

F.V.E.A.A. NEWSLETTER

March 1992

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NEXT MEETING

March 20th @ 7:30

College of Dupage

Student Resource Center

Room 1046

Use Lambert Rd. Entrance, Lot 7 at the Southeast corner of 22nd & Lambert

Nonmembers are always welcome!

Director

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THIS IS YOUR LAST ISSUE!

Well...this is your last issue only if you haven't payed your dues or you are a past member and wish to rejoin the organization. We are sending out this newsletter to every past member to reintroduce ourselves. If your name is not on the roster listed inside this newsletter then we invite you to rejoin. Membership is still only \$15.00 per year from November to November. If you are joining us in the middle of the year then you need only pay for the months remaining until November (\$1.25 per month).

In addition to having membership from around the country, we continue to exchange newsletters with other organizations from New England, Vancouver B.C., Australia, and California to name a few. This keeps us upto date with what is happening in the industry.

We continue to meet every third Friday of each month at the College of Dupage. Meetings include talks by experts in the industry and club members covering topics such as EV components, presentations on vehicle conversions, slide shows on recent electric vehicle races, electric vehicle design, component design, etc.

A membership application is located on the back of the newsletter and should be mailed to Dale Corel at the above address. Welcome back!

Fox Valley Electric Auto Association

336 McKee Street
Batavia, IL 60510

FDX VALLEY 20:57 03/16/92 #2

FDX VALLEY 20:00 03/16/92 #3



First Class

ADDRESS
CORRECTION
REQUESTED

JOHN EMDE
6542 FAIRMOUNT AVE.
DOWNERS GROVE IL 60516

PREZSEZ

There is no doubt that electric vehicles are grabbing national attention these days. Articles appear daily in newspapers and magazines about electric vehicles. A majority of the concept cars at auto shows are electric. Each issue of Popular Science and Popular Mechanics now have at least one full length article on the subject. EVs are actually breaking their way into Road & Track and Car & Driver. The GM Impact gets as much press as the Ozone hole. There is even an article from Investor's Business Daily that emphasizes the impact (every pun intended) that legislation is having on the EV world. Is the general public and the industry itself ready for the massive surge of EVs that is about to hit. How well is this large change going to integrate into society? Will it slip into everybody's daily life as easily as the Microwave did? Is the general public going to be expecting too much of EVs?

Those of us who follow the industry are getting tired of seeing the same old information on the Impact. So why did I include yet more articles on the Impact in this newsletter? Well, I think these particular articles will be of interest. They contain information about the Impact and its development that we haven't seen before. The article from the NY Times opens a window into GM's use of the twin AC motors in a DC environment. While the article from Anderson Indiana sheds light on manufacturing of the Impacts power train components. Indicating even stronger commitment by GM to actually mass produce an EV this time.

This is perhaps the best time of year for EV news. It's race season! Starting in April is the Pheonix Solar and Electric 500, followed by the American Tour de Sol from Albany to Boston, the Swiss Tour de Sol, even the Indy 500 has an electric entry this year. All of these races plus the half dozen or so California races and the local Electrathon races that are cropping up all around the country. There are at least a few club members as well as myself that plan to make it to the 500 and the American Tour de Sol so we will keep every informed.

On a different subject. It seems that last months discussion lead by Dick Marsh on the development of an intelligent EV controller was very well received. As a result he will continue the discussions as a regular part of our monthly meetings. After the closing of regular business and before break, roughly 15 minutes, will be the time slot allotted for this discussion.

Guest Speaker: Dan Schmidt **The design of a** **High Efficiency Electric Vehicle**

Dan Schmidt, an undergraduate student in Mechanical Engineering at the Milwaukee School of Engineering will present his design of a High Efficiency Electric Vehicle.

Minutes of February 21, 1992 FVEAA Meeting

The meeting in Room 1046 at the College of DuPage was convened by President Marsh at 7:35 pm. There were 17 members present.

Treasurer Corel reported a balance of \$1681.26 in the savings account and \$1997.54 in the checking account.

Members commented on electric cars exhibited at the Chicago Auto Show. These included BMW, Dodge (Epic), Ford (Connecta & Ecostar), Honda solar, & Nissan.

President Marsh reported on information received including the 1992 Electric Vehicle Directory and Green Car Journal. He also reported on an electric car project at Oswego High School by teacher Jim Phillips. He concluded his remarks with 1992 electric car events including the Tour de Sol Albany to Boston May 12-23, Alternative Vehicle Symposium in Texas March 12-14, and A Technology Conference in Los Angeles March 5-6.

Secretary Shafer read a draft of a proposed FVEAA letter directed to John Costello, Director of Public Relations at Commonwealth Edison, regarding an offer for the FVEAA to evaluate one of 5 Ford Ecovans to be tested by CECO. Member Kaminski moved approval which was seconded by member Emde. Discussion of the motion resulted in several suggested changes to the draft and authorized President Marsh to proceed with the offer.

Members suggested that President Marsh prepare a Newsletter mailing emphasizing that 1992 renewals are now due.

Member Richard Marsh presented a program that will be the first in a series of discussions about his proposed development of a microprocessor directed dc controller. The objective would be a device that would be suitable for an electric car conversion that could be assembled by the owner and could be sold for about \$250. Most of the discussion considered various types of dc motors and their required rating.

The meeting was adjourned at 10:40.

Submitted by

William H. Shafer
Secretary

Delco Remy goes electric

GM's new Impact motor finds home in Plant 17
By STEVE LEER

Reprint from the ANDERSON HERALD BULLETIN
Anderson Indiana

The road to the nation's first mass-produced electric car will wind through Anderson.

Thursday, officials of Delco Remy, United Auto Workers and local and state government confirmed what had been rumored for months: The local General Motors Corp. division will manufacture the car's propulsion motors.

"This is a great day for Indiana, Delco Remy and Anderson," said Robert D. Wight, Delco's general manager. "Today, Delco Remy is increasing its stake in the electric car."

Speaking at a local news conference, Wight said the 100 horsepower motors will be made in Plant 17 and create about 140 jobs. He said those jobs will probably be filled by laid-off workers from other GM plants or from within Delco's jobs bank program.

The general manager said cooperation among management, union and government played a significant role in GM's decision to build the motors here.

Wight declined to say when production might begin or how many motors would be made annually.

GM hopes to market an electric car by the mid-1990's.

Delco plans to invest about \$9.3 million in equipment acquisition and employee training. State grants totaling \$250,000 will help with the retraining of 990 employees.

No new construction at Plant 17 is necessary, Delco officials said. Approximately 50,000 square feet in the plant's northeast corner is being cleared to make room for the motor production. Plant 17 is Delco's largest U.S. plant, at 631,591 square feet.

The AC induction motors are smaller than a conventional 4-cylinder engine and feature an "integral gear reduction system," in which the transmission is part of the motor itself. The motors are powered by rechargeable lead-acid batteries and are 90 to 95 percent efficient.

Muncie's Delco battery plant has been selected to manufacture the car's special batteries. The car will be assembled at the former Buick Reatta Craft Centre in Lansing, Mich.

Wayne Simpson, chairman of the bargaining committee for UAW Local 662, said "every GM facility" wanted a

part of the electric car project.

"We believe the dedication of our employees will turn out to be fruitful," Simpson said.

The UAW official added that Delco management has responded favorably to bringing relocated Delco workers back to Anderson.

Lt. Gov. Frank O'Bannon and Mayor J. Mark Lawler predicted the electric car would signal a new automotive era in Anderson.

"This project will put your business, the city and the state at the forefront of automotive technology," O'Bannon said.

Lawler said there could be a "significant market" for the electric car.

"You're on the cutting edge of technology," he told Delco officials.

GM introduced a prototype electric car, named the Impact, in January, 1990. Delco engineers designed the car's twin 57-horsepower motors and its 32 10-volt lead acid batteries.

On a full charge, Impact can travel 120 miles at 55 mph.

Delco officials said the electric car GM eventually markets may not resemble Impact in every detail.

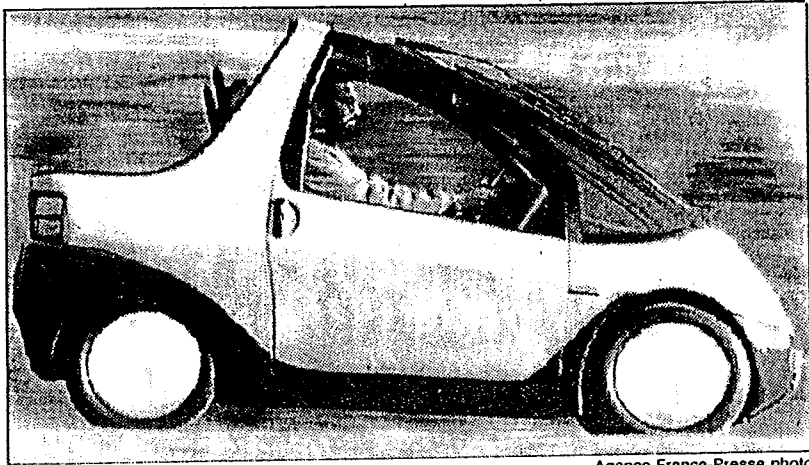
GM has not announced an estimated retail price for the car.

Electric Vehicle and Sustainable Energy Equipment for Sale

1978 Fiat, 72 volt system with roof mounted solar panels. One year old battery pack. The entire works in perfect shape. \$4000.00. Also for sale are 2 volt NiCad batteries, 70' tower with wind 32 volt wind generator, additional wind generators, solar panels, etc. Contact Bill Paschack for details at (219) 874-3171.

The car that German chocolate built

Reprint from Chicago Tribune, Wednesday, March 4, 1992



Agence France-Presse photo

STUTTGART, Germany (AP)

Was this the automotive future? A parking lot in Stuttgart hummed with electricity as a slew of German battery-powered cars showed off their zip.

They were ordinary or exotic, big or small, with four wheels or three, built with traditional auto money or chocolate profits.

Yes, a new entry in the electric car stakes owes its existence to a German candy fortune. Alfred Ritter, 38, whose name is on a half-billion Ritter Sport chocolate bars sold each year, launched the EL Sport.

The car and its competitors are aimed at satisfying California's future requirement for zero-emission cars and grabbing a share of a market that U.S. and Japanese companies are also seeking.

"The electric car will only succeed if it's fun for people to drive. The EL Sport has the stuff to be a darling of the public," Ritter said.

The yellow prototype EL Sport shown last month in Stuttgart is 8 feet, 11 inches long, weighs 1,320 pounds and features the egg shape favored by designers of futuristic cars. It can carry four people and two cases of beer as fast as 75 m.p.h. and as far as 120 miles. Its powered by a zinc bromide battery that takes five hours to recharge.

Ritter and his engineer partners, who sold him on the concept, said they will build 50 to 100 cars this year at a former motorcycle plant in eastern Germany. They're looking for a big partner to go into mass production.

But the EL Sport, like a host of other ideas for electric cars, is hampered by its lack of a light, durable battery that can compete with the gasoline engine that's cheaper to run.

EL Sport engineers, noting they had developed a working model in only two years, said it was as good as prototypes produced by BMW and Volkswagen. But a Daimler-Benz researcher, Dietrich Sahn, challenged the EL Sport battery. No battery approaches the goal of a four-year life, Sahn said, and replacing it would mean high operating costs overall.

EL Sport is the newest European electric.

There's also the Mercedes 190 prototype with "Zero Emissions, Electric Research Vehicle" written on its sides, and two Danish-made Mini-ELs, a three-wheeled one-seater. Three E-Mobils are the result of a German-Swiss-Hungarian venture. All were at Stuttgart.

ELECTRIC CARS ARE POWERING UP

Autos Leaving Drawing Board Despite Problems

Reprint from Investor's Business Daily, Friday Feb. 28, 1992

By Paul A. Eisenstein

Its aerodynamic exterior bears an uncanny resemblance to the egg-shaped automobile Woody Allen tried to steal in his futuristic comedy, "Sleeper."

But by 1997, General Motor Corp.'s electric car will have to be more than just science fiction.

Electric cars are being billed by some as muscle cars, by others as environmental salvation. And to find its niche, GM's Impact will likely have to be a bit of both.

California lawmakers have passed new clean-air regulations requiring that 2% of all cars be non-polluting Zero Emission Vehicles, or ZEVs, come 1997. (That jumps to 10% in 2003.)

Theoretically, there are many ways to meet the ZEV standards. At last fall's Tokyo Motor Show, Mazda unveiled a hydrogen-powered rotary concept car that produces water vapor when its fuel is burned. But in practical and immediate terms, electrics are the only alternative.

"This is not buy legislation. It says we have to sell electric cars," said Robert Wrágg, Impact's West Coast marketing director. "It doesn't say anybody has to buy them. So we have to find a way to make them exciting and attractive."

That won't be easy. Electric vehicles, or EVs, are plagued by a variety of problems:

- They have a range of little more than 100 miles.
- They can take a whole night to recharge.
- Their batteries are costly and must frequently be replaced.
- There is no infrastructure in place to sell, service and charge electric cars.

But unless California lawmakers have a sudden change of heart, those are problems the auto industry will have to solve in a hurry. For without an electric car, the Big Three will have to write off the California market, which accounts for nearly 12% of total U.S. sales.

"(California) is a powerful economic force and a vital customer to the auto industry," said Los Angeles City Councilman Marvin Braude. "If a major customer (tells) a manufacturer of a special need, the manufacturer (should) do all he could to meet that need."

"To clean our air and to prevent future generations of Californians from facing the kinds of health and economic losses which we face, we must make it happen," he continued.

There is added impetus. Under federal law, California is permitted to set its own clean air standards. Other states can copy California's tougher rules, and so far, eight smog-plagued states in the Northeast have. Others states, including Colorado, may soon follow.

So automakers are charging off in search of marketable EVs. There already are several low-volume manufacturers producing EVs for the eco-minded. Fiat SpA has a small electric car, and Volkswagen A.G., with its partner Swatch, hopes to have a model on the road by 1994.

Continued on next page.....

The first high-volume electric car will go on sale in California about a year now. Dubbed the LA301, it is an international effort. Conceived by Swedish-based Clean Air A.B., it was designed in Britain by International Automotive Design, and Japan supplies many of its components.

Research and development was aided by a \$7 million grant from the city of Los Angeles. Clean Air's director of engineering, Sir John Samuel, expects to sell about 1,000 LA301s a year at first, and he's hoping the yearly total will reach 30,000 by 1995.

'Really' Competitive

Sir John said the LA301 is the "first electric car that can really compete with conventional cars in comfort, ride and practicality."

Looking much like a conventional gasoline-powered sedan, the two-door LA301 can travel 40 to 60 miles on a charge. Research indicates the typical California commute is 35 miles a day.

Still, experts maintain that range will have to be increased significantly to make EVs more attractive to a mass audience.

That's a tough challenge. Consider GM's Impact. Its 875 pounds of lead-acid batteries generate no more energy than 1.5 gallons of gasoline.

Impact's lightweight composite skin is formed into an egglike shape with the aerodynamics of a jet. Special tires minimize rolling resistance. And to improve efficiency in California's stop-go traffic, Impact uses regenerative braking.

Regenerative braking works by using the drive motors in reverse, turning them into generators," explained Larry Oswald, a manager with GM's Advanced Engineering Staff. "So when you apply the brake pedal, essentially you're storing the energy back in the battery."

But range is only part of the problem. Though Impact can be partially recharged in two hours, it takes eight hours if the batteries are completely drained.

"It won't be the car you'll want to buy if you need it to drive from Los Angeles to San Diego," said GM's resident battery expert, Dr. John Dunning.

The Impact requires about eight cents of electricity to travel 100 miles, and batteries must be replaced every 20,000 to 30,000 miles. At \$1,500 a set, that increases its operating cost to six to eight cents a mile. At today's gasoline prices, that's like getting 14 to 18 miles on a gallon of gas.

Paced A Marathon

Last fall, a Mercedes-Benz powered by a sodium-nickel-sulfide battery paced the New York City Marathon. Nissan's version of the Impact, dubbed the FEV, has nickel-cadmium batteries. Using a special, 440-volt charger, the FEV can get a 50% recharge in about six minutes.

But these alternative power sources have problems, too. Mercedes' sodium-nickel-sulfide batteries must be heated to 570 degree Fahrenheit before they'll generate power. The batteries would cost \$22,000 if the car went into production today, and it would last less than three years.

That would work out to about \$1 a mile, according to project director Dr.

U.S. Vehicle Sales Total Vs. Electric Car

Participating States	2001 Sales Share %	2001 Vehicle Demand (in thousands)	2001 Electric Car Demand (in thousands)
California	12.06	2,050,000	102,500
New York	5.48	928,000	46,400
Pennsylvania	4.34	738,000	36,900
New Jersey	3.41	580,000	29,000
Maryland	2.63	447,000	22,350
Virginia	2.61	444,000	22,200
Massachusetts	2.14	364,000	18,200
New Hampshire	0.55	94,000	4,700
Delaware	0.44	75,000	3,750
Maine	0.43	73,000	3,650
District of Columbia	0.14	24,000	1,200
Group Total	34.21	5,816,000	290,800
Total U.S. Vehicle Sales	100.00	17,000,000	850,000

Source: Auto Facts Inc., West Chester, Pa.

Owning An Electric Car Will Require Effort

By Paul A. Eisenstein
Investor's Business Daily

Owning and operating an electric car will take some extra effort.

For example, a driver will have to plug in the auto each night for a recharge. As General Motors Corp.'s planners see it, owners would install home-charging units or park in specially designated spots in their apartment garages.

If a driver needed a recharge during the day, parking lots with chargers would be available. There might even be special spots on the street, just as there are spaces designated for the handicapped.

In California, laws require large companies to promote car-pooling. And those laws may be modified to require businesses to provide outlets for employees with electric cars.

California lawmakers also may force utilities to provide reduced-rate electricity at night, to encourage

people to charge up when there's plenty of extra power in the utility grid. GM engineers are working on ways to shorten the Impact's charging time — now about eight hours.

They're also working on ways to improve the safety and utility of the interface — the power cord — that would be used to charge the car.

"Once a vehicle is plugged in, we can run not only power through that interface but information," explained Robert Wragg, West Coast marketing manager for the Impact. "Even if you're parked in a lot somewhere miles from home, the utility could interrogate the vehicle to find its identity and thus, the identity of its owner, sending him a bill no matter where he lives."

The interface could also check to see whether the car was stolen. If it was, the interface wouldn't allow the vehicle to recharge. The police would automatically be notified, and the onboard computer would be told to shut down until they came.

Dietrich Sahn. "We have to cut the price by a factor of at least three, and we have to extend the life by a factor of at least two" to make the car acceptable to most consumers, said Sahn.

As for the NiCads in Nissan's FEV, they also are expensive and suffer from problems that can sharply reduce range if they're not charged properly. It's unclear whether there's enough cadmium available to supply large fleets, and the metal is highly toxic.

While NiCads deliver a longer range than lead-acid batteries, they don't have the short-term punch for fast acceleration. One possible solution may be combining several different batteries to take advantage of each one's special properties.

Japanese automaker Isuzu may have a different cure: an ultra-high-power capacitor that can reportedly store (though not generate) enough power to propel an electric car several miles at high speeds.

Another alternative — viewed by some as a cop-out — is the hybrid. The LA301 is actually two cars in one. Its battery drive is mated to a conventional gasoline engine. For longer, intercity drives, a driver would switch to the internal combustion engine.

Several automakers are working on hybrids of their own, including VW and GM. But for the short term, GM is sticking with the lead-acid-battery-powered Impact. One advantage is its performance, demonstrated during a recent drive around the test track at the GM Proving Grounds in Mesa, Ariz.

Turn the key and nothing seems to be happening — until a driver presses on the accelerator. Suddenly, the Impact bursts to life, racing from 0 to 60 mph in barely eight seconds.

'People Are Surprised'

"People are always surprised by what this car can do," said Wragg. GM is billing the Impact as an electric muscle car, able to race from 0 to 60 faster than a BMW 325ix. That might seem a mixed metaphor, but in the performance-oriented U.S. market, that is certain to improve the allure of EVs.

"We're back in 1905, starting the biggest revolution in the auto industry since we changed from horses to cars," said Ernie Holden. He has spent much of his life racing cars and managing tracks. Now he is working on the Solar and Electric 500, which will make its second run at Phoenix International Raceway in late April.

Holden hopes the 500 will help sell the public on the merits of EVs. Officially, major automakers are shunning the 500.

The race is likely to highlight innovations in aerodynamic body designs and lighter, more powerful motors. But everyone will be paying close attention to any new battery technology, like the Zinc-Air batteries that helped Honda Motor Corp. clinch first place at last year's race.

Some of the more exotic formulations could house 50 times as much energy as the lead-acid batteries in GM's Impact. Researchers are looking for new chemical formulas, but they say the biggest hope for a battery breakthrough comes from the new Advanced Battery Consortium.

The program teams the Big Three U.S. automakers, battery manufacturers and the American government. "Battery development is a slow-moving technology," said Sahn of Mercedes-Benz. "You can't expect a breakthrough from one month to the next."

In the face of all the pitfalls, some industry officials are hoping California will delay or even cancel its tough new ZEV standards. But for the moment, lawmakers are holding firm. So the major automakers are getting their product plans in place.

Targeting Fleets

Wragg won't say when the Impact will debut, but insiders suggest 1995 is the target, probably with a price tag of around \$25,000. While GM is aiming at environmentally conscious, middle- and upper-class individuals, most of its competitors will be targeting commercial or government fleets with electric-powered minivans and light trucks.

Industry experts caution that if lawmakers want to mandate EVs, they'll also have to help sell them. Some state and federal laws already provide financial aid to EV buyers. In parking garages, EVs would be given the best spots — equipped with rechargers. Special highway lanes may be opened only to electric vehicles.

Utilities will likely have to provide lower-cost electricity at night for home charging stations. That would have the added advantage of shifting demand to off-peak hours when there is a huge surplus of available power. According to one study, California has enough nighttime capacity to charge several million EVs without adding any new power plants.

Ultimately, though, the EV debate comes down to a basic question: Is there a willing market?

With better batteries and government support, there quite well could be, says Mishli Polit, who follows the electric car industry for the consulting firm Auto-facts Inc.

In those states that are planning to mandate ZEVs, "You'll have 290,000 EVs in the year 2001," Polit predicted. "And if all the states sign up, you'll have 850,000 EVs being sold this year and already about two million on the road by that time."

But if the technology doesn't move forward and the states back away from the ZEV standard, Polit warns, electric car sales are likely to run a minuscule 10,000 units a year.

CARS THAT WHIRRR AND BURN RUBBER

The New York Times 2/2/92 by Matthew L. Wald

Say "electric" and the car that comes to mind is smooth-riding, quiet and almost antiseptically clean. It's not exactly the model muscle car. But muscle is how the General Motors Corporation is positioning the Impact, the two-seater that it plans to bring to market in the mid-90's.

To meet California requirements that 2% of each car company's sales in the state be "zero emission vehicles" by 1998 - a requirement that only battery-powered cars can now meet - G.M. has focused on a sales virtue that it thinks will give it perhaps the best chance of reaching such a high penetration: performance.

"They've made a decision that you have to show people something that makes them want to buy an electric car," said one California official, who asked that he not be identified because, he said, it sounded as if he were shilling for General Motors.

Some people like the idea. Mark Scheinberg, executive director of the Greater New York Auto Dealers Association, said that the male ego wants a "throaty, sporty kind of sound," and the electric car's silence could be a drawback. "They're answering that by putting a little guts behind it," Mr. Scheinberg said. "It's a very clever idea; it should work very well."

But at the Center for Auto Safety, Clarence M. Ditlow, the executive director, said, "If you want to sell the car, you're better off going to the mass market, which is not a muscle market." Besides, he said, electric cars should be pitched to "the environmental market, the socially conscious consumer, who is very turned off by muscle cars."

The Impact goes from 0 to 60 mph in 8 seconds. Among 1991 models, according to Road & Track magazine, that is faster than the Lexus LS 400 and the Chevrolet Beretta GT and substantially faster than the Pontiac Grand Prix SE; it is just a shade behind the BMW 325iX. As one G.M. engineer put it recently as he watched the Impact whoosh around a test track at G.M.'s proving ground here, "This is not your father's Oldsmobile."

People outside the company are impressed with the performance too. "It will snap your head back," said William Sessa, a spokesman for the California Air Resources Board, who rode in the car at the Los Angeles Auto Show in early January. And performance is not limited to jackrabbit starts; because electric motors deliver torque very quickly, the Impact's mid-range acceleration - from, say, 25 mph to 60 mph - is substantially better than in most gasoline-powered cars.

Its styling is also dramatic. "It gives the stylists a lot of freedom," said Larry Oswald, of G.M.'s Advanced Engineering staff. "It opens up all kinds of possibilities. You don't need a big engine compartment, and if you want, you can break up the batteries."

While other car makers are working on electric vehicles, none have been as open as G.M. about showing them off. (Even G.M., however, will not discuss a specific date, price, or even the name, except to say that "Impact" is interim and not a contender for the final nameplate.)

In what G.M. described as an effort to educate the public about electrics, it recently trotted out the Impact on a look-but-don't-touch basis and made two Geo Storms and a Chevy Lumina with Impact drivetrains available for test drives.

The company is probably right that public acceptance of electrics will require some familiarity. Apart from large problems, like recharging, there are a thousand small ones, like the one pointed out by advocates for the blind: Will guide dogs have to be retrained to be alert to a car that is silent?

And G.M. has its own set of problems to solve before it can release the car. Because the car lacks the background noise of an engine, every whistle and squeak can be heard, sending engineers in search of new ways to damp sound. The \$100,000 cost of the power electronics in the models on the test track must come down by a factor of 50.

What is more, while the batteries will move the car more than 100 miles, the car will not go nearly that far if it must also keep passengers warm or cool. California, whose regulations serve as the model for at least 11 states, has yet to allow for, say, a small propane space heater. Without a heater,

"We don't know how to build a car for Maine," said Jean L. Crocker, a G.M. spokeswoman.

Although the Impact's batteries weigh nearly 900 pounds, the electric car has energy equivalent to only about 1.5 gallons of gas. Thanks to stingy engineering, that will take the car more than 100 miles - impressive but only about a third as far as an average car will go on a tankful of gasoline. The range may eventually be substantially greater, but for now, proponents hope that recharging stations will be readily available and that consumers will accept the car as useful for everyday drives.

So how can a car with such energy limitations be so lively? It is an unexpected result of a combination of technological limitations and marketing considerations, which drove G.M. to a series of choices.

Among them, the auto company chose to use the familiar lead-acid battery rather than one based on newer technology. Amid disadvantages like prodigious size and weight, G.M. found a compelling marketing benefit in the lead-acid battery: its ability to deliver power fast.

On the down side, lead-acid batteries offer limited storage. The Impact's lead acid holds about 35 watt-hours per kilogram, compared with 100 watts per kilogram for sodium sulfur batteries, which Mercedes is working with, and 165 watts per kilogram for lithium iron disulfide, another newer technology.

Yet lead-acid batteries deliver power faster, much as a bigger garden hose will drain a tank of fixed capacity faster than a smaller hose. In case of lead-acid, the hose is large; it can deliver 280 watts per kilogram of battery weight, versus 110 for sodium sulfur and 200 for lithium iron disulfide, according to G.M. engineers.

And just as lead-acid batteries deliver power faster, they also accept it faster. The Impact has "regenerative braking," or the ability when a driver lifts his foot off the accelerator to turn the motors that power each front wheel into generators instead. Rather than converting electricity into mechanical force, they turn mechanical force - the inertia of car - into electricity, which is dumped back into the battery.

In city driving, regenerative braking captures two-thirds of the energy lost at each stop sign or red light, energy that in a conventional car is converted to heat by the brakes, and then dissipated.

To make up for the heaviness and low storage capacity of lead-acid batteries, the company chose an induction motor, which at high speed turns electricity into mechanical force with an efficiency of about 95%. Unlike other motors, it is also very efficient at low speed. It can also run at up to 15,000 rpm, which eliminated the need for a transmission.

At 57 horsepower each, the two motors together have about the same power as the 4 cylinder gasoline engine commonly used in a small to mid-sized car; but they give this light-body two-seater a lot of zip.

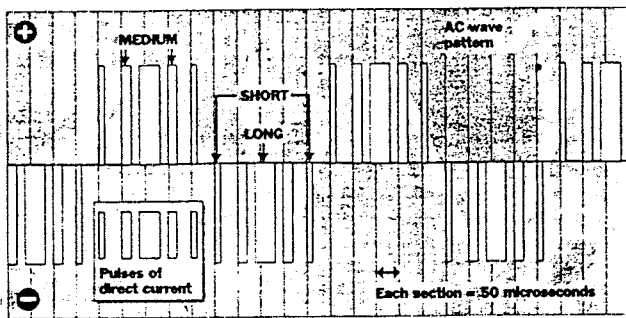
The combination of the lead-acid battery and the induction motor, however, added complications. While the batteries supply power to the motor quickly, it is direct current; the motors run on alternating current. That pushed G.M. engineers to come up with new advances in a field of electronics called power conditioning, converting electricity from one form to the other.

Power conditioning essentially means using silicon switches, akin to computer chips, to synthesize a precise alternating current. Before G.M., this technology was used in windmills, where the blades could turn at whatever speed the wind pushed them but the generator would turn out perfect 60-cycle alternating-current power for the utility grid.

To make the conversion, G.M. chopped the direct current into pulses. By alternating short, medium and longer pulses of direct current, the switches create a power flow that looks like a sine wave, rising and falling in the pattern that the electric motor needs.

Power Conditioning

Electricity is stored in batteries as direct current (DC) but motors run on alternating current (AC), in which the polarity moves smoothly from positive to negative. Power conditioning synthesizes an alternating current by alternating short, medium and long pulses of direct current, creating the appearance of a normal AC wave.



The power electronics also controls acceleration, and does it smoothly. To go faster, the motors need more torque, or mechanical power, and more speed. The torque increases with the amplitude of the sine wave - that is, with its "height" if it were charted on a graph - and the motor speed rises with the frequency, which, unlike a utility electric system, is not fixed at 60 cycles. The power electronics system takes its cue from the driver's foot on the accelerator.

Packing a car with sophisticated electronics may have some side benefits. The car would probably be charged on a circuit controlled by the electric utility, so the utility could supply the power during off-peak periods, at a reduced price.

Once connected to the utility with a communications link, all kinds of possibilities emerge. "It can run diagnostics at 3 A.M.; when the thing's plugged in, you can talk to it," said Bob Wrapp, G.M.'s manager of electric vehicle market development for California. The car could report back to a G.M. computer, which in turn would send the owner a letter saying that the right rear tail light was out. And because each car is identifiable, it could notify the police that a car had been stolen.

None of this clever engineering, however, is completely voluntary. If 11 Eastern states all follow California's lead as they promised to, a third of the national car market will require that 2% of sales be electric cars. (Massachusetts on Friday became the first to complete adoption of the California rules.) The requirement rises to 5% in 2003, meaning hundreds of thousands of electric cars will be sold.

California has not yet spelled out the penalties for missing the quota, but they could include refusing to let the car maker sell cars there the next year. But a company that sells more than its quota could find itself in a new, very profitable line of business: selling credits for its extra electric production to competitors who have fallen short.

CHRYSLER CONNECTS ON ELECTRIC CARS

Chicago Tribune 3/4/92 by Jim Mateja

Chrysler Corp. has chosen to team with Westinghouse Electric Corp. to develop an electric car for the late 1990s that would double the existing driving range before the need to stop for a lengthy recharge.

is Chrysler's first commitment to building electric cars. The automaker has been developing batter-powered mini-vans. The partnership is intended to save Chrysler time and money in bringing an electric car to market.

Generals Motors Corp. is expected to be the first automaker to sell electric cars. A two-seater is being developed for 1995 under the name Impact. Ford Motor Co., like Chrysler, has been developing electric-powered mini-vans.

Chrysler said it chose Westinghouse for the venture in the hope that its electrical expertise in space can be applied to technology on land. The partners said they're working on a new electric-propulsion system and advanced electric motor that would make it possible to develop a car that could accelerate from 0 to 60 mph in less than 15 seconds.

Chrysler's electric mini-van, code-named TEVan, requires more than 25 seconds to make the 0-to-60-mph jaunt, making expressway and interstate travel-especially the simple merge onto those roadways-impractical, if not outright unsafe.

In addition, the two said they hope to develop batteries that would have a range of 200 miles before having to be plugged into a 220-volt socket for an eight-hour recharge. Maximum driving range between battery charges with the TEVan is about 120 miles. The limited travel and lengthy recharge long have made batteries a less-than-viable alternative to gasoline.

GM had boasted that its Impact car was designed specifically as an electric and that Chrysler and Ford simply were working on adding batteries to existing mini-vans and calling them electrics.

"Our electric car would be an entirely new purpose-built vehicle, designed specifically for electric power," Chrysler spokesman Tom Kowaleski said.

waleski said the Westinghouse partnership won't change Chrysler's plans to bring out a battery-powered mini-van, even if its range is limited to 120 miles before an eight-hour recharge and even though acceleration to 60 mph takes 25 seconds.

"We're moving ahead with plans to bring the van out in 1995," he said. "Our feeling continues to be that the first users of electric vehicles will be utility companies and commercial firms, and that makes an electric van the most practical at the outset.

"Our electric van will beat the electric car to market, though we aren't saying when the electric car would come out, because there's no timetable," Kowaleski said.

The Chrysler/Westinghouse partnership will focus on advancing electric-vehicle propulsion, examining design, performance, reliability, weight, noise and cost.

"We have some basic issues that need to be answered," Kowaleski said, "such as weight, cost, range and recharging time, the four major issues facing electric vehicles today."

Chrysler is working with General Electric Corp. in developing the TEVan. It opted for Westinghouse for the car, Kowaleski said, "because it provided us with another alternative in developing electric-motor technology."

Westinghouse has been involved in electric-vehicle research since the early 1910s.

The electric car initially will be developed using the same nickel/iron batteries being tested in the TEVan. Nickel/iron batteries suffer from limited range and maximum recharge time but promise 10 years or 100,000 miles of use before having to be scrapped, Chrysler said. Replacing the estimated 800 pounds of batteries needed to propel a car could cost \$2,000 or more.

"If we find a new breakthrough, we'd run with it in both the car and the van," Kowaleski said.

GM in the early '80s said it made a breakthrough in battery technology and vowed to develop electric cars. When gas lines disappeared after the oil embargo and gas prices stabilized, thoughts of 120-mile ranges and eight-hour recharges for electric vehicles discouraged consumers. GM dropped the project.

Today, there's renewed interest in electrics because of concern over cleaner air and the desire to lessen U.S. dependence on foreign oil.

But the deciding factor has been California's passage of laws requiring that 2% of vehicles sold in that state starting in 1998 must have zero emissions. By 2003, 10% of the vehicles must fall under the zero-emissions rule. Only electric vehicles would qualify.

1992 MEMBERSHIP

1 John Ahern	624 Pershing Avenue	Wheaton	IL	60187	USA
2 Paul Bowarchuk	4107 Park Street	Westmont	IL	60553	USA
3 Alfred Brinkmeyer	4323 Devon Street	Lisle	IL	60532	USA
4 Jack Cahill	1 S 736 Vista Avenue	Lombard	IL	60148	USA
5 Carl R. Chapman	310 Greenfield Road	Shorewood	IL	60435-9674	USA
6 Tom Cartwright	1104 Douglas Terrace	Dixon	IL	61021-1724	USA
7 Steven Clark	4533 Downers Drive	Downers Grove	IL	60515	USA
8 Dale Corel	595 Gates Head North	Elk Grove Village	IL	60007	USA
9 Frank Cilyo	117 Sumac Court	St. Charles	IL	60174	USA
10 Frank Delmonico	5629 Bohlander Avenue	Berkely	IL	60163	USA
11 John Emde	6542 Fairmount Avenue	Downers Grove	IL	60517	USA
12 Leonard Fisher	6351 Amston Drive	Dublin	OH	43017	USA
13 William T. Forde	12231-44th Dr. SE	Everett	WA	98208-9101	USA
14 Steve Frankenfield	712 Quassen Ave	Lake Bluff	IL	60044	USA
15 Alexander Glowiak	101 Rumsey Road	Westmont	IL	60559	USA
16 Hendly Hall	530 Lawn Drive	Loves Park	IL	61111	USA
17 Everett Harris	214 Nebraska Street	Geneva	IL	60134	USA
18 J.E. Helenowska	5754 N. Elston	Chicago	IL	60646	USA
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20 Thomas Kaminski	4828 West Warwick	Chicago	IL	60641	USA
21 George Krajnovich	17W381 Eisenhower Rd.	Oakbrook Terrace	IL	60181	USA
22 John Krueger	25952 S. Locust Pl.	Monee	IL	60449	USA
23 Lad Kucera	8 Arthur Avenue	Clarendon Hills	IL	60514	USA
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30 Kenneth Myers	1303 Indiana Street	Saint Charles	IL	60174	USA
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40 William Shafer	308 South East Drive	Oak Park	IL	60302	USA
41 Dr. Henry Shaw, M.D.	3317 Dan's Drive	Stevens Point	WI	54481	USA
42 John Stockberger	2S643 Nelson Lake Rd	Batavia	IL	60510	USA
43 Robert J. Sullivan	6520 Reservation Road	Yorkville	IL	60560	USA
44 Dale Tuott	635 221st Ave N.W.	Cedar	MN	55011	USA
45 Vladimir Vana	5558 Franklin	LaGrange	IL	60525	USA
46 Rick West	P.O. BOX 742	Lombard	IL	60148	USA
47 Alan V. Wilson	917 White Avenue	Beloit	WI	53511-4549	USA
48 Kenneth Woods	1264 Harvest Court	Naperville	IL	60565	USA

APPLICATION FOR MEMBERSHIP OR RENEWAL

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JUST INTERESTED IN ELECTRIC VEHICLES

I HAVE AN ELECTRIC VEHICLE.....DESCRIPTION _____

I WISH TO BUILD AN ELECTRIC VEHICLE

AMOUNT ENCLOSED \$ _____ FOR _____ MONTHS

MAKE CHECK PAYABLE TO: FOX VALLEY EAA

MAIL TO: Dale Corel
 595 Gates Head North
 Elk Grove Village, IL 60007