Electric Auto Association

CURRENT EVENTS

May-June 2004 Promoting the use of electric vehicles since 1967 Vol. 36 No. 5 & 6

PEACE, LOVE AND THE ART OF [ELECTRIC] SNOWMOBILING

By Monte Gisborne, EAA Member

Let me put this straight right from the beginning: I don't like snowmobiles. They're noisy, dirty, smelly, horrendously inefficient machines which create huge emissions, perhaps the worst of any of the vehicles used for recreation or otherwise. Worse, they are used almost exclusively in environmentally sensitive areas.

From some of the articles I have read, their emissions are deadly harmful to lake systems and some areas like Yosemite National Park are forced to take the bold move of banning them outright. This argument applies mainly to 2-stroke machines, but the same argument holds for 4-strokes — these machines simply cannot burn 100% of the fuel which enters into the combustion chamber. And then there's the human element — to some people, they seem to be a license to act like an idiot, 100 kph+ (60 mph) on an open lake, disturbing any peace that may exist for miles.

Oh I'm sure that there are responsible operators who will object to these comments, but no one can refute the fact that my diatribe stems mainly from the design of the machine and man's natural impulse to take things to their limits and beyond. It's just the way it is, plain and simple.

Author with nicad batteries and electric motor exposed

Tamarack Lake is an oasis in my family's life. Situated about 1-3/4 hours north of our home in Whitby, Ontario, it is a small lake, full of natural beauty and charm, smack dab in the middle of cottage country about 20 minutes south of Haliburton. The nearest town is Gooderham, a very small community perched on the 503 highway with a general store, a liquor store, a gas station, a hardware store, a few churches and very little else.

Nothing too serious has ever happened there and probably never will. If you feel an urge to know the town's goings-on, you need only visit the Truck Stop restaurant on the edge of town where the locals congregate to discuss issues and concerns such as the possibility of an asphalt plant opening in their area. For most, the environmental aspects of such an operation in their community looms large, but the reality is that the world seems to need more roads, even better ones in their area, and more local employment is necessary so a price must be paid. The people of Gooderham know that you can't have your cake and eat it too. Or can you?

Fall came a little early this last year so in early October I found myself attaching a come-along to a sturdy old pine tree and securing the other end to my ElDeBo electric deck boat and winched it ashore. But the fun we had this past summer! With grace and style, this amazing electric boat leads my family on many lazy day excursions around our little lake.

A full trip would take about 1-1/2 hours, which would usually include a mid-lake

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COVER STORY

Photos provided by Monte Gisborne

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COMMENTARY: GASOLINE BURNING ENFORCED BY BIG AUTO, OIL

By Hugh Webber

Essay submitted to the Orlando Sentinel s Friday Forum*: "How Much For Gas?"*

Editor:

How much for gas? Perhaps the question should be: "Why burn gas?" I drove a GM EV1 for four days in 2000; it was well appointed, zippy and electric-powered. The battery-driven coupe burns no petroleum and emits no pollution, accelerates from 0-30 mph in 3 seconds (0-60 in 8) and ranges over 100 miles on a full charge. It would go over 250 miles if GM put lithium batteries in it.

EVs can free us from oil dependency. Yet however I've tried, I cannot buy, lease or even rent a highway-capable electric vehicle (EV) in the United States.

Electric cars have engines with one moving part (when was the last time you had to tune up your vacuum cleaner?) EVs have no fuel injection, ignition or exhaust systems; they need no fluid-filled radiators or complex automatic transmissions. EVs charge overnight at home and drive trouble-free for less than a nickel per mile.

As a result, Big Oil and its executives in the US and state governments, along with Big Auto and its service-dependent dealerships are fighting tooth and nail to suppress EVs. They're winning; heard anything good about EVs before now?

GM is now crushing perfectly good EV1s repossessed from enthusiastic lessors, after refunding over $22,000 in attempted lease-renewal payments. According to GM itself, the EV1 is the most efficient production vehicle in history; GM's expensive, ultra-safe inductive charging system is its only drawback (installation of the $3000 charger in home garage was required before vehicle delivery,) although hundreds of free public chargers dot the Southern California test-market area.

Nissan's Altra electric vehicle (EV) miniwagon is lithium powered; it has never been offered to individuals on any terms. Honda's EV Plus sedan continues to be driven by a few lessors (who gave up warranty rights in order to keep their EVs); only 330 were ever built. Ford abruptly cancelled planned sales of its Norway-built Th!nk City EV. Toyota built the RAV4-EV and, alone among major makers, eventually actually sold a few hundred to eager California buyers.

Auto makers have also adapted or converted vehicles to battery power; Chrysler's TEVan, Ford's Ranger EV and GM's S-10 electric pickups are heavier, slower EVs with limited driving ranges.

Americans want electric vehicles: private and small-time converters have built thousands of American-made EVs, probably more than the automotive giants' combined production.

Every major-maker EV has had a waiting list of ready lessors. Buyers snapped up every RAV4-EV; it sold out within six months. Americans repeatedly express their concern for the environment, and back it up with cash: hybrid auto sales continue to outpace production.

As to pure EVs: a respected market study (in 2001) projected US EV demand, initially around 10-20,000 sales, rising to 100,000 sales yearly a few years after initial EV sales. Five years in, demand might be over a quarter-million EVs. The study concludes: "... a market awaits..."

Automakers all cited a "lack of demand" as their reason for halting EV production. They built few EVs, generally failed to promote or sell them (Saturn sales people actually steered interested people away from the GM EV1!) made difficulties and created delays for individuals trying to lease them. GM put woefully inadequate batteries into its first batch of EV1s, which had to be returned to dealerships for power-pack replacement. Thousands still signed up for a chance to pay $500 a month to lease an EV1; most never got one.

At this time, it is impossible for any American driver to obtain a highway-capable EV from any major automaker. Only 25-mph "neighborhood" EVs, golf cars, Segways and electric scooters are available to individuals in this country.

Big Auto and Big Oil have spent many millions in anti-EV lobbying, PR attacks, planted opinion pieces and slanted "studies" in order to kill state mandates for zero-emission vehicles. The Bush Administration has transferred nearly all battery- and EV-development funds to its vaunted fuel-cell program.

EV enthusiasts decry the shutdown of Federal support for existing, practical, non-oil-dependent vehicles, referring to hydrogen fuel-cell as "fool-sell" (hydrogen takes far more energy to make than one saves by burning it as fuel.) We will likely never be able to buy hydrogen-powered cars, according to many experts.

GM and Chrysler sued the State of California to avoid producing their zero-emission EVs. The Bush Administration intervened in support of the automakers. The California Air Board backed down, virtually eliminating zero-emission vehicle requirements. Several Northeastern states' mandates were tied to California's, so now there are no requirements that major automakers ever offer EVs to individual American drivers.

Tens of thousands of highway-capable EVs are on the road in Europe. India and China both produce "city" EVs (top speed: 50 mph.) Of course, none of these EVs can pass US safety standards, so they remain unavailable here...

A prototype lithium-powered sports car, the tZero (built in California,) does 0-60 mph in 3.7 seconds, ranges over 250 miles and beats all internal-combustion engine vehicles through the quarter mile. Like Tucker, that late, great automotive innovator, most small EV makers are having unusual trouble with financing, parts suppliers, safety regulations, insurance...

A good mass-produced EV might be sold at a profit for under $30,000; only about 2500 have been built by six major automakers for US (primarily fleet) use.

How much for gas? How about nothing? All we need is for the oil and automotive industries to get out of our way. We want to drive clean!

Hugh E Webber
Winter Park, FL

Hugh is a longtime EV activist.

SAGA OF CHANGING BATTERY TYPES/SIZES

By John Wayland,
OEVA & NEDRA member

Battery Specifications

Exide Select Orbital® Extreme Cycle Duty									
Part Number	Voltage	Amp Hour	Max Amp @ 5 Sec.	Max Charging Current (A)	Internal Resistance (mΩ)	Dimensions (in.)			Weight (lbs.)
						Length	Width	Height	
34XCD	12	50	1100	35A	<3	10.17	7.00	8.12	41

For an explanation of the Exide Warranty Program for the Exide Select Orbital® XCD, please call 1-800-START-IT.

Ryan Bohm wrote:
> Question: *Do the Orbitals have some sort of mounting brackets on the base? If so, how does one make the mounts to interface with these brackets (or can they be bought somewhere)?*

Yes, they do. They have a stepped-out rib molded into the case, down low near the bottom on each side. These are for use with battery clampdown brackets like so many regular gas cars and trucks use these days, as opposed to the more traditional top mount type brackets. For EV use, instead of being a helpful mounting system, these lower clamp moldings are creating additional problems to deal with.

In 'all' EV conversion projects, finding space to mount a bunch of batteries is always a tough job. A spare 1/4 inch here, or a half inch there, can mean the difference between getting all your batteries to fit, or not. Take, for instance, the Orbital® Blue Top marine version. These batteries are the easiest to stack in an EV, where the XCD model poses even more problems with its goofy protruding side posts. If the marine versions sit side by side, it is the bottom clamp molding that keeps the batteries from being able to butt tight next to one another. This creates a 3/16 inch gap between each pair of batteries set side by side, (not lengthwise). Stack four batteries next to each other then, and you've just lost 3/4 of an inch. This may not seem like much, but trust me, it is!

Here's a real life example. When we converted White Zombie over from its 336V pack of 28 small 13.5 lb. Hawkers (a 378 lb. pack), to run with the new larger 26 lb. Exide rectangular-shaped UPS style AGMs (imported for Exide from China), we had to come up with a new dual battery box configuration. Since a 26 lb. battery is roughly twice the weight of a 13.5 lb. battery, and since both the Hawkers and the Exides were rectangular shaped, it should come as no surprise that the Exides were pretty much the same shape and size as two Hawkers stacked next to each other. This made it easy then, for 14 of the 28 Exides to fit in the rear seat located aluminum battery box that used to hold all 28 of the Hawkers. For the second set of 14 batteries, we had to create space in the trunk floor area.

Up to this point, the little Datsun's stock kidney shaped sunken spare tire well had been left alone and was a hollow unused area. Marko and I thought ahead, and decided that since we had to use it for battery containment, we'd 'improve' on it by cutting it out of the car, and replacing it with a newly fabricated sunken well more suited to holding batteries than a spare tire. Gone would be the kidney shape with a non-flat floor molded to fit a tire's sidewall, and in its place would be a flat floored, larger, more battery-friendly shape.

We cut out the original tub of metal that made up the spare tire well, then cut over right up to the flanged edge of each of the car's Unibody® frame rails to get as much additional width as possible. We gained quite a bit, too. We also cut further back in the trunk floor, again right up to the car's frame, and gained a few more inches in this direction as well. Marko has turned into quite a sheet metal guy, and he built a new well with a ribbed floor for strength, and with nicely rounded lower rear corners so the finished tub would have a factory look from behind the car, instead of a shop class sharp-edged box look.

Once we had welded the new tub in place, I finished it up with some Bondo® body filler, primer paint, then white paint on the inside, and externally, painted it semi-flat black, so that the sunken tub looked like it was original equipment when we were done. It hangs down about the same, as did the original spare tire well, too. Next, Marko and I designed an aluminum battery box shaped exactly, to hold the other 14 rectangular Exide UPS style batteries. This was securely bolted to the sunken well.

Then.... that ill-fated race day proved to us, that the experiment with 728 lbs. of Chinese made UPS batteries was a failure... Hawker tough, they were not!

Next up, I decided to go with the powerful but larger and heavier Exide Orbitals, finalizing on a 216V pack that would weigh 720 lbs., pretty close to the 728 lb. pack of the imported Exide UPS batteries. With full battery sponsorship from Exide, I suddenly had a shop full of both XCD models and Blue Top marine models! It didn't take long to get totally frustrated with the XCDs and their awkward side posts that do nothing but get in the way.

But the cleaner shaped marine models seemed perfect. Eight of them easily fit into the rear seat battery box, leaving the other ten to go inside the rear well.... that's when the extra 3/16 inch space in between the batteries gave us fits.

We had jettisoned the aluminum box insert and had made up a thick aluminum bottom plate (more on this later). The exact space from side to side of the newly fabricated well is 33-3/4 inches.

In order to cram ten of the Orbital® in the sunken well, I needed to fit five of the batteries side by side, in the largest width rear portion of the well (the well is not a perfect rectangle, rather it has a stepped shape) in order to get all ten batteries in the rear. With the lower clampdown ribs still intact, 5 of the marine batteries needed 34-11/16 inches, and so they would not fit. Cutting off the ribs with a table saw made each battery 6-9/16 inches wide, instead

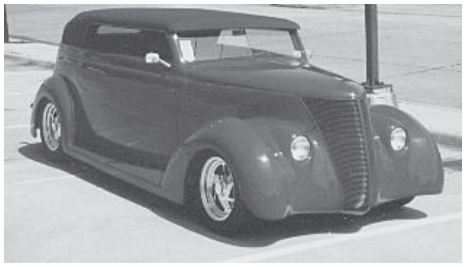
PHOENIX MOTORCARS MOVING FORWARD

Source: *Phoenix Motor Cars*
http://66.218.37.153/news.html

February 2004

First off, we have moved our corporate offices across town in Ojai. Our new address is: Phoenix Motorcars, Inc. 410 G Bryant Circle Ojai, CA 93023 Our phone number (805 646-7073) and web address (www.phoenixmotorcars.com) remain the same.

A large utility has asked us to put together a quote on a base order of three hundred pick-up trucks for their fleet. They have identified a total of twenty five hundred vehicles in their fleet that they want to be electric and have said that they want to expand the base order as quickly as we can ramp up production capacity.



'37 Phaeton

In this regard, we have entered into negotiations with Roush Industries (www.roushind.com), a Tier I automotive assembly sub-contractor to do the actual manufacturing of our vehicle design. Roush Industries also provides us with the safety engineering horsepower to assure that we are producing a safe and reliable product.

The three way discussions between the utility, Roush, and Phoenix have already reached the point of specific task assignment for each entity and those action items are being completed at this time. All involved believe that we will be able to sign final documents in April 2004, with product rolling off the assembly line by early summer. In addition, Phoenix Motorcars has been contacted by numerous local, state, and federal governmental agencies with requests for quote on other fleet requirements numbering in the hundreds of total vehicles.

We are expanding our discussions with Roush to address these requests as well. In conjunction with the talks with the utility customer, we have contacted a local commercial bank to provide Phoenix Motorcars with an operating line of credit. Release of this financing will coincide with signing of the purchase contracts likely in April - May 2004.

In the mean time, Phoenix still has ongoing overhead and expanded engineering and development expenses that exceed our current capital.

If you are so inclined or if you know someone who would be interested in our fast growing company, please contact Dana Muscato or Dan Riegert to discuss this opportunity.

December 2003

We finally completed testing and certification with California Air Resources Board (www.arb.ca.gov) in October 2003. This was a major milestone for the company, as we now will receive the clean air credits for each of our vehicles registered in California.

'37 Cabriolet

We are now ramping up production of the Taxicab order. In addition, we are in active negotiations with a Southern California utility for an order of 100 vehicles per year for three years. We have also contacted and are in project development talks with a tier I automobile assembly subcontractor to do that production.

We have received requests for quote from a number of local and state governmental agencies as well as individuals. We are offering vehicles on 90 days after receipt of order basis to those who are interested in purchasing one or more of our cars. Initially, we would want to have a beta site relationship with any early purchasers so that we can monitor performance and reliability.

'37 Ford Pickup

If you are interested in purchasing a vehicle please contact us at (805) 646-7073.

June 2003

On January 2, 2003, Phoenix Motorcars (PMI) received a purchase order for twenty electric automobiles from a taxicab company based in Sacramento, California. They ordered 1937 Ford style Phaeton 4-door touring sedans. Incidentally, the company wants a total of eighty vehicles in their fleet

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Saga of Changes *- continued from page 4*

of the regular 6-15/16 inches. So now, 5 batteries stacked side by side, equaled just 32-13/16 inches, and they all fit nicely!

We utilized the two holes between the six spiral cells of each battery, and passed two, long 5/16 bolts through them, with fender washers on top. The lower portion of the bolts thread into the thick bottom plate. This will help to securely hold the batteries.

Hope this helps....
See Ya.... John Wayland

'32 Coupe

Phoenix Motorcars *- continued from page 5*

and every indication is that they will exercise their option to order the other sixty cars upon delivery of the first twenty.

In addition, they introduced us to an outstanding battery technology, Evercel's Nickel Zinc batteries. These batteries have roughly the charge density of nickel metal hydride batteries, but cost just slightly more than lead acid bat-teries. Preliminary testing has demonstrated a range of approx. 100 -120 miles per charge. We are currently in production of the vehicles to fill this order.

In the mean time, we completed our production prototype 1937 Ford style Cabriolet and are scheduled to complete California Air Resources Board testing and certification by the end of June. This certification is required to receive the California Zero Emission Vehicle Credits for our cars.

We have also been contacted informally by several of California's largest utilities regarding quotes for several hundred vehicles per year for the next five years. We have asked them to hold off until we ramp up production and deliver the first twenty cars we have on order.

We currently plan to deliver all 20 of the vehicles on order by the end of September 2003. We expect to garner approximately 28 ZEV credits per vehicle (total of 560 credits) for these cars. It appears that we would receive these credits by the end of this year.

Overall, although slightly behind our original schedule, we are progressing nicely. We are extremely excited about our existing order and look forward to fulfilling additional requests for our products.

TOYOTA HYBRID DRIVE GOES ITALIAN

Source: *E4 Engineering* [Mar 07, 2004]

Electric motors give the Alessandro Volta concept sports car a 0-100 kph (0-60 mph) acceleration time of 4.03 seconds, and a top speed limited to 250 kph (150 mph). A 50-liter (13.2 gal) fuel tank provides an impressive range of 700 km (420 miles). Weight is 1250 kg (2750 lbs).

An exotic three-seat supercar with hybrid power and no gearbox was among the highlights of this week's Geneva Motor Show.

The Toyota Alessandro Volta, a collaboration between Italdesign-Giugiaro and Toyota, is powered by a modified power train from the Lexus RX 400h sport-utility vehicle, which goes on sale early next year.

'We wanted to create an exotic car using not a typical transmission but the power train of the future,' said design center vice-president Fabrizio Giugiaro. Italdesign-Giugiaro, which is known mainly as a styling house but has 1,100 engineering staff, designed the car's chassis and form then approached Toyota to supply the power unit.

'We have designed a very compact, high-performance car,' said Giugiaro. 'The idea was to show that if a racing shell could be combined with a clean and innovative propulsion system, there would be huge potential for creating environmentally-friendly saloon and compact cars.'

The car, which is named after the inventor of the battery, has a carbon-fiber body with a 3.3-liter V6 engine mounted between the rear wheels. But unlike in the RX 400h, the engine generates power for two 300kW (408bhp) electric motors that drive the front and rear wheels. There is no gearbox, with electronics modulating the power delivered to the wheels. All the mechanical parts lie within the car's wheelbase, improving the weight distribution.

Batteries weighing 70 kg (154 lbs) are needed to power the car, but this is compensated for by the elimination of the transmission, which would typically weigh 100-120 kg (220-264 lbs).

The car is also less than 2 m (<6'-6") wide. "As a rule, sports cars with mid-mounted engines expand lengthwise, with the engine, drive train and suspension occupying a lot of space," said Giugiaro. "With the Alessandro Volta, we have achieved the same performance, attaining better weight distribution and more comfortable seating."

Elimination of the transmission allows for a flat floor, with room for two adults and a child. Alternatively, use of drive-by-wire technology allows the steering wheel and pedal box to be slid sideways to the center of the car to make more room for the driver.

The Alessandro Volta is a running prototype, and could go into production (though without drive-by-wire) if public reaction is sufficiently favorable.

Contact: http://www.italdesign.it/dinamic/index.html

Italdesign-Giugiaro S.p.A.
Via Achille Grandi, 25
I_10024 Moncarlieri (TO), Italy

CONVERSION WORKSHOP, STEP 21 FINAL CHAPTER

By Michael P. Brown © 2004, EAA Member

Last issue, you were learning to drive your new conversion EV by making a series of small trips. By making each trip a little longer you learned how the conversion affected the handling and stopping characteristics of the vehicle. These trips also served as a gentle break-in period for the batteries. Using the batteries leads to the subject of battery maintenance, so we discussed watering and cleaning the batteries and the importance of keeping the terminals tight. Since driving an EV discharges the batteries, some time was spent on proper charging methods.

Now its time to get to the reason we built the conversion: to do as much driving as we can under electrical power. So let's look at driving an EV in the real world.

While you were making your short testing and get acquainted runs you learned when to shift gears, and how to find the "sweet spot" for the most efficient driving. You learned that sometimes you make better progress when you relax and don't push as hard, which — along with the conversion's quiet as it goes down the road — is some of the Zen-like experience of EV driving. Since we have the basics let's look some of the challenges we will find in our travels.

Hills

Climbing hills in EVs is different from doing it in a gas car, both going uphill and coming down. In a gas car, as you start to climb a hill, you need to shift down to get more power. The same thing happens in an EV, but you need to shift down much sooner. This is something you will learn by experience. After driving up a few hills, you will get the feel for when to shift down to get the power you need.

Then there's the downhill. Since conversions don't usually have regenerative braking, the car freewheels and gains speed going downhill. This can be both good and bad.

One bad part is that the car can easily exceed redline and destroy the motor by over speeding it. Say you climb up a hill in second gear, and then you start to coast down the other side. Very soon, you're doing 50 mph or more, which is too much for second gear. In a gas car, you would shift down to slow the car down. In an EV, that will only destroy the motor. Instead, you need to shift up to protect the motor.

You control your downhill speed with your brakes. This is why it's a good idea to have power-assisted brakes, and to use the beefiest metallic shoes and pads you can get for your car. For some models, there are fairly simple upgrades from drum to disk brakes, or to larger disk brakes, and these are a good idea.

It's also a good idea to brake with periodic pulses, not steady braking. Continuous braking for several minutes can overheat your brakes, especially since the conversion is heavier than it was as a gas car. If you have hills on your regular route, you need to approach them cautiously the first few times, until you see how the car handles on them. With a little practice, you can learn the most effective places to use your brakes for a few seconds.

Now for the good part about hills. When you top the crest and start down, take your foot off the throttle. You don't need any juice. Coast, and let gravity do the work. If you drive through hilly areas where traffic is light and flows freely, you can learn to use your downhill momentum from one hill to carry you up the next one. You will be amazed at how far it can take you. I have a stretch where I can coast for four miles without touching the throttle, make a ninety-degree turn, and coast another several blocks, right into a parking space at the Post Office.

Highways

Most conversions with at least 96-volt systems can achieve highway speeds. This type of driving can actually be very efficient if you find the "sweet spot" and cruise steadily at that speed.

Third gear will generally handle speeds up to about 65 mph, and fourth gear is probably good up to about 85 mph. Your best efficiency is at the top of the rpm band for a particular gear. If traffic is flowing at 60 mph, you will be more efficient in third gear than in fourth. Higher gears can give your more speed. Just be aware that it is probably costing you amps, and therefore range.

You may want to pass some of those pokey gas cars that are slowing you down (even sometimes on an uphill!). In a gas car, you may downshift for more power for passing. In an EV, you have to be careful about this. If you downshift at too high a speed, you will exceed the rpm limit of the lower gear, and grenade your motor. This is very embarrassing, and expensive. Learn the speed ranges for each gear until they become second nature to you, and stay within them.

The power band on the electric motor is different from that of a gas engine. The best way to learn this is by experimenting. Get on the highway where there isn't much traffic, and play with the gears. You'll soon get the feel for where to find your best acceleration for passing at various speeds.

And Byways

We talked earlier about driving on hills. But what if you're not just tackling hills, but driving up gravelly, unpaved hills, or even going cross-country? EVs aren't really meant for this type of driving, and it will reduce your range quite a bit. Anything that reduces traction interferes with efficiency.

That said, if you're going to drive off-road, here are a few things to think about. Experiment cautiously until you know what your car can do. You don't want the embarrassment of having to be rescued.

Protect your components. A little road splash won't hurt things, but you don't want major amounts of water or mud in your motor or on your electrical connections. And rocks can really spoil your fun. If you're going to be driving in these kinds of places, install some belly panning and terminal covers to protect the motor and electrical connections. Be sure that your protective measures still allow necessary cooling airflow to your components. This might mean carefully

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Workshop - *continued from page 7*
placed air intake and exhaust openings. The outflow opening should be larger than the intake, and should be placed at a natural negative air pressure point. This is so that the normal flow of air around the opening will draw the air inside out. You may want to completely enclose the air intake end of your motor and cool it with forced air through a filter.

Don't ford streams. To paraphrase the old anti-war poster, water is bad for motors and other electrical things. In addition to protecting yourself and your car, protect the environment you drive through as well. Some components are likely to get hotter than normal if you are stressing them with heavy-duty work. If these components brush against tall dry grass, they can start a fire, just as a gas car's hot exhaust system might do.

Strategies

EVs typically get used for the same jobs over and over, day after day. You probably drive to work and back, to the grocery store, to the bank, etc. You have the opportunity to plan which route to take for each of these normal errands. Sometimes you can significantly improve your performance with a slight change of route to avoid a particularly bad hill, or stop-and-go traffic, or extra stop signs or lights.

Even if you can't avoid some of these things, there are different ways to deal with them. We've already talked about hills. Stop-and-go traffic is also bad for range. Every time you touch the brakes, you are wasting momentum that you paid for with amps.

Heavy traffic frequently moves in pulses. You speed up a little, catch up to the car in front of you, hit the brakes, wait for the next guy to move, speed up again, etc. It never actually stops, but it moves forward in spurts. Often, if you watch the traffic several cars ahead of you, you can find a steady pace that allows you to keep up with the flow of traffic without touching your brakes.

The car ahead pulls away from you a length or two. Don't speed up; let him go. In a minute, he'll tap his brakes, and you'll catch up to him. About the time you catch up, he'll speed up again. In the midst of everyone else doing stop-and-go, you're progressing smoothly and steadily-and efficiently. More EV Zen.

Handling & Pedestrians

Your familiarity with the new handling and braking characteristics of your conversion will increase as you spend more time driving it. Drive cautiously until the seat of your pants gets used to the car. It can be more difficult if you are used to driving it in its gas form. It feels like the same car when you sit in the driver's seat. But it is heavier than it was before, the balance may have changed somewhat, and its power curve is different. It will corner differently (sometimes better), and it will accelerate and brake differently. If you try to drive it with your old gas car reflexes, you could get into trouble.

The EV's silent operation adds a safety issue that is not found in a noisy gas or diesel vehicle. You will also need to be more aware of pedestrians, bicycles, skateboarders, and animals. They won't hear you coming, and may move right in front of you, or wait too long to get out of the way. This is especially true when backing out of a space in a parking lot. For this reason, some EV drivers install back-up warning beepers and deer whistles on their cars.

Stopping

Okay, you've been driving around for quite a while now. Let's learn about stopping. In a gas car, most people stay on the throttle up to the moment they switch to the brake. As soon as you lift off the throttle, the car will start to slow down. This isn't true in an EV.

If you see a light turning red a block away, lift off the throttle now. The car will continue to keep up with traffic, and will only gradually slow down. If you have low rolling resistance tires, this process can be very gradual. With a little practice, you can time it so that the car has nearly stopped by the time you reach the light. Use your accumulated momentum-don't waste it.

When you do stop, you don't need to put in the clutch as you would with a gas car, since you can't kill the motor. You can simply depress the brake and stop, and the motor stops, too. Unlike a gas engine, it doesn't need to keep idling at stop, so it isn't wasting energy.

If you do put the clutch in when you brake to a stop, you need to keep it in until the motor stops spinning. The motor can easily take a full minute to run down to a stop if it is disengaged and freewheeling. If you let the clutch out before the motor stops spinning, it will try to move the car, causing an embarrassing lurch before it gives up. This is unpleasant for both the driver and the motor.

Remember to use your parking brake! Leaving the car in gear will not keep it from rolling away. I know of one EV that had low rolling resistance tires and was so light that a breeze would send it across a flat parking lot.

When Empty Isn't Empty

Here's the driving question everyone asks about EVs: what happens when I run out of juice? If you do things right, this shouldn't happen. After you have driven it for a little while, you'll know just about what your range is. These cars are typically driven on the same routes day after day, so there shouldn't be any surprises. The car should have some kind of voltmeter or state-of-charge gauge to let you monitor your battery pack status.

But let's say the unthinkable occurs. You have to make a surprise detour on the way home, or you have a slow leak in a tire, which creates drag and reduces your range. As you get to the bottom of the usable charge in the pack, the car will gradually lose speed, especially on any upgrade. It doesn't happen all at once like a gas car running out of gas. You have some warning, and can travel at a reduced speed to a safe place to pull over.

Then some magic happens. If you park the car for ten minutes and let the batteries rest, they will "recover" some of their lost charge. This is also called "growing amps." You can watch your voltmeter needle climb. You can then drive a little farther. If necessary, you can rest the batteries several times to make it home. Stop, meditate peacefully for a few minutes, and both you and your batteries will be refreshed.

Bonus Miles

It really doesn't take much effort to learn a few simple tricks to maximize your EV's performance. It can be a game you play, where you try to find the most efficient technique for each stretch of road, and keep the ammeter needle as low as possible. The techniques can quickly become habits that you don't even think about.

Workshop - *continued from page 8*

The bonus is that when you get into a gas car, your EV driving habits will carry over. The same techniques that make for great range in an EV will make for great gas mileage in a gas car. There's just one habit you don't want to carry over-passing by gas stations. The gas car won't magically refuel itself in the driveway overnight, so you'll have to remember to fill it up.

This is the last article in the Conversion Workshop series. We covered a lot of ground, starting with why should a person do a conversion, through all the mechanical, fabrication, and electrical aspects of the conversion process, and ending up here discussing how to drive the finished product.

I had fun doing the series and it helped me organize all my thoughts and experiences with and about the conversion process. I have all the articles available in text form so if you missed or lost an issue let me know and we can print or email you a replacement.

Thanks for your time and attention.

MIND YOUR UNITS!

By Edward Ang, EBEAA Member
December, 2003

I had enough of these for the year and want to make this clear before the year ends. We have to get the units correct. Stop using Amp to refer to battery capacity, kW or kW per hour to refer to energy etc.

It causes me pain to read a post that says something like these:

"My EV uses 200W per mile."
This is like saying I run 5mph per mile. What?! It should be 200Wh per mile.

"My charger puts out 3kW per hour."
I run 5mph per hour?! What?! It should be 3kW period.

"My EV takes 7kW to get a full charge."
It should be 7kWh. It would be nice if your EV becomes fully charged instantly the moment your charger puts out 7kW of power.

"My battery is 20A per hour." Huh?!
It should be 20 Amp hours. It would put out 20A for an hour. So, it is Amp multiply by hours.

"I get 13kW per hour from my solar panels." What?
It should read 13kW if you are referring to peak wattage or 13kWh if you want to say total energy produced a day. There is no such thing as 13kW per hour.

"I pay $0.13 per kW of electricity."
Although I love to pay $0.13 per kW no matter how long I keep this kW going, I doubt that this is how your power company charges you.

From last issuse (Mar/Apr 04)
Trevor Blackwell of Anybots Inc. ©2003
[Editor note: this is the more technical design and notes behind the construction of a home-built balancing scooter, like a Segwey"]

Balance and Control

Balancing is easy. Just keep the wheels under the center of gravity. It's just like when you pick up a stick and balance it resting on the palm of your hand.

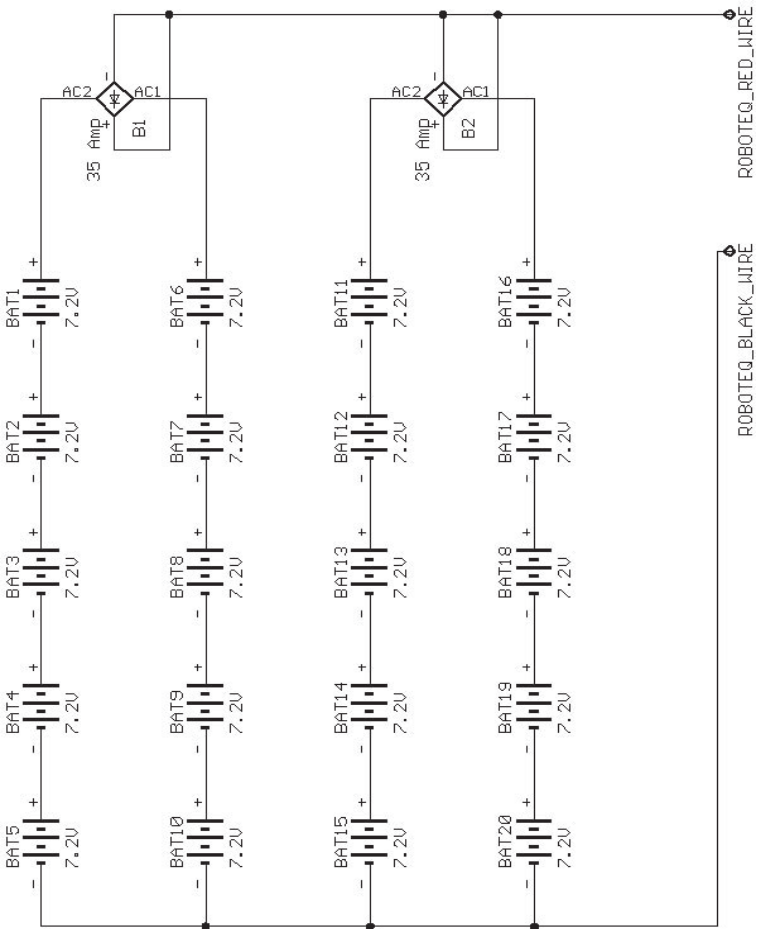
Actually, there are some complications. You don't know where the center of gravity is. You don't know exactly which way up is. And you may not be able to move the wheels fast enough to keep under it.

I discuss knowing which way is up under "Gyroscope" below, but for now assume it's known. Technically what it knows is the angle between the scooter's chassis and the direction of gravity. And instead of keeping the wheels below the center of gravity, it keeps the stick vertical (ie, the angle equal to zero.)

With the stick vertical, if you stand in just the right position, the center of gravity will be right over the wheels and the scooter will be stable. But if you lean forward, the center of gravity will be in front of the wheels and the scooter will start tipping forward. The computer senses this and moves the wheels to keep the stick vertical. But by then it has fallen some more, and it needs to move the wheels faster.

The net result is that when you lean forward, the scooter accelerates forward and when you lean back it accelerates back. It's surprisingly intuitive. Most people find they can control it within seconds of getting on it. If you're used to riding busses or subways, you're used to leaning forward when the bus is about to accelerate. Well, this scooter follows your lean instead of you having to follow it.

There is another complication. What happens if you keep leaning forward until the scooter is going so fast that the wheels can't keep up? It has to change the tilt of the scooter so instead of keeping the bar vertical, it tilts back. The bar is at waist level, so it pushes you back until the center of gravity is no longer in front of the wheels and it stops accelerating. If you lean farther forward it keeps tilting back in order to keep the speed down. In order to be able to tilt the scooter back it needs to speed up the wheels and get them out in front, so the speed limiter needs to kick in before the motors are maxed out. I currently have the limit set to 50% of maximum speed.



Battery pack is 4 strings of 5 RC car NiMH batteries in series

Keeping the Stick Vertical

Keeping the stick vertical is easy. If it tilts forward, it runs the wheels forward until the bottom of the stick is under the top.

Here too there are complications. It has to move the wheels just the right amount forward. Too much and it'll have to move them back, then forth, until the thing is bucking widly. This is pretty much the default thing that happens until you get it tuned just right.

It needs to know both the angle of the stick and how fast it's changing. Knowing how fast it's changing lets it slow down before it overshoots the mark. Technically this is known as a PD loop. The amount of drive it sends to the wheels is proportional (P) to the error in angle, and also to the derivative (D) of the error.

I mentioned above that when it's going too fast it needs to tilt the stick back. This is tricky to do, because in order to tilt back it needs to accelerate the wheels forward to get them a few inches out in front. It then seems like it's going even faster, and it tries to tilt even farther back. This is called "positive feedback" and it's a recipe for uncontrollable oscillation. Making this stable was the trickiest part of the whole project, and the fact that it can only be tested at high speed resulted in several moments of terror and a few bruises before I got it right.

Wheels and Steering

Steering is done by making one wheel go faster than the other. Because all the mass is centered between the wheels, it can spin around quite quickly.

When not moving, maximum turning corresponds to having one wheel at about

10% forward and the other at 10% reverse. This spins it around pretty fast. You wouldn't want to turn this fast at high speed because it would tip sideways, so it reduces the maximum turning speed as the forward speed increases.

The wheels have 0.5 degrees of toe-in, meaning that they are both angled slightly inwards. The front wheels of most cars have a similar amount of toe-in. Pneumatic tires are inherently flexible sideways, and it makes it more stable to have them always flexed slightly. I don't know if 0.5 degrees is the right amount and I haven't tested any alternatives. But the steering is quite stable despite not having any active correction in software.

Putting it all together

What takes many paragraphs to explain is surprisingly simple to code. Here is the basic pseudocode of the balance algorithm, complete with the numbers which made my scooter feel stable and responsive.

Inputs

angle, angle_rate: the tilt angle of the scooter in radians and
its derivative in radians/sec

steer_knob: the reading from the steering knob, between -1 and +1.

Balance

*balance_torque = 5.0 * (angle - rest_angle) + 0.4 * angle_rate*

Limit top speed by tilting back

overspeed = max(0, cur_speed - 0.5)
if (overspeed > 0) {
overspeed_integral = min(0.4, overspeed_integral + min
*(0.2, overspeed+0.05) * dt)*
}
else {
overspeed_integral = max(0, overspeed_integral - 0.04*dt)
}
*rest_angle = 0.4*overspeed + 0.7*overspeed_integral*

Steer. Decrease steering rate at high speed

*steer_cmd = 0.07/(0.3+abs(cur_speed)) * steer_knob*
Track current speed
*cur_speed += 1.2 * balance_torque * dt*

Differential steering

left_motor_pwm = balance_torque + cur_speed + steer_cmd
right_motor_pwm = balance_torque + cur_speed - steer_cmd

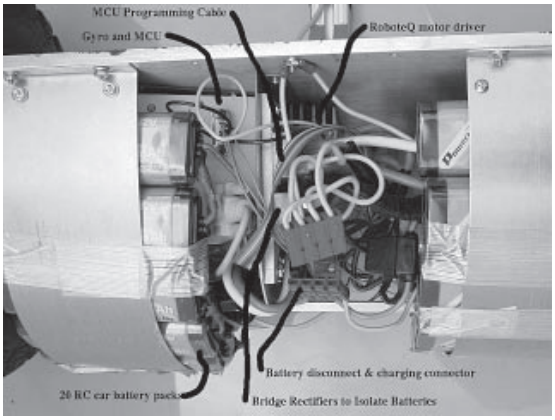
Outputs

left_motor_pwm and right_motor_pwm directly set the duty cycle of the pulse width modulator for the wheel controller, and range from -1 to +1 (+1 is 100% forward, -1 is 100% reverse.)

Gyroscope

In order to keep the handle vertical, it needs to know which way is up. Humans, other mammals, and even lobsters have a nifty little sensor in the inner ear which does this, and it's possible to do something similar mechanically. The simplest way to know which way is up is with a pendulum. A pendulum at rest points down.

Unfortunately, the scooter is not at rest. If it's accelerating forwards a pendulum will swing backwards. It may also get swinging back and forth. It needs a much more stable notion of up.



A gyroscope made from a spinning wheel is the classical solution to keeping a vertical reference. They are still used in airplanes to remind pilots which way is up when they're in the clouds. But having an actual spinning flywheel is clumsy. They take time to spin up, they need expensive precision bearings and lubrication and use a lot of power, and occasionally the flywheel explodes (they have to spin pretty fast) and sends little bits of shrapnel into the rest of the system.

Although it's hard to visualize, it turns out that if you have a tuning fork vibrating and rotate it, it will cause a measurable vibration in the perpendicular direction. By measuring the vibration you can tell which way it is rotating and how fast. The scooter uses a very small ceramic tuning fork in just this way. Fortunately, I didn't have to make a tiny ceramic tuning fork on a tiny pottery wheel. They are a standard electronic product called a piezoelectric rate gyro. They're used in handheld camcorders to detect your hand jiggling and subtract out the motion from the picture to make it stable. One of the first successful applications of nanotechnology, they're a vital enabling technology for TV shows like C.O.P.S.

Unfortunately, these rate gyros are not perfect. They tend to report a small rate of rotation even when they're perfectly still. And if the balancing software integrates this small rate for long enough, it'll think it has rotated a lot. So it needs to compensate for that, and it does it with a pendulum. While a pendulum may swing around and wobble back and forth in the short term, the long-term average of its position is straight down.

Again, it doesn't use an actual pendulum. It uses a "micromachined silicon accelerometer", a silicon chip with a sort of diving board etched into it. This diving board bends a tiny amount in the direction of gravity, and some electronics detect how much it bends. With two of these arranged perpendicular to each other, it can compute the angle of gravity by computing the arctangent of the ratio of the bending measurements. And unlike a pendulum they don't get swinging around.

So now it has to combine the short-term reading of the rate gyro and the long-term reading of the pendulum. There is a theoretically optimal way to combine these pieces of information into a good estimate of actual tilt angle. This is called a Kalman filter. Such a filter was a good place to start, but I found I got better results with a hand-tuned feedback loop.

Sound complicated? It's not as bad as it sounds. In fact, the whole code, including stuff to read ADCs and manage serial communication is about 500 lines.

Microcontrollers

All the software needs somewhere to run. Not so long ago this task would have required more computer than you could lift, but now it runs in a tiny chip costing $10. The one I used is from Atmel. They're fast and very easy to write software for; I wrote the code in C using floating point arithmetic and trigonometric functions, and it has plenty of speed for this kind of application.

The Atmel chip I'm using has built in analog data converters to interface with the gyroscopes and steering controls so it's a nearly complete solution. There are only about 5 chips in the whole scooter.

Motor driver

The software needs to exert precise control over the speed and torque of the motors. Under worst-case conditions, like going fast up a steep ramp, the motors need to work very hard to keep up and can consume a tremendous amount of power doing so, as much as 5000 watts.

The torque generated by the motor is directly related to the current flowing through the motor. The current is controlled by alternately switching the motor across the full battery voltage, then short circuiting it. If it did this slowly it would do just what you'd think: alternate full speed, then full stop. But it alternates very fast, about 4000 times per second, and this produces a smooth output from the motor. If it spends 37% of the time with the motor connected to the battery, the motor runs about 37% of full speed.

The scooter uses a device made by RoboteQ to switch all this power around. It's a popular unit among Battlebot builders since it's small and handles a lot of power. It receives commands from the microcontroller over a serial port, such as "left motor 37% forward, right motor 35% forward" (but in a compact binary format) and it gives the motors that much power. This command would correspond to going about 5 mph in a gentle right turn.

Limits

In theory, balancing is quite simple. Just keep the support under the center of gravity. Where it gets complicated is in handing the limitations of the motor & battery system. The simple control strategy may require much more power than the motors & battery can deliver. If it lets the scooter get into a situation where the wheels can't keep up with the center of gravity, the rider will be thrown.

If you're going fast and then run into something like a ramp or speed bump, it may require a lot of power for a short time to keep the wheels going up the ramp. As batteries get low and motors get warm, the amount of available power goes down. It's hard to predict exactly when it doesn't have enough to run safely. There's certainly a large gap between when it couldn't handle hitting a speed bump at 10 MPH and when the batteries actually run down.

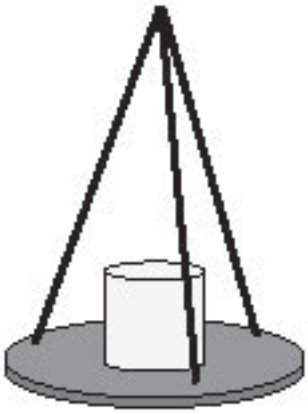
I plan to experiment with using a bank of capacitors to provide enough short-term oomph to handle hitting a major bump at high speed. It's much easier to calculate the amount of energy needed to handle a bump safely than the maximum speed for a given battery condition. It just needs enough to get the wheels out ahead of the center of gravity, so it can slow down. My back-of-the-envelope calculations suggest about 2500 Joules delivered in 0.5 seconds. The new carbon aerogel ultracapacitors (not to be confused with mere supercapacitors) can store this much power in small 4" x 4" x 2" package costing about $250. Or, I could just stick a wheel in front of it. But that would seem like something of a compromise.

Performance and Testing

When I first built this, I had never been on a Segway or even seen one close up. You'd think with all my geeky friends I'd know someone with one, but I didn't. I tuned the system according to how I thought it should work. A few days after I put up this page, I got to try a genuine Segway and I realized two things: it felt better to have a stiffer feedback loop so the handle didn't move back and forth so much, and that it should limit maximum speed by tilting back. I changed both, and it feels much better now.

I'll try to get some videos of the current performance up soon. It still doesn't quite match the Segway in two respects. First, my gyroscope drifts a bit especially when accelerating hard or going up a ramp, so the handle position wanders around a bit. This is tiring on the arms, and makes it harder to limit top speed. Second, my balance feedback loop isn't quite as stiff as the Segway's, so it still feels a bit mushy. I can't make it any stiffer without getting oscillations. It may need a higher-performance gyroscope, but I think the main difference is that the Segway's wheels have a large moment of inertia which allows it to apply a reaction torque to the chassis. My wheels are smaller and have most of the mass in the center, so it only gets reaction torque between the ground and the mass of the scooter body. The soft rubber tire adds a large spring between the wheel and the ground, and the mass of the scooter is not very stiff either since the batteries flop around.

The Segway is also bigger, stronger, lighter, and has more ground clearance and battery power. But I still like mine pretty well.



Cupholder

I like to use the scooter to go for coffee, but it's very hard to hold onto a cup of coffee and ride it at the same time. It needed a cupholder. I tried a very simple design, basically some cable ties on the main bar, but it didn't work well. I lost about 3/4" of coffee in 1/2 mile and got coffee spatters all over my pants. But, the great thing about publishing your experiments is that you get lots of minds thinking about the problem and one of them will probably suggest the right answer. Bob Beichner, from the physics department at North Carolina State University, wrote:

…all you have to do is make a little "hammock." Take a large drink coaster or other disk and drill three small holes near the rim, 120 degrees apart so they are equal distances apart. Run a string through the holes and tie together a foot or so (the distance depends on the size of your cup and the coaster diameter) above the center of the coaster. Support the hammock from the knot where the strings come together by hanging it on a hook or something. As long as the coaster doesn't bump into anything (it has to be able to swing freely) it is pretty hard to spill anything, regardless of how you move around the knot. You can even spin the thing in a big vertical circle so the cup is sometimes upside down, and nothing comes out. (Hopefully you won't do that with your scooter!)

Sure, I thought, in theory. I think I saw that demo in Physics 101 too. But it can't possibly work in practice, with 3D wobbling, swerving and bumping. With no damping, the cup will swing around wildly. But, I tried it anyway. Instead of the plate Bob suggested, I used a large cup that a normal coffee cup will fit into. As well as keeping it from sliding off when it's jiggling up and down, it should also help keep the coffee warm in the fast-moving air. As a worst case test, I just filled it with water and put no lid on.

The first version used a string about 30" long. It worked as long as the cup didn't bump into anything, but the string was so long that it was hard to avoid hitting obstacles or the scooter itself. For version 2 I shortened the system to about 14" including the cup and hung it about 15" out in front of the handlebars. It swung around crazily, but didn't spill. It's quite amusing to watch: it looks wildly improbable and out of control.

Current Problems

These are the things that are currently bad about my prototype.

- The ground clearance is very low. Even large acorns get stuck under it. Using larger wheels is one solution, and I think with more clever mounting of batteries I could get them at least 1.5" higher. If I make the wheels much larger, I'll want to find a way of getting the foot plate below the center of the wheel since I'm already 8" off the ground.
- It should detect when I've stepped off it, so it doesn't simply zoom away with no rider. My big worry is that I'll shift my feet around and it will erroneously detect me having stepped off. At high speed, this could be Really Bad.
- It really should give some indication of battery charge, other than by falling over when it gets too low. The voltage of NiMH batteries isn't a good indication of charge, so there's no easy way to do it.
- It doesn't detect when the wheels are off the ground or slipping. Once when leading it down a curb, I got it twisted a bit and it hung up on the battery supports. With the wheels free, they started spinning very quickly and it gave a huge lurch when it got back on the ground. I don't know what the general solution is. Probably it should limit the speed to 1 MPH when the rider is off.

Things Learned

- You don't need high-tech low-inertia motors for adequate responsiveness. Regular old copper-wound motors work pretty well even though they have a lot of rotating mass that acts like a flywheel. This might actually help with handling a bump, as the inertia helps keep the wheels spinning up the incline.
- You don't need low-backlash gearboxes either. The conventional non-precision spur gear units give about 1/8" backlash at the wheel diameter. You can feel a tiny clunk sometimes when the torque reverses, but it's hardly noticeable. They do make some gear whirring noise which is noticeable indoors. It'd probably be quieter if they weren't bolted to a big aluminum sounding board.
- I didn't need any feedback in yaw (left-right steering) to keep it heading straight. I just give equal motor drive voltages, and it keeps nice and straight even on slopes or going over bumps.

Future Work

Things I'd like to try, if I had more time:

- I can take both hands off the control bar and control with my feet, at least at low speeds. Handy when going through doors. I wonder if I could learn to control it without a handlebar at all. Perhaps with some sort of ski boots & bindings for greater control.
- Put the vertical handle bar off to the side, instead of in front, and hold it with one hand.
- Make wacky new vehicles on the same principle. Why not go for coffee in a miniature dragster, doing a wheelie all the way? Or in a greco-roman chariot, without the horses? You could also make improbably tall vehicles, like a phone booth that zoomed around upright.
- Take a regular 3-wheeled "mobility scooter," and make it do wheelies all the time. You might even be able to use its original motor driver, and just add a gyroscope and feedback controller. Seeing one of those 3-wheeled scooters, normally associated with geriatric mall cruisers, doing a wheelie would really surprise people. And if it fell, you'd at least have a wheel to land on.
- The ideal vehicle might be something that rides like a motorized recumbent 3-wheeled bike on roads, but tilts back to balance on sidewalks. You'd have to get off to change modes.
- Build one with a small gas engine and generator instead of batteries to power the electric motors. It'd probably need a substantial capacitor bank to smooth out the power demand. The engine and alternator might even be lighter than the batteries, and it'd have tremendous range. It might go faster too.
- Build a balancing scooter without any batteries at all, but instead control the braking force on the wheels to keep it balanced. It would only work going down a hill. You could use the same motors and dump their power into a bank of big resistors. Mountain boarders might dig this.
- Build a real experimental platform with 20 or so knobs to control each of the feedback parameters. It's very interesting to adjust a parameter and feel the difference in real time under your feet. It'd need to have some fail-safe scheme for returning to a reasonable set of parameters if the user adjusts them too far.

This article was reprinted with the permission of the author from the webpage: www.tlb.org/scooter.html

SRP SOLAR SPECTACULAR 2004

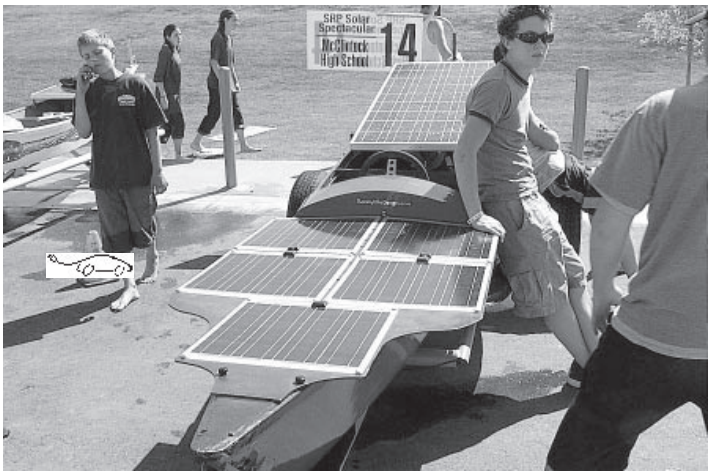
By Jim Stack, PEAA

There were more Solar electric boat races on Saturday, March 27 at Tempe Town Lake in Phoenix, Arizona. Here are a few of the pictures. The big finals races are scheduled for May 2004. The Phoenix EAA Chapter is sponsoring the final day with over $2,000 in prizes from our club, not to mention the other prizes in early days from the local SRP power company.

One of the schools, which participated in the boat races, said they have 2 EV cars. These vehicles were built as educational projects and are used to race against a few local schools. As a result, the EAA Chapter is planning to join with them in some future races.

SRP is for Salt River Project, a quasi-municipal power and water company started in Phoenix many years ago. They also provide about half of the free charging stations we have across the city. They used to have a small fleet of Electric Vehicles but have sold most of them off. We have a few for sale on our web classified at www.phoenixeaa.com

The Phoenix EAA tries to encourage SRP since they don't have any solar buy-down programs, like all the other power companies. Most of SRP's power comes from dirty coal, nuclear and some oil and gas. They aren't clean like Sacramento's SMUD but we keep try to sway them.



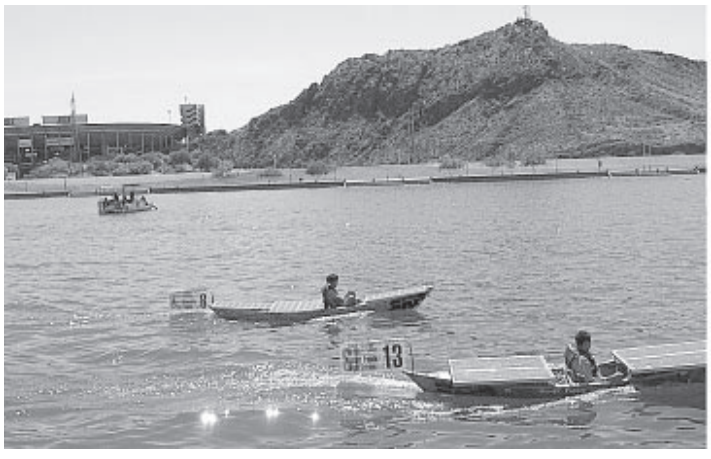
PV panels

Unloading

Heading Out

Making Waves

High Speed



Endurance

Electric Vehicles Today!

Electric Auto Association (EAA)

April 2003

Why Electric Vehicles?

EVs (electric vehicles) produce zero tailpipe emissions and up to 99% lower emissions than gasoline and diesel vehicles. EVs help America reduce its dependence on oil.

POWERED BY AMERICAN ELECTRONS

Thousands of EVs are registered across the country. New battery technology gives full-function EVs ranges of 80-120 miles per charge traveling at highway speeds. An EV fits perfectly into multi-car households; the EV for everyday travel, and a hybrid or conventional car for extended trips. Studies have shown that 80% of commuters travel less than 40 miles per day. How about *you*? Could 100 mile range *and* convenient refueling at home meet *your* daily driving needs?

We know there is a market for EVs. Every EV produced is immediately sold or leased! EVs are high performance vehicles and priced competitively when measured against comparable gasoline-powered vehicles. In addition, fuel and maintenance expenses are significantly lower for EVs. And talk about lasting value, an electric drive motor provides as many as 1,000,000 miles of service. The initial purchase price for EVs will drop as production volume increases. Prices always go down as volume goes up - Henry Ford knew that long ago! In the meantime, EV owners enjoy the financial benefits of significantly lower fuel and maintenance expenses.

EVs are a clean, efficient alternative to conventional vehicles – using technology readily available today!

EVs, Hybrids, and Fuel Cell Vehicles

There are primarily three electric vehicle technologies in America today: electric vehicles (EV), hybrid gasoline/electric vehicles (Hybrid), and Fuel Cell vehicles.

EVs draw electricity from batteries to power an electric motor to propel the vehicle, generating zero emissions. Hybrid gas/electric vehicles use both a battery-powered electric motor and a conventional gasoline-powered engine for propulsion. Hybrids generate tailpipe emissions, but less than its gasoline counterpart. Fuel cell vehicles use an onboard fuel cell to generate electricity to power an electric motor to propel the vehicle. Fuel Cell vehicles are emissions free, but decades away from a commercial market.

EV technology is at the core of all three. But a big difference between EVs, Hybrids, and Fuel Cell vehicles is the method used to generate the electricity that powers them. The batteries in an EV are charged using standard household electricity and electricity captured by regenerative braking. An EV can be 'filled-up' at home. The battery in a Hybrid is charged internally by electricity generated by the gasoline engine and electricity captured by regenerative braking. A Hybrid can be 'filled-up' at the neighborhood gas station. The electricity that propels a Fuel Cell Vehicle is generated from the combustion of hydrogen in its onboard fuel cell. There is no infrastructure for dispensing hydrogen into vehicles; therefore, while this vehicle technology is promising, it is not yet practical.

About the EAA

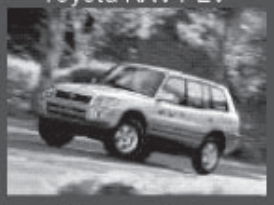
The EAA is a non-profit educational organization that promotes the advancement and widespread adoption of electric vehicles; organizes public exhibits and events of electric vehicles to educate the public on the progress and benefits of electric vehicle technology.

"Promoting the use of electric vehicles since 1967"

Solectria Force

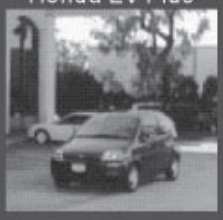
GM EV1

Toyota RAV4-EV

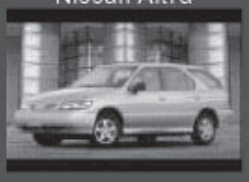


Chrysler Epic

Honda EV Plus



Nissan Altra



Corbin Sparrow

"EAA EV drivers have logged over 3 million clean miles"

Ford Ranger

AC Propulsion tZero

Th!nk City

FeelGoodCars ZENN

GEM

Mike's E-Bike

Segway Scooter

E-mail: info@eaaev.org
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Earth's Finite Resources

US oil production has been declining since 1970 (since 1998 in Alaska) and US imports have risen by 67% since 1970[1]. The Union of Concerned Scientists states the US (4% of the earth's population) consumes 25% of the world's total oil production[2]. Our demand grows daily. We *must* have alternatives!

Electric Vehicle Information

Why EVs?

EVs offer the best and cheapest alternative to petroleum-based transportation. Driving an EV helps improve the quality of life for all Americans. They are fun to drive. It is patriotic!

Are EVs safe?

Yes. EVs must pass all state and federal safety standards.

Can EVs go fast?

Yes! For real speed, check out the National Electric Drag Racing Association (nedra.com).

EVs just move the pollution, don't they?

No. Even including the effects of electricity generation, the California Air Resources Board reports that ***EVs are 98% cleaner than the average 2002 new car and 95% cleaner than a SULEV*** [3] – and that's not including the environmental impact of oil refining! EVs are a proven "clean and green" choice.

Are EVs practical?

Yes. Studies show that 80% of daily commuting is less than 40 miles. Internal combustion vehicles generate the greatest amount of pollution during the first 20 minutes of operation. EVs require no warm-up period and are the perfect transportation option.

Where do you "fill up" an EV?

EVs are primarily charged at home overnight, using surplus (low-cost) electricity. There are also many public charging locations (evchargernews.com).

Are EVs expensive to purchase?

Not when you consider the total lifetime costs[4]. As production volumes increase, EVs will cost no more than conventional cars and trucks in every price range. Many states and the federal government recognize this low-volume pricing issue and offer incentives to reduce the initial cost of buying or leasing an EV.

Are EVs expensive to operate?

No. A Toyota RAV4-EV costs less than 3 cents/mile to operate. EVs are nearly maintenance free (no smog checks, oil changes, or tune-ups). At $2.00 per gallon, a gasoline-powered car must average 67 mpg to match this!

Do batteries pollute landfills?

The Battery Council International reports that 93% of *all* battery lead is recycled. A higher recycling rate than newspapers (55%) or aluminum cans (42%). Typical new lead-acid batteries contain 60-80% recycled lead and plastic[5]. A true recycling success!

Electric Auto Association

[1] http://www.wri.org/wri/climate/anwr.html
[2] http://www.ucsusa.org/publication.cfm?publicationID=492
[3] http://www.arb.ca.gov/msprog/zevprog/factsheets/evfacts.pdf
[4] http://www.epri.com/corporate/discover_epri/news/downloads/EPRI_AdvBatEV.pdf
[5] http://www.batterycouncil.org/recycling.html

Rev: 20030403

High Gas Prices Got You Down? Drive Electric!

Electric Auto Association (EAA)

April 2004

Gasoline is refined from crude oil and primarily used to fuel automotives and light trucks[1]. You can avoid the cost and headache of rising gasoline prices by driving an electric vehicle (EV). An EV refuels at home. You simply plug it in, and let it charge while you sleep – using surplus (low-cost) electricity available at night (during non-peak hours).

Why is the Price of Gasoline Rising?

Today's gasoline price, adjusted for inflation, is lower than in 1981 – the price peak. Our price is a bargain compared to the price paid in the rest of the world (over $5/gallon in many countries)[4]. **It's estimated that if US government subsidies were removed, the price of gasoline in America would be between $5.60 and $15.14 per gallon**[5]. Petroleum is a non-renewable resource. Enormous price increases are inevitable given that the demand for gasoline is rapidly outpacing the world supply.

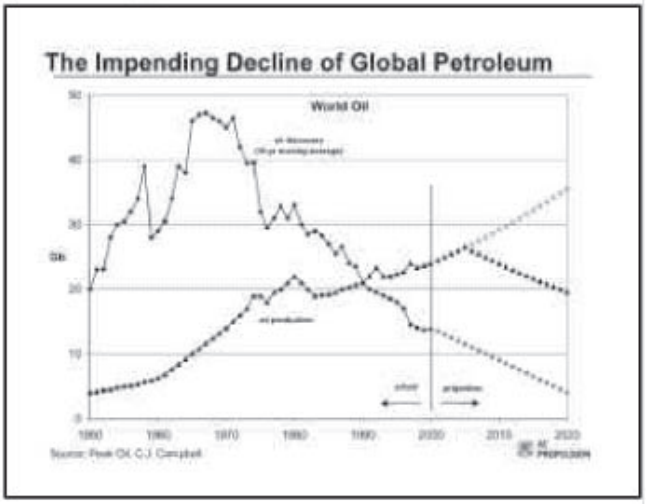
California Historical Prices

	Gasoline[2]		Electricity[2]
		Adjusted for Inflation	
Year	**$/gal**	**$/gal**	**$/kWh** (peak rate)
1970	$0.34	$1.32	(not available)
1981	**$1.34**	**$2.94**	$0.0569
1990	$1.09	$1.42	$0.1063
2004	**$2.42**	**$2.42**[3]	**$0.1238**

In contrast, the price for electricity has not drastically changed in the past 14 years. Electricity is generated locally, can be generated using renewable resources (solar, wind, biomass, geothermal), and is conveniently and safely delivered to our homes.

Finite Resources

With 4% of Earth's population, the US consumes 25% of the world's total oil production[6]. Oil production has been declining since 1970 while US imports have risen by 67% since 1970[7]. According to "Peak Oil: An Outlook on Crude Oil Depletion"[8]: 1) oil discovery peaked in the 1960s; 2) we now find 1 barrel of oil for every 4 we consume; 3) Middle East share of production is set to rise (short-term); 4) the rest of world production peaked in 1997, and is therefore in terminal decline. This decline of global petroleum is not a re-run of the oil shocks of the 1970s. This **decline in production is driven by resource constraints, not politics, and is a permanent (not temporary) condition**.



"Promoting the use of electric vehicles since 1967"

"US Government deficits lead to higher gas prices. Deficits lead to the lower US dollar value. World-wide oil prices are in US dollars, therefore oil producers raise price per barrel to counter the lower value of the US dollar." –4/2/2004, "PBS's Now With Bill Moyers".

[1] US Dept of Energy, http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/primer_on_gasoline_prices/html/petbro.html
[2] California Energy Commission, http://www.energy.ca.gov/electricity/rates_iou_vs_muni_nominal/residential.html
[3] Highest price listed from http://gaspricewatch.com, on 4/14/2004.
[4] http://money.cnn.com/pf/features/lists/global_gasprices/price.html
[5] http://www.icta.org/projects/trans/rlprexsm.htm
[6] http://www.ucsusa.org/publication.cfm?publicationID=492
[7] http://www.wri.org/wri/climate/anwr.html
[8] http://energycrisis.org/de/lecture.html

"EAA EV drivers have logged over 4 million clean and petroleum-free miles"

"'By 2015, we will need to find, develop and produce a volume of new oil and gas that is equal to eight out of every 10 barrels being produced today" – Jon Thompson, President Exxon Mobil

"The Federal government recognizes that the steady growth of imported oil, to meet US requirements, cannot continue..." Spencer Abraham, US Secretary of Energy (01/09/2002)

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Rev: 20040415

How Far Does Your Money Go?

Since most of our oil is imported, your gasoline money goes pretty far – overseas, that is. Electricity is much cheaper than gasoline, and is generated locally. The energy equivalent of one gallon of gasoline is 33.53 kWh of electricity (GGE)[9]. However, 1 GGE of electricity in an EV takes you 110 miles. Over 2 times farther than an HEV, and 11 times farther than a full-size SUV. An EV simply takes your money farther.

2004	$/GGE	Miles/GGE	$/mile	Miles/GGE Efficiency Relative to an EV
Full Size SUV	$2.42	10	$0.242	**11X worse than EV**
Mid-Size SUV	$2.42	17	$0.142	**6.5X worse than EV**
Mid-Size Sedan	$2.42	22	$0.110	**5X worse than EV**
Compact Sedan	$2.42	32	$0.076	**3.5X worse than EV**
Hybrid (HEV)	$2.42	50	$0.048	**2.2X worse than EV**
EV (peak electricity)	$4.15	110	$0.038	**1**
EV (off-peak, $0.075/kWh)	**$2.66**	**110**	**$0.022**	**1**

What Can You Do?

Everyday choices make a difference. *Drive Less*. Use alternative forms of transportation, including public transportation, bike, walk, or telecommute. People are driving more than ever. The total Vehicle Miles Traveled (VMT) is increasing rapidly[10]. In California, VMT increased 93% from 1980 to 2000, while the population only increased by 37%; and VMT is projected to increase another 70% over the next 25 years.

Drive Different. Drive alternative-fuel vehicles, including vehicles powered by electricity, compressed natural gas (CNG)[11], and bio-diesel[12]. Take the Clean Car Pledge[13] that your next car will be the highest mileage and "greenest" possible.

Why EVs?

EVs offer the best and cheapest alternative to petroleum-based transportation. Driving EVs helps improve the quality of life for all Americans. But EVs are also needed for our energy independence and national security. EVs make use of technology that is readily available today to reduce our thirst for gas – we can't wait decades for potential alternatives, like fuel cell vehicles.

About the EAA

The EAA is a non-profit educational organization that promotes the advancement and widespread use of electric vehicles and organizes public exhibits and events of electric vehicles to educate the public on the progress and benefits of electric vehicle technology.

Electric Auto Association

[9] US Dept of Energy, http://www.afdc.doe.gov/p_single_faq.cgi?5
[10] http://www.transportationca.com/archives/CaliforniaStudy2001.htm
[11] For more information on CNG powered vehicles, see http://www.afdc.doe.gov/altfuel/natural_gas.html
[12] For more information on biodiesel powered vehicles, see http://www.afdc.doe.gov/altfuel/biodiesel.html
[13] http://www.cleancarcampaign.org/pledge.shtml

By Steve Clunn

On Saturday, March 13 I took my EV Mazda truck to a Classic Car show in Okeechobee, Florida. My EV friend Tom mentioned in and it doesn't take much to get me to stand out in public with my hood open.

Well when we got there, there were so many beautiful Classic cars and hot rods, all chromed-out and all looking like something out of a hot rod magazine. I felt very out of place with my plain 86 Mazda with a poor paint job.

EV attracts quite a crowd…

While waiting in line, sandwiched between to beautiful classic cars, I could hear the check-in guys talking, and they weren't saying "what a beautiful truck" either. For a minute, I though they weren't going to let me in. A third guy came up and talked to Tom, so he knew the truck was electric and gave us a place to park.

This little car show out in the middle of nowhere had 200 classic cars, a arts and craft show and some live country music. We parked where they told us and I popped the hood. My EV friend Tom had his EV on a trailer. It's one of those projects that never gets finished. Every time it's drivable he takes it apart and rebuilds it different. I parked next to him.

It was not long before there was a steady stream of people looking under the hood and asking questions. After about 15 minutes I felt right at home, and not a bit out of place. I got all the usual questions. When people asked me how far could I drive, it was nice to be able to say "I drove it here from Fort Pierce" (35 miles away). For such a large number of people, only two asked about putting a generator on the wheel and recharging the batteries when driving. I heard about lots of EV projects that didn't work like truck starter motors with car batteries, etc. Met a welder who worked on a Citicar and heard some of his stories.

At around noon Tom's wife say to me, "Stand here and turn 360 degrees and tell me what you see." "Well there are cars, lots of beautiful car," I said. "Yah, lots of cars and lots of people walking around, but do you see one car with more that 10 people standing around it?" Well, I hadn't noticed because I was so busy talking to all the people standing around my EV. Our EV's were getting way more attention than any of the other cars there.

As I walked around looking at all these fine chrome-plated works of art sitting alone while my plain-Jane Mazda had a crowed sometimes 2 or 3 people deep. It just didn't seem fair.

…while all the classic gas cars just sit around

So what's this got to do with tractor's. I think an EV tractor at a gas tractor pull would get the same kind of attention.

My friend got a call from the organizer of the event, she liked the EV's and hope's we'd come next year.

Ford: U.S. Should Offer Hybrid Tax Breaks

Wed Apr 7, 2004
By John Porretto, AP Auto Writer

NEW YORK - Ford Motor Co. chairman and chief executive Bill Ford Jr. said the government should offer $3,000 tax breaks or possibly boost taxes on gasoline to spur consumer interest in gas-electric hybrid vehicles.

Ford's comments Wednesday were a reaffirmation of views he has previously expressed and come as his company is investing heavily in more fuel-efficient vehicles.

He said incentives like tax breaks or rebates of, say, $3,000 per vehicle, would be most effective.

He also mentioned his past support of an additional 50-cent-per-gallon tax on gas, which he said would make fuel economy "a purchase motivation for the customer." But he said he wasn't prepared to say now how big a tax hike might be appropriate and acknowledged such a tax increase "doesn't have legs" in the political arena.

"I'd like to get either federal or state and local help ... and I think it's the responsible thing to do," he said. "If the federal government really wants to encourage this kind of behavior—and they should — then that's a way they can clearly help."

Ford's remarks came to automotive journalists at the New York International Auto Show even as the nation's second biggest automaker announced it was increasing to three from two the number of hybrid vehicles it will offer in the next few years, adding another sport utility vehicle.

Ford will build a Mercury Mariner hybrid SUV for the 2007 model year. The Mariner will join the Ford Escape SUV and a future midsize sedan in the automaker's hybrid program.

The Escape hybrid goes on sale this summer. Ford says its hybrid system allows the compact SUV to get 35 to 40 miles per gallon in city driving, compared with 20 miles per gallon in a 2005 Escape with a V6 engine.

Hybrids draw power from two different energy sources, typically a gas or diesel engine combined with an electric motor. For now, the only versions available in the United States are small cars made by Honda Motor Co. and Toyota Motor Corp., but nearly every automaker is investing in hybrid technology.

Off for a quiet EV ride through the snow.

Snowmobiling - *continued from page 1*

swim, as our 6-year-old daughter Deanna would practice her diving and jumping off the deck. The loons (who secretly own the entire lake) were never too shy of our clean, quiet boat although the much-louder pedal-boats seemed to cause them great concern whenever they passed by. They would pass within a couple of feet and seemed to signal their approval of our most "civilized" watercraft. With a 6-hour running time capability at a top speed of about 8 kph (5 mph), not once did I ever run out of charge nor was the threat even remotely present.

The ElDeBo proved to be the perfect conveyance for us and as I cranked the come-along and robbed the boat of its watery freedom, my thoughts turned to the long eight months that would have to pass before I could once again enjoy zero-emission recreation in this wonderful area.

Then it hit me. Why wait until May? Couldn't the electric fun continue even in the coldest winter months? What if a snowmobile were converted to battery-electric power? Wouldn't that be fun!

As is normal with my EV projects, I opened up napkin and sketched the basics asking myself questions like: where do the batteries go? How many and of what type? Should it be AC or DC power? At some point, the questions stopped and the answers started to trickle in.

I recognized that the challenge would be great and simply put, snowmobiles aren't cars or boats and to make a practical electric sled wouldn't be the same as a lead-acid conversion of an internal-combustion car.

I would be working with much less space and if the battery distribution wasn't properly considered, the nose would dive down into the snow and the track would spin wildly without forward motion. Furthermore, these machines are well known to be very inefficient, with most of the energy wasted in overcoming track resistance, a considerable hindrance.

I hit the ground running and by late October, I had chosen an ideal chassis for conversion. I chose to convert, rather than purpose-build, to save time, money and as a logical starting point until I understood the dynamics of snowmobiles much better and felt comfortable designing from scratch. I decided to treat this project as a "proof-of-concept" rather than a completed thought and my final word on the subject.

A 1971 Gilson 440 2-stroke snowmobile was chosen (I know, a what??!!) which ironically had a running-but-smoky Kohler 2-cylinder motor which I was very quick to yank out. The chassis was perfect — it had a very wide 18" track that went from the front of the machine to the very back, giving the sled an excellent track footprint to carry the extra weight I would be adding. The frame and tunnel were made of steel, unfortunately a little heavier but worth it since I would be afraid of warping or buckling a lighter-built frame due to the high torque and heavy weight.

It was designed to have a gas tank in the very rear of the machine, which would prove

Family with the Sk-E-Boose in tow

useful for weight distribution since batteries could be mounted in its place. To top it off, the front, although not pretty by anyone's standards, was a great big box and if there's anything a potential EV converter loves, it's a great big box to package all those batteries!

I didn't have an unlimited budget, so I looked around my shop to identify surplus stuff I already own which could prove useful. Given that this vehicle will be expected to always perform in colder weather, I decided to use some of the Saft STM100 (100 amp-hour) Nickel-Cadmium batteries I had left over from the ElectriFly project. I also had a Curtis 1221 controller (72 - 120 volts DC input) so that also formed a starting point.

At 6 volts apiece, I would require 12 Ni-Cads, each approximately 5"w X 10"l X 10"h (totaling 3-1/2 cubic feet) and weighing 27 lbs. each... doable, but with much challenge ahead! I also had a 72-volt lead-acid charger (suitable for an "opportunity charger" in the bush) that would give comfort should I need a boost while I'm out on the trails, so I could see the plan coming together as a 72-volt traction system. A trip to D&D Motors in Syracuse in October yielded a great power plant, a DC series-wound motor at a very reasonable price rated at 27 hp continuous which was a perfect match to my controller.

Add an Albright emergency disconnect, an old GE contactor, a PB6 potbox (governed down to 3,500 from 5,000 ohms), a few trips to Princess Auto Surplus and a DC-DC converter which my good friend Darius Vakili at ElectroCraft built and gave me years ago and voila! we have a complete plan.

Nothing was simple about the packaging of so many batteries. I had to place two in the very back of the machine, three between my knees, four in front of those and three more on top of the electric motor! Oh, and I also found a little spot to put a small lead-acid auxiliary battery (constantly recharged off of the main pack through the DC-DC converter) to power the main contactor and headlights only.

The main thought in my mind was this — I wanted to keep as much weight over the track as possible and as little as possible on the front skis. In the final analysis, I succeeded in placing about 70% over the track! I don't believe that this would have been possible on a newer design of sled without a major re-design.

Recharging in the snow

Using the computer printout from D&D Motors, I chose a gear ratio that maximizes efficiency (about 85% at about 4,000 rpm) at 40 kph, my target "cruising speed" of the machine. This yielded an overall ratio of about 3.5:1 and accounting for the stock transfer case ratio, I chose sprockets for the electric motor and secondary shaft that produced those results.

I modified the stock braking system, which works off of the secondary shaft, saving me time and effort to redesign and fabricate. I had some serious packaging difficulties and had to raise the hood by about 1" to accommodate the required height. The rest seemed to bolt together easily and after about 120 hours, I was finished the "Sk-E-Doo", Canada's first electric snowmobile (with apologies to Armand Bombardier).

Does it work? You bet! It accelerates briskly, as all electrics do, and I cruise at the designed-speed of 40 kph easily. A little slower up the hills and a little faster down them. My range is about 30 kilometers, which is more than adequate for my family's recreational enjoyment. It is much quieter than a gas-powered sled, although there is still gear and track noise, which I think, can be minimized on a purpose-built machine. We have enjoyed many outings with the sled, no incidents to report, and we particularly enjoy the night trips we have taken around and on our lake. The drive train growls when you punch it, which does add to the excitement of the ride.

Remember I said that the motor/controller system is rated for 72 - 120 volts? Well this leads to the second phase of the project that was completed and tested just before the end of the snowmobiling season. It involves the 48-volt "Sk-E-Boose" which is a kid-hauling, grocery-packing, range-extending trailer on skis so that my entire family can go on local excursions.

Like an automotive "range-extending trailer", the machine will operate with or without the Sk-E-Boose and I simply connect or disconnect the trailer hitch and electrical connector when required. The controller "sees" 120 volts if the trailer is connected and 72 volts if it isn't, within the upper and lower limits of the controller. A simple arrangement, it adds about 10 more miles of range and increases my family's enjoyment immensely. Snowmobiling is even more fun when *everyone* gets to go for the ride!

O.K., I take back what I said earlier. I love *electric* snowmobiles!

Thai Company Offers Limited Edition Electric Motorbike

Tigar Motorsales has begun offering 100 Nano Torque limited edition electric motorbikes. "We have introduced the limited edition of the Nano mini motorbikes because of the [Warner Brothers] movie 'Torque,' in which motorcycles play a central role," said Tigar Motorsales special product manager Parida Manomaiphibul.

The company has priced the limited edition Nano Torque electric motorbikes, which are on display at 21 movie theaters in the country, at 24,900 bahts (about $640 each). (THE NATION: 2/9)

Demonstrators Stage Hybrid 'Parade' at CA Ford Dealer

Stanford University's daily newspaper recently reported that San Francisco, CA-based environmental group Bluewater Network last week sponsored a "parade" of two dozen hybrid electric vehicles through Palo Alto in protest against what Bluewater Network event coordinator Rachel Harold said is Ford Motor Company CEO Bill Ford, Jr.'s failure to fulfill his promise of developing cleaner vehicles and encouraging Congress to increase auto industry mileage standards.

The parade reached its final destination at the local Peninsula Ford, where dealership manager Ron Fodrey was confronted by demonstrators urging Ford not to "gamble with our planet."

The newspaper said that Fodrey expressed support for the parade's aims, noting that Ford plans to release a hybrid version of the Escape SUV later this year. "We're all living in this place, we all want to get better gas mileage," said Fodrey. "In the long run, I hope Ford does a better job." (STANFORD DAILY: 2/9)

Yamaha to Offer PAS Lithium Hybrid Electric Bicycle

Yamaha Motor Company, Ltd. plans to offer the PAS Lithium, a new hybrid electric bicycle in its power assist system (PAS) lineup, beginning March 15. The PAS Lithium is equipped with a lithium-ion battery that features "superior high-current discharge capability." Yamaha has expectations of selling 66,000 units of the new PAS series this year.

RECC to Introduce EV Monitoring Software

Reva Electric Car Company (RECC) plans to introduce Portable Electronic Tool (PET) Soft, a new monitoring software for the company's Reva electric vehicle (EV).

PET Soft, which works in conjunction with the Reva electric car's energy management system (EMS), is designed to allow drivers to monitor the vehicle's processes and functions via a Palm Pilot personal digital assistant (PDA), which can be connected to the EMS. Officials noted that the software sounds an alarm when vehicle components malfunction.

RECC plans to publicly introduce PET Soft, which will cost approximately 1,500 rupees (about $30), "in four months time."

New Mexico State Passes Bill Allowing NEVs on Some Streets

New Mexico governor Bill Richardson recently signed into law House Bill 388, which allows for the use of neighborhood electric vehicles (NEVs) on certain streets, roadways and highways. According to the governor's office, the NEVs allowed for public use must qualify as "low-speed," meaning they have a maximum speed of over 20 miles per hour (mph), but less than 25 mph.

Volta of Sarasota Seeks Dealers for Electric Bike Line

The Sarasota Herald Tribune recently reported that Volta of Sarasota, Inc. has begun seeking dealers willing to offer the company's new line of electric bicycles.

Manufactured in Taiwan and "widely marketed" in Europe during the past four years, the bicycle line includes single-gear and five-speed gear-shift models priced at $1,200 and $1,299, respectively. The electric bikes are capable of traveling approximately 30 miles per charge at speeds of up to 15 miles per hour.

Volta of Sarasota owner Piero Rivolta has already launched a bicycle store to help boost sales of the new line, and company division manager Eric Kauk has approached several boat dealers and resort operators who may be interested in renting the electric bicycles to passengers and visitors. (HERALD TRIBUNE: 2/20)

Genxt Power to Launch Electric Bikes in India

Mumbai, Maharashtra-based Genxt Power India, Ltd. plans to officially launch its line of electric and hybrid electric bikes in India in April. Genxt Power will offer three models — the 15,000-rupee (about $331), all-electric GENXT-18T moped; the 50,000-rupee (about $1,104), all-electric GENXT 800M; and the 120,000-rupee (about $2,650), hybrid electric GENXT 800H.

Genxt Power president Vishwas Panse noted that the company, which currently features its bikes on display at roughly 50 area dealers, has already received 5,000 bookings "in a span of three months."

Canadian Professor, Students Develop Electric Bike

Canadian news source Canada East recently reported on the development of an electric bicycle featuring an electrical system that can be operated by three different energy

sources, including manual energy panels, hydrogen batteries, and solar power.

The bicycle, which was developed by l'Universite de Moncton (UdeM) professor Jamel Ghouili with help from engineering students, utilizes dedicated static converters and multi-numeric processors, and is one result of an ongoing joint research project between the electrical engineering faculty at UdeM and the School of Engineering and Architecture in Fribourg, Switzerland.

Canada East noted that companies in Quebec and Ontario have shown interest in manufacturing the bike. (CANADA EAST: 2/17)

EDTA Appoints New Co-chairman

The Electric Drive Transportation Association (EDTA) recently announced the appointment of Honda North America vice president of government and industry relations Edward Cohen to the position of board co-chairman. Cohen is currently responsible for federal and state government relations, in addition to industry relationships in Washington, for Honda.

In his new position at EDTA, Cohen will be responsible for directing the association's activities, primarily through policy, conferences and public education initiatives, as well as monitoring activities of EDTA's public policy, conferences and media relations committees.

Local Vietnamese Automaker Develops Electric Vehicles

Private Vietnamese automobile manufacturer Dang The Minh, together with colleagues from Hanoi City's Gia Lam District, has developed five new 12-passenger electric vehicles. The electric vehicles are said to be capable of speeds of up to 45 kilometers per hour (about 28 miles per hour). Dang The Minh now has "nearly" 50 electric vehicle models ready for production. (VIETNAM ECONOMY: 3/1)

Raser Introduces 500-hp Symetron Enhanced Electric Motor

Raser Technologies, Inc presented a compact 500-horsepower Symetron enhanced electric motor, "a purchased low-cost industrial motor enhanced with Raser's proprietary Symetron technology" at the Clean Heavy-duty Vehicles show in Palm Springs, CA in February.

According to Raser, the prototype motor "has the potential to do the work of two conventional motors in some bus applications." Raser also presented a new P-2 series motor based on Symetron technology that the company believes "may be ideal for use in next-generation hybrid trucks and heavy vehicles that require integrated starter generators for commercial and military use."

continued on page 24

CHECK YOUR BATTERIES

By Lee Hart 7/97

This is the story of Edison Stout
Who wouldn't check his batteries out
His owner's manual left no doubt
And his EV dealer would beg
and shout
But Edison would not check
them out

And when his GFI would trip
He just decided to bypass it
His EV tickled him quite a bit
His door grabbed him when he
grabbed it

Corrosion grew like some disease
Across the tops of the batteries
A putrid rainbow, if you please
Like yellow pus, green cottage cheese
As wires turned to bluish grease
The floor dissolved by slow degrees

Batteries shot (just bought
last Autumn)
His ample range was now forgotten
Charging smelled like something
rotten
The floor like mushy sauerbraten

He'd still be driving it, no doubt
If molten lead had not flowed out
And acid geysers squirt about
Until, at last, said Edison Stout
"All right, I'll check the
batteries out"

But alas, it was too late
Corrosion covers the car, to date
From roof down to the license plate
And Edison suffered a terrible fate
That's just too horrible to relate

So, EV owners do not pout
When asked to check your
batteries out!

Lee Hart
with apologies to Shel Silverstein
for his poem about
Sarah Cynthia Sylvia Stout
Who wouldn't take the garbage out

Local Chinese Province to Operate Electric Buses

The Zhejiang provincial government in China plans to begin operating electric-powered buses in the city of Hangzhou next month. The buses, which are capable of traveling either 280 or 380 kilometers (about 174 or 236 miles) per charge depending on size, will initially operate on a circuit route in the city's West Lake area.

Upon successful completion of the trial, the government expects to utilize the electric buses along the city's other "scenic routes," with plans to eventually operate such buses in "other major provincial cities."

Japanese Man to Travel 'Around-the-Globe' on Electric Scooter

Agence France-Presse (AFP) recently reported that 42-year-old Kanichi Fujiwara of Japan has announced plans to conduct an "around-the-globe" trip on a battery-powered Yamaha Passol scooter in an effort to draw attention to environmental concerns.

Fujiwara's planned trip, which is scheduled to commence March 19 from Japan, is expected to log more than 25,000 miles through 33 countries, ending in Southeast Asia at the end of 2006. Yamaha has pledged both financial and mechanical assistance to Fujiwara.

"I hope this trip will make people think about the natural environment," said Fujiwara.

Maldives to Require Registration of Battery-powered Bikes

The Maldives Ministry of Transport & Civil Aviation has begun signing amendments requiring the registration of imported battery-powered bicycles, which have become increasingly popular among residents. The bicycles are capable of reaching speeds of up to 18 miles per hour.

Transport director general Ahmed Saleem noted that the ministry has yet to set a specific date on which the amendments will be enacted into law. (HAVEERU DAILY: 3/11)

Officials to Allow Segway Use at Singapore

Business HubGovernment officials in Singapore have announced their intention to allow the use of Segway, LLC's two-wheeled, battery-powered Human Transporters (HTs) at the "One-North" science hub in Buona Vista. Singapore trade and industry minister George Yeo said the HTs would only be allowed on "pedestrian walkways and certain roads." If no complications arise, officials noted that they may allow the use of HTs "elsewhere." (CHANNEL NEWS ASIA: 3/12)

NESEA Green Car Club to Host 'Spring Brake' in PA

The Northeast Sustainable Energy Association's (NESEA) Green Car Club will host "Spring Brake," its inaugural event for owners and enthusiasts of environmentally friendly vehicles, April 10 in Boyertown, PA.

According to NESEA, "dozens" of green vehicles are expected to gather for the event, which will offer a "full day of activities," including test-drives in a new 2004 Toyota Prius, a road rally and a visit to the Boyertown Museum of Historic Vehicles.

"The Green Car Club provides a sense of community for people who drive hybrid vehicles or use alternative fuels," said Green Car Club technical correspondent John Murphy. "This rally will give club members a chance to socialize, share stories and join in fun and educational activities...."

Global Electric Motorcars Introduces New Line of NEVs

DaimlerChrysler subsidiary Global Electric Motorcars, LLC (GEM) recently announced the release of its 2005 GEM neighborhood electric vehicle (NEV) line.

The new line consists of four redesigned vehicles featuring new front suspension, wider track-width, "customer-friendly" electrical panels, improved regenerative braking systems and top-speed regulation, improved steering and new digital driver information displays.

In addition to the current options and accessories, GEM said it will introduce several new options throughout the year for the 2005 line, which is expected to become publicly available "towards the beginning of April."

WELCOME ALL!

The EAA board meets on the 3rd Saturday of each month (except December and September) from 8 am - 9am Pacific Time (11 am - noon Eastern Time). All members are welcome to join any of these board meetings. All you need is a telephone, simply dial 1-888-583-9625 and then enter the meeting identification number of 303303.

Don't miss the infrastructure report that begins on page 28.

Errata

We inadvertantly misspelled the name of our EAA Board Chaiman when we credited him for the 2004 EAA Fellow Award article in the last issue. He is Ron Freund. Our apologies to him.

AUSSIE EWHEEL BARREL

I do not have an electric vehicle. But here are 2 photos of the 24v electric drive on a wheel barrel I made up using a salvaged golf buggy motor & controller, actuator is from an army salvage, chassis is made up from old farm machinery, etc. I finished it on my 80th birthday. I thought this would be of interest to you & your readers.

Cliff H. Hansen
Lyndock S.A., Australia

Board of Directors 2004

Chairman
Ron Freund
chairman@eaaev.org

Membership Chapter Relations West
Will Beckett
membership@eaaev.org

Secretary
Scott Leavitt
secretary@eaaev.org

Treasurer
Gabrielle Adelman
treasurer@eaaev.org

Chapter Relations East
Jerry Asher
ChapterRelationsEast@eaaev.org

Elections Board Calendar
Bill Carroll
electionadmin@eaaev.org

Education Program Manager
Kim Rogers
education@eaaev.org

East Coast Coordinator
Karen Jones

Nick Carter

Delegates:
Tom Dowling - *EV Charging*
charging@eaaev.org

Charlie Garlow - *Junior Solar Sprints*
juniorsolar@eaaev.org

Bruce Parmenter - *EAA Technology*
webmaster@eaaev.org

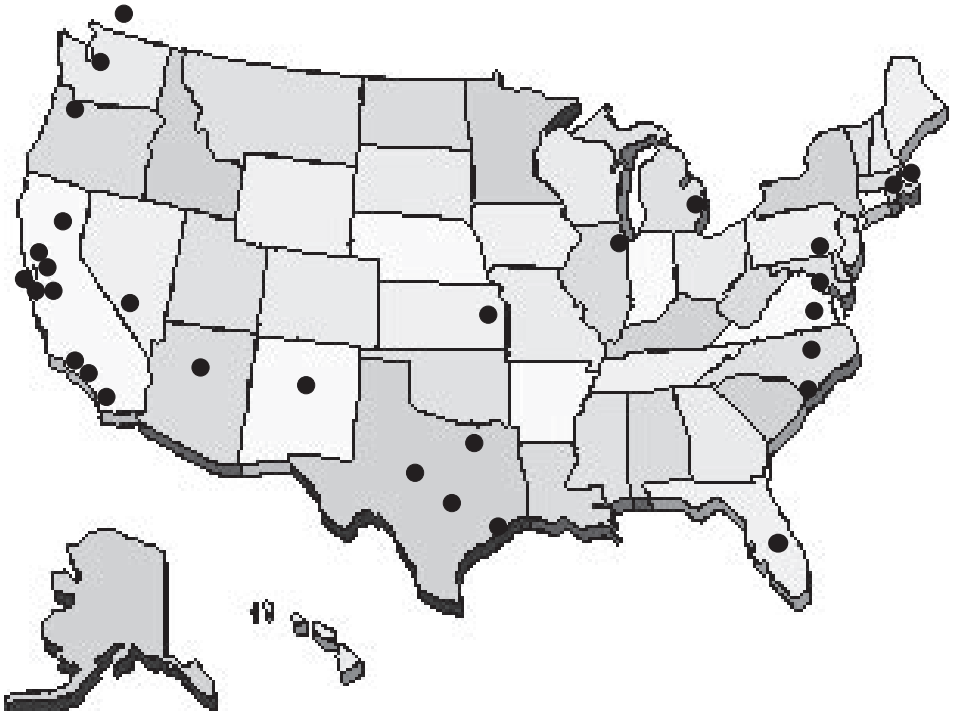
Ed Thorpe - *CE Publications*
ceeditor@eaaev.org

Terry Wilson - *Historian, Awards*
historian@eaaev.org

EAA Board contact:
board@eaaev.org 1-510-864-0662

Notice: IRS requires us to ask for a full disclosure by the donor for donations of $1000 or more. This should include Full Name, Complete Address, Phone Number, and Social Security or Tax ID Number.

ELECTRIC AUTO ASSOCIATION CHAPTERS



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, 349 W. Georgia St., Vancouver, BC V6B3Y4, Canada
Meetings: 3rd Wed./month (except July and August, 7:30 to 9:30 pm
Location: BCIT Electrical Bldg SE1 Cafeteria - see map on website

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)
Web Site: http://geocities.com/sfpeaa/
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)
Web Site: http://geocities.com/sjeaa/
Contact: Terry Wilson, 1-408-446-9357 dongillis@yahoo.com
Mailing: 20157 Las Ondas Way, Cupertino, CA 95014-3132, USA
Meetings: 2nd Sat./month, 10:00 am
Location: 2350 Cunningham Ave., San Jose, CA

SILICON VALLEY EAA (SVEAA)
Web Site: http://eaasv.org/
Contact: Will Beckett, 1-650-494-6922, will@becketts.ws
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.

ELECTRIC AUTO ASSOCIATION CHAPTERS

FLORIDA

FLORIDA EAA (FLEAA)
Web Site: http://www.floridaeaa.org
Contact: Shawn Waggoner, shawn@suncoast.com
Meetings: Varies, see website

KANSAS / MISSOURI

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, stevenslough@comcast.net
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., Gaithersburg, 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 4/1/04. Please check main web page for any changes in current listing. The Electric Auto Association is a 501 (c)(3) nonprofit organization.

By Tom Dowling, CEAA and EAA Board member and Ron Freund, SJEAA and EAA Board member

PROGRESS!

The EV charging infrastructure is alive and well, reports to the contrary not withstanding! In the Bay Area, at several sites, old large-paddle inductive (LPI) chargers were replaced with small-paddle inductive (SPI) chargers that the RAV4 EV can use. The LPI is now obsolete, scrappable material, good only for the power-factor corrected front-end. A 220V only non-isolated charger could be created from this foundation piece.

- A new inductive and conductive site recently came on line in South San Francisco.
- Two other sites that were inductive only are now conductive as well as inductive.
- In the Solano County area, thanks to Ed Huestis (City Transportation Systems Manager in Vacaville), new sites have opened in both Vacaville and nearby Dixon, and more are in progress. Many large-paddle inductive chargers have been replaced with small-paddle, keeping the current fleet moving.
- Thanks to a Clean Air Grant from the Placer Air Pollution Control District, matched 100% by a RAV4 EV driver, and partially matched by Roseville Electric (the local utility), several new sites have been opened in Roseville, along with another in Colfax, and are planned for Auburn, Truckee, Tahoe City, and South Lake Tahoe. This would make reality of that planned "EV Vacation to Lake Tahoe".
- In Southern California, new sites have opened in San Luis Obispo County, and small-paddle installations are planned for 25 locations in the South Coast Air Quality Management District.

So, there is much activity on the charging station front, and there are still hundreds of cars out there actively using the infrastructure. The RAV4 EV retail fleet will be around for many years. Many of the cars were purchased, and those that are on lease can and most likely will be purchased at the end of the leases. There is still a need for drivers to keep informed about the location of charging stations.

NEED DATA!!

The EV1 Club recognized way back in 1997 that EV drivers were the best source of information about charging stations. Databases maintained and published by utilities, charger manufacturers, auto manufacturers, and even by air districts just were never complete nor up-to-date. Many of those host locations and sites are no longer maintained or available, and new sites coming on line are not being added to the databases.

In late 1999 Tom Dowling started publishing an e-mail update, called the "EV Charger News". The purpose was to keep drivers up to date on the status of charging stations, in a more timely fashion than the existing Web-based lists could do.

As more and more of the other lists were no longer maintained or no longer available, that effort grew into a full-blown Web site that was a supplement to the EV1 Club list, with information about conductive charging stations, adding still more current information.

In 2002, Gil Dawson, an EV1 driver from Los Angeles, volunteered to help develop that fledgling Web site into a complete site, so that drivers would have one source to refer to for all charger related information, rather than having to refer to multiple sources. The EV1 Club Webmaster, Dave Kodama, was also instrumental in this effort, and allowed us access to all of the EV1 Clubs materials, photos, etc.

With Gil's help, we've developed the site http://www.evchargernews.com. It's still a work in progress, but it includes all of the known charging stations in California, Arizona, and Georgia, plus a few elsewhere. We're keeping track of about 650 separate EV charging sites. We even include some friendly RV parks that can provide charging on long trips.

WHICH COMES FIRST — INFRASTRUCTURE OR EV?

One EAA "visioneer" would like to be able to connect major West Coast metropolitan areas such as San Diego, greater Los Angeles, Las Vegas, Phoenix, San Luis Obispo, Monterey, the San Francisco Bay Area, Sacramento, Lake Tahoe, Reno, with Chico, Redding, Ashland, Eugene, Portland, Seattle, and Vancouver using redeployed US Postal Service charging stations. Similarly, on the East Coast connecting Key West, Miami, Tampa/St. Pete, Savannah, up the coastal Carolinas, toward Washington, Baltimore, into New Jersey, metropolitan New York, Connecticut, Boston, Nashua and up toward Portland. But first we need to take those small but significant steps, and then fill in the critical gaps between major milestones...

We have several unique features on the evchargernews Web site:

- Tiger Maps, and Microsoft Streets & Trips maps.
- Up to three photographs per site.
- Global Positioning System (GPS) coordinates (lat/long) for out-of-towners and even locals who haven't been to that site before.
- Adopt-A-Charger program — volunteer sponsors for charging sites to keep an eye on things periodically.
- An "I Was There" report form, for drivers to submit after using a site.
- "Emergency charging location" list — password protected list of about 120 residential locations that have agreed to be emergency backup.
- Signage photos.
- Links to an EAA-sponsored driver fund for tax-deductible contributions for public charger maintenance and expansion.
- Google search within the site for keywords, status, etc. *Palm-compatibility for the whole Web site, via AvantGo.
- Search by City name, with city-to-county cross-reference.
- Mailing list (listserve) for immediate driver feedback to webmaster for changes needing updates, also available immediately to other drivers.

We are updating the list frequently and freely share our information with CleanCarMaps. We firmly believe that EVChargernews.com is the most complete and up-to-date source of information for EV drivers. If you know of a public charger that's functional and accessible please drop an email to updates@evchargernews.com.

Point your browser to this site — www.evchargernews.com. It might charge your batteries too!

EAA MERCHANDISE

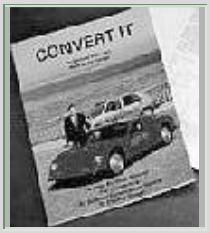
-- General Items --

	*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

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

May 31, 2004
INFINEON RACEWAY, Sonoma, CA, USA
Gates open at 8:00 a.m.
EV racing starts at 7:30 a.m. so you can get a couple runs in before the staging area gets crowded.
Web Site: http://www.infineon.com/
Web Site: http://www.nedra.com/

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 4-6, 2004
3RD EVER EAA ALL CHAPTERS CONFERENCE, Vancouver, BC, Canada
This will be the third annual conference to bring together EAA members from different chapters 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 4, 2004
REV2004!, Vancouver, BC, Canada
Annual Vancouver Chapter EV event.
- EV displays and Ride-alongs
- Electric Bicycle and Scooter area
- Two Electrathon Races
- Miniature EV Tractor Pull
- Smoking Tires (otherwise zero emissions)

Web Site: http://www.veva.bc.ca/

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 19, 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/

August 28, 2004 (tent.)
NEDRA NATIONALS, Woodburn, Oregon, USA
Premiere electric drag race event at the end of summer.
Web Site: http://www.nedra.com/

October 9, 2004
SVEAA ELECTRIC CAR RALLY, Palo Alto, California, USA
32nd Annual Silicon Valley Chapter EV distance rally and display/ride event.
Web Site: http://eaasv.org/

October 16, 2004
SUSTAINABLE TRANSPORTATION RALLY AND FESTIVAL, Amherst, Massachusetts, USA
Pioneer Valley EAA Chapter partipates with other alternative fuel vehicles.
Web Site: http://www.geocities.com/pveaa

November 20 - 21, 2004
GEORGIA EV RALLY, Jefferson, Georgia, USA
Student teams will be competing in the 8th Georgia Electric Vehicle Rally.
Web Site: http://www.eveducation.org/

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

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