Electric Auto Association

CURRENT EVENTS

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My RAV4 EV

By Patricia Lakinsmith, SJEAA member

Who am I?

I work for Monterey Technologies, a local human factors consulting firm doing user interface design, evaluation, and simulation research for NASA and various DoD components interested in developing better human-machine systems. I'm a cognitive psychologist by training. Mostly my work centers on understanding how technology can best be developed to support the user's needs.

I am not what you call a "political" animal, a vegetarian, a socialist, a techno-geek, a car enthusiast, a member of Greenpeace, or any of the other stereotypical labels some might be tempted to attach to someone who drives an electric car. In fact, until I became familiar with electric cars the topic of politics bored me to tears. I am a fanatical recycler and composter, however, and have taken on the job of bringing home my office's stuff to recycle (since our office complex in Santa Clara doesn't do it). I have even installed a worm bin at work for recycling organic stuff like coffee grounds and fruit refuse.

The more I learn about this wonderful technology, the more I love it and the more inspired I am to tell people about it. It's remarkable to me that everyone who has ever decided to lease or buy an electric car refuses to go back to gasoline. It's cheaper and cleaner than any other alternative even remotely close to coming to market. The customer loyalty is amazing; despite what some of the car companies want the general public to believe in the interest of lining their own pockets. I simply want to make choices that are good for the environment, and believe that everyone should have factual information for making their choices.

How / why did I get interested in electric cars?

I've been interested in electric transportation for a few years now, reading what I could find and trying to get smart on the technology. The Internet offered a number of useful sites on electric car technology, and I tried to learn as much as I could about batteries, range, available models, etc. I knew that electric cars were expensive and had not yet been widely produced or adopted by the general public. I knew that it would take people who *could* afford to become early adopters to help speed the transition from earth-unfriendly car choices, to affordable, earth-friendly ones. Sure, I could drive something a lot cheaper (although about $370/month including incentives, amortized charger installation, and insurance isn't bad!), but this seems very reasonable for a car that gets me where I need to go and emits no pollutants.

A springtime trip to Disneyland found my family visiting the Santa Ana zoo where an Earth Day event was being held. There were a number of alternative fuel vehicles there, and I spoke at length with one of the people working there. He told me that electric cars were in high demand but low production, and that the best way to claim one of these vehicles for my own was to get yourself on an auto company's waiting list for a new one.

There are alternatives to new, production EVs, but not many of them seemed like they would work for me. Quite a few handy folks have converted their old gasoline engine cars into electric cars (for relatively little money compared to buying a new EV), but something like that was well out of the range of my abilities and interest. Heck - I'd rather spend an afternoon puttering in the garden

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Photos by Patricia Lakinsmith

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By Dave Goldstein

Forwarding a letter that I have just written to an official of the American Lung Association in New York State, regarding a legislative proposal that would rob EV1s from California drivers and send these used cars to New York instead. <GRRRRR>

Not that we wouldn't mind having some of those great EV1s here in the East (although GM proposes to *hide* them in campgrounds and "remote locations.") But IMO, this is NOT the way to do it! It's about time that GM showed some true EV commitment and stopped playing games with government agencies and the public.

What do you think?

February 19, 2003

Re: New York Shell Game

Dear Mr. Iwanowicz,

It should be evident to the State of New York from the letters that you are now beginning to receive from California EV1 lessees and former lessees, that GM is offering to play a *shell game* with New York. Frankly, I thought New Yorkers were smarter than that.

GM has confiscated these EV1s from California owners by the simple device of refusing to renew leases, despite impassioned pleas from former EV1 owners. Not only is this evidence of *bad faith* on the part of GM in terms of its commitment to California to provide clean Zero Emission Vehicles to residents of that state, but it should be evident to New York that GM now seeks to minimize its commitment to *New York* as well by essentially foisting *used cars* on your state, with no evidence of any intent to manufacture, support, or extend this offer in any manner sufficient to meet public demand or to impact air quality in your state.

If GM were sincere in their desire to show any true commitment to the citizens of New York, at the very least they should agree to take their mothballed "lean manufacturing" EV1 assembly plant *out of storage* in East Lansing, Michigan, reassemble it and commence manufacturing in *upstate New York.* Even though that plant might only require 50 or 60 employees to operate (as it did in Michigan,) this would provide a ripple effect in employment for New York's skilled manufacturing workforce, including automotive suppliers as well as marketing and customer support personnel, while helping to build a *sustainable* market for true Zero Emission Vehicles, that, we are confident, would continue to grow and to improve New York's air quality as well as its economy.

We would urge NYSDEC to reject GM's offer, and to seek stronger evidence of GM's commitment to provide — and to *continue* to provide — ZEVs to the citizens of the Great State of New York.

Sincerely,

Dave Goldstein President, EVA/DC
The Electric Vehicle Association of Washington, D.C
www.evadc.org

February 18, 2003

Re: the fate of your EV1

Hi all—

The New York State Department of Environmental Conservation has issued the following notice. As you can see, this may explain why GM has denied your request to hold onto your EV1. The NYSDEC has indicated that they have assurances from GM that all of the EV1s are "coming off lease" and that none are being taken away from owners.

I have not been able to track down statistic on how may EV1 lessees would like to keep their vehicle vs. how many are ok with the end of the lease.

If there is information available on this I would appreciate learning it.

For those interested in commenting on the "Intent to Approve," please feel free to contact me.

Thank you.
Peter M. Iwanowicz
Director of Environmental Health American Lung Association of New York State, Inc.
www.alanys.org

Intent to Approve General Motor's Alternative Compliance Plan for Meeting NYSDEC 6 NYCRR Part 218-4 Zero Emission Vehicle Requirements General Motors Corporation (GM) has submitted a proposed Alternative Compliance Plan (ACP) in accordance with the provisions of subpart 218-4.2 for the generation of Zero Emission Vehicle (ZEV) credits for compliance with New York State's ZEV mandate.

The New York State Department of Environmental Conservation (Dept.) proposes to approve that plan. The proposed plan includes information claimed by General Motors as business confidential. Therefore, a summary of the proposal is included, as described below.

Summary of General Motors Corporation Alternative Compliance Plan.

General Motors Corporation (GM) will place into service a number of reconditioned EV 1 battery electric automobiles, equipped with advanced Nickel metal hydride batteries. These are vehicles, which have recently come off lease in California, and have been thoroughly reconditioned, and batteries brought up to specific standards.

The vehicles will be placed in service with employees at GMs Global Alternative Propulsion Center (GAPC) in Honeoye Falls, New York. Employees at the site as regular use vehicles, including commuting, errands, family and community use, will use the vehicles. GM will promote the use of the vehicles in high visibility applications by its employees. GM will also place up to 8 EV 1s with one or more New York State agencies.

The Department has been asked to identify the appropriate agencies, with the express desire by GM that this be limited to one or two agencies in close proximity. These vehicles will be for general use by the agency, although assignment by the agency to individuals on a rotational basis (to maximize vehicle use and driver input, exposure of individuals to the technology, and program visibility) would be desirable.

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By Mike Kane mikewkane@yahoo

I was at the workshop Thursday, along with several others. At the end of this summary I'll add my formal comments that were submitted to CARB, but in general the workshop was pretty informal, with the morning dedicated to prepared presentations, and the afternoon an open discussion forum.

Morning presentations were given by EPRI (Electric Power Research Institute) and CalCars focused on need to incentivize plug in hybrids. AC Propulsion also offered a technical comparison of Fuel Cell and battery electric offerings. Conclusion: Fuel Cells are 1/2 to 1/4 as efficient as BEV's and will suffer from similar or more severe range limitations.

Presentations were also given by Jerry Pohorsky (most memorable quote of the day: "we don't need credits, we need cars") and a short presentation by the VP of R&D for Honda America on their Fuel Cell car (The Only Big Auto company voice heard during the day).

The most surprising outcome from my point of view is that auto and oil interests were virtually silent at the workshop. Those speaking up were almost entirely EV drivers or those affiliated with the EV industry. Key points that I took away from the hearing.

- Lots of focus on plug-in hybrids. (Maybe just a reflection of EPRI and Calcars folks attending).
- Many speakers addressed the need to reduce 120-mile BEV range requirement.
- Many speakers addressed need to remove or severely limit NEV credits.
- Several speakers addressed the desire to bring fuel cell and BEV credit multipliers into line with each other.
- Several speakers spoke against adding Hydrogen infrastructure credits.

It's hard for me to say what the impact on CARB's proposal will be, no one on the staff really gave feedback or indication on how they received what they heard. It was obvious that the inputs at the hearing (as far as I can determine, the only public forum for staff input) were very one-sided. Big auto interests seemed to have either decided not to show up, or to stay silent.

My prepared comments submitted to CARB

Comments to the California Air Resource Board Public Workshop to Discuss Possible Modifications to the Zero Emissions Vehicle (ZEV) Regulations 5 December 2002

Ladies and Gentlemen

Over the last decade, California has seen steadily improving air quality, the result of stringent air quality standards and consistent enforcement efforts in applying them. Unfortunately, 2002 marked a reversal of this trend. In fact, a number of complicated factors likely compounded in creating this recent trend, however it is clear that, several regulatory and social factors will lead to a continued worsening of our air quality unless we take action. This reversal, should serve as a wake-up call to maintain vigilance in our efforts to clean our air.

Sales of more lightly regulated SUVs and small trucks have increased dramatically over the past few years, while, at the same time, continued urban sprawl has increased average vehicle miles traveled. Unabated, this trend portends disastrous results for our state, particularly in the already heavily polluted LA region. Unfortunately, given these vehicles typically stay on our roads for 10 to 20 years; much of the damage is already done. In order to simply maintain our current poor air quality, dramatic action is required on several fronts. Incremental improvements in pollution controls for gasoline-powered automobiles will not, on their own, solve our increasing dilemma.

California's ZEV regulations have served as a keystone in providing a regulatory path toward cleaner air. The technology exists today, in fact, it's existed for years, to dramatically reduce our impact on the air we breath, without significantly limiting our transportation options. I am able to achieve, today, virtually all of my local transportation needs with virtually no impact on local air quality. I do this driving an electric vehicle, whose energy consumption is offset by a photovoltaic solar array on the roof of my home in southern California. The vehicle I drive was manufactured by GM 5 years ago, using components developed almost a decade ago, and it easily meets my needs.

The auto manufacturers will tell you that there is insufficient demand to sell these vehicles, and that they are too expensive to build. It is certainly true; that electric vehicles do not meet the needs of every driver and that they are more expensive to produce. However, the auto manufacturers have significantly overstated their claim that they cannot profitably sell these vehicles, in numbers sufficient to meet the current ZEV regulations. Costs quoted by the manufacturers for extremely small runs of hand built vehicles are not representative of volume production costs. Further, the recent market success of the Toyota Prius attests to the fact that there is a significant market segment in California willing to pay a premium for properly marketed Green vehicles.

In fact, the manufacturers themselves have imposed the major inhibitors to a robust electric vehicle market. Models are limited, many are fleet vehicles with few creature comforts; sales channels are severely restricted, vehicles are not available for test drives, buyers need to go through rigorous qualification procedures and then wait long periods before receiving a car, sometimes being told after long waits that the vehicles are no longer available, and vehicles have been withdrawn from the market after very short production runs. Not surprisingly, many buyers are unwilling or unable to go to the extra effort to purchase one of these vehicles or to wait an undetermined period to take delivery. Many more are reluctant to make a significant financial commitment without any guarantee of long-term commitment or support.

Despite these obstacles, most electric vehicles have had unfulfilled waiting lists of buyers willing to pay significant premiums over similar gasoline cars. In order for the Electric Vehicle market to reach beyond these very early adopters, however, the purchase of an Electric Vehicle must start to approximate the ease of purchasing any other

vehicle. What's required is consistent availability of a range of vehicles, which meet the diverse needs and tastes of California drivers.

As long as uncertainty remains about the fate of the ZEV regulations, auto manufacturers will hold back and take a wait and see attitude toward this market. Now is the time for CARB to send a clear message that the rules will stand and be will be enforced. Legal challenges will be vigorously fought, and any portions of the regulations that are deemed unenforceable by a court of law, will be re-written to make them enforceable. I encourage CARB, not to weaken the existing ZEV regulations, but rather to take strong steps to enforce them.

In particular, the issue of banked credits was addressed in the background brief. Many of the vehicles, which generated these credits, were leased on 3-year lease terms with no option for renewal or extension. With the notable exception of Toyota, vehicle manufacturers made these vehicles available only on lease and virtually none are privately owned. As a result we will be in the untenable position in 2005, of allowing the use of credits generated by vehicles that are no longer even in service in California. If we are to have any full-function ZEVs available during the balance of the decade we must address the issue of credit glut.

I strongly urge staff to consider the following rule changes.

- Reduce the value of banked credits over time or limit the number used in any one year. For instance, banked credits could be allowed full value for 3 years after the date the vehicle is placed in service, and decline 25% per year thereafter or their use could be limited to 50% or less of a manufacturer's current year requirement.

- Reduce the value of credits for vehicles, which are taken out of service before the end of their useful life. Clearly, the intent of the program was not to treat a ZEV, which stays on the road for 3years on equal footing with a gasoline vehicle that stays in service for 10 to 20 years.

- For instance, leased vehicles could be granted 10% of the vehicle credit for each year leased. Vehicles, which are sold to the public, could be granted full credit at the time of sale.

In addition, the proposed credit multipliers and options for future compliance as designed will compound the problem of credit glut in the future.

- Fuel Cell multipliers of 40x combined with other options for compliance are likely to significantly delay the introduction of any significant quantity of ZEVs for the foreseeable future. Manufacturers will effectively comply by producing a handful of science experiments, while our air quality continues to worsen. Let's reduce the technology specific incentives in order to provide additional incentives to market currently available ZEV technology.

- The addition of AT PZEVs to the compliance option for Gold Standard ZEVs further dilutes incentives to bring ZEVs to market, while providing little incentive to bring additional Advanced Hybrid Electrics to market. CARB is already allowing the manufacturers to use ATPZEV credits in the Silver Catagory. Let's maintain at least the current gold standard as true ZEVs.

- Refueling infrastructure is important to ZEV market development, however, further reducing ZEV requirements to incentivize infrastructure is not the best way to bring about any significant market changes. If staff feels compelled to add this category, infrastructure qualifications should at least be fuel neutral, allowing credit for Electric Vehicle charging as well as Hydrogen refueling infrastructure, and in both cases, only for publicly accessible infrastructure.

Finally, the issue of ZEV tiers needs to be addressed. Particularly, the range requirements for BEVs. Staff's recommended range of 120 miles for a full function BEV will severely limit the market, by necessitating unnecessary costs on manufacturers. If vehicles were driven only the approximate 250 workdays per year, a 120-mile range would equate to 30,000 miles per year. This is more than twice the average annual vehicle miles traveled, and certainly an onerous requirement in light of the 12-15,000 annual mile limitations imposed on many gasoline vehicle leases.

Clearly, changes to the current ZEV regulations are required in order to ensure it's enforceability, however as written, the current proposal, is likely to result in the near elimination of even the current meager ZEV sales for the next several years. The auto manufacturers have had 12 years to comply with the regulations, however they have worked instead to frustrate them. Given the recent increases in vehicle size and average miles traveled, it is imperative that we act now, not to provide fuzzy incentives toward ZEV adoption a decade or more in the future, but rather to increase incentives to bring available technology to market in the near term.

Thank You for your time.

By Lee K. Galbraith, Ph. D.

Auto manufacturers are coming out with hybrid cars, but are they the right hybrids?

Hybrid cars are suddenly appearing on the market and are becoming popular not only with the public, but also increasingly with auto manufacturers as well. Why is this? It appears that hybrid technology is, at least for the time being, the easiest path to greater fuel mileage combined with lowered emissions.

Why? Because the internal combustion engine (and indeed most heat engines) works best in a narrow range of speed and power output. If operated at higher or lower outputs, fuel efficiency goes down and emissions go up. But a car requires a wide range of power levels at different times, and so the internal combustion engine is really a poor match in terms of efficiency. The average car needs around 100 horsepower to accelerate from 0 to 60 MPH, but only 10-20 hp to maintain a steady 60 MPH. The engine has to be sized at 100 horsepower to give reasonable acceleration, but most of the time it is operating at only a fraction of this power.

That means that if the engine is optimized for good acceleration, it is going to be operating at suboptimal power most of the time, and efficiency will be less than optimum, too. (Because of the high internal friction in typical internal combustion engines, efficiency at low power is much less than at peak power). Furthermore, this extra power needed for accelerating is throw away as heat in the brakes whenever the car is stopped, which makes city driving less fuel-efficient than highway driving even though average speeds (and drag) are less.

Ideally, if you want to build the most fuel-efficient car for freeway speeds, you should size the engine for the actual steady-state horsepower requirements (on the order of 10-20 HP). Obviously, though, this car will be a really sluggish performer. It may run fine at 60 MPH, but it will take almost forever to get there. What is needed is some kind of boost power to provide the brief "kick" needed for acceleration.

This is where hybrid technology enters the picture. Suppose we use an electric motor to provide the boost power. Electric motors can put out enormous amounts of power for their size for short periods of time.

At lower power outputs, they can also run at very high-energy efficiencies (over 90% for brushless DC motors) with hardly any heat generation. If we can somehow couple such an electric motor to the wheels of a car and also add the steady output of a small internal combustion (IC) engine, we can get the best of both worlds. We can run the IC engine at a steady speed and power, at which it gets the best fuel efficiency and lowest emissions (since the catalytic converter works best under steady-state conditions), and have enough power for freeway cruising.

The electric motor is only called upon for acceleration, and perhaps some low-speed cruising around the neighborhood. The combination of a small IC engine and operation at its optimum power greatly improves fuel efficiency.

Actually, it gets even better. When we accelerate a car, it stores kinetic energy. If we can capture that energy while slowing down, instead of wasting it as heat in the brakes, we can get even better fuel efficiency. It turns out that an electric motor can be turned into a generator for just this purpose. (This is called regenerative braking).

Putting this together with the small engine results in hybrid vehicles getting 50-80% better gas mileage overall than the same vehicles with only IC engines sized for the same performance, and with lower emissions. It's this kind of improvement that has wakened up the auto companies.

But aren't hybrid cars a lot more complicated? After all, a hybrid vehicle not only needs an IC engine, it also needs: an electric motor, a transmission, a battery to store energy for the motor, a generator (for regenerative braking and to recharge the battery when needed) and a control system for all this. But notice: a standard, non-hybrid vehicle has: an IC engine, an electric motor (to start the engine), a transmission, a battery (for the starter and electrical accessories), a generator (alternator) to recharge the battery and run the accessories, and a control system (engine computer). In other words, a standard car has exactly the same number of components as a hybrid car! (The components are just sized differently and used for different purposes).

So, it shouldn't be any more difficult to manufacture a hybrid car than a regular car. The expense comes from having to resize and redesign the components. The electric motor/generator must be bigger and more powerful, as does the battery; the transmission has to be designed to work with both an IC engine and the electric motor/generator. But the extra cost and weight of the motor and battery are offset to a large degree by the smaller and simpler IC engine needed. Indeed, if the hybrid design is of a type known as a "series hybrid", it can actually be simpler than a standard powertrain: one can eliminate the transmission (letting the electric motor and control do all the work), and just use a simple fixed reduction gear.

A Missed Opportunity?

When we look at hybrid cars presently in the market or on the auto manufacturers' drawing boards, we note a decided bias in favor of the IC engine. It is as though the public is "spooked" by any suggestion that the car is an electric car, with all the supposed attributes of short range, sluggish performance, etc. So, the hybrid car marketers reassure everyone that the car is really an enhanced gas car, and although electric, never has to be plugged in and can run indefinitely as long as gas stations are available.

Apparently, no one thought to ask if people would really mind plugging their cars in, especially if they could save money and avoid most trips to the gas station by doing so. Of course, with a pure electric car, one has to plug in the car to refuel, and range is limited to 50-100 miles with present state-of-the-art batteries. But this is not really a limitation for most driving. Studies have shown that 40 percent of all car trips are less than 5 miles, 92 percent are under 25 miles, and 85 percent of drivers drove less than 75 miles per day.

Surely it is not overwhelmingly inconvenient to plug in an electric car each evening for an

overnight recharge that will cover all the next day's driving in most cases. Of course, there are those occasional but important cases where one needs to drive more than 50-100 miles, as well as the real possibility of running out of "juice" during a particularly harrowing day of errand-running, that intimidates the average person when electric cars are mentioned. Hybrid car technology offers a definitive solution to these worries: use the onboard IC engine to recharge or run the car when the batteries are depleted.

We have come closer to true sustainability (defined as the ability to do tasks without using up the earth's finite resources) with hybrid cars, but are not there yet. As long as hybrids are of the present "mild hybrid" design, emphasizing the IC engine, we have not yet weaned ourselves away from dependence on fossil fuels. But if the hybrid concept is pushed just a little further in the direction of emphasizing the electric motor and battery, we can get sustainability. How?

By building what might be called "plug-in hybrids": designs with powerful enough electric motors to handle the whole driving task, and battery packs large enough for the majority of daily errands, say, 50-70 miles per charge. Then the IC engine can be scaled down to sustain steady freeway speeds (15-20 hp). The engine would not have to be run very often (reducing maintenance and trips to the gas pump), but it would be there when needed.

Most of the driving would be done on electricity, which potentially can come from renewable sources. The car would be plugged in each night for a recharge when normal electrical demand is low (and cheaper rates are available in many areas). The capacity of the electric utility grid would not be strained because excess capacity is already available at these times; indeed, the utilities would welcome the prospect of selling more electricity and "load-leveling" at the same time.

The technology is already here. Thousands of electric car enthusiasts are driving standard automobile models converted to run on pure electricity with off-the-shelf components totaling a few thousand dollars. They are quite happy with the range and performance they are getting. Removing a hundred pounds of batteries and adding a hundred-pound IC engine-generator pack would produce a "plug-in" hybrid. The Toyota Prius already has an electric motor powerful enough for the job, and indeed some people are talking about adding extra batteries to a Prius and removing the engine to convert it to a pure electric car.

The "plug-in" hybrid would truly be a bridge to the future. The first models could start with IC engines running on gasoline or diesel fuel. These could be upgraded to Stirling engines for even better fuel economy, or gas microturbines if these become cheaper to manufacture (both can run on any fuel, including renewable fuels). There is a lot of talk about fuel cell cars and hydrogen as an energy source. If the fuel cells are sized to the 10-15 kilowatts needed for a plug-in hybrid, rather than the 100 kilowatts being contemplated to run the car directly, they would be a lot cheaper. And if hydrogen becomes the preferred fuel, it's still easier, cheaper and more energy-efficient to use electricity for most of the car's needs, with hydrogen refueling being necessary only for long trips where the inconvenience and expense have less impact.

So, two cheers for the auto industry for developing and marketing hybrids, but let's reserve the third cheer for the time they really "get" the hybrid concept and bring out "plug-in" models. Then the clear path will truly exist to have our transportation needs met without dependence on foreign oil, and eventually, without fossil fuels altogether.

LEE K. GALBRAITH is a Ph. D. physicist and inventor who works as an independent consultant in electronics and optics, but whose main avocation is in the areas of "green technology" aimed at shifting society away from using up irreplaceable resources

Over his long career he has worked in low-temperature physics, oceanography, solar energy, analog and digital systems design, lasers and fiber optics. He is the original designer of the Surfscan™ line of wafer inspection tools manufactured at KLA-Tencor Corporation. He presently resides in Santa Clara, CA.

Shell Game, continued from page 3

Both GM and Government drivers of the EV 1s will be required to complete log sheets and questionnaires for the vehicle operations, to provided feedback on the vehicle technology. Information collected will provide real world data regarding advanced EVs in the northeast climate and roadways. Vehicle performance data and driver response will provide information useful in continuing the development and advancement of zero and advanced emission technology.

GM will place chargers at the GAPC and State Agency fleet locations to serve the recharge needs of those vehicles. GM may place additional chargers at strategic locations in the Rochester area, and potentially additional chargers to extend the state fleet range. Additional chargers placed in this manner will generate additional program credits for GM.

GM has indicated its intent to place into service a number of Neighborhood Electric Vehicles (NEVs) at various locations in New York State. These vehicles are being placed in restricted use areas, such as campgrounds, parks, etc. GM has projected introduction of gasoline Partial Zero Emission Vehicles (PZEVs) in New York during the planning period of the ACP. These are gasoline vehicles, which are certified to Super Ultra Low Emission Vehicle tailpipe standards, meet California's Zero evaporative emissions standards, and are provided a 150,000-mile emissions system warranty.

GM has committed to offering for sale or lease in New York any advanced technology vehicle models that GM sell or leases in California during the term of this ACP. General Motors Corporation will earn Zero Emission Vehicle credits through the conduct of this alternative compliance plan. Credits earned will be sufficient to offset requirements for ZEV credits under the ZEV mandate included in 6NYCRR 218-4.1. In addition, under this Alternative Compliance Plan, GM will earn sufficient credits to carry forward into future years, after the term of this ACP, to be used as determined by GM.

CONVERSION WORKSHOP, STEP 15
LOW VOLTAGE WIRING, MATERIALS & LAYOUT

By Michael P. Brown, © 2003

In the last issue, we discussed how to connect the donor vehicle's existing electrical system to the various EV components and how these components were wired to each other. In that installment, we were talking about current paths among these various pieces. This issue we will talk about choosing wires and connectors, and planning your wiring layout.

Also although the title says low voltage wiring, there will be some instances where these wires will carry traction pack voltage at low current levels. We will talk about the high voltage/high amperage cables in later article.

Size Matters

The first step in connecting two components with a wire is to pick which gauge wire to use. If a wire is too small to carry the load that is placed on it, the resistance in the wire will cause heat, which could cause failure or fire. The wire gauge size is determined by how many watts (amps x volts) the wire is expected to carry continuously over what distance. There are charts that will help you find which gauge to use in electrical handbooks, manufacturer's catalogues, and on the Internet.

I have found that 16 ga. wire is good for most EV applications except DC-DC converter output to the battery and battery charger output to the battery pack. In those cases, I use 10 ga. wire.

Make sure that the vehicle's existing keyed 12-volt positive wiring is the right gauge for the new loads it is expected to carry. If you feel that it is too small, you might want to use a load-carrying relay is closed by the 12-volt positive signal from the ignition switch, bringing 12-volt positive current from the battery to the loads through a wire large enough to handle them.

Let the Color Be Your Guide

Once the proper gauge wire for the job has been determined, we have to establish a way to identify each wire's purpose. This is important when you are first wiring the EV to avoid confusion and mistakes that - at least - might keep the car from running when you turn the key for the first time. At worst, they might damage a new component due to mis-wiring.

Most important is being to identify a wire and know its function at some time in the future when you are troubleshooting a failure. There is nothing worse than a conversion EV that has been wired with one color wire. The way to avoid this problem is color-coded wires.

You probably noticed when you were disconnecting the wires from the engine before you removed it that each wire's insulation had a different base color, and most of the time had a stripe or band of another color. This is a color code.

This color code is also found in your factory shop manual's wiring section, which is helpful when tracing the wire back to the fuse block or ignition switch. It is your job to maintain this color code when extending the wire's length to reach the location of the EV component it will be operating.

Continue the color code by using a new wire whose insulation color matches as closely as possible the original wire's color. To duplicate the colored stripe or band that was on the insulation, use model paint or automotive touch-up paint that matches the stripe or band. Paint a few bands of your own on the new wire near its ends if it's a long wire, or the full length if it's a short one.

If you can't match the original wire's insulation color, use a wire color you have available to give you the length you need. Be sure to note any such changes you make in your Project Notebook to avoid future confusion. (I don't want to hear anyone say, "What project notebook?" Document everything.)

You will have to add some wires to the conversion when you hookup the EV drive system. Be consistent with your wire colors when you do this. For wires that have the same function as the car's existing wiring, such as 12-volt positive and negative wires from the battery or the keyed 12-volt positive from the ignition switch, use wires with the same color code as the factory wires for those additions.

For new control system wires, use one color for all wires carrying the battery pack positive voltage, another color for all wires carrying battery pack negative voltage, and so on. As always note these wire colors and their meanings in your Project Notebook. In addition, use colored pencils to draw a wiring diagram of the EV drive system in the notebook for future reference.

Connections

If we are adding another piece of wire to an existing wire, or making up a new wire to connect two of the new drive system components, we need a way to make a durable connection. Just twisting the bare ends of two wires together and wrapping the joint with an excess of electrical tape does not make a good splice. Attaching a wire to a component's terminal by sandwiching a bare wire end between a mounting screw and the terminal is not the way to make a lasting connection. Save these methods for the emergency field repairs needed to get you home after a failure on the road.

The proper way to join two wires or attach a wire to a component terminal is the solderless crimp-on connector. These handy little parts come in many sizes and types. There are closed or ring terminals that will fit terminal studs or screws from # 4 to ½" diameters. Male and female flat quick disconnects are available in sizes ranging from 7/64" to 3/8" wide.

These connector types, which are only two of many types available, are the two styles I use the most. For joining two wires, use a butt connector, which is a metal tube like the barrel of the connectors described above covered with an insulated jacket. To use, place the bare ends of the wires to be joined

the opposite ends of the butt connector and crimp.

Buy a good quality connector for the best results. The insulated jacket on the crimping part of the connector is made of either PVC or nylon. Try to get the nylon type if possible, as they take a tight crimp without the insulation cracking.

Believe it when it says solderless and don't try to solder the connector to the wire after you crimp it on. You will only burn the insulation on both the wire and the connector, and might weaken the wire if it gets stiff from solder "wicking" up the wire's insulation above the place you are trying to solder it.

There are three steps to getting the connector permanently crimped to the wire. The first step is to use the right size connector for the size of wire you are using. The insulated jacket of the connector is color coded to indicate which wire gauges it fits: red for 22-18 ga. wire, blue for 16-14 ga. wire, and yellow for 12-10 ga. wire.

Using a connector that is too small for the wire it's being installed on leaves some of the wire outside the jacket which looks sloppy and doesn't let the wire inside the barrel far enough to make a good crimp. If the connector is for a larger size wire than the wire it is being crimped onto, this will result in a loose crimp because the barrel won't compress enough to make a good crimp on the small wire.

The second step is stripping the right amount of insulation from the end of the wire, about ¼". Stripping off too little insulation from the wire will result in less contact between the wire and the barrel of the connector and a weaker crimp. If too much insulation is removed from the wire, bare wire will poke out the contact end of the connector, which on a ring type connector will interfere with the fasteners used to hold the wire to the component's terminal. If too much wire is crimped into a flat quick disconnect connector, the excess wire on the contact end will keep the two connectors from locking together properly.

The third step is to use a good crimping tool. A good crimper has oval shaped crimping openings in its jaws that are color coded to show which size connector that they are to be used on. Crimp the connector to the wire with this pair of openings.

Then move the connector/wire assembly to the part of the crimper jaws that has half of a oval on one side of the jaws and a projecting crimping stud on the other. Squeeze the crimping tool until the crimping projection leaves a deep dimple in the insulation. Test the crimp by holding the wire and giving the connector a hard tug.

All Together Now

Now that we understand the importance of color codes, discussed wire size, and learned how to select and install crimp on connectors, it's time to run some wires.

As we look under the hood of our almost completed conversion, we see the components that we have mounted around the edges of the engine compartment. Now is the time to connect them together with wires so they can do their job.

Suppose we have one component in the right front corner of the engine compartment that needs to be connected to another component in the left rear corner. Just run a wire of the proper size directly across the engine bay from one component to the other component and you're done, right?

Then the right front corner component needs 12-volt positive current from the auxiliary battery in the left front corner of the bay. So you run another wire across the front of the engine compartment to the battery and its done, right? You keep running wires in this manner until everything is connected and you've got the low voltage wiring done, right?

Wrong! What you've got is what I call "the explosion in a spaghetti factory effect". Wires running in every direction by themselves, with no visible order, flopping around unsupported, interfering with access to other components, and in general, an accident waiting to happen.

The right way to do the low voltage wiring takes a little more time, thought, and wire but gives you a neat professional looking wiring job and a great deal more reliability and safety.

Wire It On Paper First

Start by drawing picture of the inside of the engine bay, with the components in their places. Then, using your colored pencils, start drawing in the wires one at a time. Start with the 12-volt keyed power wire. Determine how many of the components need this power to operate.

Since all additions to the vehicle's existing electrical system should be fused, maybe the wire from the igniting key should go to a fuseblock, with the wires to the components starting at the fuseblock.

If there are several components in a line that are connected to the fuse block, don't run a separate wire to each component. Instead, daisy chain the components together with a series of "taps" in one wire. A tap is made by stripping a ½" of insulation from the ends of the two wires being tapped. One wire leads back to the fuseblock, and the other proceeds to the next component in line. Twist these bare ends together, slip a connector of the type you need with a barrel that fits over the twisted wires properly, and crimp it to the wires.

Draw the fuseblock and wire taps into your wiring diagram, and stay with this one wire until you have connected it to all the places it is needed. Repeat this procedure until you have wired all the components together.

When you have finished your diagram, go over it one more time to make sure that each component is wired into the circuit according to the manufacturer's instructions and that all polarities are correct. It's easier to correct a mistake on paper than on burned wires and blown components.

Now you have your supply of the correct gauge of wire, proper connectors, and a good crimping tool, and you have planned your wiring colors and routes. Next time we'll talk about some tips and tricks for doing the actual Installation of the wires in the car.

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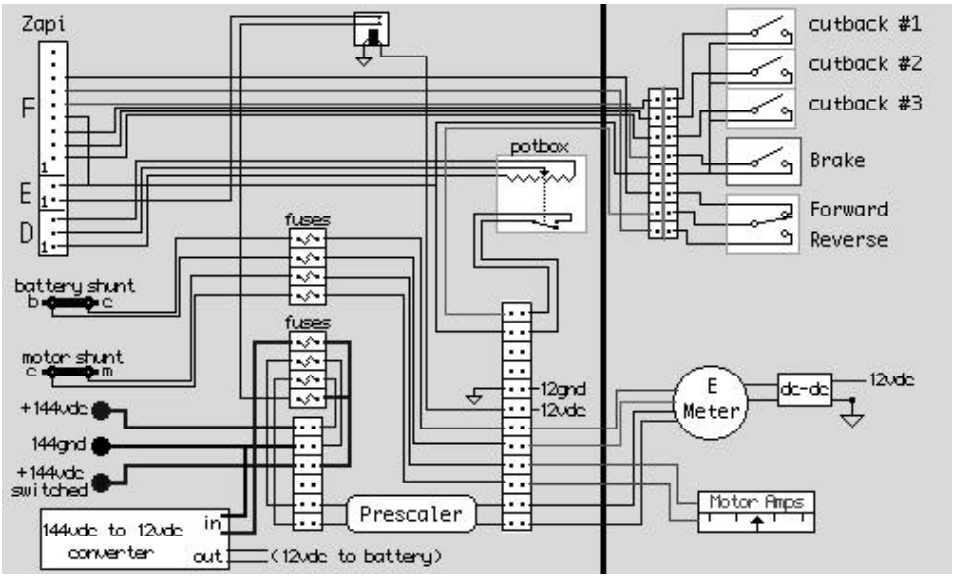
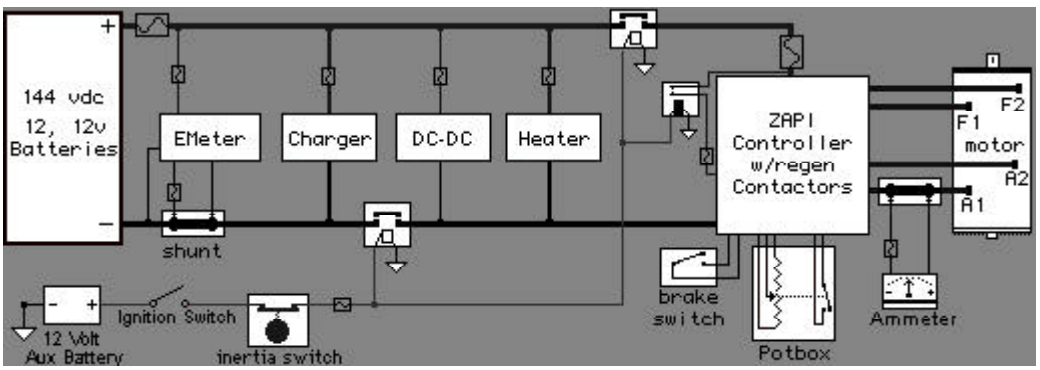
Examples provided of documented wiring of Zapi controller EV layouts. Originals have color notation for wiring.





AC VS DC MOTORS

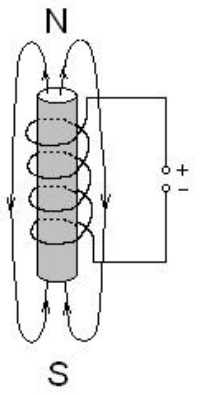
By Victor Tikhonov, OEVA member

Many Evers probably have heard AC vs. DC debates. For many though it is hard to grasp the essentials because good enough understanding of technology is often missing. It is no surprise that few people can tell how exactly AC motor works. In this series of articles I will concentrate on AC machines most commonly used in EV. This will be an exclusively induction machine. Occasionally you will encounter mentioning of synchronous machines but they are not used as widely as induction ones. Don't worry about definitions now; we'll get there. Also for clarity I will often refer to common DC motors for comparison, this will help understanding the differences. I'll try to avoid math and formulas as much as possible without sacrificing clarity. Will start with very basic so if you get lost, you can always come back as far as needed to read over and catch up. So…

Any electric machine (motor) used to produce mechanical movement using electricity is exploiting phenomenon known as magnetism. To be more precise, this is the interaction between magnetic fields. Two magnetic fields can physically attract or repel the each other, and this is basis for any kind of motor operation principle, AC or DC. Without unnecessary details let's review the principles.

As we know, if you pass electric current through a conductor, magnetic field is created around this conductor. More current requires a larger and stronger magnetic field. If we arrange conductor in a coil, winded around "magnetic field conductive" material like iron, the imaginary lines representing magnetic field inside the coil (called magnetic flux) become parallel and dense, all facing one direction. The lines are most dense in the places where magnetic conductivity is the best, i.e. iron core is present. What we've created is an electro-magnet, which acts just like a regular permanent magnet as long as we keep supplying the current through the coil, and the current value is constant. For practical purposes it is important to remember three things:

1. The magnetic field strength is directly proportional to the current through the coil. Double the current – and electro-magnet is twice as strong.



2. What I just said above is valid only up to some point, called magnetic saturation, meaning further current increase won't make proportionally stronger magnet anymore. See it as iron cross section can contain only so many "flux lines" running through it. If you want stronger magnet and have extra amps at your disposal, you must increase core size.

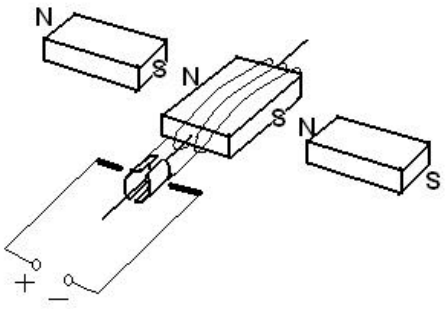
3. The current through the coil (and so magnetic field in the core) cannot appear and disappear instantly. It takes finite time for current to reach a maximum value when voltage is applied, and reduces to zero when voltage is removed. Accordingly, magnetic field will grow and collapse with certain rate as well. More iron – slower the process.

Just as permanent magnet, electromagnet will have two "poles", places where flux lines entry the iron core, and exit it. If we place another permanent or electro-magnet magnet coaxial to the first one, its core will be attracted or repelled by the first core, depending on what poles are facing each other (which in turn depends on the direction of current flow, or polarity of voltage on the coil.

If we attach a electromagnet to a stationary point and manage to keep supplying the current to another electro-magnet while allow it to move, this is the principle how DC motor works. (Variations where stator or rotor consists of permanent magnets are not relevant for now). Well, we almost created well known DC motor: several electromagnet are arranged in circle stationary, and several others – in rotating part (rotor) The current is delivered to stationary electromagnets and with the help of commutator – to the rotating electro-magnets. Arrangement is such that when current flows, there are always pairs of magnets attracting each other and thus rotating rotor trying to stay in front of each other. As they approach this position, commutator re-connects the supply to another (next) pair(s) of magnets and the rotor keeps rotating, creating mechanical torque.

The point of this crude description of DC motor operation is to remember that attraction between electromagnets makes it run, and is fundamental for understanding motors in general. AC motors function on the same principle, the difference is the methods and means of delivering energy to electromagnets.

Well, we're close to unleashing a motor operation. It's been probably a long time, but you may remember seeing this picture somewhere. This is to illustrate how DC motor works. Actually such simple arrangement won't work without initial kick, but all we need is illustrate important principles applied to AC motor as well.



So, in this case we have a source of magnetic field stationary attached to the common fixture. In this case the source(s) are two permanent magnets. In real motors they often are electro-magnets. In the middle we have a core with winding on it, which is able to rotate around one axis. (For the sake of discussion we omit details like the fact that the core is not really one solid slab of iron, and also omit discussing reasons for it). Finally, the wire wound around this core and connected to a couple of hand rings attached to the same axis as core and thus rotating

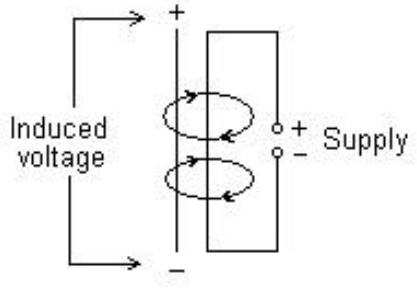
with it. Brushes touching half rings are connected to external voltage supply. Rings and brushes are just means of connecting the coil around core to the voltage supply and also to change direction of the current through the coil. So:

Once the voltage is applied, the current through the coil wire flows. This makes the core electromagnet. Polarity of the field is shown on the picture, this is "stable" position of the core because S and N poles of magnetic fields on both sides attract. If initial position of the core is not horizontal, the core would rotate to this position thus creating mechanical torque. In real motors there are more than two poles and commutator rings supply the current to certain coils such that there is always not quite stable position and portions of core continuously being attracted to magnets (electro-magnets), but this is not relevant at the moment. The critical point is that rotating core must be supplied with current in order to become electromagnet and create magnetic field around it. This field reacts with the field of magnets around and rotating force results.

Exactly the same happens in AC motor.

Before we go further we have to understand another phenomenon, called induction. If an electric field (flux lines) cross a conductor, there is a voltage "induced" on the ends of this conductor. "Crossing" here means changing magnetic field conductor is in over time. It is so important for further understanding, let me rephrase and repeat: if you have a conductor within magnetic field of a magnet or electromagnet, and the field strength (amount of flux lines) seen by conductor changes, this will induce the voltage on the ends of this conductor.

In this figure, an induction phenomenon is illustrated. As soon as voltage supply connected to a right conductor and the current start flowing, magnetic field is



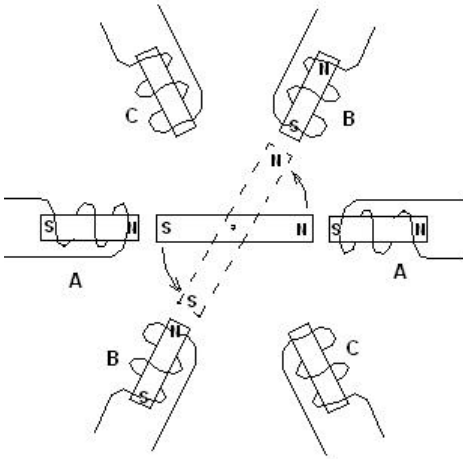
created around this conductor. We already know this, and the fact that we can increase the field by making conductor as a coil and placing iron core in it. What's new is that within the reach of the magnetic field there is another conductor. If we connect a voltmeter to it, we can detect voltage on it. And, if this conductor is arranged in closed circuit (like ends of it are connected through a resistor or directly shorted), the current will flow.

Again, two critical things to note:

1. The voltage is induced by **action** of crossing the conductor by magnetic field, so amount of flux lines mist change in time to induce the voltage. If you place the conductor in the strongest field but hold it still (so no field **change** takes place), no voltage will be induced. By the way that's why DC transformers do not exist – while magnetic field of one conductor (coil) crosses another conductor, the field strength is constant.

2. Means of changing the field seen by left conductor are not in principle relevant. You can change the field strength by varying the current through the right conductor so field size grows, or you can physically move conductors relative to each other, or both. This is why AC line voltage, for example, can be transformed – for 60 Hz the magnetic field appears and collapses 120 times per second, so since change in time takes place, voltage in any conductor within the reach of this field, is induced. Understanding this is critical for understanding electrical slip in AC induction motor.

What will happen if we put permanent magnet in the place of core (will call it "rotor")? Well, we no longer need to supply current to this rotating part, because this magnet already has magnetic field around it. If we put stationary electromagnets around, the rotor will attract or repel to the electromagnets, which are energized. Imagine six pairs of electromagnets around such rotor, like on this picture. Let's supply the voltage to two electromagnets labeled "A" with such polarity that resulting magnetic field has direction shown on this image. (Usually both coils "A" are connected



in series, will omit this for now). Granted, the rotor immediately will be attracted to these electromagnets and will get into position shown with solid line. If we disconnect the voltage from coils "A" and connect them to coils "B", the rotor will rotate 60° CCW and get into position showed by dashed lines. Same situation happens with electromagnets "C". Now to keep the rotor rotating will need to energize coils "A" again, but with reverse polarity, so approaching S and N poles of the rotor will keep moving the same direction. The same applies to "B" and "C" coils. In other words, we should supply the coils sequentially, each pair with AC voltage.

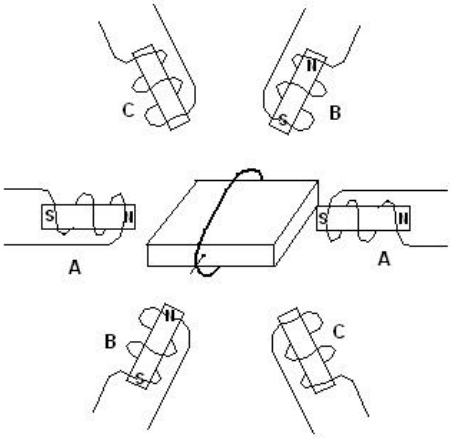
This will keep the rotor being attracted to electromagnets, turning, thus creating mechanical torque. To avoid jerkiness in the rotor rotation, every pair of electromagnets should pass the rotor on to the next pair smoothly: as the current through the coils "A" is fading, it gradually should start flowing through the coils "B". The currents are overlapping in time. As you realize, this can be accomplished with 3-phase sine wave current passing through the coil. It makes magnetic field "rotate" rather than suddenly appear on one spot and collapse in another.

Apparently, the frequency with which we complete sequential energizing all the coils with both polarities exactly determine the rotation speed of the rotor. Well, we've created a variation of synchronous AC motor now. Note the fundamental difference from DC machine: now there is no need to supply the current to any rotating parts, so there is no commutator and brushes. We have to commutate the voltage applied from outside to the coils now (by external means), but this

is different issue, and not part of the motor anymore.

If this is understood, let's take it one step further and modify the rotor of our previous example.

This time will have an iron core and a coil shorted to itself. The coil consists of just one turn, as on this image. (For clarity the rotor is shown at the slight angle, but basic arrangement is the same as on the previous figure. Also, real rotors have many shorted coils, and the rotor core is not a flat slab of iron).



Let's try to energize the coil pairs "A", "B" and "C" in a sequence, with 3 phase sine wave voltage (thus current), exactly as we did before. What happens now? Magnetic field will rotate around as in previous case. This field is crossing the core and so the conductor on it (one turn coil). We already know that it will induce the voltage on this conductor, and since it is shorted to itself, the current through it will flow. So, what is this core rotor with a coil around through which the current flows? Plain old electromagnet! We just supplied energy to the rotor single turn coil (induced current in it, thus the name of such motor – induction) without touching this coil, making the rotor electromagnet. The rest of operation is almost the same as in previous case with permanent magnet, only now we have electromagnet instead. This "almost" means we have something new: in order to keep the current flowing through the single turn coil, electric field crossing it must change in time. What happens if we externally rotate the rotor with the same frequency as we rotate electric field around with 3-phase supply? There would be no relative position change, and thus no induction will take place. So in order to get induction going we need either slow down the rotor compare to the external field rotation, or speed it up. This will ensure that the single turn coil really perceives changes (in time) of the magnetic field because the field rotates faster or slower. So the end result is that rotating field makes the core an electromagnet, and rotates it around, but the rotor rotation speed is slower than magnetic field by the coils "A" "B" and "C". This difference is what is called electrical slip, and is necessary to make a rotor an electromagnet, so it's newborn magnetic field can react with the field of the stator coils and create mechanical torque.

What happens if we'll rotate the shaft slightly faster than the frequency we supply? The polarity of the voltage induced on the rotor coil changes to opposite (the stator magnetic field crosses it now from the other direction), so instead of consuming the energy (reducing the voltage on the stator windings by the field

continued on page 16

By Eric Ryan, Director, EV Challenge (www.evchallenge.org)

As many of you may realize, Georgia is one of the leading states in the nation when it comes to EV technology. Surred largely by a push to clean Atlanta's air, businesses and the state have joined forces to create a variety of programs to promote EVs.

One program that grew out of business/'state partnerships in the highly successful Geogia EV Education program. Begun several years ago with a handful of schools, the program's recent rally included seventeen schools from four states. The article below is a press release on the rally. For more information on the Georgia EV Education program, contact Alan Shedd at Jackson EMC (706-367-6194).

Georgia's Fifth Rally a Great Success!

Rain, high winds, and cold temperatures were no match for the hot competition that took place at the 5th Georgia Electric Vehicle Rally, held November 21 and 22 at Lanier National Speedway in Braselton and Flowery Branch High School in Flowery Branch, Georgia. More than 200 students from seventeen schools brought 30 electric vehicles they had constructed to compete in two days of intensive academic and hands-on driving events. By any measure, the rally was a great success.

Held twice a year in the fall and spring, this fall's rally was the first to draw teams from other states. Out-of-state participants included Cascade High School from Plainfield Indiana, Northampton East High School from Conway North Carolina, and Miramar High School from Miramar Florida.

Of the fourteen Georgia schools participating, three of the schools were new to this rally's competition, including Flowery Branch High School, Sprayberry High School, and Worth County High School.

Of the schools returning to the competition, three had newly constructed vehicles never entered in previous competitions, including Dawson County, Turner County, and West Jackson Middle School. Many teams made significant modifications and innovative changes to their vehicles in their attempts to capture the gold.

An impressive number of schools fielded more than one vehicle in a school curriculum program that is still very new. Jackson County High School fielded four vehicles, Dawson County High School, Gilmer County High School, and West Jackson Middle School brought three, and Franklin County High School, Turner County High School, and West Hall High School each brought two.

Three classes of vehicles were entered in the Rally. The EV Master Teaching Vehicle (EM-TV) Class, consisting of go-kart-like vehicles constructed from kits as teaching tools, had 20 vehicles in competition; E-kart class had five, and five full-size vehicles.

Although Thursday dawned gray, with a forecast for rain, it didn't dampen the enthusiasm of the intrepid EV teams as they unloaded their vehicles at Lanier National Speedway – venue for the driving competitions. Rain turned to drizzle and ended as each vehicle completed technical inspection to insure safety and compliance with competition rules and specifications.

From there, teams boarded buses and traveled to Flowery Branch High School, host of the academic competitions. Students participating in the Oral Presentation event had to demonstrate that they could articulate the value of their electric vehicles study to a panel of judges. Gilmer County won first place. Meanwhile, in another room, teams participating in the Troubleshooting competition were asked to accurately identify faults that prevented an EV's operation. Hart County was the winner**,** correctly identifying two of the three faults in the allotted seven-minute hands-on test.

After a short bus ride back to the track, participants enjoyed lunch while a team of volunteers set things up for the afternoon driving competitions. Both the acceleration and autocross competitions were hotly contested and fun to watch. Winners were determined by mere fractions of a second in these highly competitive events. In the acceleration event Jackson County's EM-TV covered Lanier Raceway's front straight in 9.71 seconds edging out West Jackson Middle School's vehicle by only 0.01 seconds! In the E-kart class, Lovejoy High School's vehicle posted the fastest time of 9.11 seconds. Miramar High School's electric conversion of a Ford Probe smoked the tires and covered the course in 10.14 seconds.

The autocross course tests vehicle handling through a twisty obstacle course of cones. White County lead he EM-TV class with a time of 43.63 seconds. Lovejoy's E-kart won again with a time of 45.10 seconds and Miramar, edged out Northampton's converted Ford Escort with a time of 54.10 seconds. It was turning cold and getting dark as teams rolled their vehicles into the big infield tent for recharging. Overnight vehicles recharged, courtesy of Jackson EMC while teams enjoyed activities at Bumpers & Bogey's in Gainesville, courtesy of EV Master, Inc., the Rally organizer.

Friday morning teams met at Flowery Branch High School for the Quiz Bowl that tested their knowledge of science, electricity and electric vehicle technology. Five teams, Dawson, Hart, Jackson, Lovejoy and Turner survived the first two rounds of the competition to advance to the finals. Jackson County won the event.

The EV competitors then returned to Lanier National Speedway to prep the vehicles for the range competition – a timed event to determine which vehicle could go the furthest. West Jackson Middle School's #18 won the EM-TV range competition with 45 laps. Dawson County's E-kart went 48 laps to win the E-kart class. Full size vehicles drove around the racetrack behind two commercial hybrid gasoline-electric pace cars provided by Milton Martin Honda of Gainesville and Heyward Allen Toyota of Athens. Miramar's electric Ford Probe won this class, completing 95 laps at speeds in excess of 55 miles an hour.

Overall rally winners in each category were determined by totaling the highest scores from each individual event. In the EM-TV Class, Gilmer County High School took first place, White County High School was second, and West Jackson Middle School won third place. In the E-Kart Class, Jackson County High School took first, Lovejoy High

Acceleration run by West Jackson Middle School

Four entries competing for the range event.

School was second and Dawson County took third. In the Full-size Class, Miramar High School was first, Jackson County High School won second place and Northampton East High School was third.

Alan Shedd, commercial/industrial engineer with Jackson EMC in Jefferson, credited the Rally's success to the students, teachers, parents and community sponsors of the Georgia EV Education Program. "They put in a lot of time and effort to prepare for the competition and make it happen. With volunteer programs and no budgets, it is the generous support of our sponsors that make these events happen. Even before the start of competition, more volunteers than I can name put in countless hours of work planning, organizing and setting up so that the rally would take place for these students," Shedd noted.

Event sponsors included EV Master, Inc., Lanier National Raceway, Hall County Schools, Jackson EMC, Georgia Power, and many dedicated volunteers.

The Georgia Electric Vehicle Education Program is an ongoing education program that brings together students from a wide variety of disciplines – including math, auto mechanics, physics, engineering, electronics, and journalism. More than 30 high schools and middle schools currently participate in the program. Throughout the year, students complete a variety of activities, developing presentations and taking part in a wide range of projects. This unique project's highlight is student design and construction of electric vehicles that they can actually drive and enter in statewide competitions.

Though in its infancy, the Georgia Electric Vehicle Education Program has accomplished great things, motivating students to learn and excel through hands-on application of classroom topics. It is a credit to the hard work of students, teachers, parents and local businesses that have volunteered to make it work. With the current national focus on the environment, energy prices, and the need to improve education, the issues students address and solutions they explore through the program are very timely. And, as the students themselves will attest, it's also a lot of fun.

Everyone had fun, even on the autocross course.

There were even a couple of Segways to show the cutting edge.

By Lee Hart, EAA member & EVDL resource

Sam Harper writes:
To own a $20,000 [ICE] two-seater sports car... you will have to pay... $673 per month.
Pros - Gas is everywhere
Cons - Polluting, supplies foreign nations with capital, expensive

To own a $27,500 [EV two-seat sports car]... you will have to pay... $758 per month.
Pros - some government money
- HOV lanes with only one person
- zero direct emissions
- EV grins

Cons - Lack of charging infrastructure
- shorter range

Lee Hart writes:
We can argue about the exact numbers, but you have the gist of it right. Driving an EV will cost more, but provides some side benefits that are hard to put a price tag on.

People who buy strictly on price are not your customers. In the short term, EVs cost more to buy. They can save you money in the long term, but most people simply don't think ahead. So, I think we have to GIVE UP on ever getting the average person to buy an EV — at least for the next decade or so.

So, it would be better to focus on that list of Pros and Cons. What features can an EV offer that is basically not available in ICEs? If there are enough of them, and if you find the "magic feature" that will change a person's mind, then you've made a sale!

Here are some other EV Pros and Cons I can think of, in addition to the ones you listed:

Pros:
- drive something TRULY different (not the same car 100,000 other people have)
- don't need to go to gas stations (refuel at home or work)
- fuel is very cheap (fill 'er up for $1; laugh at $2/gal gas)
- won't "run out of gas", stranding you someplace unpleasant (can keep driving an EV at slower speeds to get to an outlet)
- stop sending money to support brutal dictatorships
- get true muscle-car performance and economy at the same time
- instant heat / air conditioning (can even work while car is parked)
- have a car that you really can work on yourself
- never any starting problems in cold weather
- no gasoline, oil or antifreeze leaks in your garage or driveway
- no risk of fire or explosions from gasoline in accidents
- no tune-ups
- no oil or antifreeze changes
- no belts, air cleaners, exhaust system, or other costly repairs
- brakes last much longer (with regenerative braking)

Cons:
- have to replace the batteries every few years
- need a 2nd car for long trips
- harder to find repair shops

Sam Harper writes:
Well this is what I think a Distortion Networks conversion would have to have: [*snip*]
-A completely replaced interior (new plastics, new seats, Wet Okole neoprene seat covers for that cool feeling, a nice stereo (I'm thinking Eclipse and JL Audio) (give $2,000in labor)
-New paint job (give $3,000 to an outside company)

Lee Hart writes:
These are all things that are the same as any ICE. The only reason to replace all this stuff is if the particular buyer *wants* it done, and will pay *extra* for it. If he wants (say) new upholstery or a better stereo, let him take it to one of the aftermarket suppliers himself.

-Lithium-Ion pack, say around 22kw capacity (give $8,000. Nice if you can get it; but this is probably Unobtainium.

I hate to say it, but for a small start-up company, you pretty much have to use a very conservative battery that has a proven track record and good availability. The risks of using a high-tech battery are just too high. That means lead-acid or nicad.

-A nice fat PFC charger - think you can make me one for Lithiums? The average customer doesn't even know what PFC is, and almost certainly won't pay anything extra for it.

AC vs. DC, continued from page 13

of the rotor) the rotor creates the field adding to the stator coils field, thus the voltage on the stators coils raises above what we supply. This is AC generator in action, or in case of EV induction motor – regenerative braking. We take mechanical power rotating the rotor and induce the extra voltage (thus the current) in the stator by the magnetic field of the rotor-electromagnet.

Because the presence of electrical slip, the induction type AC motors also called asynchronous to emphasize the difference between them and synchronous motors where there is no slip.

Real processes are more complex than this bare bones explanation, which is good only to explain the principle of induction motor. A rotor of real motor is round cylindrical shape made of laminated electrically isolated pieces similar to the core of AC transformer, just different shape. They have many single turn windings with a few degrees offset, and north and south poles of this electromagnet continuously moves around with the speed of electrical slip, i.e. rotor is demagnetized by the stator field.

If we vary the load (as in EV case), the rotor rotation speed changes dynamically, and to maintain desired slip the rotation speed tracking system usually is implemented. Actual speed then is fed to the AC supply system, which adjusts its frequency such that it always by the slip amount ahead (or behind for regen) than the mechanical rotor rotation speed. Too little or too much slip - and the torque is diminished.

If there is little slip, there is not much current induced in the rotor windings (not enough relative movement), so the electromagnet is weak. Too much slip – and the rotor can't keep up with rotation of the stator electric field, i.e. rotor's attracting N and S poles at any instant are too far from fading fast S and N stator poles fields.

For more information and AC motors/ inverter for EV conversions, go to www.metricmind.com.

ZAP to Unveil New EV Product Line in Las Vegas

Electric Vehicle Manufacturer ZAP recently announced plans to introduce a new line of electric vehicles (EVs) at the Consumer Electronics Show in Las Vegas, NV later this week. ZAP said it will also introduce a new technology that "appears to triple the performance of battery-powered automobiles."

ZAP subsidiary Voltage Vehicles said it has reached an agreement with a consortium of European companies, including Torino, Italy-based Studio Linia 2, for the design and manufacture of the new product line. ZAP noted the group has already begun production of several different light utility EVs for urban transportation and commercial use.

The company said the first vehicle available under the new arrangement will be a 25-mile per hour (mph) neighborhood EV with additional offerings to include freeway-capable cars, vans, pickup trucks and commercial vehicles.

"Electric drive technology is almost silent, so it can eliminate noise restrictions and extend working hours to around-the-clock production," said ZAP chief executive officer Steve Schneider. "Whether in suburban areas or high-density city locations, contractors can meet time sensitive deadlines without noise regulations."

DOE Testing Th!nk city EVs in Four States

The Department of Energy (DOE) recently announced that its Advanced Vehicle Testing Activity (AVTA), which is jointly managed by the Idaho National Engineering and Environmental Laboratory (INEEL) and the National Renewable Energy Laboratory (NREL), is currently conducting a demonstration program examining 340 battery-powered "urban" electric vehicles (EVs) in four states, including California, Georgia, Michigan and New York. The agency said the goal of the program is to enhance public awareness of urban EVs; define markets and niche applications for urban EVs; increase EV infrastructure; and investigate the "economic sustainability" of urban EVs.

According to DOE, the Th!nk city EVs, which are manufactured by Th!nk Mobility, will be used in such "urban applications" as "a military base's shared-use vehicle system, as commuter vehicles to and from transit train stations and as private vehicles." During the three-year demonstration program, AVTA will collect vehicle-use data, including "miles driven; driver profiles; operations and maintenance requirements; and energy use."

The agency said the two-seat Th!nk EVs are able to achieve a top speed of approximately 55 miles per hour and to travel approximately 45 miles without needing a recharge.

DOE noted that activities observed during the first year of the program are described in a recently released report available from the AVTA website, located on the World Wide Web at http://avt.inel.gov/uev/ThinkcityDemoReport.pdf. The agency said the report includes information on the "extensive marketing efforts by Th!nk and

the New York Power Authority to support the introduction of urban EVs, and…examines the initial economic sustainability of urban EVs."

Spokane EV Company Receives $300,000 Loan

Officials with Spokane, WA-based electric vehicle (EV) company Commuter Cars Corporation recently announced the receipt of a $300,000 loan from a friend of company founder Rick Woodbury, as well as the discussion of further funding with "other potential investors." The company said its new Tango EV prototype, which measures 39 inches wide, is able to accelerate from zero to 60 miles per hour in four seconds and has a single-charge range of approximately 80 miles.

"This isn't the car you take your family out to the country in," said Woodbury. "It's the car you drive to work and back."

According to the company, the prototype Tango EV is "ready for replication," although early buyers could be required to self-assemble their Tangos, a project that is estimated to take up to eight hours. However, Woodbury noted that the company hopes to eventually offer pre-assembled EVs for less than $20,000 after it opens a "larger-scale operation."

"We're not in it for the money," said Woodbury. "We just want to change the world."

Commuter Cars said the Tango EV, which can reach speeds as high as 124 mph, is powered by 25 batteries and weighs approximately 3,000 pounds. Additionally, the EV features a "racing-regulation roll cage" and a patented "ballast system."

Takara to Introduce New One-Seat 'U' EV

Japanese toymaker Takara Company, Ltd. recently announced plans to introduce a new one-seat electric vehicle, known as the "U," later this year. According to the company, which has received 300 orders for its initial "Qi" model EV offering, the new EV is capable of reaching speeds up to 60 kilometers (about 37 miles) per hour and traveling for approximately 80 kilometers (about 50 miles) per charge.

Takara noted that the U comes equipped with such standard vehicle features as a roof and trunk, as well as options for a car navigation system and a roof rack.

"Our electric cars have won a reputation as environmentally friendly products," said Takara president Keita Sato.

Takara said the EVs will sell for 1.09 million yen (about $9,225), with the company hoping to deliver 3,000 units during the first year of availability.

"If we sell 1,000 cars, the business will turn profitable," said Shuichiro Tanaka, director of Choro Q Motors, the joint venture established between Takara and Cox, Inc. to manufacture the EVs.

Montreal MTA to Provide NEVs for Public Use

Officials with the city of Montreal, Quebec's Metropolitan Transit Agency (MTA) recently announced plans to purchase 120 battery-powered neighborhood electric vehicles (NEVs) for a program that will make the vehicles available for public use at various locations throughout the city beginning next January. If the initiative is approved by Transport Canada, the agency said commuters will be able to purchase a "smart card" that will allow them to "rent a clean vehicle to boot around town."

MTA said the goal of the program is to encourage "off-island commuters" to ride the train into the city and provide an NEV for public transit users "when necessary." According to MTA, the battery-powered vehicles would be reserved via a central phone registry or the Internet, with the smart card used to open doors and start the engine.

Later this year, the agency said the Centre for Electric Vehicle Experimentation in Quebec (CEVEQ) will provide "20 to 30 electric vehicles" to residents in Saint Jerome, Quebec as part of a program to evaluate how the vehicles perform "on real roads, driven by real people." MTA noted that the results of the program will be examined by the province's Transport Department for "guidelines and licensing regulations for electric vehicles."

Additionally, MTA said Montreal-based tour company Nevtours will use NEVs to transport tourists around the Port of Montreal. The company also hopes to rent the NEVs to tourists after the vehicles have been licensed for the city's streets. (MONTREAL GAZETTE: 1/16)

Lady Lake, FL to Review EV Regulations

The Lady Lake, FL town commission recently voted against an electric vehicle (EV) safety proposal devised last year by the

Lady Lake Police Department. According to officials, the proposal would have required EVs to be regulated by the same town ordinance that governs golf carts.

The commission maintained that the state already has regulations in effect for EVs, which classify them as "low-speed vehicles," and that additional restrictions are unnecessary.

However, while Florida's EV rules require tags, titles and licensing to operate the vehicles, supporters of additional regulations argue that residents of The Villages retirement community in Lady Lake often use EVs as their primary source of travel, resulting in frequent accidents and occasional injuries.

The Lady Lake town commission agreed to create a committee to evaluate the current EV and golf cart regulations and consider any necessary safety improvements. (ORLANDO SENTINEL: 1/15)

NY Alliance to Operate New Electric Buses

The Alliance for Downtown New York business improvement group recently announced plans to introduce eight new electric-powered buses to the city's fleet later this year. Six of the 22-foot long, 30-passenger buses will operate seven days a week along a U-shaped citywide route, while two of the buses will be held in reserve.

The buses will primarily be used to transport tourists to downtown sites and to connect state residents to area subway trains. A spokesman noted that the Alliance has already tested the buses' performance several times and hopes to have them operational by the summer.

The buses, which were manufactured by Chattanooga, TN-based Advanced Vehicle Systems, were purchased for $220,000 each through city and state grants. (DOWNTOWN EXPRESS: 1/18)

NESEA Announces 2003 Tour de Sol Festival

The Northeast Sustainable Energy Association (NESEA) recently announced that the 2003 "Tour de Sol: The Great American Green Transportation Festival" will be held May 11 through 14 in Philadelphia, PA; Trenton, NJ; and Washington, D.C. According to NESEA, the annual festival, which has transformed from its inception in 1989 as a competition for solar-powered racing cars to an "over-the-road event...for an ever-growing variety of 'greener vehicle technologies," will this year highlight cars, buses and scooters powered by biodiesel, electricity, hydrogen, natural gas and propane.

"The need to decrease our dependency on foreign oil and to reduce greenhouse gases is more important than ever before," said Tour de Sol director Nancy Hazard. "Fortunately, the number and type of cars and buses that use domestically produced, environmentally friendly fuels is increasing rapidly. Owners of new gas-sipping hybrid vehicles are reportedly very happy with their new cars, and new electric scooters and neighborhood vehicles are offering new ways of getting around. This year's Tour de Sol will showcase all these options."

NESEA noted that the free, public festivals in Philadelphia, Trenton, and D.C. will showcase "green" vehicles, consumer products, programs and services, while the road rally competition connecting the festivals is open to individuals, companies and schools operating "everything from one-of-a-kind prototypes to vehicles that are already available on the market."

WA Transit Agency Uses Hybrid Buses in Tunnels

Officials with Metro Transit in King County, WA recently announced that the agency has operated a 60-foot, diesel-fueled hybrid electric prototype bus since August 2002, recording approximately 36,000 test miles.

As a result of the test, the agency said it expects to purchase 200 more of the hybrid buses to replace the 236 Italian-built Breda buses that currently operate in the 1.3-mile tunnel connecting the city of Seattle's Convention Place and International District. Metro Transit said the cost of replacing the aging Breda-style buses, which are powered by a combination of diesel fuel and electric trolley wires, could reach as high as $1 million apiece, while the new prototype hybrid buses cost approximately $600,000 each.

Officials said the prototype hybrid, known as Bus Number 2599, is powered by its electric motor at speeds below 15 miles per hour (mph). Additionally, the agency said the prototype bus features an "engine-braking gear" that uses kinetic energy to recharge the vehicle's battery pack when it is coasting or braking. Agency officials noted that the bus is also able to operate in an "all-electric" mode when traveling in tunnels. (SEATTLE TIMES: 2/2)

ZAP Unveils New Battery Technology

Electric vehicle (EV) manufacturer ZAP recently announced plans to unveil a new battery technology that it claims will increase the single-charge range of its lead-acid battery-powered EV product line from 60 miles to "more than 200 miles."

"I have personally experienced the performance of this new technology and look forward to sharing it with our customers," said ZAP chief executive officer Steve Schneider. "We expect third-party testing to confirm the energy capabilities shortly."

continued from page 1

than even a few minutes under the hood of a car any day.

In my continuing investigation learned I learned that there were some all-electric cars out there, like the EV Plus (Honda), and the EV-1 (GM), but they have been leased (and not sold) in small numbers and eventually discontinued, despite good performance, high demand and many happy drivers. I even looked into the Corbin Sparrow, a one seat, 30-mile/charge vehicle manufactured locally. My one way commute is 20 miles, but my office complex offered no obviously workable way to plug in a car, even though as I understood it, the Sparrow can be configured at purchase time to use 110 or 220v. Though quite a catchy piece of eye candy, the limited range and capacity of that vehicle prevented me from rushing out to buy one, and I'm glad I did, because a better option was about to become available.

Why do I drive a RAV4 EV?

Last November upon arriving at the Budget Rent-A-Car (a.k.a. EV Rentals) at LAX on business, I noticed signs proclaiming, "We rent alternative fuel vehicles!" Without too much convincing from the counter clerk I cancelled my compact gas-powered car reservation and rented a Toyota RAV4 EV. I was surprised to discover that it looked just like a regular car. It *was* a regular car, but with a clean, quiet electric motor under the hood, and no tailpipe to be found. Before long I was in the parking lot with an EV expert showing me how to turn the car on, and how to drive it. That lesson took all of 2 minutes, and I was on my way.

I was so excited driving down the 405 that I phoned my husband to announce that I was at that very moment driving an electric car! He laughed at my childlike enthusiasm, but little did either of us know how our lives would change because of that moment. I was blown away by how well the vehicle performed. It was peppy, quiet, and roomy. The 100+ mile range was more than adequate for my 3-day business in Torrance.

When I took it back to the rental lot I jokingly asked the attendant how much he wanted for it, and offered to write him a check on the spot. He alluded that the cars might become available to the public soon, and it turns out that he was right.

After about 4 years of use in the rental and government vehicle fleets, in February of this year Toyota made the electric RAV4 available for sale and lease to the general public in California. This was part of the company's program to comply with the California Air Resources Board (CARB) mandate that by 2003, 10 percent of all new vehicles sold in California will be required to meet low emissions standards, with two percent qualified as zero emission vehicles (ZEV).

Knowing how hard it might be to get my hands on one of these cars, on February 2 I went to my local Toyota dealership, deposit in hand, to reserve my car. The 11 1/2 weeks I waited for it seemed like the longest wait of my life. I wanted to drive an electric car, and bad.

During that time, I joined an online discussion group sponsored by Yahoo for people interested in the car, and found an informed, helpful support group eager to help me understand and adopt this new way of getting around. They helped educate me about the charger installation process, available state and federal incentives, and vehicle performance, and they serve as an ongoing support network for all of us early adopters.

Buy versus Lease?

I decided to lease the car, but now I wish that I had bought it. I can live with the 15,000 miles per year mileage cap you get with a lease - that number works about right for me. The one reservation that I had about buying it was related to the cost of replacing the batteries after 100,000 miles, which was quoted at around $20-$30,000, but is falling every day. It will probably be a lot cheaper by the time I get to 100,000 miles, but that won't even come close to happening in my 3-year lease.

The bulk of the incentives are available to someone who leases the car - the $9,000 CARB rebate ($3,000 per year for 3 years), the single occupant carpool lane perk, free public charging. If you buy the car you get another $4,000 in Federal tax credits. I expect to receive my first check from CARB sometime soon.

Whether you lease or buy, you still have to pay for the charger installation at your home. This is largely coordinated by Clean Fuel Connections, a between your Toyota dealer and the subcontractors who install the charger. You can also install it yourself if you feel inclined, but neither my husband nor I was up for that.

I had the charging station installed in my garage, and it was a fairly simple job as they go. The desired mounting place was within a couple of feet of an electrical sub-panel, and installation was performed quickly. However, I was not comfortable with the fact that I had to pay some $750 to have this thing installed before I had any kind of guarantee that I'd get a car, or any kind of written document outlining what I would pay for the car.

What has my RAV4 EV driving experience been like?

I've been driving the car since April, and have put about 5,500 miles on it (end of 2002). My charger has never failed me, and I've never "run out of juice". Half of my 40-mile/day commute is on the highway, and half is city driving, and I use about half of

the SOC meter to do this. There is more than enough range on a charge for me each day. I am free to decide to take colleagues out for lunch at the last minute, or run errands, and don't think twice about it.

I live in the Santa Cruz Mountains, and drive down Highway 17 every day to work in Santa Clara and back again (40 miles), some days continuing down the other side of the mountains to Santa Cruz and back home again (another 35 miles). The mountains do eat more of my charge than flat road driving, but I can do the trip I just described using about 80% of my available range, according to the SOC meter (it's a few miles in to the yellow when I get home).

When I get home I back the car into the garage, engage the "timed charge" mode, plug it in and forget about it. At around 3am the charger starts up, fully charges the batteries, and shuts itself off automatically. I come out in the morning, unplug the car, and off I go. No more gas stations, smelly hands, or time spent waiting for the car to fill up.

I drive at normal highway speeds, but following the speed limit. Only once have I pushed it into the red zone - I get nervous doing this. However, there are some that claim to have seen the elusive "turtle" mode indicator that goes on when your charge is extremely low.

I'm sure after time goes by and I gain more of a feel for my power usage I'll push the limits a bit, but for now it goes everywhere I need to go, and I don't have to think twice about it. I have lots of extra range left on most days of the week, and use some of my extra charge "budget" to step out quickly from stoplights so that folks don't think EVs are slow. It sure does turn some heads.

I'm learning tricks for getting more range out of a charge, by coasting when I can, by using the "EB" and "B" regenerative braking modes when coming down Highway 17 or when coming to a stoplight, and by watching my speed. It's more of a game than anything else - I don't need to drive 100 miles on a charge most of the time, and I'm just practicing for some day when I decide to take it on a long trip. I have to tell you, though, I hold my own with traffic, and pass other cars as often gas-powered cars do.

The RAV4 EV dashboard.

My husband and I have taken the car on one extended trip so far up to San Francisco, which is about 70 miles from our house. We drove on 17 to 85, and up 101, traveling at about 60-63 mph most of the time. We were almost into the SOC's yellow zone when we arrived at the St. Mary's Square parking garage, where they had a Small Paddle Inductive charging station and cheap weekend parking.

We took taxis around town when we needed to go far distances (we would have done this anyway), and when we returned to the garage to drive home the car was fully charged, and ready to go. Parking for the weekend was $10, which included "gas", so to speak. One of these days I'm going to take a trip to Sacramento where my in-laws live, once I plan my route and where I'll stop to charge along the way. Charging in Sacramento seems to be widely available.

What is my electric vehicle "hot button"?

I'm very sorry that the automakers and the media have not done their part to widely disseminate factual information about the practicality of electric car choices that are out there now. I am convinced that the reason they want to convey the impression that people don't want these cars is that possibly their profits are not as great as they are with the gas guzzlers. Perhaps their relationship with the oil companies and political straphangers would be in jeopardy if they fully promoted electric vehicles. All this talk about fuel cells being the real technology to shoot for is just an attempt divert people's attention from the fact that electric cars can work for many people right now. The environment and our oil-tinged global politics cannot wait for a far horizon solution to appear.

I think that we should have the freedom to choose not only the type of car we drive, but also the kind of fuel that it runs on. There are more workable alternatives out there than the car and oil companies would care for us to know about.

I'm happy to have become a member of the Electric Auto Association and enjoy doing my part to help spread the word about how easily this car works for me, and can work for lots of folks. It's a completely practical option for a second car in a two-car family - most folks just don't need more than one car that can go long distances.

I would suspect that if there were one thing right now standing in the way of mass adoption of this car it would be the price, although I have to wonder about that argument every time I see another huge, expensive, gas-guzzling SUV (or luxury sports car, for that matter) passing me on the road. Given how little it costs right now to drive this car when there are only a tiny number of them being produced, it would be a very economical choice once it were mass produced.

Conclusion

I've learned a lot about electric cars since I started this quest, but still don't exactly understand the difference between a watt and an ohm, a volt and an amp, but a new friend from the EAV4 EV Yahoo group promises to give me an Electricity 101 lesson one of these days. I'm in no rush, however - I barely understood what was under the hood of my gas powered car and it didn't keep me from getting around in it. This car gets me where I need to go, is economical, and helps send a message to people who see it, and that's enough for me. Now my only problem is convincing my husband that I'm really not an activist. Or am I?

By Kimberly Rogers
(krogers@alumni.calpoly.edu)

This article offers a quick overview of the proposal presented at the Annual Meeting on Feb 15, 2003.

Goals

To enhance the effectiveness of information exchange with the public, in accordance with the EAA Mission:

"Act as a source of ***information to the public*** on the developments in electric automobile technology, to encourage experimentation in the building of electric autos, and to ***organize public exhibits/events*** of electric automobiles for the purpose of ***educating the public*** on the progress and benefits of the electric vehicle technology."

Additional goals include improving the relationship and leverage of the EAA with other non-profit groups (e.g. American Lung Association, environmental groups). Building relationships with these groups can lead to additional educational opportunities, not to mention the opportunity to leverage materials. The final goal is to improve the visibility of the EAA to the public at large.

EV Education Overview

There are four primary groups to reach out to with educational activities.

Classroom Outreach

Provide classroom guest speakers for Transportation days, Career days, Environment days; demo EVs for up-close viewing; contact and coordination with local schools to arrange guest speakers; donate books and/or articles to the library.

Student Outreach

Partner with school clubs (science, auto tech, environment) and work with them on EV projects. Excellent example projects include the EV Challenge and Junior Solar Sprints. We may want to include donation of project materials (kits), and the incorporation of the project results into inter-school challenges, and/or other EAA community EVents (to showcase the student efforts). The EAA could also explore a student membership plan.

For the long-term, we can consider sponsoring or teaching an EV conversion class. There is a wealth of materials and support for such an activity (i.e., "Convert it" by Michael Brown and Shari Prange, along with conversion kits). This may be an activity suitable for high school, community college, or even adult education.

Teacher Outreach

Develop and distribute information suitable and available for teacher integration into classroom study. Work with "teacher reviewers" to tailor materials for the classroom.

Contact schools via a tiered program introduction to offer EAA services for guest speakers, project sponsorships, community EVents, etc.; invite teachers to attend EAA meetings with EV technology speakers; add teachers/ schools to EAA newsletters; invite teachers/students to EAA EVents and meetings

Community Outreach

Sponsor/attend community EVents, such as Earth Day, Transportation Fairs, and Health Fairs. Many businesses sponsor such EVents for their employees. Large businesses often also have sustainability and environmental employee groups. We can draw upon these contacts to participate in their EVents (with presentations or demo EVs). We may also consider contacting the local Chamber of Commerce to demo EVs and/or give presentations to the chamber members. This could be an excellent opportunity to reach smaller businesses with the message of clean vehicles.

We could partner with cooperating groups, such as the American Lung Association (www.lungusa.org), Spare the Air (www.sparetheair.org), RIDES (www.rides.org), and other environmental action groups. Many of these groups have contacts within businesses and the community. More importantly, they sponsor education or community awareness EVents – an excellent opportunity to get out the word on EVs.

There are also many other non-traditional EVent opportunities, such as community celebrations (parades, providing EV "pace cars" for bike/foot races); Farmers Market (information booth); local Clean Cities Coalition (http://www.ccities.doe.gov) activities.

What types of materials?

The actual materials used for the education outreach programs can be heavily leveraged from a wealth of books, articles, web sites, programs already in place, and the talent within the EAA membership. The goal is to leverage and organize these materials for easy access and retrieval. Naturally, enhancing the EAA web site to have an education section will be an important part of our action plan.

Example materials may include presentation materials for guest speakers, customized for EVent (i.e., grade/age specific); variety of EVs for display (or demo rides); white papers and fact sheets; flyers/hand-outs, Current EVents rally edition; targeted mailings; project activity materials (e.g. kits for EV Challenge or Solar Sprints); list/links for additional information; newsletters; books, articles. Also important will be materials to make us more effective, like documented best practices for reaching out (to schools, businesses and the community at large), organizing and sponsoring EVents, and using any presentation materials.

What's next?

In order to turn this proposal into reality we need commitment from the EAA Board to keep this going, by designating an existing or new board member, as "Education Program Manager". This person will coordinate setting up a small Education Team that will set-up and keep the program in motion. The Education Team will set program goals; organize and prepare materials; coordinate distribution of materials (primarily via the web); identify and recruit "teacher reviewers"; build a public awareness plan; build relationships with other non-profits with cooperating goals and agenda; review potential need for additional funding sources ("special funds", grants, etc.) to support the program; web development to enhance the EAA website to accommodate education materials (organized for easy access); and develop a plan of action to keep all materials fresh.

I'm happy to report that the EAA Board has taken immediate action, in the Feb 15, 2003 board meeting, to appoint an Education Program Manager. I'm pleased and honored to fill this role. I'm asking for volunteers to join me on the Education Team to fulfill these duties.

EAA Chapter Responsibilities

We will draw upon the national EAA organization to help distribute these materials to all chapters and interested parties. However, the real action will come from our chapters – who know their local communities best.

We ask the chapters to use the materials developed and provided by the Education Team. We also ask the chapters to provide feedback for continuous improvement of these materials. Please share chapter-developed materials (e.g. Fox Valley EAA, EV Challenge, Junior Solar Sprints, flyers and handouts) with the Education team so that we can leverage these to other EAA chapters. Identify local school and community EVents to participate in and/or organize. Share chapter best practices used to make these EVents successful. Recruit EAA volunteers for Chapter EVents. Recruit guest speakers, EV project sponsors (there may be local businesses willing to donate project materials), and EVs to demo. In addition we will ask each chapter to provide an annual report to the EAA Board on local Education EVents status and recommendations for improvements.

What can I do?

You can share your wisdom and knowledge with the Education Team to ensure the highest quality materials available. You can volunteer to become a member of the Education Team. You can volunteer to review and provide feedback on education materials. You can share information and best practices for EVents that your local chapter sponsors in or participates in. But most importantly, be a volunteer in your local chapter to participate in your local EVents.

To get involved with the Education Team, contact Kim Rogers by email at krogers@alumni.calpoly.edu.

When does this start?

The spring and summer 2003 main activities are:

Education Team: prepare, review, and distribute materials.

Chapters: Build relationships with schools and community groups. This is a critically important function for the local chapters to perform. Part of the materials from the Education Team will be to document best practices to make this easier. However, the local chapters know their local community best.

Chapters: Continue existing local chapter EVents. Don't stop the good work that is already being done. Remember we want to leverage this so that other chapters can also be successful with initiating these EVents.

For the fall 2003 school year, we want to implement the new school education plans as the school year starts.

Sample Education Links

The following links provide just a few examples of materials that we can draw upon:

http://evworld.com/eveducation/index.cfm

http://www.ccities.doe.gov/

http://www.ccities.doe.gov/pdfs/vol2i.pdf

http://panthersspeed.virtualave.net/articleedu.htm

http://chatt.net/~james/Carta/teacher.htm

http://www.nesea.org/education/links.html

http://www.entfored.com/nav3/etrans.html

http://www.evtraining.com/Archive_Jan02.htm

http://www.evchallenge.org

http://www.transoptions.org/JSS/jss_home.htm

By Terry Wilson

My original title for this presentation was, volunteerism, but that title would be inaccurate. Volunteerism is only part of what the EAA needs from you. As a non-profit we need you to tap into any skill, interest, or opportunities you can provide. One EAA Member works for a Software Company and can provide software at his employee discount. I have a one-ton flatbed truck; I have picked up batteries from as far as 50 miles and delivered them to Don Gillis for the battery recycle program. At the last Silicon Valley Rally many volunteers spent one hour sitting at a table just to watch over the displays, so nothing would be taken. These tasks however small, just one hour, just watching over things, are more important than you may know.

We don't have funds to hire professionals, yet we need professional quality help, to be the best EAA we can be. In the Awards presentations you heard about Members who have participated in many ways. Some of this participation was serving with tasks requested by the EAA; however, many of these tasks were created and carried out by the individual who conceived them. The Board has begun writing up possible tasks, and I urge you all to look them over and consider volunteering.

You need not volunteer for endless hours. You need not volunteer for tasks that you don't feel you have the skills to do. You need not volunteer to take on a task by yourself. What you can do is to think of a way to serve, giving only the amount of time that you are comfortable with. Doing something you feel is within your abilities. Put together a team to share responsibilities, to use different talents our Members have. By volunteering I have learned many new skills. Before I joined the EAA I had never used a computer, never written an article, never served as a Board Director, never battled a Board of Directors!

The point I am trying to make is that by involving yourself you help make the EAA, a better EAA. You can make ourselves more knowledgeable, learn more skills, and HEY! It's fun!

by Terry Wilson

The EAA is pleased to announce three Awards categories: Fellowship, Keith Crock, and Lifetime.

The EAA Fellowship is awarded for outstanding service to the EAA. The Keith Crock Award is awarded for outstanding Technical achievement. The Lifetime Achievement Award is for outstanding service to the EAA or EV community, for an extended period of time.

In the past couple of years the EAA Board has made an effort to make the EAA a truly National organization by interacting with Chapters and Members outside of the San Francisco Bay area. There has been an impression that outside the Bay area Members didn't do much. Well I never accepted that! With the first award presentation today we will put that myth to rest!

2002 EAA Keith Crock Award: Rich Rudman & Joe Smalley (Manzanita Micro)

By Ron Freund

Born on Bainbridge Island Washington west of Seattle, once home of many Manzanita trees, Rich Rudman and his buddy Joe Smalley (born in Coeur d'Alene, Idaho) have been partners for nearly 20 years. Their friendship began at the University of Idaho. They have had several businesses together. Initially they created and sold sports timing equipment - for performance assessment using microprocessors.

Along the way - Rich did contract work for Cruising Equipment on their E-meter product many of us know and love, and worked with another well recognized name in the EV community - Lee Hart. Rich was co-founder of DCPower Systems maker of the Raptor controller. His sophistication has come a long way, and today recognizes that the tools he used then were primitive. The schematic capture software and board layout tools he uses were in their infancy then.

Joe does the design work, while Rich does the prototype testing and does the marketing. Joe currently works for Navel Undersea Warfare Engineering Systems (our US Navy) building sonar electronics and actually did the design on the PFC chargers. These EV power electronics designers are actually a "closely knit" community. Joe, Rich, Damon, and Otmar all still communicate (and tease each other) though they are "competitors" with different areas of expertise.

The EAA wants to recognize these two individuals for their efforts in creating and delivering outstanding EV chargers. These unit embrace modern circuitry, enabling daily drivers to pull the maximum current out of the wall socket without nuisance tripping of the breakers due to high harmonic currents. This is quite common unfortunately, as most other modern solid-state battery chargers suffer with this trait. In their PFC-20 /50 they delivered another wonderful addition to the state of the art in EV chargers. Their use of a fully automatic auto-ranging PFC front-end, (so we can charge from any 90VAC to 240+VAC input without changing settings) really adds to the versatility of their product.

Some EV tinkerers in the audience today may "pshaw" their accomplishment, but reliably delivering over 10,000 watts of DC to the load at over 90% efficiency is definitely NOT trivial.

To Joe and Rich - Thank you for showing what can be done. We wish you well in your business.

2002 EAA Lifetime Achievement Award: Shari Prage & Mike Brown

By Ron Freund and Terry Wilson

For many years the EAA has helped to promote ICE to EV conversions. The team of Shari Prange and Mike Brown has been at the forefront of this effort. Even today their book "Convert It" is still the one people look for and still the most recommended, for people doing conversions. Their VoltsRabbit and Porsche kits made for an easier do-it-yourselfer conversion. Shari and Mike not only had articles printed in our own CE, but also, each have their own column in Home Power magazine.

The Electric Auto Association has selected the two of you to receive our 2002 Lifetime Achievement Award, for your dedication and support of our cause during the last nearly twenty-five years. Looking back at the effort you've expended it's our way of saying "Thank You, for a noble effort!" Your books and articles written, the classes you developed and presented, the kits you've created and delivered - all are instrumental in getting people started in this wonderful alternative form of transportation.

2002 EAA Fellow Award: Don Gillis

By Terry Wilson

Don Gillis has served as a Chapter officer for the San Jose Chapter of the EAA. Don started the San Jose Chapter handouts for which he wrote many technical articles. He also during the 1980's wrote indexes of CE articles. He started and still takes surplus Current Events to Libraries, coffee shops etc., and bundles them up at Chapter meeting for others to distribute. Don has donated Historical material to our EAA Historical collection.

He created and has run the EAA Merchandise (store). He orders, stores, packages, and mails out ordered products. He also created and runs the EAA Battery Exchange Program. He stores batteries in his yard, tests them, and provides batteries when asked. In the past, when a Chapter Handbook was needed, he would photocopy the approximately 80 pages, put them in Binders in page order, put the Binders in envelopes, address them, and take them to Post Office to obtain proper postage. He's regularly attended EVents to promote EV's, showing first his Bradley, and now his Porsche 914. At the Silicon Valley Rally's he sells Merchandise and runs the soda concession. In the past Don has driven people to meetings and events, and even paid retired Members dues out of his own pocket. His activities raise money for the EAA, promote EV's, and serve EV enthusiasts.

2002 EAA Fellowship Award: David Goldstein

By Charlie Garlow

David is well deserving of such an award due to his many long hours, long years of

service to the EV movement. David has served as the President of the EVADC since before the first 1973 oil crisis. He has attended EV meetings in far flung corners of the world, usually at his own expense.

He has donated so many hours to responding to citizen/member requests for information, at no cost to those who inquire, that we wonder sometimes how he is able to financially afford to continue. He has spent hours working on other people's cars and serves as the most reliable EV mechanic in our club.

He has led tech sessions at which he leads the session. David maintains the EVADC member list and several other lists of interested, but non-paying people, and sends out regular email and other communications, on a monthly basis. He has such an extensive Rolodex, now electronic, that he is the source of information on who can answer whatever EV question there is. He knows just about everyone at DOE, the EVAA, PEPCO and other institutional sources of power that affect EVs.

Known as Goldie to his friends, he has appeared on radio and other shows to promote EVs. He has been a tireless supporter of EVADC's educational outreach efforts, spending countless hours at inner city high schools who would never get their EV running without Goldie's help. He ran interference with several D.C. officials who walked off with the money that DOE intended for Phelps Technical High School in the District intended for the purchase of a sophisticated battery system for the school's EV. He helps keep our solar slot cars exhibit alive with constant repairs.

He has officiated at Jr Solar Sprint races. He has arranged trips to Boyertown, PA, the antique auto museum, and endeavored to establish exchanges and friendships with EV Chapters from Philadelphia to North Carolina, and with the First EVer EAA All Chapters meeting, extended that hand of camaraderie to all EV Chapters nationwide. Goldie is a persistent zealot who never tires in his defense of EVs. He has done so at considerable financial and personal expense. He is a hero to our movement and deserves recognition as an EAA Fellow.

Junior Solar Sprints Race In 38 Locations

By Charlie Garlow

These solar powered dragsters may not burn rubber or blow the doors off the hot wheels at NEDRA events, but the junior high school students are sure having fun, learning while jumping up and down and screaming: "Go, Thunder'n Lighting" or whatever they have named their car.

What do they learn? They learn science and math, engineering and construction skills, electric drive, gear ratios, low rolling resistance, suspension systems, photovoltaic effect, aerodynamic streamlining, and more, all for under $50 for the solar panel and electric motor kit.

Go to http://www.nrel.gov/education/student/host_sites.html for a list of the locations and dates of the 38 race locations, from the Virgin Islands to Virginia, from Texas to Tennessee, from North Carolina to North Dakota, from Missouri to Maine, from California to Colorado. Team up with the folks in your neighborhood who are already running these races and bring your EVs to add to their show.

Back up to http://www.nrel.gov/education/student/natjss.html for full details on how to buy your kit[s], tips on building your race cars, and becoming a host site. Then reach out to local junior high or middle school science teachers to see if you get a nibble. Contact boy and girl scout troops. This might get them a merit badge !! Tell them you will come to their class or scout meeting to give them the pitch.

Once you have a crew to compete, think trophies and you are well on your way to having a successful EVent. Questions? Contact me at charlie.garlow@juno.com.

Historians Report

By Terry Wilson

During the past year I have continued scanning historical items. Some of the material is material donated to the EAA from Members, some from the Silicon Valley library started by the late Earl Dolby. Increasingly I have been scanning more recent EVent photos of rallies, races, etc. Bob Wing, the last person to serve as the President of the EAA Board, once said to me, "History starts now!" So with that in mind I have spent more time scanning and archiving; newer documents, pictures, brochures, etc. which are in excellent condition, before they degrade. This type of material is more often requested, primarily by our webmaster, Bruce Parmenter, to use for various websites.

Each year I receive requests for information on EV's, mostly from students. This is a job I really like. The last request I got was from a college student who needed information on the 1912 Buffalo electric. She had searched everywhere and couldn't find a thing. Except the EAA website! Even I was surprised at what I was able to find. The company had gone through several, (but similar sounding) name changes. That was not unusual for the time, and in fact was more the rule than the exception. My favorite request this year was from India, where a gentleman wants to build small 2 passenger vehicles. I sent him manuals and plans from E-vehicle no longer made or were never produced. He sent a message saying, " I have been showing my friends the things you have sent me and they are loving it".

The most important addition to the EAA Historic Collection this year was the very generous donation by Margo Wing. A short time after Bob's passing Mrs. Wing invited me up to their home in Inverness, Ca., by Point Reyes along the Ca. coast. Seems she had some boxes with my name on them. Bob had set aside these boxes to donate to the EAA Historical Collection. Margo asked if we would like Bobs' EV book collection, and all of the EV files in his desk. I thanked her and said yes. In the collection there is a book that is rather unique. The title is, "Electric Cars in 1903". It is the minutes of proceedings of the institution of Civil Engineers, London, England, 1903. There are some interesting comparisons between; steam, gas, electric vehicles and horses, although how you can make a comparison between hydrocarbon emissions and road apples is beyond me.

March 4 - 6, 2003

Hydrogen: The Freedom FuelSM, Washington , D.C. , USA
Longest standing annual hydrogen meeting, with U.S. and international content and an exhibition of technology and products from around the world.
Phone: +1-202-223-5547
Fax: +1-202-223-5537
Web Site: http://www.HydrogenUS.org

March 5 - 7, 2003

Automotive Fuel Cell Systems Seminar, Detroit, Michigan, USA
Phone: +1-877-606-7323
Fax: +1-724-776-0790
E-mail: CustomerService@sae.org
Web Site: http://www.sae.org

March 29, 2003

EV Auto Show, Scottsdale, Arizona, USA
PEAA Chapter will display EVs at one of the largest ongoing car shows in the Phoenix area.
Web Site: http://www.phoenixeaa.com

April 11 - 12, 2003

8th Annual EV Challenge, Raleigh, North Carolina, USA
Located at the EPA Campus in Research Triangle Park, for High School students.
E-mail: earyan@worldnet.att.net
Web Site: http://www.evchallenge.org/

April 16 - 18, 2003

BATTERIES 2003 5th Conference & Exhibition, Paris, FRANCE
Address the latest trends and market opportunities, new applications components, achievement in power supply. Discussion on raw materials, power management, research, electronic devices, high energy batteries, and Lithium evolution.
Phone: +33-1-5324-3356
E-mail: s.houssin@icad.fr
Web Site: http://www.batteries2003.com

April 19, 2003

Earth Day Exhibition and Alternative Energy Conference, Houston, Texas, USA
Participation by the Houston EAA Chapter, display of vehicles. Located at Rice University.
Web Site: http://www.heaa.org & http://www.houstonearthday.org/

April 24 - 25, 2003

Making Hydrogen Available to the Public, Reykjavík, ICELAND
Icelandic New Energy brings this conference on how hydrogen will be available to the public in the near future.
Phone: +354-588-0310
E-mail: maria.maack@newenergy.is
Web Site: http://www.newenergy.is

April 26, 2003

NEDRA Wicked Watts, Las Vegas, Nevada, USA
Las Vegas EAA hosts Wicked Watts Nedra season opener electric drag race.
Web Site: http://www.nedra.com & http://www.geocities.com/lveva

April 26, 2003

EBEAA EV Distance Rally, Pleasant Hill/Concord, California, USA
Annual East Bay Chapter display and distance event.
Web Site: http://geocities.com/ebeaa

April 27, 2003

Earth Day Expo, Austin, Texas, USA
Participation by the Austin EAA Chapter, display of vehicles.
Web Site: http://www.austinev.org

May 3, 2003

Fort Pierce EV Rally, Fort Pierce, Florida, USA
Local Florida EV Rally/display.
Web Site: http://www.grassrootsev.com

May 5 - 7, 2003

FuSys2: Fuel Cell Systems Conference, Las Vegas, Nevada, USA
Phone: +1-561-367-0193
Fax: +1-561-367-8429
Email: powersourcesnet@aol.com

May 6 - 9, 2003

Advanced Automotive Battery Conference, Nice, FRANCE
Conference will discuss batteries for advanced vehicles, power generation and distribution on board vehicles, technical and financial challenges for ultracapacitors and fuel cells.
Phone: +1-530-692-0140
Fax: +1-530-692-0142
Web Site: http://www.advancedautobat.com

May 10 - 13, 2003 P

2ND EAA ALL-CHAPTERS CONFERENCE, Washington, DC, USA
Planned to be held in conjunction with the Tour de Sol. All Chapters invited.
E-mail: evjerry@usa.net
Web Site: http://www.eaaev.org

May 10 - 14, 2003

2003 Tour de Sol: The Great American Green Transportation Festival,Washington, DC, USA
From Burlington County NJ., through Trenton, NJ and Philadelphia, PA. Sponsered by NorthEastern Sustainable Environment Assoc.
Phone: +1-413-774-6051
E-mail: nesea@nesea.org
Web Site: http://www.TourdeSol.org

June 3 - July 4, 2003

Fuel Cell 2003, Lucerne, SWITZERLAND
The Fuel Cell World & 2nd European PEFC
Phone: +41-56-496-7292
E-mail: info@efcf.com
Web Site: http://www.efcf.com

June 7, 2003

VEVA REV!2003, Vancouver, British Columbia, CANADA
'EV Rides' in a show and ride event near Science World at First and Ontario.
Web Site: http://www.veva.bc.ca

June 8 - 11, 2003

Hydrogen and Fuel Cells 2003 Conference and Trade Show, Vancouver Canada
The Canadian Hydrogen Association
Phone: +1-604-688-9655
E-mail: hfc2003@advance-group.com

June 10-13, 2003

Advanced Automotive Battery Conference, Nice, FRANCE

Sponsered by the Advanced Automotive Batteries
Phone: +1-530-692 0140
E-mail: info@advancedautobat.com
Web Site: http://advancedautobat.com/aabc_current.html

June 11 - 12, 2003 ✈

Advancements in Battery Charging, Conditioning & Testing symposium, Denver, Colorado, USA
Conference focused on applications and technologies in battery charging, conditioning, monitoring and testing of VRLA, NiCD, NiMH, and LI batteries.
E-mail: marshah@infowebcom.com
Web Site: www.batterypoweronline.com

June 23 - 25, 2003 ✈

Automotive Fuel Cell Systems Seminar, Costa Mesa, California, USA
Phone: +1-877-606-7323
E-mail: CustomerService@sae.org
Web Site: http://www.sae.org

June 29, 2003 🚌

NEDRA Power of DC, Mason Dixon Dragway, Hagerstown, Maryland, USA
Third annual Power of DC electric vehicle drag race.
Phone: +1-301-490-0657
Web Site: whttp://ww.powerofdc.com & http://www.nedra.com

June 30 - July 4, 2003 ✈

Fuel Cell 2003, Lucerne, SWITZERLAND
Phone: +41 56 496 7292
E-mail: info@efcf.com
Web Site: http://www.efcf.com

August 17 - 20, 2003 ✈

Energy 2003: Real World, Real Solutions, Orlando , Florida, USA
Sponsered by FSEC
Phone: +1-321-638-1014
E-mail: joann@fsec.ucf.edu
Web Site: http://www.energy2003.ee.doe.gov

August 23, 2003 (tentitive) 🏳

EBEAA EV Distance Rally - part II, Hayward, California, USA
Second half of the Annual East Bay Chapter display and distance event. Second location due to physical geography of region.
Web Site: http://geocities.com/ebeaa

August 23 - 25, 2003 ✈

2003 Challenge Bibendum, San Francisco, California, USA
Challenge Bibendum was conceived by Groupe Michelin as an objective way to bring together and test the best available technologies for environmentally positive vehicles. The event is open to all energy sources. It features vehicles from virtually major vehicle manufacturer and brings together vehicle manufacturers, designers, energy suppliers, technical and industrial partners.
Phone: +1-864-458-4698
E-mail: lynn.mann@us.michelin.com
Web Site: http://www.challengebibendum.com

August 31, 2003 🚌

NEDRA 2003 Nationals, Woodburn Drag Strip, Woodburn, Oregon, USA
Annual national electric drag races.
Web Site: http://www.nedra.com

September 13 - 14, 2003 (tent.) 🏳

GASLESS AT THE CROSSROADS, Seattle, Washington, USA
Alt.Fuel Vehicle / and Electric Vehicle show, sponsored by the Seattle EVA, will be located at Bellevue's Crossroads Shopping Mall.
Web Site: http://slough1.home.mindspring.com/seva.html

September 20, 2003 🏳

SVEAA ANNUAL ELECTRIC CAR RALLY, Palo Alto, California, USA
31th annual Premere West-coast EV rally. This year the event will be held at Palo Alto High School, at El Camino Real and Embarcadro Road.
Web Site: http://eaasv.org/

September 24 - 26, 2003 ✈

8th Grove Fuel Cells Symposium 2003, Oxford, UK
Building Fuel Cell Industries conference and exhibition
Phone: +44-1322-663-006
E-mail: pamchattin@aol.com
Web Site: http://www.grovefuelcell.com

October 3 - 4, 2003 (tent.) 🚌

NORTHAMPTON ELECTRIC VEHICLE RALLY, Northampton, North Carolina, USA
Eighth Annual road rally and autocross, the kickoff event for the 2003-4 EV Challenge.
Telephone: +1-252-534-1258
Email: johnsond.east@ncs.schoollink.net
Web Site: http://www.evchallenge.org

November 15 - 19, 2003 ✈

EVS-20 The International Electric Vehicle Symposium and Exposition, Long Beach, California, USA
Powering Sustainable Transportation, the theme of EVS-20, highlights the important opportunity that electric drive technologies represent for addressing societal and economic issues shared by citizens and nations across the globe.
Phone: +1-408-741-5870
E-mail: EVS20Symposium@aol.com
Web Site: http://www.evs20.org

November 2003 *(Date TBD)* 🚌

RICHMOND EV RALLY, Richmond, Virginia, USA
Seventh Annual rally at Richmond Technical Center
Phone: +1-804-780-6237
Email: basketbaul@aol.com
Web Site: http://www.evchallenge.org

December 9 - 11, 2003 ✈

POWER-GEN International 2003, Las Vegas , Nevada
Sponsered by the PennWell Corporation.
Phone: +44-1992-656600
E-mail: powergen@pennwell.com
Web Site: http://www.pennwell.com

To submit information on an EAA Chapter Events - please email <cenews@eaaev.org>.

Legend:

EAA **Chapter** Event	=	🏳
EV related **Event**	=	🚌
EV related **Conference**	=	✈

Other USA EV Groups:

Bay Area Action
Web Site: http://www.baaction.org/
Location: San Francisco Bay Area, CA

Fox Valley
Web Site: http://www.fveaa.org
Location: Chicago, IL

Denver EV Council - DEVC
Web Site: http://www.devc.org
Location: Denver, CO

National EV Organizations:

Electrathon America
Web Site: http://electrathonamerica.org/
Focus: Light-weight EV racing

EV Challenge
Web Site: http://www.evchallenge.org/
Focus: Educating Middle & High School children

National Electric Drag-Racing Association - NEDRA
Web Site: http://www.nedra.com/
Focus: EV racing

National Station Car Project
Web Site: http://www.stncar.com/
Focus: EVs to public Transportation

Electric Vehicle Association of the Americas - EVAA
Web Site: http://www.evaa.org/
Focus: EV industry organization

Northeast Sustainable Energy Association, - NESEA
Web Site: http://www.nesea.org/
Focus: Sponsers of the annual Tour de Sol

EV List Photo Album
Web site: http://www.evalbum.com/
Focus: Listing almost 400 electric vehicles from around the world - EVDL List owners

Union of Concerned Scientists
Web Site: http://www.ucsusa.org/
Focus: Citizens and Scientists for Environmental Solutions

Non-USA EV Groups:

EV Council Of Ottawa
Web Site: http://econogics.com/ev/evco.htm
Location: Ottawa, Canada
Focus: Canadian EV organization and resource

Australian Electric Vehicle Association
Web Site: http://aeva.asn.au/
Focus: Australia national group

Japan Electric Vehicle Club
Web Site: http://www.asahi-net.or.jp/~MR5T-OKB/index.html
Focus: Japan national group (Choose the english pages)

Sources - Existing EVs-4-Sale:

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

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

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

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

Phoenix Chapter EAA
http://phoenixeaa.com/

EVFinder
http://www.evfinder.com

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

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

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

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

EV Charging Maps And Information:

Tom Dowling's EV Charger list
Covers Arizona, California and Georgia.
Web Site: http://evchargernews.home.attbi.com/

EV1-club inductive Charging
Web Site: http://ev1-club.power.net/chglist.htm

AVCON Charging
Web Site: http://www.hondaev.org/chg.html

Arizona EV Public Charging Sites
Web Site: http://www.1opossum.com/chargers/

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

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

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

FOR SALE

For Sale:

- Advanced FB1-4001A Motor
- Curtis 1231C-8601 Controller
- plus most other parts

for a complete conversion.
Will sell as a group or individually.
Contact *Lee Dunn* at 325-949-8534 or e-mail at elpulga@juno.com

1982 JET ELECTRICA

Refurbished, new paint, new tires, 16 USB Batteries
20 HP Cont./40 HP Peak Prestolite Motor, PMC 1221 B Cont. 96V/400A, On Board 25A Charger, 30A DC/DC Converter
Top Speed 65 MPH $4,995
(650) 366 0643

The Electric Auto Association (EAA) is a *nonprofit* organization for the promotion of public Electric Vehicle (EV) use / awareness as a viable choice. All proceeds are used to cover the costs of our nonprofit efforts in this cause. Please show your support with your purchases for a better, cleaner, quieter, and lower maintenance transportation option.

Image	Description	Item#	Price	#
	License Plate Holder, black plastic frame, white lettering on visible green.	LICPH1	$10.00	
	In motorcycle size, only comes in metal & in either black or chrome, special order, allow 6 weeks.	LICPH2-B LICPH2-C	$14.00	
	*Embroidered Sew-On Paich, white* *This is a special order, please allow an additional three weeks.*	PATCH1	$ 9.00	
	*Embroidered Sew-On Paich, green* *This is a special order, please allow an additional three weeks.*	PATCH2	$ 9.00	
	*Embroidered Hat, adjustable fit.*	CAP002	$15.00	
	*Embroidered Bucket Hat, comes in:* small/medium and large/xlarge.	DCP01-S/M DCP01-L/XL	$25.00	

	*Ceramic Coffee Mug*	MUG003	$ 5.50	
	*Insulated Car Coffee Mug*	MUG02	$ 6.50	
	*EAA Car Window Shade*	SS001 S	$ 8.00	
	*EAA Bumper Sticker #1 (10.5x3.75 inch)*	BS800	$ 2.00	
	*EAA Bumper Sticker #2 (The Switch is on) (15x3.75 inch)*	BS002	$ 2.00	

	*Embroidered Polo Shirt (Forest or Navy S,M,L,XL,XXL), 10 weeks for all colors other than the Forest.*	SHIRT01-F- S M L XL XXL SHIRT01-N- S M L XL XXL	$40.00	
	-- *EV Buyers Guides* --			
	*Electrifying Times Preview 2000* *1997 EV Buyers Guide* *1996 EV Buyers Guide* *1995 EV Buyers Guide*	BG1998 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	
	Back issues of CE (Specify month/year)	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 * some assembly required - 6+ week delivery after payment deposited.*	ADAPT1	$200.00	
	Electric Auto Association Membership	EAAM01	$39.00	
		SUBTOTAL	$____	
	US RATE. -10%, or CANADA -15%, or OTHER = 20% of the total	Shipping	$____	
		Handling	$ 2.00	
		TOTAL	_____	

To order:

- Check off which items and how many you want, total the amount
- Postal mail it with your payment for the amount plus * shipping and * handling to:

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

Name: _____ Address: _____

City, State Zip: _____ Email, Tel# _____

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

VANCOUVER EVA, BC, CANADA
Web Site: http://www.veva.bc.ca/
Meetings: 3rd Wed./mon., 7:30 pm, Vancouver

PHOENIX EAA, AZ
Web Site: http://www.phoenixeaa.com
Meetings: 4th Sat./mon., 9:00 am, Phoenix

CHICO EAA, CA
Web Site: http://geocities.com/chicoeaa/
Meetings: 2nd Sat./mon., 11:00 am, Chico

EAST (SF) BAY EAA, CA
Web Site: http://geocities.com/ebeaa/
Meetings: 4th Sat./mon., 10:00 am, Alameda

LOS ANGELES EAA, CA
Meetings: 1st Sat./mon., 10:00 am, Pasadena

NORTH BAY EAA, CA
Web Site: http://geocities.com/nbeaa/
Meetings: 2nd Sat./mon., 10:00 am

SAN DIEGO EVA, CA
Web Site: http://home.att.net/~NCSDCA/EVAoSD/
Meetings: 4th Tues./mon., 7:00 pm, San Diego

SAN FRANCISCO PENINSULA EAA, CA
Web Site: http://geocities.com/sfpeaa/
Meetings: 1st Sat./mon., 10:00 am, San Bruno

SAN JOSE EAA, CA
Web Site: http://geocities.com/sjeaa/
Meetings: 2nd Sat./mon., 10:00 am, San Jose

SILICON VALLEY EAA, CA
Web Site: http://eaasv.org/
Meetings: 3nd Sat./mon., 10:00 am, Palo Alto

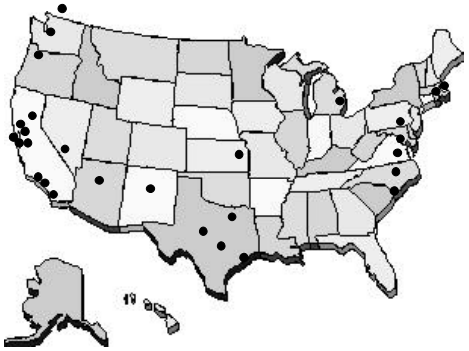
VENTURA COUNTY EAA, CA
Web Site: http://geocities.com/vceaa/
Meetings: 4th Sat./mon., 10:00 am, Ventura

MID AMERICA EAA, KA/MO
Web Site: http://maeaa.org/
Meetings: 2nd Sat./mon., 1:30 pm, Kansas City

NEW ENGLAND EAA, MA
Web Site: http:/neeaa.org/
Meetings: 2nd Sat./mon., 2:00 pm, Worcester

PIONEER VALLEY EAA, MA
Web Site: http://geocities.com/pveaa/
Meetings: 3rd Sat./mon., 2:00 pm, Amhurst

DMC-EAA DETROIT MOTORCITY CHAPTER, MI
Web Site: http://geocities.com/detroit_eaa/
Meetings: Detroit



LAS VEGAS EVA, NV
Web Site: http://www.lveva.org/
Meetings: 2nd Sat./mon., 10:00 am, Las Vegas

ALBUQUERQUE EAA, NM
Web Site: http://abqev.org/
Meetings: 1st Tues./mon., 7:00 pm, Albuquerque

EAA OF COASTAL CAROLINAS, NC
Location: Southport, NC

TRIANGLE EAA, NC
Web Site: http://www.rtpnet.org/teaa/
Meetings: 3rd Tues./mon., 5:30 pm, Raleigh

OREGON EVA, OR
Web Site: http://www.oeva.org/
Meetings: 2nd Thur./mon., 7:30 pm, Portland

EASTERN EV CLUB, PA
Web Site: http://members.aol.com/easternev/
Meetings: 2nd Wed./mon., 7:00 pm, Plymouth

AUSTIN AREA EAA, TX
Web Site: http://www.austinev.org/
Meetings: Austin

HOUSTON EAA, TX
Web Site: http://www.hea.org/
Meetings: 3rd Thurs./mon., 6:30 pm, Houston

NORTH TEXAS EAA, TX
Web Site: http://www.geocities.com/nteaa/
Location: Richardson

CENTRAL VIRGINIA EAA, VA
Meetings: 3rd Wed./mon., Richmond

SEATTLE EVA, WA
Web Site: http://slough1.home.mindspring.com/seva.html
Meetings: 2nd Tues./mon., 7:00 pm, Seattle

EVA OF WASHINGTON DC, DC
Web Site: http://www.evadc.org/
Meetings: 2nd Tues./mon., 7:00 pm, Bethesda

Listing current as of 3/1/03.

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chairman@eaaev.org

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