ELECTRIC AUTO ASSOCIATION NEWS

EAA

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World Solar Challenge.

I am sure that you will find the attached Press Release self explanatory.

The Society of Automotive Engineers (**SAE**) has not only decided to provide finance, but in also offering their vast experience.

The World Solar Challenge now has 24 entries from around the world, namely the **U.S.A Canada, Germany, Switzerland, Denmark, Japan, Nigeria, New Zealand,** and of course **Australia.**

The event will have up to four major sponsors, and numerous suppliers that help an event of this magnitude to function.

The end result is to the benefit to the world. The SAE will assure that the enormous creation of ideas will be recorded technically to make it all a worthwhile R&D (research and development) into alternative transport.

The 1987 event saw the creation of the GM Sunraycer, that rewrote the book on electric and economical vehicles; at the lowest possible energy consumption of land transport. Ford and Mitsubishi also contributed with many innovative ideas, adding to that the universities, schools and private contributions, the benefits are enormous.

When considering the Greenhouse effect; the words of Barry Jones as Minister of Science "The motor car is responsible for 50% of the Greenhouse effect" - and he is right, making it even more important to create the efficient electric car.

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1st battery-powered production car due from Peugeot in 1990

By Sue Baker
London Observer Service

PARIS—The puzzled frown on the face of the elderly Frenchman said it all: He clearly wondered why I appeared to be coasting silently downhill in the little Peugeot, its engine apparently switched off.

If he had been able to see inside the Peugeot 205's engine bay, he would have been even more surprised: The engine space was packed tight with a dozen six-volt nickel cadmium batteries.

Peugeot plans to put the hatchback 205 on sale in 1990, the first battery-powered production car from a major car manufacturer.

Memories of the ill-fated Sinclair C5 are inevitable, but misleading. The new electric car looks indistinguishable from a normal Peugeot 205, and drives like one, capable of transporting four people and their luggage, although not too far or fast.

Convulsive decade

Top speed is only 60 miles an hour. Acceleration to 30 m.p.h. takes 11 seconds—roughly the same time as a comparable gasoline-engined car takes to reach 60.

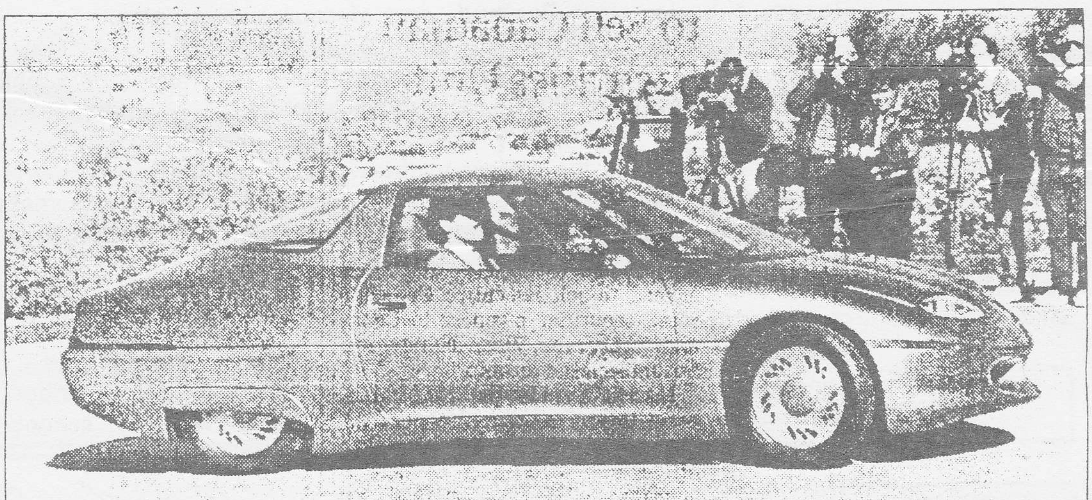
It is a heavy car for its size, weighing a ton. Its range is only about 60 miles before the batteries are drained and need an overnight recharge. Until someone invents a new kind of battery, performance and range are limited.

Even so, Peugeot is convinced that the environmental appeal of a nonpolluting, exceptionally quiet and simple-to-drive car (no gearstick and just two pedals) that plugs into electrial outlets rather than stopping at a gas station, is strong enough to be commercially viable.

Unlike previous electric cars, it doesn't give up trunk space to batteries. To go into reverse, you press a button on the dashboard.

As a city car, for shopping, school runs and short commuter trips, the battery car is a pleasant alternative, although not a cheap one. When it goes on sale next year, the price will be "a little dearer" than its gas-driven cousin, according to Peugeot.

GENERAL MOTORS' IMPACT



KEN LUBAS / Los Angeles Times

GM's teardrop-shaped concept of an electric auto designed for the consumer market.

- **Power:** Two electric AC motors, one for each of the front wheels.
- **Battery pack:** 32 10-volt lead-acid batteries, total weight 870 lbs. Can be recharged in about six hours on ordinary household current.
- **Acceleration:** from 0-60 m.p.h. in eight seconds. On the highway, can accelerate from 30-60 m.p.h. in 4.6 seconds.
- **Range:** 124 miles on one charge.
- **Cooling system:** Fan-assisted flow-through air cooling.
- **Tires:** Special low-resistance tires, inflated to 65 psi (double the inflation of ordinary tires).
- **Weight:** 2,200 lbs.

OPPORTUNITY CHARGING WITH INDUCTIVE CHARGING SYSTEMS

J. G. Bolger, Inductran Corporation

BACKGROUND

Opportunity charging offers the prospect of a radical improvement in the viability of electric cars. It is a technology that is continually finding effective new industrial applications, and it is now time to prove its worth to electric automobiles.

The propulsion energy for an EV can be supplied in three basic ways: 1) by periodically charging a battery or other energy storage device on the vehicle while the vehicle is stopped, 2) from a source as the vehicle moves, e.g. from an electrified highway or solar cells, or 3) by periodically replacing a depleted battery with a charged battery.

Opportunity charging is one form of the first method in which the vehicle is charged at convenient opportunities, rather than once a day or once a shift. When this method is correctly applied it can substantially reduce the size and significantly extend the life of the battery that is required, and improve the operational flexibility of the EV. In so doing, it can help to make the EV a cost effective, convenient vehicle for the general public's use. In order to obtain the benefits of opportunity charging, however, charging operations must be made an easy, safe procedure for even the most unskilled driver. This is a major reason that inductively coupled chargers are so important to the future of EVs.

OPPORTUNITY CHARGING EXPERIENCE.

A considerable amount of experience with opportunity charging has been accumulated in recent years. Battery powered buses have been operated in Germany with opportunity charging cycles since 1982 with apparently good results. We also installed our first inductively coupled opportunity charging system for 12 automated vehicles in Disney's EPCOT Center in 1982; this system has proved to be highly reliable with very low maintenance requirements. A number of other applications are at airports, for push tractors and for other ground support vehicles.

Many applications of opportunity charging are in automatically guided vehicle systems such as those used in automated factories. The cycles range from occasional charging of either lead acid traction or fiber-nickel/cadmium batteries at a high rate, to more frequent charging of "maintenance free" batteries at lower rates.

Charging power is delivered to the vehicle either through manually operated conventional connectors, through an automatically operated connection to exposed contacts, or through an inductive (magnetic) coupling. Reliance on conventional connectors often results in the vehicle operator's failure to initiate the charging cycle due to either forgetfulness or laziness. The use of exposed contacts introduces the problem of frequent contamination of the contacts, and makes the method unsuitable in outdoor or hazardous environments. Inductive couplings eliminate these problems and make it possible for vehicles with different battery voltages and capacities to be charged at the same station.

OPPORTUNITY CHARGING WITH INDUCTIVE CHARGERS.

The lessons learned from the experiences cited above can make electric automobiles much more broadly applicable. When convenient access is provided to charging energy during the operating cycle of an EV, its range is no longer stringently limited, its first cost and operating cost are significantly lessened, and its performance is improved because a smaller, lighter battery can be used.

Inductively coupled chargers are of particular importance in opportunity charging because they are uniquely able to serve as universal charging stations, in that they can charge electric vehicles with a wide range of battery sizes and voltages. An inductive charging station uses a source inductor that is matched to the utility electrical service, and vehicles carry coupling inductors and charging controllers that are matched to the vehicles' batteries. Since power is transferred magnetically, there are no electrical contacts to corrode or arc, and the EV is completely isolated from the utility electrical service. The inductive couplings are designed to charge at as high a rate as is possible without gassing the battery, up to the maximum power rating of the charger.

Figure 1 shows an arrangement for a charging station in which the vehicle parks over the station. The station magnetically senses the presence of the vehicle's inductor and turns itself on. The source inductor is pulled up to contact the rubber pads on the vehicle's inductor by the magnetic flux in the inductive coupling, and the charging cycle continues until the battery reaches a preset state of charge as indicated by the charging current. The charger automatically turns itself off and the source inductor returns to its lowered position when the charging cycle is completed or when the vehicle drives away. This arrangement is similar to several hundred chargers that we have supplied for automated vehicle systems.

In an alternative arrangement, shown in Figure 2, the vehicle inductor is mounted at the front of the vehicle and the source inductor is mounted on a stand. This configuration was demonstrated some years ago at an EAA rally with an early prototype system. Figure 3 is a block diagram that shows the components of the charger.

The inductors will tolerate a considerable amount of misalignment without seriously degrading their maximum power transfer capabilities. Our standard 8"x 21" inductors will deliver 3 kw of net charging power with a charging system efficiency of 89 %. The 3 kw power rating is compatible with the typical 230 volt residential electrical service.

Inductive chargers are extremely "user friendly". The user needs only to park the vehicle at a charging station to have his vehicle charged automatically. He does not have to connect and disconnect the charger, is not exposed to electrical hazards from damaged cables or plugs, and cannot drive off with a charging cable still connected. The availability of charging stations in public parking lots will ensure that EV users will always be able to obtain the energy for extra trips during the day and that they will never be stranded with a discharged battery.

Consider the implications of having inductive charging stations available in parking lots and at home. Let's assume as an example that a commuter travels 17 miles each way to and from work, and that his EV requires 0.18 kwh/mile. Let's also assume that the battery provides a range of 50 miles to a 20 % state of charge, i.e. weighs about 875 pounds. The opportunity charging cycle would result in the EV's battery being charged and discharged daily between about 50 and 80% state of charge, and equalized approximately every 10 days.

The charging time required at the work site and at home would be one hour using a charger with a 3.1 kw rating. The life of opportunity charged batteries in electric buses was reported to be 82,300 miles in severe operating cycles. This was with tubular plate batteries, a battery cooling system, and electrolyte agitation. The life of the EV's lighter duty, but less severely stressed battery might approximate 30,000 miles. The energy and battery replacement cost of the EV would total about 4 cents a mile- about the same as the cost of gasoline for the typical compact car. The battery in a heavier non-opportunity charged vehicle might last for 350 (47 % DOD) cycles or 12,000 miles. The operating cost would approximate 7.4 cents/mile for battery replacement and 2.1 cents for energy, or a total cost of 9.5 cents/mile- more than double the cost in the opportunity charged EV.

The factors that allow the rational projection of a long battery life are:

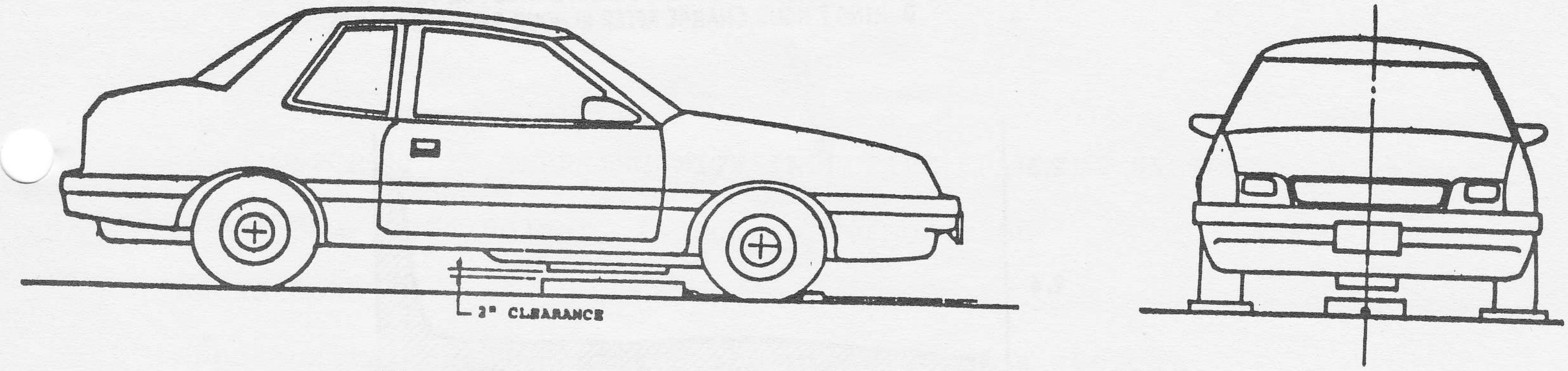
1) The battery is only infrequently charged to a full state of charge and/or equalized. Equalizing cycles are particularly hard on a battery because of the heating and gassing that occurs. Figure 4 is from a report by Exide that shows the heating of a battery during a discharge and charging cycle; the figure clearly shows the tremendous increase in heat evolution that occurs as the battery approaches a fully charged condition. The inductive charger automatically terminates the opportunity charging cycle at a preset state of charge before heating and gassing begin.

2) The battery is regularly charged at a rate that is sufficient to avoid the adverse effects on the battery of extensive charging at low current. This also makes frequent equalizing unnecessary because it tends to lessen the stratification of the electrolyte. The charging cycle between 50 and 80% state of charge maintains the charge receptivity of the battery at all times so that it can always be recharged at a relatively high rate without damage.

In order to achieve the maximum battery life, initial implementations should explore such factors as the optimum operating states of charge and the value of electrolyte circulation.

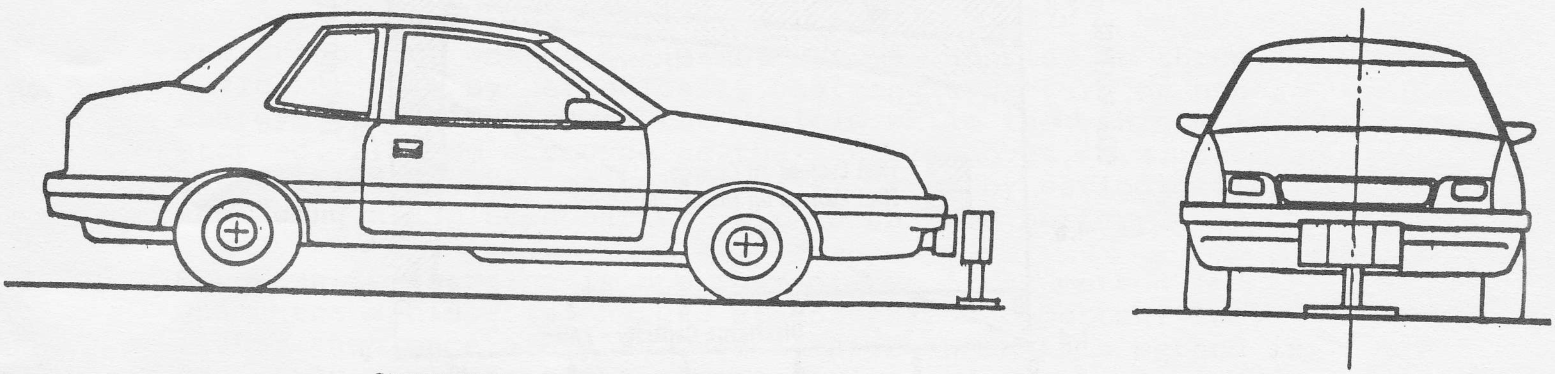
The battery capacity required is considerably less when opportunity charging is available. In the example above, an EV without the availability of opportunity charging would probably have to be provided with increased battery capacity for at least 60 miles in order to achieve an acceptable battery life, provide for unanticipated trips, and provide a capacity reserve for battery deterioration as it ages. The increase in battery weight would be about 300 pounds, which would far exceed the weight of the inductive charger (about 55 pounds), and would degrade the performance of the vehicle and add substantially to its first cost and operating cost. The loss in convenience and flexibility in operating the vehicle is also a major penalty.

The cost of 3 kw Inductran opportunity chargers is strongly influenced by the quantity in which they are produced. If they are produced steadily in modest quantities, the retail prices would be on the order of $950 per vehicle system and $850 per charging station. These costs will be offset many times over by the major improvement in the utility of the EV and by the reduction in the costs of the EV and its battery.



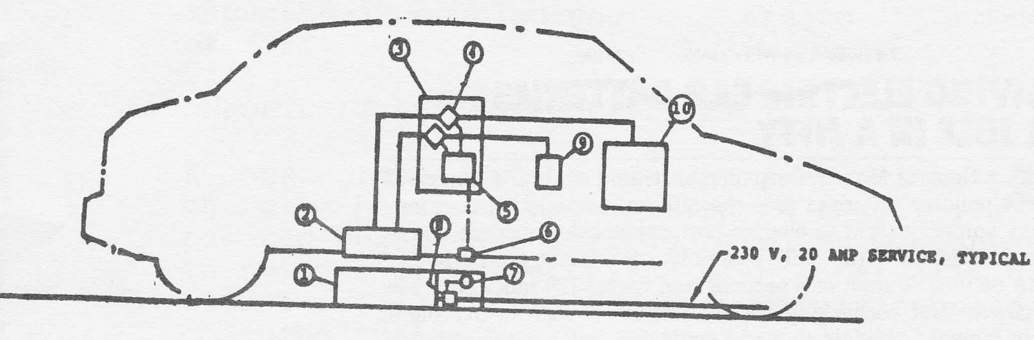
FLOOR MOUNTED CHARGING STATION

FIGURE 1



STAND MOUNTED CHARGING STATION

FIGURE 2

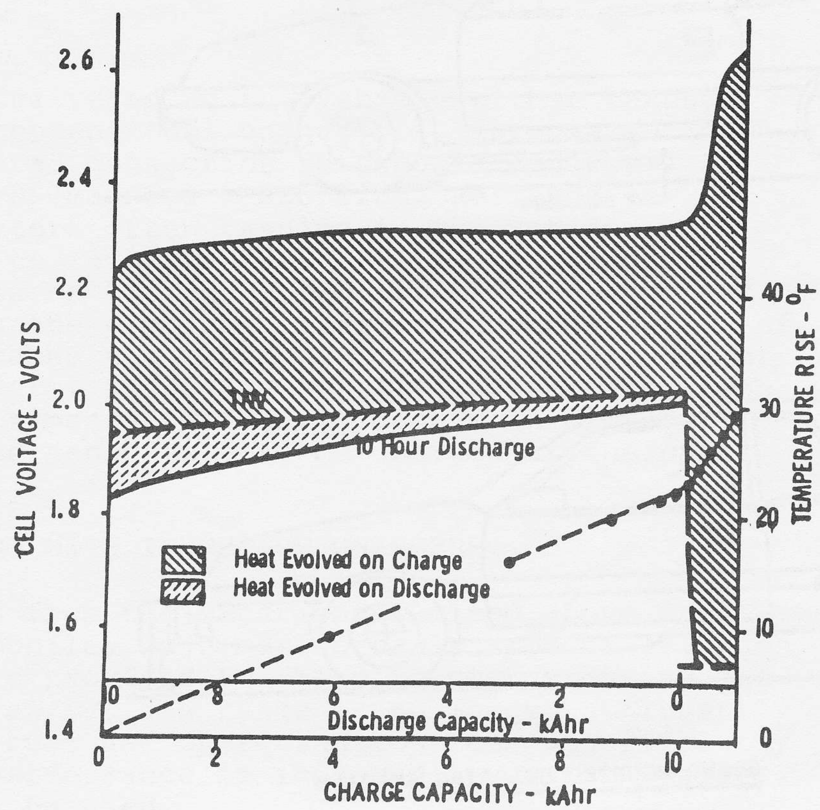


BLOCK DIAGRAM OF THE CHARGER

FIGURE 3

ITEM	DESCRIPTION
1	SOURCE INDUCTOR
2	COUPLING INDUCTOR
3	CHARGE CONTROLLER
4	RECTIFIERS
5	CHARGING LOGIC
6	CONTROL ELECTROMAGNET
7	SOLID STATE MAGNETIC SWITCH
8	SOLID STATE RELAY
9	AUXILIARY BATTERY
10	TRACTION BATTERY

HEAT EVOLUTION AND TEMPERATURE RISE FOR VLL45 CELL
DURING 7 HOUR CHARGE AFTER 10 HOUR RATE DISCHARGE



HEAT EVOLUTION DURING A DISCHARGE/CHARGE CYCLE
(EXIDE DATA)

FIGURE 4

78 BUSINESS WEEK/JANUARY 22, 1990

GIVING ELECTRIC CAR BATTERIES A JOLT IN A JIFFY

As General Motors Corp. demonstrated on Jan. 4, the chief polluter of urban air—the internal combustion engine—may someday yield to electric powerplants that provide spiffy performance for the daily commute: GM's latest prototype car can do 0 to 60 mph in 8 seconds and travel 120 miles between charges. But recharging those batteries is still an overnight job. Suppose, though, that you could pull into a service station for a quick recharging—in 30 minutes or less. Then electric cars might be practical even for long trips.

That's the vision of Yury Y. Podrazhansky, chief executive of Electronic Power Devices Corp. His Atlanta startup has patented a way of rapidly reinvigorating any size rechargeable battery. And, he says, the technique doesn't damage the battery, which is what usually happens when recharging is speeded up simply by pumping in more electricity.

The trick is a special electronic controller that jolts the battery with high current for a few hundred milliseconds, then discharges it for two or three milliseconds. After a brief respite, so the battery can adjust, the cycle repeats. Podrazhansky perfected his method to recharge the batteries in the video cameras at Turner Broadcasting System Inc., where he went to work shortly after emigrating from the Soviet Union in 1978. He is now working on a commercial prototype.

Automakers Shop for "Designer" Fuels

Non-gasoline cars targeted for 1997

Los Angeles Times

LOS ANGELES — In a major effort to accelerate the shift to cars powered by cleaner fuels, the California Air Resources Board on Thursday endorsed the broad outlines of a plan to wean state motorists of conventional gasoline-powered cars by as early as 1997.

The proposed requirements, which go far beyond the already tough 1994 tailpipe emission limits adopted last June for conventional gasoline-powered cars, would have major implications for automakers and oil companies, as well as for consumers. The new regulations almost certainly would require use of alternative fuels such as methanol, compressed natural gas and electricity. New emission control technologies would also be required.

> 'This is a very, very significant milestone along the path to clean air.'
>
> — *James Boyd*

The requirements, if approved by the board in September, would set the course of California's vehicle emissions controls into the 21st century.

Without a new generation of motor vehicles, the board said that the South Coast Air Basin — containing Los Angeles, Riverside, San Bernardino and Orange counties — will not be able to meet its 20-year goal of meeting federal clean air standards.

Earlier this year, the South Coast Air Quality Management District adopted a sweeping clean-air strategy that touches nearly all aspects of Southern Californians' lives, from driving habits to backyard barbecuing.

Beginning in 1997, one out of every four cars sold in the state would have to emit 70 percent less of smog-forming hydrocarbons than required by the 1994 standard, under the board staff proposal. By 1998, half of all cars sold would be required to meet the tougher standard.

In effect, there would be two tailpipe standards — one for conventional gasoline cars based on the 1994 standard and another for so-called "low-emission cars," which the state would require to be sold in California.

The 1997 standard limits hydrocarbon emissions to 0.075 grams per mile. The 1994 standard limits them to 0.25 grams per mile. Current federal standards set hydrocarbon limits at 0.41 grams per mile.

As time passed, the market share of low-emission cars would grow from less than 10 percent in 1994 to 100 percent of new cars sold in the year 2000.

Change in gas use by 2010

By 2010, the board staff estimated that two-thirds of gasoline use in California would be displaced by the cleaner fuels. Heavy-duty trucks and off-road vehicles, among others, would continue to use conventional gasoline.

"This is the first time we've started to wean people away from gasoline and cars as we know them," board spokesman Bill Sessa said Thursday.

Added board executive officer James Boyd: "This is a very, very significant milestone along the path to clean air."

Oil companies would be required to sell alternative fuels at their service stations as a condition for continuing to sell gasoline in the state. Automobile makers would be required to make the lower-emission vehicles in order to meet the tougher standard.

Automakers and the oil industry two months ago launched a joint research and testing program looking at advanced vehicles and fuels. On Thursday, industry representatives cautioned that the board staff's proposed timetable was unrealistically fast and may not be technologically feasible.

Still, the Western States Petroleum Association and ARCO Products Co. both applauded the board's general strategy, although they expressed concern about details.

Asked if it could be done, Douglas Henderson, executive director of the association, said, "We think so.

"It's a watershed event. The impacts on our industry are huge and will determine all the work done by petroleum producer and refiners for years," Henderson said.

Henderson predicted that whatever California does will have national and even global impact. He noted that Northeastern states have already copied California's existing tailpipe emission standards rather than settle for weaker federal standards.

Dan Townsend, manager of operations support for ARCO, said the board staff's general approach was "conceptually sound and holds promise for success." But, he urged the board to remember that a complex program "depends critically upon its details for the promise to become reality."

Three categories of cars

As envisioned by the staff, there would be three categories of progressively cleaner cars — transitional low-emission vehicles, low-emission vehicles and ultra low-emission vehicles.

But even the transitional low-emission vehicles would spew out only half as much smog-forming hydrocarbons as the cleanest new cars on the road in 1994. The low-emission vehicles would be 40 percent cleaner still, and the ultra-low emission vehicles would cut hydrocarbon emissions half-again as much.

According to the board, for the first generation of cleaner cars — transitional low-emission vehicles — significant modifications to current engine design and control technologies would not be required.

Indeed, the staff noted that the Nissan Sentra already meets the hydrocarbon standard that takes effect in 1994.

But the second generation of low-emission vehicles would require advances in control technologies. Gasoline engines might be able to comply with the standard if, for example, electrically heated catalytic converters work as the staff said early tests show.

In the alternative, substitute fuels like methanol and compressed natural gas could meet the standard without the electrically heated catalytic converters.

CALENDAR

Planned East Bay Meetings

- Feb. 10, 1990 - Dr. Benson - Stirling Engine & Hybrid
- March 10, 1990 - Steve Post - Curtis PMC Controllers
- April 14, 1990 - Toni de Bellis - Proposal of rental Electric Cars at BART Train stations

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Santa Clara Meetings changed (because of Earthquake) to:
Mercury Savings, 19376 Stevens Creek Blvd.

Battery Council International 102nd Convention April 29-May 2
San Francisco, Ca. Marriott Hotel

AMERICAN TOUR de SOL May 23-27 1990 5 Day race through New England

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WORLD SOLAR CHALLENGE-Due to start in Darwin, Austrila on Sunday November 11 1990. ENERGY PROMOTIONS P.O. BOX 290, Bribie Island Qld. 4507, Australia

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