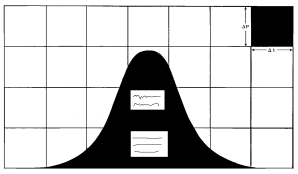
H.C. DEDICATION NEWSLETTER



The M. KING HUBBERT CENTER FOR PETROLEUM SUPPLY STUDIES
located in the Department of Petroleum Engineering
Colorado School of Mines
Golden, Colorado

The Hubbert Center has been established as a non-profit organization for the purpose of assembling and studying data concerning global petroleum supplies and disseminating such information to the public. The views expressed by the Center Coordinator and by authors of Center publications are their own, and do not reflect the opinions of Colorado School of Mines, its faculty, its staff, or its Department of Petroleum Engineering.

The question of WHEN worldwide oil demand will exceed global oil supply is stubbornly ignored. The world's oil problems, timing and ramifications can be debated and realistic plans made only if the question is publicly addressed. A growing number of informed US and European evaluations put this crisis as close as the years 2000 - 2014. The formation of this center is to encourage a multi-field research approach to this subject.

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Notes:
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The Hubbert Center will archive work files of recognized experts in this field.
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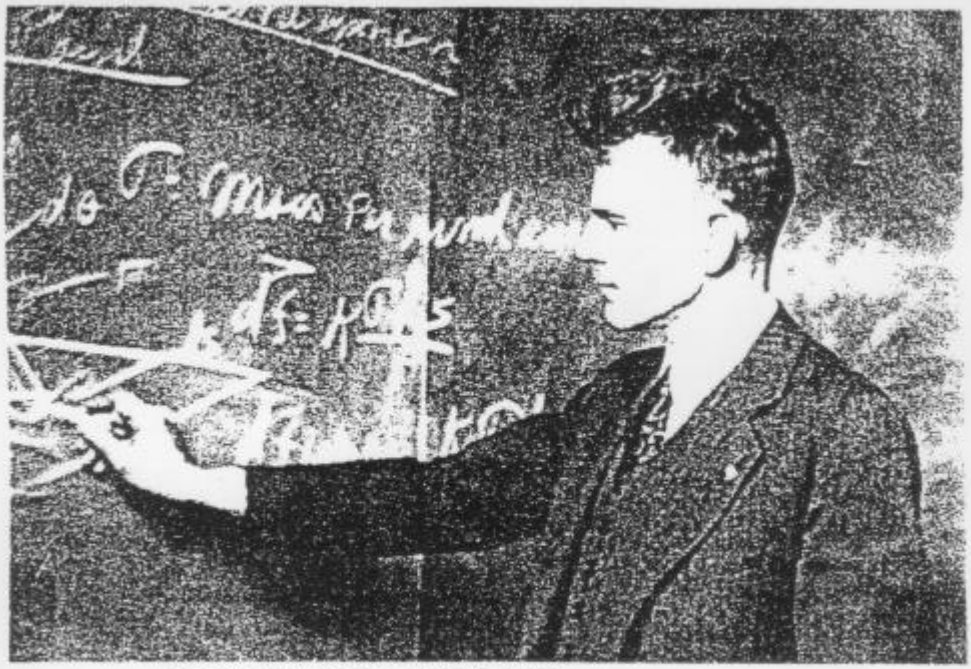
Oct. 8, 1996



THE NEW YORK TIMES **NATIONAL** TUESDAY, OCTOBER 17, 1989

M. King Hubbert, 86, Geologist Who Influenced Oil Production

By ALFONSO A. NARVAEZ

M. King Hubbert, an award-winning scientist whose work in physics and geology brought radical changes in the petroleum industry, died Wednesday at his home in Bethesda, Md. Dr. Hubbert, who was 86 years old, had been undergoing treatment for a pulmonary embolism.

Dr. Hubbert's research in structural geology, the mechanics of earth deformation and the physics of underground movement of fluids led to sweeping changes in the way oil and gas are produced.

His paper, "Theory of Ground Water Motion," published in 1940, helped change methods of gas and oil exploration by showing that oil and gas flowed through cracks and pores in rocks and did not remain in static, subterranean pools as had been thought.

Dr. Hubbert's work also led to his prediction in 1948 that worldwide supplies of petroleum were limited and that the United States would run short of petroleum in the 1970's, making the nation dependant on foreign oil.

His repeated warnings in 1956, 1962 and in 1967 went generally unheeded. It was not until the Arab oil embargo of 1973 that the full impact of his message was realized. Government agencies scaled back their estimates of gas and oil resources in the United States, and the nation began an energy policy that stressed conservation.

Dr. Hubbert received the Rockefeller Public Service Award in 1977 and Columbia University's "premier award for earth science," the Vetlesen Prize, in 1981.

He was a member of the National Academy of Sciences and of the American Academy of Arts and Sciences, and was the author of many articles in professional journals.

Marion King Hubbert was born in San Saba, Tex. on Oct. 5, 1903, and earned undergraduate and graduate degrees at the University of Chicago. He earned a Ph.D. in geology and physics in 1937.

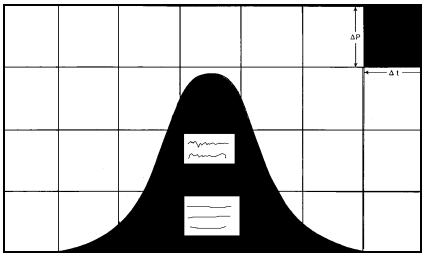
Taught Geophysics at Columbia

After working several years for the Amerada Petroleum Corporation, which later became the Amerada Hess Corporation, he became a teaching assistant at the University of Chicago. He joined the faculty of Columbia University in 1931 and taught geophysics until 1941.

Dr. Hubbert was a senior analyst with the United States Board of Economic Warfare before becoming a research geophysicist with the Shell Oil Company in 1943. He worked with Shell in a variety of capacities until his mandatory retirement in 1964.

He then became a research geophysicist with the United States Geological Surveys and also taught at Stanford University. He retired in 1976.

Dr. Hubbert is survived by his wife, Miriam; two sisters, Nell Jessup of Los Angeles and Dorothy Colin of Adrian, Tex., and two brothers, Leo Hubbert of Torrance, Calif., and Jack Hubbert of Ballinger, Tex.



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OIL RESERVES AND SEMANTICS

by
L.F. Ivanhoe

The prestigious British newsmagazine "The Economist" stated in its 10/07/95 feature article 'The Future of Energy':

> "Fossil fuels supply over three-quarters of the world's energy needs...In the energy needed to move transport, oil is still king, supplying 97% of the fuel used...Truly modern renewables such as solar and wind power provide less than 1% of world electricity...Proven reserves of oil are now enough to supply the world for 43 years at current rates of production, compared with 35 years during the 1970s, according to BP, one of the oil giants...But even given the growth in demand, the proven reserve figures probably underestimate the longevity of fossil fuels... 'I don't believe that we will be out of oil in 40 years', says Sean O'Dell, chief economist of the International Energy Agency."

Such optimistic statements are typical of the views of most economists in financial newspapers and magazines. Unfortunately, their opinions are often based on research quoting questionable data. For example, the much-quoted annual 'BP Statistical Review of World Energy's' tables and graphs on 'Distribution of oil reserves in 1994' contains a fine-print footnote:

> "...(reserve) estimates contained in this table are those published by the Oil and Gas Journal (O&GJ) in its issue of 26 Dec. 1994, plus an estimate of natural gas liquids (NGL) for North America."

O&GJ RESERVES

One must go back to the O&GJ annual year-end reports to check each of the oil producing nation's oil and gas reserves / production. On close examination, one soon runs into problems with the O&GJ numbers. The O&GJ merely compiles the RESERVE information provided annually by each country's government source. There is no way for the O&GJ to check on the accuracy of foreign reports. To many foreign ministries, the O&GJ requests for reserve data was either a sensitive state secret or a nuisance chore that no one was critically concerned about. Due to lake of guidance or ignorance, a common answer was apparently "same as last year". (52% of the 67 nations listed in O&GJ's 25/12/95 report gave the identical oil reserve numbers as on 26/12/94; many for several years.)

Some nations' numbers are obviously gross approximations. IRAQ doubled its reported reserves from 47 Bbo to 100 Bbo (Billion barrels of oil) in 1987, the number that IRAQ still lists for its reserves. Who could prove IRAQ wrong? And what difference did it make to IRAQ if the world's economists and planners were misled? By 1989 all of the OPEC nations had raised their reported reserves to maintain everybody in line for their "oil quotas". All of this increase was creative bookkeeping "political reserves" rather than new oil discovered. These are the figures that bolster the apparent change as reported by The Economist, that the world potential of reserves / production (R/P) increased from 35 years in the 1970's to 43 years in 1995.

Operating oil companies pay only limited attention to details of the O&GJ reserve numbers which are the domain of academic planners. It is simply impossible to check foreign reports. Caveat Emptor! If the USA / UN will not trust IRAQ's Saddam Hussein to correctly report details of his military might - how can they trust his report on IRAQ's OIL RESERVES (his economic might)? The same question might be raised for all nations who get foreign government and

World Bank grants and loans based on large reported RESERVES. In summary - don't trust the O&GJ (or BP's) reserve numbers implicitly - some 300 Bbo of political reserves may need to be subtracted therefrom.

In short - OPEC nations' claimed reserves are intended to increase their "OPEC PRODUCTION QUOTAS" - not to evaluate their oil as in other countries. Consequently, relating OPEC's with other nations' oil reserves is like comparing apples with oranges (see Figure 1).

USGS OIL RESOURCES

The possible exaggerations in the O&GJ reserve numbers don't bother me nearly as much as the economists' treatment of the U.S. Geological Survey (USGS) "RESOURCE" numbers. These are commonly added to the O&GJ RESERVES to produce a grand total of each nation's "OIL ENDOWMENT". The sum of two (unknown) values gives huge numbers which are routinely and incorrectly called "RESERVES" - rather than "undiscovered RESOURCES". The equation should be:

(known) RESERVES + (undiscovered) resources = (unknown) resources.

The two technical terms (known) RESERVES and (unknown) RESOURCES are virtually synonymous to the public - but not to the oil industry. Known RESERVES are calculated by the petroleum reservoir engineers and conservative bankers will lend money on such RESERVES. RESOURCES, however, are estimates by scientific geological committees, of the total amount of oil they feel may be present but still undiscovered in any area. Conservative bankers will not lend money on undiscovered RESOURCES.

USGS geologists now prepare RESOURCE numbers for all nations, based on elaborate computer programs and global data bases. Nobody else could do a better job. Unfortunately, the basic problem - like earthquake predictions - is beyond the ability of any scientific committee to solve. The USGS uses a statistical formula that gives estimates of the PERCENTAGE PROBABILITY OF NEW DISCOVERIES (oil volumes) and their reports have lots of guesses, assumptions and fine print qualifying their methodology. Their final computer printouts are very impressive. However, few operating oil companies concern themselves much with the USGS RESOURCE numbers, which are designed for global planners/economists rather than working oil people who have different problems. Government and academic scientists are always much more optimistic about the chances of new discoveries than are their oil company colleagues who are regularly humbled by dry holes drilled on the very best of data.

The 1994 USGS undiscovered world oil RESOURCE numbers were:

95% probable (sure things)	=	292 Billion barrels oil
50% probable (likely)	=	582 Billion barrels oil
5% probable (unlikely)	=	1005 Billion barrels oil

But the actual oil discovered in new global fields discovered during the 1982-1991 decade was only 91 Bbo, at the declining end of a global finding curve (see Figure 2). A straight extrapolation of the 1982-1991 finding rate would be 180 Bbo during the next 20 years...far less than the USGS 95% (sure thing) numbers! This USGS discrepancy may be the result of errors in their basic computer model assumptions - or the lack of any TIME limits in their computations. Oil to be found more than 20 years in the future- is effectively worthless today.

If "Reserves" are "apples", and OPEC "quota reserves" are "oranges", then USGS "Resources" might be "olives." Combining them results in "fruit salad" - not "apples."

SUMMARY

Unfortunately, planners who trust the O&GJ and USGS numbers base their economic projections on overly optimistic data. It is now a question of WHEN-not WHETHER the foreseeable world oil supply shortage will confront us sometime between 2000-2010 AD when the global demand will exceed the world's oil production...to the surprise and dismay of those who believed the superoptimistic economists.

L.F.Ivanhoe #HC96/1-2
7/18/96

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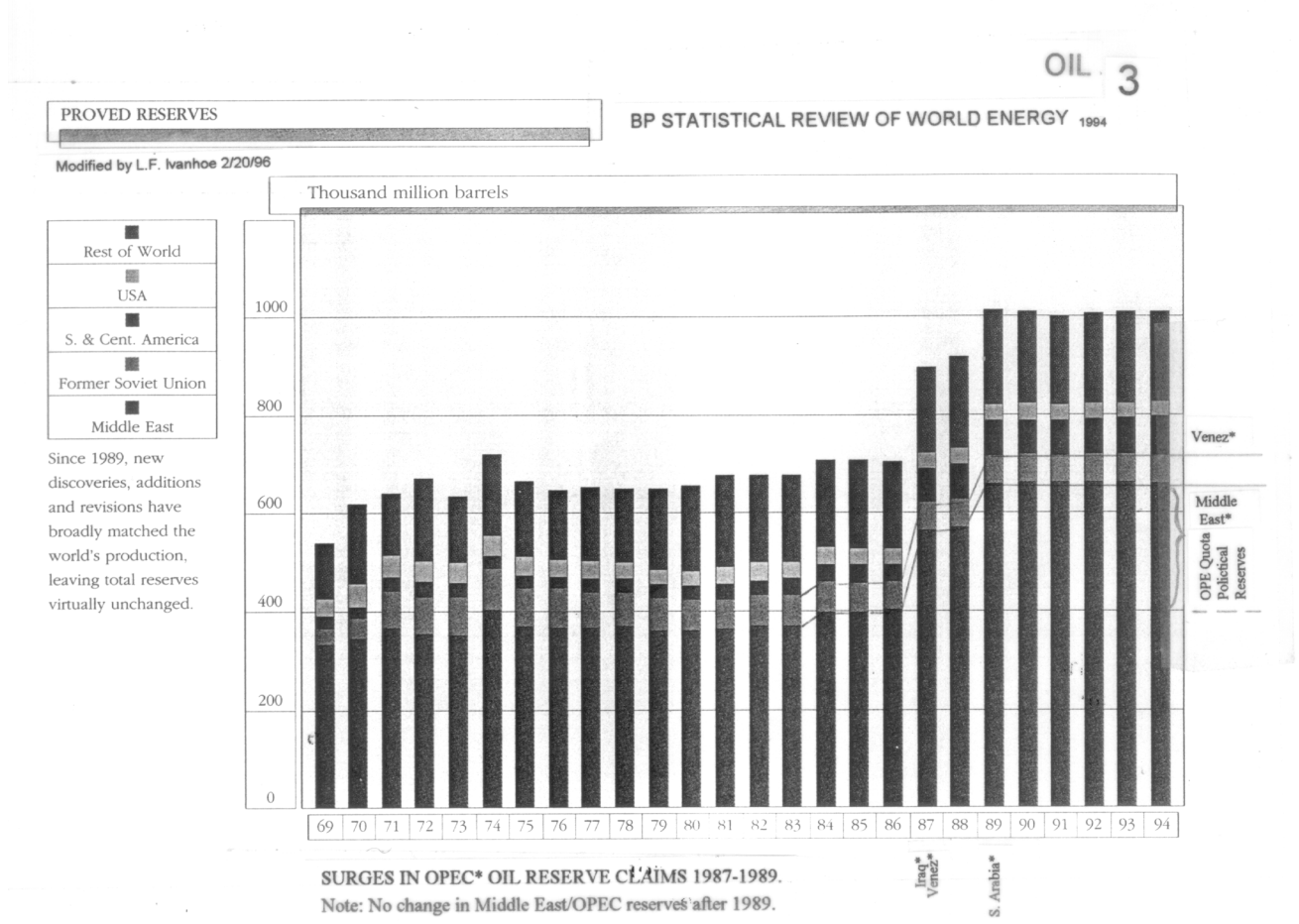

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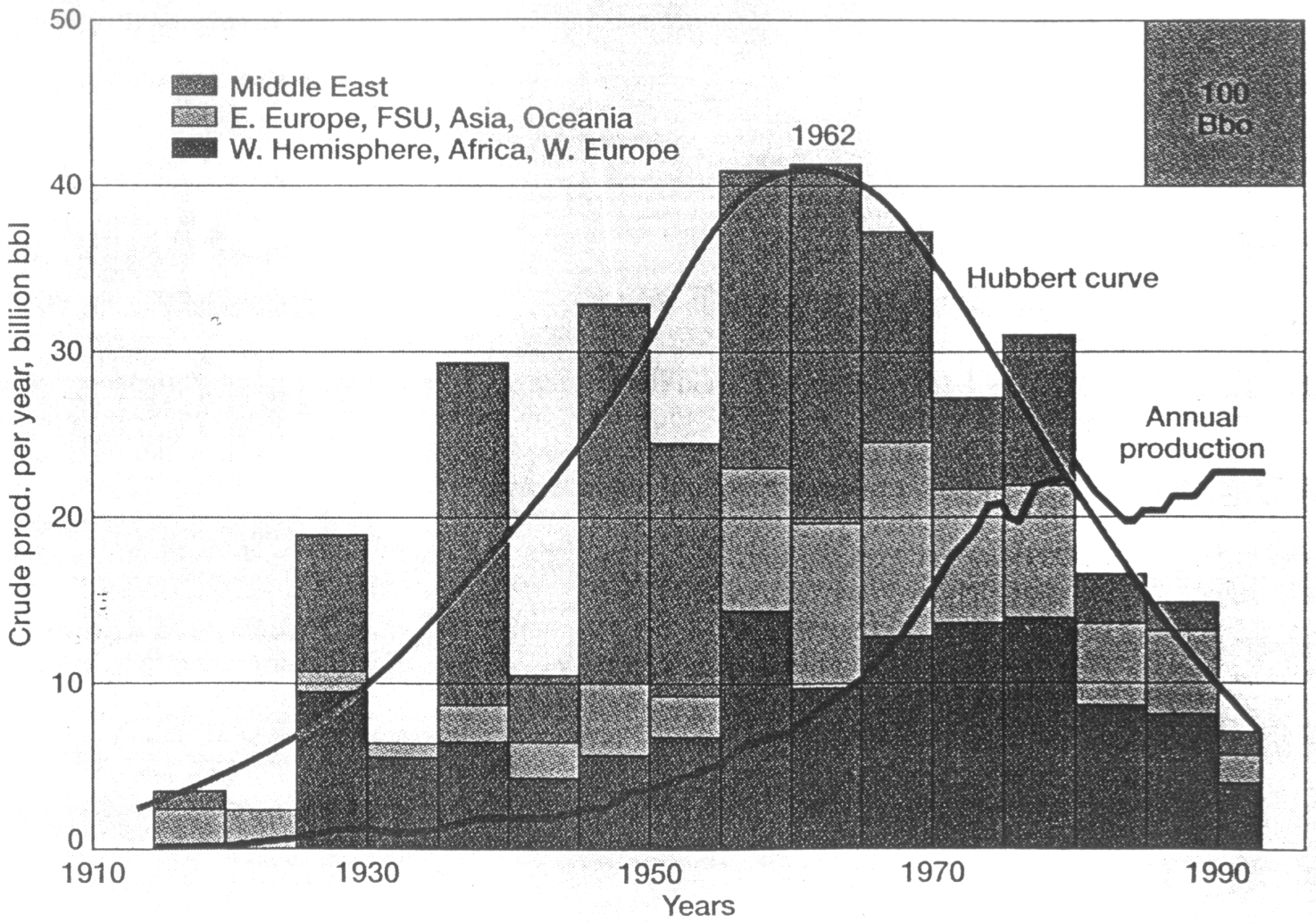


Fig. 1. World annual crude discovery rate averaged over 5-yr periods, 1912–1992.[4] Hubbert curve is weighted average of global oil discovered 1915–1992. **(Adapted from USGS/Masters, 1994 - Ivanhoe added "Hubbert Curve")**

Ivanhoe, Figure 2
(Rev. 2/22/96)

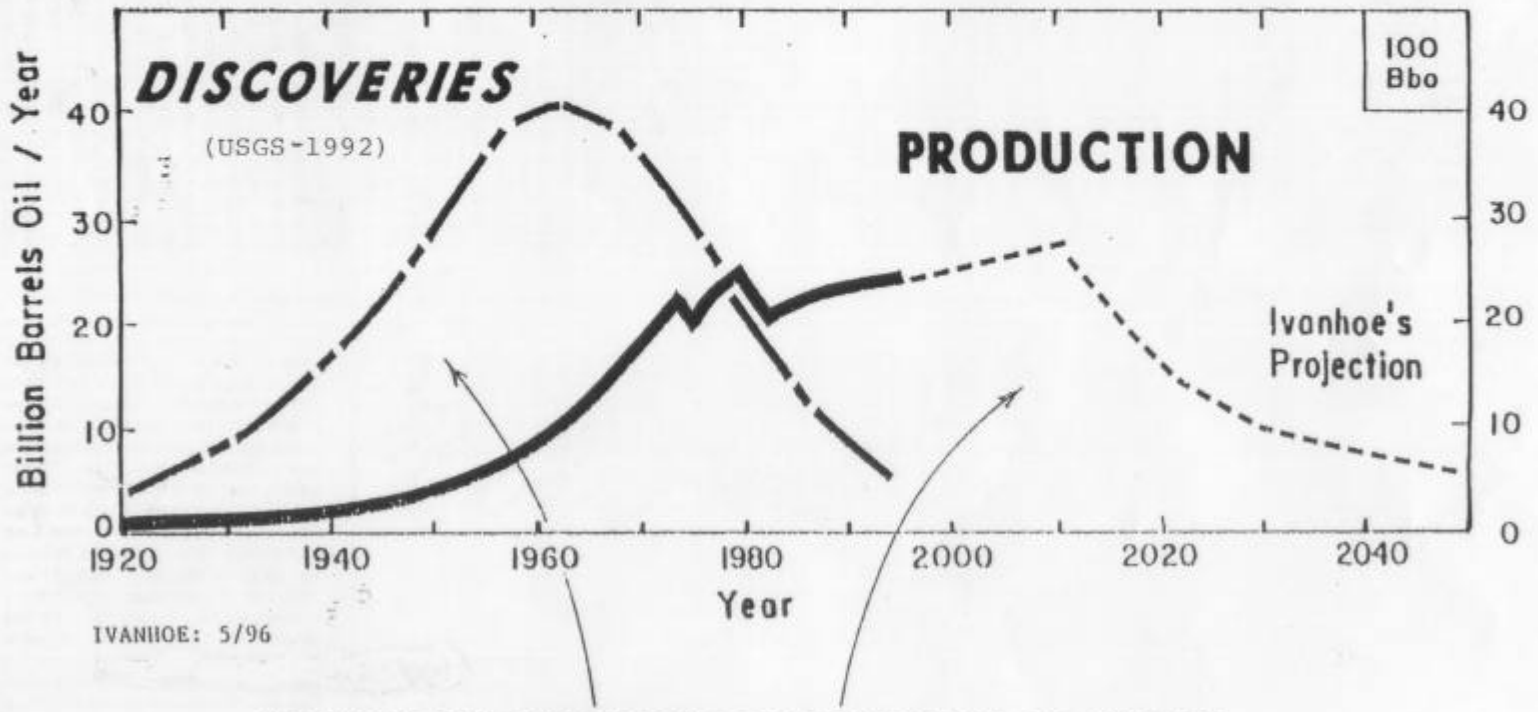
HC#96/1-2(F.2)

Axiom: One cannot produce more oil than has been discovered.

Oil Production volume/(area under the Production Curve)
cannot exceed Discoveries volume / (area under Discoveries Curve);
(per M. King Hubbert, 1956.)

Discoveries Curve adapted from USGS/Masters,1994.
Production Curve extrapolated to match Discoveries volume/(area).

WORLD OIL SUPPLY



IVANHOE: 5/96

THE TWO AREAS (DISCOVERIES & PRODUCTION) MUST ULTIMATELY BE EQUAL, OR PRODUCTION AREA MUST BE LESS THAN DISCOVERIES.

HC#96/1-2(F.3)

*Ref: "Oil As A Finite Resource"
By: James J. MacKenzie, Mar.1996
World Resources Institute
1735 New York Ave. NW
Washington, DC 20006

Cutting Gas Taxes Will Make Things Worse

■ **Energy:** We're more dependent than ever on OPEC nations, which may have less oil than they're saying.

By JAMES J. MacKENZIE and KATHLEEN COURRIER

In the debate over gasoline price increases, American politicians fail to grasp that the global oil supply picture is soon to change, permanently and with wrenching effects for the unprepared.

For the past 50 years, oil companies, geologists, governments and independent researchers have been estimating how much recoverable oil remains in the Earth's crust. The consumption pattern for oil—or any nonrenewable resource—follows a fairly symmetrical bell-shaped curve. Peak and decline are inevitable and can be estimated fairly accurately, and at the peaking point prices will start to rise.

Today's price spike doesn't mean that we are at that turning point now any more than the oil price shocks of 1974 and 1979 did. But more than 40 studies published since the early 1950s show a remarkable consensus among petroleum experts worldwide on how much oil ultimately will be recovered. That fateful day when prices will begin to rise permanently is now within sight.

Experts believe that between 1,100 billion and 1,500 billion barrels of recoverable oil remain in the ground. Considering that annual consumption is only 22 billion barrels and that cumulative consumption from the 1850s to the end of 1995 was about 765 billion barrels, that amount sounds huge. But given the not very daring assumption that demand will rise by 2% a year as populations and economies grow, oil production will not be able to keep up with demand beginning between 2007 and 2014.

Estimates of total recoverable oil weren't wildly different two decades ago, when the first oil shocks sent lines around the block and prompted Detroit to get serious about automotive fuel efficiency. But for three reasons, the big picture has changed.

First, with oil prices high from around 1975 through 1985, exploration increased dramatically. Yet no major new fields were found anywhere. Geologists have a good understanding of where to look for oil and few expect any giant new fields to be discovered.

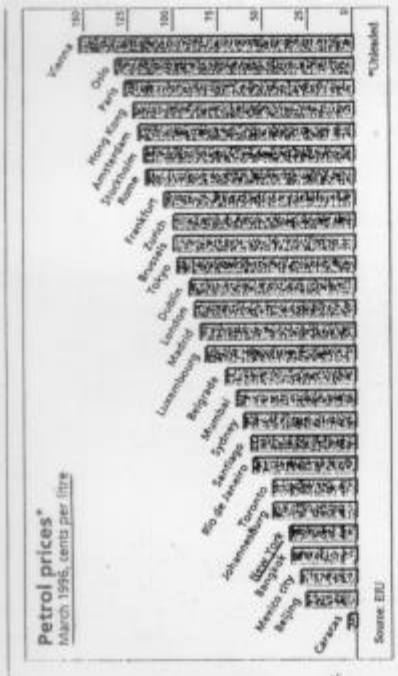
Second, the massive, self-reported oil reserves of the Organization of Petroleum Exporting Countries may be greatly overstated. The Oil & Gas Journal reports proven reserves in 1995 of about 1,000 billion barrels, two-thirds in the Persian Gulf. But in the early and mid-1980s, proven crude oil reserves ranged between 650 billion and 700 billion barrels. What happened here? Beginning in 1985, OPEC members began reporting huge increases in their reserves: 41% in Kuwait; 50% increase in Saudi Arabia; 100% in Iran, Iraq and Venezuela; 200% in Abu Dhabi and Dubai. Industry insiders classify these mammoth increases as "political reserves"—related more to OPEC quota negotiations than to new finds. The 300 billion barrels of "political reserves" have remained exactly the same year after year, a fish-and-loaves story considering how much oil these countries have exported since 1985.

Third, the first and second decades of the 21st century seemed light years away 20 years ago, but now many of us have mortgages that will last longer than the day of petroleum reckoning. Now we have 10 to 15 years to reengineer our transportation sector to depend less on oil. Even champions of electric vehicles and other alternatives to petroleum-powered mobility admit this will be difficult.

Meanwhile, dependence on OPEC is growing. In 1995, OPEC accounted for about 41% of world oil supply. By 2010, OPEC's share could reach 53%, essentially the same as in 1973 during the Arab oil embargo. In 1973, the United States imported 5% of its oil from the volatile Middle East. Last year it was 9%.

Cutting gas taxes would discourage the use of electric or other alternative-fuel vehicles and promote wasteful and dangerous driving habits at high speeds. (At 75 mph, your car uses 50% more fuel than it does at 55 mph.) Reaching a bipartisan consensus on national energy goals is a lot harder than buying votes at the gas pump. But since declines in the real price of gas trigger more pollution, greenhouse gas emissions, sprawl, congestion and import addiction, it's worth a try.

James J. MacKenzie and Kathleen Courrier work at the World Resources Institute in Washington, which just published a report, "Oil as a Finite Resource."



■ THE COST OF MOTORING The local price of petrol depends on lots of factors, but most notably on the levels of taxes or subsidies, and on the cost of transporting fuel. As a rule, petrol is most expensive in Europe, where taxes are relatively high. Petrol prices in Frankfurt and Rome, for example, are roughly three times higher than those in New York. The most costly city in the chart in which to fill your tank is Vienna, where peripatetic New Yorkers can expect to pay over four times the price at home. Prices in South America, meanwhile, tend to be low, thanks to large local supplies of crude oil and, often, subsidies. Petrol costs only five cents a litre in Caracas, the cheapest of any city in the chart. This means that a dollar buys 30 times more fuel than it does in Vienna.