

The Future of Crude Oil Production

CHAPTER 1: Overview

Global oil production will probably reach a peak sometime during this decade. After the peak, the world's production of crude oil will fall, never to rise again. The world will not run out of energy, but developing alternative energy sources on a large scale will take at least 10 years. The slowdown in oil production may already be beginning; the current price fluctuations for crude oil and natural gas may be the preamble to a major crisis.

In 1956, the geologist M. King Hubbert predicted that U.S. oil production would peak in the early 1970s.¹ Almost everyone, inside and outside the oil industry, rejected Hubbert's analysis. The controversy raged until 1970, when the U.S. production of crude oil started to fall. Hubbert was right.

Around 1995, several analysts began applying Hubbert's method to world oil production, and most of them estimate that the peak year for world oil will be between 2004 and 2008. These analyses were reported in some of the most widely circulated sources: *Nature*, *Science*, and *Scientific American*.² None of our political leaders seem to be paying attention. If the predictions are correct, there will be enormous effects on the world economy. Even the poorest nations need fuel to run irrigation pumps. The industrialized nations will be bidding against one another for the dwindling oil supply. The good news is that we will put less carbon dioxide into the atmosphere. The bad news is that my pickup truck has a 25-gallon tank.

The experts are making their 2004-8 predictions by building on Hubbert's pioneering work. Hubbert made his 1956 prediction at a meeting of the American Petroleum Institute in San Antonio, where he predicted that U.S. oil production would peak in the early 1970s. He said later that the Shell Oil head office was on the phone right down to the last five minutes before the talk, asking Hubbert to withdraw his prediction. Hubbert had an exceedingly combative personality, and he went through with his announcement.

I went to work in 1958 at the Shell research lab in Houston, where Hubbert was the star of the show. He had extensive scientific accomplishments in addition to his oil prediction. His belligerence during technical arguments gave rise to a saying around the lab, "That Hubbert is a bastard, but at least he's our bastard." Luckily, I got off to a good start with Hubbert; he remained a good friend for the rest of his life.

Critics had many different reasons for rejecting Hubbert's oil prediction. Some were simply emotional; the oil business was highly profitable, and many people did not want to hear that the party would soon be over. A deeper reason was that many false prophets had appeared before. From 1900 onward, several of these people had divided the then known U.S. oil reserves by the annual rate of production. (Barrels of reserves divided by barrels per year gives an answer in years.) The typical answer was 10 years. Each of these forecasters started screaming that the U.S. petroleum industry would die in 10 years. They cried "wolf."

During each ensuing 10 years, more oil reserves were added, and the industry actually grew instead of drying up. In 1956, many critics thought that Hubbert was yet another false prophet. Up through 1970, those who were following the story divided into pro-Hubbert and anti-Hubbert factions. One pro-Hubbert publication had the wonderful title "This Time the Wolf Really Is at the Door."

Hubbert's 1956 analysis tried out two different educated guesses for the amount of U.S. oil that would eventually be discovered and produced by conventional means: 150 billion and 200 billion barrels. He then made plausible estimates of future oil production rates for each of the two guesses. Even the more optimistic estimate, 200 billion barrels, led to a predicted peak of U.S. oil production in the early 1970s. The actual peak year turned out to be 1970.

Today, we can do something similar for world oil production. One educated guess of ultimate world recovery, 1.8 trillion barrels, comes from a 1997 country-by-country evaluation by Colin J. Campbell, an independent oil-industry consultant.⁴ In 1982, Hubbert's last published paper contained a world estimate of 2.1 trillion barrels.⁵ Hubbert's 1956 method leads to a peak year of 2001 for the 1.8-trillion-barrel estimate and a peak year of 2003 or 2004 for 2.1 trillion barrels. The prediction based on 1.8 trillion barrels makes a better match to the most recent 10 years of world production.

In 1962, I became concerned that the U.S. oil business might not be healthy by the time I was scheduled to retire. I was in no mood to move to Libya. My reaction was to get a photocopy of Hubbert's raw numbers; I made my own analysis using different mathematics. In my analysis, and in Hubbert's, the domestic oil industry would be down to

half its peak size by 1998. Fortunately, universities were expanding rapidly in the post-Sputnik era, and I had no trouble moving into academe.

Hubbert's prediction was fully confirmed in the spring of 1971. The announcement was made publicly, but it was almost an encoded message. The San Francisco Chronicle contained this one-sentence item: "The Texas Railroad Commission announced a 100 percent allowable for next month." I went home and said, "Old Hubbert was right." It still strikes me as odd that understanding the newspaper item required knowing that the Texas Railroad Commission, many years earlier, had been assigned the task of matching oil production to demand. In essence, it was a government-sanctioned cartel. Texas oil production so dominated the industry that regulating each Texas oil well to a percentage of its capacity was enough to maintain oil prices. The Organization of Petroleum Exporting Countries (OPEC) was modeled after the Texas Railroad Commission. Just substitute Saudi Arabia for Texas.

With Texas, and every other state, producing at full capacity from 1971 onward, the United States had no way to increase production in an emergency. During the first Middle East oil crisis in 1967, it was possible to open up the valves in Ward and Winkler Counties in west Texas and partially make up for lost imports. Since 1971, we have been dependent on OPEC.

After his prediction was confirmed, Hubbert became something of a folk hero for conservationists. In contrast to the hundreds of millions of years it took for the world's oil endowment to accumulate, most of the oil is being produced in 100 years. The short bump of oil exploitation on the geologic time line became known as "Hubbert's peak." In chapter 7, I explain how Hubbert used oil production and oil reserves to predict the future. We scientists don't like to admit it, but we often guess at the answer and then gather up some numbers to support the guess. A certain level of honesty is required; if the numbers do not justify my guess, I don't fake the numbers. I generate another guess. Hubbert's oil prediction was just barely within the envelope of acceptable scientific methods. It was as much an inspired guess as it was hard-core science.

This cautionary note is needed here: in the late 1980s there were huge and abrupt increases in the announced oil reserves for several OPEC nations.⁷ Oil reserves are a vital ingredient in Hubbert's analysis. Earlier, each OPEC nation was assigned a share of the oil market based on the country's annual production capacity. OPEC changed the rule in the 1980s to consider also the oil reserves of each country. Most OPEC countries promptly increased their reserve estimates. These increases are not necessarily wrong; they are not necessarily fraudulent. "Reserves" exist in the eye of the beholder.

Oil reserves are defined as future production, using existing technology, from wells that have already been drilled (not to be confused with the U.S. "strategic petroleum reserve," which is a storage facility for oil that has already been produced). Typically, young petroleum engineers unconsciously tend to underestimate reserves. It's a lot more fun to go into the boss's office next year and announce that there is actually a little more oil than last year's estimate. Engineers who have to downsize their previous reserve estimates are the first to leave in the next corporate downsizing.

The abrupt increase in announced OPEC reserves in the late 1980s was probably a mixture of updating old underestimates and some wishful thinking. A Hubbert prediction requires inserting some hard, cold reserve numbers into the calculation. The warm fuzzy numbers from OPEC probably give an overly optimistic view of future oil production. So who is supposed to know?

A firm in Geneva, Switzerland, called Petroconsultants, maintained a huge private database. One long-standing rumor said that the U.S. Central Intelligence Agency was Petroconsultants' largest client. I would hope that between them, the CIA and Petroconsultants had inside information on the real OPEC reserves. This much is known: the loudest warnings about the predicted peak of world oil production came from Petroconsultants.⁸ My guess is that they were using data not available to the rest of us.

A permanent and irreversible decline in world oil production would have both economic and psychological effects. So who is paying attention? The news media tell us that the recent increases in energy prices are caused by an assortment of regulations, taxes, and distribution problems. During the election campaign of 2000, none of the presidential candidates told us that the sky was about to fall. The public attention to the predicted oil shortfall is essentially zero.

In private, the OPEC oil ministers probably know about the articles in *Science*, *Nature*, and *Scientific American*. Detailed articles, with contrasting opinions, have been published frequently in the *Oil and Gas Journal*.⁹ Crude oil prices have doubled in the past year. I suspect that OPEC knows that a global oil shortage may be only a few years

away. The OPEC countries can trickle out just enough oil to keep the world economies functioning until that glorious day when they can market their remaining oil at mind-boggling prices.

It is not clear whether the major oil companies are facing up to the problem. Most of them display a business-as-usual facade. My limited attempts at spying turned up nothing useful. A company taking the 2004-8 hypothesis seriously would be willing to pay top dollar for existing oil fields. There does not seem to be an orgy of reserve acquisitions in progress.

Internally, the oil industry has an unusual psychology. Exploring for oil is an inherently discouraging activity. Nine out of 10 exploration wells are dry holes. Only one in a hundred exploration wells discovers an important oil field. Darwinian selection is involved: only the incurable optimists stay. They tell each other stories about a Texas county that started with 30 dry holes yet the next well was a major discovery. "Never is heard a discouraging word." A permanent drop in world oil production beginning in this decade is definitely a discouraging word.