

Lec #5: Can We Avoid Another Oil Crisis?

PREVIOUS: Exponential Growth & Finite Resources

THIS WEEK: Expiration of Finite Resources

- How Long Will A Resource Last?
- Historical Energy Consumption Trends
- Per Capita Consumption and GDP

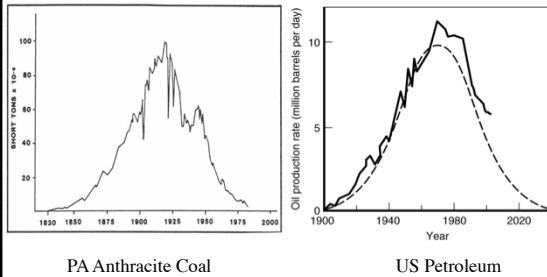
NEXT WEEK: Begin Mechanical Energy (Chapters 2 & 3)

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

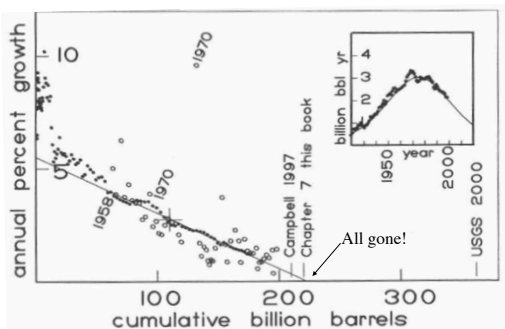
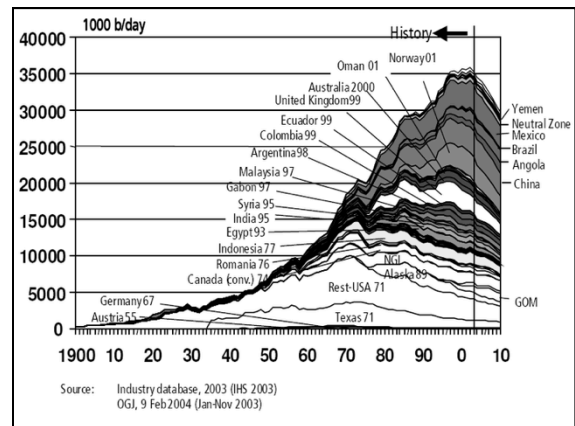
How Do We Estimate Lifetime?

1. assume resource is infinite
 - discoveries must keep pace with consumption
2. deplete at constant amount (current use rate)
 - must decrease per capita use at same rate as population increases
 - production must maintain current pace
3. exponential growth until resource expires
 - production rate must also *increase* exponentially
4. Hubbert model
 - early exponential rise
 - production slows & peaks when 1/2 resource is consumed
 - steady decline in production rate
 - symmetric, bell-shaped curve

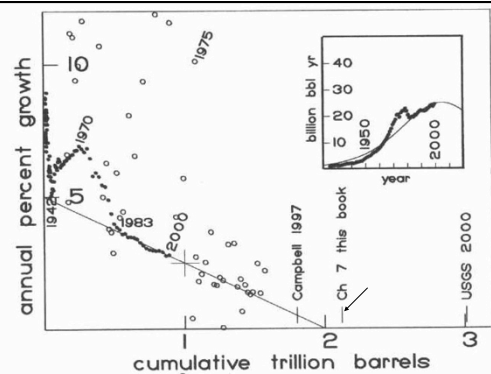
Hubbert Curves



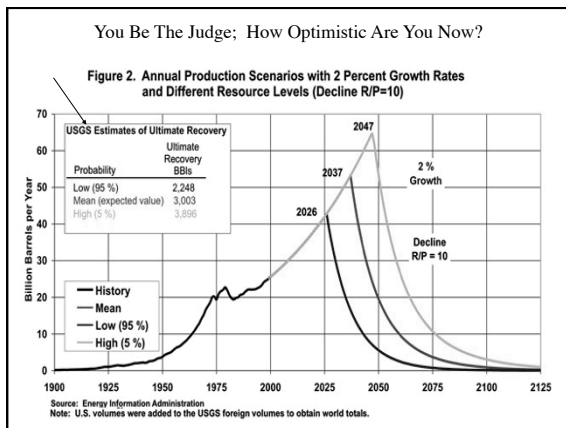
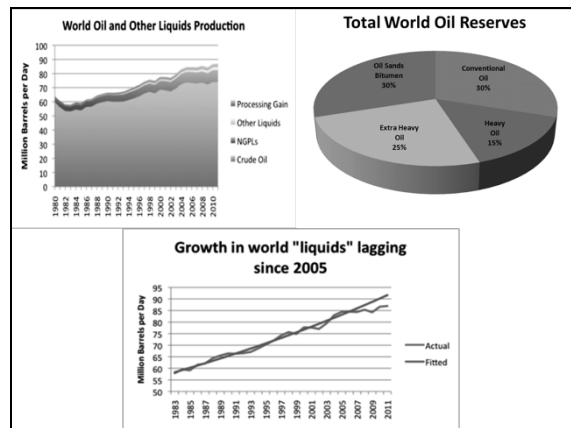
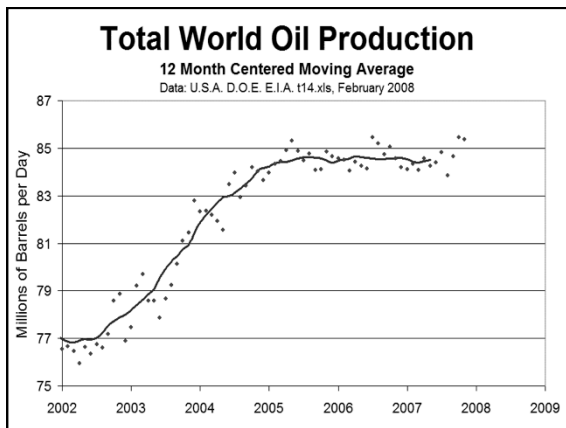
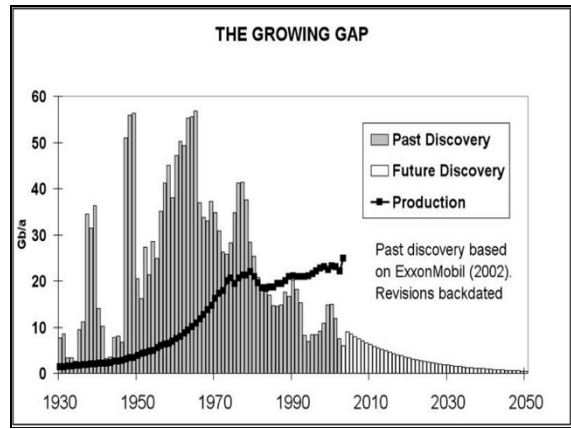
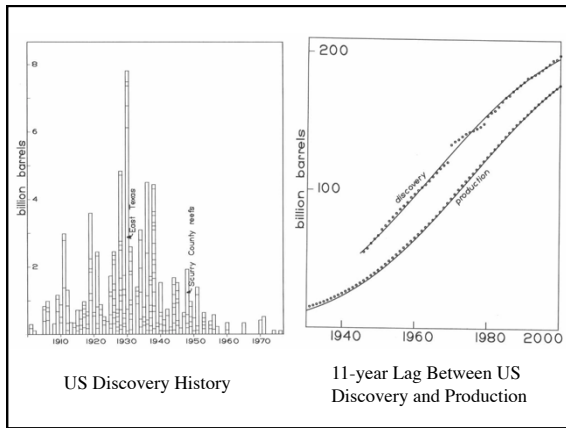
"Hubbert's Peak: The Impending World Oil Shortage" (Deffeyes, 2001)



Production v. Cumulative Consumption
Total Yield When Production \rightarrow 0



Total Recoverable World Oil ~ 2.1 Trillion Barrels

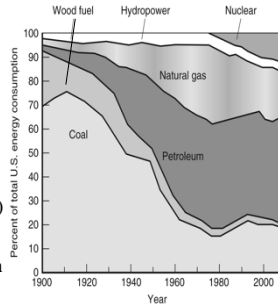


What Causes a Crisis?

- Different assumptions give different T_{exp} :
 - exponential expiration is shortest
 - "@ current rate" is much longer
 - Hubbert curve $\rightarrow \infty$, 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)

