The Gathering Storm
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The dean of energy analysts sees a difficult future

THE ENERGY CRISIS WE ARE IN today is entirely different from the temporary problems we experienced in 1973-74, 1979-86, 1990-91 and 2000. Then, there were political issues: Some nations were willing and able to produce oil for our use and some were not. There was always sufficient worldwide geological capacity to produce additional barrels of crude oil to meet the world's needs.

No longer. In the next major energy crisis, that capacity will likely be eroded. So the crisis should have a severe impact, be global in scope, and be difficult to solve. Plainly, it will be unprecedented. What may emerge could well be a restructured world, as well as a restructured oil industry.

Over the next 25 years, a new world energy economy will arrive in three waves. We are near the top of the first and smallest one, a warning wave. A second more powerful wave likely will hit in the 2009-2010 period when the non-OPEC world may reach its all-time highest output of crude oil, subsequently declining to become ever more dependent on OPEC for incremental barrels of production. The final wave should break around 2020, or earlier, as even OPEC's vast reserves are tapped at a maximum rate of production. After that, oil volume should head down and keep falling, never to revive.

Then the world's energy companies and governments finally may begin to address new sources of energy to replace oil, and this issue should become the principal economic and political preoccupation for the rest of the century.

An international economic disturbance of this magnitude will create potential conflicts between nations and civil competition within societies. These could be a trial for us and for our children, made worse in the early years by our lack of preparation and our failure to understand what is already happening to us. There could be a good deal of time wasted in recrimination while we seek to pin responsibility on culprits and conspirators and demons: The oil companies, government regulators, Wall Street, the automobile companies, OPEC, the Arabs, gas-guzzling U.S. consumers and so on.

Eventually, we will have to get down to addressing the real issues. They are geological -- the limits on supply -- and they are human -- the tendencies toward greater consumption.

There will be many who claim that the root of the problem is that we are "running out of oil." This is not an accurate way to describe the situation. We are running

out of the ability to produce 2% more barrels each year to meet world demand that increases about 2% annually. The potential loss of the incremental barrels of output in the non-OPEC world as early as 2009-2010 would put the availability of additional barrels -- and power over the price at which the world's consumers might purchase them -- in the hands of five OPEC nations: Saudi Arabia, Iraq, Kuwait, the United Arab Emirates and Iran. (Under some circumstances, Venezuela might be an additional member of the club.)

Depending on their perception of their own political and economic strength, these countries might decide to lift crude prices much faster than the rate of dollar inflation, thus initiating economic and social changes in energy use on a global basis.

For the period 1987 to 2003, the historical range of oil prices was approximately $10 to $40 per barrel, with an average of $20. For 2004 to 2010, the price range could be $30 to $60, with an average of $40. For
2011 to 2020, the range could be $50 to $100, with an average price of $70 per barrel.

Such prices would unleash both destruction and creativity throughout industry and finance. As occurred in the 1970s, the design of cars, trucks, ships, planes and trains would change, commercial buildings and homes would be modified; chemical and industrial processing and most machinery would be redesigned to emphasize fuel economy or substitute fuels; tax systems would be thoroughly overhauled, with changed incentives and penalties. Urban planning and residential patterns would change. Living standards might slip a bit and they would recover in different shape: Cooler rooms in winter and warmer rooms in summer, changing clothes instead of thermostats, taking quicker showers and buying fewer hot tubs, using less lighting, indoors and out, accepting smaller and lighter cars, walking and bicycling more, and using public transportation; these are the obvious changes to come. Europeans, who long ago forced themselves to accept this lifestyle by imposing high energy taxes, might at last receive an economic return on their investment, while the U.S. struggles to change.

Could all this really result from the lack of a few extra barrels of oil in the non-OPEC world, and only five or six years out? Actually, a crisis could develop even earlier if one or two of the main OPEC producers were closed down for an extended period by a political or military emergency.

Close to 40% of global energy consumption is based on petroleum. Currently, we are utilizing about 98% of our world crude oil-producing capacity. The system should be considered stressed at a 95% utilization rate. We are no longer investing enough to lift capacity additions above the level of future demand growth on a consistent basis.

Greater use of natural gas would help, if adequate supplies were available at reasonable cost. However, in North America, the problems of obtaining gas are similar to those of obtaining oil. The U.S.'s natural-gas output appears already to have peaked. Canada can produce a bit more, but not enough to meet its own needs, along with ours, for the next decade. Europe might have an easier situation switching some oil demand over to gas, but new gas supplies would have to be transported long distances by pipeline from Russia, Turkmenistan, Iran, Algeria, and four or five countries of the Arab Middle East or by liquid-natural-gas tanker from Nigeria, Trinidad, or the Gulf. These incremental gas volumes would not come cheaply, quickly or without political risk. Some major gas-production developments are starting up in China and Southeast Asia, but the infrastructure to transport this gas and distribute it to local markets is not yet ready for use, and may require many years before it is. Most critically, gas cannot easily or cheaply take over the role of oil as the major transportation fuel. So, in the next decade, natural gas can only stand in for some oil consumption.

Our ability to substitute more coal for oil is also circumscribed since the technology to burn coal cleanly is still under development, and our vast coal supplies cannot yet be utilized without changing public opinion on the environmental consequences or changing the technology to avoid pollutants. That goes double for nuclear power. Using a lot more of these two fuels in the near term cannot be done in any case, since it would take many years to bring new plants and equipment on line.

If substitution is not immediately available, what about increasing production beyond conventional estimates? Surely, if prices rose a bit, a substantial new supply could be made available to the market? In many commodities, this would be correct. But, not in crude oil. The great Shell Oil geophysicist, M. King Hubbert (1903-1989), outlined the reasons for this in the mid-1950s when he predicted that the peak of U.S. oil production would occur in the early 1970s (and, despite considerable skepticism about his prediction, he was right on target).
His case was that oil explorers, entering a new geological basin searching for petroleum, would always choose the largest and most accessible fields to drill first, because that would maximize their early returns. This selection would delay until later the harder work, at higher unit costs, of finding midsize and smaller fields in the mature years of basin production.

In addition, he observed, as oil reservoirs approached the halfway point of the production levels they were eventually going to yield, daily output would peak and subsequently start down.

Hubbert's two principles do work in practical terms in oil fields. The depletion of recoverable reserves in oil fields whose production levels have gone beyond their halfway point is causing a decline today in the output in certain mature oil-producing areas of the U.S., Canada, the North Sea, Russia, China, Saudi Arabia, Iran, Venezuela and Indonesia, among the major producers. Each year

now, some 4% to 5% of world crude production is depleted, and an equivalent amount must be found, developed and brought onstream to maintain the original production volume. A further 2% must be found, developed and made available to the market to cover global growth needs.

Few people outside the oil industry understand that 6% to 7% more oil must be found and made available to the market each year in order to meet 2% growth in world consumption. It's a huge job; and it is getting harder to do, as the potential reserve size of prospects we are drilling today is smaller, and the large, prolific fields found in the past are advancing along their decline curves. Currently, some 70% of the oil that is consumed comes from fields discovered 25 or more years ago.

Most of the likely oil-bearing basins of the world have now been prospected, and the odds of vast new reserves suddenly making an appearance are low. Of course, relatively large individual discoveries will occasionally turn up in the years ahead, but not in size and number to suggest these finds can equal the substantially greater amount of supplies that are being burned up. Today, the world is consuming some 30 billion barrels a year, and we are finding less than one-third that amount. This is a far cry from the mid-1960s, when the world discovery rate peaked at an annual figure of over 45 billion barrels, and we were using something less than 15 billion barrels each year.

Perhaps new technology can produce more? New equipment and methods do allow us to produce more from present fields, and to exploit some smaller fields at lower cost. However, the last decade brought the greatest application of oil-field technology ever seen, and the angle of the downtrend in the number of barrels discovered each year has hardly changed. Furthermore, no devices are known to be under development now in the oil industry's labs that would dramatically change the basic trend. Technology doesn't seem to be moving fast enough to save us.

Our country's leaders have three main choices: Taking over someone else's oil fields; carrying on until the lights go out and Americans are freezing in the dark; or changing our life style by deep conservation while heavily investing in alternative energy sources at higher costs.

The first two choices can be only temporary palliatives. Taking over foreign energy fields would be against this country's principles, and, like most violations of principle, it wouldn't work. This strategy wouldn't protect us from war, terrorism and the exhaustion of our military and moral resources. Carrying on as we are until we crash looks more like "surrender" than "adjustment."

By elimination, if not by wisdom, we will eventually turn to a massive national and international conservation effort. It should be launched with further development of coal and nuclear energy, along with imported liquid natural gas, tight-sands

gas, coal-bed methane, gas-to-liquids conversion, tar sands and wind power. (Solar and biomass are not yet sufficiently developed to play a leading role.)

Whenever we decide to confront this reality, the resulting program surely will require many years of investing vast amounts of capital. It could, therefore, pre-empt some other lines of investment in economies already strapped for adequate returns to support the promises they have made to their aging societies. Without discipline, mental and physical preparedness and an intelligent selection of priorities conceived early enough to keep us from wavering, we will not pass the oncoming test.

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