F. V. E. A. A. NEWSLETTER

FEBRUARY 1991

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DEADLINE for newsletter *STUFF* - in my hands two weeks before the next meeting. Editor

MEETING NOTICE

The next FVEAA meeting will be FEBRUARY 15th at College of DuPage Building K 22nd & Lambert Rd. Glen Ellyn Time Meeting 7:30 P.M. sharp. We can arrive at 7:00. Guests are welcome and need not be members to attend the meeting. NOTE: Enter at EAST entrance. We meet in room # K-157

THE PREZSEZ

This issue of the FVEAA Newsletter is the first for our new editor, Richard Sachtschale. Many thanks to John Emde, our former editor who did a magnificent job for the past 8 years.

I believe a discussion of controllers will be appropriate during our February meeting. Several members with cars have mentioned to me questions they have that can best be addressed by the collecive wisdom of members at the meeting.

I have written to the sponsors of the Midwest Environmental and Renewable Enery Expo accepting their offer of free booth space as was approved at our January meeting. The event is scheduled for Sat & Sun, February 23 & 24th and will be a discussion subject for our February meeting.

Bill

FOX VALLEY ELECTRIC AUTO ASSOCIATION
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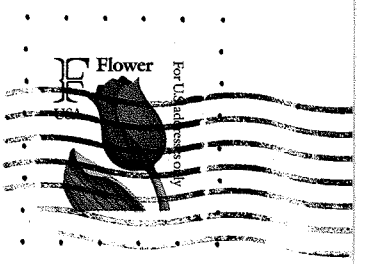

FIRST CLASS

JOHN EMDE
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ADDRESS CORRECTION REQUESTED

Minutes of Fox Valley Electric Auto Association

December 21, 1990

Meeting called to order at 7:35 P.M.
Treasurer Vana reported the Now account balance at $2032.02 and the savings account balance at $925.59 for a total of $2957.61.
Pres. Shafer recommended the club purchase "Electric Vehicle Conversion" manual by Williams at $12.95 and also the latest Clarence Ellers manual for $30.00 and the S.A. E. Publication at $55.00. Motion by John Stockberger and seconded by Dick Ness. Vana to order through Bob Barrett. The electric car calendars by Ellers are out again for $5.00. Ken Woods made motion to order 10 - seconded by Tom Kaminski. John Stockberger introduced new member Robert McCullough, a pilot for TWA. Richard Sachtschale introduced Chris Jensen who works at Fermi Lab.
Pres Shafer announced that dues are due by January 1991 or you can be dropped from mailing list. The pres. also asked that the club participate in only two events where we could display cars and talk to people like "Toys for Dads" at Yorktown Shopping Ctr. on Fathers Day weekend - Fri Sat Sun. Also a second recomendation was somthing similar to Triton College as a workshop - Breif discussion was held - not much enthusiasim for 3 day event or even 2 day stint so Yorktown was not recommended. Ken Woods to check on Naperville events. Feb. 21 - Argonne - WTTW program Energy - probably at noon - Free admission - details to come.
John Emde reported on Midwest Renewable Energy Fair. He hopes The club can be represented once again June 21st - 23rd 1991.
Bob Barrett gave a talk on Binary Motor Array Vehicles.
Pres Shafer adjourned the meeting at 9:42 P.M.

Respectfully submitted

Paul P. Harris , Secretary

Minutes of the Fox Valley Electric Auto Association

18 January, 1991

Meeting was called to order at 7:32. There were 19 members and 2 guests present. The Treasurer reported a balance of $ 929.92 in the savings account and $ 1956.75 in the checking account.

President Shafer reported that the 1991 Calandars and two SAE books on electric vehicles ordered last month have been received and are available. Calendar cost is $5 each. The book, Electric & Hybrid Vehicles" will be added to our library. The second was ordered for Member Kaminski.

President Shafer expressed thanks to Newsletter Editor Emde for preparation of the January Newsletter which President Shafer was unable to do as promised due to the press of reassessment work.

FVEAA participation in the February 23-24 Midwest Environmental and Renewable Energy Expo at Triton College was discussed. Participation using the Triton Fiat and possible one other member's car was approved. President Shafer was authorized to prepare and present a program on the subject " RECYCLING AND REPOWERING A CAR FOR ELECTRIC DRIVE" IF The Expo sponsor wishes.

Purchase of the following material was authorized: "Guide to Electric Auto Conversion" written by Bill Palmer and available from KTA Services for $ 12.50; 1-year subscription to Alternate Transportation News; Nine copies of a Battery Charger Manual for members.

Vice President Woods reported on the February 21st filming of an energy-related program at Argonne. They would like to have an electric car available. Ken Woods will contact Dr Klima and suggest a car from Soleq. Addditional details on the event will be announced at the February 18th FVEAA meeting.

Bob Barrett and his associate, Robert Reynolds, presented a follow-on to last month's discussion of his development of a binary motor control concept.

The meeting adjourned at 9:45 PM.

Secretary Pro-Tem
William H. Shafer
William H Shafer

Presenting news and photographs of local people, schools and organizations, plus WCTV cable listings, a recipe page and special interest articles.

Wheaton Leader
PEOPLE
JANUARY 9, 1981

SECTION II, PAGE 1

Ahern puts a charge into driving

by MICHAEL VAUGHN
Wheaton Editor

With gas prices soaring and future oil supplies in doubt, you may find yourself driving around town paying added attention to the fuel gauge. And you may feel your grip on the steering wheel tighten as frustration swells inside when you pull into a local gas station for a fill-up.

But not if you're John Ahern. Ahern, a Wheaton resident, isn't a slave to the gas pump. In 1980 he had a gasoline powered car converted to electric power more out of personal interest than out of a concern for the future of petroleum fuel. Under present economic conditions, however, Ahern's hobby is becoming quite a fortuitous one.

"My aunt had an electric car," Ahern remembers, "and my brother and I would ride in the car with her when she ran errands. That's how I became interested in electric cars." Then, about ten years ago, Ahern, a retired postman, enlisted the aid of some of his fellow members of the Fox Valley Electric Auto Association and converted his four-door Fiat to electric power.

"And now that car has over 11,000 juice powered miles on it," states Ahern. The car uses six-volt, golf cart batteries as its source of power, and twelve of them are required to give the car its 12 horsepower. Now 12 is a modest number when compared to the horsepower of a four cylinder, gasoline powered car which ranges between 80 and 120 horsepower, but Ahern has no problem doing normal city driving in his car.

Electric cars, of course, do have significant advantages. Their impact on the environment is less than gasoline powered cars which spew carbon monoxide exhaust into the air. Also, electric cars generally require much less maintenance than gas cars.

Ahern still has a gasoline powered car which he uses for much of his driving, especially in the winter because the electric car has no heater. But as a second car, the electric car does just fine.

William Shafer, president of the Fox Valley Electric Auto Association, says that the most viable function of electric automobiles would be as a way for commuters to go back and forth to the train station. And Shafer reports greater interest in the method involved in converting gas cars to electricity since gas prices began to rise due to the crisis in the Middle East.

Since the FVEAA began in 1975 as a response to the oil embargo, it has converted 23 cars. "The nice thing about our organization is that we have all sorts of talent among our members and we help each other," says Shafer.

The steps for conversion aren't as complicated as they may seem. Shafer outlines the process this way. First, find a car that has the body intact and engine problems that can be purchased cheaply, anything over $400 is too expensive. And small, light unibody cars seem to work the best. Then the internal combustion engine needs to be removed.

Next is the electric motor, and surplus aircraft generators generally make the least expensive motors. Then the drive train needs to be adapted to the new motor, this usually requires the work of a machinist. Next, depending on the car being converted, the number of batteries to be used and their placement in the car is determined. Then a device called a potentiometer is connected to the accelerator to vary the voltage to the motor, and a few changes need to be made on the instrument panel.

Finally, a battery charger is required, so that when the car runs down it can be plugged in to any normal electrical outlet to be recharged.

Shafer estimates that an average conversion cost is $3,500, which includes the cost of buying the car to be converted. The most expensive items, according to Shafer, are the batteries, which run about $40 apiece, and the vehicle.

Once a car is converted, there is little difference between operating it and a gasoline powered car. Electric cars don't accelerate as quickly as gas cars, but Shafer says that any electric motor can be designed to provide enough power to get an electric car to go from 0-30 mph in between six and eight seconds. Also, electric cars run almost without a sound, and when the car is at a stop, virtually no electricity is used.

The FVEAA has estimated the cost to own and use an electric car to be about 25 cents per mile, depending on local electric rates. And Shafer says, "My electric car has been the principle life saver of my station wagon."

And it makes pulling into a gas station a little less frustrating.

Let Detroit cooperate on electric cars

Detroit automakers have hunkered down for a recession year of shoppers deserting showrooms and assembly lines grinding to a halt. In addition to slumping sales, they face increased foreign competition, tougher environmental regulations and uncertain oil markets roiled by the war in the Persian Gulf.

Ford, Chrysler and the United Auto Workers union are responding with calls for strict limits on sales of Japanese cars in the United States, even those made by Americans in American-based plants. They want to cap Japan's share of the domestic auto market at well below the 32 percent it had last year.

Attacking a recession by attacking trade is as ignorant as it is perverse. It punishes American consumers, forces up the cost of living at a time when personal spending power is suffering and ultimately kills American jobs. And Congress should not forget that while limiting Japan's share of the U.S. auto market might save some jobs at Big Three facilities, it would eliminate others at Japanese auto plants in Illinois and other states that employ nearly 28,000 Americans.

If Washington wants to help U.S. automakers weather the recession, it can clear the way for them to join forces in fighting their foreign competition—not give them the false comfort of new quotas.

For example, federal antitrust watchdogs should not interfere with plans by General Motors, Ford and Chrysler to combine their financial resources and research talents to develop improved battery technology for electric cars.

Automakers have been tinkering with electric cars for years. Now, with heightened demands for cleaner air and greater fuel efficiency, the need for alternatives to gasoline-powered cars is critical. So far, though, engineers haven't found a way to make an inexpensive battery that can power a car for much more than 100 miles before it needs recharging.

By pooling research teams and chipping in more than $100 million, the Big Three have a chance to beat the Japanese in achieving a breakthrough in battery technology and getting electric cars on the road. This is the type of cooperative research effort that the White House, Congress, antitrust agencies—and American consumers—should applaud.

Business

Chicago Tribune Friday, February 1, 1991

Detroit to cooperate on electric car

California demand for emission-free vehicle is spur

From Chicago Tribune wires

DETROIT—The Big Three automakers, in a rare display of unity, announced a joint research project Thursday to find new technology to help them meet tough California air-quality rules by 1998.

General Motors Corp., Ford Motor Co. and Chrysler Corp. hope that by pooling resources, they can advance the electric-car race and develop power systems that perform as well as the internal-combustion engines that propel today's cars.

"We're hoping to provide electrical energy systems capable of providing future generations of electric cars with range and performance competitive with those of current vehicles," said Ford spokeswoman Beryl Goldsweig.

Goldsweig said initial funding will be about $35 million. The companies hope to raise the annual budget to $100 million by 1993.

Stringent clean-air standards in California, toughest in the nation, will require that by 1998, 2 percent of the cars a company sells in the state have no emissions, a rule that essentially mandates electric cars. By 2003, 10 percent of the cars must meet the no-emissions requirement.

Each of the Big Three have electric-vehicle programs, and each has said the range of its prototype vehicles is limited because of current lead-acid battery technology.

The consortium said in a statement Thursday that it does not plan to develop a new electricity-powered vehicle or a new battery. Instead, it plans to develop advanced energy systems "capable of providing future generations of electric vehicles with significantly increased range and performance."

Because of stiff antitrust restrictions, the consortium is one of the few instances of Big Three cooperation. Other ventures include a transmission-building company owned by GM and Chrysler and an auto-plastics research group formed by all three companies.

Goldsweig said formation of the venture is subject to Justice Department approval, but the group does not expect difficulty getting the government's consent.

Research is due to begin soon, with preliminary results expected in about 3 years. The findings will be shared equally among consortium members.

Although battery-powered electric cars emit nearly zero emis-

See Car, pg. 2

Electric cars

General Motors, Chrysler and Ford announced a joint venture Thursday to develop new technology for electric cars. Some advantages and disadvantages of electric cars include:

Pros

- **Conservation:** Energy would be conserved since car does not directly rely on fossil fuels
- **Emissions:** Engine emissions are near zero
- **Ride:** Car's operation is very quiet

Cons

- **Space:** Passenger space is limited; GM's concept car seats only two
- **Battery replacement:** Needed every 25,000 miles; GM's concept car uses 32 auto batteries
- **Disposal:** Used battery disposal is an environmental problem
- **Recharging:** Batteries take 8-10 hours to recharge and need recharging about every 100 miles
- **Speed:** The fastest electric car can reach only 65 miles per hour

Chicago Tribune Graphic; Source: News reports

Car

Continued from page 1

sions, run noiselessly and conserve energy because they don't require gasoline, the problems have been many.

GM's Impact battery-powered car, perhaps the closest to actual production, seats only two people and requires an 8- to 10-hour recharge by being plugged into an electrical outlet after about 100 to 125 miles of driving.

In addition, after an estimated 25,000 miles of driving, the 32 batteries that power the Impact would have to be replaced—a costly service.

Ford and Chrysler have converted existing mini-vans to run on battery power, which would help solve the problem of limited passenger-hauling capability, but the vans still face the same limited range.

GM also has developed the HX3, a hybrid van that seats five and is powered by a one-cylinder gasoline engine as well as a pack of 32 batteries. When the battery pack nears discharge, the gasoline engine is turned on to serve as a charging unit. Travel range reportedly increases to 300 miles from about 100 miles—but a gas engine detracts from the zero-emissions goal and from fuel conservation.

GM said it also is looking into another hybrid vehicle that would use batteries for short-haul, inner-city travel in the more heavily polluted areas while a gas engine would take over on expressways in less-congested areas. A hybrid of this type would eliminate the fears of restricted travel. Although it would not eliminate pollution, it could help reduce it in specific areas.

ELECTRIC CAR COLD WEATHER PERFORMANCE

Some electric car owners continue to drive their cars through the winter while other put them on blocks, preferring not to cope with frigid interiors, frosted windows, and reduced performance that accompanies cold weather. This paper is meant to cover the effect of lowered termperature on battery capability.

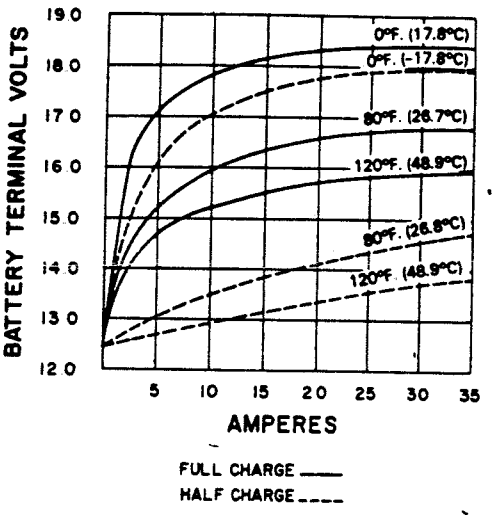
It is no secret that battery performance declines as temperature drops. A lead acid battery that is marginal in the fall will fail during the winter. The capability of a battery to store electrochemical energy declines as electrolyte temperature drops. Experiments have indicated that capacity decreases about 1% for each 1 degree temperature drop below 77 degrees F. This indicates a reduction in range of 70% at 0 degrees F compared to a summertime range because cell reactions at plate surfaces are impaired as electrolyte temperature gets lower.

When a battery is discharging there is a reaction at the plate surface where a molecule of sulfuric acid gives up its sulfate ion to lead oxide on the plate, forming a lead sulfate molecule on the plate and water molecule in the electrolyte. Until the water molecule diffuses into the remaining electrolyte it can momentarily form a slushy mixture if the battery is significantly below freezing.

The electrolyte freezing point must be considered when batteries are used in cold weather. At 77 degrees F a fully charged cell will generally have a 1.265 specific gravity. This corresponds to a mixture of 36% sulfuric acid by weight or 25% by volume. The remainder is water. (Pure sulfuric acid has a specific gravity of 1.835) Cells have a temperature-dependent fully-charged specific gravity as listed below:

State of Charge	Specific Gravity	
	Winter Conditions	Summer Climates
Full Charge	1.265	1.225
75% Charge	1.225	1.185
50% "	1.190	1.150
25% "	1.155	1.115
Discharged	1.120	1.080

To compensate for reduced temperatures, the charging voltage is increased to overcome battery resistance. A battery is fully charged when the cells are gassing freely at a low charging rate and there is no observable change in specific gravity for a 3-hour period.



The accompanying graph taken from the Battery Service Manual published by the Battery Council International shows the temperature-related effects for charging a 12-volt Starting-Lighting-Ignition (SLI) battery.

At low temperatures a charge-depleted battery can have its life significantly reduced. A contributing factor is the lead sulfate accumulation on plate surfaces that cannot be disloged during recharge if it left standing in a discharged state. This is called cell sulfation and is irreversible. Immediate recharge after use is the best way to avoid this problem. Cars used in winter to drive a short distance to a commuter train station and left standing for 8-10 hours during a regular workday can be particularly vulnerable.

When a car is in use, the internal resistance of a cell causes some heating. A typical 6-volt EV battery has about one milliohm of internal resistance. The heat generated during charging at 25 amperes amounts to less than one watt. When discharging at a 200 ampere rate the heat would be 40 watts, but even this will do little to warm a 70 pound battery that is already below freezing.

The electric car owner who chooses to store his car for the winter should do a few things to lengthen batttery life. About once a month during winter storage, the battery should be given a 4-6 hour equalizing charge.

Periodic replacement of batteries is the largest operating cost for an electric car owner. Investment in a first-class charger and its correct use can lengthen battery replacement invervals and lower costs.

William H Shafer
3 February, 1991

EDITORIAL

Electric cars seem to be getting more press these days than I can ever remember. From John Ahern's car in the Wheaton Leader's, People section. To the pooling of Research and Development resources of American Automakers in the Chicago Tribune's, Business section. The media often shapes public opinion as much as it echos it. Indeed, in these times of almost instantaneous electronic media the two sometimes become hard to discern. Public opinion and media bias.

The F.V.E.E.A. is in a unique position to promote the benefits of the Electric Auto, in a factual way, to our community. As interest builds via the media, our audiences at rallies will build as well. I forsee many questions such as; Where can I buy one? The answer isn't an easy one. This will probably be so until battery technology improves. Until then, auto makers will stick to concept cars, fleet vehicles, such as the Peugot Delivery Van, and possibly a Family Van. These vehicle body styles have the required space for battery packs, are often used for short trips, and provide the best profits. It appears at this time we have a nitch defined for us as electric auto enthusiasts. To convert the smaller vehicle to electric. It can be done and it doesn't have to be restricted to two passengers. Often the media tells us differently. As enthusiasts that know better we have the oppurtunity to display the facts and fruits of our efforts. When battery or some other energy storage technology improves, our goals will still be the same...only easier to achieve.

Electric cars are a hot topic, but still are not too practical

Keeping Your Car Alive

By Peter Bohr

"I wish I could be more enthusiastic about electric cars. Really I do," said Dennis Simanaitis, *Road & Track's* engineering editor.

As we are confronted with the prospect of $2 a gallon gasoline, vehicles powered by electricity have suddenly become a hot topic.

But to "gearheads" like Simanaitis, who look beyond wistful notions about alternative fuels, the current state of electric vehicle technology presents some formidable obstacles.

Electric cars run just fine; the problem is giving them sufficient range to be practical. It takes a great many batteries to store enough electricity to allow a car to travel even a third of the distance our cars now travel on a tankful of gasoline.

This year, General Motors introduced the "Impact," a prototype electric car that carries modified lead acid batteries (like those we now use to start our cars).

GM says that the Impact will out-accelerate a sporty little Mazda Miata, an impressive claim.

The trouble with the Impact — apart from its unfortunate name — is that its range is only around 120 miles between charges. And recharges take far more time than the typical five-minute pitstop we now make at our local gas station.

Moreover, the batteries have a limited life and are expensive to replace.

An Impact is expected to require a new set of batteries every 20,000 to 25,000 miles (or less than two year's worth of driving for the average American car) at an estimated cost of around $1,500.

Advances in battery technology will make electric cars like the Impact more viable. For instance, one new battery that operates at temperature as high as 850 degrees has very good energy density.

However, an accident in a car loaded with lead and acid heated to extraordinary high temperatures is not a pleasant thought to contemplate.

"One of the more promising ideas," wrote Simanatis in *Road & Track's* November issue, "comes from a joint effort of Isuzu and Fuji Electrochemical. Energy is stored as electricity in what's essentially an oversized condenser, two conducting plates separated by an insulating material. "This is in contrast to a conventional battery, which uses chemical reactions for storage and discharge.

"The new condenser devises are said to have 20 times the output density and one-third the resistance of conventional batteries," Simanaitis reported.

This means a recharge could take only seconds, not hours. Problem is, the device also discharges very rapidly. And it's unknown whether its mixtures and resins are sufficiently robust for rugged automotive use.

Another innovative idea involves feeding electric vehicles while they're moving, using cables imbedded in streets and highways.

Because of their advantages, electric cars undoubtedly have a bright future. But that future surely won't come until long after Saddam Hussein disappears from the front pages.

Peugeot generates automotive interest

Its electric truck 1st in mass output

By Veronique Maurus
Le Monde

HONG KONG—It was a light truck painted white with blue markings, similar in every way to those seen on Paris streets. Except it worked on electric power, and it carried a price tag of $26,000. It was the big talking point at the 10th International Electric Vehicle Show in Hong Kong.

For the first time, a major carmaker—France's Peugeot S.A.—is marketing an electric vehicle mass-produced on the same assembly lines as its conventional gasoline-driven look-alikes and sold at a price only 30 percent higher.

It has been an immediate success. The French Electricity Authority, EDF, has ordered 250, the China Light and Power Co. is buying 50 and Austria wants 25 vehicles.

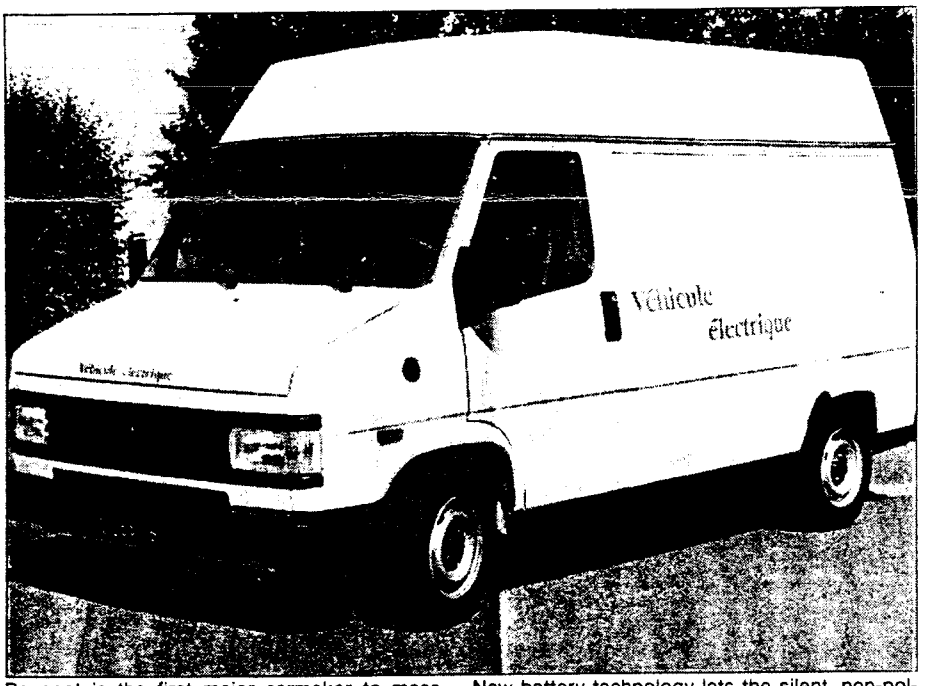
Peugeot is negotiating to sell them to 15 French municipalities, the principality of Monaco, 10 European countries, France's postal and telecommunications service, Eurotunnel, airports and big corporations.

After 20 years of faltering attempts and disappointments, the electric vehicle has gotten on the road.

Gone are the days of more or less fanciful prototypes and ad hoc experiments. After this commercial vehicle, sold at a higher price to a special category of customers, Peugeot plans to produce in 1994 the Electric 205 for the general public, which will be sold at the same price as the gasoline version.

A special-purpose vehicle is planned for the end of the century. American manufacturers, headed by General Motors Corp., will be marketing mass-produced electric models two years from now, and the Japanese will be doing the same in three years, though they may spring a few surprises along the way.

A China Light spokesman said: "Our president is 84 years old, but attends every board meeting. At each meeting, he keeps asking "when are you going to launch an electric vehicle?" Up to now we've found no automobile manufacturer who wanted to sell us electric vehicles. This time, we've found one. We're planning to electrify half our fleet rapidly."



Peugeot is the first major carmaker to mass-produce an electric vehicle, this light truck. New battery technology lets the silent, non-polluting truck go longer between charges.

Why this craze for electric vehicles after so many years of setbacks? The environment and the oil crisis. Environmental considerations, long a secondary matter, have acquired so much political importance that they are among the priorities of all decision-makers. Non-polluting, silent and not fast—a maximum speed of 100 kilometers per hour (60 m.p.h.), which consequently makes it safer—the electric vehicle is the solution for urban transport.

The industry was given an impetus when California recently required carmakers to sell at least 3 percent of vehicles equipped with electric motors by 1998 and at least 10 percent by 2003. Similar regulations should follow everywhere else, with perhaps a ban on gasoline vehicles in cities.

By drawing attention to the consumer countries' vulnerability to Middle East oil, the Persian Gulf crisis also has lent a helping hand.

Because, though alternate solutions exist for producing primary energy (nuclear power, coal, natural gas, hydraulic energy), transportation is just as dependent on oil. Here again the electric vehicle appears to be one of the few viable solutions in the long run.

A potential market exists, especially as the production of vehicles for urban travel, which are put to limited use and generally supplement the main automobile, is expanding fast.

Peugeot reckons that the market for small, low-powered second autos traveling no more than 70 kilometers a day will reach 400,000 (up from 300,000 today) by 1995. Electric vehicles could make up half that.

The market remains to be conquered. It is not the easiest, because electric vehicles have two major drawbacks—a limited autonomy and a high cost. Outstanding technical advances have been made in the last 20 years. The autonomy of better-performing vehicles reach about 100 kilometers, batteries are leakproof, the time for charging the batteries does not exceed 10 hours and the speed can reach 100 k.p.h.

This is equivalent to the normal usage of an auto driven an average of four hours a day in town and recharging at night by plugging into an ordinary wall outlet. But the technical revolution expected in batteries, a major handicap because they are heavy and cumbersome, still has to come.

Up to now, the price has been quite excessive. And prototypes, because they are not mass-produced, have remained a talking point though there have been many of them.

These drawbacks should be gradually eliminated. By adapting the electric motor to models produced on the assembly line, Peugeot has proved that the price difference can be reduced to a level acceptable to highly motivated institutional customers such as municipal corporations, power companies and administrations. This is particularly true because the operating costs of electric vehicles are much lower.

The head of technical services in La Rochelle, France, which for many years has been experimenting with electric vehicles built by the Volta Co. from parts supplied by big automakers, says the extra investment involved in procuring the vehicles was amortized in three years because of extremely low maintenance costs and, above all, the cheapness of electrical power.

At the night rate offered by the electric authority, it costs $1.20 to $2 to recharge an electric vehicle for 100 kilometers traveled, compared with an average of $10 for a gasoline vehicle.

Peugeot is confident the price differential between a conventional and an electric vehicle can be eliminated in three to four years.

The switch to long [illegible]oly runs—at least 50,000 [illegible]s a year—should help more than halve the cost of the motor, the battery and the electronic control system.

Within 10 years, it might even be possible to produce a specific type of electric vehicle at prices below those of gasoline models, thereby reversing the problem.

"We have deliberately set out to break the vicious circle," said Yves Helmer, director of Peugeot's auto division. "Up until now, electric vehicles didn't sell because prices were high, and prices were high because they didn't sell."

But it is a determination without illusions. Even Peugeot, which has pioneered in this field, does not imagine that electric vehicles will replace all gasoline models.

With long-distance traffic almost untouched—though many solutions exist, on the drawing boards—the electric vehicle will for a long time remain limited basically to specific urban needs.

But experts estimate that by the turn of the century, electric vehicles could account for 10 to 15 percent of the world's auto market. That is inciting EDF to look into group battery charging systems for garages, parking lots and even service stations.