Electric Auto Association

# CURRENT EVENTS

Mar-Apr 2004 | Promoting the use of electric vehicles since 1967 | Vol. 36 No. 3 & 4

# BUILDING A BALANCING SCOOTER

*By Trevor Blackwell ©2003*

Self-balancing scooters, like the Segway™ are often thought to be technological miracles, but it is not actually very hard to build one. I built the one described here in about a week using Short MPEG Video [1.0 MB] off-the-shelf parts. I spent another week tweaking the high-speed stability, improving the steering control, and writing about it.

Although the Segway has several exotic components, mine is built from common low-tech parts like wheelchair motors and RC car batteries. The parts, even at small quantity retail prices, cost less than half of a genuine Segway. It also doesn't need complex or high-performance software. The first version was written in Python and used serial ports to talk to the gyroscope and motor controller. The current software, now in C running in an onboard 8-bit microcontroller, is only 500 lines of code.

Riding the scooter is definitely fun.

**Things I like about it are:**

- It's easy, when riding down the street, to stop and chat. Somehow on a bicycle or a regular scooter, it's a huge nuisance to stop. But on this scooter, it seems very natural to pull up and chat while standing on it.
- It's pretty easy to drive around inside the office. The low-speed maneuverability makes it easy to go through doors.

**Things I don't like are:**

- It's fairly tiring to ride. Standing still on a hard, bouncing platform makes my feet tired. Not as bad as rollerblading, but a somewhat similar feeling. The body is really evolved to be in constant motion, and the combination of static posture (even more static than standing normally, since you try to keep your weight centered) and being jolted by bumps is probably bad for your spine.

- I feel like a total techno-dweeb riding it around. It just screams "silicon valley nerd," even more than having 3 cellphones and a PDA strapped to your belt. OK, I am in fact a silicon valley nerd, but I don't want everyone to know it.
- I get stopped on almost every block by someone asking questions. I don't mind telling people about it, but it does take an awfully long time to get to the coffee shop and back in the morning. And I can't quite drink a cup of coffee on it while moving at any speed, so the net result is that I arrive back at the office, 30 minutes later than if I'd just walked, with a cold coffee. All in the name of science, though.
- Its speed and terrain handling is an uncomfortable middle ground between walking and bicycling. When walking, I usually go in pretty straight lines, over grass and curbs. Biking is fast enough that I don't mind going around on the road. But the scooter is neither fast enough to make going the long way round feel right, nor maneuverable enough to go up and down a lot of curbs.
- It's not relaxing and conducive to having deep thoughts the way walking is. Riding it is fun but tense.
- I don't know whether to ride it on the road or the sidewalk.

## Rolls Royce vs Model T

The Segway is made with quite high-quality, high-tech, and expensive components. Overall, the components I used are a lot lower-tech and cheaper than the ones in the Segway. Yet, mine seems to ride pretty nicely. It suggests that there's room for a Henry Ford of balancing scooters to develop and sell a low-cost everyman's version. Here's a quick comparison. Quotes below are from *segway.com*.

*continued on page 16*

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*Photos provided by Trevor Blackwell*



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## COMMENTARY: EV FUTURE IS BLEAK…BUT PARTS ARE AVAILABLE

*By Ed Thorpe, EBEAA & CE staff*

EV future is bleak. In early February, most of the EV parts from Emotion's Smart car conversion project were placed on the auction block of Ebay. At the end, MapCorp raised close to $90,000 in basically a one-day fire sale.

The conversion project was based on the European Smart car, which was originally designed to be electric but was produced only in gas and diesel versions in the EU.

The USA-base conversion effort used Solectria AC motors, controllers and accessories. The design was also based on the Saft Lithium-Ion battery — a much sought after commodity.

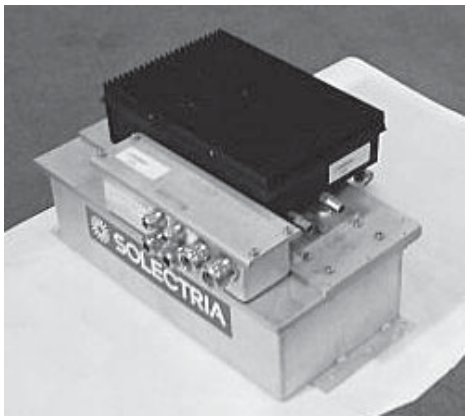
At the end, 14 Smart cars were auctioned. The one unmodified gas Smart car went for over $10,000. There were a total of nine rolling chassis and four partially converted EVs.

There were some Saft High-Energy Lithium-Ion Battery Packs also up for sale — total of 5. These fetched from over $3,000 to over $8,000 a pack (12 batteries). Each pack is designed for 273V nominal, 312V max, when new. This would provide 11.6 kW-hr, 41 amp-hr, 25 kW continuous/35 kW peak at C/3 when new. Packs this size weigh approximately 330 lb. And are liquid cooling, controlled by a CAN bus.

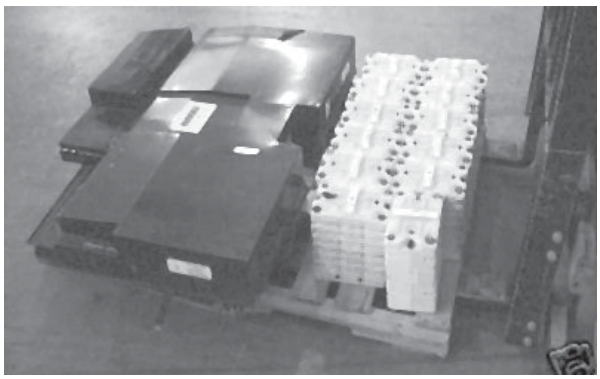
Hopefully we will hear from some of the new owners as some of these Smart EVs get built out and put onto the road. Too bad seeing another EV venture sold off, but at least the assets were made available for the general public and EV enthusiasts.

*Smart Car partially converted from gas to electric*

*Smart Car rear end — no motor here, front wheel drive*

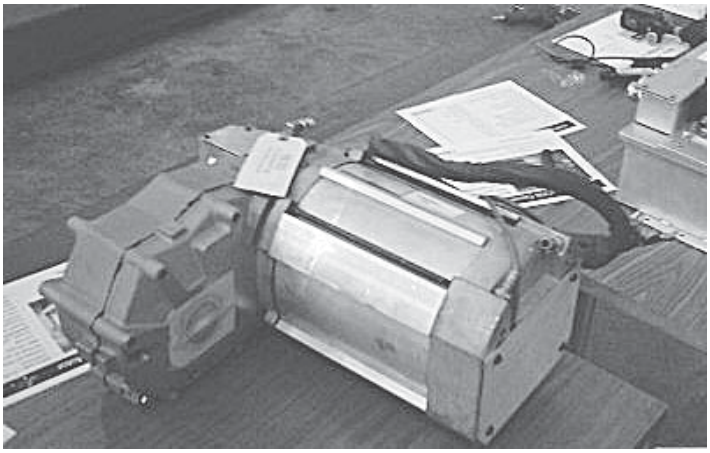



*Solectria controller and DC/DC*



*Saft LiOn battery pack*

*Solectria charger*



*Solectria AC motor and 10:1 gearbox*

## PERSPECTIVES ON SHOCK HAZARD

*By Dave Stensland, Megawatt Motorworks*

*Megawatt Motorworks News and Reviews*
2/6/2004

**Let's set something straight: *Electrics and hybrids are NOT more dangerous than typical gas cars!***

True, one danger is that our newer vehicles are frightfully fast compared to our pokey gas friends, but the high voltage power that moves us is tame compared to the gallons of explosive liquid hauled around in the cars of yesteryear! Let's take a minute to talk about this common and paranoid myth as it applies to the cars we love and admire.

Those of us lucky enough to own electric or hybrid electric vehicles know how much fun they are to operate. Our clean and efficient vehicles run in stark contrast to the more prevalent yet graceless petrol-laden behemoths that hog our roads.

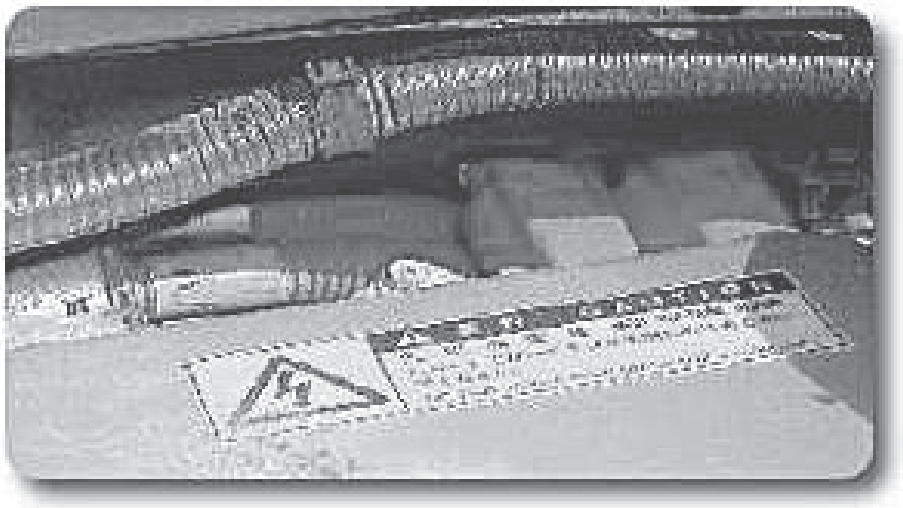
There are different safety concerns involved in good times and bad, but in the event of a wreck I'm certain that gasoline ignition is a much greater risk than shock hazard!

I have utmost respect for the heroic professions of police and rescue workers, but as someone who advocates electric and hybrid electric vehicles it's unsettling to learn that emergency crews are still grasping to understand a technology that's propelled me for the last four years. I abhor the thought of an electrically ignorant and risk-averse responder delaying minutes should I, or someone I love, need immediate assistance!

The following bulletin can be viewed as positive evidence of deliberation and education, so I'm not entirely disappointed. It also provides an important aspect for hobbyists to consider for EV projects. In fact, it implies reasons for those who build pure EVs to adopt the orange high voltage cable standard found in today's hybrid vehicles.

Take a look at the following text or download the original document, and feel free to share your comments.

*Special thanks go out to Tim Humphrey for bringing this to our attention!*



**Los Angeles County Sheriff's Department**
**SAFETY BULLETIN**
**Field Operations Support Services**

*Safety Bulletin #19*
DATE: January 26, 2004
ELECTRIC & HYBRID VEHICLE HAZARDS

New fuel or engine technologies, such as powerful electric batteries used in electric and hybrid vehicles, pose unexpected risks to law enforcement and other first responders.

A firefighter from Montgomery County, Maryland, noticed something strange recently when he approached a wrecked car. The engine appeared to be off and the injured driver had her foot on the brake. The firefighter was unaware that the engine was still running on silent electric power and could have surged forward, hitting rescuers or bystanders.

The car was a Toyota Prius, a gasoline electric hybrid vehicle that uses battery power at low speeds. These hybrid vehicles are completely silent when stopped or at low speeds.

In addition to running silently, the battery in a hybrid packs enough voltage to kill a person — more than 500 volts in the 2004 Prius, compared with 12 volts in the standard car battery. In the Prius, the battery is in an unexpected spot, behind the rear seat.

Both Toyota and Honda, the only companies currently selling hybrids, win high praise from rescue workers for marking high-voltage parts with attention-grabbing blaze orange and for engineering their cars with safety in mind. For instance, the powerful batteries are not grounded to the frame, which means there is little danger someone could be electrocuted by simply touching a wrecked car.

Other vehicle manufacturers will soon be entering the market of hybrid vehicles. For example, Lexus has scheduled the release of a hybrid RX330 SUV later this year. It is important that all personnel who may come into contact with a hybrid vehicle are aware of these dangers and take appropriate precautions. Take a few minutes to examine the vehicles you approach to determine if it is an electric or hybrid vehicle. Be cognizant of the high voltage and use caution around the cables and battery.

For questions regarding this bulletin, contact Field Operations Support Services at (323) 526-5760.

*By Jim Stack, PEAA*
http://ev1-club.power.net/

*From an anonymous contributor comes confirmation of GM's scorched-earth EV1 policies. These photos were taken in December 2003 at GM's Desert Proving Grounds in Mesa, AZ.*

While I was out mountain biking 2-8-004,the other day I went near the GM Desert Proving grounds in Mesa AZ. I looked through the fence and saw 31 EV1's and 22 Electricar S10's all waiting to be crushed. I called the proving grounds but was told they have cut down on manpower since they are closing and moving the testing to New Mexico. So I e-mail GM in Detroit to see if any of these great vehicles could be sent to museums or other non-profit groups. The response I got follows.

Until I get some action I'll keep trying. Maybe we could at least strip out the NiMH batteries or some exterior emblems as a remembrance. I'll try to keep an eye of these vehicles to see if they are crushed or sent to the Northeast for the new cold weather tests GM talks about.

I also tried to get one of the workers to talk at our monthly EAA meeting about EV's but also got no help. Some interesting facts are the proving grounds officially opened in 1953, the year I was born. They had an open house last year for their 50th but I missed it since my wife an I were working in Mumbai India. My friend Bill took his electric G20 van and GM tested it on the track going 97 miles at 46 mph to test range. Not too bad for a 5 ton EV. He runs on 3 strings of 186 cells of military surplus 600AA wet Nicads.

From: info@gm.com
To: jstack6@juno.com
Date: 9 Feb 2004 16:47:50 -0400
Subject: RE: GMability

Dear Mr. Stack,
Thank you for contacting the GM Customer Assistance Center. We appreciate you taking the time to write us in regards to your vehicle donation inquiry.

General Motors receives a great number of similar requests for free vehicles each year.

*Death Row: Awaiting destruction...*

*... and after the hammer has fallen*

Many of these requests are from other very needy and deserving individuals or organizations and we wish we could fulfill every one. Since we are unable to grant all of these requests, we regret that we must not grant any.

If you should need to contact us in the future, simply reply to this message or call our GM Customer Assistance Center at 1-800-222-1020. Customer Relationship Managers are available Monday through Friday from 8:00 a.m. to 11:00 p.m., Eastern Time.

Again, thank you for contacting Chevrolet.

Sincerely,
David R. Policar
Customer Relationship Manager
GM Customer Assistance Center

## Emeter and Peukert

*By Lee Hart, EAA member*

Peukert 'is' valid for changing discharge currents. The E-Meter uses it this way.

Emil Naepflein wrote:
> *This is wrong or at least not very exact. You can use Peukert for changing discharge currents, but the result will be pessimistic because the battery will regain capacity under no load or small load because only so much active mass has been transformed that is equivalent to the derived Ahs and the rest of the active mass is still available.*

Emil, are you familiar with the E-meter? In my experience, it actually does provide a fairly accurate indication of battery capacity (once it is programmed to match the battery's actual characteristics). It is certainly more accurate than the usual voltage-based or coulombmetric-based state-of-charge meters.

The E-meter keeps track of the number of amphours you have removed from the battery, and estimates the charge remaining *if you were to keep drawing current following the same load pattern*. Obviously, if you reduce your load current, you can draw out more amphours. As you do this, the E-meter recalculates a new value for the remaining time.

For example, suppose I am driving home. It normally takes me another 30 minutes. But the E-meter tells me I only have 20 minutes of time left at the present rate. So I slow down to a speed where it would take 40 minutes to get home. The E-meter's 'time remaining' display changes to 45 minutes; now I know I can get home before the pack goes dead.

Or, assume the same example, but I am watching the SOC and amphour displays instead. I know that it took 20ah to get to work, so I need 20ah to get back home. I also know that 40ah is "dead" (20% SOC) at the speeds I normally drive. But as I leave work, I see that the SOC is 40%; not 50%. Thus I know I have to drive slower or I'll run out. So I slow down, and the currents are less. The E-meter uses Peukert's equation on an incremental basis to calculate SOC. When I get home, I will have removed 50ah from the pack (possible because of the lower currents), and the E-meter will still show 20% SOC (because the pack could deliver more amphours at the lower discharge rate).

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## Practical Application of Peukert's Equation

*By Steve Kahle*

One of the most interesting new features implemented in the E-meter is the treatment of Peukert's Equation. Peukert describes the effect of varying discharge rates on a battery, but he neglected to document a comprehensive description of both charge and discharge currents needed to determine the state-of-charge of the battery. CECO engineers have tried to complete the description of the cycle in a practical way that will be described below.

**Discharging**
Using a user selectable capacity (C) and a user selectable Peukert coefficient (N), the E-meter calculates a 20-hour discharge rate (I20) and capacity (Cp) based on Peukert's equation. Then a multiplier (M) is calculated from the ratio of Cp/C. Two state-of-charge capacity values are tracked:
Crem = C + (I x time) and
Cprem = Cp + (Ip x time)

I20 = C/20 hr

Cp = (I20) N x 20 hr

M = Cp / C

Discharge rates equal to or less than the 20 hr rate are multiplied by the factor (M) to normalize them to Cp. Then they are used as the effective discharge rate (-Ip). *Example:*

C = 200 Ahr N = 1.25

I20 = 200 Ahr / 20 hr = 10 A

Cp = (10 A)^1.25 x 20 hr = 355.6 Ahr

M = 355.6 Ahr / 200 Ahr = 1.778

Therefore a 20 hr discharge at 10 A would deplete the 100% of the battery capacity using Crem or Cprem at the same rate.

Discharge rates greater than the 20 hr rate are calculated using Peukert's equation and have a greater effect on capacity, reducing the time the load may be supplied. *Example:*

C = 200 Ahr N = 1.25I = 30 A

time = (Crem - C) / I = (0 Ahr - 200 Ahr) / 30 A = 6.67 hrs (this is time to deplete the battery)

Ip = (30 A)^1.25 = 70.2 A

time = (Cprem - Cp) / Ip = (0 Ahr - 355.6 Ahr) / 70.2 A = 5.06 hrs (Peukert time to deplete)

As the discharge rate goes up, the greater effect Peukert's equation has.

**Charging**
When I goes from discharge to charge, a multiplier (U) is calculated from the ratio of Cprem / Crem. Charging current is then the observed current (I) multiplied by (U) and then multiplied by the battery's efficiency (CEF) to calculate an effective charge rate (+Ip). Further Cprem is limited while rising by Crem as an upper limit. *Example:*

C = 200 Ahr I = +30 A
Crem = 100 Ahr
Cprem = 148 Ahr CEF = 90%

U = 148 Ahr / 100 Ahr = 1.48

+Ip = (30 A) x 1.48 x 0.90 = 39.96 A

This way as the battery is charged both Crem and Cprem will reach full at the same time.

**Summary**
Using this combination of formulas to determine a Peukert's capacity (Cp), a 20 hr discharge rate (I20), multipliers for discharge (M) and charge (U), with given data representing a 20 hr capacity (C), charge efficiency (CEF) and Peukert's coefficient (N), the E-meter can calculate an accurate state-of-charge on a wide variety of batteries and applications. The break point at the 20 hr discharge rate with the (M) multiplier used at or below the 20 hr rate removes the portion of the performance curve where Peukert's equation diverges from reality. The charge multiplier (U) used with the battery's own efficiency (CEF) finishes the other half of the cycle that Peukert didn't choose to address.

## EV RANGE CHAMPION

With all the talk about limited ranges for lead-acid batteries, some EVs have been able to cover substantial distance.


Here's a picture of the Team New England's 1999 entry into the Tour de Sol. Attached to the Solectria Force car is a range-extension trailer, doubling the pack. The team set a lead-acid range record of 156 miles and the actual range of the car was about 180 miles. Due to this performance, the car was nicknamed "Tortoisol Super-FORCE." They won the Tour de Sol that year with this configuration.

**The specifications were:**

- 2 dr, 4 seat hatchback
- White with green trim
- 144V 35kw Solectria AC induction drive system
- Air conditioning & 1KW electric heater
- 31A/12V DC DC converter
- 1kw Solectria charger, charges overnight
- 144V Group 27 pack (~80Ahr), typically gets about 1Ahr/mile, or 120-150whr/mi, for a reliable 40-mile range, 60-80 miles if you drive carefully. Or even further, as demonstrated at the Tour.
- Battery boxes behind rear seat and under hood, leaving front and backseat passenger spaces untouched.

# THE LAS VEGAS ELECTRIC VEHICLE ASSOCIATION (LVEVA NEDRA PRE-SEASON OPENER / TEST AND TUNE AT LAS VEGAS MOTOR SPEEDWAY)

*By Roderick Wilde ©2004*

The National Electric Drag Racing Association (NEDRA) announced that a Pre-Season Opener/Test and Tune Event will kick off next year's drag racing season at Las Vegas Motor Speedway on January 24, 2004. NEDRA is affiliated with the National Hot Rod Association and races under NHRA rules.

Dubbed as an Exide Orbital "shootout", many of the racers will be testing the performance of Exide Battery Company's new Orbital XCD Sealed Lead Acid batteries to compare their performance against the Optima YT and Hawker Sealed Lead Acid batteries that have been preferred in previous competitions.

Also, EVParts.com and NEDRA President Roderick Wilde will be unveiling his recent "made for TV" project that will be filmed for a pilot documentary to be aired on The Discovery Channel in Spring 2004. NEDRA stalwarts Roderick Wilde, Father Time (aka Don Crabtree), Rich Rudman, Otmar ('Zilla) Ebenhoech and many other supporting "ampheads" have worked intensely over the last two months to create "Gone Postal", a hot rod postal delivery van. Rod has been posting the progress of the "Suck Amps Racing Team" on Yahoo's EV Discussion List:

*(November 29, 2003)*
"Speaking of an Orbital shootout, I think it is time I spilled the beans about the secret project at the Suck Amps EV Racing Laboratory. We are building an all wheel drive, street commuting electric vehicle based on a 1983 all aluminum postal van. Even the frame is aluminum. I can grab the rear bumper and do deep knee bends so I'm sure this rig weighs way more than a hundred pounds without motors and batteries ;-)

We are running three motors. The one in the front is a 9" GE through a 1991 G60 supercharged VW Corrado transaxle with 100 mm axle flanges and 1997 Passat GLX hubs and rotors that are being adapted to the 1983 VW Rabbit lower A arms. The motor torque is handled by a 228 mm Centerforce clutch and pressure plate that they are building especially for us. In the rear we are running two ADC 8" Sparrow motors through a quadruple Goodyear belt drive to an independent rear minus differential from a 1992 Subaru Legacy station wagon. We are having special axles machined out of 4340 steel and they will be heat-treated.


*Suck Amps EV Racing*

*Rich Rudman manning the charging station*

*Photos courtesy of Chip Gribben, Seth Allen, Craig Uyeda, Otmar Ebenhoech and Joanne Granum.*

Further information about the Las Vegas Electric Vehicle Association is available on their website, www.lveva.org

The company doing this does many of the quickest front-wheel drive drag imports up here. We are running 40 XCD Exide Orbitals configured in two parallel strings for a nominal voltage of 240. This pack will be fed through two Zilla Z2Ks to the three motors. The rear Z2K will be operated through the hairball interface for series/parallel switching while the front will be standard using the five speed.

The Corrado cable shifter is mounted on the dash to the right of the steering wheel for karate style shifting. It's a right hand drive of course and I'm right handed so I didn't want to shift with my left hand. In summation, I believe since all the forces are running in the same direction that we want to go we will not have torque steer problems like the "Maniac Mazda" I further theorize that we have enough batteries, motors and controllers to make this a fairly if not extremely quick commuting grocery getter that has range as well as performance. It's name is "Gone Postal"

*(December 2, 2003)*
I first coined the phrase "Dreams are the seed of creative reality" back in 1969 and I sincerely believe that notion and have for a long time. I do not have any contacts with TV people. I was found on the Internet by a story editor employed by the producer.

*Different views of Gone Postal*

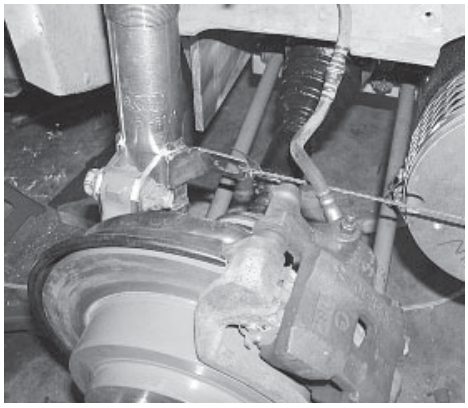
The choice for doing the postal van was not my first choice. I believe it was number four on my list. The producers decided on the postal van and frankly, I'm now very happy with that decision.

In the old days we had cars we would call sleepers — cars such as an old Rambler or something that you would instantly assume wouldn't have a chance against your souped up Chevy and then it cleans your clock. Well, I've always been into the "in your face" manner of promoting electric vehicles. I really don't believe that you can change minds in this particular culture by just telling people that electric vehicles are the right thing to do. Can you imagine how humiliating it would be to be beat by an electric powered postal van if you were driving a very expensive sports car considered to be one of the quickest production cars in the world.

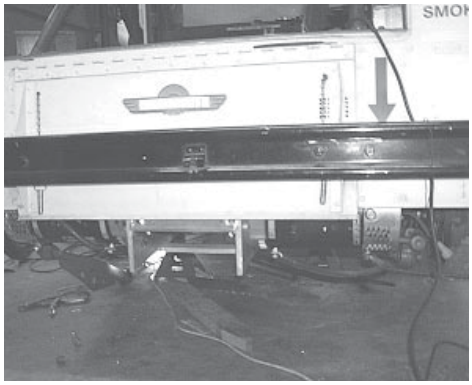
Back in my hippie days I beat a Corvette and a Trans AM in a short drag race with my hot rod 1949 Chevy hippie school bus so I've been into this kind of stuff for awhile. I've been wanting to build an all wheel drive electric street car for some time. All wheel drive is something you are seeing and will be seeing more and more in modern cars. All wheel drive gives you four tires worth of traction and good handling in extreme cornering.

We plan to also race this vehicle in SCCA autocross events. The best part of all wheel drive in this particular case will be the four wheel burn outs with the front wheels in reverse while the rear are turning forwards. This should be a real crowd pleaser. We could have built a rail job and we still may in a future episode. In my opinion it would take a great deal to really impress the general public that doesn't understand drag racing. After all, it is the general public whose minds we are trying to change. People who know nothing of the sport expect a rail shaped vehicle to exceed 300 MPH in the quarter mile because they've seen that on TV. For right now the postal van is poised to blow away a lot of perceptions.

For handling purposes almost all the batteries are located down low in the center of the vehicle in order to keep a low moment of inertia. We've put a great deal of thought in this vehicle. We want it to be much more than just a drag vehicle. With the amount of batteries onboard we should have very good range as well. We can run in just front wheel drive when we wish.



*Gone Postal's IRS*



*Gone Postal's rear motor setup, before paint*

Concerning affordable EVs, the EV that I have the most fun with at the moment is a chopped board scooter with ape hanger handlebars that I only have a few hundred dollars in. I sit down on it to ride and I ride it all over town. It really cracks people up. It is also very efficient. I checked it's socket usage and a fill up is less than half a kilowatt hour. That is about three cents a fill up. You can't even start a gas car for that amount. Whether or not you get a vehicle ready for Las Vegas you are, of course, very welcome as are all EVers and non EVers.

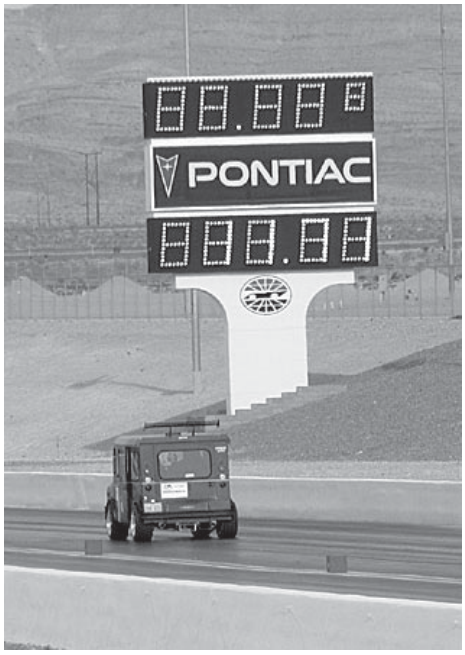
All of us on this list are dreamers. We all have the common dream of making EVs a big part of our transportation system for the good of all people and the planet. Hope to see you in Vegas.

*(December 7, 2003)*

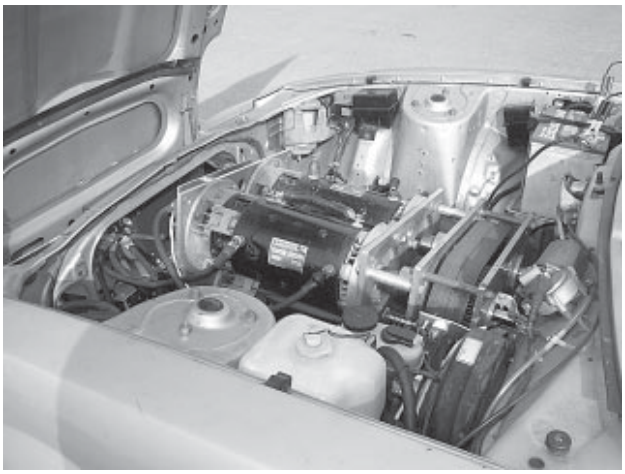
We now have the front motor installed with the Quaife posi unit installed in the 1991 VW Carrado transaxle and a lightened racing flywheel from Autotech (www.autotech.com) with a Centerforce (www.centrforce.com) 228 mm racing clutch and pressure plate. This feeds the 1997 VW Passat hubs with discs. These hubs are supported by custom H&R coil over shocks (www.hrsprings.com) which have small springs. H&R is located here in Western Washington in Bellingham and they hand delivered the shocks.

*continued on page 10*


*Starting Line*




*Fastest Postal Van in the West (11.71 seconds)*



*Two of Silver Bullet's three motors*

*Sizzlin'!*

...The rear aluminum box has been welded up. Two 8" Sparrow motors are getting mounted on either side. They each drive two Goodyear Eagle herringbone-style belts on the inner side of the box to a hub that has an outer 100 mm modified VW axle drive flange. The axles to be custom made of heat treated 4340 to adapt to the 1992 Subaru Legacy hubs with brake rotors. Casey, our FX guy and fabricator, has almost finished the 6 point roll cage. Roll bars are required by the NHRA for cars that do 11.99 seconds or quicker. I like to be not only optimistic but also safe. The rear aluminum box also bolts to the rear roll bar struts as do the upper shock towers. This will give us the needed stiffness for SCCA autocross events. The cage will also allow us to run at the Bonneville Salt Flats at some future date if they ever decide to make street classes for electric cars. Right now you have to compete against streamliners and I'll tell you this postal van definitely does not have a low coefficient of drag. Well, maybe compared to a 737 hanger door.

David Cloud got a cameo appearance on Friday when he drove down from Woodinville to deliver some orangeboard. An extremely light and strong composite board used for the floors of Boeing airplanes. We like to use it for battery boxes as it is not conductive and lightweight. I gave him a new 24 volt 1.6 kw Perm Motor from Germany (www.perm-motor.de) to test in an Electrathon to determine if we wish to carry them. They are designed exactly like a Lynch. They also cost much less than the Lynch but more than the Eteks. They also make a 7.22 kw, 24-to-72 volt version.

*Silver Bullet vs Ca Pop E*

Also appearing this week in cameo spots will be our EV Listers Otmar "Zilla" Ebenhoech, Rich "Madman" Rudman and Paul "Neon" Gooch. Crunch time is here. We have to finish this vehicle this week. Next week it goes to the paint shop in Casey's BMW repair shop in Shelton for the silver with electric blue metalflake paint. It's going to be a very insane week with this many amped out ampheads in one room. More to follow.

*(December 18, 2003)*

Due to a great deal of help from amp heads who came in to help during crunch time we were able to get "Gone Postal" done on time. We got it running on Tuesday and yesterday morning we drove it on to a trailer to take it to Shelton, 75 miles to the South for it's custom paint job.

When it gets out of paint we will install the custom dash, set up the suspension and take it out to break in the batteries and then break anything else we can in order to get it in prime racing condition for Las Vegas. I can sincerely tell you that this project has been a real drain on me and the crew both mentally and physically and that reality TV has even made me doubt the truth of my own fantasies.

A great deal of thanks and gratitude go to the additional crew members, Paul "Neon" Gooch, Rich "Madman" Rudman, and Otmar "Zilla" Ebenhoech who drove up all the way from Palo Alto to assist in the project. We couldn't have done it without them. Although Bob Schneeveis was not involved I would like to thank him for his inspiration. Also present in spirit was Ed Rannberg.

A film crew from the production company of the documentary, "Sucking Amps" will be filming the NEDRA-sanctioned time trials at the Las Vegas Motor Speedway during this Event.

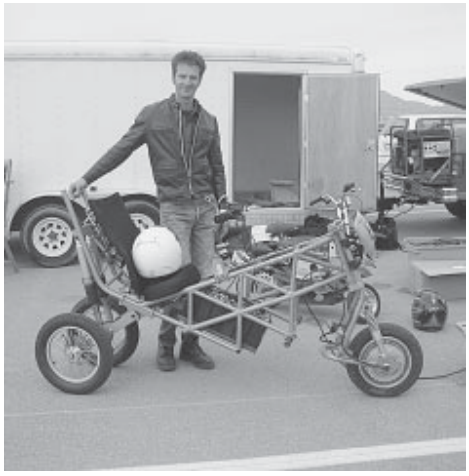
Here is a reprint of NEDRA's class competition categories from their web site:

**Entering Your Vehicle**
All EVs are welcome to race, providing they pass our safety/technical inspection. If you are interested in racing, below are the vehicle and voltage classes. Each vehicle will have denoted by a "Race Class - Voltage Division" code.

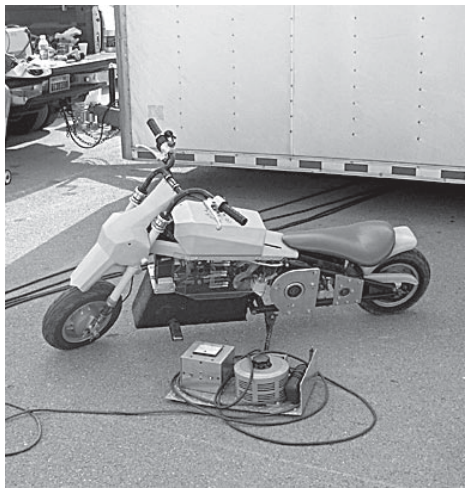
**Race Classes**
SP = Street Production
MP = Modified Production
SC = Street Conversion
MC = Modified Conversion
MT = Motorcycle - Trike
DR = Dragster
GE = Go Cart
HS = High School Street
HM = High School Modified
CSF = Class 64
CV = Concept Vehicle

**Voltage Divisions**

| | |
|---|---|
| A = 241 V and above | G = 73V - 96V |
| B = 193V - 240V | H = 49V - 72V |
| C = 169V - 192V | I = 25V - 48V |
| D = 145V - 168V | J = 24V and below |
| E = 121V - 144V | |
| F = 97V - 120V | |



*Evolve Motorworks I-Lean*

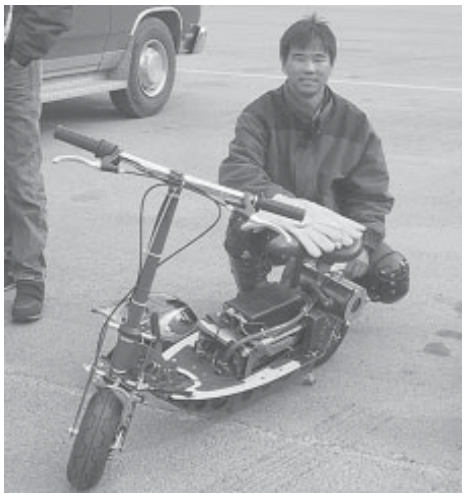


*Father Time's Dragon Amps*

"Street vehicles are any vehicles that are licensed to drive on the street. Modified vehicles are ones that are not street legal. For example, the tires are not Department of Transportation certified. Production vehicles would be GM's EV-1 or Toyota's EV RAV—vehicles that were intended to initially be EVs Conversion vehicles, or any vehicle that was not an electric vehicle in a previous life is a conversion. An example of vehicle/voltage classification: GM's EV-1 is an SP-A; the 'SP' because it is produced as an EV and is street legal, the 'A' because it has a voltage of 336V.

Check our records and see which is the time to beat. If a combination of vehicle class and voltage division does not have a time, it means that you could be the new record holder!"

The LVEVA will once again host this year's local EVent. LVEVA President Bill Kuehl and Board of Director member Richard Furniss will be racing their electric dragsters in competitive time trials. LVEVA members are encouraged to participate in the organization, planning and operation of this year's competition.



*Craig Uyeda's 36-volt scooter*

*Revolt and I-Lean G2*

*An Electric Moped*


*Richard Furniss EX-3*

## CET Donates GEM Electric Vehicles to Local MA Organizations

Pittsfield, MA-based nonprofit community organization Center for Ecological Technology (CET) recently announced the donation of 15 Global Electric Motors (GEM) vehicles it received from DaimlerChrysler to cultural groups, academic institutions and municipal governments in western Massachusetts.

According to CET, recipients of the neighborhood electric vehicles (NEVs) include Berkshire Theatre Festival, Gould Farm, Hancock Shaker Village, Jacob's Pillow Dance Festival, Mass MOCA, Norman Rockwell Museum, the city of Northampton, Simon's Rock College of Bard, Shakespeare and Company, the city of Springfield, Tufts University and Williams College. CET noted it is keeping several of the GEMs for its own use for deliveries and local travel.

"Everyone benefits from alternatives to standard gasoline engines," said CET director Alan Silverstein. "Our communities get cleaner air, commuters have clean, quiet and convenient transportation and people are exposed to the design and capabilities of these all-electric vehicles."
(IBERKSHIRES.COM: 11/25)

## Columbia ParCar Introduces New NEV

Columbia ParCar Corporation recently announced the launch of the Columbia Summit, a new low-speed neighborhood electric vehicle (NEV).

Equipped with Columbia's ACEplus electric drive system, the company said the Summit, which is available in two- and four-passenger models, is a National Highway Traffic Safety Administration (NHTSA)-compliant, street-legal NEV.

## Ecology Action Offers Electric Bicycle Rebates

Santa Cruz, CA-based nonprofit organization Ecology Action recently announced it is offering a rebate worth up to $375 off the purchase of an electric bicycle through its Santa Cruz County Electric Bike Commuter Incentive Program.

To quality for the rebate, Ecology Action said local residents must attend a free two-hour safety training class. Ecology Action noted that the rebate is accepted at such local retailers as Cycle Works, Electric Sierra Cycles and Subaru of Santa Cruz. (REGISTER-PAJARONIAN: 12/6)

## RECC to Ship Reva Electric Cars to Europe

Bangalore, India-based Reva Electric Car Company (RECC) recently announced plans to begin shipping its Reva two-door, battery-powered vehicle to Europe next month, as the company has received exportation approval from the European Union (EU).

According to RECC managing director Chetan Maini, the company will initially offer 500 Reva cars in Britain under the brand name "G-WIZ."

Maini noted that RECC has set a "conservative" goal of selling 5,000 units throughout Europe within the next three to four years.

## ZAP Opens New Dealership in Las Vegas

Electric vehicle (EV) company ZAP recently announced the opening of a new "full-service" auto dealership in Las Vegas, NV, "where you can test-drive, rent and purchase electric cars."

According to ZAP, the dealership, which includes a parts and maintenance center, complements the company's two other rental outlets on the Las Vegas strip, which offer more than 100 EVs.

"We are proud to operate the largest electric car rental fleet in the world" said ZAP manager Barry Rutigliano.

## Eneco Hybrid Bus Completes Non-stop Journey

West Sussex, U.K.-based Eneco, a provider of "leading edge and innovative design and development solutions for zero and ultra-low emission vehicles," recently announced that an Eneco-built series hybrid bus has successfully completed a non-stop trip of over 300 miles from Sussex to Preston.

During the journey the hybrid bus, which combines a 1.9 TDI VW engine and a 120-kilowatt (kW) electric motor and is based on an Optare Solo 32 seat urban bus platform, achieved an "overall" fuel consumption of 20 miles per gallon while traveling at speeds of 50 to 80 kilometers per hour (kph). Additionally, Eneco noted that the bus' batteries remained fully charged upon arrival in Preston.

Eneco plans to begin mass-producing the hybrid bus this spring with partner LTC, "with orders for the first production batch of 16 buses already received."

## RECC Electric Vehicle Wins Innovative Product Award

Industry officials in India recently reported that the Institute of Directors has presented Reva Electric Car Company (RECC) with a 2003 Golden Peacock Innovative Product Award for the company's Reva electric vehicle.

"This year, the Reva will move from being a concept car to a world car," said RECC managing director Chetan Maini. "Our achievements in 2003 In being awarded EEC certification, the successes of our pilots in various parts of the globe and the commencement of our exports to the U.K. are positive signs of the Reva's acceptance globally."

According to officials, Golden Peacock awards are presented annually to "the most innovative product as determined by the satisfaction of customers' long-term

unexpressed and unarticulated needs and aspirations in a most cost-effective manner." (TIMES OF INDIA: 1/23)

## ILSR Says HEV Alterations Could Help Support 'Ethanol Highway'

The Institute for Local Self-Reliance (ILSR) recently announced the release of a new report by ILSR vice president David Morris which notes that while "the use of hybrid electric vehicles (HEVs) by itself could reduce liquid fuel consumption by 30 to 50 percent," expanding the electric-only driving capacity of HEVs' electric battery system "could reduce liquid fuel consumption by another 30 to 40 percent and allow the vehicle to run off renewable electricity," with "the dramatically reduced liquid fuel consumption that would result [enabling] the building of an ethanol highway," instead of the "hydrogen highway" proposed by California governor Arnold Schwarzenegger.

In the report, titled "A Better Way of Getting From Here to There: A commentary on the hydrogen economy and a proposal for an alternative strategy," ILSR said Morris urges Schwarzenegger to conduct a study of the comparative costs and benefits of hydrogen and ethanol before implementing the hydrogen highway proposal. Additionally, ILSR said the report notes hydrogen's "major shortcomings — astonishingly high costs, low overall energy efficiency and a reliance on non-renewable fuels."

"On cost alone, an HEV transportation stra-tegy, with cars that run on ethanol, is far su-perior to a hydrogen fuel strategy," said Morris.

## University of Washington Motor Pool Offers Electric Vehicles for Rent

The University of Washington (UW) Motor Pool, which rents out vehicles to students and staff, offers a variety of electric vehicle options, including six Toyota Prius hybrid electric vehicles (HEVs), five Taylor-Dunn electric trucks, one Bombardier neighborhood electric vehicle (NEV) and one Segway Human Transporter.

According to UW Motor Pool manager David Carr, the university also test-drove a Global Electric Motorcars NEV for campus use, but prefers the Bombardier NEV's performance on inclines and in inclement weather. "We would buy more [of the Bombardier NEVs] but the problem...is that they don't make them anymore," noted Carr. (UNIVERSITY OF WASHINGTON DAILY: 1/26)

## G-8 Summit Organizers Offer Customized NEVs

Organizers of the upcoming Group of Eight (G-8) summit in Sea Island, GA, scheduled for June 8 through 10, recently unveiled a customized Global Electric Motorcars (GEM) neighborhood electric vehicle (NEV) for use by President Bush during the meeting.

Summit organizers noted that the other leaders attending the event would also be presented with customized GEM NEVs. Savannah, GA-based company Digital Image will affix each NEV with special decals emblazoned with the G-8 countries' respective flags.


*EAAs main website - http://www.eaaev.org*

## REVA EXPORTS 500 ELECTRIC CARS TO BRITAIN


*Business News India*

Bangalore, Dec 9: The makers of India's first compact electric car Reva have entered into a marketing tie-up with Going Green Plc to export 500 cars to Britain over the next nine months.

**Reva Electric Car** will sell the vehicle in Britain under the brand name G-WIZ.

Promoted by Bangalore-based Maini Industrial Group, the battery-run vehicle has recently been granted the European Economic Community certificate for homologation that qualifies the firm to enter the European market in a big way.

"The certification validates Reva's technical expertise in the auto industry. It makes the compact electric car an ideal solution for mobility in European cities and towns," Chetan Maini, the firm's managing director, said here Tuesday.

Priced about 40 percent higher than its Indian luxury model in the premium segment, G-WIZ will be the most economical electric vehicle in Britain and the European markets.

"We began test-marketing Reva in Britain early this year and modified its features based on customer feedback to suit their requirements, including climate control seats and remote control heating. G-WIZ will be the only vehicle in Europe with these features in the non-fuel segment," Maini claimed.

As its sole distributor in Europe, Going Green will promote Reva in Britain as an ideal environmental vehicle alternative to

gasoline models and undertake its after-sales service support.

On Indian roads, the car gives a mileage of just 40 paise a km or nine units of power for 80 km against Rs.2.60 a km by petrol-driven small cars.

"With the British government granting road tax exemption, 100 percent depreciation and waiver of congestion charges and parking fee for G-WIZ, we are upbeat on its success with the potential for more export orders," Maini group chairman Sudarshan Maini told IANS.

Of the 2.5 million cars sold in Britain in the last 10 months, 875,000 were in the super mini category. With 38 percent having single occupancy and 34 percent double occupancy, the potential for G-WIZ is about 100,000 in the next couple of years.

In the run-up to its foray into the European Union market, the company has started test marketing Reva in Malta, Norway, Germany and Switzerland.

"As the second largest electric car producer the world (behind) Ford in the US, Reva has the first-move advantage in the emerging trend for zero-pollution cars," Maini said at a preview of Reva Classe, the new export model with additional comfort and safety features.

Cashing in on strict emission norms in European countries, where legislature amendments and regulations are being made to check pollution by gasoline and diesel-powered vehicles, the company is set to introduce enhanced and customized versions to meet the demands of emerging export markets.

To meet the market demand, the Rs.600-million group is stepping up production at its Bommasandra facility on the outskirts of Bangalore to roll out about 250-300 cars a month from the yearend.

Reva hit the Indian roads in mid-2001. The company has sold about 550 units in India and 50 overseas. About 50 percent of the cars were sold in Karnataka.



## EV TOWING AND TRANSPORTING

*By Jim Stack, PEAA member*

I always feel bad when I see an EV on a flatbed or being towing. I'm afraid that may be the only EV some people ever see and it gives them the wrong impression.

The following three real life incidents are presented to help explain the transport and towing problems associated with EVs. These experiences illustrate some of the many differences between EVs (Electric Vehicles) and ICEs (Internal Combustion Vehicles). This is especially true of conversions since they look almost the same as the original vehicle.

The first 2 examples are about my Chevy Electricar S10 pickup. I sold it in Phoenix, Arizona, to a person in California. We used A1 Transport to have the vehicle delivered to California. They apparently didn't understand EVs and tried to pick it up when I wasn't there. They said it wouldn't start. EVs aren't like a gas car; when they start they are silent. I explained this again over the phone.

On the third attempt they finally understood and drove it onto the transporter and off it went. They must have finally understood because when it arrived in California the batteries were down very low. I think they did some joy riding. Typically I can drive the S10 50-70 miles on a charge or leave it for weeks with a full charge and the pack voltage never gets very low. I had put new batteries in it weeks before I sold it, and when the EV was picked up it had a full charge.

The second example happened after the S10 arrived in California. After receiving it, the new owner drove it a few times, and then, feeling he knew all about the EV, he decided to take it on a longer trip. He drove too far and was left with no charge, far from home, in a hilly area. Now sometimes, if you only go a little too far and are near a charging location, you can use the recovery mode. If you wait 10-15 minutes, the batteries recover a little and you can drive a short distance at slower speed. But he was much too far away.

He called a towing company that came, connected to it, and drove off. And then the tow strap broke. Just as luck would have it, the tow driver had neglected to attach the extra safety chain. He was probably too distracted wondering how an electric works instead of completely doing his job. The S10 was totaled after it went off the edge of a steep drop off and the frame was bent.

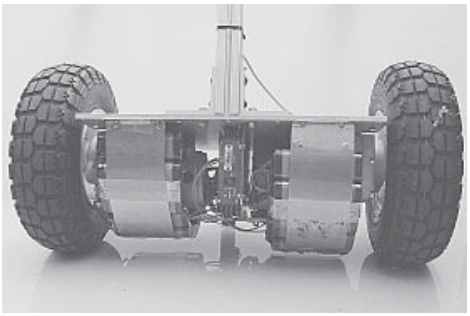
In a third incident, a friend here in Phoenix, Arizona with a large G20 electric van had a flat tire. He left the vehicle to get the spare and heavy-duty jack. While he was gone, the police saw it on the side of the road and called their tow company. The tow truck was trying to pull the van onto a flat bed, backwards, which you aren't supposed to do with the G20. There was even a large factory label stating not to do that. As my friend had just arrived back he explained the potential problem, so they stopped and tried to jack it up to change the tire. But the weight was way too much. My friend showed them the documentation explaining the weight and then showed them the heavy-duty jack he had brought. They used that, got the tire replaced and he was back humming down the road.

It all goes to show that the general public, and even professional car companies, don't understand the special needs EVs have for driving and towing. Some basics are: first, know the range to get to your destination AND back, and know what to watch for on the EV's meters. Second, know how to tow and jack your vehicle, and carry the spare and jack with you. Third, take the time and be sure to explain any special precautions to the towing or transport company. They may actually listen. It's a great opportunity to tell about your EV and educate someone about EVs.

***Balancing*** *- continued from page 1*

| | **Segway** | **My Scooter** |
|---|---|---|
| Motors | Brushless servo motors with neodymium magnets. "The highest-power motors for their size and weight ever put into mass production". | Conventional DC motors with gearbox widely used in powered wheelchairs. $286 each from National Power Chair or from Robot MarketPlace. |
| Gearbox | "Like a precision Swiss watch". Engineers designed the "meshes in the gearbox to produce sound exactly two musical octaves apart." | Part of the wheelchair motor above. When going up a ramp, they sound kind of like the starter motor on my old Dodge Dart. Rrrrr-rrrr-rrrr-rrrr. |
| Batteries | 2, 60-cell custom-designed NiMH packs producing 72 volts. "the highest power of any currently available chemistry". | 20, 6-cell NiMH packs made for RC cars. They have "IDEAL SOLUTION FOR RC TOY" printed on them.$15 each from Powerizer.<br>Update 2003/11/10: I've been unhappy with these; there are sharp metal edges inside the thin plastic shrinkwrap which cut through it causing a short circuit which melted several batteries. I'd suggest using 3 of the 36 volt NiMH battlepacks from Robot Marketplace instead. |
| Wheels | Wheels are "sophisticated engineering-grade thermoplastic." Tires by Michelin, with a "unique tread compound (a silica-based compound instead of traditional carbon-based materials)". | Wheels are stamped steel. I think they're made for utility trailers. Tires made by Cheng Shin tire works. They make startlingly loud squelching sounds on tile floors. Tire and wheel are $79 each from NPC, and hubs are $20 each. |
| Controller | "Sophisticated controller boards from Delphi Electronics" with "Texas Instruments digital signal processor, monitoring the entire Segway HT system and checking 100 times per second." | An 8-bit microcontroller from Atmel, running code written in C using floating point arithmetic. It sends speed control commands out the serial port at 9600 baud in ASCII to the motor driver. $10 from Digikey. |
| Motor Driver | "a set of 12 high-power, high-voltage field-effect transistors (FETs)". | The controller has 16 MOSFETS and can handle way more current than my batteries can supply. Made by RoboteQ, it's $485 from Robot MarketPlace. It's a popular part for use in Battlebots. |
| Gyroscope | "packed with five solid-state, vibrating-ring, angular-rate sensors" | One ceramic rate gyro, of the same kind that's in your camcorder (to detect your hand jiggling and stabilize the video) or RC helicopter (to stabilize the tail), and a 2-axis accelerometer to correct for drift. $149 from Rotomotion complete with the Atmel microcontroller. |
| Structure | Plastic and aluminum in smooth swooping shapes. "Chassis withstands 7 tons of force." | Two pieces of aluminum plate with holes drilled in them, and a standard aluminum extrusion for the handle. |
| Safety features | Everything is dual redundant. For example, "in the unlikely event of a battery failure, the system is designed to use the second battery to operate the machine and allow it to continue balancing until it is brought to a safe stop." | There is no redundancy or backup system It is not even robustly made. Loose wires literally dangle out the bottom. In the fairly likely event of the software crashing, a wire coming loose, a component failing, or the batteries running low, the wheels will stop and the entire kinetic energy of the system will be used to accelerate my head toward the ground. |

Despite being able to build my own, I'm still impressed with the Segway™ and with the courage it takes to bring such a product to market. Like with cars, it's pretty easy to put together a motor and wheels and make it go. But building a safe, comfortable vehicle requires a huge amount of R&D, and it's very hard to be certain that such a thing is as safe as it can possibly be. And when you're the only company doing it, and when the product is cool enough to make good news fodder, you're guaranteed to get massive negative coverage and lawsuits when there are accidents.



## Warning

There is one very important difference between what can be built as an experiment and the commercial Segway: The commercial one has a lot of safety features, redundancy and fool-proofing. Mine has none whatsoever (Well, it does have a kill switch so it doesn't go zooming away if I fall off, and it does shut down if it finds itself tipped more than 45 degrees.) This is pretty darn important, and you should think about it very carefully before considering building such a thing yourself. With a scooter like this, if it stops working for any reason (software crash, hardware failure, low battery) you will fall, hard, and probably on your face. Imagine zipping along at 10 MPH, and suddenly the platform you're standing on stops dead. Oh, and there's a T-bar in front of you to trip you up if you start to run. So you really shouldn't try to replicate this experiment, and I can't be responsible for what happens if you read this and try to build something.

A scooter that you ride on is not the best place to learn how to build a two-wheeled balancing device. Getting them working properly is quite subtle, so you should really start with a two-wheeled balancing robot and then scale up. See my notes on safety if you're considering trying to build something.

Another caveat: I am not a lawyer, but beware that the Segway folks have a US patent on the whole idea of a balancing scooter. Note that this is not a set of instructions for building one, it's just notes on how I built mine. I built this one for my own amusement and to satisfy my personal curiosity about how balancing scooters worked, but in the US building such a thing with any kind of commercial motive without a license from the patent holders could get you in legal trouble.

*continued on page 18*

# *Notes on Safety for a Balancing Scooter*

If you're developing a balancing scooter, unless you have elaborate automated test facilities, you will fall quite a few times. I didn't fall or get hurt at all testing at low speeds, but testing at high speeds earned me a few bruises. Testing such a scooter is not for timid, frail, or un-coordinated folks. Segways look and feel quite safe, but if you build your own balancing scooter, until the software is tuned perfectly it is very likely to lurch violently and throw you off. Controlling and/or leaping off a wildy lurching scooter requires a lot of physical strength and agility and is inherently hazardous. I would rate it more hazardous than skateboarding, but less than racing motocross bikes. Skateboarders fall a lot, but at least they don't have an 80 lb thing under them with spinning tires.

For initial testing at low speed, the most important things are a very handy kill-switch, sturdy shoes and shin guards. Mine, at 80 lbs, isn't heavy enough to hurt much running over your toes, but if you're standing behind it and it backs into you the bare metal plate can really bruise your shins. You also want to make sure to limit the maximum motor speed, so you don't find yourself suddenly testing at high speed.

Unless you have the feedback loop parameters just right, it will start oscillating back and forth out of control when you turn it on. You'll want to shut it down quickly, and the right kind of kill switch is essential. I made a mistake here that you should avoid. I first used a circular power jack of the same kind that most wall transformers use as a combination kill-switch and dead-man's switch. (Terminology: a kill switch is something you press. A dead-man's switch is something that is triggered when you fall off.) I connected the wires together and tied the wire to my belt. Completing the circuit through the power jack turned on the scooter. This is unsafe. When I fell off, it pulled at an angle and ended up ripping the wire instead of pulling out the jack. The exposed ends of wire touched, and it kept going.

Then I changed to a proper combination dead-man's- and kill-switch made for snowmobiles and jet skis. It can handle being yanked out in any direction, and it has a big red button to press to shut it down manually.

Testing at high speed is scarier. The dynamics of limiting speed are quite complicated and hard to get right, and it's really frightening when it starts lurching around near maximum speed. Ideally you'd test on some kind of springy surface, like a rubberized jogging track. I didn't have one handy, so I tested in a parking lot. It can fail either by tipping forwards or backwards . When it tipped forwards at high speed, I ended up straddling the vertical bar, still holding the handlbars, with my feet on the ground. Once it tips that far the software locks up the rear wheels, so I was able to bring it and myself to a stop without losing balance. In this case, it's better to hang on to the handlebars and use the scooter to keep your balance than to try to get your legs over the bar and risk getting tripped up or run over. You want sturdy shoes for this: real running shoes, tightly laced, or they'll come off.

Tipping backwards is actually worse. One time it started oscillating at medium speed and zoomed out from under me. I landed on my butt and elbows. You really want to be wearing elbow pads when this happens.

I should point out here that I while I was testing experimental software, the motor driver was a solid, reliable product. Testing a motor driver of your own design is much more dangerous. Motor drivers have a tendency to fail in full-on mode when they get overloaded. Imagine getting up near top speed and all of a sudden one of the wheels goes full forward or full reverse. In most designs, not even the kill switch will shut it down. Please, use a dependable motor controller, and test it under some a heavy simulated load before using it.

I never had much trouble with steering and steering control on mine, and never felt in danger of tipping sideways. I don't know what I'd do if a software problem caused a major steering change. In general, you never want more than 7% differential speed between the wheels.

If it turns too fast and you tip off sideways, you need to let the scooter go rather than get yanked around by it. You're more likely to let it go if there aren't cars parked all around. So you really want to find the biggest possible space you can so you'll feel free to just let the scooter go if it goes crazy. If the kill switch is working properly, it should stop pretty quickly.

I haven't gone fast on a slippery surface and skidded out, but I imagine this would be pretty scary. This is the sort of thing that the Segway folks have probably put a lot of R&D into, but isn't practical for an amateur to figure out.

I mention various wacky vehicle ideas on my page. Don't start with them. For one, count on crashing it a dozen times before it finally works. So start with basic metal pieces. Also, it's really important that you can leap off quickly when things go wrong. Something enclosed, like a Roman chariot, would be a lot more dangerous.

The testing cycle is roughly like:

- wheel it out to the test range
- start it up, get going
- it starts lurching violently and you wipe out
- bring it back to your computer
- edit the code, tweak a parameter or two
- hook it up to the serial port of your computer and download the new program

You're likely to have to repeat the cycle 50 times or more to get it working well. In order to make it most convenient, you should really have a laptop you can take with you outside, rather than dragging it up and down the basement stairs dozens of times.

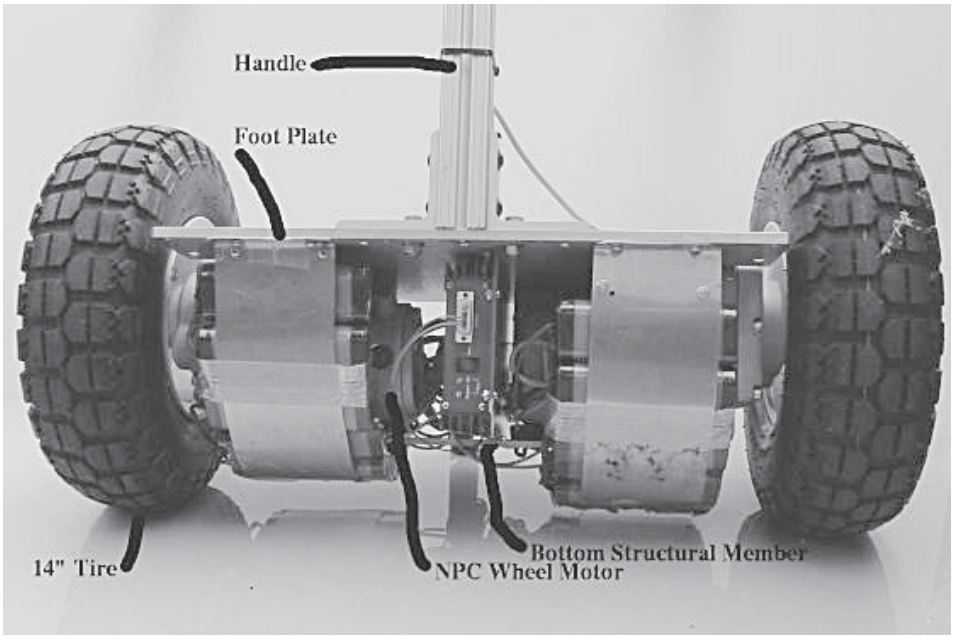
To summarize, you'd really be a fool to test with less than the following. For low speed:

- sturdy shoes
- shin guards
- an open area at least 20'x30'
- easily reached kill switch

and for high speed:

- helmet
- sturdy shoes
- elbow pads
- shin guards
- several acres of empty parking lot
- easily reached kill switch
- dead man's switch

***Balancing*** *- continued from page 17*




## Construction

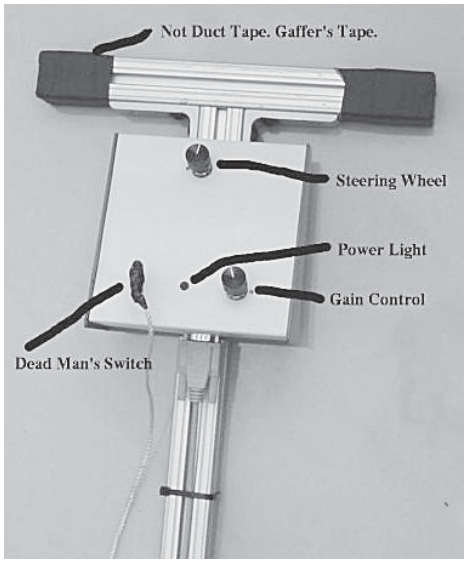
The mechanical construction is incredibly simple. Just a plate to stand on bolted to the tops of the motors, a support across the bottom, and a handle. Hanging from the foot plate are two pieces of hand-bent sheet metal to support the batteries. The batteries are just taped and cable-tied to the sheet metal.

Mechanically it's much simpler than any other kind of vehicle. With only two wheels side-by-side, there is very little structure. With no steering it doesn't need complicated pivots and linkages. It is literally just two motors bolted to a frame and a stick to hold.

The electronics and footrest all fit entirely within the 14" wheel diameter. Without the handle, it can roll end over end. But the ground clearance is pretty small. I should go up to 16" wheels, hopefully a bit lighter than the big tires I've got now. Currently it weighs about 90 lbs with its full load of batteries. The wheels alone must account for 20 lbs of this.

## Dashboard

The dashboard is an electronics chassis box with knobs for steering and balance feedback loop gain. This shows the early version of the dead man's switch, which really is not adequate. I found this out when I fell off, but the wire pulled apart instead of yanking out the connector. When it pulled apart, the exposed strands ended up touching to complete the circuit and keep it going. Fortunately, a safety feature in the software shut it down before it ran over my head.




## Power

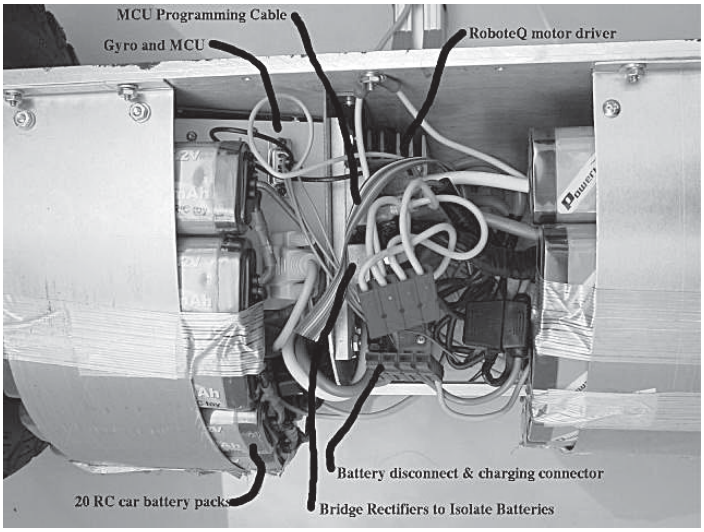
The motors I used are made for wheelchairs where they are driven from a 24 volt battery. I want a little more speed, so I drive them from 36 volts. My wheels are also a bit larger than the wheelchair's. It should reach 15 MPH flat out. I got 36 volts by putting 5 standard 7.2 volt RC car battery packs in series. The batteries are rated for 30 amps discharge and I wanted over 100, so I put 4 strings of 5 in parallel for a total of 20 packs or 120 cells.

There is a a complication with multiple NiMH batteries in parallel. You want to avoid current flowing between them when their voltages are a bit different. So there is a bridge rectifier for every pair of batteries, with both + and - terminals connected to the motor driver. That way the voltage on the 4 strings of batteries can differ by up to 1.5 volts without current flowing.

The batteries can be disconnected by the 4-way connector for safety, and for charging. I use an Astroflight model 112 charger, which delivers 5 amps charge current at the 40 volt charging voltage. See schematic diagram.

The system pumps energy back into the batteries when it's decelerating or doing downhill. I had worried about the frequent current reversals harming the batteries, but I'm assured by a number of people who've had experience doing this with NiMH batteries that it works well. There might be some extreme case, like starting at the top of Pike's Peak and riding all the way down, where it could overcharge and destroy the batteries.

*…this article will be continued next issue*



# The 2004 Tour de Sol is coming

The 2004 Tour de Sol will be held during National Transportation Week, May 21-25, as planned — but the logistics have changed.

The Tour de Sol will start in New Jersey. We will hold press events, technical testing and an open house in New Jersey from May 21-23. On Monday, May 24, we will go to New Jersey's State Capitol, where several thousand people will attend the Tour de Sol street festival. Tuesday, May 25 the Tour will go to New York City's financial district, for its grand finale festival and awards ceremony. Thousands of business people, the press, and the general public will be drawn to our large tent that will accommodate exhibitors, food vendors, speakers, the press, and much more.

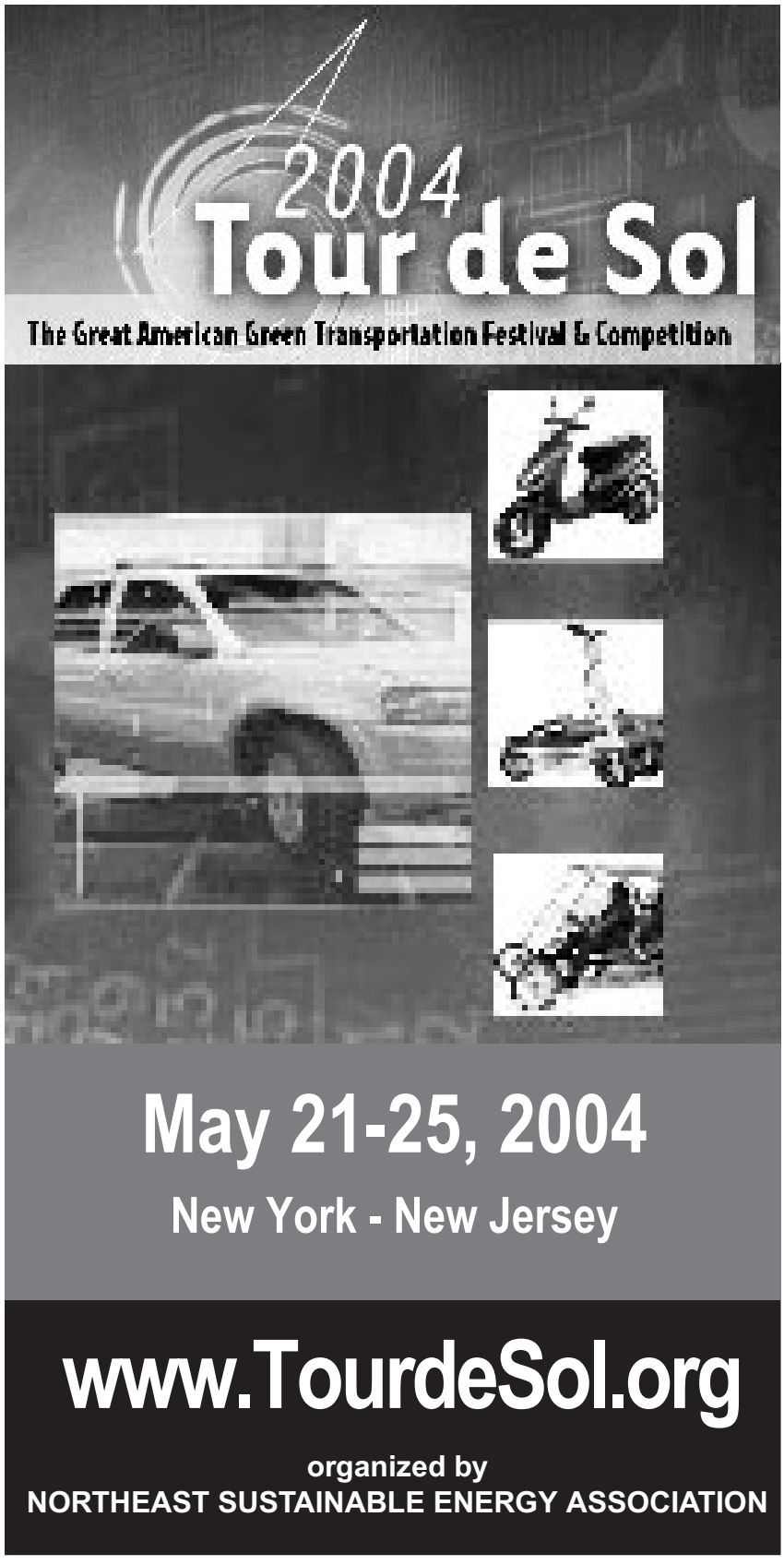
Changes in any event are never welcomed. From a competitive perspective, we expect to be able to hold all events as planned. We also believe that ending the event in New York City will provide high value. The Tour will be located in an area with high foot traffic and excellent access to the major news media, maintaining and enhancing the key attributes that have made the Tour a unique, highly attended, and newsworthy event for the past 15 years.

Your participation and satisfaction as an entrant and exhibitor of the 2004 Tour de Sol is of utmost importance to us. If you have already registered for the 2004 Tour de Sol and have any questions or concerns please contact Nancy Hazard. If you have not yet registered - don't delay! The deadline for registration is March 15th.

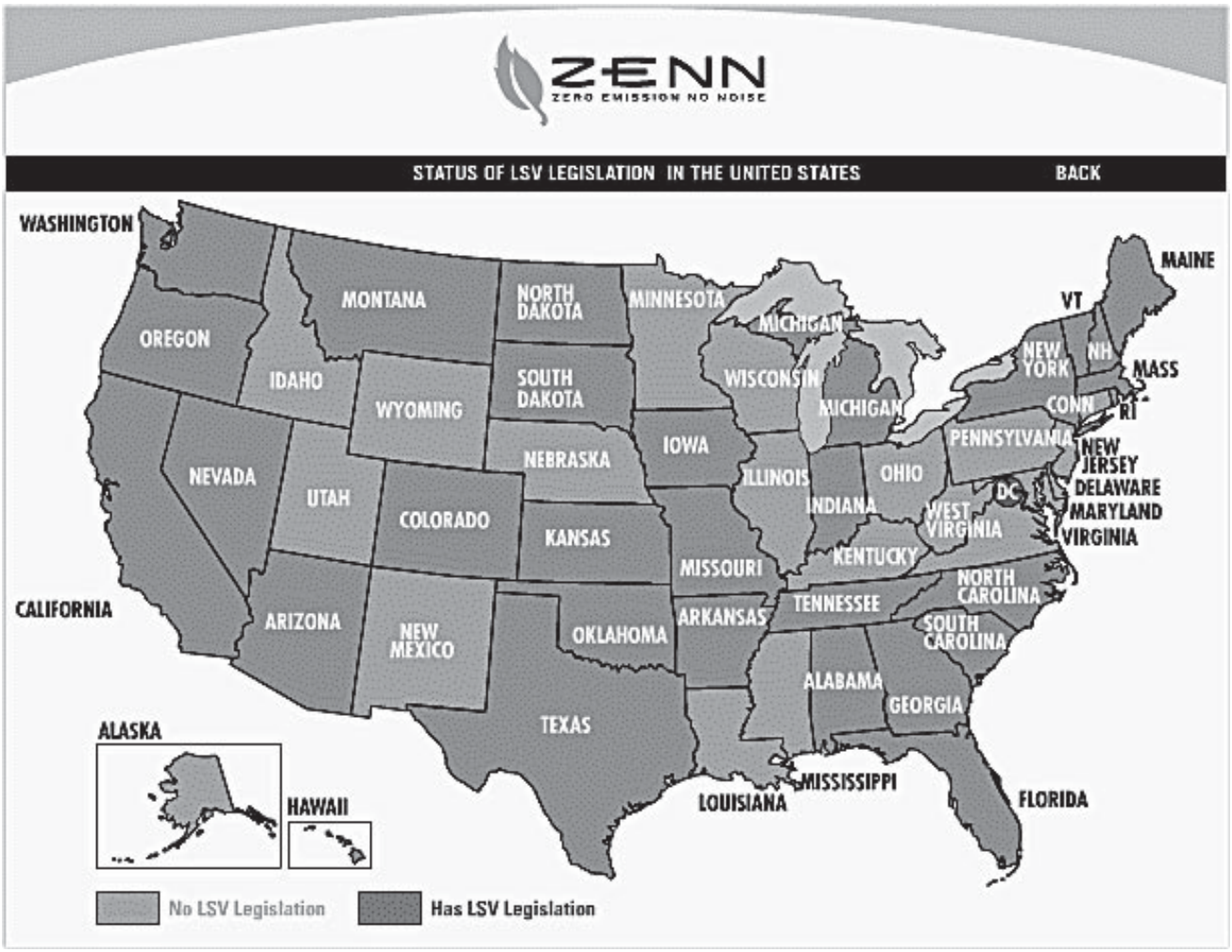
We very much look forward to having you with us this year!

Sincerely,
Nancy Hazard
Director, Tour de Sol
Anissa Sanborn
Transportation Event Coord.
David Knowles
Logistics Coordinator
Northeast Sustainable Energy Association
413-774-6051

http://www.TourDeSol.org



## WHERE LSV / nEV VEHICLES ARE LEGALIZED




*Map of where LSV/nEV vehicles have special requirements and acceptance.*
http://feelgoodcars.com/availability/availability_usa.html

*Lineup of EVs (and one hybrid) and owners who attended the EAA Annual Meeting in Palo Alto, CA, USA*

*By Jim Stack, PEAA*

Here's some information on the electric boat races being done here in Phoenix by area high schools. Our Phoenix EAA will be the official sponsor of the final day giving out over 2,000 dollars in prizes. They will name the final day May 8th,for our club. We will have our members displaying our car during the EVents. This EVent combines electric motors, controllers, and lead-acid batteries at a total of 24-vdc in a boat. They can only charge from their solar PV panels.

I have some pictures from the Jan 31st trail runs; there will also be more test runs on Feb 21st with the big finals on May 6 thru 8, 2004. Below are some of the details from their web site. They compete on Tempe Town Lake that only allows no polluting boats like electric, paddle and sailboats. They have electric boats for the public to rent too.

We are all very involved with Sam Demarco and his brother helping one of the schools and I have been helping a different school.

http://www.srpnet.com/environment/spectacular/default.asp

## SRP Solar Spectacular 2004

Since 1903, SRP has made extraordinary efforts to preserve and protect Arizona's natural resources. Today, we continue our centennial heritage of environmental leadership by offering a diversified portfolio of renewable energy technologies and forging powerful earth-friendly partnerships within the community.

Through its partnership with Enviro-Tech, SRP awards grants up to $3,000 so high school teams can apply theory to a hands-on project, building boats powered by solar technology.

The program culminates with the Solar Spectacular competition at Tempe Town Lake, where students test their engineering skills after researching, purchasing and installing photovoltaic equipment on one-person boats.

## How the competition works

Participating teams receive a technical manual, competition rulebook, and the materials to build a boat hull. Teams attend a hull-building workshop and a technical seminar, and receive personal mentoring from technical advisors. Each team receives ongoing communication and support from SRP to help the students successfully complete a functional boat.

Schools can earn points and receive awards in the following categories:

***Progress reports:*** All teams will be given a standard format for reporting progress at regular intervals in advance of the competition.

***Attendance at required seminars:*** Teams earn points for attendance and performance at required seminars in advance of the competition.

***Qualifying:*** Each team will test their boat on the water prior to other competitive events. Qualifying will be used to test safety, seaworthiness, handling, speed and maneuverability of each craft.

***Sprint:*** Teams will compete in classes over a 200-meter straightaway course. The sprint event will not require teams to carry solar arrays on their boats.

***Endurance:*** Teams will travel simultaneously around a closed course not exceeding 2 kilometers in length. The team that completes the most laps around the course in the specified time will win. All boats must carry photo-voltaic cells.

## Find out more

Stay up-to-date with 2004 Solar Spectacular by checking this site regularly. Also, be sure to read the latest editions of the Solar Spectacular newsletter. To view the newsletters, you will need Adobe Acrobat Reader if you don't have it. It is free and you will only need to download it once. Then, return to this page to view newsletters. January 2004, November 2003, October 2003

If you have questions about the 2004 SRP Solar Spectacular, please contact:

Darrell Sheppard
SRP Community Outreach
PAB 332, P.O. Box 52025
Phoenix, AZ 85072-2025
(602) 236-2533, dlsheppa@srpnet.com.

## ZILLA CONTROLLER EXPLAINED

*By John 'Plasma Boy' Wayland, NEDRA and OEVA Member*

***Question:** The picture on the Zilla controllers is a T-Rex Dinosaur?*

No, it's not a T-Rex Dinosaur. Catch a clue.... as in 'Zilla…as in Godzilla…as in the fictional Japanese monster.... as in 'Godzilla vs Mothra (a giant moth monster)!

As the creator of both names for both of these controllers, take note....

**(1)** I named Oat's incredibly powerful controller line 'Godzilla', after a wild ride in White Zombie with the none other than the Luke Skywalker clone, the free spirit of Palo Alto, Mr. Ebenhosersluzenhouser at the wheel! Oat had just scared the crap out of me, when he nailed the throttle of my quick EV in the middle of Glisan Street (traffic all around us) and his mighty new controller (painted an ugly brick red-brown) had sent huge amps to the electric motor under the hood.

The car did a 180 with smoke peeling off the rear tires as all the blood drained from my face and my sphincters tightened.... around us, horrified commuters had steered clear of us as we could see their looks of shock and disgust through our smokey haze. I proclaimed, "That's not a controller under the hood, it's a monster!!... it's.... it's... Godzilla!!! Right then and there, Oat's stupid idea to call his insanely powerful controller 'The Brick' vanished, and the name of Godzilla was born (uh, well.... borrowed).

Subsequent to that day, my assignment was to research the true color of Godzilla, so Cheryl and I cruised all the local comic book joints and collected as many Godzilla rags as possible, opening their wonderfully illustrated pages and comparing the varying shades of green-to-blue green color of Godzilla's frame. We chose the color for the Godzilla line of controllers, showed it to Oat, then had the first generation controllers powder-coated right here in Portland. Oat was a bit concerned over using the full Godzilla name, so it was eventually shortened to Zilla.

**(2)** When DCP's Damon Crocket and I were scheming together over his new high voltage version of the Raptor (named by Rod Wilde), a controller that was to be first installed along with the first prototypes of the Optima group 31's in my 192V Datsun minitruck 'Baby Blue', I beat Rod to the punch in the 'name that controller' game, and suggested 'T-Rex' as a worthy prehistoric beast to battle Godzilla. At the time, there was a healthy, but respectful controller war between Damon and Oat.

The T-Rex's were not super reliable and often fried when high voltage and high current were applied at the same time. Damon did his best to support and repair the flood of T-Rexes coming back to him; that against the Godzilla, were no match. He eventually shut down production of the T-Rex and just made the up-to-156V Raptors in 450, 600, and 1200 amp versions.

**Interesting personal notes...**

My early version Raptor 1200, one that the Madman had a lot to do with, has been flawless in Blue Meanie, for something like 5 years now. It cranks out incredible power and is a wonderful controller. That said, it's soon to be replaced when I finally get back to the Blue Meanie upgrade soon, with Oat's compact Z 1K Zilla, as the Raptor cant go much higher than 156V, and at 204V, the Zilla is the answer.

The first-out-the-door T-Rex is still going strong under the hood of Baby Blue, now owned by my friend John Tuss here in Portland. It gets driven nearly every day, and the controller has never given any problems. Note though, that it's only been subjected to 192V, nothing higher, and, with John's relaxed driving style, usually never gets called on to deliver anything more than 300 amps or so.

Godzilla #3 is still performing well, and other than a recent tune up, has never, ever, failed.... ever! I'd like to say that his controller has been tortured under Plasma Boy duty, but the truth is, everything 'behind' the controller has been tortured...snapped-off transmission input shafts, mangled drivelines, smoked clutches, twisted-off axles, vaporized rear end gears, blown batteries, melted cables, welded contactors, melted motors.... I could go on, but through it all at 1400 amps and up to 336V, the controller has been the one thing I can't seem to break!

Those new to the EV since, say, post nineties, should take note about Oat's expertise in controller design and manufacture.

In an era when the standard conversion type EV motor controllers were the Curtis 1221B, the Auburn Kodiak, and a few other 400-600 amp, 120-156V models by various makers, Oat blew in with no college degree or other documents to wear on his shoulder (high school was too boring for him) and made a controller capable of triple the amperage power levels and able of running at before unheard of voltages up 336V! Where it's proven difficult for major manufacturers with rooms full of engineers to make a controller that runs at 120V and 400 amps 'and' stays reliable.... in between trips to Burning Man to hang with the artsy-fartsy crowd, Oat builds a controller that blows them all into the bushes!

Keep in mind, that when Oat talks of the three controllers that had a problem, one was hooked up backwards by college students, one was at the cruel hands of Crazy Rod (run at super duty loads without its cooling system...tortured), and one was running the world's quickest EV...just a bit of a load test! Out of interest, Dennis caught his hair on fire when the controller, mounted right behind his head, ignited the wind-fluffed Berube's hairball! How Oat could tell the story of that blown controller and 'not' include the famous flaming Berube', is beyond me!

The Zilla controllers power up the most of the world's record setting, quickest EVs with over a half megawatt of steady power. They do it without resorting to goofy squeal inducing frequencies, they do it reliably, and they do it while other controller manufacturers play catch up to a man that can be found in a seedy unground garage racing grocery carts powered by electric motors with flames shooting out the back, cruis'n through the desert with a couple of au'natural ladies in a 12 foot high electric tricycle he just threw together, flying around in a Frankenstein s-t-r-e-t-c-h-e-d VW bus with a 780 watt sound system pump'n, or popping wheelies in a twin motor electric couch down College Ave. in Palo Alto!

# Café Electric llc

## Home of the Zilla
## Because the answer is "*More Power*" for your Electric Vehicle

NEW **The Zilla Motor Controller now available in six ratings.** NEW

New lower cost 1000 Amp version is in beta test and low voltage models too.

Z1K 1000 Amps

Z2K 2000 Amps

The new Z2K Zilla Motor controller with Hairball interface and Precharger is now available. Check out the Zilla controller package page.

Z1K 1000 Amps

Hairball Interface

Precharger

### Success Stories:

Here are links to some vehicles that are using one or more of the Zilla motor controllers:

http://www.CurrentEliminator.net/
The World's QUICKEST Electric Vehicle!**

http://www.killacycle.com/
The World's QUICKEST Electric Motorcycle!**

http://www.electricdragster.com/
Jim Ludiker's electric powered Dragster**

http://www.go-ev.com/
NetGains' Bad Amplitude

John Wayland's White Zombie
The Datsun 1200 drag race EV **

http://www.eas.asu.edu/~horizon/
ASU's Formula Lightning electric racecar

http://www.commutercars.com/
Commutercars' first prototype, the Tango **

Bob Schneevies' "Snowhite" electric racecar. This is for sale.

http://evcl.com/914/
Otmar's own electric 914, built for testing Zillas controllers.**

** *Vehicles with NEDRA World Record Holders*
http://www.nedra.com/record_holders.html

NEDRA
National Electric Drag Racing Association

## 2004 EAA FELLOW AWARD: Bruce Parmenter

*By Terry Wilson, EAA Historian*

Of all the things Bruce has done for the EAA, the EV movement, and the EAA Members, the thing he is most well known for is; EAA Webmaster. In my experience the "EV Angel" is easily the most well known person in the EAA. Whether corresponding with Members in other Chapters, or with EV enthusiasts in other countries, Bruce is the person they usually mention.

He fought for an EAA on-line presence when the Board was not interested. He has created Chapter websites for a number of Chapters.

He served as a National Director, and as EAA National Technology Director and Webmaster. Bruce has attended EV Symposiums, CARB meetings, and written articles for CE. He also started SJEAANEWS-on line. He has been the Editor of the EV Discussion List since 1992. Bruce has also started on line discussion groups for Hybrids and Fool cell, oops! I mean Fuel Cells.

Bruce Parmenter has been involved with EV's since 1975, when he rode his electric "Aurenthetic" mini-bike to college classes each day. Bruce has gone to exceptional lengths to promote EV's. He's experimented with multiple Chargers in parallel, trying nearly all chargers available, at considerable cost to him.

He has pushed the limits of multiple charging. He has traveled 6 times, round trip from San Jose, California to Sacramento California a distance I believe of roughly 150 miles round trip.

Bruce has served as SJEAA Activities Director, and Webmaster. He has exhibited his EV Blazer frequently at EVents. He started a computer recycling system, taking donated computers and selling them at low cost usually to EAA Members, and donating all profits to the SJEAA Chapter. He also has repaired Members computers for little or no money! He also has trained Members to use computers, for free!

## 2004 KEITH CROCK TECHNICAL AWARD: Otmar Ebenhoech

*By Ron Freud, EAA Board Chairman*

Otmar has been a controller wizard for many years. He has gone through countless design iterations and finally ended with the 'Zilla 2000, capable of controlling an amazing 650,000 watts of DC power. (That's a lot of horsepower).

Initially he ran a business called EVCL, this was targeted at mostly the golf cart market (since it is much larger.) That ended and he started Cafe Electric to develop the new on-road version of the 'zilla.

A tireless worker, modest, (he often acts as if it's nothing at all) - he works at all hours of the day when most others are either asleep or out having fun. Ya' gotta' respect he passion and his amazing ability to teach himself whatever he needs to know!

The electric vehicle community is fortunate to have someone like him focused on what is clearly important to us - the brains of an EV - the motor controller.

I won't go into detail about the controller family he is "raising" (see his website <http://cafeelectric.com>) but it is truly a 21st century marvel that has yet to be emulated by any other firm, worldwide - to the best of my knowledge.

To give you an idea of the kind of person he is, always helpful and enthusiastic, ready to "fix things" - a recent evening at a local public charging facility found him dismayed at the dead state of an Avcon charging station. He pulled out some tools and immediately began taking the thing apart! After nearly an hour in a dark parking lot in the middle of the night, the problem was traced to the locked building. No fix to be had tonight.

He is one of those "reference people" you could call up in the middle of the night and ask any technical EV question.

## 2004 EAA FELLOW AWARD: Tom Dowling

*By Ron Freud, EAA Board Chairman*

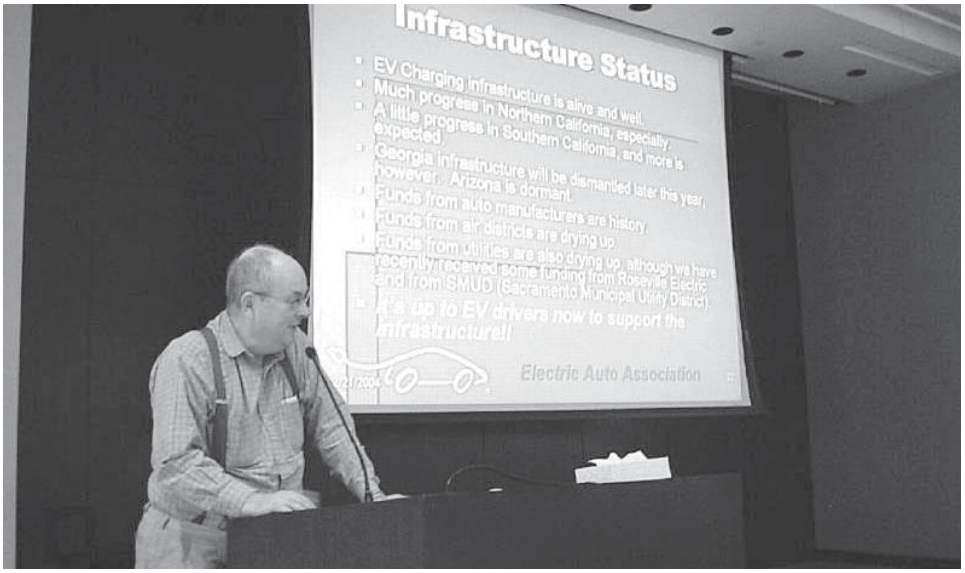
Tom Dowling is one of those "been there done that people. He has single-handedly made a more visible impact on the EV-driving community than anyone I can think of. I believe he started driving EV's in the mid-1990's ranging from the GM EV-1 and the GM S-10 Electric Pick-up, to his current two Toyota RAV4's. He networks really well in the community, and, just to illustrate by example the kind of "huge heart" he has.

Not too long ago he assisted another EV'er who needed his own leased S-10 serviced. Tom suggested a visit to an experienced and capable mechanic in the Sacramento area for some "battery work". The local driver took a day, drove up from the Bay Area only to experience a "range surprise" enroute, typical of the NiMH battery equipped GM products. This is where the State of Charge (SoC) indicator drops like a rock in front of your ever-widening eyes! By phone, the driver had to be 'shepherded' into a nearby public charging facility to complete his out-bound trip. Tom then hops into his own EV-1 to spend the rest of his day providing company and shuttling the otherwise helpless EV'er around so he could accomplish the necessary servicing.

Tom has helped or directly been involved in installing a large percentage of the Northern California public EV charging infrastructure. In the past, he advocated at Bay Area Air Quality Management District meetings, spoken at CARB hearings, and kept an eye on the large and small paddle inductive chargers through repeated visits. Most recently, he is solely responsible for successfully negotiating the deal between the EAA and the United States Postal Service for the redeployment of their no longer needed Avcon conductive charging stations. That, in itself, was no small task!

With the help of another former EV-1 driver, he still maintains the EV Charger News website http://evchargernews.com, an invaluable up-to-date reference for California, Arizona, and Georgia drivers.
He has taken over the RAV4 discussion forum, maintaining that growing and active mailing list as well.


*Chairman Ron Freund opens up the EAA Annual meeting*




*Tom Dowling presents updates to the EV Infrastructure status*

*Long-time EAA Webmaster Bruce Parmenter receives recognition with his award*

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**Charlie Garlow** - *Junior Solar Sprints*
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**Bruce Parmenter -** *EAA Technology*
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**Terry Wilson** - *Historian, Awards*
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**EAA Board contact:**
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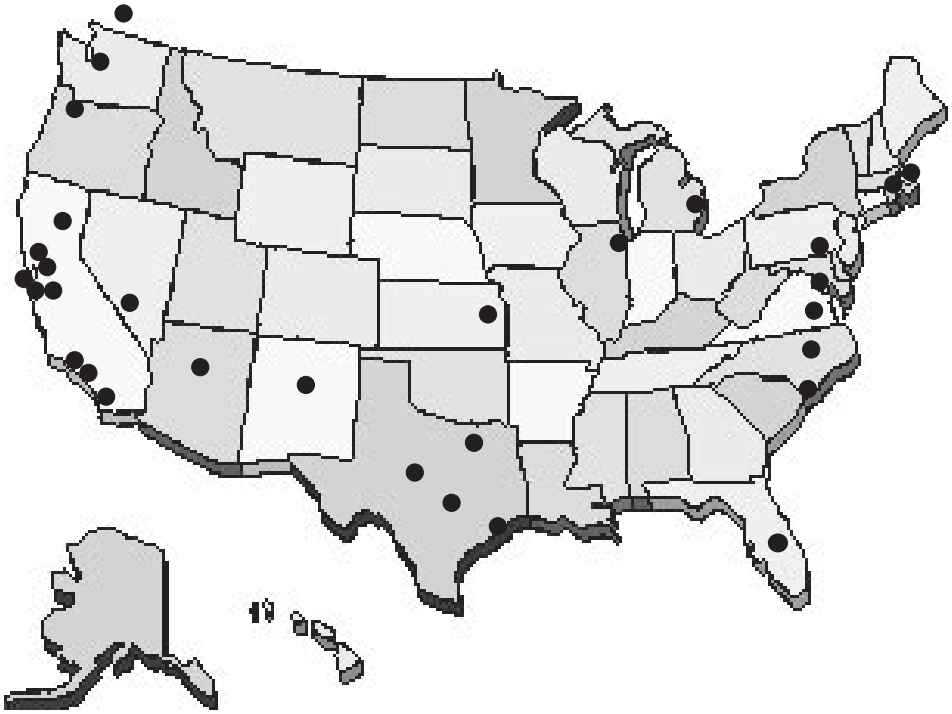

### CANADA

**VANCOUVER EVA (VEVA)**
*Web Site:* http://www.veva.bc.ca/
*Contact:* Haakon MacCallum,1-604-258-9005, info@veva.bc.ca
*Mailings:* P.O. Box 3456, Vancouver, BC V6B3Y4, Canada
*Meetings:* 3rd Wed./month, 7:30 pm
*Location:* 3750 Kitchener St., BC Transit

### UNITED STATES

### ARIZONA

**PHOENIX EAA (PEAA)**
*Web Site:* http://www.phoenixeaa.com/
*Contact:* Sam DiMarco, 1-480-948-0719, voltek_2000@yahoo.com
*Mailing:* PO Box 6465, Scottsdale, AZ 85258-6465, USA
*Meetings:* 4th Sat./month, 9:00 am
*Location:* Varies, see Web Site for details.

### CALIFORNIA

**CHICO EAA (CEAA)**
*Web Site:* http://geocities.com/chicoeaa/
*Contact:* Chuck Alldrin, 1-530-899-1835, calldrin@sunset.net
*Mailing:* 39 Lakewood Way, Chico, CA 95926-1555, USA
*Meetings:* 2th Sat./month, 10:00 am.
*Location:* 1350 East 9th St, Chico, CA

**EAST (SF) BAY EAA (EBEAA)**
*Web Site:* http://geocities.com/ebeaa/
*Contact:* Ed Thorpe, 1-510-864-0662, eaa-contact@excite.com
*Mailing:* 2 Smith Ct., Alameda, CA 94502-7786, USA
*Meetings:* 4th Sat./month, 10:00 am.
*Location:* 1515 Santa Clara Ave, Alameda, CA

**LOS ANGELES EAA (LAEAA)**
*Contact:* Louis Weiss, 1-323-935-2690, warbucks@attbi.com
*Mailing:* 1811 Hi Point St., Los Angeles, CA 90035-4621, USA
*Meetings:* 1st Sat./month, 10:00 am
*Location:* 1200 E California Blvd, Pasadena, CA

**NORTH BAY EAA (NBEAA)**
*Web Site:* http://www.nbeaa.org
*Contact:* Nick Carter, 1-707-573-9361, nick@npcimaging.com
*Mailing:* 2228 Magowan Drive, Santa Rosa, CA 95405
*Meetings:* 2nd Sat./month, 10:00 am-12 noon
*Location:* See web site or contact for meeting location.

**SAN DIEGO EVA (SDEVA)**
*Web Site:* http://home.att.net/~NCSDCA/EVAoSD/
*Contact:* Chris Jones, 1-619-913-6030, NCSDCA@WorldNet.ATT.net
*Mailing:* 315 South Coast Highway 101, Encinitas, CA 92024-3543, USA
*Meetings:* 4th Tues./month, 7:00 pm
*Location:* 2080 Pan American Plaza, Balboa Park, San Diego

**SF PENINSULA EAA (SFPEAA)**
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*Contact:* Bill Carroll, 1-650-589-2491, billcarroll@eaaev.org
*Mailing:* 160 Ramona Ave., San Francisco, CA 94114-2736, USA
*Meetings:* 1st Sat./month, 10:00 am
*Location:* 601 Grand Ave, South SF, CA

**SAN JOSE EAA (SJEAA)**
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*Meetings:* 2nd Sat./month, 10:00 am
*Location:* 2350 Cunningham Ave., San Jose, CA

**SILICON VALLEY EAA (SVEAA)**
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*Mailing:* 4189 Baker Ave., Palo Alto, CA 94306-3908, USA
*Meetings:* 3rd Sat./month, 10:00 am
*Location:* 3000 Hanover St., Palo Alto, CA

**VENTURA COUNTY EAA (VCEAA)**
*Web Site:* http://geocities.com/vceaa/
*Contact:* Bruce Trucker, 805-495-1026, tuckerb2@adelphia.net
*Mailing:* 283 Bethany Court, Thousand Oaks, CA 91360-2013 ,USA
*Meetings:* Call or email for location/meetings.

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**FLORIDA EAA (FLEAA)**
*Contact:* Larry Wexler, 407-292-4844, larrylightnino@aol.com
*Meetings:* in Kissimmee, FL

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**MID AMERICA EAA (MAEAA)**
*Web Site:* http://maeaa.org/
*Contact:* Mike Chancey, 1-816-822-8079, eaa@maeaa.org
*Mailing:* 1700 E. 80th St., Kansas City, MO 64131-2361, USA
*Meetings:* 2nd Sat./month, 1:30 pm
*Location:* See web site for details.

**ILLINOIS**

**FOX VALLEY EAA (FVEAA)**
*Web Site:* http://www.fveaa.org/
*Contact:* Bill Shafer, 1-708-771-5202, assessorbill@cs.com
*Mailing:* 1522 Clinton Place River Forest, IL 60302-1208, USA
*Meetings:* 3rd Fri./month 7:30 pm
*Location:* 2000 Fifth Ave., River Grove, IL

**MASSACHUSETTS**

**NEW ENGLAND EAA (NEEAA)**
*Web Site:* http:/neeaa.org/
*Contact:* Tony Ascrizzi, 1-508-799-5977, tonyascrizzi@juno.com
*Mailing:* 34 Paine Street, Worcester, MA 01605-3315, USA
*Meetings:* 2nd Sat./month, 2:00 pm
*Location:* Call or email for meeting location.

**PIONEER VALLEY EAA (PVEAA)**
*Web Site:* http://geocities.com/pveaa/
*Contact:* Karen Jones, 1-413-367-9585, pveaa@hotmail.com
*Mailing:* P.O. Box 153, Amherst, MA 01004-0153 USA
*Meetings:* 3rd Sat./month, 2:00 pm
*Location:* 43 Amity Street, Amhurst, MA.

**MICHIGAN**

**DMC-EAA DETROIT MOTORCITY CHAPTER (DMCEAA)**
*Web Site:* http://geocities.com/detroit_eaa/
*Contact:* Richard Sands, 1-734-281-4087, rsands01@comcast.net
*Mailing:* 13162 Fordline St, Southgate, MI 48195-2435, USA
*Meetings:* Call or email for location/meetings.

**NEVADA**

**LAS VEGAS EVA (LVEAA)**
*Web Site:* http://www.lveva.org/
*Contact:* William Kuehl, 1-702-645-2132, bill2k2000@yahoo.com
*Mailing:* 4504 W. Alexander Rd., N. Las Vegas, NV 89115-2489, USA
*Meetings:* 2nd Sat./month, 10:00 am
*Location:* 1401 E. Flamingo Rd, Las Vegas, NV

**NEW MEXICO**

**ALBUQUERQUE EAA (AWAA)**
*Web Site:* http://abqev.org/
*Contact:* Tom Stockebrand, 1-505-856-1412, info@abqev.org
*Mailing:* 1013 Tramway Ln NE, Albuquerque, NM 87122-1316, USA
*Meetings:* 1st Tues./month, 7:00 pm
*Location:* 6810 Menaul NE, Albuquerque, NM

**NORTH CAROLINA**

**COASTAL CAROLINAS (EAACC)**
*Contact:* Jayne Howard, 1-910-457-4383, EAAofCC@aol.com
*Mailing:* 4805 E. Southport Supply Rd., Hwy 211, Southport, NC 28461-8741, USA
*Meetings:* Varies, call for details.
*Location:* 4805 E. Southport Supply Rd., Hwy 211, Southport, NC

**TRIANGLE EAA (TEAA)**
*Web Site:* http://www.rtpnet.org/teaa/
*Contact:* Ken Dulaney, 1-919-461-1241, teaa@rtpnet.org
*Mailing:* 202 Whitehall Way, Cary, NC 27511-4825, USA
*Meetings:* 3rd Tues./month, 5:30 pm
*Location:* Varies, call for details.

**OREGON**

**OREGON EVA (OEVA)**
*Web Site:* http://www.oeva.org/
*Contact:* Ralph Merwin, prizmev@yahoo.com
*Mailing:* 2905 NE 29th Ave., Portland, OR 97212-3558, USA
*Meetings:* 2nd Thur./month, 7:30 pm
*Location:* SW Salmon & 1st St, Portland, OR

**PENNSYLVANIA**

**EASTERN EV CLUB (EEVC)**
*Web Site:* http://members.aol.com/easternev/
*Contact:* Peter Cleaveland, 1-610-828-7630, easternev@aol.com
*Mailing:* P.O. Box 717, Valley Forge, PA, 19482-0717, USA
*Meetings:* 2nd Wed./month, 7:00 pm
*Location:* 201 E Germantown Pk, Plymouth, PA

**TEXAS**

**AUSTIN AREA EAA (AAEAA)**
*Web Site:* http://www.austinev.org/
*Contact:* Aaron Choate, 1-512-453-2890, info@austinev.org
*Mailing:* PO Box 49153, Austin, TX 78765, USA
*Meetings:* Call or email for location/meetings.

**HOUSTON EAA (HEAA)**
*Web Site:* http://www.heaa.org/
*Contact:* Dale Brooks, 1-713-729-8668, brooksdale@usa.net
*Mailing:* 8541 Hatton St., Houston, TX 77025-3807, USA
*Meetings:* 3rd Thurs./month, 6:30 pm
*Location:* 3015 Richmond Ave., Houston, TX

**NORTH TEXAS EAA (NTEAA)**
*Web Site:* http://www.geocities.com/nteaa/
*Contact:* Paul Schaffer, 1-972-437-1584, pshf@hotmail.com
*Mailing:* 430 Ridge Crest, Richardson, TX 75080-2532, USA
*Meetings:* Varies, call/email for details.

**VIRGINIA**

**CENTRAL VIRGINIA EAA (CVEAA)**
*Contact:* Ernest Moore, 1-804-271-6411, ernie_moore@yahoo.com
*Mailing:* 4600 Melody Ct., Richmond, VA 23234-3602, USA
*Meetings:* 3rd Wed./month, Call for details.
*Location:* Westwood Ave., Richmond, VA.

**WASHINGTON**

**SEATTLE EVA (SEVA)**
*Web Site:* http://www.seattleeva.org/
*Contact:* Steven Lough, 1-206-524-1351, slough1@mindspring.com
*Mailing:* 6021 32nd Ave. NE, Seattle, WA 98115-7230, USA
*Meetings:* 2nd Tues./month, 7:00 pm
*Location:* See website, call for details.

**WASHINGTON D.C.**

**EVA OF WASHINGTON DC (EVA/DC)**
*Web Site:* http://www.evadc.org/
*Contact:* David Goldstein, 1-301-869-4954, goldie.ev1@juno.com
*Mailing:* 9140 Centerway Rd., Gaitherburg, MD 20879-1882, USA
*Meetings:* 2nd or 3rd Tues./month, 7:00 pm
*Location:* Building 31-C, 6th, Bethesda, MD.

*Listing updated, verified and current as of 2/28/04. Please check main web page for any changes in current listing. The Electric Auto Association is a 501 (c)(3) nonprofit organization.*

## Looking for an EV to meet your driving needs?

*If you are trying to decide if an EV is right for you, or are not sure what kind of EV to choose, here are some guidelines.*

The first thing to do is to determine how far you really drive each day. It's easy to do but most people greatly overestimate how far they drive. If your car has a trip meter then just set it before starting out in the morning then check how far you have driven when you get home at night. If your car doesn't have a trip meter just note the mileage from the odometer. Do this for a week or so and look at the maximum mileage that you did. That will give you a good idea of the reliable range your EV will need.

Now look up the range in the table below and see what type of EV will be best for you. For example if your daily commute is 5 miles then an electric bike would work for you. You could also select any vehicle, that other than the Zappy style scooter, as 5 miles is within the range of all these vehicles. Also remember that if you can charge at work during the day then you can select an EV with half your required range.

| | |
|---|---|
| **Less than 3 Miles** | Zappy style scooter |
| **Less than 8 Miles** | Electric Bike |
| **Less than 15 Miles** | Electric motor bikes and scooters - Lectra, Voloci, Lepton, Sol Gato, Swap |
| **Less than 20 Miles** | NEV if you travel on surface streets with speed less than 25mph - GEM, Th!nk Neighbor, Columbia ParCar, Planet Electric, Humdinger<br><br>Electric three wheelers - Sparrow, Gizmo<br>Electric Car Conversions usually operate in this range but check carefully before you buy |
| **Less than 35 Miles** | City EV - Th!nk City<br>Full Sized EV - PbA Ford Ranger, Solectria Force |
| **Less than 70 Miles** | Full sized EV - RAV4 EV |
| **Less than 100 Miles** | Aerodynamic full sized EV - EV1 |
| **Greater than 100 Miles** | Hybrid Electric Vehicle (not an EV) - Toyota Prius, Honda Civic HEV, Honda Insight |

I have tried to be somewhat conservative on the numbers above because there are many factors that effect EV range such as driving in hilly areas, the ambient temperature, or the way that you drive. The numbers above should be taken as a guideline. I believe these ranges will give a more reliable idea for daily operation than relying on the often overblown range claims of the various manufacturers.

Information taken from the website: www.evfinder.com

## Sources - Used EVs-4-Sale:

**EAA Main Links Page**
http://www.eaaev.org/eaaevsforsale.html

**Silicon Valley Chapter EAA**
http://www.sveaa.org/

**Innevations**
http://www.innevations.com/used-evs.html

**Eco-Motion Electric Cars**
http://www.halcyon.com/slough/contributions.html

**Phoenix Chapter EAA**
http://phoenixeaa.com/

**EVFinder**
http://www.evfinder.com

**EV Tradin' Post**
http://www.austinev.org/evalbum/geobook.html

**EVA/DC**
http://www.evadc.org/forsale.html

**Triangle EAA**
http://www.rtpnet.org/~teaa/forsale.html

Check out these websites and the various EAA Chapter websites for new and used EV vehicles, production and conversions, and EV parts.

## EV Charging Maps & Info:

**EV Charger list**
Covers Arizona, California and Georgia.
*Web Site:* http://evchargernews.com/

**Ottawa Canada Charging Locations**
*Web Site:* http://www.econogics.com/ev/chargloc.htm

**Additional Canada Charging Locations**
*Web Site:* http://www.ve-montreal2000.com/site/en/vebornes/Cartebornes.htm

**How to Install Electric Vehicle Charging**
*Web Site:* http://www.eaaev.org/eaaevcharging.html

## EAA MERCHANDISE

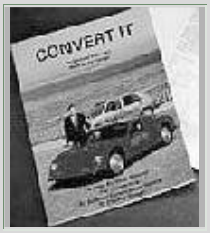
### -- General Items --

| | | | | |
|---|---|---|---|---|
|   | *License Plate Holder, black plastic frame, white lettering on visible green.* | LICPH1 | $10.00 | |
| License Plate | *Motorcycle size, only in metal & black or chrome. (Special order, need additional 6 weeks.)* | Black: LICPH2-B Chrome: LICPH2-C | $14.00 | |
|   | *Embroidered Sew-On Patch, white. (Special order, allow an additional 3 weeks.)* | PATCH1 | $ 9.00 | |
|   | *Embroidered Sew-On Patch, green. (Special order, allow an additional 3 weeks.)* | PATCH2 | $ 9.00 | |
|  | *Embroidered Bucket Hat, comes in: small/medium & large/xlarge.* | S/M: DCP01-SM L/XL: DCP01-LXL | $25.00 | |
|  | *Ceramic Coffee Mug.* | MUG003 | $ 5.50 | |
|  | *Insulated Car Coffee Mug.* | MUG02 | $ 6.50 | |
|  | *Embroidered Polo Shirt (Forest or navy S,M,L,XL,XXL), 10 weeks for all colors other than Forest.* | SHIRT01-F-S SHIRT01-F-M SHIRT01-F-L SHIRT01-F-XL SHIRT01-F-XXL Same for SHIRT01-N-… | $40.00 | |
|  | *EAA Car Window Shade.* | SS001 | $ 8.00 | |
|   | *EAA Bumper Sticker #1 (10.5"x3.75").* | BS800 | $ 2.00 | |
|   | *EAA Bumper Sticker #2 "The Switch is on"(15"x3.75")* | BS002 | $ 2.00 | |

### -- EV Buyers Guides --

| | | | | |
|---|---|---|---|---|
|   | **Electrifying Times Preview 2004 *Electrifying Times Preview 2000 *1997 EV Buyers Guide *1996 EV Buyers Guide *1995 EV Buyers Guide* | ET2002 ET1999 BG1997 BG1996 BG1995 | $ 5.95 | |

### -- Literature --

| | | | | |
|---|---|---|---|---|
|   | *Convert-It EV conversion Book* | CONV01 | $24.95 | |
|   | *KTA Electric Vehicle Kits & Component Parts Catalog* | CATAL1 | $5.00 | |
| | *Window Literature Holder (light plastic)* | WL002 | $15.00 | |
| Indicate Month/Year and/or Vol #, back 20 yrs. | *Back issues of CE (Current EVents) magazine* | CE001 | $ 3.00 | |

### -- Special --

| | | | | |
|---|---|---|---|---|
|  | *AVCON to 14-50 adapter kit - sheet metal box, 14-50 outlet (2 hots and a ground, no neutral), for 220 VAC chargers, no 120 VAC (6weeks)* | ADAPT1 | $255.00 | |
| (fill out complete membership form on flip side of page) | ***Electric Auto Association Membership ($10 rebates to local chapter.)*** | ***6 /year of Current EVents, member voting rights*** | $39.00 | |

Shipping: USA 10%, Canada 15%, All Others 20% of subtotal
Handling $2.00 Send check (USA dollars) to:

**EAA Merchandise, 5820 Herma St, San Jose, CA 95123 USA**

# Electric Auto Association (EAA) Membership Application Form

Copy and fill out this form, attach a check or money order or use PayPal in US funds only for $39 ($42 Canada) ($45 International) payable to '**Electric Auto Association**'. You can fold this form as indicated and mail it with your payment enclosed. Use tape to seal the form before you mail it. Or send information in this form and pay through PayPal using http://eaaev.org/membership.htm.

New Member: ❑ Renewal: ❑ Country (if non-USA):_____ Date: _____

Name: _____ *email: _____

Mailing Street Address: _____ Home phone#: _____

Mailing City, State & ZIP: _____ *Work phone #: _____

*Do you ❑ own or ❑ lease an Electric Vehicle? ❑ Production ❑ Conversion ❑ Bicycle ❑ Other:_____ ❑ No

I support the _____ EAA Chapter, or please select an EAA Chapter closest to me. ❑

(*optional) All information in this application is for the exclusive use of the EAA and not be sold or given to any other organization.

(fold back ward, this will protect your personal information, placing it on the inside)

Please Identify your primary areas of interest relating to the EAA (check as many as you wish):

❑ Hobby/Builder ❑ Professional (income) ❑ Competition (Rallies, Races, Records) ❑ Owner/Driver
❑ Environmental/Gov. Regs. ❑ Social (Rallies, Shows, Dinners) ❑ New Technology & Research
❑ Promotion & Public Awareness of EVs ❑ Student or General Interest ❑ Electrathon/Bicycle/other

**The Electric Auto Association www.eaaev.org**

*'Providing free Electric Vehicle information to the public since 1967'*

The Electric Auto Association is a non-profit, 501(c)(3) for the promotion of electric vehicles. Membership includes the informative complementary EAA publication, "**Current EVents**". Donations are tax deductible. All information and statistics in this application are for the exclusive use of the EAA and is not sold or given to any other organization or company. From your membership dues, a percentage goes to the EAA Chapter you support for public Electric Vehicle promotion EVents like rallies, shows and EV rides.

(fold the bottom half under. This will now be the front of the letter. Be sure to seal it with tape)

**Return address**

_____
_____
_____

**membership@eaaev.org**

**1st Class Postage Here**

**Electric Auto Association**
**Membership Renewals**
**4189 Baker Ave.**
**Palo Alto, CA 94306-3908 USA**

## EV CONFERENCE AND EAA CHAPTER EVENTS CALENDAR

**April 2004**
**EARTHDAY EVENTS**, Everywhere
Various local celebrations of Earthday. Plenty of opportunities to participate with EVs, from display to presentations and rides.

**April 2, 2004**
**NATIONAL AFV DAY ODYSSEY,** various locations, USA
Showcasing cleaner choices in transportation. Coordinated through the National Alternative Fuels Training Consortium at West Virginia University.
*E-mail:* obyssey2004@mail.wvu.edu
*Phone:* 1-304-293-7882 *Web site:* http://www.nationalafvdayodyssey.org/

**April 2 - 3, 2004**
**EV CHALLENGE, FINAL EVENTS,** North Carolina, USA
Premere College event, sponsored by the Triangle EAA Chapter, to promote education and student exposure to EVs.
*Web Site:* http://www.rtpnet.org/ev/
*Web Site:* http://www.evchallenge.org/

**April 10, 2004**
**NESEA SPRING BREAK 2004,** Boyertown, PA, USA
Test drives, lunch tour of Boyertown Museum of Historic and Electric Vehicles.
*Web Site:* http://www.greencarclub.org

**April 19 - 24, 2004**
**INTERNATIONAL H2/FC GROUP EXHIBIT**, Hannover, Germany
The world's biggest commercial exhibition on Hydrogen + Fuel Cells, presenting their latest H2/FC developments and products.
*E-mail:* arno@fair-pr.com
*Website:* www.virtual-fair.com

**April 24, 2004**
**EBEAA EV DISPLAY AND DRIVE/RIDE RALLY,** Concord, California, USA
Annual East (SF) Bay Chapter EV distance rally and display/ride event.
*Web Site:* http://www.geocities.com/ebeaa/

**April 27 - 30, 2004**
**15TH U.S. HYDROGEN CONFERENCE AND HYDROGEN EXPO**, Los Angeles, California, USA
Annual hydrogen Conference and Expo.
*Phone:* 1-202-223-5547
*Fax:* 1-202-223-5537
*Website:* www.hydrogenconference.org

**May 2 - 5, 2004**
**10TH NATIONAL CLEAN CITIES CONFERENCE AND EXPO,** Fort Lauderdale, Florida, USA
A voluntary, locally based, government/industry partnership that mobilizes local stakeholders in order to expand the adoption of alternative fuels and alternative fuel vehicles (AFVs). Focused on sharing new technologies, research and development and to attract AFV purchasing.
*Phone:* 1-303-275-4358
*Website:* www.ccities.doe.gov

**May 21 - 25, 2004**
**2004 TOUR DE SOL,** New York to Philadelphia to Washington, DC, USA
17th annual green car show and performance rally.
*Web Site:* http://www.nesea.org/transportation/tour/

**May 22, 2004**
**NEASEA'S GREEN CAR CLUB RALLY,** Burlington, NJ, USA
For the start of the Tour de Sol
*Web Site:* http://www.greencarclub.org

**June 1-4, 2004**
**ADVANCED AUTOMOTIVE BATTERY CONFERENCE,** San Francisco, California, USA
Presentations about high-power Li Ion batteries, Ultracapacitor design and fuel cells.
*Web Site:* http://www.advancedautobat.com/

**June 4, 2004**
**REV2004!,** Vancouver, BC, Canada
Annual Vancouver Chapter EV event, with parade, EV displays, EV rides, Electrathon races and Junior Solar Sprints.
*Web Site:* http://www.veva.bc.ca/

**June 5, 2004**
**3RD EVER EAA ALL CHAPTERS CONFERENCE,** Vancouver, BC, Canada
This will be the third annual conference to bring together EAA members from different chapter and work together for reaching out and promoting the use and development of EVs. Hosted by the Vancouver EAA Chapter.
*E-mail:* chapterrelationseast@eaaev.org
*Web Site:* http://www.eaaev.org

**June 13, 2004**
**JUNIOR SOLAR SPRING NORTHEAST CHAMPIONSHIP,** Springfield, MA, USA
Over 200 middle-school students will gather at Walter Vincent Smith Muesum courtyard to compete with their model solar cars. Cars will be judged for speed, innovation, craftsmanship and technical merit. Free entry.
*Web Site:* http://www.neasea.org

**June 26, 2004**
**NEDRA POWER OF DC,** Hagerstown, Maryland, USA
This will be the 4th annual electric drag race event in the Washington, DC area.
*Web Site:* http://www.powerofdc.com/
*Web Site:* http://www.nedra.com/

**June 27 - 30, 2004**
**2004 FUTURE CAR CONGRESS**, Washington, DC, USA
Presented by the U.S. Department of Energy (DOE) and the U.S. Council for Automotive Research (USCAR) tol showcase the latest developments in automotive technologies.
*Phone:* 1-202-328-2000
*E-mail:* meetings@sae.org
*Web Site:* www.futurecarcongress.org/

**July 31, 2004**
**EV AWARENESS DAY**, Portland, Oregon, USA
Annual Portland EVA Chapter EV display event in downtown Portland.
*Web Site:* http://www.oeva.org/

**August 21, 2004**
**EBEAA EV DISPLAY AND DRIVE/RIDE RALLY**, Hayward, California, USA
East (SF) Bay Chapter EV distance rally and display/ride event.
*Web Site:* http://www.geocities.com/ebeaa/

Email information to <cenews@eaaev.org>.
EAA **Chapter** Event =
EV related **Event** =
EV related **Conference** =

ELECTRIC AUTO ASSOCIATION
2 Smith Ct, Alameda, CA 94502-7786

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