



Traversing Hubbert's Peak

Between 1859 and 1968, world oil consumption totaled 200 billion barrels used. In 1930, the world found 10 billion new barrels of oil and used 1.5 billion. Peak world oil discovery was in 1964, with finds of 48 billion barrels and usage of 12 billion barrels. By 1988, oil discovery and consumption reached parity, with oil found totaling 23 billion barrels and oil usage consuming 23 billion barrels. In 2005, new oil discovery totaled 5-6 billion barrels while world oil consumption exceeded 30 billion barrels.

Hubbert's Peak is not a summit to be scaled, but refers to the peaking of oil production observed in many oil fields and regions throughout the world, better known as "Peak Oil". Peak oil is based on the fundamental observation that oil is a finite resource. Hubbert's peak originated as a theory presented to the American Petroleum Institute in 1956 by the American geophysicist Marion King Hubbert. His theory modeled known oil field reserves and production rates and stated that early in the production curve the production rate accelerates, due to additional discovery and infrastructure, and that late in the curve production decelerates, due to resource depletion. More generally applied, "peak oil" references the singular point in time when the world attains peak oil production.

In 1974, Hubbert projected that global oil production would peak in 1995. In retrospect, Hubbert's projection was incorrect. Peak oil projections vary greatly, with expected projections generally ranging from as early as 2010 on out to 2030. Nonetheless, experts are projecting a peak. In fairness to Hubbert, his research focused on "easy" oil or oil that was produced and discovered by means of conventional methods at the time. Clearly over the past thirty years, advanced technologies have enhanced production rates and new discoveries, resulting in increased world resource base estimates. As oil resource base estimates trend higher, peak oil projections are extended.

International Energy Agency (IEA) - Resources to Reserves

- Oil and gas totaling 1.5 trillion barrels of oil equivalent (boe) have been produced to date. Roughly the same amount will be needed to meet demand over the next 25 years.
- The world contains at least 20 trillion boe of oil and gas. Some 5 to 10 trillion boe are technically recoverable today.
- The challenge is to ensure that the vast amounts of technically recoverable resources are also economically recoverable. This means turning "resources" into proven "reserves".
- Technology is the key to achieving this at prices that do not threaten economic growth around the world.
- Technologies are urgently needed to ensure:
 - Greater efficiency
 - Enhanced oil recovery techniques
 - Improved deep water technologies
 - Technologies for non-conventional resources

U.S. Production, Demand and Consumption

Hubbert did correctly project peak oil production in the United States with his peak oil projection of 1965 - 1970. According to the Energy Information Administration (EIA) U.S. oil production actually peaked in 1970. In fact, U. S. proved oil reserves peaked in 1959 and has been steadily depleting since then. Since 1980, U.S. proved oil reserves have declined by approximately 28%. During the same period, total oil and petroleum products consumed by the U.S. increased by nearly 16%. To put it in perspective globally, The U.S. consumes more than 20% of world oil production, while producing less than 10% of world oil output. Consequently, the U.S. is the largest importer of energy products.

Transportation is the largest source of petroleum product consumption in the U.S., consuming 67% of the total oil products supplied. During the decades of the 1960s and 1970s, gasoline product consumption increased by 40% and 45%, respectively. Following the oil price spike of the 1970s, conservation and technologically improved efficiencies worked, resulting in gasoline consumption growing by only 3% through the 1980s. However, consumption re-accelerated in the 1990s to a 12% growth rate and the trend so far in the new millennium has gasoline consumption growing by nearly 15% this decade. Increased gasoline demand along with a backdrop of gasoline reformulation regulation pressures, hurricane destruction, and a reduction of petroleum refineries by more than half since 1980, goes a long way in explaining the anxiety and volatility of pricing in recent years. In September 2006, an estimated 20.7 mb/d (million barrels per day) of petroleum products were supplied for domestic use. Transportation fuels accounted for 73% of the total and motor gasoline demand alone was estimated at 9.2 mb/d.

Globalization: Increased Demand, Tight Surplus Capacity

In our May 2004 publication of *Investment Watch*, we reported that world oil demand increased by 7.9% between 2000 and early 2004, to a demand level of 82 mb/d. During the same time period world oil supply grew by only 7.5%. Since then, world oil demand has grown to an estimated 85.3 mb/d in 2006, up another 4%, with a projected 1.4% increase in 2007. In general, history demonstrates an average annual increase in world oil demand of 1%-1.5% with an accompanying increase of supply at an average rate of 1%-1.5%. So what's changed?

In retrospect it's pretty clear. Following the Asian crisis of 1998 and a global recession in 2001, excess oil inventory accumulated. Energy prices tumbled, world oil production trends decreased, and capital development directed toward future oil production resources declined. By early 2002 world oil production surplus capacity exceeded oil demand by more than 5 mb/d, or approximately 6-7%. In 2003, a world economic recovery emerged and world oil demand increased, narrowing production surplus capacity. The year 2004 brought a surge in non-OECD (Organisation of Economic Cooperation and Development) nation oil demand followed by a significant demand increase in 2005. By the end of 2005, increased demand, geo-political conflicts, and hurricane destruction left

world oil surplus capacity near a mere 1 mb/d, or 1.1%. The supply/demand capacity surplus was the tightest on record.

Since 2005, world production capacity has increased, particularly from non-OECD countries, and demand growth has moderated toward a more typical 1.5% demand growth rate. However, adequate surplus capacity remains a challenge looking forward. Of the 1.2 mb/d demand increase in 2005, non-OECD demand accounted for 1.1 mb/d with much of the demand growth originating in non-OECD Asia (particularly China and India). Non-OECD oil demand accounts for three-fourths of the increase in world demand and is projected to surpass the developed nation's energy use by 2015. IEA (International Energy Agency) projected world oil demand growth assumes average growth of 1.4% per year with energy prices rising based on demand growth of the world economy. According to the *International Energy Outlook*, OPEC production capacity is expected to supply 1.5% growth per year to 2030. Given that OPEC's capacity utilization currently operates in excess of 90%, it is clear that in order to achieve a more comfortable 5-6% capacity surplus, increased oil production capacity, and investment, must focus on non-OPEC and non-OECD countries.

World production - Supply Peak

"Earth's endowment of conventional reservoirized crude oil is a large but finite volume. Production from it may well peak within the century. All or very nearly all of Earth's prolific petroleum basins are believed identified and most are partially to near-fully explored. All or nearly all of the largest oil fields in them have already been discovered and are being produced. Production is indeed clearly past its peak in some of the most prolific basins."

Long-Term World Oil Supply Scenarios (EIA 2006)

As earlier mentioned, U.S. known oil reserves peaked in 1959 and production peaked in 1970. According to Chevron, "oil production is in decline in 33 of the 48 largest oil producing countries." Mexico's Cantarell oil field peaked in March of this year and production is in decline, while Kuwait announced declining output of the Burgan field in 2005. Together, Cantarell and Burgan are two of the three largest oil fields in the world and the No. 1 field in the world, the Ghawar field in Saudi Arabia, is expected to be close to peaking.

Many of the major oil producing countries have already passed their discovery peak and their production peak. Here is a list of just a few with the year of peak production: Canada (1973), Mexico (2002), Venezuela (1970), France (1988), Germany (1966), Ukraine (1970), Oman (2001), Syria (1995), Yemen (1999), China (2005), India (2004), and Indonesia (1977). Retrospect is the only certain way to identify peak oil production and while the amount of oil remaining in the ground is not certain, production output is a measurable quantity that identifies trend.

Increased Production – Elevated Risks

As stated in the *International Energy Outlook* (IEO), world oil demand is expected to grow from 80 mb/d in 2003 to 98 mb/d in 2015. To meet the projected increase in world oil demand,

OPEC producers are expected to increase investment and increase production capacity to satisfy part of the increased world needs. Non-OPEC oil production is expected to supply the difference, which represents 62% of the increase in total world oil demand. Russia is the largest non-OPEC oil producer by a factor of more than two times, producing 8.5 mb/d, followed by South and Central America (4.2 mb/d), and China (3.4 mb/d). Non-OPEC production is expected to increase because higher oil prices substantially increase non-OPEC oil production. Simply put, higher oil prices produces more oil and lower oil prices produces less oil.

Despite efforts to slow growth, China's economy is growing in excess of 10%; thus energy consumption and production are on the rise. India's economy is expanding at close to 9% with some signs of potential overheating. Brazil's growth has re-accelerated following a slowing in the 2nd quarter and appears to have averted a potential currency crisis. Russia, bankrupt a decade ago, has experienced eight straight years of economic growth, with 2006 growth estimated near 7%. Oil and Gas accounts for 65% of Russia's exports and 60% of federal tax receipts. Russia is now the world's largest gas exporter and second biggest oil exporter, after Saudi Arabia.

The following list points to a few other countries where oil production can be increased: Algeria, Angola, Chad, Iran, Iraq, Kazakhstan, and Vietnam. Without question, a significant drop in oil prices would alter the growth path and wealth of BRIC (Brazil, Russia, India, and China) and others, potentially further elevating geo-political risks, economic disaster, and world destabilization.

The Future: More Oil... More Money... More Places

Conservation can reduce oil consumption and alter the peak oil curve. Following the oil shock of the 1970s, mitigation proved a valuable tool in reducing consumption. The implications of crossing Hubbert's peak means continued oil production decline, so demand must be reduced to meet supply.

Peak oil theory does not consider future technological advancements that have historically pushed the peak oil curve forward in time. Technology is a tool that can and will be deployed, especially with higher prices. As mentioned earlier, higher oil prices produces greater oil production.

Alternative energy sources, such as ethanol, bio-fuel, tar sands, oil shale, etc. will play a significant part in pushing out the peak oil curve. But unintended consequences will arise. As an example, corn pricing has more than doubled in the past year as a result of increased ethanol production, raising livestock feed prices and diverting corn from food products.

Energy experts argue that under investment in the oil industry has been in place since the oil price collapse of 1986, which led to surplus capacity of 20%. Currently, the industry is rebounding from twenty years of under investment and a more recent tight capacity surplus. There are no clear signs that ample capital has yet been deployed to alter supply/demand conditions. The future will require more capacity... more capital development... in more obscure parts of the world.

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