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The Price of Petroleum

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The price of crude oil is undoubtedly the most important single indicator of the energy situation, and it can be argued that it is the most important individual commodity price in the world economy. Oil will continue to be the world's major incremental source of primary energy over the next decade. It is the energy source whose output is by far the most sensitive—upward or downward—to changes either in rates of investment or in governmental policies. Its price, along with that of its sister fuel, natural gas, will determine the levels of investment in facilities to produce energy from resources other than oil and gas, and will therefore determine the prices of energy from those sources. Furthermore, the price of crude oil has secondary and tertiary impacts too numerous to mention upon the volume and structure of demand, upon industrial structure, international flows of commodities and capital, and upon general inflation and general economic growth. The following article considers a number of factors affecting that crucial price.

For about three years the oil exporting nations, the international oil companies, and the Administration have been lecturing us that "the era of cheap energy is over." Since the Arab embargo and the consequent tripling of world prices, this slogan has become incorporated into the popular wisdom. Nevertheless, crude oil prices in the vicinity of \$10 per barrel, and investment plans in oil or in competing fuels, based upon the expectation that such prices will hold, should be regarded with deep skepticism.

Something like nine-tenths of the oil produced in the world today comes from giant and super-giant fields (whose ultimate recoverable reserves exceed 1 billion

and 10 billion barrels, respectively) and is lifted at an economic cost (the cost of capital, labor and materials) of less than \$1 per barrel. In very round terms, a barrel of crude oil can be moved from almost any major producing area in the world to any tidewater refinery in the world for less than one additional dollar, and refined at a cost of less than \$1.

These figures put the refinery cost of the vast bulk of the world's gasoline, distillate and heavy oil at less than \$3 per barrel or 8¢ per gallon. Any price in excess of \$3 (whoever may get that excess and whatever it may be called: royalties, lease bonuses, participation, buyback, severance taxes, income taxes, excise taxes, or excess profits), therefore, represents either unearned economic rent or contrived economic waste.

The era of cheap energy may well be over for the consumer, but mankind has by no means discovered, developed or extracted all the hydrocarbon energy that is cheap to produce. More specifically, most of the new supplies of energy which can have a really significant impact on supply over the next decade will in fact be cheap. The most important of these sources will be oil that can be produced at the well for between a dime and a dollar per barrel, or natural gas that can be produced at a similar cost per unit of heating value.

Crude oil from Alaska's Prudhoe Bay field will be laid into the West Coast of the United States at an economic cost of around \$2. I believe that we can expect that field to be joined very soon by other very large (and consequently very low cost) reservoirs in northern Alaska. The landed cost of North Sea crude oil in the U.K. or Norway will be similar. Past experience suggests, and recent bidding patterns indicate that the petroleum industry believes, that the cost of developing, producing and landing oil and gas from offshore

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Louisiana or Texas is typically about \$2.50 per barrel and 30¢ per million Btu, respectively.

The crucial uncertainty about world oil prices concerns just how fast new fields, particularly super-giant fields, are discovered; who controls them as landlord, as sovereign and as operator; and consequently, how fast they are developed. A world oil glut and a collapse of prices within three to five years, as suggested last winter by *The Economist*, is not something I would dare to predict, nor, however, would it be a surprise.

Expanding oil supplies

We are now seeing an unprecedented worldwide oil exploration boom which will mount even higher as present bottlenecks in the supply of drilling rigs, tubular goods and other materials are resolved. The location and character of this exploration effort is particularly favorable to a real expansion of world oil supply. Firstly, exploration is now being concentrated in virgin frontier provinces that are a priori at least as promising as the regions where major discoveries were made in the past. This is true overseas, and as the acreage is made available for lease, our domestic efforts are expected to move increasingly offshore and to Alaska, which are actually *more* promising than earlier exploration frontiers.

Secondly, the new exploration effort is being carried on mainly outside the Persian Gulf and outside the OPEC countries. For this reason, new discoveries are likely to be developed more rapidly and more intensively than Persian Gulf reserves, and will have a collateral effect of weakening the cartel's ability to control production and prices.

Thirdly, the new exploration is being conducted with a technology that is advancing with 20-league boots. In some geological environments, "bright spot" seismic techniques offshore and electrochemical methods on land now *almost* make it possible to ascertain the existence and likely volume of hydrocarbons even without drilling. These developments alone might herald a new wave of major discoveries.

Costs and prices

A radical change in the world supply picture depends upon finding and developing super-giant fields—those with 10 billion or more barrels of recoverable reserves. Such discoveries are, however, comparatively rare events and are, regardless of the present exploration boom and the recent advances in exploration technology, random events. The necessary discoveries to tilt world oil prices sharply down may come about this year or in the next five—or they may not.

The popular wisdom has a corollary to the proposi-

tion that the era of cheap energy is over. That thesis reads as follows: "The oil exporting countries will, at some time in the future, lower their prices sufficiently to compete with whatever alternative fuels the importing nations can themselves produce." In other words, the world price of oil will be determined by the cost of producing clean liquid and gaseous fuels from coal, oil shale and tar sands, and by the cost of electricity from nuclear energy. I have used this formula myself; it is correct, but only as a statement of limits, and only with respect to a time period of 10 years or more. The *price* of natural crude oil with an economic cost of \$2 or less would not, for example, be determined by the incremental cost of synthetic crude oil if \$2 oil were so plentiful as to make synthetic oil superfluous.

Oil and gas resources are, of course, finite. No matter how ingenious or lucky our exploration may be, production of natural hydrocarbons cannot increase indefinitely at rates of 5 to 7% compounded annually. A period will inevitably come during which oil and gas must give way to other energy sources, which may be relatively very costly. The world as a whole has clearly not yet reached this juncture, but it appears that the United States cannot maintain a high level of energy self-sufficiency without increasing reliance upon more expensive alternative fuels.

It is important to understand, however, that for the next decade the cost of synthetic oil and gas or of nuclear power will have no direct influence upon the price of crude oil or the price of energy generally. Notwithstanding the rhetoric of Project Independence, none of the synthetics is likely to contribute as much primary energy as one new giant oil field anywhere in the United States or as one giant gas field located in the lower 48. Even if the technologies for synthetics were proved and their environmental problems resolved (and they are not), the process construction capacity of the free world is simply incapable of adding enough producing capacity in the synthetics to make a real difference within the next decade. Moreover, because of long construction lead times, it is only a slight exaggeration to say that 100% of the nuclear capacity on line in 1984 will be from facilities committed to construction before the announcement of Project Independence.

Counting on coal

I believe there is only one substitute for natural gas and crude oil that will count in the next decade; only one other fuel whose contribution might have a significant impact on the supply of energy and upon its cost to the domestic economy. That substitute is the conversion or reconversion of electric utility boilers to

coal. If the environmental and transportation problems of this conversion can be resolved rapidly, it is conceivable that the maximum cost of low sulfur coal at electrical generating plants might determine the price which either domestic or foreign producers can get for oil. This price would be considerably greater than the laid-in *economic cost* of crude oil, and considerably less than its current world price.

If the price remains as high as \$10 or \$8 (or rises to \$12) over the next few years it will not be because we failed to invest enough in high-cost energy sources, in conversion of coal and oil shale to liquid fuels or gas; in

the discovery and development of smaller oil and gas fields left behind in earlier searches, or in reworking of old oil fields. It will not be because we failed to deregulate natural gas (however desirable that action might be on other grounds). All of those factors together cannot possibly fill the gap between the shortfall of cheap domestic fuel from existing reserves and domestic demand.

If the price stays high, it will mainly be because the world has not found and developed enough oil in new giant and super-giant fields to overwhelm the cartel of producing nations. 