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Oil or Not?

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EXPERIENCE | Transportation

Oil or Not?

Why are fuel prices going up? Why do they take erratic swings? Why do the markets get scared every time any oil producing country gets a cold? Are we running out of petroleum, or is something else to blame? These are questions without definitive answers, but careful analysis can reveal plausible explanations.

Are We Running Out of Oil?

First off, we are not running out of oil, we are running out of inexpensive oil. Broadly speaking, petroleum sources fall into one of two categories: conventional and non-conventional. Conventional oil is that which is pumped from the ground through a well. When the initial tap is made in many fields the subterranean oil is under pressure; that is why initially tapped oil wells are called gushers.

As wells and oil fields mature, the oil must be pumped. Then, water and gas has to be pumped into the edges of the field to push oil to the well heads. As time goes on the percentage of water mixed with the crude starts rising. When the pumps start pulling out too much water the field is depleted of the recoverable petroleum, even though there as much as 50% of the field's oil may remain in the ground.

It is not that there are no more oil fields to find on the earth, it is just that the largest and least expensive to recover have been already tapped. We will find more petroleum, especially in deep waters. It will cost more per barrel to recover, it the recovery will be done at greater risk and the fields will likely not be as large as the major fields being pumped today.

Source rocks are those from which oil can be generated. The classical view is that source rocks must have layers containing the bodies of dead plants and animals and that these gradually change to oil. The contrarian view is that all basement rocks have the potential to be source rocks because oil has non-biological origins deep within the Earth.

What Is Meant by Peak Oil?

The term "peak oil" has two meanings. First as it applies to an oil field: a field has peaked when the maximum yield per day begins to fall. Depending on how the petro-geologists manage the pumping and injection of water, the field could still have many years of production, but lesser and lesser daily flows.

The term is commonly associated with a geologist who worked for Shell in the 1950's and 60's named Marion King Hubbert.¹ He predicted in 1956 that United States petroleum production would peak in 1970. It did peak in 1970. Since then U.S. production has fallen by over 40%.

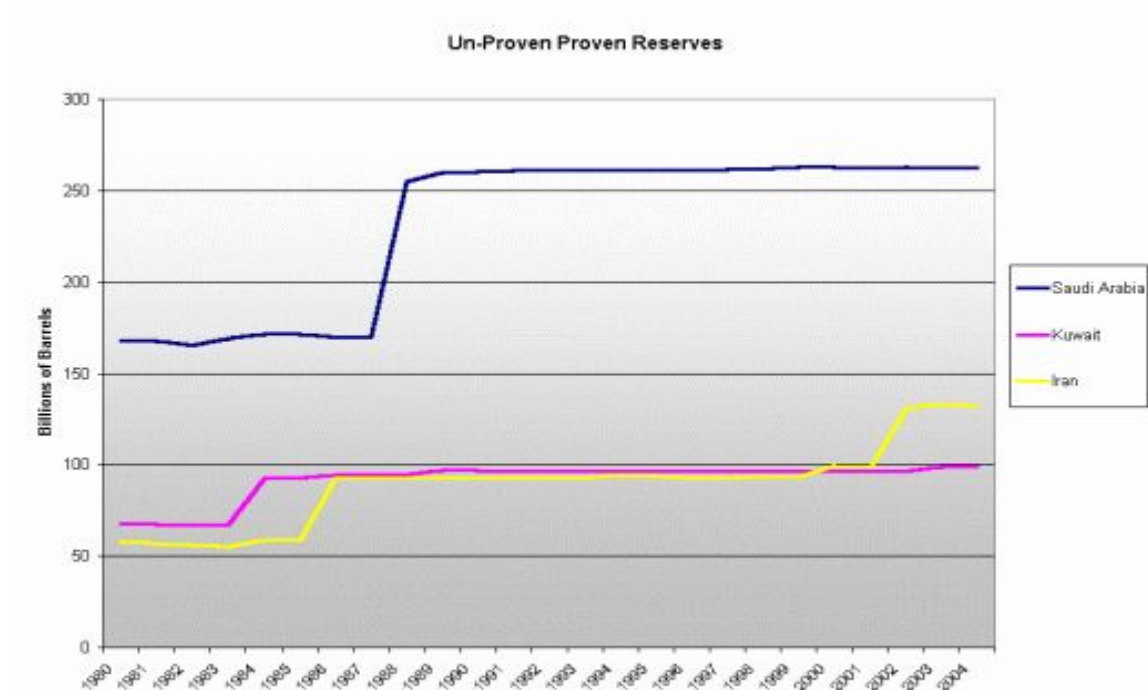
¹ Marion King Hubbert, American Petroleum Institute, March 1956



Based on the past peaking of other commodities, Hubbert calculated that oil supply is like a bell curve. This curve is symmetrical with half the total supply's being used up in the first half of the curve to the peak, and the second half after the peak has occurred.

Hubbert then took his theory of production's reaching a peak to the world supply. He calculated that the world would peak in the first decade of the 21st century. We are at Hubbert's Peak.

At best, one has to regard OPEC's official oil statistics with a jaundiced eye. The table below shows historical oil estimates from OPEC countries over the past 25 years.



Source: British Petroleum, *Oil & Gas Journal*

Note in particular that Saudi Arabia's oil estimates mysteriously jumped by about 100 billion barrels – a value more than three times the proven reserves of the US today-- between 1987 and 1988. Because there were no major new oilfield discoveries in the country over that time, one must assume that these new reserves were "found" in the country's existing fields. But many of the kingdom's biggest fields had already been in production for more than three decades by 1988.

Matthew Simmons is the head of a petroleum advisory investment firm. His research shows that the ability of Saudi Aramco to continue producing 10 million barrels per day of crude is very questionable.² Simmons work is consistent with the finding by a geophysicist working for Saudi Aramco eight years ago.

These issues concern both the size of the problem and that of timing. The seriousness/size of the problem could be confirmed if there was a consensus among the

² Twilight in the Desert, Matthew Simmons, 2005



experts. The range of predictions for recoverable future oil makes projecting future scenarios more difficult. Four leading expert sources of petroleum reserves predict total reserves to fall into two completely different ranges, as indicated below:

Remaining proved oil reserves for "ME Five," according to the major assessors

Country	Oil & Gas Journal [1]	BP Statistical Review [2]	Colin Campbell [3]	Bakhtiari 's range [4]
Iran	132.5	132.5	69	35-45
Iraq	115	115	61	80-100
Kuwait	101.5	99	54	45-55
Saudi Arabia	264.3	262.7	159	120-140
United Arab Emirates	97.7	97.8	44	40-50
TOTAL	711	707	387	320-390

[ASPO-USA's Peak Oil Review February 20, 2006](#)³

Not everyone is on the same page with Hubbert and his prediction concerning timing either. There is no consensus among the experts. Their predictions for the Peak crude flows range from 2005 to 2050.⁴ They are all, (except for one noted below), in agreement that there is not an unlimited supply of oil, and that once we are about halfway through that supply that production will not be possible at the same high rates. What they disagree on is a definition of total petroleum production versus economical total production. My analysis is that we are talking more about at what price oil is available than whether petroleum is available or not.

Mike Waite, who both spent eight years with Chevron and was Chief Financial Officer of Canadian Pacific Railway, replied when asked whether Hubbert had it correct, "Hubbert was mostly on target except that Hubbert was not an economist."

Competing theories range from serious academic discussions to those of self-appointed experts who challenge the last 145 years of geology and petroleum exploration knowledge. The most controversial states that the Soviets have discovered an unlimited amount of oil seeping up from the mantle of the earth.

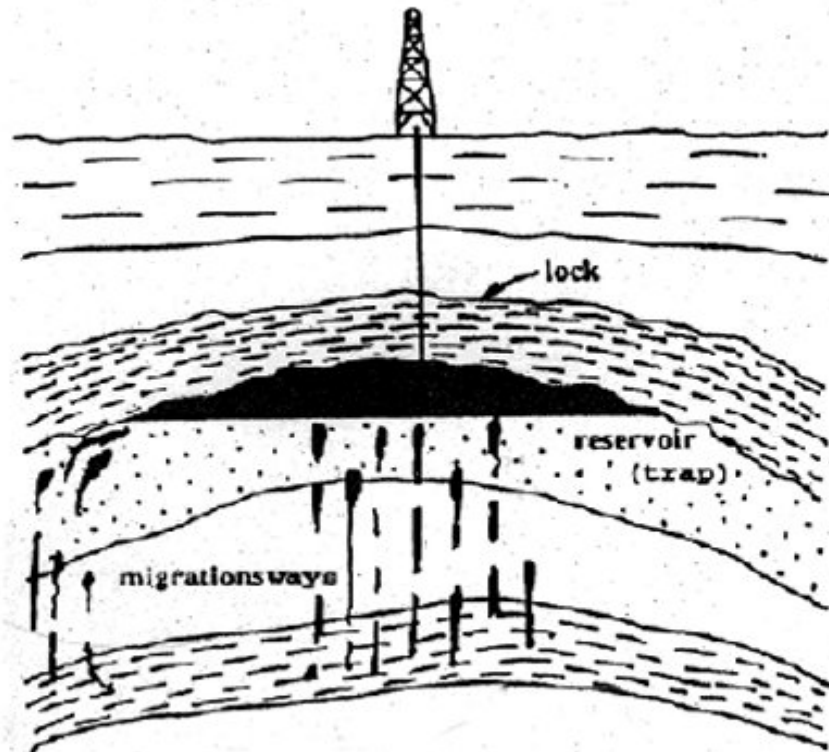
³ References: [1] & [2] As in Table 1. [3] ASPO Newsletter #62, February 2006. [4] February 2006.

⁴ Peaking of World Oil Production: Impacts, Mitigation, & Risk Management, Robert L. Hirsch, Department of Energy, February 2005



Simplified Plan of Ultra Deep Oil

Viewed from the top, the drilling rig drills downwards into the oil reservoir [shown in black], then runs production tubing back to the surface to transport the crude oil to the refinery. All western geologists believe that the oil is formed locally from decaying organic matter [marine life for example], which then migrates up into the reservoir, where it is trapped by the impervious lock or cap rock above. All very simple and easy to believe, but the Russians have now proved western geologists hopelessly wrong.



During the forties and fifties, Russian reservoir engineers realized their reserves were somehow being "topped up" from below, despite a total lack of additional decaying matter. All that lay below was solid granite and basalt, meaning that the oil was actually being manufactured in the mantle of the earth, before slowly migrating between 70 and 150 miles upwards to the existing reservoir. It all seemed too fantastic to believe, but the Russians persevered. Since that time they have drilled more than 300 producing oil wells through solid granite and basalt, with another 20 drilled the same way in the White Tiger Field in Vietnam. By the mid-nineties Russia was so far ahead of the west, that Wall Street asset Mikhail Khodorkovsky was ordered to 'acquire' Yukos Oil Company in order to steal the technology.

The problem with this theory is that it has been disproved by practical science. The theory is based on the earth's being able to produce abiotic petroleum. Even though the core of the earth does produce some abiotic methane, there have been no findings that the more complex petroleum molecules can be produced, even from volcano output. ⁶ So we are stuck with the world's supply of organic petroleum.

⁵ Russia Proves 'Peak Oil, Joe Vialls, 25 August 2004

⁶ Whiskey & Gunpowder, March 8, 2006, Byron W. King, Pittsburgh, U.S.A.



It's a Matter of National Security

Even though oil production is peaking, demand is not. Not only is demand still growing in the United States, but it is also mushrooming in Asia. The growing economies of India and China are creating huge new demand for petroleum. Burgeoning demand is manifesting itself in many ways. There is a reason why China tried to buy Unocal in 2006, namely, that controlling and securing a long term flow of petroleum is an issue of national security for them. It was announced in 2007 that the "Major Chinese oil corporations continue to expand into Kazakhstan as they search for oil to meet a portion of China's booming demand for energy through the Western Kazakhstan-China oil pipeline."⁷ These trends will continue as China and India work to secure their future oil needs.

Petroleum and national security are linked to all nations in today's world. A study by the US Army Corps of Engineers Engineer Research and Development Center released in September 2006 stated, "As worldwide petroleum production peaks, geopolitics and market economics will cause even more significant price increases and security risks."⁸ The Army's report further states, "Security risks will also rise. To guess where this is all going to take us is would be too speculative. Oil wars are certainly not out of the question."⁹

"The high probability that a supply of cheap oil will peak over the next 10-15 years poses a serious challenge for the global economy. We ... are more dependent on imported oil for our energy requirements than almost every other ... country and it will take up to 10 years to significantly reduce this dependence. Therefore, it is essential that we now begin to prepare for such a challenge".¹⁰

The Laws of Supply and Demand

It is a commonly accepted economic fact that if supply is limited and demand remains strong, prices will rise. Well welcome to Economics 101. World oil demand is expected to grow 50 percent by 2025.¹¹ If supply remains stagnate then prices must rise. The questions are how much and how soon?

The answers are easy. Just ask any one of about a dozen experts and you will get twelve different answers. An accurate answer is hard if not impossible to come by. It is almost impossible because there is no sure way to determine the geopolitical events that will affect supply and price. Some of the geopolitical effects are the result of demand growth in China and India. China especially is expected to act defensively if its leaders feel

⁷ China Thirsts for Kazakh Oil, 27 Jun 2005, By Maria Yakovleva, Russian Petroleum Investor

⁸ U.S. Army Corps of Engineers, Engineer Research and Development Center, September 2005, p. vii

⁹ Ibid, p. 53

¹⁰ A Baseline Assessment of Ireland's Oil Dependence, Forbas (Ireland National Policy Advisory Board), April 2006

¹¹ U.S. Department of Energy, Energy Information Administration, *International Energy Outlook – 2004*, April 2004.



threatened by tightening supplies. It is anticipated that China will act aggressively to buy controlling interests in long term supply sources.

There are only twenty nations of the world that use more than one billion barrels of oil per day. Of those, only eight use more than two billion barrels and only three, the United States, China and Japan, use more than five billion per day. Equally important is the percentage of their supplies that must be imported for each of these largest eight.

Top 8 Use and Risk¹²

Country	Daily Demand	Daily Production	Percent Import
United States	20517	7241	65%
China	6684	3490	48%
Japan	5288	0	100%
Germany	2625	0	100%
Russia	2574	9285	0%
India	2555	819	68%
South Korea	2288	0	100%
Canada	2206	3085	0%

Half Full or Half Empty?

Canada could be the source of an unexpected tightening of. Whereas the flow of conventional crude can be expected to continue, supply derived from oil sands may be a problem. The current technology requires significant amounts of natural gas for the production of synthetic crude from oil sands. Canadian natural gas demand is now expected to close in on western Canadian natural gas yield. At a minimum, this will put pricing pressure on the use of this gas for oil sand crude production. Additionally, it is not out of the question for the Alberta and/or Canadian governments to put restrictions on the use of what is expected to be an increasingly tight commodity.

Some of the recent assessments of conventional natural gas potential in the Western Canada Sedimentary Basin varies by over an order of magnitude. This prompted a study of the reasons for the discrepancies. Most of the differences are based on how the assessments were made to—the minimum pool size, the definition of conventional, and whether pool growth was included or not. Methodological differences also seem to have had an effect. For assessments to be useful they need appropriate detail, such as pool size, to allow understanding of how relevant various parts of those volumes may be to actual supply and on what time scales.¹³

On the bright side, recent experiments offer hope that technological breakthroughs will lower the ratio of energy used to produce each barrel of product.

¹² BP Statistical Review of World Energy, June 2005

¹³ The Future of Petroleum: Optimism, Pessimism, or Something Else?, Ronald R. Charpentier, USGS Open-File Report 03-137, 2003



Other Hopeful Signs

Not all is desperate. There are some signs that Canadian oil sands will meet some of the US demand. The Canadian story is one of evolving technologies and plentiful if expensive crude. The solution to the Canadian gas problem is to use some of the energy of the crude production to refine the crude. The "lighter ends," which is what refiners call the propane and butane components, can be used to run the cooking process. This scavenging of product will lower the effective yield and raise the cost. There is more recoverable oil sand crude in Canada than the remaining crude in Saudi Arabia. We will not run out, but what will be the price?

The Problems of Refining Capacity

"Will foreign refiners step up and meet this increased demand from the United States? That's really uncertain now," said Mr. Felmy of the Petroleum Institute.¹⁴ U.S. refinery capacity has barely kept up with the growing demand. Part of the problem is that the tight supplies of crude are magnified by tight refining capacity. A hurricane can knock out 5% of total US refining capacity for months. Eight months after Katrina, 350,000 barrels of capacity per day is still shut down in the gulf coast region.

What Will Oil Cost?

The hardest question to answer is that of future price. Going back to Hubbert's Peak, remember that it was a symmetrical bell curve. Campbell, Simmons and others say that we are now at the top of that curve. Then why are we still able to afford oil? The economist will tell you that even in the use of a finite resource; supply will try to meet demand at a price point.

The "at a price" saying means that producers will produce more oil as long as they see their profit margins increase on the higher production cost crude supplies. That is why oil sands which cost \$30 to \$40 per barrel are now attractive. As crude prices keep rising the higher risk exploration in deep off-shore waters such as those off Brazil which Petrobras has successfully exploited and oil shale production will both expand.

If you look back using 2005 constant dollars as a measure, \$100 per barrel oil would be equal in cost to the peak pricing in 1981. The effect on the economy was close to stagnation. GDP annual growth of only 0.5 percent, CIBC Financial predicted in early 2007 that crude would be at \$100 per barrel by the end of 2007. People say that these prices will begin to stifle petroleum use worldwide. These higher prices will create an economic cap that will keep demand within the available supplies. As supply gets increasingly hard to maintain over time, price will continue to rise only to the extent that demand is kept relatively constant. Hubbert's Peak from the economist's view that Mike Waite described becomes shaped like a mesa. The flat of the mesa will be a period of increasing price to the point that finally depletion of the crude supply can not keep up with demand at any price, or that the price gets so high that the demand starts to drop and supply then begins to fall accordingly

At What Level Will the Peak Price Settle?

¹⁴ John Felmy, Chief Economist American Petroleum Institute, NY Times April 8,2006



We can not predict how high prices will go for two reasons, stagnation pricing and world disruptions. Stagnation due to high crude prices will keep somewhat of a cap on how high prices will go. Several observers have predicted that peak pricing will be in the \$200 per barrel range. World disruptions have caused major price surges in the past. There are too many opportunities for disruption for us not to believe that they will continue to happen. They will cause major spiking of prices now that we are on the mesa of Hubbert's Peak.

Who Will Win and Who Will Lose?

I would not want to be an airline right now. While airlines' highest cost used to be labor, it is now fuel. I also would not want to have my business be dependent on low-cost air fares to be profitable. The more efficient will gain and the less efficient will loose.

What Does this Mean for Diesel Fuel Pricing?

There is a basic relationship between crude prices to diesel fuel pricing. When crude was \$35 per barrel the pump price averaged \$1.75. Crude at \$65 a barrel is causing a \$3 price. Extrapolating out, \$100 crude will give us a diesel price of between \$4.50 and \$5 per gallon.¹⁵

Five-dollar-pergallon diesel pricing will change the way we look at transportation and logistics decisions. As the transportation component becomes a greater percentage of the cost of a product there will be greater focus on where a product is produced relative to the final customer. These decisions will change the way we all do business. A real driver of economic decisions will be the percent of a finished product's cost dependent on transportation. The higher that percentage the more pressure there will be to move flows from, let's say, truck to rail which is roughly four times more energy efficient.

What Does This Mean to the Railroads?

The bottom line is what all this means to the railroad companies. Ike Prillaman, former Vice Chairman of Norfolk Southern, summed it up well in a 2006 statement, "The railroads from a market standpoint will do well until the prices increase to the point that the whole economy crashes." The prediction that the economy should have already crashed can be summarized by a statement of Michael Ward, Chairman of CSX Transportation, "My experts told me that we would be in the tank when prices hit \$60. Well that has come and gone and we are still doing well." His point being that we do not know what is the price breaking point.

But this issue does not involve merely market share and possible traffic growth opportunities. In the railroad industry, we must look at our own operations and determine what internal changes are necessary. Our major railroad companies need to act versus

¹⁵ Thus, for example, in today's tight market a 1 percent increase in world oil consumption (0.85 million barrels per day), or a similar decline in supply, can be expected to increase world oil prices by between 5 percent and 10 percent (\$3.50 to \$7 per barrel, at current prices). National Security Consequences of U.S. Oil Dependency, Report of an Independent Task Force; Council on Foreign Relations, 2006 by the Council on Foreign Relations, Inc.



react. In an industry where we are making twenty-year investments daily we need to ask, "Are we thinking far enough out?" "How should we be running our operations? wWhat locomotives should we buy? Ultimately we must ask, "How far will our paradigm have shifted when oil is at \$100 per barrel, or \$150?"

What is required is not just out-of-the-box thinking but also a fundamental look at the basis for our business decisions and investments. I am concerned that we are not bold enough to ask all the important questions.

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