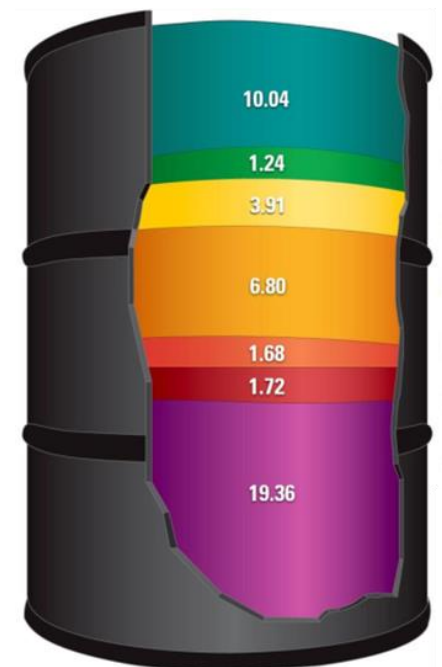


Energy from Petroleum – An Introduction

Kenneth M. Klemow, Ph.D.

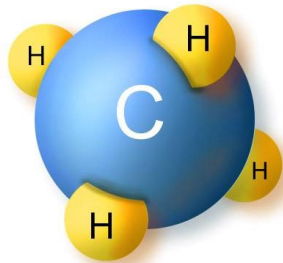
For EGY 105 – Energy in Our World
at Wilkes University



What is petroleum?

- Thick flammable liquid, ranging from yellow to black
- Word derived from Greek
 - Petros = rock
 - Oleum = oil

Petroleum includes a mixture of organic substances rich in carbon (and hydrogen)



Natural gas
(methane)



Gasoline



Naphtha



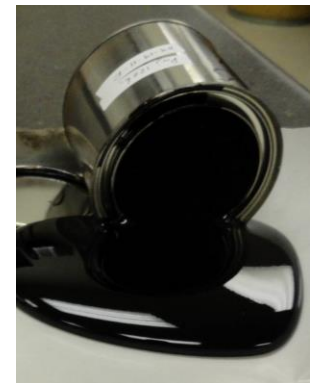
Kerosene



Lubricating



Paraffin



Asphalt

Classification of petroleum I

Crude oil



<http://english.mubasher.info/EGX/news/2588820/>

Refined oil



www.nipic.com

11921109246

Classification of petroleum II



<http://www.businessweek.com/articles/2012-09-27/the-oil-hub-where-traders-are-making-millions#p4>

Light
(API gravity ≥ 31)

Intermediate
(API gravity 22-31)

Heavy
(API gravity 10 - 22)

Notes: API = American Petroleum Institute.

Denser oils have lower gravity values

Denser oils are made of longer-chain molecules

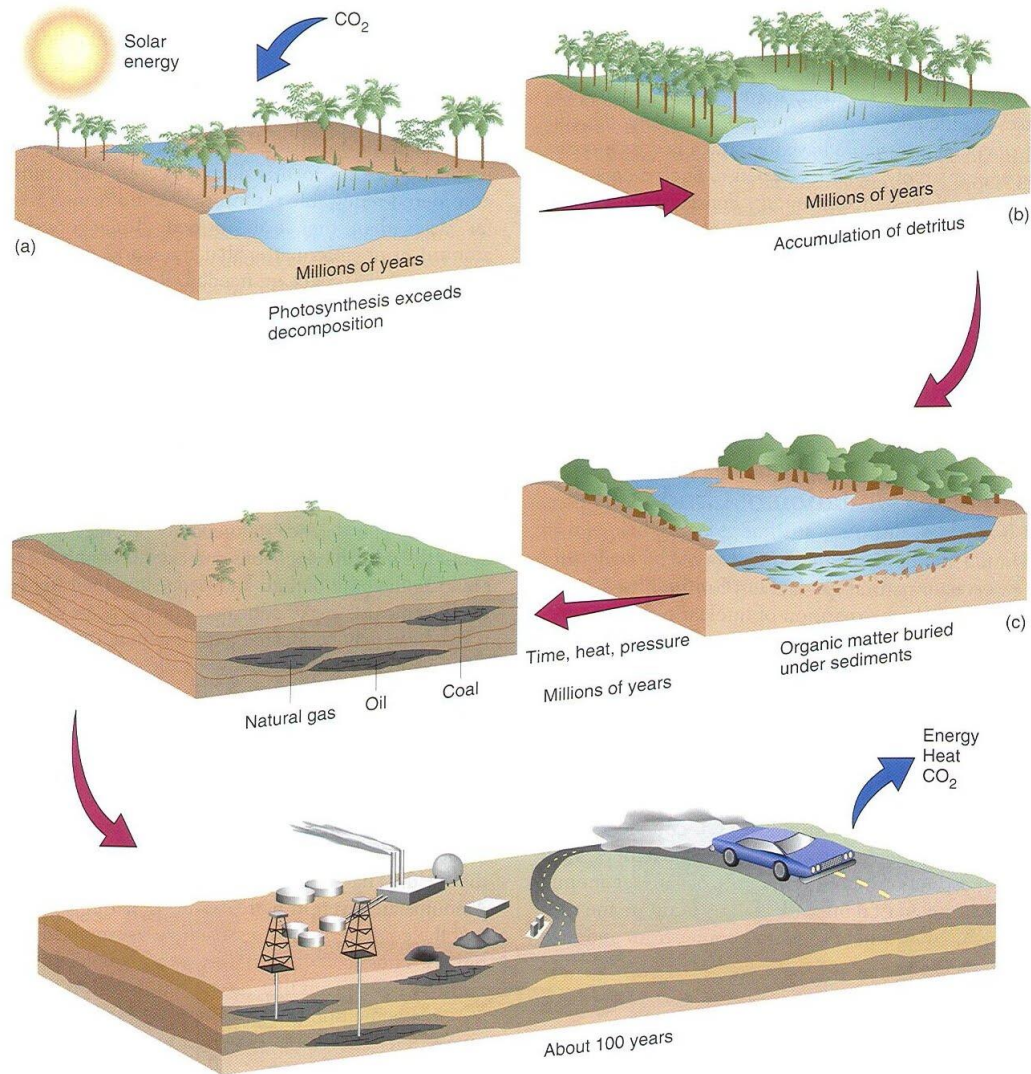
Classification of petroleum III

Sweet oil
($<0.5\%$ sulfur)

Sour oil
($>1.0\%$ sulfur)



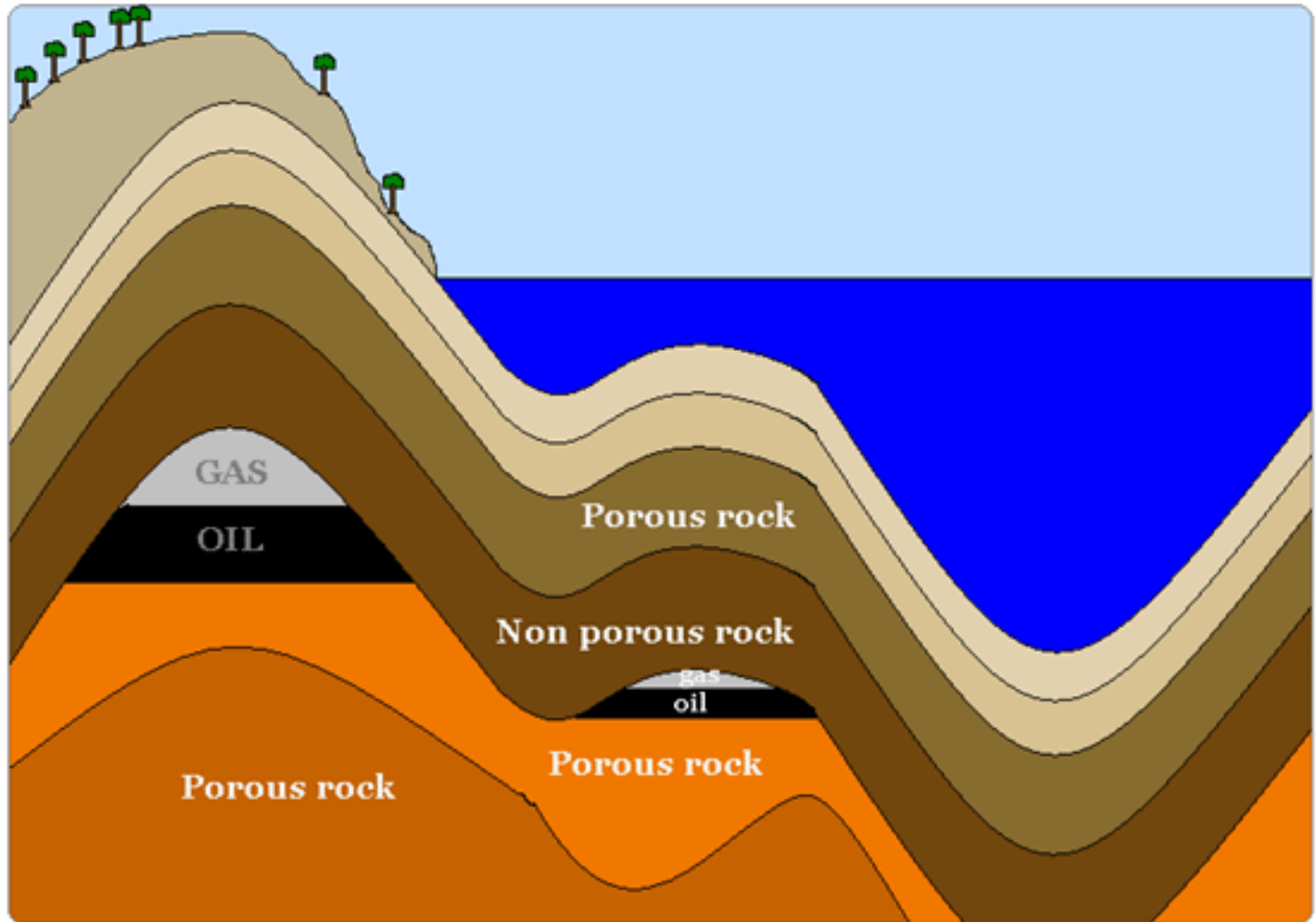
How does it form?



▲ **FIGURE 13-10**

Energy flow through fossil fuels. Coal, oil, and natural gas are derived from biomass that was produced many millions of years ago. Deposits are finite and, since formative processes require millions of years, they are nonrenewable.

Oil in earth's crust



Oil can be found in shale

- Shale is a type of sedimentary rock
- Some shales contain kerogen
 - Waxy, organic material
 - Can liberate oil when heated
- Other shales contain oil
 - Liberated through hydraulic fracturing
- See [this reference](#)



Oil is also available as oil (tar) sands



<http://www.desmog.ca/2013/09/30/oil-export-tar-sands-bitumen-cannot-be-refined-eastern-canada>

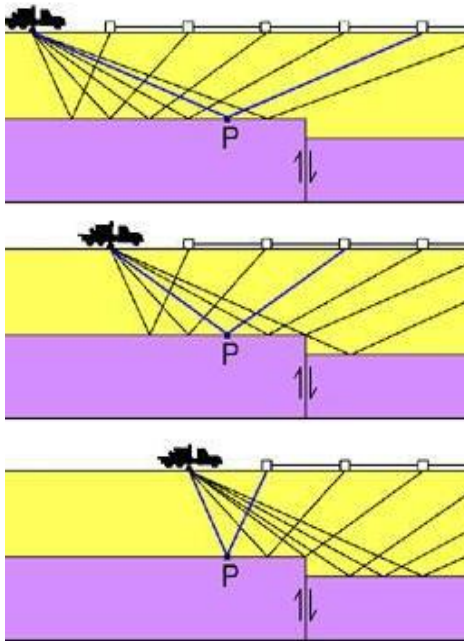


<http://ostseis.anl.gov/guide/tarsands/>

Extracting petroleum

- Three main steps

Oil exploration



<http://www.oilandgaslawyerblog.com/2009/04/how-do-seismic-surveys-work.html>

Drilling



<http://sdrjlx.en.made-in-china.com/productimage/>

Pumping



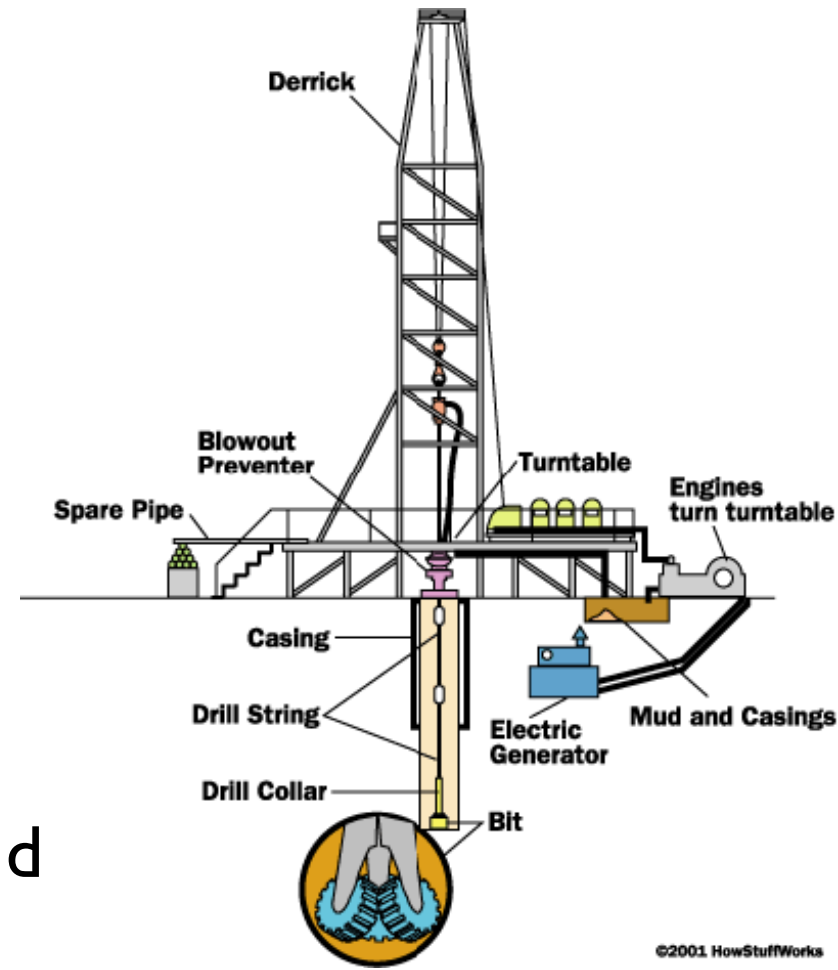
http://image.china-ogpe.com/pimage/1073/image/Pumping_Unit_Product1073.jpg

Oil exploration

- Done by geologists
 - Look for evidence of source and trap rock
 - Interpret maps
 - Test drilling
 - Look for oil bearing strata
 - Presence of certain micro-algae
 - Additional methods
 - Magnetometers / gravity meters
 - Seismic testing
 - “Sniffers” detect hydrocarbons in the air

Oil drilling

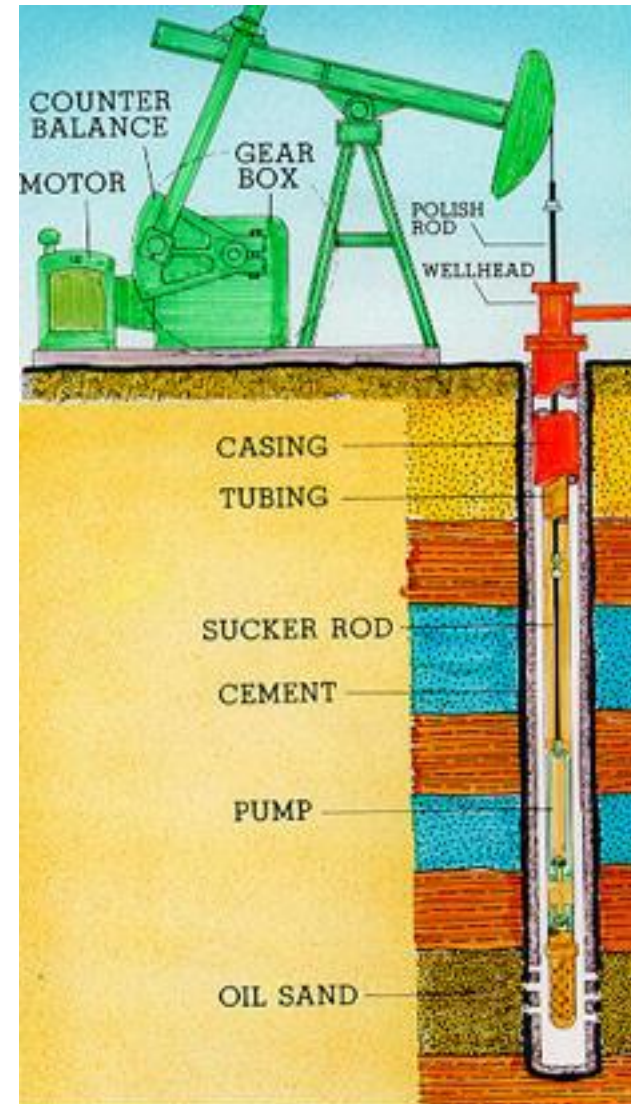
- Clear land
- Secure source of water
- Install rig - derrick
- Commence drilling
 - Drillbit
 - Establish casing
 - Introduce drilling mud



©2001 HowStuffWorks

Pump oil from the ground

- Place pump at wellhead
- Place rods in the borehole
- Motor drives assembly
- Suction created in upstroke, drawing oil upward

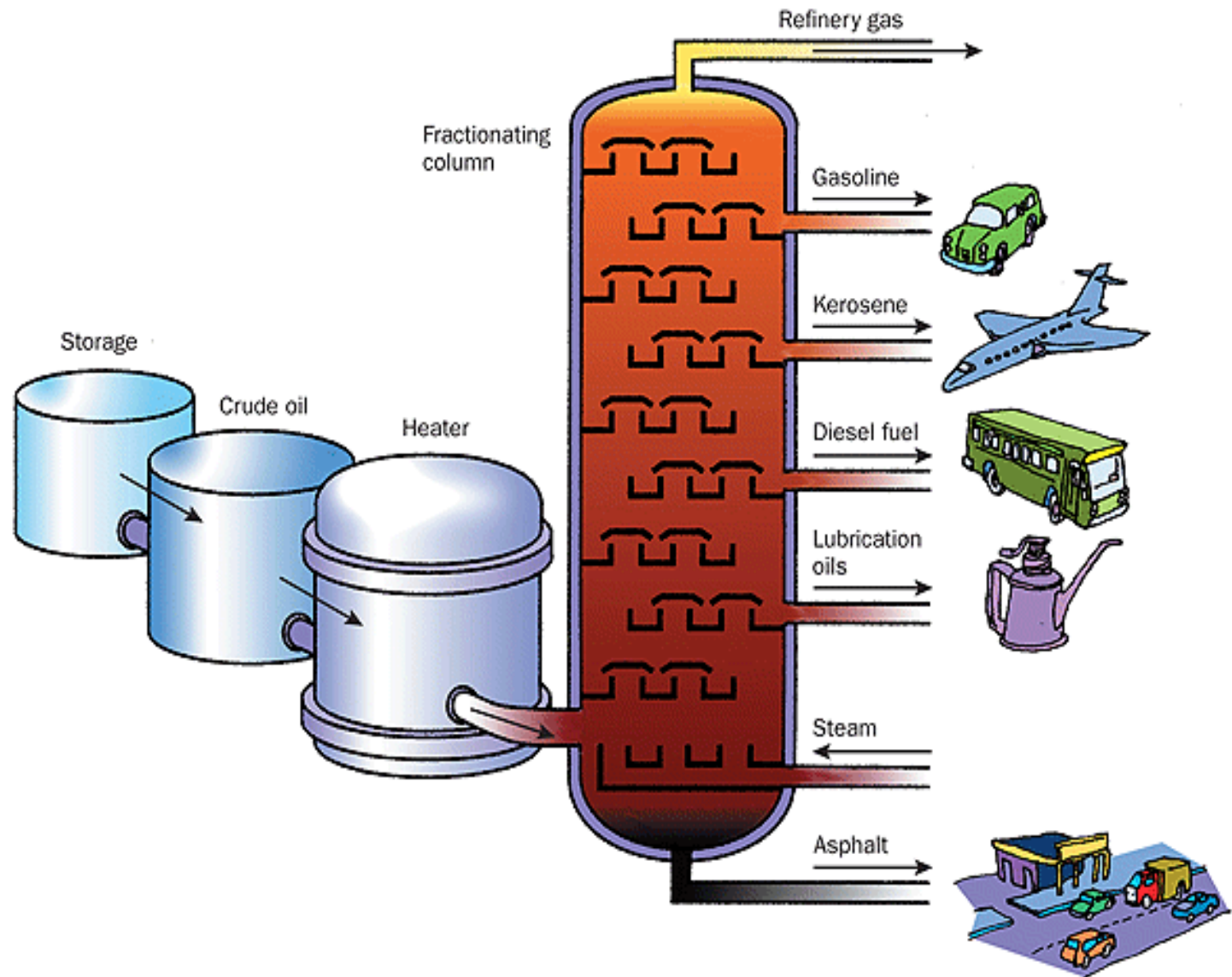


Crude oil must be refined to separate components

- Done at fractionating column (cracker)

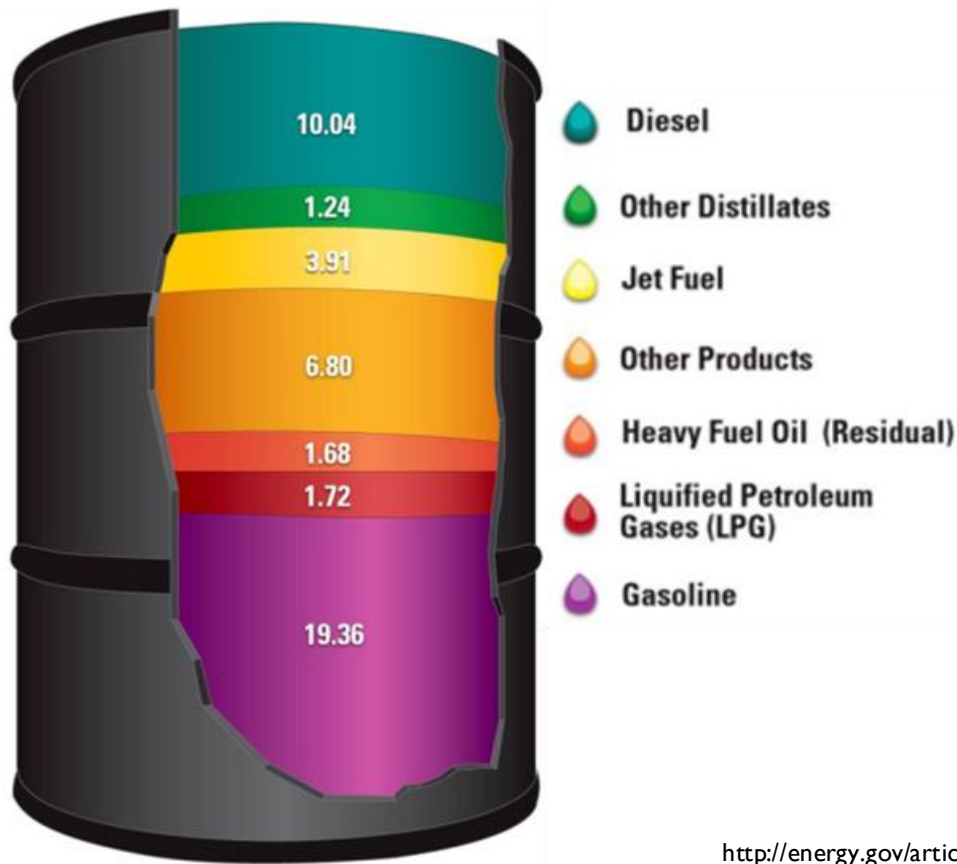


Inside a column



Energy from petroleum products

Products Made from a Barrel of Crude Oil (Gallons) (2009)

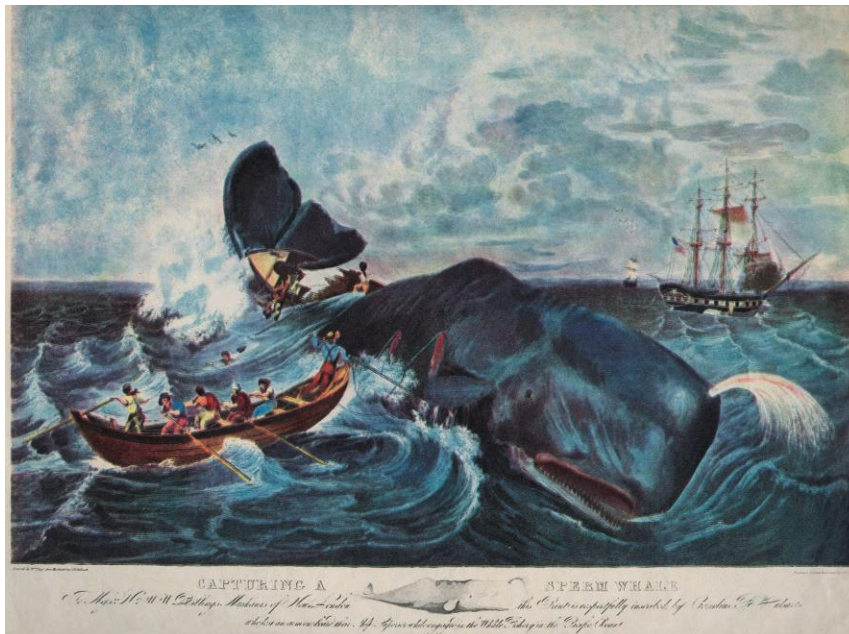


History of Petroleum

- Oil well known in ancient world
 - Ancient Babylonians, Greeks, Chinese used for paving streets, lighting, medicines, producing salt
- By Middle Ages, kerosene isolated, used for lighting
- In US, oil obtained in PA and NY from shallow pools.

Whale oil industry

- Between 15th and 19th centuries, whale oil used for lamp lighting and other purposes
 - Whalers hunted whales for blubber
 - New England became a center for whaling industry.



19th Century Energy Transition

- Discovery of petroleum in 1859:
 - Drake oil well
 - Titusville, PA
- Led to transition from whale oil to petroleum from fossil fuels



Vanity Fair illustration from 1861



Petroleum in latter 19th Century

- Production increased greatly in US and Europe due to improved drilling technology
 - Other wells in California, Europe, and Canada in next few years
 - Development of internal combustion engine in late 1800s increased demand.



Petroleum in 20th Century

- Demand and production increased throughout the first half of century.
 - Cars, Trains, Planes, Home heating
 - Rise of plastics
- Drilling increasingly shifted offshore
- Middle-Eastern countries became large-scale producers by 1950s.
- OPEC formed in 1960.
- Oil embargos in 1973 / 79 had worldwide economic impact.
- Environmental issues noted by 1980s.
- Focus on finding alternatives.



What's in Lecture 14?

- Data on the following with respect to oil
 - Availability (reserves)
 - Production
 - Consumption
 - Pricing
- Benefits and drawbacks