Lec #5: Can We Avoid Another Oil Crisis?

LAST TIME: Estimating Lifetime of Finite Resources

TODAY: What Causes a Resource Crisis?

- Per Capita Consumption v. Economic Development
- Energy History of United States
- What causes an "oil crisis"? Can it be avoided?

NEXT WEEK: Mechanical Energy (Chapters 2 & 3)

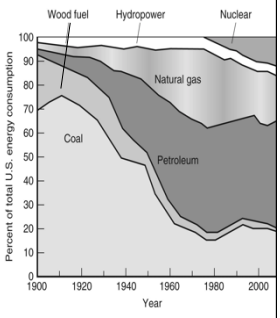
- Forms of Energy; Conversion of Energy
- Laws of Motion; Forces in Nature
- Work, Kinetic Energy, Potential Energy, Power
- Conservation of Energy

What Causes a Crisis?

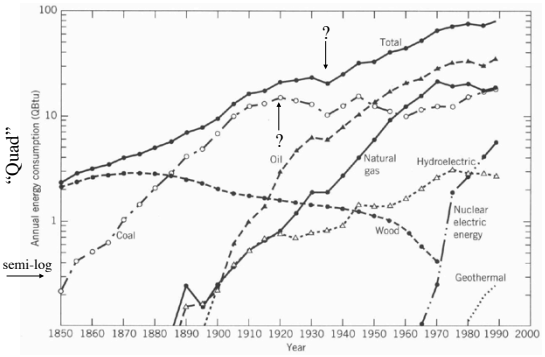
- Different assumptions give different T_{exp}:
  - exponential expiration is shortest
  - "@ current rate" is much longer
  - Hubbert curve -> ∞, but forever *decreasing*
- When does the "crisis" occur?
  - Population growth is slowing [but still growing exponentially]
  - Can per capita rate drop fast enough to keep pace with population growth?
  - Finite resources becoming *increasingly difficult* to exploit (hence the Hubbert peaks)
  - *Running out* of the resources is NOT the problem!

Energy Consumption & Economic "Growth"

- For most of history: manpower, animal power, water, wind, biomass
- Industrial Revolution fueled by consumption of non-renewable resources (did not account for replacement costs)
- Growth in GDP tied to growth in energy production...



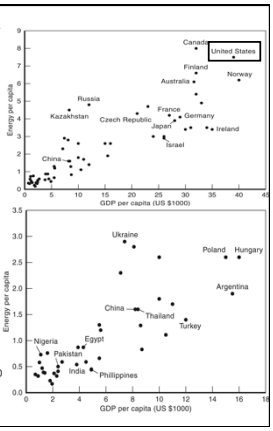
History of US Energy Consumption (by Source)



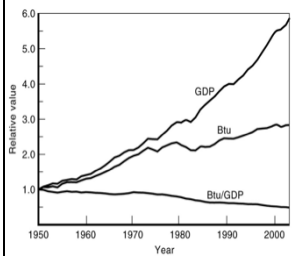
Per Capita Energy Consumption

Much higher in North America than anywhere else

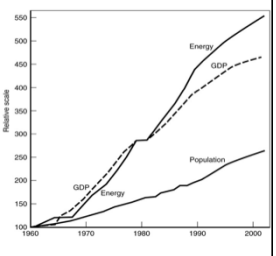
Western Europe & Japan achieve same or greater GDP per capita using far less Energy per capita



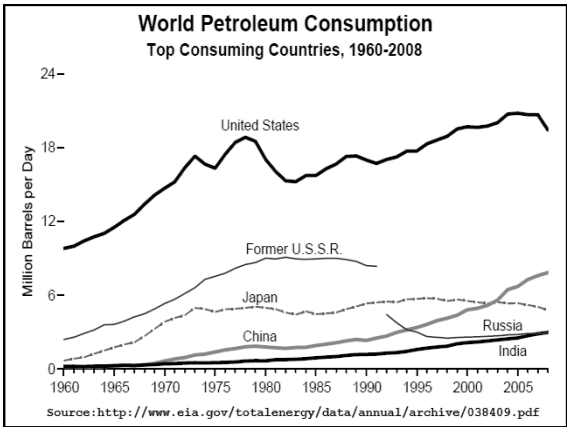
But, recent trends show that growth in consumption of resources is NOT required, at least to SUSTAIN wealth...

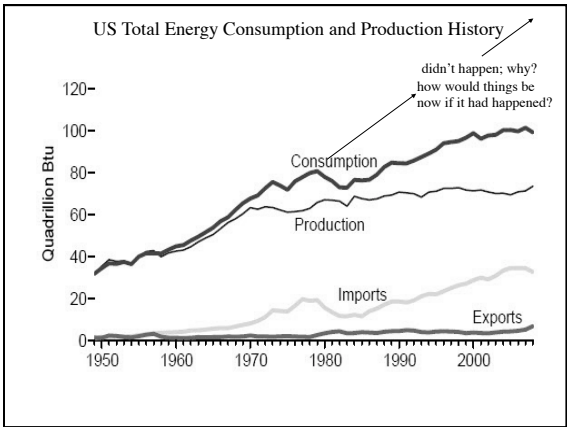


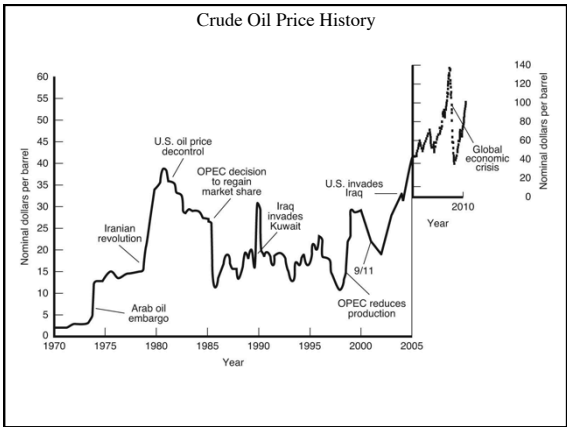
US GDP and Energy Consumption

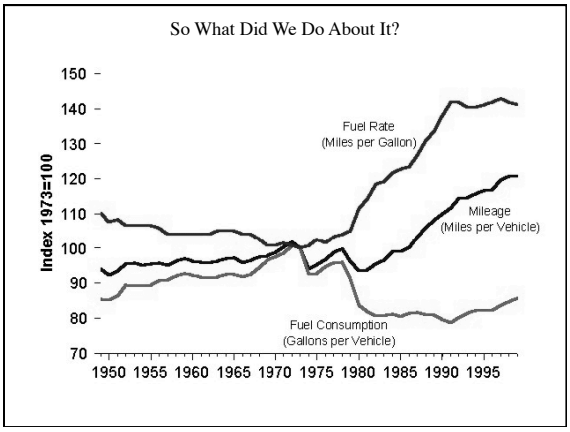


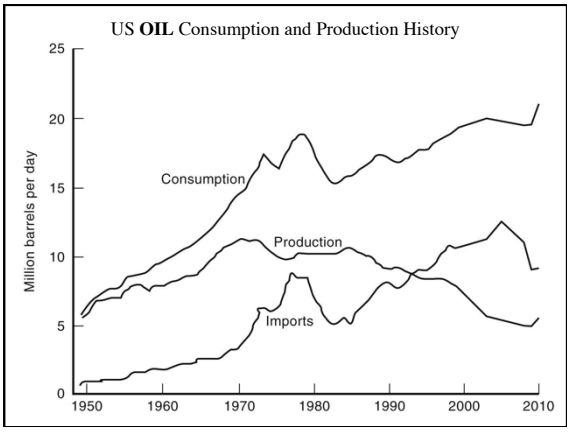
Different for "Developing" World











Lifetime of Current "Reserves" (assuming constant consumption)

Table 1.1 WORLD AND UNITED STATES PROVEN RESERVES: 2003

Resource	World	United States	Lifetime*
Oil	1213×10^9 bbl 7.0×10^{18} Btu	22.7×10^9 bbl 0.12×10^{18} Btu	10 years
Natural gas	5505×10^{12} cf 5.4×10^{18} Btu	187×10^{12} cf 0.19×10^{18} Btu	9 years
Coal	1.08×10^{12} tons 27×10^{18} Btu	0.27×10^{12} tons 7×10^{18} Btu	250 years
Oil sands	272×10^9 bbl 1.5×10^{18} Btu	22×10^9 bbl 0.12×10^{18} Btu	8 years

*Ratio of U.S. reserves to 2003 U.S. production rate.
Source: U.S. Energy Information Administration.

Lifetime of Current "Reserves" (assuming constant consumption)

Table 1.1 WORLD AND UNITED STATES PROVEN RESERVES: 2008

Resource	World	United States	Lifetime*
Oil	1342×10^9 bbl 7.7×10^{18} Btu	29.4×10^9 bbl 0.13×10^{18} Btu	10 years
Natural gas	6254×10^{12} cf 6.1×10^{18} Btu	237×10^{12} cf 0.24×10^{18} Btu	12 years
Coal	0.93×10^{12} tons 23×10^{18} Btu	0.26×10^{12} tons 6.4×10^{18} Btu	230 years
Oil sands	525×10^9 bbl 2.9×10^{18} Btu	32×10^9 bbl 0.17×10^{18} Btu	12 years

*Ratio of U.S. reserves to 2008 U.S. production rate

What Then Must We Do?

- Growth must stop. Earth has finite carrying capacity, and we are approaching it (almost certainly in *your* lifetime).
- Per capita use will go up in developing world; hopefully down in developed world.
- Tremendous investment in fossil fuels required.
- Must also accelerate pace of renewables.
- Nuclear power?
- Conservation plays a critical role!