
Securing The Supply

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Chapters Covered

11. Is the World Running Out of Oil?

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11. Is the World Running Out of Oil?

- Peak Oil Theory: The world is at or near maximum output
- Consequences: Chaos!
- Aboveground risks (Unrelated to physical resources)

Running Out Again and Again

1859 - Discovery of Oil in Titusville, PA. Main market was illumination (oil lamps)

Times the world “ran out” of oil:

1. 1885. Oil was a “Temporary and vanishing phenomenon” - Then oil was found in Oklahoma, Texas, Ohio, and Kansas. Rise of the Automobile
2. WW1. Use of oil to fuel the war and growing numbers of automobiles. Seismic technology emerged from the war and further discoveries were made and in 1931 the East Texas oil field was discovered
3. WW2. 6 out of 7 billion barrels used by allies were from the United States. Discovery of the Middle East fields.

Running Out Again and Again (cont.)

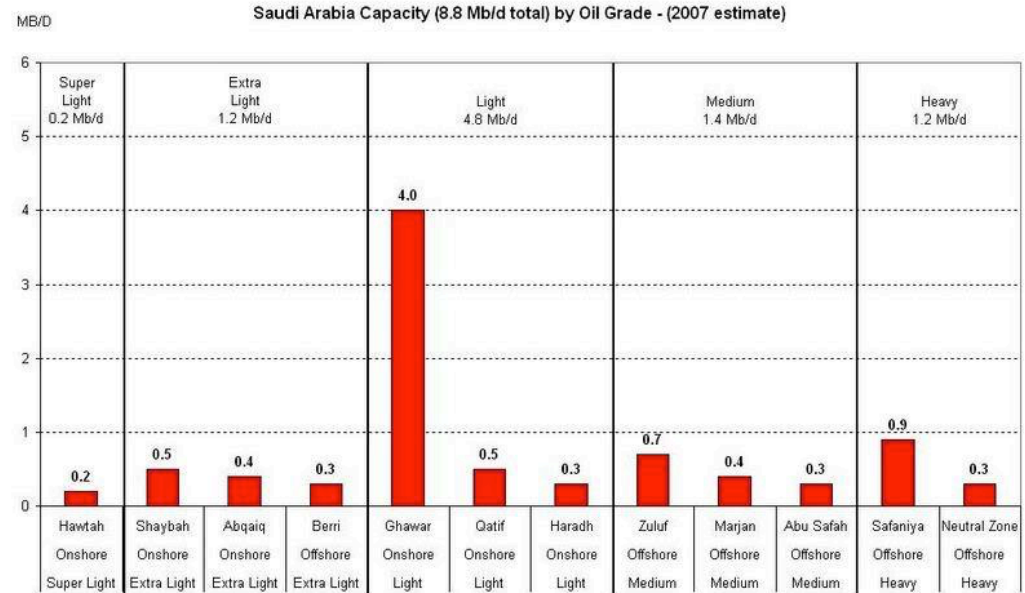
4. 1970s. October War by Arab countries on Israel in 1973. Embargoed oil shipments to the West. Prices Quadrupled. Followed by Iranian Revolution in 1978. Discovery of Alaska's North Slope and Oil fields in the North Sea.
5. 21st Century "Peak Oil" - Oil consumption in China, concerns on climate change, moving away from carbon based fuels.

Supplies continue to grow due to innovation and modern technology.

The Supergiant

Ghawar Field:

- Largest oil field in the world.
- First drilled in 1948.
- Network of five fields.



Saudi Aramco, 2007

Discoveries vs. Additions

- Reservoir discovery rates are declining.
- Large estimates of supply come after development of wells and studying the fields.
- 86% of oil reserves in the US are a result of revisions and additions that came after further development.

How Much Oil?

- Proven reserves 1.5 trillion barrels (2009).
- Estimates for total stock of oil keep growing.
- Total of 1 trillion barrels since the inception of the industry.
- Estimates of 5 trillion barrels in resources.
- 93 million barrels/day in 2010, estimate for 2030 is 110 million barrels/day.
- Access to resources is required and widening of the definition of oil to unconventional oils.

12. Unconventional

Unconventional Oils are oils that depend on advances in technology to be developed.

- Invention of Offshore Drilling:
 - 1880s, H.L. Williams in Summerland ranch, Santa Barbara, CA.
 - Oil discovered beneath the ranch and he decided to drill into the seabed.
- 30% of total world oil production today is from offshore
 - Deepwater production in 2010 [6 mb/d].
 - Deepwater production in 2020 [10 mb/d]

Early Offshore Development

- In the Beginning of the 20th Century: Limited to platforms in lakes
- In 1947, Kerr-McGee found oil in the Gulf of Mexico, 10.5 miles offshore.
- Development in the Gulf of Mexico was stalled by legal battles over ownership of the waters and who receives the tax revenues and royalties.
- By the end of the 1960s, Offshore production became a significant source of oil.
- In January 1969, a blowout in Santa Barbara, CA put a stop to new drilling off the coast of California

Early Offshore Development (Cont.)

- The North Sea: Discovery of the Ekofisk oil field in 1969 by Phillips Petroleum.
- Quadrupling of oil prices in 1973 had Western governments pushing for development of new sources, which developed the offshore industry.
- By 1985, the North sea was producing 3.5 mb/d.

Deepwaters

- In 1992, Petrobras, Brazil's state owned oil company, placed the Marlim platform in 2,562 ft of water.
- Seismic technology was used to explore deepwater prospects in the Gulf of Mexico.
- In 1994, the Auger platform went into production in 2,864 ft of water. Producing 100,000 barrels/day.
- 1.5 mb/d in 2000 to 6 mb/d in 2010 from Deepwater production
- “The Golden Triangle” - Brazil, West Africa, and the Gulf of Mexico

Deepwater Horizon

- Executives from TransOcean and BP awarding the team for their safety record on April 20th, 2010.
- The team has been having troubles with gas kicks in the Macondo prospect for a while, it was called the “well from hell”.
- At night, oil and gas started seeping out through the cement and a blowout was occurring.
- The fail-safe blowout preventer was activated but its sheer rams failed to cut through the pipe. Multiple explosions happened.
- 11 crew members lost their lives and the platform sank two days later.



Deepwater Horizon Aftermath

- No established methods for stopping the flow.
- Relief well would take 3 months.
- Mid-July 2010, a newly designed capping stack was put in place and it finally ended the spill.
- Two months later, a relief well was connected and the well was pronounced “effectively dead”
- 45,000 people contributed in the clean up of the spill.
- Microbes called “hydrocarbonostics” in the sea feasted on oil and it biodegraded faster than expected.

Oil Sands

- Canadian oil reserves estimates jumped from 5 billion to 180 billion in 2003.
- Oil sands were dismissed for years.
- Fastest growing oil supply in North America.

Early Challenges with Oil Sands

- Bitumen is trapped in clay and sand, does not flow.
- Extreme weather.
- High taxes in the 1960's.

Breakthrough in Oil Sands

- New mining methods (Large shovels on trucks, refiners)
- Steam-assisted gravity drainage (SAGD) - Superhot steam injected to heat bitumen underground.
- Investments due to potential [1.5 mb/d in 2010]

Current Challenges with Oil Sands

- Large industrial developments in remote areas.
- Highest new oil development in cost.
- Environmental Challenges (Toxic waste, higher CO2 emissions)

Oil Shale

- Immature oil (in the form of Kerogen) needs millions of years to be useful.
- 8 Trillion barrels estimated, 6 trillion in the U.S.
- High Cost.
- Lack of appropriate technology.
- Attempts are being made to turn Kerogen into a commercial fuel.

Tight Oil or “Shale Oil”

- Locked in Shale and other rocks.
- No way of extracting it until the 2000s.
- Bakken Formation [400,000 barrels/day]
- Technique spread to Texas, New Mexico and North Dakota.
- Estimates of 20 billion barrels of recoverable tight oils in the U.S.

13. The Security of Energy

- Energy Security: The availability of sufficient supplies at affordable prices.
- Instability in oil-exporting nations raise fear of losing supplies.
- Countries need reliable energy to power economic growth.
- Oil-Importing countries consider the “Security of the Supply”.
- Oil-Exporting countries consider the “Security of the demand”.

Strategic Significance of Energy Security

- Embargo by Arab countries in the 1973 October War.
- International Energy Treaty of 1974.
 - Outlined new systems to deal with disruptions.
 - Meant to keep member nations supplied with energy and the global economy functioning.
 - Established the International Energy Agency (IEA) to meet their objectives.

The International Energy Agency

- Headquartered in Paris, France.
- 28 industrial countries as members.
- Requires members to hold strategic oil stockpiles as “emergency stocks”.
- 1.5 Billion barrels of stocks, 700 million in the U.S. Strategic Petroleum Reserve.
- Emergency Stocks were triggered 3 times:
 - Gulf War 1990-91.
 - Summer of 2005 to deal with Hurricanes Katrina and Rita.

Achieving Energy Security

- Multiplying sources of energy
 - Relying on a variety of countries for sources instead of one country or one region.
 - Provides resilience in case of disruptions.
- High quality information and data are needed.
 - Such as the Energy Information Agency of the U.S. Department of Energy.
 - To cope more efficiently with energy crises.

New Threats to Energy Security

- Cyberattacks
- Pirate and Terrorist attacks on oil and LNG (liquified natural gas) transport.

14. Shifting Sands in the Persian Gulf

The countries in the Persian Gulf produce more than 25% of the world's oil, and contain almost 60% of the known reserves

The shifting political and social climate in region has led to many conflicts started to preserve the supply of oil for first world countries.

Early Conflicts

1956 - Suez crisis (Egypt vs Britain, France, Israel)

Due to the expropriation of the canal, larger tankers were developed that could bypass the canal and cross around africa.

Disruption of supply:

1967 (USA, Britain, West Germany) - israel's victory in 6 Day war

1973 (USA) - Yom Kippur attacks (4x increase in oil prices)

1978-1979 Iran Revolution

1990 Saddam Hussein invaded kuwait (-5 million Barrels a day from iraq)

2003 Iraq war - no oil production from iraq

Discovery

In the early 1900's it was assumed there was not a significant amount of oil in the middle east, more hope was placed in reserves in albania and the gulf-caribbean area.

Oil discovered in kuwait and saudi arabia in 1938, production as halted with start of world war 2

Everette Lee DeGolyer - "The Oil in this region ins the greatest single prize in all history"

Saudi Arabia

1/5 of proven oil reserves

8.2 million barrels per day 2010, 10% of total world production

Maximum output of 12.5 million barrels per day, used as buffer in case of unforeseen circumstances

Almost all drilling is run by State owned Saudi Aramco

Largest oil conglomerate in the world

Owns over 100 fields, 370 resevoirs

Drills in only 19 fields/100 fields, but the most productive

Other Countries

Kuwait - 2.3 mbd

Abu Dhabi - 2.3 mbd

Qatar - 0.8 mbd

Islamic Terrorism

Until the 2000's most islamic terrorists did not attack oil reserves or fields. The wealth gained helped their islamic state

Eventually new "rules" called for no long term damage to oil production in terror attacks (Bin Laden supported this)

2006 - Abqaiq processing plant attempted attack

Processing plant puts out more than 7 mbd

Saudi arabia created a 35,000 man security force in response

Arab Spring

Young arabs who were treated poorly by the government were upset and began protests and eventually toppled several countries regimes.

Tunisia fell first

Egypt (feb. 2011) Mubarak resigned

Bahrain - Saudi Arabia intervned to maintain order

Libya - civil war to overthrow Ghaddaffi

Oil Prices rose to 130\$ a barrel

Causes of unrest were unemployed educated young generation (30% unemployment)

Iraq

Post war production

2009 - production back to levels in 2001 of 2.5 mbd

Massive amounts of tech to achieve this

By 2020 6.5 mbd is the goal of the government

Estimated reserve of 1.43 billion barrels

Iran is against this, as they are the second largest oil producer after Saudi arabia

Similar religious makeup (shia islam) may affect the progress of iraq

Iran

Oil production peaked at 6 million mbd

Went as low as 1.3 million mbd during iraq-iran war

Low refining capabilities, actually needs to import gasoline despite being second largest producer globally

American oil company (Conoco) tried to sign deal with iran in 1995, but was canceled by executive order by Clinton

US - Iran relationship was shaky, despite aid provided against the taliban post 9/11

President Mahmoud Ahmadinejad ruined all possible progress with his hatred of

Straight of Hormuz

Passage between the Persian Gulf and high seas

Up to 20 tankers per day pass through the channel

17.5 mbd, 20% of world oil demand, 40% of all oil traded internationally

Bordered by Iran, Oman, and UAE

Iran has threatened attack in the straight before

US Fifth Fleet out of Bahrain is tasked with maintaining the freedom of the sea in that region.

Iran Nuclear program

Program was started in the 1950's, primarily for power production

1970's shah encouraged growth due to belief that oil reserves would eventually run dry

1980's Khomeini sought weapon technology

It is believed that if iran gains the "bomb" they will be able to demand or direct the flow of other nations oil in the region

Enrichment programs in the country have faced many difficulties and sanctions (90% uranium needed for weapons systems)

15. Gas on Water

LNG - Liquefied Natural Gas

Very expensive to build facilities to produce

When natural gas is taken to -260 F it turns to liquid and take up 1/600th the space it does as a gas

Simplifies transportation in a global market

Qatar makes a lot of money off of LNG

Thomas Cabot

Developed idea to compress natural gas based on an idea by his father.

Focussed on cryogenics as a scientific interest

Refrigeration was used to build the earliest LNG facilities around world war 2

LNG beginnings

1952 - Coal fog in England prompted the import of LNG from America to reduce smog and improve air quality

1964 - Royal Dutch Shell developed LNG fields in Algeria

Due to expense of LNG facilities and equipment most business is long term contracts with mutual equity

1960's - Europe came to rely on LNG, specifically from the North Sea and the Netherlands

LNG generally is used to replace coal as a power source

Price indexed to oil price

America

Post world war 2 saw rise in natural gas usage in expanding suburbs

Long distance pipelines had to be developed to transport gas to population areas

By 1970 25% of America's energy came from natural gas

Huge swell in demand due to low government regulated prices

Natural Gas Policy Act of 1978 - began to remove government control of prices

Act banned usage of Natural Gas in power plants

Surge in supply reduced the demand for LNG causing projects to be cancelled

America cont.

1990's increased demand for electricity led to natural gas being in high demand again, for power plants

High demand and limited sources led to an increase in LNG shipping to maintain a constant price

International projects

North field discovered in 1971 by Royal Shell

Estimated at 900 trillion cubic feet, 3rd largest reserves in the world after russia and iran

At the time there was no market for the natural gas so Shell gave up

1971 Mobil Oil discovered Arum in indonesia

Largest LNG project of 1970's and 1980's

Fuel went to japan

Eventually output began to decline

With the North Field abandoned by Shell, Mobil approached qatar about buying shares in Qatargas and RasGas

Qatar

Hamad Bin Khalifa al-Thani replaced his father as sheik in bloodless coup

Hamad desired to become world leader in gas production

LNG became crucial in moving supply around the world.

When natural disasters affect country's power production LNG shipments provide a flexible way to provide fuel

Japan has had to use this after earthquakes destroy existing plants

16. The Natural Gas Revolution

George P. Mitchell

Developed fracking technology to release natural gas from shale formations

fracking was difficult to create but Section 29 tax credit offered money to companies who were working on new methods of harvesting gas and oil

His company was acquired by Devon Energy in 2001 for 3.5 billion

Domestic production

2007 and 2008 showed increase in domestic natural gas production that no one expected

Gas obtained from fracking is actually cheaper to harvest than conventional natural gas drilling

Perennial shortages in the US allowed for a large surplus to build up and to drastically reduce the need for LNG in the US

Estimated 3,000 trillion cubic feet (around 100 years worth of fuel)

Fracking has received a lot of bad press for loose regulations and negative environmental impacts

Global Market

The rapid rise in the US's natural gas production undercut many of the investments in LNG technology around the world (Qatar, Australia)

Large Oil reserves in the Soviet Republic led to increased trade in fuel between the east and west.

Reagan's administration tried many things to combat the use of soviet gas in europe

After Soviet russia's collapse, Gazprom emerged as a state gas company.
They provide around 25% of the gas for western europe

Ukraine vs. Russia

After fall of Soviet republic, ukraine began to face difficulties over fuel and tariffs from russia

Russia provided fuel at steep discounts, but the pipeline carrying fuel to western europe ran through ukraine

Gazprom tried to cut ukraine off, until they paid back billions of dollars of debt for fuel costs. Ukraine tried to siphon fuel from the pipeline, despite warning from gazprom.

EU

The EU is working to diversify the sources of fuel they have, rather than relying so heavily on russian gas. This has led to conflict and other issues in the european continent

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