



JOINT EAA STANFORD MEETING

STANFORD PROJECT DEPENDS ON YOU! OCT. 17. Details Pg. 2

INTERNATIONAL EAA/DEVC RALLY

The INTERNATIONAL EV RALLY AND SYMPOSIUM were an unqualified success with a dozen vehicles in the rally and more on display, a real good turnout by the public, good coverage by channel 9 TV and 40 in attendance at the symposium. Credit for good publicity for the events goes to **Carrie Bailey, Ron Putnam, Genny Clark, Tim Cutforth, Mik Cseh, Leonard Quinn, Jim McCullough, Bob Anderson, George Huizinga, David McNeil, William Sackschewsky, Don Hibbard** and all the others who made phone calls and sent letters. We must also include **Clarence Ellers** with his publicity sent out through the EAA. We had visitors and members from a number of states and Canada to add breadth and depth to the meetings.

Two of the chief contributions to the events were the presentations by President **John Gould** and Chief Engineer **David Wright** of **Unique Mobility** at the plant and at the symposium. The plant visit gave an overview of the R & D activities of the firm while the coverage at the symposium gave an in depth look at primarily the high performance motor-generator developed by **Unique** and its application to vehicle drive. R & D activities include a robot firefighter for the Navy, an unmanned tank killer and a vehicle which finds its own way down a road using artificial intelligence being developed by **Martin-Marrietta**. Even though the latter is about the size of a one ton van and is over half filled with computer equipment to provide guidance, it was stopped by dirt spread on the snow by a truck crossing the road because it "thought" it had run off the road! The tank killer is a hybrid with electric motors in the wheels. The firefighter is unique in that the four wheels are steerable through 360 degrees. It also has the motor-in-the-wheel concept.

The high-performance motor was developed by taking an entirely new approach to the design. The armature is a thin belt of copper wires imbedded in an insulating supporting medium. The rotor consists of a belt of permanent magnets on the inside and the outside of the armature. The magnets are neodymium which are 10 to 40 times as strong as the more commonly used ferrites. The result is a motor whose weight is at least an order of magnitude less than that of a conventional machine but still not highspeed -- the capability is 40 HP at 2500 rpm. By adding weight to the rotor, the motor-generator becomes a flywheel capable of storing energy mechanically and delivering it electrically. Putting a motor in each wheel of an automobile could eliminate the use of the usual driveline components and give close control over the torque delivered to or by each wheel, thus giving unusual handling qualities to the vehicle. The prime mover could be an engine driven alternator or a battery pack. To get high performance, the flywheel mentioned above could be added to the system to supply the bursts of power needed for rapid acceleration and to absorb the energy of braking. The engine would now only have to supply the average power needed and could therefore be much smaller and run efficiently and cleanly at a constant speed. Such a system could give an auto 100 mile per gallon performance whether in stop and go driving or at speed on the highway.

INTERNATIONAL RALLY Con't from Pg. 1

The rally was held over a 4.6 mile course in Englewood, Colorado, with typical conditions for urban driving with numerous stops and grades. The day was partly sunny, cool with occasional showers (The barbecue was rained out!). The Griffon van set no records, although it might well have, but it certainly made a hit with the public as many of them went for short rides. Also **Senator Armstrong** drove himself to a summit conference on air pollution at Denver University using the van and called attention to the fact before the hundreds of attendees.

CAR NO.	MAKE	OWNER	DRIVER	NO. OF BATTS	MILEAGE
E-164	Chev. Corvair	Tim Cutforth	Tim Cutforth	20 6-volt	46.0*
E-29	Vanguard	David McNeil	David McNeil	6 6-volt	23.0
HYBRID2	Special	Clarence Ellers	Clarence Ellers	16 6-volt	18.4
PNM	Griffon van	PNM (lease)	Michael Lechner	36 6-volt	9.2
E-172	Renault	Jim Closius	Jim Closius	16 6-volt	9.2**
E-8	Comuta-Car	Ron Putnam	Ron Putnam	8 6-volt	9.2
E-93	KarminGhia	Leonard Quinn	George Gless	10 12-volt	4.6
E-152	Special	David Gransee	David Gransee	8 6-volt	18.4
E-24	EFP Hornet	David McNeil	David McNeil	22 6-volt	18.4

E-150	MGB/GT	George Gless	George Gless	8 6-volt	4.6
38PH-22	Electrek van	Unique Mobility	George Gless	16 6-volt	9.2
06-3144	Renault	Univ. of Colo.	George Gless	12 6-volt	4.6

On display only were Roy Tiff's Bug, Betty & Gene Thorton's Marathon C-300, DEVC hybrid & Vega.

*Should add approximately 10 miles for the roundtrip to home base for unofficial total.

**Should add approximately 12 miles for the roundtrip to home base for unofficial total.

Prizes awarded: Mileage; 1st, Tim Cutforth; 2nd, David McNeil; 3rd, Clarence Ellers, David Gransee & David McNeil. Keith Crock (for technical excellence), David Gransee. Door prizes at the brunch: DEVC membership, George Huizinga; EAA membership, Mrs. Ratzlaff. Rally entrants drawing: Clarence Ellers, Lestronic charger; Ron Putnam, radio; Jim McCullough, Hydrocaps. The generous contributions of the firms involved were certainly appreciated. Thanks are due to Rally master **Bill Tyree** and his assistant **Roy Tiff** for keeping things running smoothly.

Reported By George Gless

JOINT EAA STANFORD MEETING

SATURDAY, OCTOBER 17TH 10AM--MARK IT NOW!

ELLIOT PROGRAM CENTER, STANFORD UNIVERSITY

We are inviting several faculty members and hope to interest one of them in acting as faculty advisor for the new "STANFORD INNOVATIVE ENERGY AND TRANSPORTATION CLUB". This is a must to continue the project.

Activities, aims, and objects for the coming year will be presented and discussed. Your input and participation is needed and requested.

A LARGE TURNOUT OF STUDENTS AND EAA MEMBERS WILL BE A TREMENDOUS HELP!

Thanks Clarence

CALL: Clarence (408) 248-2588
John (415) 322-8886

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the aluminium/air battery

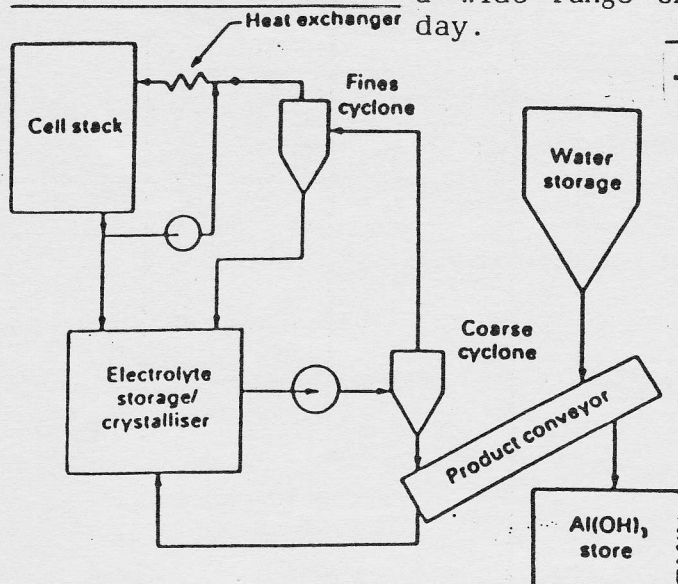


Fig 7 Schematic flow diagram of the cell stack/crystalliser electrolyte management system showing the heat exchanger loop and the cell/crystalliser exchange flow which involves particle size separation devices for aluminium hydroxide removal and a return flow of electrolyte to the cell*

Table 1 Comparison of metal/air cell systems

Metal	Electrochemical equivalent (Ah/g)	Theoretical cell voltage* (V)	Theoretical specific energy (Wh/g)	Operating voltage (V)
Li	1.86	3.4	13	2.4
Al	2.98	2.7	8.1	1.6
Mg	2.20	3.1	6.8	1.4
Ca	1.34	3.4	4.6	2.0
Zn	0.82	1.6	1.3	1.2
Fe	0.96	1.3	1.2	1.0

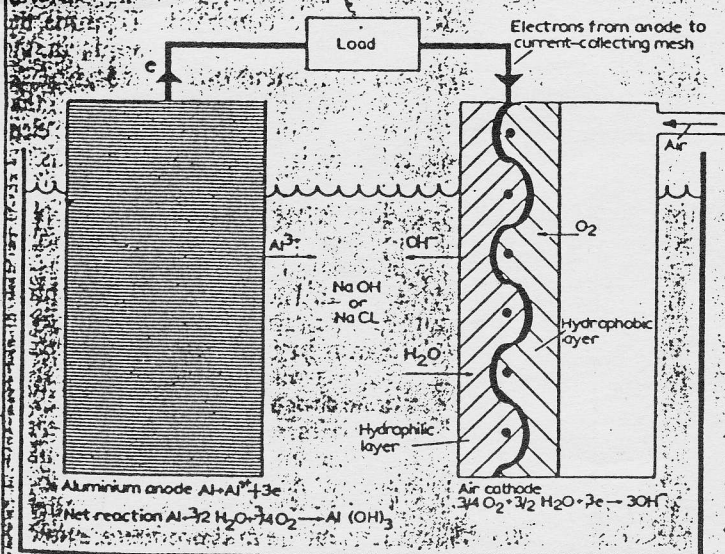
* Cell voltage with oxygen cathode

Table 2 Summary of potential markets for aluminium/air batteries

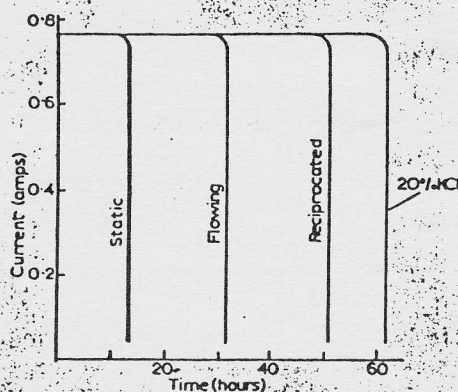
Market	Size (annual)
Mobile radio communication	\$100M to \$300M
Educational/hobby/novels	\$100M to \$300M
Recreational/camping	\$300M to \$1000M
Non-marine emergency	\$300M to \$1000M
Portable power tools	\$100M to \$300M
Military	\$100M to \$300M
Transportation*	> \$1000m

* Alkaline battery system

The battery that agitates for power



An aluminium-air cell (left) performs best if its electrolyte moves (above). This prevents hydroxides coating the cathode. The electrolyte's conductivity also affects performance. Potassium chloride conducts electricity better than sodium chloride



Better electrodes will also determine the success of aluminium-air batteries. Air cathodes in alkaline systems, for example, must carry heavy currents for two years or more of continuous operation. The layer of the cathode which is open to the air must be both permeable to gas and hydrophobic. The layer in contact with the electrolyte must be hydrophilic and also impervious to gas. A mesh, to conduct electricity, sits between the two layers. This complex

AN ALUMINIUM-AIR battery with an alkaline electrolyte can power a greater load for a longer time than a saline system. The efficiency and life of both systems depends on how well the battery designer deal with the hydroxides that precipitate in their electrolytes. Efficient saline systems stir, pump or move their electrolytes to and fro, this encourages granular hydroxides to precipitate rather than gelatinous hydroxides to stick to the electrodes and cell walls. An agitated saline electrolyte carries up to four times as much current as a stagnant one. Current also depends on the conductivity of the electrolyte. This probably

explains why the cell's performance drops suddenly when it needs replenishing. It is likely that precipitating hydroxides remove water from the electrolyte. Concentrated electrolytes may increase a cell's life but they may also create a less efficient cell.

Alkaline systems regenerate their electrolytes continuously. Alcan has shown the US Department of Energy a feasible design for a regenerator that will lead to a battery powerful enough to drive a car. The regenerator removes supersaturated electrolyte from the cell and then seeds it so that the hydroxides precipitate out. A cyclone removes the precipitate and the replenished electrolyte returns to the cell.

structure must stand up to continuous movement in the liquid.

At the moment, an effective electrolyte management system (bubbles to agitate the liquid) and electrodes exist to make a useful saline system. Such an aluminium-air cell could run a 30-watt bulb for more than 7 hours. It is said to have a power density of 30 watts per kilogram (W/kg) and a specific energy density of 220 watt hours per kilogram (Wh/kg). The figures for an alkaline system are 175 W/kg and 400 Wh/kg. The masses refer only to the amount of chemically active material in the system and not to the packing or other parts.

4 OAKLAND

1987 Rally



Name	Vehicle	Vehicle Weight #	Battery Weight #	Time, min.	Total miles	Rank	Miles per ton of batteries	Rank	MPH per ton of batteries	Rank	Vehicle ton-miles per ton of batteries	Rank
Is Tillin	Honda Civic	2480	992	65	20	6	40.3226	7	37.2208	4	50.0	6
Carl Schaeffer	Renault	2121	566	41	12	8	42.4028	6	62.0529	2	44.9682	8
John Bennett	Datsun 310	3400	1264	126	44	1	69.6203	3	33.1525	6	118.3545	1
Dave Cole	Dodge Dart	3600	1142	109	28	2	49.0368	5	26.9927	8	88.2662	3
Bruce McCaskie	VW Bug	2750	1208	68	20	6	33.1125	8	29.2170	7	45.5297	7
John Wasylina	Renault	2530	675	89	28	2	82.9630	2	55.9301	3	104.9482	2
Angus MacDonald (driven by Jim VanSyoc)	Electric Shopper	600	280	134	24	5	171.4286	1	76.7591	1	51.4286	5
Lou MacMillan	VW Wagon	3000	1088	91	28	2	51.4706	4	33.9367	5	77.2059	4

Distance Award

Efficiency Award

Jon Gabel,

8/10/87

1986 Rally Results

Name	Vehicle	# batteries	Total Miles	(1) Ranking	Miles per battery *	(2) Ranking	Vehicle weight, #	Ton-miles per battery	(3) Ranking
Anna Cornell	VW Rabbit	14	19	6 (tie)	1.266667	5	2800	1.773334	6
Scott Cornell	Chery Vega	18	23.6	4	1.242105	6	3600	2.235789	4
Russ Kaufman	Custom	17	29.7	1	4.983333	1	2300	5.730833	1
Lou MacMillan	VW Wagon	16	24.4	3	1.43329	4	2960	2.121269	5
Bruce McCaskie	VW Bug	16	19	6 (tie)	1.117647	7	2750	1.536765	7
Is Tillin	Honda Civic	14	25.9	2	1.726667	3	2750	2.374167	3
John Wasylina	Renault Alliance	10	22.8	5	2.072727	2	2530	2.622000	2

(1) Distance award (2) Efficiency award (3) No award - but interesting!

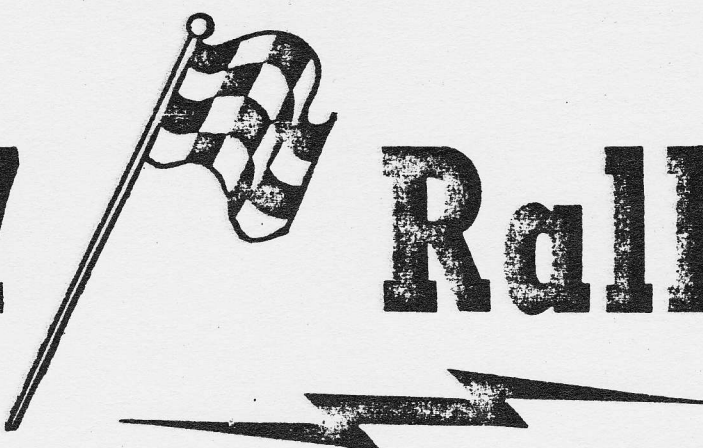
* # batteries + 1 except for Lou MacMillan, who has no accessory battery
 accessory

Jon Gabel
7/11/87

ELECTRIC VEHICLE ASSOCIATION

of Southern California

1987 Rally

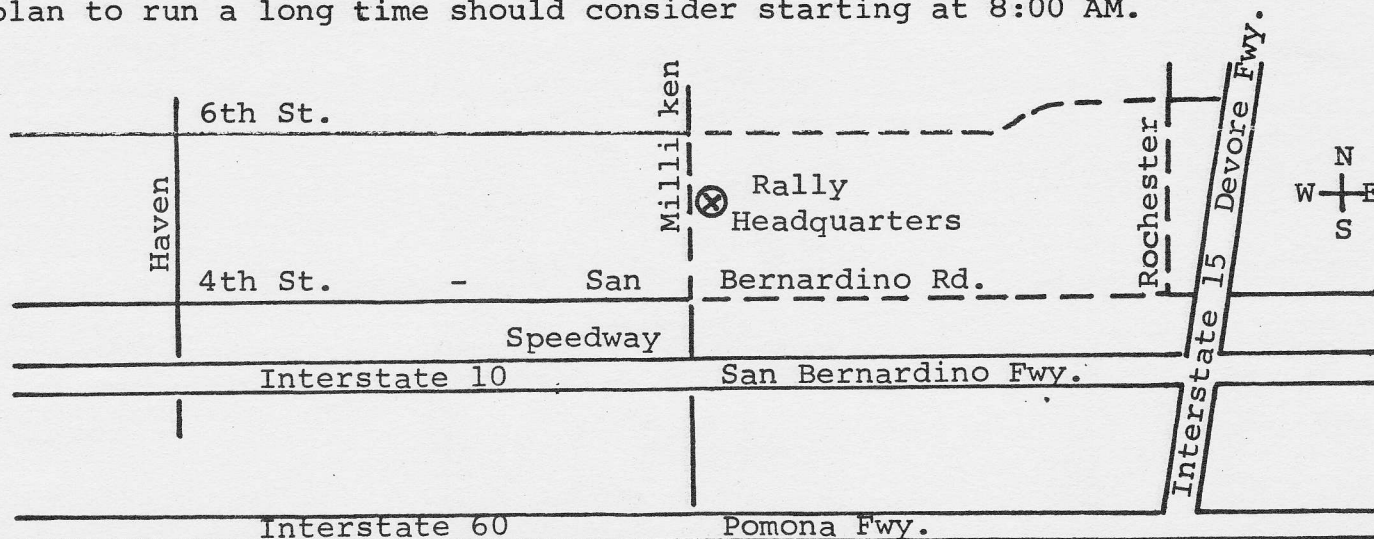


WHEN: Saturday - October 17, 1987 - 8:00 AM 'til ?? with one hour lunch break starting at noon.

WHERE: Ontario near the old Ontario Motor Speedway. Rally Headquarters are on Milliken Ave. between San Bernardino St. and 6th St.

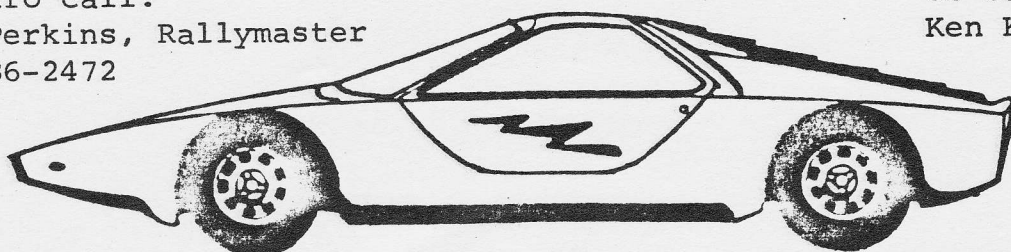
WHO: E V E R Y B O D Y ! Club members, guests, the media, the general public.

Come one, come all, and enjoy this very special Club activity....Bring your electric vehicle, running or not, so that all may share in your experience....Free electric vehicle rides for the public....Course is 2.6 miles per lap....All Rally entrants receive an award....Special awards given for endurance, efficiency, most innovative, most practical, plus class winners....Bring a picnic lunch and make a day of it....Those who plan to run a long time should consider starting at 8:00 AM.



For info call:
Stew Perkins, Rallymaster
714/986-2472

or call:
Ken Koch, EVAOSC Prez
714/639-9799



Associated Press

Montreal

A last-minute compromise between the United States and the European Common Market broke an impasse last night to produce a historic agreement to protect the Earth's ozone layer.

"I'm very happy," declared Lee Thomas, administrator of the U.S. Environmental Protection Agency, after a tense day of negotiating.

Although the agreement is subject to formal approval by 46 nations at a plenary session of the U.N.-sponsored conference today, key players expressed confidence that the protocol would be signed.

Once ratified, the pact would freeze consumption and production of chlorofluorocarbons at 1986 levels by 1990; reduce them 20 percent by Jan. 1, 1994, and cut back an additional 30 percent by Jan. 1, 1999.

Chlorofluorocarbons, used in aerosols, refrigerator coolants and plastic foam, float into the stratosphere and attack the ozone layer.

The holes in the ozone, a 20-mile belt of protective gas around the Earth, permit the sun's ultraviolet rays to reach the Earth, resulting in more skin cancer and potentially damaging crops and disrupting weather patterns.

Scientists estimate that 3 to 7 percent of the ozone layer has been destroyed, and a huge 40-percent hole has been discovered over the Antarctic.

The United States is the world's largest producer of chlorofluorocarbons, responsible for 30 percent. It banned chlorofluorocarbons in aerosols in 1978 but the chemicals are more difficult to replace in other products. DuPont estimates it will take five to seven years to find a nontoxic substitute.

A related group of chemicals,

halons, used in high-tech fire extinguishing systems, causes up to 10 times as much damage as chlorofluorocarbons. Their production will be frozen in 1992 pending more research.

Developing countries would have a 10-year grace period under the pact, and the Soviet Union would be allowed to expand production by opening plants too late to be canceled under its centrally planned economy, said conference chairman Winfried Lang of Austria.

Thomas said the United States would move quickly to ratify the pact.

"I fully intend to send it to the U.S. Congress as a strong protocol and one in the best interests of the world and the United States," he told reporters.

Canadian Environment Minister Tom McMillan said other countries "cheered on" U.S. and EEC negotiators in the final stages.

He said the pact "isn't the final word" but would begin to reverse the damage.

Geoffrey Webb, international director of Friends of the Earth, commented: "Science indicates we need an 85 percent reduction to stabilize the problem. At the same time, we applaud these nations for coming together to take this first step."

ADVANCED BATTERY FOR ELECTRIC VANS SETS NEW RECORD

An advanced battery for electric vans has set a new distance record in simulated, stop-and-go driving tests at the Department of Energy's Argonne National Laboratory, near Chicago.

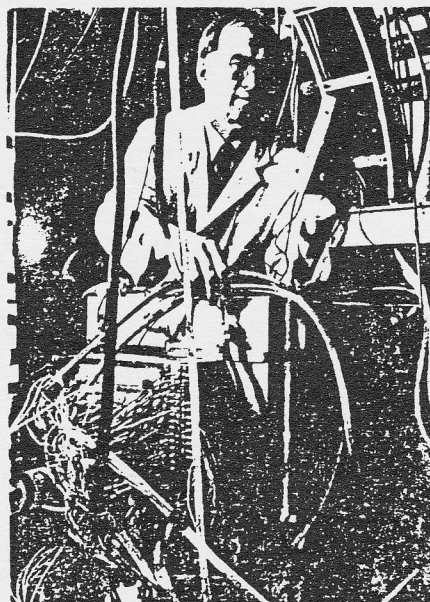
In tests controlled by a computer, the battery delivered the equivalent of 200 miles of stop-and-go city driving without recharging. The unit tested is a 36-volt module of the lithium-iron-sulfide (LiFeS) battery, consisting of three 12-volt modules. The battery was invented by Argonne and built by Gould Inc. of Rolling Meadows, Ill.

"This range exceeds our program goals by 100 miles and is three times as far as the best that could be achieved with a conventional lead-acid battery of the same weight," said Al Chilenskaskas, manager of Argonne's LiFeS battery program. The tests simulated use of the battery in a GMC Griffon van bearing a load of 900 pounds, including the driver.

Tests showed that single cells within the battery could be recharged in about an hour, he said.

Market studies funded by the Electric Power Research Institute (EPRI), the research-and-development arm of the utility industry, Chilenskaskas said, show that a battery that could provide a 100-mile

range would allow the conversion to battery power of three million to four million gasoline-powered vans in commercial service in the United States.



An engineer at Argonne National Laboratory checks an experimental electric-van battery that delivered a record 200 miles of stop-and-go city driving without recharging in computer-controlled, laboratory tests.

"This range exceeds our program goals by 100 miles and is three times as far as the best that could be achieved with a conventional lead-acid battery of the same weight," said Al Chilenskaskas.

Such a battery, he said, would be a 216-volt version made up of 18 of the 12-volt modules tested. Each 12-volt module would comprise 10 series-connected cells, assembled into a single removable unit. Gould plans to build a full-sized 216-volt battery for testing at the Tennessee Valley Authority (TVA) in 1988.

For maximum efficiency, Chilenskaskas said, the battery operates at about 860° F (460° C). To help maintain this temperature, the battery is encased in high-efficiency, vacuum insulation.

Normal heat generated during battery discharge, he said, keeps the battery at the required temperature during the day. At night, the battery cools to its starting temperature of 860° F (460° C). A commercial van battery would be recharged each night in about eight hours.

Development of the electric van battery is funded by EPRI, the TVA and the U.S. Department of Energy's Office of Transportation Systems. Argonne National Laboratory is operated by the University of Chicago for DOE.

CALIFORNIA ENERGY COMMISSION

CHARLES R. IMBRECHT

Chairman



September 2, 1987

Mr. John B. Newell, Chairman
Electric Auto Association
1249 Lane Street
Belmont, CA 94002

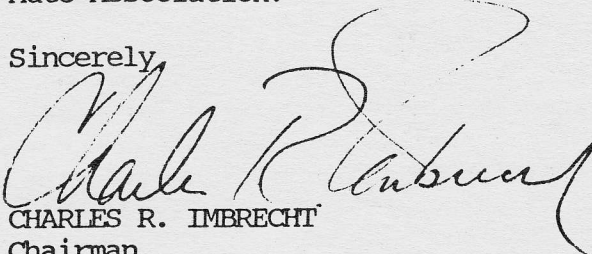
Dear Mr. Newell:

Your letter to Governor Deukmejian regarding the Stanford Solar Car Project and EAA's upcoming Electric Vehicle Rally has been referred to me for reply. The California Energy Commission (CEC) has a definite interest in the activities of organizations like yours seeking to advance technologies for the practical use of electric energy in transportation. We share the view that electric vehicles should be explored further to determine their potential contribution, along with other options, to the diversity and security of California's transportation energy supply.

The Stanford project reflects an ingenious approach to integrating mobile and stationary energy uses through application of solar electric technology. This project was recently selected by the CEC as a state semi-finalist for the national awards program for energy innovation conducted by the U.S. Department of Energy. Our staff has reviewed the video tape you provided, along with other information on this project, and intend to examine its results in detail. The Electric Vehicle Rally conducted by your association looks like a good opportunity to directly inspect a variety of electric vehicle concepts and applications, and we will attempt to have a member of the CEC staff attend the September 19 event.

The advent of super-conducting materials, the continuing advancement of solar photovoltaic and battery storage technologies, and the expectation of abundant electricity supplies in years to come all add new impetus for electric vehicle research and development efforts. We appreciate your providing us information on electric vehicle projects and look forward to continued interchange with the Electric Auto Association.

Sincerely



CHARLES R. IMBRECHT
Chairman

CRI:TM1:kh

cc: Governor's Office

SUNNYVALE RALLY

SUNNYVALE SEPT. 19TH:

THE WINNERS:

CHUCK OLSON & LLOYD WENZEL TIE
FOR FIRST STOCK.

BOB STEINFELD CUSTOM

ANGUS MAC DONALD THREE WHEELER

TONY DE BELLIS TECH AWARD FOR APPLE COMPUTER
INSTRUMENTATION SYSTEM MORE NEXT ESSUE

The '87 model year federal emission standards for cars are:

CO: 3.4 grams/mile

Hydrocarbons: 0.41 g/mile

NOx: 1.0 g/mile

From: R. C. Cudney

Subject: vehicle vs powerplant emissions

When the EGR valve clogs on a car, NOx emissions get very large, and the EGR valve never gets fixed, because the vehicle runs just fine.

For a typical pulverized coal fired power plant, emissions for the same parameters are:

CO: 0.14 g/kwhr

HC: .01 g/kwhr

NOx: 2.2 g/kwhr

I understand that a typical electric car uses about 0.6 kwhr/mile, and the electric vans use 1.0 kwh/mile, measured at the charger meter.

Thus:

	CO	HC	NOx	
'87 Fed	3.4	0.41	1.0	grams/mile
electric car	0.08	.006	1.32	
elec. van	.14	.01	2.2	

The '87 federal gasoline powered vehicles have a slight edge in NOx, while new. In all other parameters, the electric vehicle has lower emissions.

There are some additional factors, as well. Sulfur is not a regulated emission from vehicles, and is dependent on sulfur content of the fuel. Sulfur is closely regulated for power plants, however. Typical emissions for a coal fired power plant are about 2.7 grams/kwhr. Supposedly, gasoline contains no sulfur, but diesel fuel does(0.4-.7%). Sulfur is thus an unknown.

One factor to consider is that the power plant emissions occur as a buoyant plume, released at 400' to disperse, not at ground level, and in a rural area, not at the *city center*.

Ozone emissions might increase due to sparking, but without all those hydrocarbons, there would be little smog formation.

Thanks.

Leonard L. Byers

Santa Fe NM

FOR SALE

Electric Austin, made in England. 9 Batteries, Street Legal, 4 speed, 1 reverse. Looks like stretch Jeep pick-up with removable surry top. CALL: Henry Edwards, (408) 484-1000.

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Gas prices are going up, but Russco's prices are still low. HV-500, 500 amp controllers, \$595 each. Prestolite MTC-4001 series motors, \$795 each. Only a few left of each. When they're gone, they're gone, and so are our low prices. Russco Engineering, PO Box 3761, Santa Rosa, CA 95402-CALL: (707) 542-4151. Subject to stock on hand.

FOR SALE

Lectric Leopard-parts liquidation: 23HP GE Series motors (NEW) adaptors, SCR Panels, Transformers, etc. Call or write for prices. J. Stevenson, 1201 Parducci Rd., Ukiah, CA 95482-(707) 468-1603.

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THANKS

ADS must be received with payment by the 10th of the month, for the following month's issue. AD rate is min. 1 to 5 lines \$5.00, 1/4 Pg. \$15.00, 1/2 Pg. \$25.00, full Pg. \$50.00, full Pg. 2 sides \$100.00. For Sale, Wanted, Trade, etc. Mail to EAA 1249 Lane St. Belmont, CA 94002.

CALENDAR

OCT. 6-8: PEAC (Power Electronics Applications Center) an EPRI spin-off. Dedication and Power Electronics Applications Conference. The Hyatt Regency Hotel Knoxville, TN

OCT. 12-15: IEEE AUTOMOTIVE ELECTRONICS, London

OCT. 17: JOINT EAA STANFORD MEETING, Elliott Program Center, Stanford Univ. 10 AM. All EAA members and students are urged to attend CALL: Clarence (408)248-2588 or John (415)322-8886.

NO! SC MEETING @ HP NOTE !!_____

OCT. 17: EVA-SC RALLY 8 AM Ontario CALL: Stew (714)986-2472 or Ken (714)639-9799.

NOV. 1: WORLD SOLAR CHALLENGE DARWIN, Australia. SEE Sept. News

EAA Chapters

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Roger Smith 602-969-9667
P.O. Box 16800 #273
Mesa, AZ 85202

CALIFORNIA:
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Irv Weiss 818 841-5994
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TEXAS: Houston
Ken Bancroft 713 729-8668
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Houston, TX 77035

WASHINGTON: Seattle
Bryan Lowe 206 632-4496
5011 9th NE
Seattle, WA 98105

WISCONSIN: Milwaukee
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Milwaukee, WI 53207

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Hackensack, NJ 07601

Vancouver, B.C.
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543 Powell St.
Vancouver, B.C. V6A 1G8

NON-AFFILIATED GROUPS

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