17.906 The Geopolitics and Geoeconomics of Global Energy, Spring 2007
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Lecture #2: The Global Energy Industry

- Crude oil is widely used because of its combustibility, density, and efficiency
- Some places with reservoirs lack proper cap rock, oil seeps to surface (Middle East, Caspian basin)

History of crude oil:

- 7000 years of trying to find uses
- Early on it was known that it burned well
- Used for incendiary weapons, hair dressing
- No large-scale application because amount seeping up was relatively small
- In 19th century modern drilling technology used to search for water, first large reservoirs of crude oil found
- Used for illumination
- Preferred method for illumination before that was whale oil
- Whaling was not cheap, safe or efficient way of getting the fuel
- People figured out you could take crude oil, process it, and create kerosene
- Toward end of 19th century electricity discovered
- More efficient, more desirable than oil based illumination
- Oil industry unsure of its future

Modern oil:

- Crude oil came into its own as stuff you could make cheap/efficient transportation fuel out of
- Railroads, modern shipping emerged
- Diesel engines for trains, big trucks, internal combustion engines using gasoline for automobiles

Alternatives/Energy Independence:

- Oil is high-density, efficient in terms of energy/unit storage costs cheap
- Crude oil is one of the cheapest liquids on the planet
- This is the problem when you want to talk about alternative fuels
- Energy independence = if we grow enough corn, make enough ethanol, collect enough biomass, we can forget about importing oil
- This idea is nonsense
- 2 things must be done in order to replace oil-based transportation fuels:
    - Must be able to produce it on massive scale
    - Must be able to produce it at a reasonable cost
- Bush said in State of the Union Address he wants to increase ethanol use
- This prompted spike in corn futures prices, corn prices in Mexico
- Corn tortilla prices skyrocketed
- President of Mexico had to put caps on corn tortillas, riots took place
- Economics matters
- If you did not care what it cost you could replace oil based transportation fuels

- We will be living in a hydrocarbon based energy economy for decades

Lifeblood of our society:

- If you can control or manipulate the supply of oil you could create massive economic and social dislocations in societies that are dependent on this
- Modern militaries cannot operate without oil
- Control of oil gives you strategic leverage
- In post WWII period, assuring reliable supplies of crude oil has been important goal for the US
- In 1950s and 1960s we worried for benefit of our allies
- By 1970s our domestic oil use was peaking, reliance on imports was greater and greater
- Last 30 years we had to be concerned with supplies of oil for us and allies

Basics of the industry:

Exploration, Production, Distribution, Marketing

Exploration:

- Find oil in places where prehistoric oceans existed and in certain formations within those oceans
- Over time we have developed expanding repertoire of knowledge about what kinds of formations are more likely than others to contain deposits
- In early days you had to do it from surface observation
- Subsurface formations tip you off
- Oil companies employ geologists for this reason
- If you just proceed on basis of geology there is 10% success rate
- Expensive to dig exploratory well
- Over last several decades oil companies started using geophysics, seismology
- Sending sound waves, observing reflections back
- Seismic imaging techniques more sophisticated, now success rate is 1 out of 6 or 1 out of 7

Production:

- Drilling elements:
    - Drill apparatus
    - Suction
    - Water for cooling, washing, suction
    - Reserve for what is being sucked out
    - Target Zone
- Use drilling mud – take water, mix with clay and chemicals and it produces a heavy solution, this is what you keep circulating around the drill as it goes down
- "Conductor Hole" with truck-based drill rig starts the drilling process
- On top of conductor hole you set up your rig, weld mast to hole
- Once drilling apparatus is set up put in circulation system to take drilling mud from surface to where the drill bit is and bring it back up
- Blowouts = bad drilling
- High pressure system, so the proper use of drilling mud is critical
- Mud engineer is one of the most highly paid people on a drill site

- He looks at pressure readings, geologist info, makes constant adjustments in weight of drill mud
- Tries to strike a balance between having it heavy enough to resist pressure so no blowout, and light enough so that if there is oil some oil will come back up with rock cuttings
- Essentially balance pressure with need to find if there is oil in the hole
- Drilling proceeds in 3 phases:
    - Dig surface hole with relatively large bit (20 in across) 1000 ft down, case it with heavy casing to keep water from seeping in
    - Dig intermediate hole from 1000 ft to within a few hundred feet of target zone, could be 1000s of feet
        - Use drill bit that is smaller, case intermediate hole
    - Production hole takes you into target zone, call it a dry hole and give up or complete the well
        - If completing, run liners and tubes to let oil flow back to surface
- Wells can have oil and still not be economically viable
- If successful, 1 well is not enough
- Target zone is part of a bigger field, begin to do assessment wells and developmental wells
- Unit of measurement is barrels (42 gallons)
- Porosity of rock tells you rough volume, permeability tells you how well it flows
- Make assessment on what we think volume is
- How much is recoverable is 30%-40%, maybe as high as 50%
- Reserve statements are not very accurate, can be altered without any new discoveries
- In wells that are being used pressure goes down over time
- Also have to worry about “water cut,” or water getting into levels of reservoir where oil is also, % of water that you are bringing up gradually increases