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## There Will Be Oil

*For decades, advocates of 'peak oil' have been predicting a crisis in energy supplies. They've been wrong at every turn, says Daniel Yergin.*

By DANIEL YERGIN

Since the beginning of the 21st century, a fear has come to pervade the prospects for oil, fueling anxieties about the stability of global energy supplies. It has been stoked by rising prices and growing demand, especially as the people of China and other emerging economies have taken to the road.



Getty Images

This is actually the fifth time in modern history that we've seen widespread fear that the world was running out of oil.



Pulitzer Prize-winning author Dan Yergin says the global supply of oil and gas has risen in the last 20 years, defying the predictions of "peak oil" theorists. In the Big Interview with WSJ's David Wessel, he looks at

This specter goes by the name of "peak oil."

Its advocates argue that the world is fast approaching (or has already reached) a point of maximum oil output. They warn that "an unprecedented crisis is just over the horizon." The result, it is said, will be "chaos," to say nothing of "war, starvation, economic recession, possibly even the extinction of homo sapiens."

The date of the predicted peak has moved over the years. It was once supposed to arrive by Thanksgiving 2005. Then the "unbridgeable supply demand gap" was expected "after 2007." Then it was to arrive in 2011. Now "there is a significant risk of a peak before 2020."

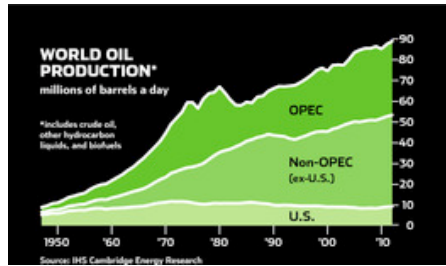
But there is another way to visualize the future availability of oil: as a "plateau."

In this view, the world has decades of further growth in production before flattening out into a plateau—perhaps sometime around midcentury—at which time a more gradual decline will begin. And that decline may well come not from a scarcity of resources but from greater efficiency, which will slacken global demand.

Those sounding the alarm over oil argue that about half the world's oil resources already have been produced and that the point of decline is nearing. "It's quite a simple theory and one that any beer-drinker understands," said the geologist Colin Campbell, one of the leaders of the movement. "The glass starts full and ends empty, and the faster you drink it, the quicker it's gone."

This is actually the fifth time in modern history that we've seen widespread fear that the world was running out of oil. The first was in the 1880s, when production was concentrated in Pennsylvania and it was said that no oil would be found west of

the world's energy future.



peak oil maintains its powerful grip.

The idea owes its inspiration, and indeed its articulation, to a geologist who, though long since passed from the scene, continues to shape the debate, M. King Hubbert. Indeed, his name is inextricably linked to that perspective—immortalized in "Hubbert's Peak."



Agence France-Presse/Getty Images

Workmen on the Pemex Ku-S oil-processing center in the Gulf of Mexico.

the Mississippi. Then oil was found in Texas and Oklahoma. Similar fears emerged after the two world wars. And in the 1970s, it was said that the world was going to fall off the "oil mountain." But since 1978, world oil output has increased by 30%.

Just in the years 2007 to 2009, for every barrel of oil produced in the world, 1.6 barrels of new reserves were added. And other developments—from more efficient cars and advances in batteries, to shale gas and wind power—have provided reasons for greater confidence in our energy resiliency. Yet the fear of

Marion King Hubbert was one of the most eminent—and controversial—earth scientists of his time. Born on a ranch in San Saba, Texas in 1903, he did his university education, including his Ph.D., at the University of Chicago. One of his fundamental objectives was to move geology from what he called its "natural history phase" into its "physical science phase," firmly based in physics, chemistry and, in particular, rigorous mathematics.

In the 1930s, while teaching at Columbia University, Hubbert became active in a movement called Technocracy and served as its educational director. Holding politicians and economists responsible for the debacle of the Great Depression, Technocracy promoted the idea that democracy was a sham and that scientists and engineers should take over the reins of government and impose rationality on the economy. "I had a boxseat at the Depression," Hubbert later said. "We had manpower and raw materials. Yet we shut the country down."

Technocracy envisioned a no-growth society and the elimination of the price system, to be replaced by the wise administration of the Technocrats. Hubbert believed that a "pecuniary" system, guided by the "hieroglyphics" of economists, was the road to ruin.

In the late 1940s, Hubbert heard another geologist say that 500 years of oil supply remained in the ground. This couldn't possibly be true, he thought. He started doing his own analysis. In 1956, he unveiled the theory that would forever be linked to his name. He declared that U.S. oil production would hit its peak somewhere between 1965 and 1970.

### **1 trillion**

Number of barrels of oil produced since the start of the industry

### **1.4 trillion**

Estimated number of barrels currently considered technically and economically accessible—out of 5 trillion total barrels of petroleum resources in the ground

### **30%**

Increase in annual world oil production since 1978

**Source: The Quest**

His prediction was controversial, but when U.S. oil production hit its high point in 1970 and began to decline, soon followed by the shock of the 1973 embargo, Hubbert appeared more than vindicated. He was a prophet. He became famous—and so did Hubbert's Peak.

For many decades, the U.S. had been, by far, the world's largest oil producer. All through the 1960s, domestic production had supplied 90% of demand. No longer. To meet its own growing needs, the U.S. became a major importer, deeply enmeshed in the world oil market and a new set of geopolitical concerns.

Hubbert was very pessimistic about future supply. He warned that the era of oil would be only a brief blip in mankind's history. In 1978, he predicted that children born in 1965 would see all of the world's oil used up in their lifetimes. Humanity, he said, was about to embark upon "a period of non-growth."

Hubbert used a statistical approach to project the kind of decline curve that one might encounter in some—but not all—oil fields, and he assumed that the U.S. was one giant oil field. His followers have adopted the same approach to assess global supplies.

Hubbert's original projection for U.S. production was bold and, at least superficially, accurate. His modern-day adherents insist that U.S. output has "continued to follow Hubbert's curve with only minor deviations."

But it all comes down to how one defines "minor." Hubbert got the date exactly right, but his projection on supply was far off. He greatly underestimated the amount of oil that would be found—and produced—in the U.S.

By 2010, U.S. oil production was 3½ times higher than Hubbert had estimated: 5.5 million barrels per day versus Hubbert's 1971 estimate of no more than 1.5 million barrels per day. Hardly a "minor deviation."

### A History Of Black Gold: Boom and Panic

1859



Corbis

"Colonel" Edwin Drake (foreground, right)

The modern oil industry was born when "Colonel" Edwin Drake struck oil near the small timber town of Titusville in northwest Pennsylvania. Other production centers arose during this era in the Russian Empire and around Baku, on the Caspian Sea. But Pennsylvania was the Saudi Arabia of its day.

1918



Getty Images

World War I was the first mechanized war, complete with tanks and airplanes.

World War I was the first mechanized war, complete with tanks and airplanes. As oil went to Europe to ensure the mobility of Allied forces, 1918 saw the highest gasoline prices (adjusted for inflation) ever recorded in the U.S. "Gasolineless Sundays" were instituted to encourage people to drive less.

"Hubbert was imaginative and innovative," recalled Peter Rose, who was Hubbert's boss at the U.S. Geological Survey. But he had "no concept of technological change, economics or how new resource plays evolve. It was a very static view of the world." Hubbert also assumed that there could be an accurate estimate of ultimately recoverable resources, when in fact it is a constantly moving target.

Hubbert insisted that price didn't matter. Economics—the forces of supply and demand—were, he maintained, irrelevant to the finite physical cache of oil in the earth. But why would price—with all the messages that it sends to people about allocating resources and developing new technologies—apply in so many other realms but not in oil and gas production? Activity goes up when prices go up; activity goes down when prices go down. Higher prices stimulate innovation and encourage people to figure out ingenious new ways to increase supply.

The idea of "proved reserves" of oil isn't just a physical concept, accounting for a fixed amount in the "storehouse." It's also an economic concept: how much can be recovered at prevailing prices. And it's a technological concept, because advances in technology take resources that were not physically accessible and turn them into recoverable reserves.

In the oil and gas industry, technologies are constantly being developed to find new resources and to produce more—and more efficiently—from existing fields. In a typical oil field, only about 35% to 40% of the oil in place is produced using traditional methods.

One example is the "digital oil field," which uses sensors throughout the field to improve the data and communication between the field and a company's technology centers. If widely adopted, it could help to recover an enormous amount of additional oil worldwide—by one estimate, an extra 125 billion barrels, almost equivalent to the current estimate reserves of Iraq.

New technologies and approaches continue to unlock new resources. Ghana is on its way to significant oil production, and just a few days ago, a major new discovery was announced off

1973



Associated Press

Dade County, Fla., motorists form a long line at a gas station in Miami in 1973.

In October 1973, Arab countries launched an attack on Israel, initiating the Yom Kippur War. In response to U.S. resupply of armaments to Israel, Arab exporters embargoed oil shipments. Within months, petroleum prices quadrupled. Fear of a permanent shortage spurred oil development in Alaska and the North Sea.

the coast of French Guiana, north of Brazil.

As proof for peak oil, its advocates argue that the discovery rate for new oil fields is declining. But this obscures a crucial point: Most of the world's supply is the result not of discoveries but of additions and extensions in existing fields.

When a field is first discovered, little is known about it, and initial estimates are conservative. As the field is developed, more wells are drilled, and with better knowledge, proven reserves very often increase substantially. A study by the U.S. Geological Survey found that 86 percent of oil reserves in the U.S. were the result not of what was estimated at the time of discovery but of revisions and additions from further development.

Estimates for the total global stock of oil keep growing. The world has produced about one trillion barrels of oil since the start of the industry in the 19th century. Currently, it is thought that there are at least five trillion barrels of petroleum resources in the ground, of which 1.4 trillion are deemed technically and economically accessible enough to count as reserves (proved and probable).

Based on current and prospective plans, it appears that the world's production capacity for "oil and related liquids" (in industry jargon) should grow from about 92 million barrels per day in 2010 to over 110 million by 2030. That is an increase of about 20%.

But this is no done deal. There are many "buts," having to do with what happens above ground. The policies of governments around the world—especially concerning taxes and access to resources—have a major impact on whether and when oil is discovered and developed.

Wars and civil wars, social turmoil and political upheavals, regional conflict, corruption and crime, mismanagement of resources—all of these can affect not only current production but also investment and future prospects. Environmental and climate policies can alter the timing and scale of development, as can geopolitics and politics within oil-producing countries.

In short, in a world whose \$65 trillion economy depends greatly on oil, energy security will be a lasting and critical preoccupation.

Meeting future demand will require innovation, investment and the development of more challenging resources. A major reason for continuing growth in petroleum supplies is that oil previously regarded as inaccessible or uneconomical is now part of the mix, such as the "presalt" resources off the coast of Brazil, the vast oil sands of Canada, and the oil locked in shale and other rocks in the U.S.

In 2003, the Bakken formation in North Dakota was producing a mere 10,000 barrels a day. Today, it is over 400,000 barrels, and North Dakota has become the fourth-largest oil-producing state in the country. Such "tight" oil could add as much as two million barrels a day to U.S. oil production after 2020—something that would not have been in any forecast five years ago.

Overall U.S. oil production has increased more than 10% since 2008. Net oil imports reached a high point of 60% in 2005, but today, thanks to increased production and greater energy efficiency (plus the use of ethanol), imports are down to 47%.

Things don't stand still in the energy industry. With the passage of time, unconventional sources of oil, in all their variety, become a familiar part of the world's petroleum supply. They help to explain why the plateau continues to recede into the horizon—and why, on a global view, Hubbert's Peak is still not in sight.

—Mr. Yergin is chairman of IHS Cambridge Energy Research Associates, an energy research and consulting firm. This essay is adapted from his new book, "The Quest: Energy, Security and the Remaking of the Modern World." He received the Pulitzer Prize for his book "The Prize: The Epic Quest for Oil, Money and Power."

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## [There Will Be Peak Oil](#)

In his book *The Prize*, Daniel Yergin showed how elegantly he can describe oil's history. In his article in the WSJ, "[There will be Oil](#)", Yergin has shown once again that he is a master of this discipline and this time he concentrates on M. King Hubbert and that scientist's world famous Hubbert peak. Yergin aired elements of Hubbert's history that are irrelevant to Peak Oil and so gave the impression that his aim was to discredit Hubbert's character rather than to discuss Hubbert's science and the facts behind Peak Oil. Hubbert's amazing achievement cannot be disputed – that using his simple Hubbert model and the limited information available in 1956, he was able to define limits on future U.S. oil production and predict the year of peak U.S. oil production as 1971. That Hubbert's prediction of a mid-1990s peak in global oil production proved incorrect was mainly related to the fact that the oil-producing countries in the Middle East closed their taps in the 1970s. ([In fact, in a 1976 TV interview, Hubbert stated that the political curtailment of Middle East oil production could delay Peak Oil until the early years of this century.](#)) Prior to the oil crises of the 1970s, the world's oil production could be described as one large system in which production increased by 7 percent per year. Hubbert based his prediction on this simple behavior. After the 1970s other methods than a simple Hubbert model are needed to describe reality. We are currently engaged in academic research on Peak Oil and today we have progressed much further than Hubbert in terms of models that describe future production. Thus it is quite clear that Daniel Yergin does not read peer reviewed academic publications. For example, we have demonstrated that an oilfield typically reaches peak production when 40 percent of its oil has been produced and that its production after that, including through the use of the new technologies that Yergin discusses, can be described as Tail End production. This means that new oilfields constantly need to be brought online to maintain, (let alone boost), global production. Indeed, Yergin contradicted his own "There Will Be Oil" mantra by stating that discovery of new fields will be lower in future. With detailed knowledge of the world's oil production one can actually show that part of Yergin's discussion supports the fact that we are living in the era of Peak Oil.

In the spring of 2002 ASPO, the Association for the Study of Peak Oil & Gas, organized the world's first International Peak Oil Conference in Uppsala, Sweden. In the press release from the conference we described how global total production of oil (crude oil, oil from oil sands and "natural gas liquids") would reach peak production in 2010 at 85 million barrels a day. This number does not include "processing gains" which is the volume increase that occurs as crude oil passes through a refinery, receives additives and is "cracked" into lighter molecules.

When Yergin discusses oil production he not describing actual production but rather the

production volume that the oil companies consider maximally possible. Using these numbers is a clever way to lull readers into a false sense of security but the numbers are almost impossible to confirm. Actual oil production in 2010 was 82.1 Mb/d (according to the BP Statistical Review of World Energy) but Yergin gives the number 92 Mb/d and that means that he believes that the spare capacity is 10 Mb/d. Thus, the fact that Yergin describes production for 2030 at 110 Mb/d means that, in reality, actual production can be much lower.

The fact that the oil production in 2010 is 82.1 Mb/d means that the production profile that ASPO described in 2002 and that was also published by K. Aleklett and C. Campbell in the journal *Minerals and Energy* in 2003, was too optimistic. One essential condition that we assumed for a production level of 85 Mb/d in 2010 was that production from Iraq's giant oilfields would increase. This increase has not materialized. When the oil industry attained a production level of 81 Mb/d in 2004 it could not increase global production further. During the six years from 1999 to 2004, world oil production increased by 9.1 Mb/d, but in the following 6 years from 2005 to 2010 it remained constant at an average of 81.5 Mb/d. Production in 2008 was above this average but in 2009 it fell below it and in 2010 it was 82.1 Mb/d. The fact that oil production is now finally starting to increase in Iraq will probably prolong this world oil production plateau for some years.

The picture of future oil production that Yergin paints is the same as his company CERA presented in February 2007 in the *Journal of Petroleum Technology (JPT)*. In a response in the same journal we were able to show just how unrealistic CERA's future scenario was. The amount of oil needed for that future is not only the 125 billion barrels Yergin cites as growth in existing oilfields around the world, but something far larger entirely. In the upcoming book *Peeking at Peak Oil* we discuss how the future total volume produced from existing fields can be as high as 500 Gb, but that even that volume will not prevent Peak Oil. The world today consumes 30 Gb a year, and Yergin's 125 GB amounts to 4 years and 2 months of consumption. However, the time it will take to get that additional 125 Gb out of the ground is more than 10 years and probably as much as 20 years.

When Daniel Yergin discusses oil reserves, he is describing what the industry calls 1P reserves (proven reserves). The real reserves that oil companies have are 2P reserves (proven and probable), but they are not permitted to book these reserves as their official reserves if they wish to be listed on the New York Stock Exchange. By declaring only their 1P reserves it is possible to create an artificial appearance of future reserve security when, in fact, statistics show that the world has already passed the moment of peak 2P reserves. The false image of the future that Daniel Yergin described in his *WSJ* opinion piece can be compared to trying to steer a supertanker on a journey by only looking in the rearview mirror. Mr Yergin is continuing to propagate the opinion that we need have no great concern for oil supplies over the next 50 years but by doing this he is reducing the ability of the American people to undertake the change necessary for the wellbeing of their children and grandchildren. With Daniel Yergin as first mate to the country's captain, we will very soon run aground.

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Author of the forthcoming book *Peeking at Peak Oil*

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