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"One thing is clear: the era of easy oil is over. What we all do next will determine how well we meet the energy needs of the entire world in this century and beyond."
 - David J. O'Reilly, Chairman & CEO, Chevron Corporation, July 2005

A Look at the Future?
Peak Oil and Beyond

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The U.S. Lower 48 Oil Production History

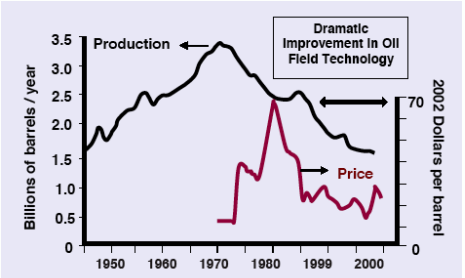


Figure 2. The decline of U.S. Lower 48 oil production was not reversed by large changes in oil prices or the dramatic improvement in oil field technologies.

Despite advanced technology and a desire to be independent of foreign oil, the production of oil in the U.S. peaked and moved to a state of decline.

Spring 2013 Q 2

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Is anything being done?

- There is very little awareness of “Peak Oil” in this country
 - even on Wall Street, and on Capitol Hill
- But the Department of Energy commissioned a study (the Hirsch Report), published Feb. 2005 that concluded:
 - peak is inevitable
 - a problem unlike any ever faced by the world
 - must start mitigation decades ahead of peak
 - options for liquid fuels replacement are limited, and mostly still fossil-fuel-derived

Spring 2013 3

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A look at the Hirsch Report

- Google: peak oil
 - go to Wikipedia link (near top of list)
 - under “Possible Effects...” heading, see reference to Hirsch Report
 - clicking the link for the Hirsch report main article, find summary (PDF) link near top
 - alternatively, full report available in link at bottom
- Let’s spend some time looking at this report...

Spring 2013 (2xQ) 4

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So the DoE knows: who else?

- Roscoe Bartlett (R-MD) and Tom Udall (D-NM) have formed a Congressional Peak Oil Caucus
 - commissioned a GAO (General Accountability Office) study on peak oil
 - Google search: bartlett gao peak
 - try: coverage of GAO... link
 - GAO study concluded essentially the same thing as the Hirsch Report: we need to act now to be assured we mitigate disaster

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GAO Report Excerpts

- Because development and widespread adoption of technologies to displace oil will take time and effort, an imminent peak and sharp decline in oil production could have severe consequences.
- Ultimately, however, the consequences of a peak and permanent decline in oil production could be even more prolonged and severe than those of past oil supply shocks. Because the decline would be neither temporary nor reversible, the effects would continue until alternative transportation technologies to displace oil became available in sufficient quantities at comparable costs.
- Response: practically none: NYT and Wash. Post did not run stories
 - crickets chirping

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Lack of Awareness

- Quote from Adam Cohen (www.peakoil.org):
 - “In my personal experience working with energy companies on stock and bond offerings during the last 3 years, I never heard any energy company employee or energy investment banker use the phrase “Peak Oil.” The few times I mentioned the phrase privately to bankers, the response was “What’s that?”
- Another quote from same source, referring to the assumed “market wisdom” of Wall Street:
 - “Put another way, how can so many smart people in suits be so wrong?”
- Look how long it took global warming to get on our radar screens
 - ironic that this one *could* be worse, but make global warming not as bad!

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So what are the alternatives?

- The Hirsch Report discusses five mitigation strategies:
 - Increased fuel efficiency in transportation
 - Heavy oil, tar sands
 - Liquefaction of coal
 - Enhanced oil recovery
 - Gas-to-Liquids (nat. gas)
- All fossil fuels; all needed in parallel
 - even then, need to start 10–20 years before peak
- Hydrogen, corn ethanol considered non-viable

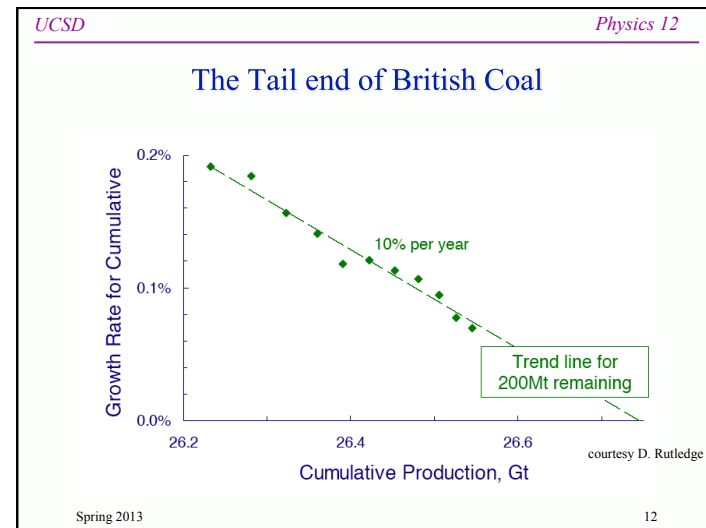
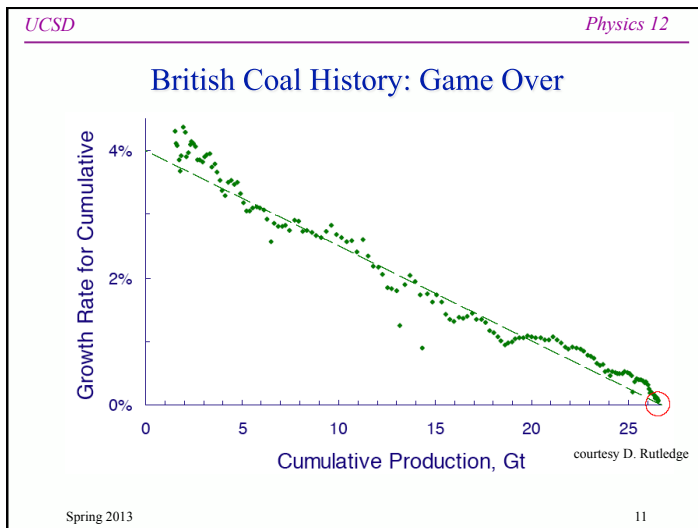
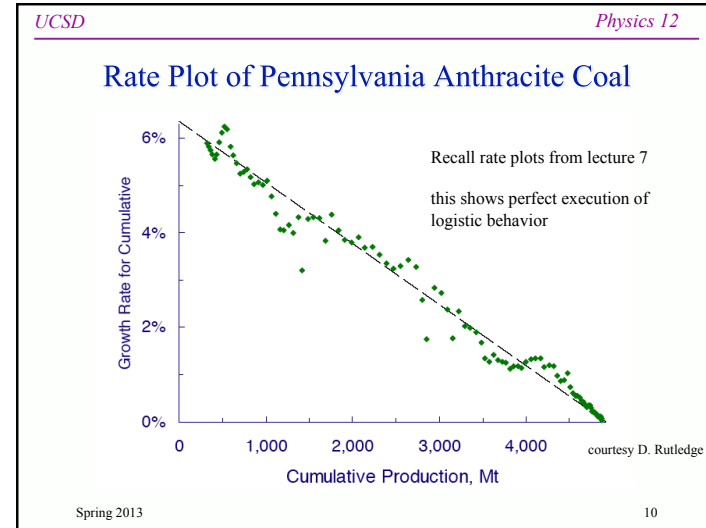
Spring 2013 8

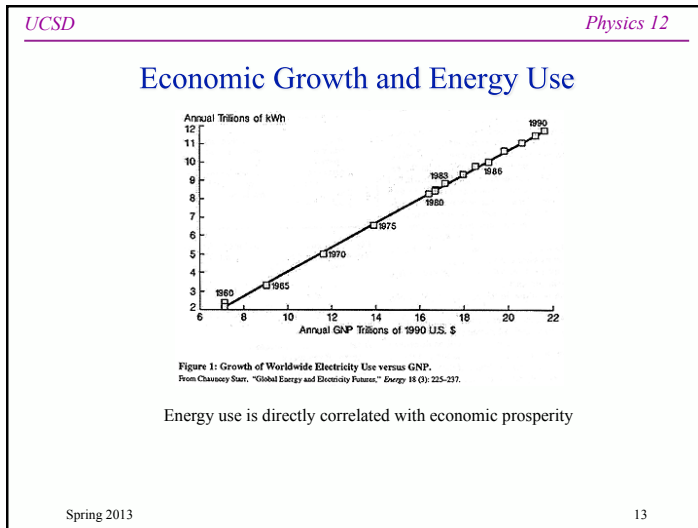
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Do we even have enough coal?

- Recent work by Dave Rutledge at Caltech hints that we may not have as much world coal as is assumed
 - Rutledge estimates 240 Gtoe (gigatons oil-equivalent) of coal left in the world (90 Gtoe in the U.S.)
 - “Official” estimates are 460 Gtoe in world, 146 Gtoe in U.S.
 - For comparison, the estimated 1 trillion bbl of oil left amounts to 140 Gtoe
 - So coal isn’t even twice as abundant as the remaining oil, if this is right
 - The U.K. down-revised their coal estimates by 99% from 1970 to 2005: they’re basically out

Spring 2013 9



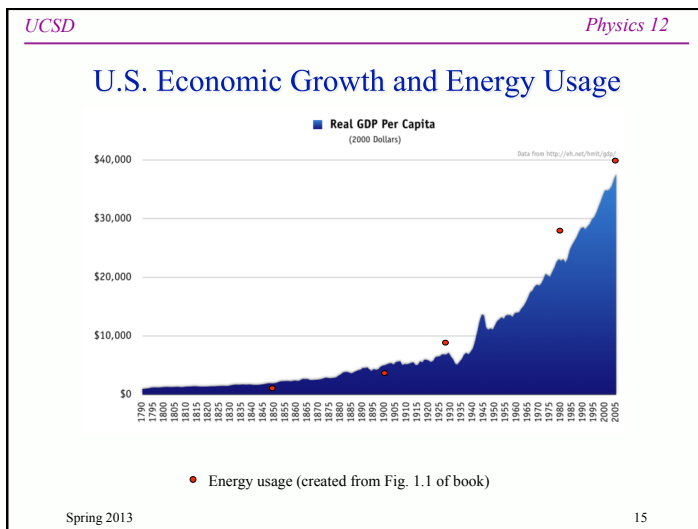


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Chicken-and-Egg Problem

- Is energy use just keeping pace with economic growth?
- Or is economic growth possible only if energy is available?
 - related issue: indefinite growth means unbounded exponential behavior—incompatible with a world containing finite land, water, resources
- The world changed with the industrial revolution, and this was only possible because energy (coal) was cheap and abundant

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What happens after world oil peaks?

- Worldwide oil production will inevitably peak
 - the speed with which we can extract oil from the ground is limited, and *will* diminish
 - the U.S. experience (plus 33 of 48 major oil-producing countries that *are in decline*) is a good example
- What happens then?
 - gas prices go way up (even more!)
 - transportation becomes expensive
 - all sectors of our economy impacted
 - all consumer goods, agriculture, etc. depend heavily on liquid petroleum

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What can/should you do?

- Understand that we don't *know* what the future holds
 - I may be over-reacting to the potential threat
- Raise your awareness of energy issues
- Make life plans that allow flexibility
 - have a plan B, or pick a direction that will be valuable in any eventuality
- Adjust yourself to a world with less stuff/goodies
 - less jarring if hard times hit, and easy to please if hard times *don't* hit
- Lower your own demand: best way to buy time for problem

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17

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Announcements/Assignments

- This is a “supplemental” lecture, breeze through in class
- Can find Hirsch Report via Google
 - executive summary is good start
 - also full text available
- Optional reading
 - Do the Math: Peak Oil Perspective

Spring 2013

18