AUGUST 1988

MEETING NOTICE

The next meeting will be Aug. 19th, at *CRAGIN FEDERAL SAVINGS & LOAN* 333 W. Wesley St. Wheaton, Ill. - Time - 7:30 P.M. sharp. Guests are welcome and need not be members to attend the meeting.

THE PRES SAYS

The hot weather this past month verifies Arizona Public Service Co's wisdom in having Mr Ohba include air conditioning in their Electric Escort. Work in my garage to upgrade the DAF is limited to about two evening hours - with a circulating fan.

This Bulletin contains two articles written by James Cook and appearing in Forbes Magazine. We thank FORBES for granting permision to reproduce these articles. The first draws attention to the short-term fragility of the oil supply situation. The second points out that there is an adequate short-term supply and precipitous price increases are not likely. Both of these factors affect public interest in FVEAA activity.

At the last meeting, resumption of design work on a petro-electric car was requested. Other organizations have reached a conclusion similar to ours that further progress toward an electric car with acceptable performance and range will require efficient use of an engine-generator. The Electric Power Research Institute has started an engineering study as an article in this Bulletin states. Also, the California EAA has received a grant to support their Project X, a hybrid development.

We will have a status review of our design effort at the August meeting and make plans for future work on this project. Also, if I can arrange it, we will have a printed circuit board soldering tutorial.

Bill

F.V.E.A.A.

FOX VALLEY ELECTRIC
AUTO ASSOCIATION
624 Pershing St. Wheaton, Il 60187

FIRST CLASS

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NO MORE GAS

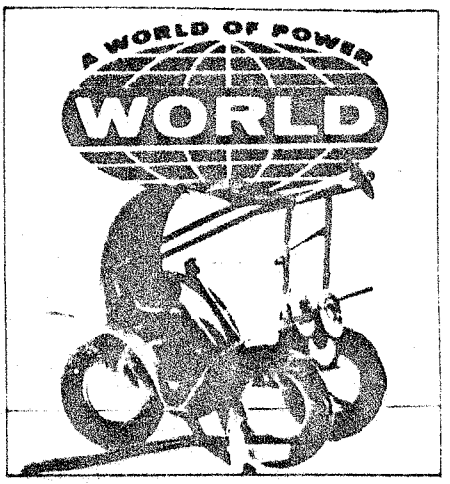
by Charles E. Miller

There was a raucous blast from the little red electric's horn as it zipped by the service station where there was the early morning lineup of commuter cars, but no one waved back. Everyone in the neighborhood knew about the electric car that got its fuel from the wall socket and they were tired of the owner laughing at them for not having the foresight to buy an electric car.

The worst time was when they washed their cars on Saturday morning. Then the little electric would glide up and the owner would ask them if they knew that 92% of their trips were well within the range of an electric car and that 2 million barrels of oil a day could be saved if they used an electric car for only 25% of their driving needs.

The best argument was that the gasoline car owners could have [illegible] themselves with is that the two types of vehicles should not be compared: each has a use and a purpose and the popular idea of replacing the gasoline car with an electric is a myth. Ambitious plans that are published about future electric cars too often promise a vehicle that will have the speed and acceleration of a gasoline engine and a 'yet to be developed' battery that will provide a comparable driving range.

Present lead-acid batteries can supply the power for a medium-size electric car to travel at speeds of 50 mph with a range of around 40 miles. To charge batteries of this size could take up to 16 hours for maximum battery life and the guarantee of a full charge. After a full day of driving, let's say that an electric car has been on the charger for three hours and an emergency comes up that requires a 10 mile trip. Better call a cab or borrow the neighbor's car because there is not enough energy in the battery for a trip that long.



So besides having a limited range, the electric car can only work an eight-hour day unless it has been run only a few miles during the work day. Car buyers have always had to make a choice between wanting a sports car and needing a station wagon, so they will have to know that an electric car is suitable only for short runs in a level urban area.

The Department of Energy might be correct that an electric car would satisfy 92% of normal driving needs, but it would only be true in Manhattan. It would not work in a hilly city like San Francisco or a sprawling city like Houston. The old retrain "Get a horse" would take on real meaning when shouted at some poor guy with dead batteries in the middle of a freeway at rush time.

It is claimed that the electric car has a much higher efficiency than a gasoline engine and a lower cost per mile, but those figures all depend on what factors are used. The five cents-per-mile cost for electric vehicles would be true if electricity is obtainable at two cents per kilowatt hour. A gasoline engine getting 18 miles per gallon will cost almost six cents per mile, so the electric car is actually more expensive to run as most consumers pay at least five cents per kilowatt hour for electricity. Starting with the fuel oil at an electric generating station and then figuring out how much of that potential energy in the fuel oil would come out of the wheels of an electric car, an efficiency rating of only 11% is achieved, less than the 15% efficiency of gasoline engines.

While it is hoped that mass production would help lower the price of an electric car, their present selling price of around $12,000 is certainly higher than most compact gasoline cars. There have been many advances made in the efficiency and cycle life of lead-acid batteries, but present production batteries will give a service life of from 18 months to three years in an electric car. This means that the owner would have to invest around $1500 for new batteries, when the gasoline car of the same age would be ready for a brake job and minor adjustments.

Figuring the vehicle cost, recharging expense and time, and limited range, where are the advantages? To those who claim that it uses less petroleum and that the initial cost is not important, it is hoped that they live in an area where all electricity is produced by hydro power or coal. One answer might be to forget about trying to compete with the speed and power of the gasoline engine and design the electric as a simple shopping car.

Long forgotten, the electric cars built 65 years ago gave a range of 100 miles at 20 mph and this is supposed to be the modern age. It just might be that the old timers knew some things about electric cars that we need to know.

If the little red electric car in your neighborhood honks his horn, wave and be nice because he is a true believer.

A METHOD OF OBTAINING REGULATED HIGH VOLTAGE CHARGING CURRENT FROM A 12v. ALTERNATOR AND REGULATOR FOR USE IN A SERIES HYBRID EV SYSTEM

- Ric Barline, Siskiyou Energy Systems (408/356-0289)
16892 Mitchell Ave.,
Los Gatos, CA 95030

In a series hybrid system, a DC generator is required to charge the propultion battery pack. Many designers use surplus 30v. generators for this purpose. As discussed in a previous paper, this approach has the problem of being unable to charge battery packs above about 36 volts. Another problem with using 30v. generators is that voltage regulation requires a surplus regulator which usually comes with no instructions or warranty.

Recently, Siskiyou Energy Systems (SES) has devised a method of obtaining regulated, high voltage charging current from a conventional automotive 12v. alternator and regulator. This approach is simple and relatively inexpensive. Automotive alternators are available up to about 100 amperes. With our system an alternator may be used to not only charge battery packs up to about 120 volts, but also to regulate the charge voltage and hence charge rate.

1) Obtain the appropriate alternator and regulator. The regulator must be external to the alternator. Either solid state or relay type regulators may be used.

2) Connect the alternator and regulator so that it will charge and regulate the first 12v. battery (or the first two 6v. batteries) in the propultion battery pack. See figure #1. Since this is how the alternator and regulator were designed to operate, any difficulties with this step should easily be solved.

3) Now disconnect the wire coming from the +BATT. terminal of the alternator and reconnect it to the most positive terminal of the entire battery pack. See figure #2. This completes the proce dure.

Theory of Operation: Since the regulator is still connected to the first 12v. battery in the string of batteries, it will continue to regulate the voltage on this battery. Now assuming that all the batteries in the pack are of equal condition, whatever voltage appears across the entire pack will divide equally over all the batteries. Therefore, by regulating the first battery, the regulator will likewise regulate the voltage of the entire pack. For example, say the battery pack consists of twelve 6v. batteries for a 72v. system. The regulator

is connected to +12 volts away from zero (the most negative side of the battery pack). Now as the alternator charges the entire pack, the voltage of the entire pack will sooner or later exceed 84 volts (7v. x 12). When it does so, the +12 voltage will exceed 14 volts (7v. x 2), and the regulator will cut off current to the field of the alternator. Thus the total battery pack is regulated to 84 volts.

IMPORTANT NOTE: The alternator housing is internally connected to the negative side of the battery. Therefore, if the alternator is mounted to the vehicle chassis, the negative side of the propulsion battery pack will become electrically connected to the vehicle chassis. If an isolated battery pack is required, the alternator must be isolated from the vehicle chassis.

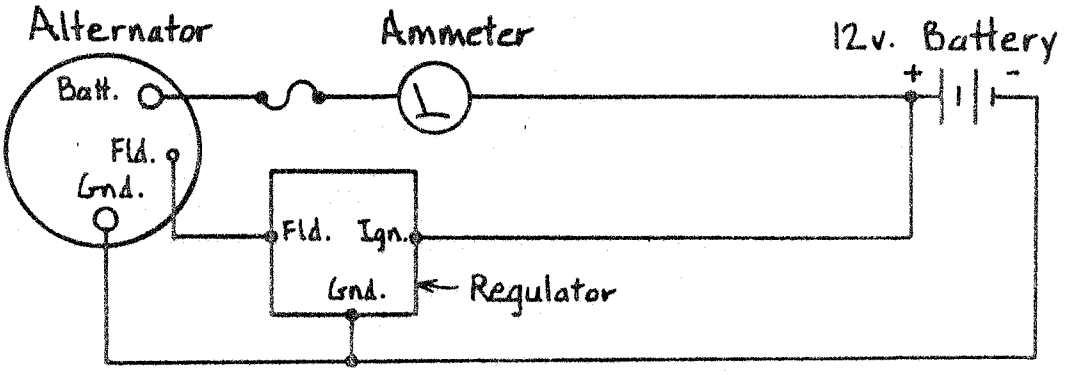


Figure # 1

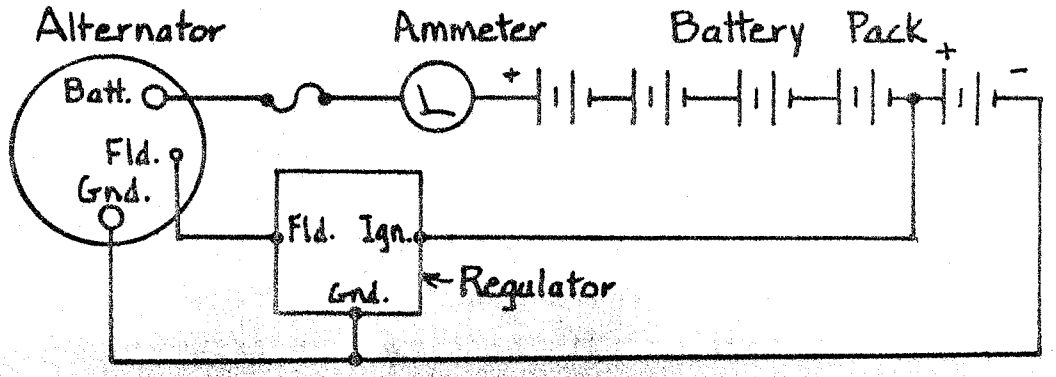


Figure #2

SISKIYOU ENERGY SYSTEMS
16892 MITCHELL AVE.
LOS GATOS, CA 95030
(408) 356-028[illegible]

OPEC's current inability to cut back oil production is more than just the last chapter in the oil crisis. Who henceforth will pay attention to the gloomy old Club of Rome predictions—the world is running out of everything!—that proved such a poor guide to policy in the 1970s and early 1980s?

We're not going to freeze in the dark

By James Cook

OPEC—the Organization of Petroleum Exporting Countries—an organization that once struck terror into the heart of the industrial world—is today a toothless old tiger. Even its roar is a mere squeak. In a feeble effort to reassert itself, OPEC managed to convene a meeting in April in Vienna between itself and seven non-OPEC oil producers. Nothing came of the meeting. It was a yawn.

The hope was that the two factions of the oil industry could agree to curtail production and if not raise prices, at least stabilize them. If the old tiger could no longer do the job alone, perhaps it could at least show a little muscle by combining with non-OPEC countries. No agreement resulted—and yet it would have taken so little to get one. A mere cutback of 5% in everybody's production would have made a huge difference. As Kleinwort Grieveson oil analyst Mehdi Varzi points out: "A 200,000-barrel-a-day swing in production can mean $3 a barrel when prices are in the $14-to-$20 range."

What does this failure to reestablish the cartel mean for the future of oil prices, for oil investments, for energy costs? It means that for the first time since 1935 there is a free market in oil, a market where prices are not administered by small groups but are determined in the old-fashioned way, at the margin of supply and demand. Oil is again a commodity like any other. OPEC's time on the stage of history is for the moment at an end.

The indications are everywhere. The volume of trading on the spot and futures markets has gone from 2 million or 3 million barrels a day to 200 million in only four years, the big oil companies are buying more and more of their needs rather than producing crude, and oil prices have begun to behave like those of any other commodity—like copper, like wheat—rising and falling with supply and demand, with rumors and news reports, with the manipulations of speculators.

"Even OPEC's power," says Chevron Chairman George Keller, "is limited by market forces. . . . Prices that are either too high or too low will be self-correcting."

What people sometimes forget is that administered oil prices antedate the rise of OPEC. Before OPEC there were the Rockefeller interests and then the Texas Railroad Commission and the Seven Sisters, those much-maligned but actually quite benign masters of the world oil business.

So the new situation represents drastic change and takes some getting used to. "I've been in the business 36 years," says Exxon Chairman Lawrence G. Rawl, "and ever since the price went over a dollar and a half a barrel, we've had nothing but uncertainties, nothing but problems." Already the uncertainties are changing the face of the industry *(see story, p 114)*, weakening some companies, eliminating some and strengthening others.

OPEC has set $18 a barrel as a target price—but that's a target, not a price. It won't be easy to maintain. Demand for OPEC oil runs around 18 million barrels a day, while OPEC goes on producing to meet the market, and even at that, close to half of its capacity is shut in. And things would be even worse if a handful of non-OPEC producers—Mexico, Norway and Oman—had not voluntarily cut their production by 900,000 barrels per day.

And what happens when the Iran-Iraq war ends and Iran again becomes a major producer? The Saudis used to support prices by cutting production in line with demand, but they lost so much market share that two years ago they shifted to net-back pricing—linking their crude prices with the prices of end products—and wound up almost collapsing prices; for a while, a few years ago, there was talk of $5-a-barrel oil.

There is a fundamental message in all this that transcends the oil business. Experience has made a joke of the once fashionable Club of Rome notion that the world is running out of practically everything. It's certainly not running out of oil. Even today, 15 years after the 1973 oil crisis forcibly brought the possibility of an oil shortage to people's attention, the world still has something like 800 billion barrels of recoverable oil reserves to draw on, over 50% more than it had in 1972 and more than 40 years' supply at current rates of consumption. And those are just proven reserves. There's nearly twice as much as that yet to be discovered or produced by various kinds of enhanced recovery techniques.

Yes, the bulk of these reserves is concentrated within a fairly small area: the Middle East. And among a small number of countries: Saudi Arabia, Kuwait, the United Arab Emirates, Iraq and Iran. In theory, oil ministers from these few could gather in a smoke-filled room and hold the world for ransom. In theory. In fact, the free market proved far stronger than their supposed monopoly power.

"In the short run," as Chevron's latest *World Energy Outlook* puts it, "politics tends to dominate thinking about oil prices; in the longer term, economic forces are a more important consideration."

Not even oil could repeal the basics of economics, which says that price influences both supply and demand. Raise prices and demand shrinks while supply rises; lower prices and demand increases while supplies tend to shrink.

That's exactly what happened. As prices went up, everybody began to cut back on consumption everywhere. Governments, businesses, individuals, reduced the energy content of everything the world economy touched—from automobiles to cement to refrigerators. By 1987 the world was consuming 7% less oil than it did in the peak year of 1979. Consumption has picked up since prices have dropped back in real terms to where they were a decade or more ago, but it has remained sluggish. According to the International Energy Agency, energy consumption per unit of gross national product fell by 20% worldwide over the past decade, and could fall another 30% by the year 2000, using technologies that are already in existence.

We're not going to freeze in the dark

High prices not only restricted consumption but after a few years they magically created additional supplies. There was an incentive to look for oil elsewhere, outside OPEC. The result was that non-OPEC production went from 22.1 million barrels a day in 1979 to 28.8 million barrels last year, and non-OPEC producers now account for 60% of the world's needs, up from 41% as recently as 1979. Higher-cost, lower-priced oil pushed lower-cost, higher-priced oil out of the market everywhere—$10 oil from the North Sea and North Slope supplanted 50-cent oil from Saudi Arabia—and OPEC was forced to shut down a good half of its low-cost capacity.

Thus today's market prices appear to be close to free market prices. David H. Vance of the State Department's Bureau of Intelligence & Research calculates that the real price of oil averaged $14.99 a barrel between 1901 and 1986, as against $27.50 from 1973 to 1986, so that today's $15-to-$18 price may seem high by the standards of a few years back but actually accords pretty well with the industry's long-term experience.

How long can the present free market last? Longer than most people think. "There's a theory that once OPEC is at 80% of capacity, it will be in a position to dictate prices and will raise them," says John Lichtblau, head of New York's Petroleum Industry Research Foundation. "I don't think so, and they're very far from 80%. History doesn't repeat itself, not in that way. They may put prices up moderately if they can. But the Saudis and Kuwaitis don't want to see a high price. They have a hundred years of production."

At the same time non-OPEC reserves have been growing. Despite a 50% drop in the price since 1981, non-OPEC production has continued to expand. That wasn't supposed to happen. U.S. production, it is true, has declined 8% from its 1985 peak, but not as rapidly as most people expected, and, according to Washington Analysis Corp. Vice President Adam Sieminski, will probably increase slightly this year. And North Sea production has not declined. At the same time, new production has been coming on in places like Yemen, Norway, Syria, Brazil and Vietnam, so that Sieminski expects non-OPEC production to continue to rise at least until 1990. "Most of our fields are very large," says Robert Horton, managing director of British Petroleum, the North Sea's largest producer, "and very large fields tend to be discovered by geologists who tend to be pretty conservative when they start talking about reserves, so that time and again we've found there are more recoverable reserves than we ever thought." Estimates of recoverable reserves in the North Sea's Claymore field, for instance, were increased last year by as much as 21%.

More important, lower prices have discouraged exploration and development far less than anyone expected. If prices have fallen, so have drilling and development costs. Explains Exxon Senior Vice President Donald McIvor, "A dollar buys a lot more. In physical activity we're not that far off from where we were." This year Exxon will drill 240 exploration wells, versus 184 in 1987 and the record 290 set in the early Eighties. According to Chase Manhattan energy analyst Robert B. Weaver, projects that used to look uneconomical at $25 are becoming economical at $18, and the trend is still downward.

At the same time, falling prices have encouraged revenue-hungry countries like Australia, Ecuador, Argentina, Peru, Canada, Great Britain and Morocco to offer better terms to companies developing resources—lower taxes, better contract terms, lower regulatory requirements. "They're looking at North Yemen," says Adam Sieminski, "and saying, 'Look what an American oil company did in a very short period of time [*see* FORBES, *Feb. 22*, "Yemen: Felix redux?"],' and they want to move back to the way things were run in the Sixties when private companies had an incentive to bring up oil. I think the model of the state-run oil company has been discredited."

Remember the alternative energy sources one heard so much about during the late oil crisis? They are still there, merely waiting offstage. Let the price exceed $25, as OPEC President Rilwanu Lukman conceded recently, and oil is subject to competition from other fuels. According to Chevron's *World Energy Outlook*, enhanced recovery methods begin to become economically viable at $25 a barrel, heavy oils at $35, oil shale at $60, and, thanks to technology, the ceiling is steadily coming down. "An incredible reduction in costs has taken place," John Lichtblau says. The Athabasca tar sands and enhanced recovery in Prudhoe Bay are now economic at $22 and $23, down from $28 a few years ago. According to Exxon's Rawl, synthetic fuels technology that a few years ago promised to need $60 a barrel is now viable at $30 to $35.

All this is good news for the human race—if bad news for the no-growth, small-is-beautiful calamity-howlers who once rallied under the Club of Rome banner. The truth is, as Julian Simon has pointed out in his brilliant book *The Ultimate Resource*, resource prices invariably decline over time, either because lower-cost resources are discovered, because lower-cost substitutes become available or because advancing technology reduces costs. That's happened repeatedly in oil *(see chart, p. 110)* and almost certainly will happen again.

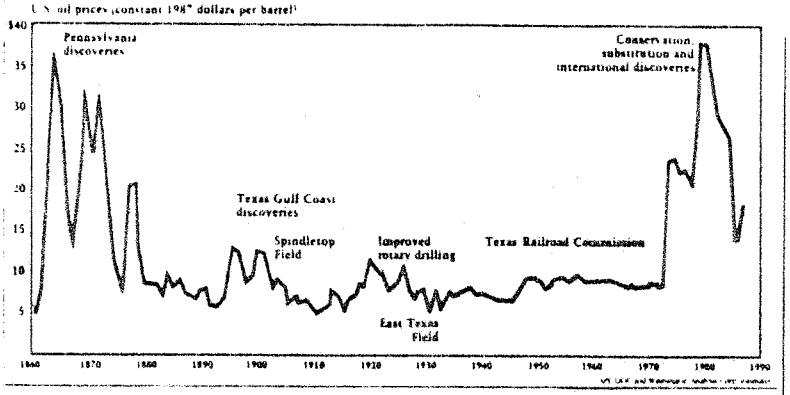
Such uncertainties pose especially difficult problems in a business where it takes ten years between the time you begin looking for oil and the time you get it out of the ground. You follow one course if you believe, as Exxon says it does, that higher-priced oil is in the offing. You follow another if you believe, as Shell and BP do, that $15-to-$18 oil is likely for the foreseeable future. The result, as Prescott Ball & Turben's Bruce Lazier points out, is that Shell concentrates on increasing market share and Exxon on maximizing profit, with long-term consequences only time will prove.

One thing is clear: The present $15-to-$18 price of oil is high enough to yield the industry reasonable profits, justify the exploration and development needed to assure its future, and low enough to discourage the development of lower-cost substitutes.

The decline of OPEC means that the future of the growing human race is less gloomy that it once looked. ■

How history repeats

For over a century now U.S. oil prices have periodically spiked sharply upward but not for long. Time and again, high oil prices have been brought down by lower-cost discoveries, new technology and interfuel competition. For over 30 years the Texas Railroad Commission succeeded in stabilizing prices at reasonable levels by carefully controlling production. But once OPEC seized control in 1970, it lofted prices so far above market levels that the inexorable operation of the market ultimately brought them down.



FORBES, JUNE 27, 1988

Adapted by permission of FORBES magazine, June 27, 1988

The third oil crisis

The consensus is that the U.S. will fare better in any future oil crisis. That is probably an illusion, though a comforting one.

By James Cook

The word began to leak out a little after 4 o'clock New York time, that afternoon in July 1988. According to reports from Beirut, Iranian terrorists, as part of a concerted attack on oil facilities throughout the Middle East, had blown up a portion of Iraq's vital 1.5-million-barrel-a-day crude oil pipeline through Turkey to the Mediterranean city of Ceyhan. The New York Mercantile Exchange had already closed, but traders professed unconcern. Oil markets had withstood similar crises in recent years with relative equanimity.

At 11 o'clock the following morning, however, an unidentified government source in Cairo reported that Saudi Arabia's Petroline pipeline to the Red Sea port of Yanbu had been blown up in three different locations, cutting around 1.6 million barrels a day of Saudi and Iraqi oil off from their export markets. At noon Saudi Arabia's oil minister, Hesham M. Nazir, confirmed the loss of the kingdom's pipeline export capacity, and claimed that the loss could be made up by shipments through the war-torn Arabian Gulf. But the damage had been done. In less than 24 hours, roughly a third of the Middle East's production had been cut off from its markets.

The third oil crisis had begun.

THE ABOVE, ONE HOPES, will never happen. The talk today is mostly about oil surpluses and weakening world prices. But it could happen. What if there were another oil crisis? After all, the five big Middle East producers—Iran, Iraq, the United Arab Emirates, Kuwait and Saudi Arabia—still provide close to 30% of the Free World's oil. And the Middle East is so volatile nobody can discount the possibility of some sort of political or military flareup at any time.

What if the region did lose a third or more of its export volume?

"Short of a World War III situation, I think we could manage," says Melvin A. Conant, head of Washington, D.C.'s Conant & Associates, Ltd., an energy consulting firm. "We are much better off than we were back in the 1970s," says Don Etchison, director of the Illinois Department of Energy & Natural Resources.

Conant and Etchison reflect the majority view. That view, as investors and business people have learned to their cost, is not always reliable in a world as interconnected as today's, where events happen with a speed inconceivable even a decade ago.

The optimists take comfort from the U.S. Strategic Petroleum Reserve, which holds enough oil to produce the equivalent of half the U.S.' import needs for four months. But the reserve may be like the Maginot Line—an illusory defense. Even counting the reserve, world oil inventories at the end of last year were no higher than in 1979. As governments around the world built their reserves, the oil companies cut inventories correspondingly. And most of the discretionary stocks they still have have probably been hedged, so that title has effectively been transferred to others.

Even worse, there's considerable unease about the U.S.' ability to get the Strategic Petroleum Reserve into production and to deliver its output to the appropriate refineries. "We have been advocating increased and more realistic testing of energy emergency scenarios," says Charles Imbrecht, chairman of the California Energy Commission, "including the simple technological capability of retrieving the SPR oil." According to one Energy Department official, in an emergency the Reserve will be supplying 3 million barrels a day within 30 days, and can do so at that rate for 120 days. What's at question, he says, is the industry's ability to get the crude where it's needed.

"What the Department of Energy is doing is fighting the last war," says Philip K. Verleger Jr., a Washington, D.C.-based commodities expert who writes a monthly petroleum economics analysis for Boston's Charles River Associates. "The world oil market has been commoditized. We're now trading over 100 million barrels of crude a day in the world market, vs. a million or two when the last crisis occurred.

The first thing that's going to happen in a crisis is that these markets are going to move, and move rapidly—much more rapidly than they did in the Seventies, when oil moved at official prices. The liquidity of the futures market will be gone. There'll be plenty of buyers, but no sellers. Prices will rise rapidly. Costs and prices are now tied to the spot market, so that retail prices will go up the full amount of the increase in the spot market. The economic damage could be completely transmitted to the economy long before the first International Energy Agency emergency meeting is held."

Verleger expects the next oil crisis to be much worse than the last. "In a panic," he says, "the shorts will rush to cover in the futures market, others will rush to buy, and margin requirements will suck cash out of other markets the way the stock market did in the October crash. Traders with short positions would have to come up with very large margin payments. Wall Street firms that are the clearing members of the Mercantile Exchange will have to come up with a good deal of capital quickly for their customers, and to get it they would be forced to liquidate other assets and so produce a major drop in stock prices. It's hard to pinpoint, but you could be talking about a need for $5 billion to $10 billion over a very few days."

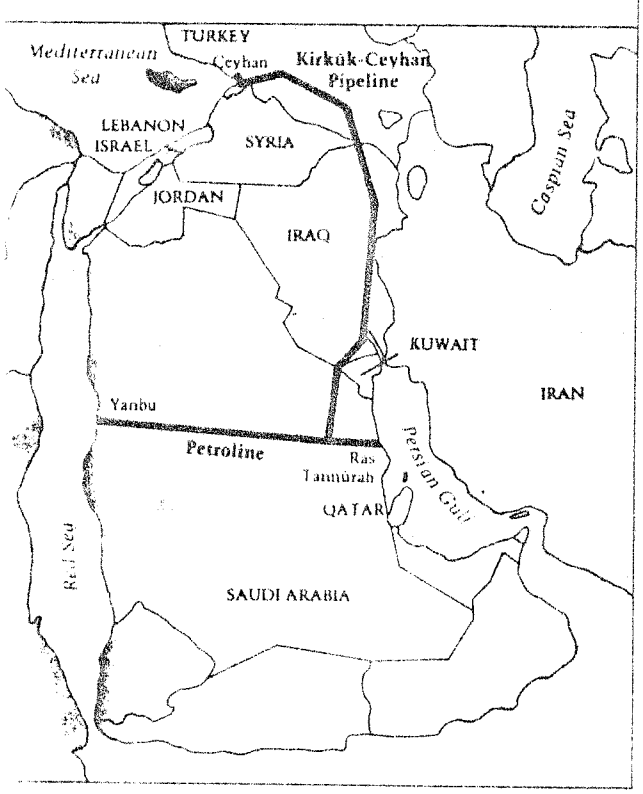
Such concerns might have seemed overdone until the stock market crash two months back demonstrated the speed with which price changes can take place in an electronic market.

In an emergency, stock-building would surge, as it always does with the threat of shortage, buyers would double- and triple-order, consumers would rush to stock up and gas lines would lengthen. "The biggest unknown is psychology," says John Lichtblau, head of New York's authoritative Petroleum Industry Research Foundation, Inc. "The more you hoard, the more the shortage, the more the shortage the more you hoard. And as the price rises, holding inventory becomes attractive, which is what happened in 1979."

Committed to the beneficent workings of the free market, the Administration doesn't expect any of this to happen. As a report from the Department of Energy concluded in March, "Increased reliance on market forces to set prices and to allocate supplies in the event of a disruption should do much to prevent the gasoline lines, regional inequities, and general confusion that prevailed before."

Choke points

Middle East oil moves to market through the Persian Gulf and by pipeline to ports on the Red Sea and Mediterranean. Only 10% of the region's exports go to the U.S., but any disruption in supply would be shared more or less equally around the world.



Other officals disagree. New York State's Energy Commissioner William Cotter replies: "Imagine some guy with seven kids who uses his car to sell ties for a living, and they tell him, 'Don't worry about a shortage, we're just going to let prices rise, and people who can afford to drive will, and those who can't won't.'"

What is worrisome is that given the rapidity of any price runup, there would be little the government could do to control the situation. It'll take three to five days to auction oil from the Strategic Petroleum Reserve, too long to dampen the price, and most private inventories will have been hedged, so that price controls would only bankrupt the traders holding the futures. The Mercantile Exchange could try to slow the price rise by raising margin requirements, requiring liquidation of positions by firms that are long and permitting trading for liquidation only. The exchange could close down, but Verleger believes the producing countries would see that as an attempt to knock down the price and react by cutting production to support prices.

Phil Verleger says: "What you need is a mechanism to flood the market with liquidity the way the Fed did during the stock market crash." He thinks the Energy Department ought to set up a trading department to buy and sell oil, so it would understand the commodities markets and in a crisis be able to sell oil into a market that had no other sellers, providing the liquidity the market needs to function. 'It's got to sell oil and be prepared to pump it out," he says. As a start, the Department of Energy could begin buying oil for the strategic reserve through the commodities markets rather than by auction.

Verleger has little hope that such a solution is possible. Populists in Congress would probably rather put the economy at risk than court the possibility that somebody would make windfall profits on a price runup. It's the same sort of paralysis that prevents solutions of many of the problems the country faces today. A nation that cannot balance its budget even in good times, that insists on living beyond its means, can hardly be expected to behave wisely in the face of something that affects every man the way mushrooming oil prices do. ■

Reprinted by Permission of FORBES magazine, December 14, 1987

Electric Power Research Institute Newsletter

Design Study for Extended Range EV Begins

Engineers have begun designing an electric vehicle (EV) capable of traveling 200 to 400 miles per charge—two to five times the range of EVs now under development.

The extended range electric vehicle (XREV) will come equipped with a small gasoline-powered generator and an electronic controller. This equipment, when operating, will serve to reduce the propulsion battery's discharge rate, permitting occasional journeys beyond the mileage range of the battery alone. The vehicle will rely solely on the battery for shorter routine trips of 50 to 60 miles per charge. The XREV concept can greatly expand the electric vehicle market because the flexibility it offers for travel planning is likely to enhance acceptance of EVs.

The EPRI-sponsored design study will define strategies for delaying battery discharge during travel, select the necessary electronic controls, and choose a commercially available generator that will fit into space available on the electric G-Van currently under development. Later this year, work will begin on prototypes of the new vehicle.

Cofunding for the project comes from Arizona Public Service Company and the Los Angeles Department of Water and Power. Both utilities will participate in prototype testing.

For more information on XREV development, contact

Gary Purcell, Project Manager
EPRI Electric Transportation Program
(415) 855-2168