Module 35: Fossil fuels

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From dead plants 280-360 million years ago

Evolution: Peat->lignite->bituminous coal->anthracite

Coal formation:



n.b. as moisture is reduced, coal is cleaner, hotter burning (more carbon, less water)
Know the formation of coal, and the stages: (see above)

- Peat: burns barely, Scotland is made of it, more like compacted wood and plants (Heathcliff! Heathcliff! Where are you?)
- Lignite: poor quality, usually high sulfur content (see London fog of 1952, also BBC news this week Jan 2023)
- Sub bituminous: better, less sulfur (bitumen = tar)
- Bituminous: more energy per kg, a bit cleaner, but still lots of heavy metals
- Anthracite: cleanest, most energy content, lowest sulfur of the bunch

Cool fact: after WWII, Britain was so poor from the war they could only burn lignite, which caused London smog deaths in 1952 with 4,000 dead
Another cool fact: Alaska exports anthracite to Korea and China for steel production since it produces clean, intense heat

- Coal is very nasty: Dangerous mining (look up coal mining deaths in China per year), shaft mining, open pit mining ruins ecosystems
- Mining tailings are toxic and lead to dam failures: Video https://www.theguardian.com/world/video/2019/feb/01/terrifying-dam-collapsed-in-brazil-caught-on-camera-video
- Burning coal releases heavy metals (e.g. mercury, cadmium, zinc), sulfur (e.g. acid rain) and particulates (PM 10, 5 and 2.5, the most toxic)
- Coal fly ash (after burning) is toxic (e.g. heavy metals) and is banned for use in construction in EU
- Know about the various mining techniques: open pit, shaft, strip and mountaintop removal

Coal to electricity: pay attention to the use of steam:



Many folks associate the cooling towers (see above) with nuclear power. This is wrong, it is simply how steam is recycled into clean water for the boilers...

Petroleum

Cleaner than coal (lower sulfur, depending on where it comes from-why is some crude oil called "sweet"?)
Drilling for it is hazardous, and hugely damaging to the environment, e.g. ANWR
Some of it is located in toxic geopolitical areas, like the Middle East

Video: opening credits of The Kingdomn.b.Wahabbis: see Lawrence of Arabia 1918Ibn Saud: **Saud**i Arabia 1932

- 1933 oil discovered
- 1938 ARAMCO
- 1945 divided Arabia, palestine with British
- 1973 arab israeli war, embargo, 4x oil price
- 1974 embargo ends
- 1990 Kuwait war
- Osama bin laden-formed the Mujahaddeen in Afghanistan (see film: Charlie Wilson's war)
- We supported them against the Soviets in 78, boycotted the Olympics that year, then Reagan moved to outspend them after their defeat there
- We sold lots of weapons in 1980, trying to outspend the Soviets, who dumped oil on the market
- 1990+ terrorist attacks Nairobi, Tanzania, USS Cole
- 2001-World Trade Center 15/19 were Saudis
- Al Quada took credit, then took over Euphrates valley

Back to the Wahabbis....---------1.14.20----------**Why oil?**

- Easy to transport
- Can be refined into many products from plastic to tar to nat gas, gasoline and kerosene
- Basic to agriculture (e.g. nitrogen based fertilizers, pesticides, tractor fuel)
- Transportation, military, heating, industrial, electrical
- Very important geopolitical implications
- Note comparison between diamonds and oil: both are the result of heat and pressure on an organic precursor.
- Now think of the salt interview with diamonds instead.
- What are "proven reserves"?
- primary and secondary extraction (latter uses steam, e.g. tar sands)
- Refining oil: also known as "cracking"



Natural Gas:

Cleanest hydrocarbon fuel so far: low sulfur, no heavy metals, simple CH4 and others:
Methane, Ethane, Propane, Butane
Natural gas: surface decomposition (swamp gas) or subsurface (thermogenic)
Kerogen = source for nat gas and oil
Swamp gas = biogenic, also in landfills
Good stuff: cleaner to burn, usually found underground, so less ecosystem damage than coal, does not spill in the ocean
Bad stuff: very flammable, leakage contributes to global warming (methane, CH4 is a very potent greenhouse gas), harder to store and transport, must be kept under pressure and cool



Other stuff
Tar sands: lately in Alberta, Canada, use steam to melt the tar out of sand, almost energy 1:1 (bad), depending on the price of oil
Liquid coal: CTL developed by the Nazis in WWII, as they had coal in Silesia (Eastern Germany, Poland) but not much oil, until they could get to the oil fields in North Africa and the Caspian Sea (after fighting the Russians)
Methane Hydrate: deep oceans, large patch in the Eastern Pacific ocean:
https://www.washington.edu/news/2014/12/09/warmer-pacific-ocean-could-release-millions-of-tons-of-seafloor-methane/
Very dangerous for global warming...Here's why:



As the ocean warms, these will no longer be "frozen" much like the permafrost, which will cause huge global warming impact...More on this: https://geology.com/articles/methane-hydrates/

Carbon capture: not yet, see HEAT movie later on
Hubbert curve: The supply of oil is finite, and those with it don't want to admit how little is left
Look up ARAMCO, and why the Saudi Kingdom is selling all of their oil fields in a huge IPO
Peak Oil has already passed, we are now on the back side of this (see poster in the elab):
This has to do with proven reserves and possible reserves...2004 graph:



Directional drilling: developed and used in Palestine...Geopolitical trends:



Note peaks and dips, some are due to supply, others to demand (recession)
See also USSR flood of cheap oil to counter Reagan's military spending 1980-88
Key dates in the price of oil globally:

73 oil embargo
78 Iranian revolution (hostages 668 days-Argo)
80-88 Reagan vs. USSR
89 USSR folds
90 Gulf war #1 (Kuwait)
99 recession #1 (dot com bust)
2001 Gulf war #2 (Iraq)
2004 hurricanes
2010 speculation crisis, economic crisis, recession #2
What's with Venezuela?





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