A
fter World War I, the United States was shaken by predictions of the exhaustion of domestic oil. Even the head of the U.S. Geological Survey (USGS)—among many others—delivered a verdict of gloom in 1918: The country would run out of oil within 9 years! (1) Facing mounting hysteria, President Coolidge set up the Federal Oil Conservation Board in 1924, to draft legislation to preserve national resources. After the conversion of Great Britain’s naval fleet from coal to oil in 1914, the UK also feared that it would be vulnerable to oil shortages and moved to secure its grip on the Persian Gulf. These cycles of hysteria followed by new bonanzas have continued to the present. Thus, it is not surprising that a new wave of “oil doomsisters” predicting imminent petroleum scarcity has gained momentum (2–4).

The worst effect of this recurring oil panic is that it has driven Western political circles toward oil imperialism and attempts to assert direct or indirect control over oil-producing regions. Yet the world is not the product of a static model that puts an unjustifiable faith in geology and does not consider technology and cost/price functions. The model’s success in predicting U.S. peak production merely reflected the peculiar nature of this area, which is the most intensively explored and exploited in the world. Elsewhere, the pattern of production does not follow a normal distribution and assumes a bell-shaped curve (see figure above).

Starting from zero, production grows over time until it peaks when half of the recoverable resources have been extracted (“midpoint depletion”). Then, production irreversibly declines at the same rate at which it grew. The area under the curve shows the cumulative production of an oil field or the “ultimate recoverable resources” (URR) it holds and their life-span. Accordingly, to forecast Earth’s URR, one needs to process worldwide production and discovery trends and geological data. In 1956, Hubbert accurately predicted the peak oil production point of the U.S. lower 48 states.

The Hubbert curves do not delineate the complex and dynamic nature of oil production and reserves in the world, because they are the product of a static model that puts an unjustifiable faith in geology and does not consider technology and cost/price functions. The model’s success in predicting U.S. peak production merely reflected the peculiar nature of this area, which is the most intensively explored and exploited in the world. Elsewhere, the pattern of production is not rendered by a bell curve but is marked by large discontinuities (see figure on next page).

Using different versions of the Hubbert model, several geologists have made predictions in the last 20 years of an imminent crisis in oil availability that subsequently had to be revised. The most eminent among them is C. Campbell, who predicted that 1989 was the year of “peak” production (6). The estimates have been increasing steadily (see table, next page).

Before looking at the real-world situation in more depth, it is necessary to clear up some points, beginning with the distinction between “resource” and “reserve.” The former indicates the overall stock of a mineral in physical terms, without any associated economic value and/or estimation of its likelihood of being extracted. In other words, there may be large quantities that can never be used because of the high cost or the impossibility of recovery, as in the case of the gold dispersed in the oceans. The concept of “reserves”—like that of “recoverable resources”—involves an economic assessment of the possibility of producing a part of the overall resources. In the oil sector, there are additional definitions—the most important being that of “proven reserves,” which include only those that can be economically produced and marketed at the present time according to existing technologies and demand. Nearly all of the estimates of the world’s oil URR, including those by oil doomsisters, do not take into account the so-called “nonconventional oils”—such as Canadian tar-sands and Venezuelan and Russian heavy oils—even though the availability of these resources is huge and the costs of extraction falling.

Although hydrocarbon resources are irrefutably finite, no one knows just how finite. Oil is trapped in porous subsurface rocks, which makes it difficult to estimate how much oil there is and how much can be effectively extracted. Some areas are still relatively unexplored or have been poorly analyzed. Moreover, knowledge of in-ground oil resources increases dramatically as an oil reservoir is exploited.

For example, the Kern River field was discovered in California in 1899. Calculations in 1942 suggested that 54 million barrels remained. However, in 1942 “…after [43] years of depletion, ‘remaining’ reserves were 54 million barrels. But in the next [44] years, it produced not 54 but 736 million barrels, and it had another 970 million barrels ‘remaining’ in
1986. The field had not changed, but knowledge had...” (7). This is but one of hundreds of cases reported in oil-related literature that underscore the inherently dynamic nature of oil reserves. As Klett and Schmoker have recently demonstrated, from 1981 to 1996 the estimated volume of oil in 186 well-known giant fields in the world [>0.5 billion (10⁹) barrels (Bbl) of oil, discovered before 1981] increased from 617 to 777 Bbl without new discoveries (8). Indeed, many studies have proved the phenomenon of “reserve growth”—i.e., that “additions to proven recoverable volumes are usually greater than subtractions” (8). This occurs because of four fundamental elements: technology, price, political decisions, and better knowledge of existing fields—the last of these being possible only through effective and intensive drilling.

We anticipate that this trend will continue. Consider, for example, the most recently discovered oil frontier in the world, Kazakhstan, and its major finding—the gigantic Kashagan field. Geological estimates about the general area around Kashagan (the Kazakh North Caspian Sea Shelf) have existed for decades, but they only indicated the possibility of hydrocarbon deposits. After the first advanced geological appraisal was conducted by international oil companies in the second half of the 1990s, the area was deemed to hold between 2 and 4 Bbl. In 2002, after completion of only two exploration and two appraisal wells in the Kashagan field, estimates were officially raised to 7 to 9 Bbl of producible reserves. In February 2004, after four more exploration wells in the area, they were raised again to 13 Bbl. This is only the beginning, because this area spans over 5500 sq km, and six exploration wells are a modest indicator of future potential. Moreover, there are many other oil fields yet to be explored in this area (including Kairan, Aktote, and Kalamkas), that have a geological structure similar to that of Kashagan.

Thanks to new exploration, drilling, and recovery technology, the worldwide finding and development cost per barrel of oil equivalent (boe) has dramatically declined over the last 20 years, from an average of about $21 in 1979–81 to under $6 in 1997–99 (in 2001 dollars) (9). At the same time, the recovery rate from world oil fields has increased from about 22% in 1980 to 35% today. All these factors partly explain why the life-index of world reserves (gauged as the ratio between proven oil reserves and current production) has constantly improved, passing from 20 years in 1948 to 35 years in 1972 and reaching about 40 years in 2003. Today, all major sources estimate that proven world oil reserves exceed 1 trillion (10¹²) barrels, while yearly consumption is about 28 billion barrels (10–13). Overall, the world retains more than 3 trillion barrels of recoverable oil resources (14).

Critics could note that new oil discoveries are only replacing one-fourth of what the world consumes every year (following a declining trend that began in the mid-1960s), and that increases in reserves largely derive from upward revisions of existing stock. However, the real issue is that neither major producing countries nor publicly traded oil companies are keen to invest money in substantial exploration campaigns. The countries richest in oil have minimized their oil investments during the last 20 years, mainly for fear of creating a permanent excess capacity such as that which provoked the crisis in 1986 (when oil prices plummeted to below $10/bbl). In fact, countries such as Saudi Arabia or Iraq (which together hold about 35% of the world’s proven reserves of oil) produce petroleum only from a few old fields, although they have discovered but not developed more than 50 new fields each. Moreover, in countries closed to foreign investments, the technologies and techniques used are, in most cases, obsolete.

Nevertheless, international public oil companies have faced two sets of limits to their expansion in the last 20 years. The first is inaccessibility to foreign investment in the largest and cheapest reserves—those in the Persian Gulf. Second are the demands of financial markets, which for years have insisted that companies provide unrealistic, short-term financial returns that are inconsistent with the long-term nature of oil investments. This has compelled private operators to reject opportunities that would normally be deemed economically worthwhile. This financial pressure partly explains recent proven reserve downgrading by some oil companies, starting with the amazing cuts announced by the “supergiant” Shell Group (15). Indeed, this Anglo-Dutch oil company has not lost its resources. This picture has nothing to do with physical scarcity of oil.

The Age of Coal began when declining supplies of wood in Great Britain caused its price to climb. Two centuries later, oil took the place of coal as “the king of energy sources” because of its convenience and its high flexibility in many applications, but coal was neither exhausted nor scarce. Oil substitution is simply a matter of cost and public needs, not of scarcity. To “cry wolf” over the availability of oil has the sole effect of perpetuating a misguided obsession with oil security and control that is already rooted in Western public opinion—an obsession that historically has invariably led to bad political decisions.

References and Notes

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