

FVEAA NEWSLETTER

November 1995

President	Vice President & Editor	Secretary	Treasurer & Librarian	Director	Director
Ken Woods 1264 Harvest Court Naperville, IL 60564-8956 (708) 420-1118	Bill Shafer 308 South East Ave Oak Park, IL 60302-3512 (708) 383-0186	Dave Aarvoid 915 Oak Street DeKalb, IL 60115-3470	Dale Corel 595 North Gateshead Elk Grove Village, IL 60007-3433 (708) 228-5952	John Emde 6542 Fairmount Downers Grove IL 60516-2919	John Stockberger 2 S 643 Nelson Lake Rd Batavia, IL 60510-9762

NEXT MEETING - November 17 at 7:30 PM

**Remember Room - 157, Building K at the College of DuPage,
southwest corner of 22nd Street & Lambert Road**

DISCUSSION TOPIC - Howard Penrose of Dreisilker Electric Motors will make a presentation on AC Electronic Drive Technology. It will feature Adjustable Frequency Drive Technology, Pulse Width Modulation and Insulated Gate BiPolar Transistor drives.

MEMBERSHIP INFORMATION

Any person interested in electric cars is welcome to join the FVEAA. The cost for a full year's dues is \$20 which will entitle the member to receive our monthly Newsletter which contains useful information about electric car components, construction, policies, and events.

FOX VALLEY ELECTRIC AUTO ASSOCIATION

308 South East Avenue
Oak Park, Illinois 60302-3512

First Class

ADDRESS CORRECTION REQUESTED

PRESEZ

The subject matter of our speaker Howard Penrose is appropriate as the Big Three are all using AC motors in their electric vehicles. Solectria used an AC motor with nickel metal hydride batteries to achieve a 238 mile range in last summers Tour de Sol.

You will find an article about an electric powered Street Rod in this newsletter. This and the races using Indianapolis type electric powered cars prove that electric vehicles can be exciting to drive and are practical for many transportation uses.

Ken Woods

FOR SALE

Electrified Rabbit utilizing an advanced DC motor 8 inch, a Curtis Controller, 108V with 2 year old Trojan batteries, the adapter plate to a clutch and 4 speed transmission, instrumentation includes voltmeter, ammeter & tachometer. Top speed 75 mph, summer range 45 miles. Asking \$3100.00 obo. Phone: Brian Klosterman at (319) 378-0866

MINUTES OF OCT. MEETING

The meeting was called to order by President Woods at 7:38 p.m. The minutes to Sept. meeting were corrected to indicate the price of the car for the COOP project was \$525. Treasurer Corel report of \$4509.22 in the checking account including \$2186.70 in the saving account was approved.

Expenses for the COOP project to date include \$625 for the car and batteries, \$1653.73 for the electric motor and \$114.34 for the plate.

Officer nominations to be voted on at the November meeting include existing officers and directors with the addition of Dana Mock as property steward and Ed Meyer as Librarian and Steve Clark as director.

COOP project car is at Ed Meyer's. The log book is with the car. All members working on the car are to fill out the time. The electric motor is at John Emde's machine shop as well as the Nissan transmission. The old engine sold for \$120.00 and the ad cost was traded for a 1995-96 membership. Bob Barrett will try to locate missing or replacement parts. Bob Munroe will be calling volunteers for modifying engine mounts, tow bar installation (welding), fabrication of the battery racks and mapping the new dashboard.

John Emde made a step by step presentation of the machining of the adapter plate connecting the electric motor to the transmission.

Ken Woods showed a videotape that appeared on cable TV of the electric car race using Indianapolis type race cars electrified by major Universities. The race in Cleveland this summer was won by Ohio State University. The first such race run the previous year was won by Notre Dame University. Pit stop battery changes were made in 34 seconds by the students.

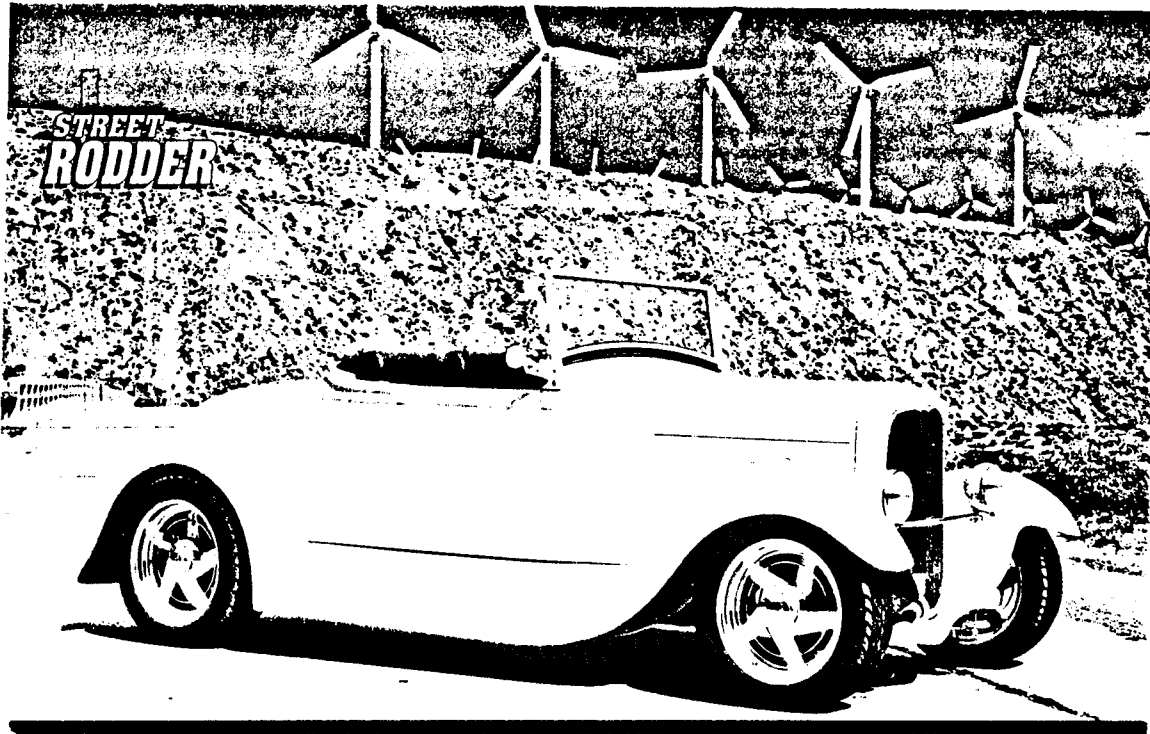
John Stockberger has (77) Rabbit parts in good condition including 4speed transmission, rear axle, struts, cv joints, rear hatch, 4 doors, steering columns, tires, wheels, radiator, misc. motors and Fiat 128 seats, rack and pinion, tires, steering column, radiator, cv joints. Give John a call if interested.

Meeting adjourned at 11:10 p.m.

Submitted by Secretary Dave Aarvold.

STREET RODDER

(September 1995 Issue)



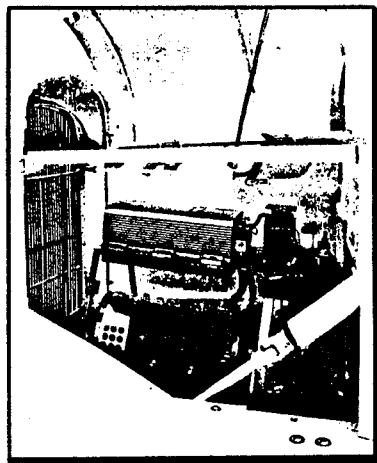
WILDE EVOLUTIONS

Electric-Powered Street Rods Are Here!

By Eric Geisert

For years, people have been looking for alternative power sources for their vehicles. We've seen steam engines, while others can run off natural gas or even a corn-based ethanol. But electric-powered vehicles have always lived under the stigma of being slow and plodding. Hearing about an electric-powered street rod would cause most rodders to roll their eyes, mostly because they can't imagine their beloved Deuce roadster humming along at golf-cart-speed, barely able to pass joggers or cause a flutter in their hair. Where's the fun in that?

But it just ain't so! Wilde EVolutions, a company in Jerome, Arizona, not only has developed an electric-powered street rod, they've made one that can easily cruise at freeway speeds (in fact, their phone number spells it out: 1-800-Fast EVs). And what's more, they can convert most any car over to electric power — from a four-wheel-drive Jeep to an expen-



Someone stole my motor! Not really — it's just an electric one instead of a gas-powered internal combustion type. The motor (an Advanced D.C. 8" prototype) is the cylindrical blue thing mounted in front of the Richmond five-speed transmission. The Curtis-PMC controller (86-144 volt/500 amp) is the boxed unit up above.

sive Jaguar. Wilde EVolutions figured out people won't use electric cars for fun if they aren't fun to drive, and what is more fun than a street rod? So they picked up a fiberglass '29 Ford roadster body, mounted it on a nearly-stock aftermarket chassis, and in a short 56 days, were briskly rolling down the road.

Their electric motor (an Advanced D.C. 8" prototype), mated to a Richmond five-speed trans and coupled to a Ford nine-inch rear, can bark the tires in low gear and zip right along with the rest of the pack. You don't get the noise or the torque of mashing the gas pedal to the floor of a big V-8 rod, but zero emissions has other (environmental) benefits. And if you've ever tried to start your car in ultra-cold weather, you'll be happy to know EV's (electric vehicles) are up and running at a flick of a switch.

Wilde EVolutions' bright Mustang Yellow '29 roadster, built for demonstration, is your

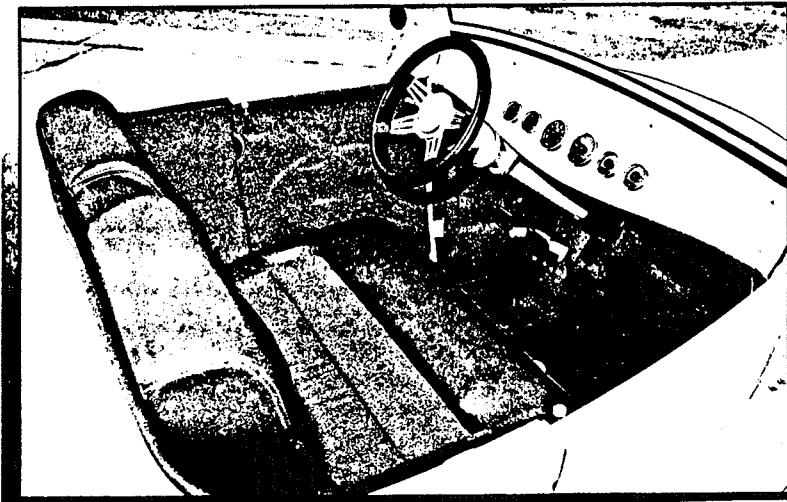
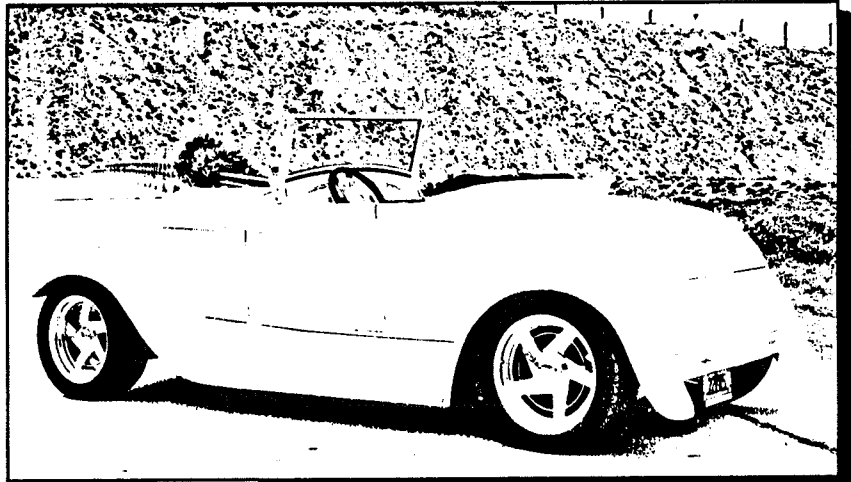
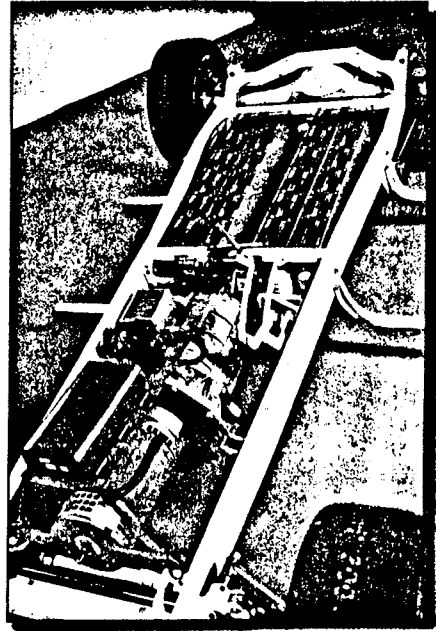
basic Model A chassis from The Rod Factory (Phoenix, AZ), modified with extra crossmembers to support rows of batteries (two stacks of 12 batteries for a total of 144 volts). The rest of the chassis is by the book — four-link rear, independent front, Aldan coil-overs fore and aft, and Wilwood four-piston calipers and discs on each corner. The rod rolls on 16 x 8 and 17 x 8 Weld wheels, wrapped in Goodyear GSC P245 & 255/45ZR rubber.

The fiberglass Poli-Form body sports hidden hinges, a three-piece Rootlieb hood, a rolled rear pan (with custom "lightning bolt" taillights), and King Bee headlights. Inside, an ididit aluminum steering column supports a Lecarra steering wheel, and a Glide Engineering bench seat (covered in teal-colored leather and tweed). To the casual observer, about the only "different" items about this rod are the custom gauges, which include the usual tach, speedo, and amp gauge, but also an expanded-scale volt meter, temperature gauge (to measure the controller temp), and a "fuel" gauge — an analog amp-hour meter that still reads E, 1/4, 1/2, 3/4, and F.

In fact, from the outside, anyone not knowing what's under the hood would think it's a normal rod, which is exactly the point. It is a normal rod, just not powered by a flathead V-8, GMC six, or a Chevy V-8. The rod's electric motor provides enough juice to cruise around town all day, and when you get home, you just plug it into the wall socket in the garage. Normal charging time on a drained battery is 8 to 10 hours. Batteries last two to three years, and are sealed, so no maintenance is needed.

With zero emissions, and safer than other gas-powered rods (no chance for fuel to catch fire or explode), the electric option is something a lot of people will be (and should be) looking into. That's one of the reasons this rod was a recent *STREET RODDER Top Ten* pick from the Goodguys 6th Annual Spring Nationals at Pomona! **SRM**

With extra crossmembers added to the Rod Factory Model A chassis, the two rows of 12 batteries (sealed Genesis SP Series Hawker Energy Products) provides the right amount of juice. Photo by Kirk McVety.



It looks like your regular rod, and even rolls around on Goodyear-wrapped (GSC P245/45ZR16 & 17's) Weld Racing wheels (16 & 17 x 8's). The '94 Mustang Yellow paint was applied by Russ Batie (Desert Rose Auto Body & Paint, Phoenix, AZ). Check out the lightning bolt taillights!

Looks normal enough, right? Both the Glide Engineering bench seat, covered with teal tweed by Craig's Custom Upholstery (Phoenix, AZ), and the Lecarra steering wheel (atop an ididit column) can be found in any rod, but the gauges are a different story. Custom made, each relates to an electrical output. The tach, speedo, and amp gauge are pretty standard, but an expanded-scale volt gauge, temp gauge (for the controller), and a "fuel" gauge are not.

1829 Ford roadster

C H A S S I S

Frame/Manufacturer — 29 Ford / The Rod Factory
Phoenix, AZ
Wheelbase — 103 1/2"
Modifications — boxed, raised and narrowed rear crossmember, extra crossmembers for battery rack, custom transmission mount
Rear end / Ratio — '78 Ford 9" / 2.75:1
Rear suspension — Rod Factory four-link, Aldan coil-over shocks
Rear brakes — Wilwood disc, stainless lines
Front suspension — Rod Factory independent, Aldan coil-over shocks
Front brakes — Wilwood disc, stainless lines
Master cylinder — Ford
Steering box — modified Dodge Omni rack & pinion
Steering column — idrift tilt
Front wheel make/Size — Weld / 16 x 8
Rear wheel make/Size — Weld / 17 x 8
Front tire make, size — Goodyear GSC P245/45ZR16
Rear tire make, size — Goodyear GSC P255/45ZR17
Gas tank — ?
Other chassis items — two rows of 12 Genesis SP Series Hawker Energy Products batteries, Curtis-PMC 96-144 volt/500 amp controller, Kilovac "Bubba" contactor

M O T O R & T R A N S

Make — Advanced D.C. 8" (experimental prototype)
Transmission — Richmond 5-speed
Clutch — CenterForce, Midway Industries

B O D Y

Body style / Material — roadster / fiberglass
Body Manufacturer — Poli-Form
Body mods — hidden hinges
Hood — Rootlieb three-piece
Grille — stainless by Poli-Form
Body work by — Russ Balle, Desert Rose Auto Body & Paint, Phoenix, AZ
Paint Color — '94 Mustang Yellow
Painter — Russ Balle
Headlights/Tailights — King Bee / custom, w/lightning bolt covers
Bumpers — none

I N T E R I O R

Dashboard — stock Poli-Form
Insert / Gauges — Rod Factory / custom for electrical application
Wiring — Wilde Evolutions Jerome, AZ
Steering wheel — Lecarra
Upholstery by — Craig's Custom Upholstery, Phoenix, AZ
Material / Color — leather & tweed / teal
Seats — Glide Engineering
Carpet — nylon teal

REAL HEROES

By Kenneth R. Woods

The newspapers, television and radio are full of stories about talented athletes, politicians and corporate leaders. I want to suggest that more important to a free society are the two women that I will write about here.

One lady ferried P51 fighter planes during WWII. Pilots familiar with the P51 remember that they were flying barn doors, with a 90 deg glide angle. She weighed about 110 pounds and had to take off at part throttle and stand on the rudder pedal to correct for the tremendous torque developed by the engine. In addition to her job as a ferry pilot, she found time to be a mother. One of her children achieved a Ph. D at the renowned Carnegie-Mellon University in Electrical Engineering.

The other lady was an architect with a sensitivity to the environment as proven by her design and construction of a solar home. She also was a mother of two boys, just starting their careers. The home utilizes a two story sun space on the South side. Heat is stored in the tiled concrete floor of the sun space during sunny weather. The roof on the South contains two active solar collectors for heating domestic hot water. She employed a twelve inch thick wall on the North exposure and closets on that wall on the second floor to act as a buffer to North winds. The design reflects the concepts of Caesar's architect Vitruvius who wrote a ten volume set of instructions to the builders of the Roman empire to build buildings for specific climates.

These women represent the best of our free society and are in my opinion **REAL HEROES**. Will the Circle be Unbroken.

RECENT EV ARTICLES

EVAOSC (The Electric Vehicle Association of Southern California) in their September 1995 issue featured an article by Ken Koch describing a new multiple function meter for the dashboard of electric vehicles. This E-Meter is microprocessor based and is in a 2-inch round automotive style case. It provides volts, amps, amp-hours, kilowatt-hours, time remaining on a battery charge and historical battery information. The meter lists for \$199.95 and is available through KTA Services in Upland, CA.

World Electric Transportation & Solar Explosion (Clarence Ellers at Yachats, OR) in their September 1995 Issue featured a study by Cambridge Reports/Research International that 72% would buy an EV if it could go 75 miles on a charge and had fast recharge. 78% said that they drove less than 75 miles per day. The poll was conducted for EEI (Edison Electric Institute). Full copies of the poll can be obtained by calling EEI-202-508-5778.

EV UPDATE (Sacramento Electric Vehicle Association) in their October 1995 Issue featured an article indicating the Role of Electronics in a Changing Industry. The automotive electronics industry is expected to grow from \$38 billion in 1993 to more than \$64 billion in 1998 according to a recent issue of Automotive Engineering. Today, there are more computers shipped inside automobiles than in stand alone computers.

ELECTRIC GRAND PRIX CORP. (Rochester, NY) in their Oct-Dec 1995 issue reported on a cross country trip by a 1912 Baker Electric. The 1912 electric vehicle left Astoria, OR on May 27, 1995 and arrived at Hurrah's Marina Casino in Atlantic City on July 3, 1995. Ray Carr of the Eastern Electric Vehicle Club and his crew chief Mike Wyka averaged 89.5 miles per day on this 3400 mile trip. One day they covered 85.6 miles on a single charge and 160 miles in a single day. The Baker Electric had a bank of 12-6volt batteries.

EVents

November 12-14, Solar/EV Symposium at the Rhode Island Convention Center in Providence. Sponsored by NESEA. This is the seventh annual renewal of an event that features electric car development discussions, workshops, and exhibits. Individual registration is \$ 395. For information write to NESEA, 50 Miles Street, Greenfield MA 01301, Phone (417) 774-6051.

December 12-14. North American EV & Infrastructure Conference in Atlanta, GA. Organized by the E V Assn. of the Americas. Exhibits & discussions. For info call Pam Turner at (415) 855-2010 or write to SHO Inc. 444 Castro ST. # 1015, Mountain View CA 90401.

January 22-23, 1996 EnV'96 in Dearborn, MI. For information contact Rich Moziro, ESD - The Engineering Society, 2350 Green Road, # 190, Ann Arbor, MI 48105, FAX (313) 663-7835

October, 1996, EVS-13, (the 13th biennial Electric Vehicle Symposium) in Osaka, Japan.

ALTERNATIVE ENERGY NETWORK ONLINE TODAY

A Daily Executive Summary Covering World News on Alternative Transportation & Fuels

REGULATORY REPORT

EPA Issues Final NGV Emission Reduction Rules

In an action long-awaited by fleet managers and natural gas interests, EPA issued its final natural gas vehicle emission reduction standards set to take effect in the 1997 model year.

EPA said the carbon monoxide, nitrogen oxide and hydrocarbon emission limits are comparable to standards set for gasoline, diesel and methanol vehicles. Under the rule, NGVs only must meet a non-methane hydrocarbon standard, though about 90% of hydrocarbons from natural gas vehicles are methane. Methane is not a smog precursor, so it poses no danger for higher ozone levels.

According to EPA, the new non-methane standard will allow current catalyst hardware to be used. The rule also calls for NGV fuel mileage to be measured and included in the Corporate Average Fuel Economy (CAFE) program. The agency said future rulemaking will detail how other gaseous fueled vehicles will be included in the CAFE program.

(REUTER: 6/3)

INDUSTRY REPORT

UC Davis Study Suggests California EV Demand Could Outstrip Supply

In contrast to prevailing thought, the preliminary findings of a survey conducted for the California Air Resources Board by the Institute of Transportation Studies at the University of California, Davis of 600 California households concludes that demand for electric vehicles in the state could be greater than supply.

"Based on initial results, we find there is a much larger market for electric vehicles than have many previous surveys," says the report. Researchers note that consumers tended to feel comfortable with EVs once they were informed about design, limited range effects and home charging. Results from the first 175 respondents found:

- 48% would buy an EV instead of a gas-powered vehicle if the average price was below \$20,000;
- Purchasers of "small sedans unanimously chose battery electric vehicles over gasoline" powered cars;
- "Only buyers of midsize sedans were more likely to prefer gasoline to electric;"
- "Hybrids" will be the dominant choice of households buying EVs;
- Range was not the determining factor, though EV market potential increased as range increased.

Institute director Dan Sperling commented, "I am optimistic about the market...I think it will be relatively easy to sell [EVs]." CALSTART communications director, Bill Van Amburg, added, "The electric vehicle fits a niche for a second or third car extremely well."

However, some industry leaders remain concerned that California's EV 1998 mandate is too strict. American Petroleum Industry spokesman Bill Taylor said, "By mandating a quota on vehicles by a government fiat, you are putting undue cost on the consumer, impacting on the market place and upsetting the balance of cost effectiveness."

(SACRAMENTO BEE: 6/1)

GRANTS & CONTRACTS

Blue Skies NGV to Perform Conversions for L.A. County Agency & California School Bus Dealer

Blue Skies NGV Conversion Company, Inc. (Ontario, Calif.) has been awarded a contract by the Los Angeles County Sanitation District for the conversion of its diesel powered vehicle to natural gas fuel. Blue Skies will convert and retrofit the existing NTC-350 Cummins diesel engine used by the county with the latest alternative fuel (natural gas) conversion technology.

Blue Skies is also preparing to embark on a conversion project involving 30 buses for a California school bus dealer. These natural gas-fueled vehicles will ultimately be utilized by various communities and school districts throughout California.

Brian Brown, Blue Skies president, said, "By converting a major portion of existing diesel powered vehicles either now on the road or destined to be on the road with cleaner burning alternative fuels, we will be making a tremendous and positive impact on the quality of our environment and at the same time, we will be meeting all of the currently mandated federal and state air quality regulations." For more information, contact Brian Brown at 909/923-8780.

(BLUE SKIES NEWS: 6/6)

EDITORIALS, REVIEWS & ASIDES

Mobil Advertorial Calls EV Mandates Premature, Costly

According to a Mobil Oil advertorial which appeared in the June 2 *New York Times*, "The battery technology to make electric vehicles practical -- and to make them perform up to consumer standards and be affordable on a mass scale -- just isn't here yet. And there's no evidence it will be by 1998 [when 2% of all California vehicle sales must be EVs]."

Says Mobil, "The electric vehicle that could be available in 1998 would have limited driving range...which would be reduced even more in cold weather and when headlights, wipers and the heater or air conditioner are used." The company suggests that the only way to sell such vehicles is by state subsidy paid by taxpayers.

The cost of manufacturing a ZEV could be \$10,000-\$27,000 more than conventional vehicles, according to a recent study by DRI/McGraw-Hill and Charles River Associates. The need to produce these cars will cause automakers to raise prices on all cars, which may encourage many drivers to keep their old cars longer and compromise the objective of ZEVs to replace high-polluting cars. California Air Resources Board data suggests that the EV mandate will reduce emissions by less than 1% by 2010, Mobil says, even under the "optimistic assumption that for each [EV] on the road, a conventional vehicle is taken off."

Though Mobil says it has nothing against EV technology and welcomes nonsubsidized competition, it does object to legislation that will "force development of a technology that simply can't be ready in four years." It says new cars will run over \$600 higher than they might otherwise because of EV subsidies, and warns buyers, "[I]f you don't plan on buying an electric car, and think this mandate won't have an effect on you, think again."

(NEW YORK TIMES: 6/2, p.A23)

NEW - 1996 NATIONAL ELECTRICAL CODE

ARTICLE 625 — ELECTRIC VEHICLE CHARGING SYSTEM EQUIPMENT

A. General

625-1. Scope. The provisions of this article cover the electrical conductors and equipment external to an electric vehicle that connect an electric vehicle to a supply of electricity by conductive or inductive means, and the installation of equipment and devices related to electric vehicle charging.

(FPN: For industrial trucks, see *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Maintenance, and Operation*, NFPA 505-1992.

625-2. Definitions.

Electric Vehicle: An automotive-type vehicle for highway use, such as passenger automobiles, buses, trucks, vans, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array, or other source of electric current. For the purpose of this article, electric motorcycles and similar type vehicles and off-road self-propelled electric vehicles, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats, and the like, are not included.

Electric Vehicle Connector: A conductive or inductive device that, by insertion into an inlet on the electric vehicle, establishes connection to an electric vehicle.

Electric Vehicle Nonvented Storage Battery: A hermetically-sealed battery comprised of one or more rechargeable electrochemical cells that has no provision for release of excessive gas pressure, or the addition of water or electrolyte, or for external measurements of electrolyte specific gravity.

Electric Vehicle Supply Equipment: The conductors, including the ungrounded, grounded, and equipment grounding conductors, the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatuses installed specifically for the purpose of delivering energy from the premises wiring to the electric vehicle.

625-3. Other Articles. Wherever the requirements of other articles of this Code and Article 625 differ, the requirements of Article 625 shall apply.

625-4. Voltages. Unless other voltages are specified, the nominal ac system voltages of 120, 120/240, 208Y/120, 240, 480Y/277, 480, 600Y/347, and 600 volts shall be used to supply equipment covered by this article.

625-5. Listed or Labeled. All electrical materials, devices, fittings, and associated equipment shall be listed or labeled.

B. Wiring Methods

625-9. Electric Vehicle Connectors. The electric vehicle connectors shall comply with (a) through (d) below:

(a) **Polarization.** The electric vehicle connectors shall be polarized and shall have a configuration that is noninterchangeable with receptacles in other electrical systems on the premises. Listed electric vehicle connectors protected by a system of double insulation or its equivalent in accordance with Article 250 shall be noninterchangeable with grounding-type electric vehicle connectors.

(b) **Construction and Installation.** The electric vehicle connectors shall be constructed and installed so as to guard against inadvertent contact by persons with parts made live from the electric vehicle supply equipment or the electric vehicle batteries.

(c) **Coupling.** The coupling of the electric vehicle connector and inlet shall be provided with a positive means to prevent unintentional disconnection.

(d) **Grounding Pole.** An electric vehicle supply connector shall be provided with a grounding pole that shall be the first to make and the last to break contact with the mating inlet.

Exception: Listed electric vehicle connectors protected by a system of double insulation or its equivalent in accordance with Article 250.

C. Equipment Construction

625-13. Electric Vehicle Supply Equipment. This equipment shall be permitted to be fastened in place or cord- and plug-connected. The equipment shall have no exposed live parts.

625-14. Rating. Electric vehicle supply equipment shall have sufficient rating to supply the load served. For the purposes of this article, electric vehicle charging loads shall be considered to be continuous loads.

625-15. Markings. The electric vehicle supply equipment shall be marked: "For Use with Electric Vehicles."

625-16. Means of Coupling. The means of coupling to the vehicle shall be either conductive or inductive. Attachment plugs, cord connectors, couplings, and inlets shall be listed or labeled for the purpose.

625-17. Cable. The electric vehicle supply equipment cable shall be Type EV, EVJ, EVE, EVJE, EVT, or EVJT flexible cable as specified in Article 400 and Table 400-4. Ampacities shall be as specified in Table 400-5(A) for No. 10 and smaller and Table 400-5(B) for No. 8 and larger. The overall length of the cable shall not exceed 25 ft (7.62 m). Other cable types and assemblies listed as being suitable for the purpose, including optional hybrid communications, signal, and optical fiber cables, shall be permitted.

625-18. Interlock. Electric vehicle supply equipment shall be provided with an interlock that de-energizes the electric vehicle connector and its cable wherever the electric connector is uncoupled from the electric vehicle.

Exception: Portable cord- and plug-connected electric vehicle supply equipment for connection to receptacle outlets rated at 125 volts, single-phase, 15 and 20 amperes.

625-19. Automatic De-energization of Cable. The electric vehicle supply equipment or the cable/connector combination of the equipment shall be provided with an automatic means to de-energize the cable conductors and electric vehicle connector upon exposure to strain that could result in either cable rupture or separation of the cable from the electric connector and exposure of live parts.

Exception: Portable cord- and plug-connected electric vehicle supply equipment for connection to receptacle outlets rated at 125 volts, single-phase, 15 and 20 amperes.

D. Control and Protection

625-21. Overcurrent Protection. Overcurrent protection for feeders and branch circuits supplying electric vehicle supply equipment shall be sized for continuous duty and shall have a rating of not less than 125 percent of the maximum load of the electric vehicle supply equipment. Where non-continuous loads are supplied from the same feeder or branch circuit, the overcurrent device shall have a rating of not less than the sum of the non-continuous loads plus 125 percent of the continuous loads.

625-22. Ground-Fault Protection for Personnel. The electric vehicle supply equipment shall have a listed system of protection against electric shock of personnel. Where a current to ground exceeds some predetermined value that is less than the current required to operate the overcurrent protective device of the supply circuit, the system shall de-energize the electric vehicle supply equipment within an established period of time. Where cord- and plug-connected electric vehicle supply equipment is used, the ground-fault circuit-interrupter protection for personnel shall be an integral part of the attachment plug or shall be located in the power supply cable not more than 12 in. (305 mm) from the attachment plug.

625-23. Disconnecting Means. For electric vehicle supply equipment rated more than 60 amperes or more than 150 volts to ground, the disconnecting means shall be provided and installed in a readily accessible location. The disconnecting means shall be capable of being locked in the open position.

625-24. Grounding. All electric equipment and installations shall be bonded and grounded in accordance with Article 250.

625-25. Loss of Primary Source. Means shall be provided such that upon loss of voltage from the utility or other electric system(s), energy cannot be backfed through the electric vehicle supply equipment to the premises wiring system. The electric vehicle shall not be permitted to serve as a standby power supply.

E. Electric Vehicle Supply Equipment Locations

625-26. Hazardous (Classified) Locations. Where electric vehicle supply equipment or wiring is installed in a hazardous (classified) location, the requirements of Articles 500 through 516 shall apply.

625-28. Indoor Sites. Indoor sites shall include, but not be limited to, integral, attached and detached residential garages, enclosed and underground parking structures, repair and nonrepair commercial garages, and agricultural buildings.

(a) **Location.** The electric vehicle supply equipment shall be located to permit direct connection to the electric vehicle.

(b) **Height.** Unless specifically listed for the purpose and location, the coupling means of the electric vehicle supply equipment shall be stored or located at a height of not less than 18 in. (457 mm) and not more than 4 ft (1.22 m) above the floor level.

(c) **Ventilation Required.** Where required, mechanical ventilation shall be provided as specified in Table 625-29(c).

Ventilation shall include both supply and mechanical exhaust equipment and shall be permanently installed and located to intake from, and vent directly to, the outdoors. Mechanical ventilation shall be sized to provide the minimum ventilation specified in Table 625-29(c), in cubic feet per minute (cfm), for each parking space equipped to charge an electric vehicle. This allows for sufficient ventilation for any configuration of electric vehicle supply equipment and electric vehicle charging spaces. Mechanical ventilation shall be electrically interlocked with the electric vehicle charging equipment to operate during the entire electric vehicle charging cycle. Electric vehicle supply equipment, receptacles, and power outlets shall be clearly marked "For Use with All Electric Vehicles."

Exception: For receptacles at each electric vehicle charging space identified "For Use with Electric Vehicles," and rated 125 volts, single-phase, 15 and 20 amperes, such receptacles shall be switched and mechanical ventilation shall be electrically interlocked through the switch supply power to the receptacle.

For other voltages and currents, minimum mechanical ventilation shall be permitted to be calculated by means of the following general formula:

$$\text{Ventilation}_{\text{single-phase}} = \frac{(\text{Volts})(\text{Amperes})}{48.7}$$

$$\text{Ventilation}_{\text{3-phase}} = \frac{(\text{Volts})\sqrt{3}(\text{Amperes})}{48.7}$$

Table 625-29(c). Minimum Mechanical Ventilation Required in Cubic Feet per Minute (cfm) for Each Parking Space Equipped to Charge an Electric Vehicle

Branch Circuit Ampere Rating	Branch Circuit Voltage							
	Single-Phase				3-Phase			
	120V	208V	240V or 120/240V	208V or 208Y/120V	340V	480V or 480Y/277V	600V or 600Y/347V	
15	37	64	74	148	171	342	427	
20	49	85	99	222	256	512	641	
30	74	128	148	296	342	683	854	
40	99	171	197	370	427	854	1066	
50	123	214	246	444	512	1025	1281	
60	148	256	296	512	599	1198	1500	
100	246	427	493	740	854	1708	2135	
150				1110	1281	2562	3203	
200				1480	1708	3416	4270	
250				1850	2135	4270	5338	
300				2221	2562	5125	6406	
350				2591	2989	5979	7473	
400				2961	3416	6832	8541	

(d) **Ventilation Not Required.** Where electric vehicle nonvented storage batteries are used or where the electric vehicle is listed or labeled as suitable to be charged indoors, mechanical ventilation shall not be required. Electric vehicle supply equipment, receptacles, and power outlets shall be clearly marked "For Use Only with Electric Vehicles Not Requiring Ventilation."

625-30. Outdoor Sites. Outdoor sites shall include, but not be limited to, residential carports and driveways, curbside, open parking structures, parking lots, and commercial charging facilities.

(a) **Location.** The electric vehicle supply equipment shall be located to permit direct connection to the electric vehicle.

(b) **Height.** Unless specifically listed for the purpose and location, the coupling means of electric vehicle supply equipment shall be stored or located at a height of not less than 24 in. (610 mm) and not more than 4 ft (1.22 m) above the parking surface.