Heater

Solectria Corp.'s Force is now available with an integrated, compact, fuel-fired heater for use in cold climates. The new heater burns a small amount of kerosene or diesel fuel to heat the passenger compartment, significantly reducing the burden on the battery system. The heater can raise the cabin temperature from 6 degrees to 70 degrees in just over 10 minutes. Recently, the Force traveled 43 miles on a single charge in mixed highway/city driving in single digit temperatures — after night temperatures dipped as low as -10 degrees. About half of all Solectria Force sedans and E-10 electric pickup trucks are located in areas subject to frigid winter conditions, yet virtually all of those vehicles remained in service throughout this past winter.
(SOLECTRIA RELEASE: 4/16)

Governor Pete Wilson and California Air Resources Board

Dear Governor Wilson and Chairman Dunlap;

On behalf of the Board of Directors of the Electric Auto Association, I am forwarding out disappointment and concerns over the planned near-term abandonment of the California Air Resources Board (CARB) Zero Emission Vehicle Mandates. We had been very encouraged by the leadership California had taken in moving to further clean air in California and the nation by forward-thinking actions of the CARB in 1990.

The Electric Auto Association is a national all-volunteer organization, formed in 1967, which is presently made up of more than 1500 electric vehicle owners and enthusiasts who are working to promote electric vehicles as an economical, clean and quiet alternative for personal transportation.

From the many public electric vehicle displays, shows and daily encounters experienced by our members, we have directly sensed the clear shift from amusement, to encouragement, to enthusiasm for EVs by the public in the last few years. The well-thought-out CARB plan for gradually introducing both lower and zero emission vehicles in 1998 via the mandate seemed a logical conclusion to changing public sentiment. Providing an 8-year lead time from 1990 to 1998 for technology and infrastructure development, and for industry planning and marketing seemed generous to us. Our membership, as EV owners, already knew the economy, ease of operation, and practicality of electric vehicles as one obvious answer to the goals of the ZEV "mandate".

The extensive and often distorted media and lobbyist campaigns which sought to belittle electric vehicles and to derail the mandate were apparently successful. Those campaigns, and long-experienced reactions from many stockholders in the auto and oil industry are many reasons we in EAA have for the present CARB proposal of voluntary efforts at introducing Zero Emission Vehicles.

We are saddened at the failure of California to vigorously lead the nation in clean vehicle technology. Like too many issues, we seem to be leaving clean air and transportation alternatives to our children and grandchildren to solve. In this vein, we, the Board of Directors of the Electric Auto Association urge you both to assert leadership and to keep the spirit of the 1998 mandate intact. Perhaps consider a compromise with the start date or the rate of introduction, but continue the state and national momentum you have initiated. Please, move the state and nation quickly towards the availability of electric vehicles that are practical, economical, fun, safe, and clean.

Respectfully,
Peter W. Barnes, Secretary

REPLY FROM THE GOVERNOR'S OFFICE

Dear Mr. Barnes:

Many thanks for your letter concerning the California Air Resources Board's (ARB) zero-emission vehicle (ZEV) regulations. The ARB's 1990 regulation regarding low and zero emission vehicle was adopted to meet strict air quality goals by controlling emissions from the major sources of air pollution — mobile sources. As a means to achieve these standards and maintain them

, ZEV technology has tremendous potential in California, both for cleaning our air and advancing environmental technologies. However we need assurances that this is both technology and commercially viable.

After extensive by the ARB, some six months of public testimony, including the findings of an independent battery audit panel which was convened earlier this year, it became apparent that modifications to the existing rule were needed if this measure was to succeed. Primarily battery technology development must lead to ZEVs that consumers will buy because they meet the driving public's expectations. It is unreasonable to expect consumers to buy a vehicle that costs $20,000 more, but gets less than 20 % of the mileage of its gasoline-powered competition. In the end, the marketplace is the ultimate test of any new ZEV technology

The proposal developed by the ARB would retain the requirement for full implementation of the ZEV mandate by 2003. Furthermore, it will permit modifications that allow enforceable emissions benefits to exceed existing requirements, and, at the same time, encourage early development of battery technology that will produce ZEVs that the market will accept. This proposal is fully consistent with the recommendations of the independent battery audit panel.

Governor Pete Wilson, Sacramento, CA 95814 Tel. (916) 445-2841

LETTERS to the Editor

EV Snowmobiles — Sooner than Expected

Hi Clare,

This is just a note about electric snowmobiles. I've been looking at all types of vehicles that will go electric, and snowmobiles may happen sooner than many think. First, park managers want badly to limit snowmobiles for noise and emissions in places like Yellowstone. Some snowmobile makers see the writing on the wall because the emissions controls will greatly reduce the power-to-weight ratios you mentioned. Until now snowmobile emissions and noise have not been regulated, but will be quite soon. The same goes for any small engine.

I do know that Bombardier, which is the largest snowmobile maker, has shown interest in building small electric vehicles as a complementary product to their other products. They may be planning ahead to do something in the snowmobile area.

As for the power thing, current snowmobiles have many possibilities for being made lighter, thus might use surprisingly small batter packs and small high speed brushless DC motors like those being put in electric motorcycles in Asia. As for the cold, the batteries would probably be NiMH with thermal management (need to be reliable at 50 below zero for Yellowstone). Ranges of course would be much shorter than gasoline-fueled vehicles, and the first generations would be quite expensive, designed to be used in niche resort and park operations like Yellowstone, where local noise and emissions regulations will be tight.

Tom Turrentine, UC Davis Institute for Transportation Studies.

ElectroAutomotive Response

We would like to clear up some information and wild speculation that has apparently been circulating about an order placed by one of our customers, which has been delayed in delivery.

This was an order for our VoltsPorsch bolt-in conversion kit for the Porsche 914. Since this order was for the first production run of this kit, there was a longer than usual lead time while we got things into motion with our various suppliers. (There are about 40). Then, as things were coming together, we discovered a couple of unexpected items on the prototype car theat necessitated some redesign, which we informed the customer about.

Once we tested the redesign on the prototype and were sure it was OK, we set about revising the installation instructions and illustrations to match. We are currently in the final stage of proofing the revisions.

Sometimes circumstances have prevented us from delivering orders as quickly as we would like. In the 17 years we have been in business, we've put a few hundred conversions on the road, and we've never failed to deliver a kit. This is the longest delay we have ever had and we feel bad about it. We are trying to get things resolved to begin shipping the order as soon as possible.

In this case, part of the problem was the fact that the VoltsPorsche is such a complete and detailed kit that any redesign, however small, can become a little complicated when integrating it with the rest of the car. Part of the problem was also our desire to smooth out every last bump and make the kit as perfect as possible.

Shari Prange, Electro Automotive

Charging Up the Psyche

Piloting Endopsychology in an EV
by Sally George, Intelligence Research

The new VoltsPorsche, known as 'Black Magic' and owned by Clare Bell, can presently be seen with INTELLIGENCE RESEARCH FUND, USA written in gold on its sides. It is being used to make known the availability of a new, practical science called ENDOPSYCHOLOGY ('endo' -Greek for 'within').

What is endopsychology? EP is like a new battery to a tired, fed-up human being.

EP is a methodology for making a turnabout in attitude and life quality which is as profound (if not more) as converting one's car to electric. EP parallels electric vehicles in that it focuses primarily on energy. It works by finding ways of accessing and utilizing a maximum charge of vital life force in daily living. As in an EV, great attention is given to accumulating, storing and efficient discharging of energy. Energy wastage, resistance and depletion are also essential factors.

In some ways, applying EP is far simpler than converting a car to electric. It involves looking for vitality, meaning and happiness in appreciation of one's actual life, rather than in future promise. Nothing new needs to be added — the old 'model', 'motor' and style are fine. The source of energy comes from finding and giving up areas of unnecessary worry and struggle.

Intelligence Research has found that driving an EV is very conducive to making a turnabout in the quality of daily living. Sally George, who has been piloting the Intelligence Research Fund in 'Black Magic', has been amazed at the difference. "I never realized how tiring and upsetting the explosions of a IC motor are. So much of one's life is 'used up' by disturbances in the environment, which we hardly notice, but take their toll."

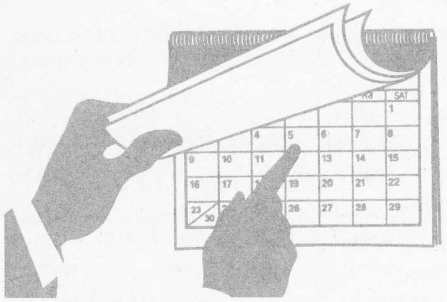
EV "Limitation" is a Blessing

In fact, the endopsychological 'conversion' begins naturally and simultaneously with acknowledgment of how one has been living up to now (i.e. wastefully). This does not mean one should 'discharge' a lot of energy in self blame. After

continued on page 20

EVents Calendar

By Anna Cornell



May 25-Jun. 9

EnerRun IV - A rally from Hardy, AR to St. Louis, MO. Contact SportsPro at (510) 856-5624.

Jun. 19-21

Alternative Transportation Technologies Symposium- Exploring emerging business opportunities. Contact Leslie Mayville (NYSTEC) (315) 338-5818 or FAX (315) 338-6124.

Jun. 10-16

1996 Future Car Challenge. Contact Argonne National Lab, 9700 S. Cass. Ave. Bldg 362, Argonne, IL 60439. Tel. (708)-252-8677, fax (708)-252-3443.

June 20-23

Solar Splash Electric Boat Regatta. Milwaukee, WA Advanced Energy Competitions, (602) 773-0230

Jun. 22

Real Goods Alternative Living Center opening - Clean Vehicle Parade from downtown Ukiah to the Solar Living Center in Hopland, CA (12 mi.). Contact Mark Winkler at (707)744-2107 or fax (707)744-1342.

Jun. 23

Palo Alto Concours de Elegance, Stanford University, Palo Alto, CA. Concours-quality EVs are welcome to display. Contact Vic Befera (415) 328-3936 or fax (415) 328-3733.

Jun. 27-29

Cleveland Electric Formula Classic - Open-wheeled ABB University spec (Formula Lightning) vehicle series in Cleveland OH. Contact EVTC at (602) 256-2599.

July 4

Pike's Peak Hillclimb. They are seeking more EV entries!. Sponsored by Chevrolet. Manitou Springs, CO (719)685-4400.

Aug. 5-6

Edison Electric Institute Electric Vehicle Conference, Troy, MI. Contact Rick Temchin at Edison Electric Institute (202) 508-5561.

Aug. 5-13

Sun Sprint of the Rockies. An electric and solar race for all. Aspen CO to Moab, UT. Individuals, high schools and colleges are encouraged to participate. (907) 872-3882

Sept. 16-18

NESEA Sustainable Transportation and Solar and Electric Vehicle '96 (S/EV96).Symposium and trade show. Contact NESEA at (413) 774-6051 or fax (413) 774-6053.

Sept. 20-26

Beijing International EV Exposition. EVs in China! Tel. 86-10-5013764.

Letters

Continued from page 19

all, we are all taught we have to struggle to survive and that the benefits will come 'later'. But it is just as easy to learn to relax and turn attention to actual, present sources of gratitude, vitality and living fully now. In this an EV is most helpful. Sally George has found that driving an EV gets her to really consider where she is going and whether it is necessary. "It turns out that the seeming "limitation" of an EV is a blessing . You really have to pay attention to what you are doing . It is wonderful to have one's assumptions about getting around checked."

EP suggests taking all kinds of practical steps to enabling a lifestyle which is:

1. Focused in the present
2. Less resistant
3. Energy efficient
4. Less dependent on complex social systems and finding artificial ways to 'charge up' one's actual life.

If you have an EV, you have already taken a big step in making a turnabout and know the far-reaching benefits of a calmer, cleaner and more sensitive mode of transportation. You should find that other kinds of changes are easier. If you are only thinking about an EV- don't wait. You cannot imagine how healthy it is to be free of dependence on gasoline and supporting huge corporate systems . With an EV you do not have to worry about gas prices, or spending time (or money) in stations. And you feel quite pleased that you are not polluting or disturbing the environment.

All donations or suggestion for fundraising are welcome. 'Black Magic' and Intelligence Research are available to visit classes or groups around the Bay Area to introduce the '5 Simple Steps to Living Fully Now'. Phone Sally George at 408 429-2214.

Editor's Note:

CE and EAA do not endorse any psychological or self-help field. This letter is presented as an example of how someone has integrated an EV into their life and work in a philosophical as well as practical sense. Intelligence Research is using the VoltsPorsche on a trial basis. The car was built with the new Electro Automotive VoltsPorsche kit. It is for sale (see want-ads) since I want to build another —CB

FOR EAA MEMBERS ONLY

EV Want Ads

For Sale

For Sale: '73 VW Karmann Ghia — Eye Catcher. 96V, Advanced DC 9" motor, PMC 1221B controller, dual DC-DC converters, on-board 120VAC charger. Converted in 1992. Restored body and interior. $6500/($7500 with new pack)/offer. Call Bruce Brooks @ (408) 268-9130. (San Jose, CA)

For Sale: Black Magic needs a home! First Volts Porsche, 1976 Porsche 914 converted with the Electro Automotive "VoltsPorsche Kit". 20 6V US 2300's, 9" Advanced DC, Curtis 1221 B. on-board K&W charger. Performed 83 miles on charge in recent EAA rally. Ultra-clean professional conversion. Well-maintained. Has log book and manual. Asking $14K/or negotiate lease arrangement. Fax inquires to Clare @ (408) 469-3714.

For Sale: '80 Omni Jet 007. 120V, EV-1 controller, 5800 miles, white, 220V on-board charger, $5800/obo. Call between 7pm-9pm EDT (201) 998-4435. (North Arlington, NJ)

For Sale: '81 Renault Le Car. 72 volt system, Curtis PMC controller, tow bar, range 30-50 miles, 7,000 miles, $4,300. Call (541) 899-1127, evenings. (Jacksonville, OR)

For Sale: Lester. Charger for 108 V pack (25 amp) with 12 volt auxilliary, 110 or 220 v input. New $375. (714) 956-3016. (Anaheim, CA)

For Sale: Electrathon/Scooter motor. Powered champ at Phoenix. 3 HP peak, 1 HP continuous, 24 volt. Several new @ $265. CAll or fax for spec. (714) 956-3016. (Anaheim, CA)

Member Want Ads

Print clearly or submit typed copy of your ad with your name, address, and phone number. The EAA is not responsible for the accuracy of ads. Want ads must be received before the 1st of each month and must include payment to run in the next issue of CE.

$7 for the first 25 words. Each additional word, 25 cents. Want Ads are available to EAA members for the sale of electric vehicles, equipment and parts only.

Please see advertising rates for commercial products or information below on the NEW! Commercial Want Ads listed below. .

If you want to run your ad in more than one issue, please specify and include payment for each issue requested. For corrections or updates, please send a written note or fax to EAA Want Ads @ 408.374.8750. Photographs of your vehicles may be submitted with your ad. If room is available, we run one photo each issue. These photos will not be returned.

Send your Member Want Ad request and check made payable to: EAA Want Ads, 18297 Baylor Avenue, Saratoga, CA 95070

ADVERTISING RATES

Full page		7.25" x 9.25"
1 ad	$400 ea	
3 ads	$300 ea	
12 ads	$250 ea	

1/2 page		7.25" x 4.50"
1 ad	$200 ea	
3 ads	$150 ea	
12 ads	$100 ea	

1/4 page		3.50" x 4.50"
1 ad	$150 ea	
3 ads	$100 ea	
12 ads	$ 75 ea	

1/8 page		2.0" x 3.5"
1 ad	$100 ea	
3 ads	$75 ea	
12 ads	$50 ea	

Ads may be placed for 1, 3 or 12 months. Camera-ready copy for each ad must be submitted along with payment. Ads may be submitted on diskette in TIF or EPS format on the PC or MAC. For 12 ads, an invoice will be billed quarterly. A minimum of 3 ads need to be prepaid per quarter.

Ad Deadline

The Deadline for camera-ready copy is the **1st of the month**. Copy received after the 1st will be run in the next issue. Ads will be placed in the priority received. Prepaid ads will receive 1st priority.

Advertising Manager

Susan Hollis, AdvertisingManager
Office: (408) 374-8605
FAX (408) 374-8750

Address

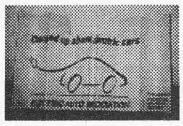
Make check payable to EAA. Camera-ready copy and payment for the ad should be sent to:

Electric Auto Association
18297 Baylor Avenue
Saratoga, CA 95070

CE ADVERTISERS

EAA **Reprint** Order Form

100% Cotton Cap
Forest Green
'Charging into the Future' EAA Logo
CAP001.....$7.50



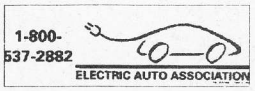
Auto SunShade
SS001.....$8.00

T w/EAA Logo
(adult small only)
TS001....$14.50

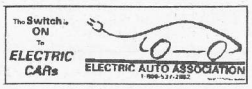
Thermal Auto Mug
MUG02...$6.00

Porcelain Mug with
'Charging into....Future'
MUG003.....$5.00

Window decal 'The Switch is on to Electric Cars' Black and Red printing. 3 x 9 inches
DC001.....$3.00



Bumper sticker 3.75 x 15 inches
BS800.....$2.50



Bumper sticker 3.75 x 15 inches
BS002.....$2.50

EAA Key Chain , actual shape may vary
KC001.....$1.50

Printed materials

CE	Selected Current EVents ***(specify specific issue)***	$ 3.00 each issue
CEFY	Current EVents - Full year ***(specify specific year)***	$20.00 each year
PB001	Discovered:The Perfect EV Battery	$ 2.00
FW001	Flywheel Energy Storage	$ 5.00
BG1996	1996 Buyer's Guide to Electric Vehicles (Feb 96 issue CE)	$ 5.00
BG1995	1995 Buyer's Guide to Electric Vehicles (Feb 95 issue CE)	$ 5.00
TT001	Team Tucson Land Speed Record Plans	$ 5.00
IDX001	EAA Current Events Index - 10 Years!	$ 4.00
XA100	EAA XA-100 Hybrid	$ 5.00

Other EV Items

PN001	Ball point pen with "EAA, 800 phone # & Charging....Future"	$ 1.00
CS001	Current Solutions/Motor Show Video Tape (14 minute runtime)	$14.00
WL001	Window Literature Holder (fits pages 8.5 x 11 inch)	$22.00
PARK01	"EV Parking Only" Sign (18"x12") green icon on white background	$22.00

Electric Auto Association **Reprint** Order Form
Send order to: EAA Reprints
5820 Herma St., San Jose, CA 95123-3410

Name_____
Address_____
City,St,Zip_____

Item#	Size	Quantity	Item Description	Unit Cost	Amount

Make check payable to: **EAA** (US dollars)

Subtotal	
Postage (10% of subtotal, for USA*)	
Handling	$2.00
Total	

* for Canada add 15% or for other foreign destination add 25%

ELECTRIC AUTO ASSOCIATION
2710 St. Giles Lane, Mountain View, CA 94040

• Address Correction Requested •

EBAY
996

• Time Dated Material - Please Do Not Hold •