The Quest: Securing the Supply

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11 - Is the World Running Out of Oil?
Peak Oil

- Peak Oil Theory is the theory that the world is either at or near max oil production
- Some say that the ramifications of peak oil could include:
  - Chaos, war, extinction
- Peak oil did not account for future developments in oil field technology
- The date of the peak has been pushed back multiple times
- Demand keeps rising, and experts predict that the peak will be more of a plateau
Risks Above Ground

- The International Energy Agency (IEA) estimates that over the next 25 years new development will require up to $8 trillion.
- Funding for oil projects comes from investors who are risk-averse.
- There are many risks inherent to oil projects beyond technical difficulties.
  - Regulation, National Stability, War.

Source: Shiloh Musings

Troop movements during the Yom Kippur War of 1973

Source: Shiloh Musings
Running Out of Oil - For the First Time

- The world has been thought to be running out of oil at least five times
- The first successful American oil well was drilled in 1859 by Colonel Edwin Drake in Titusville, PA
- The primary use of oil for the first 40 years of American production was illumination
- Gasoline, a byproduct of lamp oil distillation, was dumped into rivers
- It was a commonly held opinion that oil would one day disappear
  - In 1885 the state geologist of PA declared oil to be a “temporary and vanishing phenomenon”
  - Shortly thereafter new fields in Kansas, Ohio, Texas, and Oklahoma were discovered
Running Out of Oil - Deja Vu

- The United States experienced an oil famine during WW1
  - War had become a mechanized affair utilizing tanks, trucks, and planes
  - American oil went to support European allies, causing “Gasolineless Sundays”
- It was largely believed that oil had won the war for the Allies, but that oil would disappear
  - Securing new reserves became a real concern
- Use of new war-driven technology advances such as seismic technology
- Discovery of new fields in Texas and elsewhere
Running Out of Oil

- WW2 increased world demand for oil
  - 6 out of 7 billion barrels of oil used by the allies were American
  - Oil was part of the reason for the invasion of the USSR, and Rommel’s failure
  - After the war, America was an importer of oil, stoking fears, then new production came online in the middle east

- Oil shortage fears appeared again in the 70’s due to a booming economy
  - Oil price jumps were exaggerated by war and revolution in the middle east
  - New production was brought on, cars became more efficient, and power plants switched from oil to coal and nuclear, causing the 80’s glut
Running Out of Oil - For the 5th Time

- Modern day challenges facing the oil industry’s ability to meet demand include:
  - New demand from emerging economies
  - Climate change and relevant regulations
  - Geologic considerations

- Modern day peak oil supporters see the world’s oil fields as a full beer, and the world’s population as a person drinking it
  - One day we will run out they say, but nobody knows how large the beer is
Hail to the King

- M. King Hubbert was the creator of Peak Oil Theory
- An eminent earth scientist with a grating personality
  - Referred to by a former student as “arrogant, egotistical, dogmatic, and intolerant of work he perceived to be incorrect”
- Hubbert was a technocrat
  - Believed that society should be ruled by scientists, not politicians and economists
- Modeled oil field production on a bell curve
- Predicted US production would peak during 1965-1970, it did
U.S. Crude Oil Production and the Hubbert Curve

Source: U.S. Energy Information Administration

www.truewealthpublishing.asia
Why Supplies and Production are Growing

- Hubbert did not account for the discovery of new fields, or increases in reservoir recovery.
- One of the sources of new reserves Hubbert didn’t know about was Saudi Arabia’s Ghawar field.
  - First drilled in 1948, it is the largest oil field in the world and produces over 5 million barrels per day at 50+ years old.
- Hubbert also did not account for the fact that as prices increase, reserves grow.
- Peak oil proponents argue that the rate of oil field discoveries has declined in recent years.
  - But reserves are still increasing, due to “additions”.
  - Revisions of reservoir capacity as new data is gathered.
  - 86% of US oil reserves are the result of revisions, not discoveries.
How Much Oil?

- At the end of 2011, the world had 1.65 trillion barrels of proved oil reserves, slightly more than at the beginning of the year
  - Additions were sufficient to replace oil used
- Replacing production is expensive and requires a long time horizon
- Currently there are about 5 trillion barrels of oil resources, and 1.4 trillion barrels of reserves in the world
- In 2010, oil production was about 92 million barrels per day (mbd), by 2030 it may be 114 mbd
12 - Unconventional

An oil rig off Angola’s coast

Source: World Finance
Unconventional Oil

- Unconventional oil sources vary widely, but all require advances in technology to be made viable.
- Unconventional sources of oil include:
  - Liquids with gas
  - Offshore
  - Oil sands
  - Oil shales
  - Tight oil
  - Oil produced from coal and other hydrocarbons
Offshore Oil Production

- Offshore oil drilling was invented in the 1880’s by H.L. Williams off the coast of Santa Barbara, California
  - Unsuccessful business venture
- Today 27% of world production, or 25 mbd is produced offshore
- Offshore shallow drilling was proven a success by Kerr-McGee in the Gulf of Mexico
  - Small company fighting for Class-A acreage in 1947
- State vs Federal gov’t for rights to outer-continental shelf taxes
- By the 1960’s shallow offshore was a large industry
  - A well blowout occurred in Santa Barbara in 1969, forever pitting environmentalists against offshore drillers
Non-Opec and New Frontiers

- Nine months after the Santa Barbara disaster, Phillips Petroleum discovered the massive Ekofisk oil field.
  - Experienced substantial investment due to oil scarcity fears of the 70’s.
  - By 1985 produced 3.5 mbd and served as a pillar of non-OPEC.
  - Total OPEC production in 1985 was 13.7-18 mbd.

Source: Subsea World News
Non-Opec and New Frontiers

- Petrobras was the first company to drill a well in deepwater, at 2,562 ft of water in 1992.
- In 1994 Shell’s Auger oil platform went into production in the Gulf of Mexico:
  - 26 stories tall standing over 2,864 ft of water
  - Took 9 years and $9 billion to build
  - Eventually reached 100,000 barrels per day of production
- By 2009 the Gulf of Mexico was the world’s fastest growing oil province, supplying 30% of US domestic demand through shallow and deep water platforms.
Deepwater Horizon

- The Deepwater Horizon was a drilling platform leased by British Petroleum (BP)
- The rig had just finished drilling the “well from hell,” the Macondo well
  - 48 miles off the coast of Louisiana
  - Fought through gas kicks, 5,000 ft of water, and 13,000 ft of rock
- The Macondo well had been drilled, and was being plugged so that it could be produced at a later date
- On April 20th, 2010 at 7:55pm oil and gas began to seep around the plug
- A device called a blowout preventer was meant to prevent a catastrophic release of gas, but failed to completely seal the well when activated
  - At 9:49pm, gas that had been escaping the well caught a spark, causing an explosion
Deepwater Horizon Aftermath

- The explosion killed 11/126 crew members
  - The rig sank 2 days later
- There was no established method for stopping oil flow resulting from a deepwater accident
  - It took 88 days for a newly designed capping stack to be installed, sealing the well
  - 2 months after that, mud and concrete was pumped into the Macondo well, “killing” it
- 6,700 ships and 45,000 people participated in the cleanup
- Damage was not as bad as expected thanks to hydrocarbonistic microbes eating the oil
Deepwater Horizon Aftermath cont.

- 3 weeks prior to the Deepwater Horizon accident President Obama had begun the process of allowing companies to drill in new areas off of America’s coast
  - Proposals removed after the accident
- Short-lived moratorium on drilling in the Gulf of Mexico
- 1 regulatory agency split into 3: one for licensing, one for safety and environmental regulation, and one for royalties
  - Federal safety inspectors, to avoid appearing cozy with the oil industry, could not accept anything while on an inspection, including water
- Oil companies collaborated to establish several companies meant to respond to deepwater accidents in the future
- Oil production in the Gulf will continue due to its economic importance in the region
North American Mega-Resource

- The Canadian oil sands are located in Alberta
  - Viscous bitumen embedded in sand and clay
  - Must be heated to allow oil to flow
- Two methods of extraction:
  - Conventional: Shovel and truck mining method
  - In-situ: Use superheated steam to stimulate wells
- In-situ extraction caused Canada’s oil reserves to jump from 5 billion barrels to 175 billion, giving them the world’s 2nd largest reserves

Source: Oil Sands Magazine
Tight Oil

- Tight oil is colloquially referred to as shale oil, and is oil that is found trapped in shale.
- Advances in hydraulic fracturing and horizontal drilling have made tight oil an important element of American reserve growth over recent years.
- Could give America an additional 20 billion barrels of oil that aren’t in Alaska.

Source: Aspen Public Radio
13 - The Security of Energy

A NOAA satellite image of Hurricane Katrina from 8-28-5

Source: Encyclopedia Britannica
The Importance of Energy

- Electricity is necessary for the internet age
- Oil is necessary for sea, land and air transport
- In 1911 Winston Churchill decided to switch the Royal Navy’s ships to oil power
  - Said it would increase mobility and firepower in arms race with Germans
- Critics said that this was foolhardy, as Britain had coal but no oil
- Churchill responded with “Safety and certainty in oil lie in variety and variety alone”
The Vulnerability of Energy

- Hurricanes Katrina and Rita struck the Gulf Coast in 2005
  - Caused catastrophic damage to electrical, transportation, and communications infrastructure
  - Production, receiving facilities were down, causing an integrated energy shock
- The 2011 Japanese earthquake and tsunami took down electricity, services, communication, transportation, and response efforts
- Both of these events have shown us how vulnerable the modern world is to disruptions in the energy supply
The Security of Energy

- Energy Security: the availability of a sufficient supply of energy at affordable prices
- Importers secure a supply of energy
- Exporters secure a demand
- In 1973 President Nixon coined the phrase “Energy Independence” as part of a push to increase US domestic output in response to the 1973 embargo
  - Stated that energy independence meant an ability to meet all domestic demand without imports
- Today energy independence can mean two things
  - Lack of imports
  - Security of the supply chain
The International Energy Agency

- The oil embargo of 1973 caused strife and turmoil within the US and between western allies
- In response, the Energy Treaty of 1974 was signed in Washington DC
- The treaty established the IEA, an agency meant to coordinate the western response to future uses of the “oil weapon”
- The IEA is headquartered in Paris, France and consists of 28 industrial nations
- Helps to foster dialogue between oil producers and importers
The Strategic Petroleum Reserve

- Part of the IEA’s job is to oversee the strategic stockpiles of oil maintained by its member nations and to disperse supplies in times of need.
- The worldwide IEA stockpile is 1.5 billion barrels, with the US maintaining 700 million barrels of oil in its Strategic Petroleum Reserve.
- Oil from these reserves is meant to be used solely in response to supply disruptions.
  - Used 1st time during the Gulf Crisis
  - Used 2nd time in response to Katrina
  - Used 3rd time in response to Libyan War

Source: Selous Foundation

SPR storage locations
Cybersecurity is a major threat to all modern infrastructure - Including pipelines and power stations

China and India must be brought to the table

National stability, war, disasters, and pirates are all threats to the supply of oil

In the Malacca straits alone, 15.2 mbd of oil and ⅔ of internationally traded LNG are transported
14 - SHIFTING SANDS IN THE PERSIAN GULF
The 1956 Suez Crisis
  - Egypt’s expropriation of the Suez Canal triggered an invasion by Britain, France and Israel
  - As a consequence of the crisis, technological advancement in development of larger tankers that
    could sail around Africa instead of using the canal.

In 1967, Arab oil embargo against the US, Britain, and West Germany for Israel’s victory in
the Six Day War - Failed

1973 embargo for U.S. resupply of Israel - Successful
  - Resulted in increased oil prices

The 1978-79 Iranian Revolution also delivered another oil shock

1990 invasion of Kuwait led to loss of 5 million barrels a day of supply from Iraq and Kuwait

2003 invasion of Iraq shut down its oil industry
  - Resulted in the oil price spike of 2008
The Center of Gravity of World Oil

- The Roosevelt administration, in 1943, sent Everette Lee DeGolyer to Persian Gulf to assess the petroleum potential.
- In 1926, one petroleum company decided that Saudi Arabia was “devoid of all prospects” of oil.
  - Suggest the big reserves would be found in Albania.
- In February 1938, Anglo-Persian and Gulf Oil found petroleum in Kuwait.
- Chevron and Texaco did the same in Saudi Arabia next month.
- DeGolyer reported that “The center of gravity of world oil production is shifting from the Gulf-Caribbean area to the Middle East - to the Persian Gulf area.”
One Quarter of World Reserves

- In 2010, Saudi Arabia’s output averaged 8.2 million barrels per day
- The country’s entire industry is operated by the state-owned Saudi Aramco
  - It has over 100 fields that contain nearly 370 reservoirs
- The part of Saudi Arabia that is heavily explored is relatively small
- Kuwait and Abu Dhabi each produce about 2.3 million barrels per day
- Qatar pumps 0.8 mbd oil
The “Hinges” of the World Economy

- Al-Qaeda has targeted what it has called the “hinges” of the world’s economy
- When Al-Qaeda first emerged in the 1990s, energy systems were not targets
- In 2004, it proclaimed the oil industry a legitimated target
  - As long as long-term oil production was not damaged
- Bin Laden urged attacks on oil targets as part of the economic jihad against the US
  - Wanted to drive oil to $100 a barrel with the aim of bankrupting the country
- A raid in September 2005 near the largest Saudi oil field discovered the practical tools for this new doctrine
A Critical Node

- The vast Abqaiq processing plant is 60 miles from Saudi Arabia’s largest oil field
  - One of the most critical nodes in the global supply system
  - Up to 8% of total world supply passes through this facility everyday
- On February 2006, the facility was unsuccessfully attacked by terrorists
  - The suicide explosions caused by them did no damage to the facilities
- The remaining shooters that escaped were killed by the police in a few days
- In the aftermath, the Saudi government moved to further enhance security
- For their part, the Arab oil-exporting countries along the Gulf have substantially deepened security and honed their intelligence operations
The Social Foundations

- In December 2010, a fruit vendor set himself ablaze in Tunisia in front of the municipal building in protest of the corrupt police and government.
- The footage of his fate set off a blaze that burned across the Middle East, shaking down the political order and bringing down part of the geostrategic structure of the region.
- The protest movement spread to Egypt.
  - Hundreds of thousands of people in Cairo demanded the resignation of President Hosni Mubarak.
  - On February 11, 2011, Mubarak gave up power.
- In Bahrain, when protests turned into protracted violence, the Gulf Cooperation Council, led by Saudi Arabia, sent troops into the country.
- Social instability had become a critical factor for energy security.
- Oil prices surged, taking the Brent price towards $130 a barrel.
- As long as there was uncertainty about the Middle East, oil prices would reflect the risk premium.
Iraq’s Potential

- Six years after the U.S. invasion of Iraq and after years of violence, oil output was almost back to the 2001 level of 2.5 million barrels per day.
- By 2020, Iraq can produce around 6.5 million barrels per day.
- That target faces obstacles and uncertainties. It requires:
  - Political stability
  - Physical security for oil fields and pipelines
- One further obstacle is Iran:
  - Iran does not want Iraq to supplant it as the 2nd largest producer in the Gulf and in OPEC.
“The Great Satan”

- Iran’s new leader after the Iranian Revolution in 1979, Ayotollah Khomeini, hated Israel and the US
- The U.S. support for the 1953 coup that toppled the nationalist prime minister Mohammad Mossadegh and brought back the shah was a powerful historical memory that fundamentalists could manipulate
- By 1992, Iran had earned the title of “the most dangerous sponsor of state terrorism
- After Khomeini’s death in 1989, the new government tried to reduce tensions with the US through commercial relations
- Iran also offered to train 20,000 Afghan troops under U.S. leadership
- Moreover, some dialogue was resumed during the early phase of Iraq war
- However, that dialogue was closed with the 2005 election of Mahmoud Ahmadinejad
  - He told the UN that the 9/11 attacks were orchestrated by the U.S. government
- With Iraq demolished as its regional rival, Iran communicated its ambition to dominate the Gulf
The Game Changer

- The biggest threat to the balance of power in Gulf is Iran’s pursuit of nuclear weapons
  - It obtained the know-how and technology from the Pakistani Abdul Qadir Khan network
- Iran temporarily halted its enrichment program in 2003 under pressure from Europe
- In 2006, the program entered a new phase with the activation of a large number of centrifuges to
  enrich uranium
  - Iran, however, claims that the enriched uranium is exclusively for its civilian nuclear program
- Iranian possession of such weapons would create insecurity for the region and world oil supplies
- The US and Europe have mounted increasing array of sanctions that restrict investment, trade and
  flow of finance
- The timing as to when Iran would cross a red line in its nuclear program is uncertain, as is the
  response of those who feel most threatened by it
15 - GAS ON WATER
Thomas Cabot started writing a scientific paper concerned with cryogenics - the study of very low temperatures, at which various gases turn into liquids. Cryogenics was based on the work of Michael Faraday. Cabot wanted to explore how extreme refrigeration could be used to compress natural gas into a liquid, enabling it to be held in storage when demand was low and returned to its gaseous state when demand was high. After World War II, interest in LNG shifted to using it as a way to transport gas over long distances.
Killer Fog

- In December 1952, a killer fog gripped London
  - It resulted from the interaction of weather conditions and coal smoke
  - The government imported LNG to replace coal with a cleaner fuel
- Royal Dutch Shell bought controlling interest in the nascent LNG company and started developing a large natural gas deposit in Algeria
- In 1959, a huge gas field was discovered in the northern part of the Netherlands
- In 1965, natural gas deposits were also found in the British sector of the North sea
  - This caused Britain to shift to natural gas for appliances and heating
- The first LNG arrived in Japan in 1969 from the United States
  - South Korea and Taiwan also became major LNG importers
THE “FUEL NON-USE ACT”

- Natural gas became a continental business, in which the main population and industrial centers were connected to gas fields that were far across the country.
- By the beginning of 1970s, natural gas provided 25% of America’s total energy.
  - But then a natural gas shortage gripped the country.
- It turned out the natural gas shortage was due to inflexible regulation.
- The Natural Gas Policy Act of 1978 started to decontrol prices.
  - Provided distinct pricing schedules for 22 different categories of a commodity that was more or less all the same.
- Congress enacted the Fuel Use Act that banned the burning of natural gas in power plants to produce electricity.
- Deregulation led to a surge in supplies and prices settled at lower levels.
- The low-cost domestic gas turned the LNG business into a bust.
- It started proving harder to step up gas output from existing basins.
  - In the face of rising demand and flat supply, the market tightened.
● The answer once again seemed to be LNG
  ○ Cabot not started to look for new LNG supplies
  ○ One possible source was Trinidad
● Cabot succeeded in bringing down costs of LNG substantially by simplifying designs and promoting much more competitive bidding
The Crown Jewel

- The North Field was discovered by Shell in 1971 in the waters off Qatar
  - Today its reserves are estimated at 900 trillion cubic feet
- In the same year, Mobil Oil discovered Arun, a huge offshore natural gas field in the northern part of Sumatra, the largest of the 17,000 islands that comprise the nation of Indonesia
  - But a problem emerged - Arun’s output appeared set to decline
- Qatar’s emir was determined to turn his small Persian Gulf principality into a global energy giant based on LNG
  - The merger of Mobil with Exxon in 1999 made the great expansion more doable
  - By 2007, Qatar had leapfrogged over Indonesia and Malaysia to become world’s number one supplier of LNG
- Natural gas had become a global commodity
THE NATURAL GAS REVOLUTION
“Figure A Way”

- Gas could be extracted from shale rock
  - Mitchell Energy owned a large region called Barnett Shale
- Producing commercial-sale shale gas was proving difficult
- In 1997, only Mitchell Energy and few other smaller independents were left developing shale gas
- The introduction of 3-D seismic improved the understanding of the subsurface
  - Still, Mitchell Energy had not cracked the Barnett’s code
Breakthrough

- Fracking - also known as hydraulic fracturing - injects large amounts of water, under high pressure, combined with sand and small amounts of chemicals, into the shale formation
  - This fragments underground rock, creating pathways for trapped natural gas to find a route and flow through to the well
- Mitchell Energy, by the end of 1998, successfully adopted a fracking technique known as LSF, or light sand fracking, to break up the shale rock
- In 2002, Devon Energy acquired Mitchell Energy for $3.5 billion
- Devon combined the fracking know-how acquired from Mitchell with its own skills in horizontal drilling
  - Shale gas, heretofore commercially inaccessible, began to flow in significant volumes
The “Shale Gale”

- Over the next few years, the output of shale gas continued to increase
  - Some now started to call it the “Shale gale.”
- In 2000, shale was just 1% of natural gas supply. By 2011, it was 25%, and within two decades it could reach 50%
- With the new abundance and lower prices, lower-carbon gas seemed likely to play a larger role in electricity generation
- Shale gas also began to have an impact on both climate change and energy security policy
- Critics warn that fracking may damage drinking water aquifers
- In fracking, the water that flows back to the surface is called “flow back” and then the “produced water” comes out of the well over time.
- This water needs to be handled properly, managed and safely disposed. 3 things can be done:
  - It can be injected into deep disposal wells
  - It can be put through treatment facilities
  - It can be recycled back into operations
● The industry is now recycling 70 to 80% of the flow back
● A recent concern is “migration”
  ○ Whether methane leaks toward the surface and into some water wells as a result of fracking
● Gas developers are now routinely taking such measurements before drilling begins in order to establish whether methane is pre-existing in water aquifers
● Some argue that drilling is an unregulated activity
  ○ In fact, the entire drilling process is heavily regulated by a mixture of state and federal agencies
● The next several years are surely to see a substantial addition to the world’s supply of natural gas
Global Gas

- In 2010, Qatar celebrated reaching 77 million tons of LNG capacity - 28% of the world total
- Australia is emerging as a new LNG powerhouse
- Between 2004 and 2012, the world’s LNG capacity will double
- Freely available LNG, sold on a spot basis, can take some market share away from pipelines
  - This not only creates competition among gas suppliers, pushing down price
- In the 1970s, a new pipeline brought the first Soviet gas into Europe in the 1970s
  - The gas trade, for the Soviets, became a major source of hard currency earnings
“Wounded By A Friend”

- By the early 1980s, major discoveries in West Siberia had propelled the Soviet Union ahead of the United States as the world’s largest gas producer.
- The Reagan administration struck back at the proposed new pipeline. It imposed a unilateral embargo that prohibited companies from exporting the billions of dollars of equipment that was essential to the construction and the operations of the pipeline.
- The British government ordered the British companies that had contracts with the Soviets to ignore the embargo and to go ahead and ship their goods.
- In the 1990s the earnings from gas exports would prove a critical source of revenues for Russia.
The Emergence Of Gazprom

- Out of the Soviet collapse, and specifically out of the Ministry of Gas Industry, a new Russian gas company emerged: Gazprom
- In mid-2008, Gazprom’s stock market capitalization catapulted to more than $300 billion
  - The company produces over 80 percent of Russia’s total natural gas output
- Gazprom, while retaining its primacy at home, has also been moving to become a global diversified energy company
- In order to promote “competition,” the European Union was seeking to break up the integrated companies that had helped build the market and move away from the stability of 25-year contracts that the companies had used as the building blocks.
UKRAINE VERSUS RUSSIA

- No relationship was more complex than that with Ukraine.
- Gas complicated the new relationship between the two countries.
- Ukraine was heavily dependent on gas from Russia. It has the most energy-intensive economy in the world.
- In its relations with Russia, Ukraine had one trump—the pipeline network, which carried over 80% of Russia’s gas exports to Europe.
- Ukraine owed Russia billions of dollars in unpaid bills for gas.
- On January 1, 2006, Gazprom had begun to cut gas deliveries directed to Ukraine itself.
- Over the next couple of years, natural gas became a heated subject of contention and suspicion between East and West.
The Russians were determined to get around Ukraine and Poland with a series of new pipelines. Gazprom and ENI had already built Blue Stream, which crosses the Black Sea from Russia to Turkey and is the deepest underwater pipeline in the world. Russia also launched a large pipeline project, Nord Stream. It travels under the Baltic Sea from near St. Petersburg to northern Germany. EU and European proposals aimed at bringing non-Russian gas to Europe. This clash of pipeline politics is further unsettled by the potential for alternative new supplies—from the global LNG market. And then there is the potential for shale gas. There is no geologic law that restricts shale gas to North America.
A Fuel For The Future

- Natural gas is a fuel of the future
- Its share of the total energy market is growing
- It is a relatively low-carbon resource
- A few years ago the focus was mainly on rapid growth in LNG
- The arrival of shale gas has, for the time being, disproved that assumption