



LIMITS TO GLOBAL PETROLEUM PRODUCTION – AN UPDATE ON RECENT ANALYSES

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Introduction

There is currently a spam e-mail making the rounds claiming the existence of a largely unreported recent crude oil discovery in North America. The discovery apparently changes everything for U.S. consumers. In short, the message reports that there is “. . . enough crude to fully fuel the American economy for 2,041 years straight”!!

How the media missed this stunning news is hard to imagine. But this got us to thinking about projections from the U.S. Geological Survey (USGS) just a few years back. According to those projections, world oil supplies were being exploited at such a rate that continued increases in supply would not be possible for much longer – that world supplies would hit a peak, after which production would decline even in the face of rising economic demand. That this was followed within several years by another report, commissioned by the U.S. Department of Energy, that said much the same thing made the projections hard to ignore.

A survey of recent literature dedicated to the topics of *future petroleum production vs. consumption*, and *peak oil* revealed an interesting mixture of articles both reinforcing the likelihood of near-term limits to petroleum availability, and deriding any notion that production limits are in sight. One report in particular caught our eye – a 2010 report from the U.S. Defense Department Joint Forces Command. The report included the sobering observation that “Assuming the most optimistic scenario for improved petroleum production through enhanced recovery means, the development of non-conventional oils (such as oil shale or tar sands) and new discoveries, petroleum production will be hard pressed to meet the expected future demand of 118 million barrels per day.” The report went on to indicate that global surplus oil production capacity could entirely disappear by 2012, and that as early as 2015 a shortfall of 10 million barrels per day could develop.

Here we explore recent findings of leading energy forecasting organizations regarding future petroleum availability and consumption, and revisit the subject of peak oil - a topic addressed in an earlier Dovetail report¹. We conclude with observations regarding U.S. approaches to energy policy.

Peak Oil Defined

The term “peak oil” originated with Dr. M. King Hubbert, a geophysicist who observed that the amount of oil is finite, and that therefore the rate of discovery must eventually reach a maximum and then decline. He noted that this relationship exists for any geographical area and for the world as a whole. Hubbert predicted in a 1949 article in the journal *Science*, that the fossil fuel era would be of very short duration (Hubbert 1949). He described the role of fossil energy as “but a pip, rising sharply from zero to a maximum,

The term Peak Oil refers to the point in time when world oil production reaches its highest rate, after which it goes into permanent decline.

--Oxford Dictionary

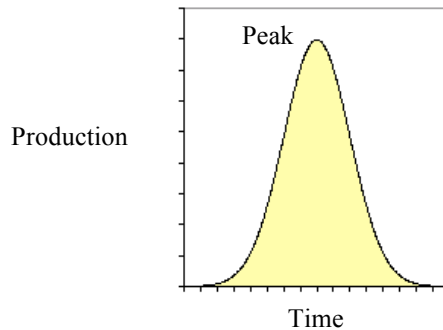
¹ Bowyer, J., Wenban-Smith, M., Fernholz, K., and Howe, J. 2007. Global Warming: Why Reducing Fossil Fuel Use is Essential Regardless of the Outcome of the Climate Change Debate. Dovetail Partners, Inc. March 28. (<http://www.dovetailinc.org/files/DovetailGlobalWarm0307ul.pdf>)

and almost as sharply declining (Figure 1), and thus representing but a moment in the total of human history.” Seven years later, in 1956, he accurately predicted that U.S. oil production would peak in about 1970 and decline thereafter.

Hubbert then turned his attention to global petroleum supplies, projecting in 1969 that world production would peak in the year 2000. His work attracted the attention of a number of others, who over the next 30 years variously projected the year of peak production at 2004 to 2035, with most projections of peak in the 2010 to 2020 time frame.

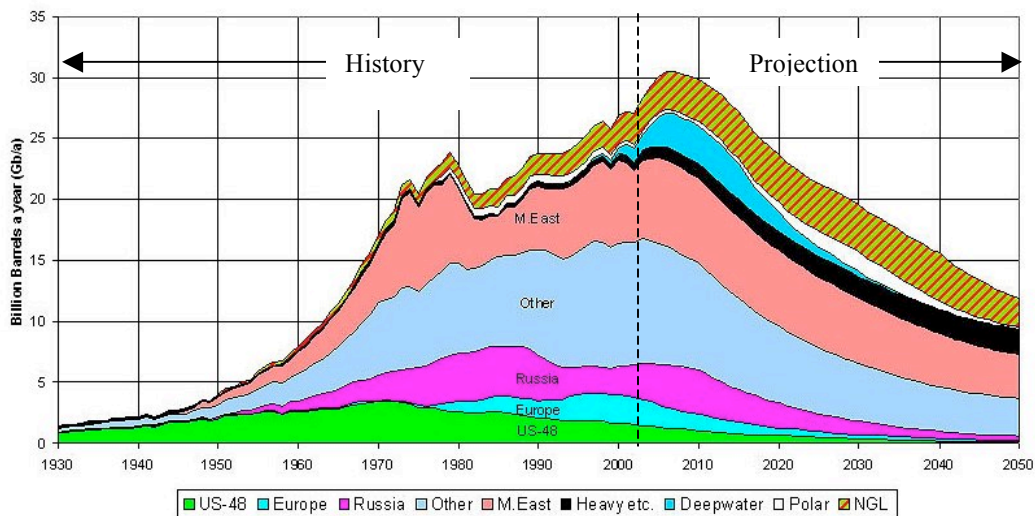
It is important to clarify that peak oil is not the point at which oil is predicted to run out. It is, instead, the point in time when world oil production reaches its highest rate, after which it goes into permanent decline. Peak production has been explained by Dr. Colin Campbell (2003), an exploration geologist, as depletion of non-renewable petroleum reserves over time, and applicable to any individual oil field or region of production.

Figure 1
 Depiction of Fossil Energy Production and Decline as Described by Hubbert



The peak phenomenon can be seen in a 2004 projection of world oil and gas supplies by Dr. Campbell (Figure 2), based on 2003 data. Campbell projected that world peak production would occur around 2008 (Campbell 2003, 2004).

Figure 2
 Oil and Gas Production, 2004 Scenario

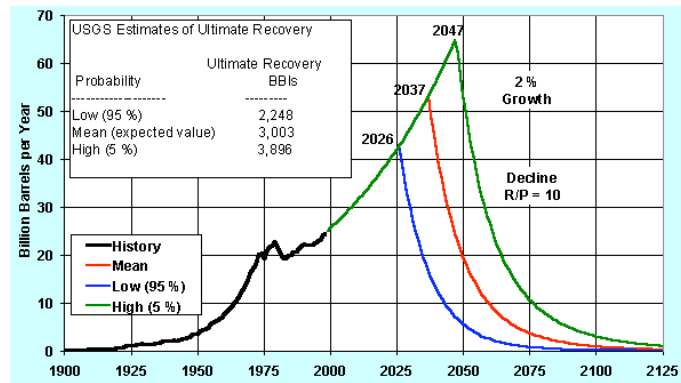


Source: Campbell (2004)

Future Petroleum Supply

Subsequent to the predictions of Hubbert and others, *peak oil* was derided, discussed, studied, and debated, but more than anything else – ignored by world governments. But it was another article in *Science* in 1998: *The Next Oil Crisis Looms Large – and Perhaps Close* (Kerr 1998), that put peak oil on the radar screens of key decision-makers. This article was followed two years later by a comprehensive assessment of global petroleum reserves, performed by the USGS and commissioned by the U.S. Department of Energy. This assessment (Wood and Long 2000) concluded that world production of conventional oil would most likely peak around 2037 and that availability would decline sharply thereafter. In the most optimistic of several scenarios evaluated, given no more than a 5 percent chance of becoming reality, peak production was projected to occur by 2047. Under the most pessimistic scenario, peak production occurred by 2026. Scenarios of supply once peak production is reached, done as part of that same study (Figure 3), suggested relative chaos in world energy and financial markets, as well as large downside risks for any nation that was unprepared for a post-petroleum-peak-world. While a number of other research groups and individuals had previously predicted peak petroleum production in the relatively near term, the USGS findings marked the first time that an entity of the U.S. government had publicly announced a similar conclusion.

Figure 3
Annual Petroleum Production Scenarios With 2 Percent
Growth Rates and Different Resource Levels



Source: Wood and Long (2000)

Attention was focused on the petroleum issue again in 2005 with the release of another report commissioned by the U.S. Department of Energy. What became known as the Hirsch report (Hirsch et al. 2005) began with the words “The peaking of oil production presents the U.S. and the world with an unprecedented risk management problem.” Among the conclusions were that “prudent risk management requires the planning and implementation of mitigation well before peaking,” and that the “the oil peak problem deserves immediate, serious attention.”

In early 2007 the National Petroleum Council, an oil and natural gas advisory committee to the Secretary of Energy, released a report focused on the petroleum supply issue (National Petroleum Council 2007). That report spoke about the urgency of today’s energy issues; accumulating risks to the supply of reliable, affordable energy; and significant challenges to meeting projected total energy demand. The report also noted that there can be no national energy security without global energy security.

A common thread in all of these reports, and an underlying reason for growing pessimism about near-term sufficiency of petroleum supplies, is recognition that China is rapidly emerging as an economic power and that petroleum consumption is rising sharply within China and other growing economies, including those of India and other Asian nations. A net importer of fewer than 10,000 barrels of oil daily in 1970, China had net imports of almost 500 times that by 2010. The importance of this phenomenon to world petroleum supplies was emphasized in November 2007 with the release of the International Energy Agency's (IEA) *World Energy Outlook-2007*. An accompanying news release (IEA 2007) described the consequences of "unfettered growth in global energy demand" for China, India, the OECD and the rest of the world as alarming. According to IEA analyses, net oil imports in China and India combined would jump from 5.4 million barrels per day in 2006 to 19.1 million barrels per day in 2030 – more than the combined imports of the United States and Japan in 2006.

Two weeks after release of the IEA report, without specific mention of China or India, the Wall Street Journal carried a front-page news article entitled "Oil Officials See Limit Looming on Production" (Gold and Davis, 2007). The article began with the words "A growing number of oil-industry chieftains are endorsing an idea long deemed fringe: The world is approaching a practical limit to the number of barrels of crude oil that can be pumped every day." The article went on to say that evidence is mounting that production of crude oil may reach a plateau globally before alternatives are sufficiently developed and "could set the stage of a period marked by energy shortages, high prices and bare-knuckled competition for fuel." The article indicated general agreement that supply problems would occur by 2030, with several suggesting difficulty in meeting projected demand by 2012. A number of executives interviewed in conjunction with the story indicated that they didn't subscribe to the idea that production will be limited by physical supplies of petroleum (the peak oil theory), but rather by a host of other intractable problems.

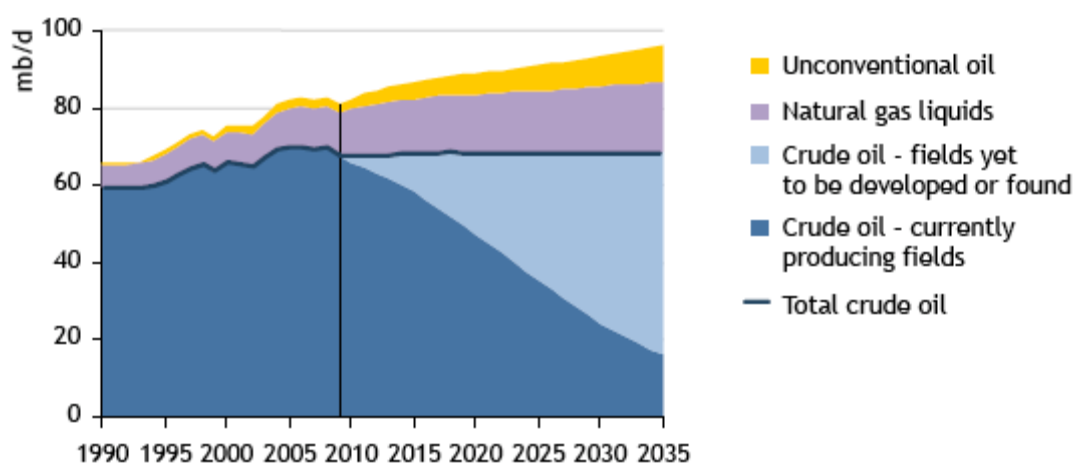
Now, flash forward to 2010. In February the U.S. Joint Forces Command published their Joint Operating Environment report. In addition to observations noted above, the report observed that "By the 2030s, demand [for petroleum] is estimated to be nearly 50% greater than today. To meet future global energy demand even assuming more effective conservation measures, the world would need to add roughly the equivalent of Saudi Arabia's current energy production every seven years." Report authors further noted that "the implications for future conflict are ominous, if energy supplies cannot keep up with demand, and should states see the need to militarily secure dwindling energy resources." Like the oil officials cited in the 2007 Wall Street Journal report, the Joint Forces Command did not refer to the petroleum problem as one of peak oil – at least over the next decade. They explicitly stated, in fact, that the primary problem for the next ten years is not a lack of petroleum reserves, but rather a shortage of drilling platforms, engineers and refining capacity, a problem that would from their perspective require at least a decade to correct even if corrective action were begun immediately.

The Joint Forces report, while scarcely mentioned in U.S. media, garnered considerable attention overseas. Shortly after its release the German news organization *Spiegel* called attention to a draft report of a German military think tank that had studied the peak oil issue (Schultz 2010). That report is said to acknowledge the possibility of peak production around the year 2010 and to suggest very serious consequences of what is described as a permanent supply crisis, "...including a decline in importance of western industrial nations and shifts in the global balance of power." Also reported were recent efforts within the government of the United Kingdom to develop a crisis plan to deal with possible shortfalls in energy supply. Earlier in the

UK, Chatham House²-Lloyds had released a white paper (Froggatt and Lahn 2010) focused on energy security. The white paper warned of a coming global oil supply crunch, and emphasized the need for businesses to address energy-related risks to supply chains, and particularly enterprises based on just-in-time business models. A key conclusion was that businesses which prepare for and take advantage of the new energy reality would prosper, while failure to do so could be catastrophic.

In November, release of the 2010 edition of the IEA's World Energy Outlook caused another stir among energy futures analysts. In a major shift from previous reporting on the matter, the IEA published a graphic of world oil production indicating that a peak in conventional oil production had occurred a year earlier (Figure 4). Also indicated was what some observers (Hart 2010, ASPO 2011) have called overly optimistic projections of new crude oil discovery.

Figure 4
World Oil Production by Type in the World Energy Outlook
New Policies Scenario, 2010



Source: Morgan (2010)

Meanwhile, many of the world's energy company executives have publicly indicated that peak oil production is at hand (Oil Drum 2010). Shell oil in a recent report (Shell 2011) describes the current situation this way:

“Underlying global demand for energy by 2050 could triple if emerging economies follow historical patterns of development.

In broad-brush terms, natural innovation and competition could spur improvements in energy efficiency to moderate underlying demand by about 20% over this time. Ordinary rates of supply growth – taking into account technological, geological, competitive, financial and political realities – could naturally boost energy production by about 50%. But this still leaves a gap between business-as-usual supply and business-as-usual demand of around 400EJ/a – the size of the whole industry in 2000.

² Chatham House is a well regarded organization dedicated to independent and rigorous analysis of critical global, regional, and country-specific challenges and offering new ideas to decision-makers and -shapers on how these could best be tackled in the near to long term.

This gap – this zone of Uncertainty – will have to be bridged by some combination of extraordinary demand moderation and extraordinary production acceleration. So, we must ask: Is this a Zone of Extraordinary Opportunity or Extraordinary Misery?”

New Petroleum Discoveries

All of the studies reported herein have considered the potential for new oil discoveries and for new techniques of obtaining oil such as from shale and from oil sands. Reports making the rounds of massive newly discovered deposits of oil in the continental United States are, well, interesting. Were they only true they would warrant a serious celebration.

What is referred to in most of these reports is the Bakken Formation, an oil deposit that lies beneath parts of Montana, the Dakotas, and southern Saskatchewan. The good news is that the Bakken Formation is, in the words of the USGS, “larger than all other current USGS oil assessments of the lower 48 states” and “the largest ‘continuous’ oil accumulation ever assessed by the USGS.” The good news gets even better with the revelation, again by the USGS, that recoverable volumes are now estimated at 25 times more than a 1995 estimate. The new figure translates to 3.0 to 4.3 billion barrels of technically recoverable oil, with a mean value of 3.65 billion barrels.

The bad news is that those 3.0 to 4.3 billion barrels are roughly equivalent to only a 5 to 7 month supply for the United States.

Policy Considerations

It has long been recognized that U.S. importation of petroleum is an economic problem, contributing significantly to the national trade deficit. Perhaps more important, as the world’s leading consumer of petroleum, the U.S. – once home to the majority of known petroleum reserves – has only a small fraction of remaining world reserves, a situation that appears increasingly untenable as global consumption rises. Layered over current realities is the looming prospect of limits to global petroleum supply that, if real, could lead to catastrophic consequences for organizations – or nations – that are unprepared.

Recent evidence seems to point to a very real possibility of a disruption in liquid fuels availability, either stemming from a manifestation of peak oil or as a result of having invested too little in extraction technology and refining capacity. Whether impending production limits will result from physical supply limits or other problems would appear to make little difference. Several increasingly important questions loom large: Is the United States ready for a world in which petroleum supplies are insufficient to meet demand? And if not, are contingency plans being developed to deal with this possibility?

At this point, renewable energy makes up a scant eight percent of energy supplies nationally, with development of the two greatest single components, biomass and hydro energy, under attack from a number of quarters. In addition, the recent earthquake and tsunami in Japan appear to have impacted the enthusiasm for development of nuclear energy. So what are our options?

From our perspective, it appears that too many of our elected leaders tend to ignore or dismiss concerns about future energy supplies with the result that zero progress has been made toward development of a meaningful and comprehensive national energy policy, or of contingency plans for dealing with the potential of reduced supplies of traditional energy sources. In this regard we

suggest that legislative leaders give serious consideration to the approach used by the military strategists who developed the Joint Forces Command report. Rather than engaging in debate and acrimony about whether the information, trends, and issues addressed in their report represent absolute truth, those involved simply started with recognition that what was being considered was speculative in nature and not intended as a prediction of the future. Consideration of the best information available and subsequent development of recommendations was for the specific purpose of providing a starting point for further consideration about what might be done at the operational level.

With respect to energy futures, instead of seeking to resolve the question of whether petroleum supplies are likely to peak, and when, military planners simply looked at available data and concluded that supply inadequacy within the relatively near term is a plausible risk. They then looked at strategic, economic, and social implications of risks posed and proceeded to define potential responses within the military establishment. This, we believe, is precisely the approach needed at every level of government – and soon.

The Bottom Line

The U.S. has only a small fraction of world petroleum reserves, a situation that appears increasingly untenable as global consumption rises. There appears to be a realistic possibility that near to mid-term supplies of petroleum may be insufficient to meet desired consumption levels. It also appears that the risks of such a development are high to our economy, lifestyle, and national security, as well as to economies around the world.

Serious, immediate, unified action is needed in developing a focused, no-nonsense energy policy for the nation and for each of the 50 states, and for developing contingency plans in the event of energy supply disruptions. There is similarly a need for businesses large and small to consider energy-related risks to supply chains and to seek to mitigate them. There is simply too much at risk to allow continued inaction on these matters.

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