

## An Aside On Some Economics of Drilling for Petroleum Fuels

The news media directed much attention in the 1980s to "windfall profits" made by oil companies. To such accusations the companies reply that the vast sums involved are needed for further exploration.

It is true, given rapid increases in the price of oil in the early 1980s, that companies were selling their oil for far more than it had cost to discover, drill for, and produce. A company selling off its "old" oil and planning no further exploration or drilling could indeed have pocketed a huge return.

On the other hand, the oil companies presumably intend to stay in the oil business as long as there is oil left. What oil remains is becoming more difficult to find and more expensive to drill for. It is widely believed that the "easy oil"-large accumulations located at shallow depths that can be tapped by moderate drilling from land-based drilling rigs-has already been found. The oil now being discovered is buried deeper in the earth. The first U.S. oil well was less than 15 meters deep; the average exploratory well today is nearly 1,800 meters deep, and the deepest gas wells now reach down nearly 10,000 meters (over 30,000 feet). Much of the new oil is being found offshore, but offshore drilling is far more expensive-perhaps fifteen to twenty times as expensive as land-based drilling-and raises concerns about environmental impacts on marine life. A single offshore well now may cost several million dollars to drill. The average cost per well drilled, whether it is a productive well or a dry hole, is close to \$300,000.

Even with the best efforts of geologists and geophysicists directing the drilling, the rate at which wells in new areas find oil and gas is embarrassingly low. For every ten exploratory wells drilled, only about two find oil or gas, and fewer than

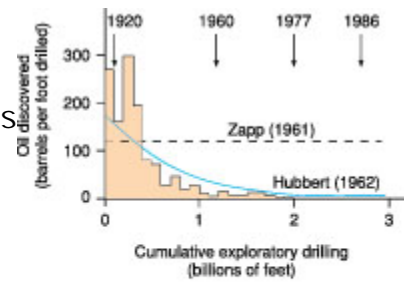


Figure 1 - U.S. oil discoveries, projected and actual.

Source: U.S. Geological Survey Professional paper 1193.

one yields a commercially valuable deposit. Once a new find is made, the oil company must drill multiple wells to produce it.

Geologists have already extensively explored the most geologically promising areas. Further exploration will move into areas long regarded as less likely to be fruitful, previously left unexplored for just that reason. As M. King Hubbert predicted decades ago, the rate of discovery of new oil as a function of drilling activity has declined with time (see figure 1), despite advances in exploration technology and increased understanding of petroleum geology. That, too, means higher cost for new oil.

The supply problem has been compounded recently by a plummeting in the price of oil. It peaked in 1981, slipped about 25 percent over the period 1982-85, and then dropped precipitously, by about half, during 1986. In inflation-adjusted dollars, the average domestic crude-oil price in 1986 was only about one-third what it had been five years before.

With such a drastic decline in revenue from oil sales, companies were forced to curtail sharply their expenditures for exploration. The number of exploratory wells drilled dropped from 17,500 in 1981 to 3,920 in 1991; the success rate also declined, from nearly 30 percent to 23 percent, over the same period. Without exploration, new reserves go unfound and unproven. Despite widespread concern, the long-term effects of the Mideast crisis of 1990-91 were negligible: prices rose about 20 percent in 1990 relative to 1989, but then dropped in 1991 to below 1989 prices (after adjustment for inflation). In the mid-1990s, oil prices, and consequently exploration activities, remain at depressed levels, with obvious implications for oil reserves.

Government policies also can greatly influence the economics of particular fuels. The National Gas Policy Act of 1978 introduced phased-in deregulation of natural gas prices, at least for "new gas" brought into production after 1977 and for expensive-to-produce "deep gas" from wells deeper than 5,000 meters.

Deregulation has made exploration for new natural gas fields much more attractive and, consequently, has spurred considerable activity in that area. As table 13.2 indicates, however, the result has not been a consistent upsurge in natural gas reserves, providing further evidence that economics can do only so much when the basic constraints are those of geologic availability.