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"The Big Picture View from the Dismal Science"

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The "Economic Problem"

- Basic economics textbooks usually have a definition that goes something like:
  - *economics is the study of how limited resources are used to meet society's unlimited wants*
    - resources include capital, labor, materials, and energy -- that are called "factors of production"
  - society faces choices of how to use those factors of production to produce and distribute goods and services to meet those wants -- the better we use them, the better off we are
  - energy is a vital factor -- sometimes overlooked
  - relatively cheap energy has been the fuel in the engine of economic growth
  - dealing with resource limits is at the very heart of what economics is all about

On the "dismal science"

- George Stigler explains why economics is still called "the dismal science" more than 160 years after it was first applied
  - "Economists are messengers who so often bring bad news, and so earn the reputation of such messengers. . . . A society that does things that are inefficient or perverse in their effects ought to be told so. Doctors are obliged to warn against nostrums that do nothing to cure and may harm, and engineers are supposed to warn the legislature against perpetual motion machines. So it is with economists."

George J. Stigler

Memoirs of an Unregulated Economist

1988

  - In short, economists are often the wet blankets that throw cold water on cherished ideas of politicians and others

(and that's what I plan to do here)

Putting the "Dismal" in the science

- Thomas R. Malthus postulated* that since population tends to increase at a constant geometric rate and output of food tends to only increases at an arithmetic rate, population will eventually outstrip food supply and result in subsistence living, misery, and starvation (dismal indeed!)
- While many agreed with the Malthusian view in the early 19th century, many economists, especially in later years, did not and took him to task for underestimating the role of technological change and human ingenuity

Thomas R. Malthus, *Essay on the Principle of Population* (1798)

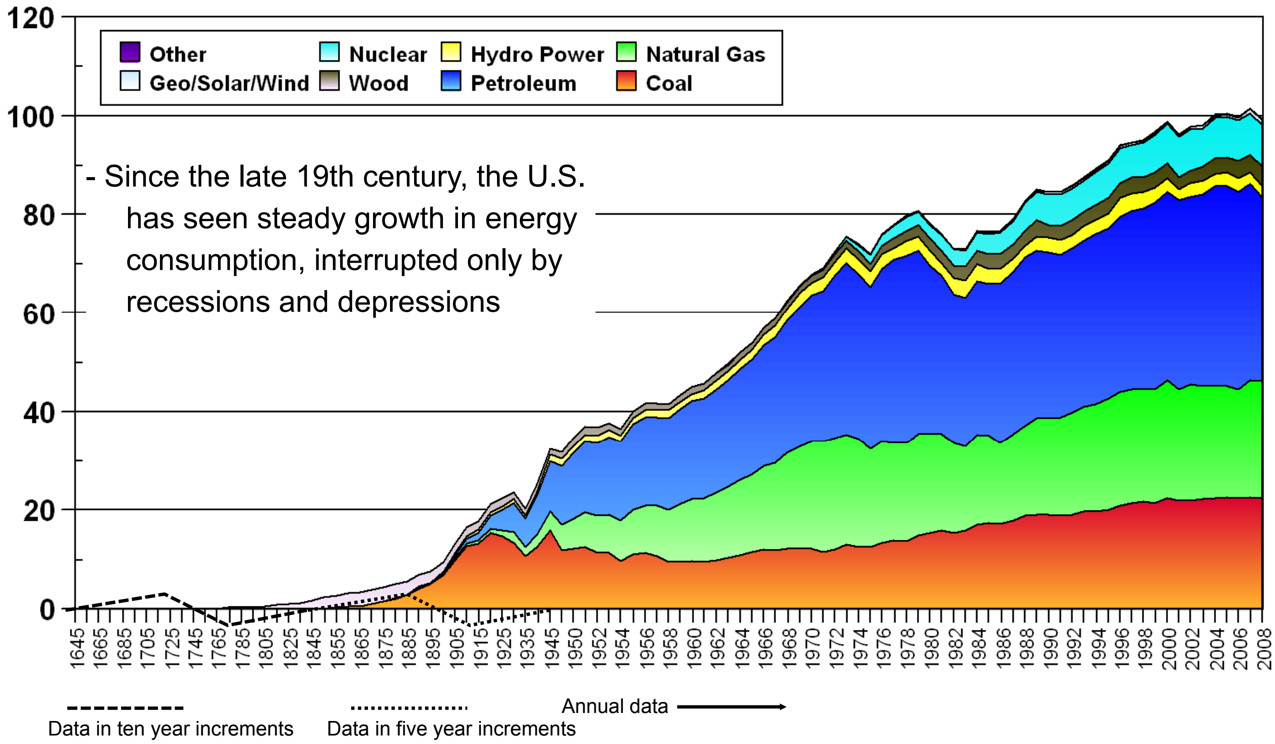
More recent "Dismal" prognostication

- A more recent (and more sophisticated) version of a similar idea was the computer simulated projections of *The Limits to Growth* first published in 1972 -- and recently updated in 2004
  - they found that there is a "potential for catastrophic overshoot" that are the "consequences of a population and economy that have grown past the support capacities of the earth"
  - they believe that "if a profound correction is not made soon, a crash of some sort is certain. And it will occur within the lifetimes of many who are alive today"
- The concern of dwindling resources is part of the "peak oil" theory as well

General view of economists today

- Most mainstream economists are resource optimists, believing that when a resource becomes scare, the price will rise, inducing consumers to use less, and inducing suppliers to innovate and produce more, or find substitutes
- While a resource may indeed be finite in a physical sense, in an economic sense it is argued, it is inexhaustible in that we will not “run out” of it
- Because of the spectacularly wrong prognostications in the past, economists are usually reluctant sign on to any doomsday scenarios
- However, those that belong to the field of ecological economics (Nicholas Georgescu-Roegen, Herman Daly for example) -- see the economy as a subsystem of the environment -- are more sympathetic to limit theories

Figure 1. U.S. Energy Consumption by Source, 1645-2008 (Quadrillion Btu)

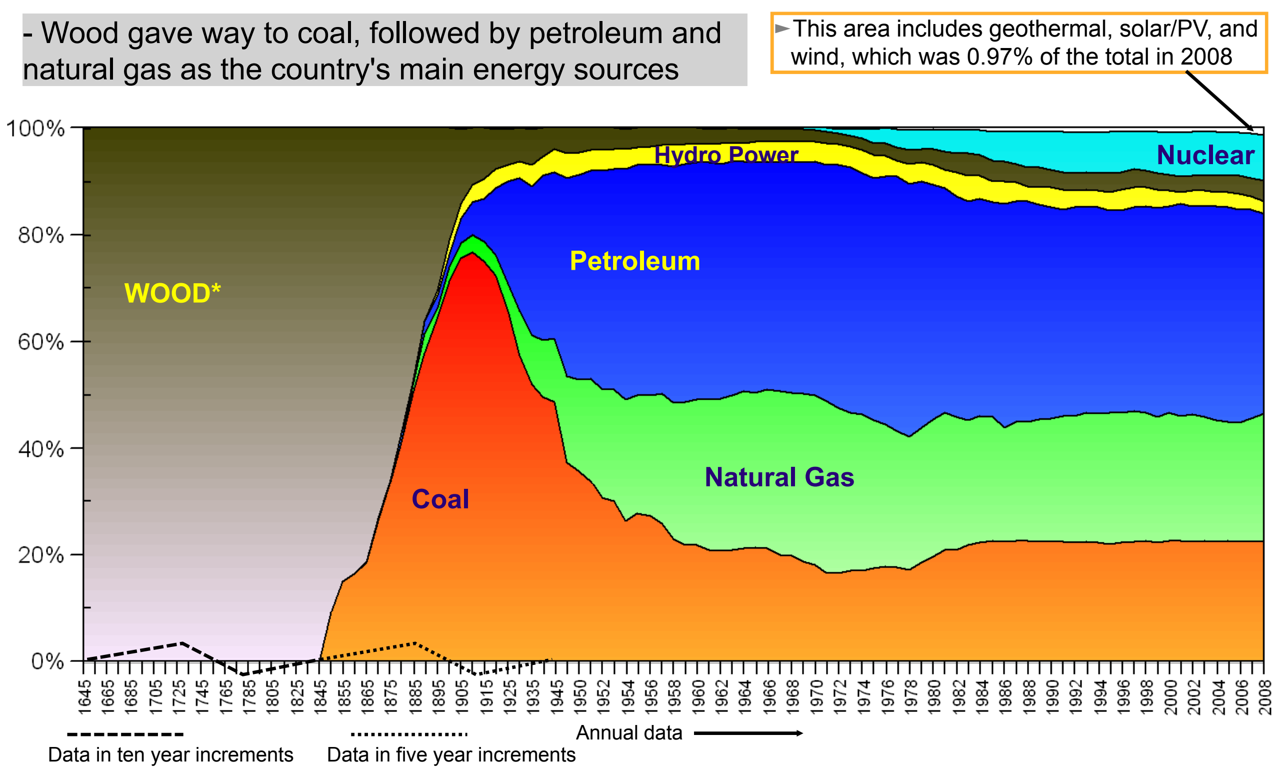


Data Source: U.S. Energy Information Administration, http://www.eia.doe.gov/

*The wood category includes biomass in later years.

Figure 2. U.S. Energy Consumption by Source, 1645-2008 (Percent of total energy consumption)

- Wood gave way to coal, followed by petroleum and natural gas as the country's main energy sources



Data Source: U.S. Energy Information Administration, http://www.eia.doe.gov/

*The wood category includes biomass in later years.

Jevons "Dismal Theorem"

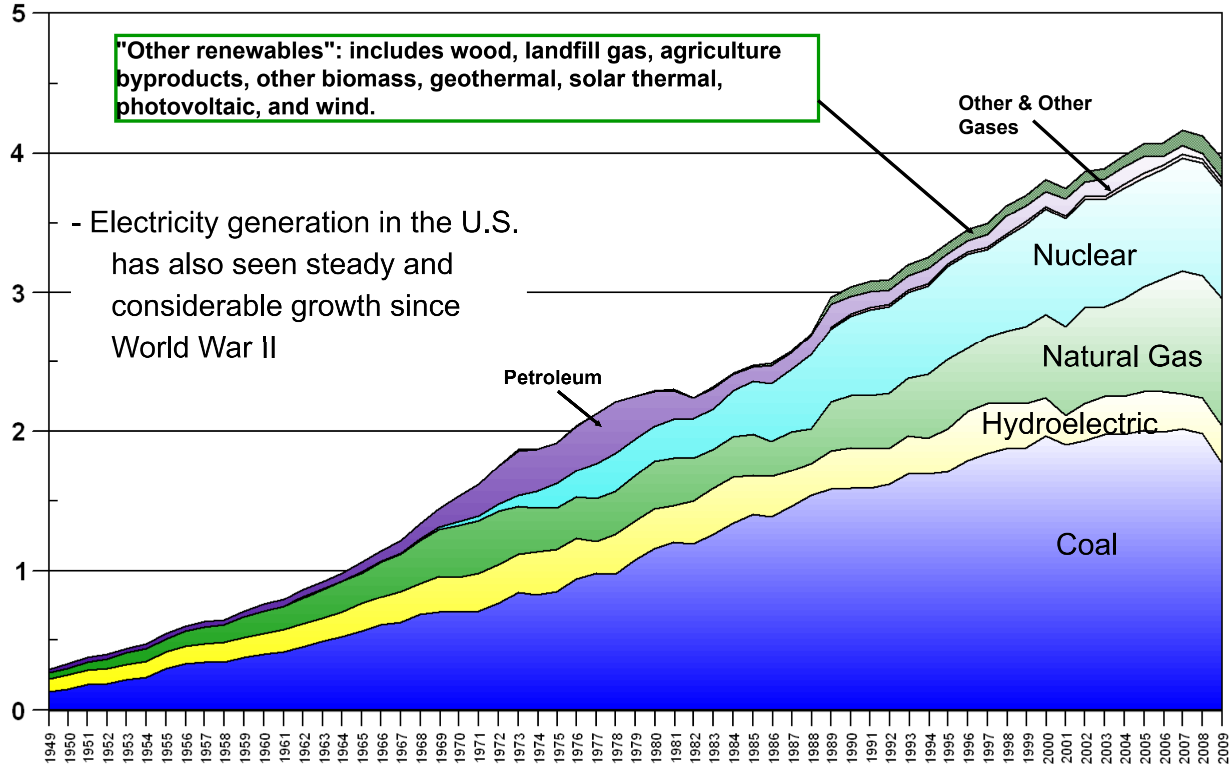
- William Stanley Jevons, while studying British coal mines in the mid-19th century,* observed that improved engine efficiency lowered the per unit cost of extracting coal (saving fuel & labor)
  - however, the engine efficiency improvement did not reduce total industry fuel use -- but instead increased it
  - this occurs because the reduced per unit cost (e.g., $/ton) increases profits and attracts new capital entry; the price for coal drops; the overall coal industry output expands because of the lower price for coal; and the industry use of coal as fuel expands (the overall economy expands also, which leads to more coal use)
  - this is now often called *Jevons paradox*, or the snapback, rebound, or Jevons effect
  - As Jevons put it, *"It is the very economy of [coal] use which leads to its extensive consumption."*

** The Coal Question; An Inquiry concerning the Progress of the Nation, and the Probable Exhaustion of our Coal-mines* (1865)

Jevons "Dismal Theorem" *(continued)*

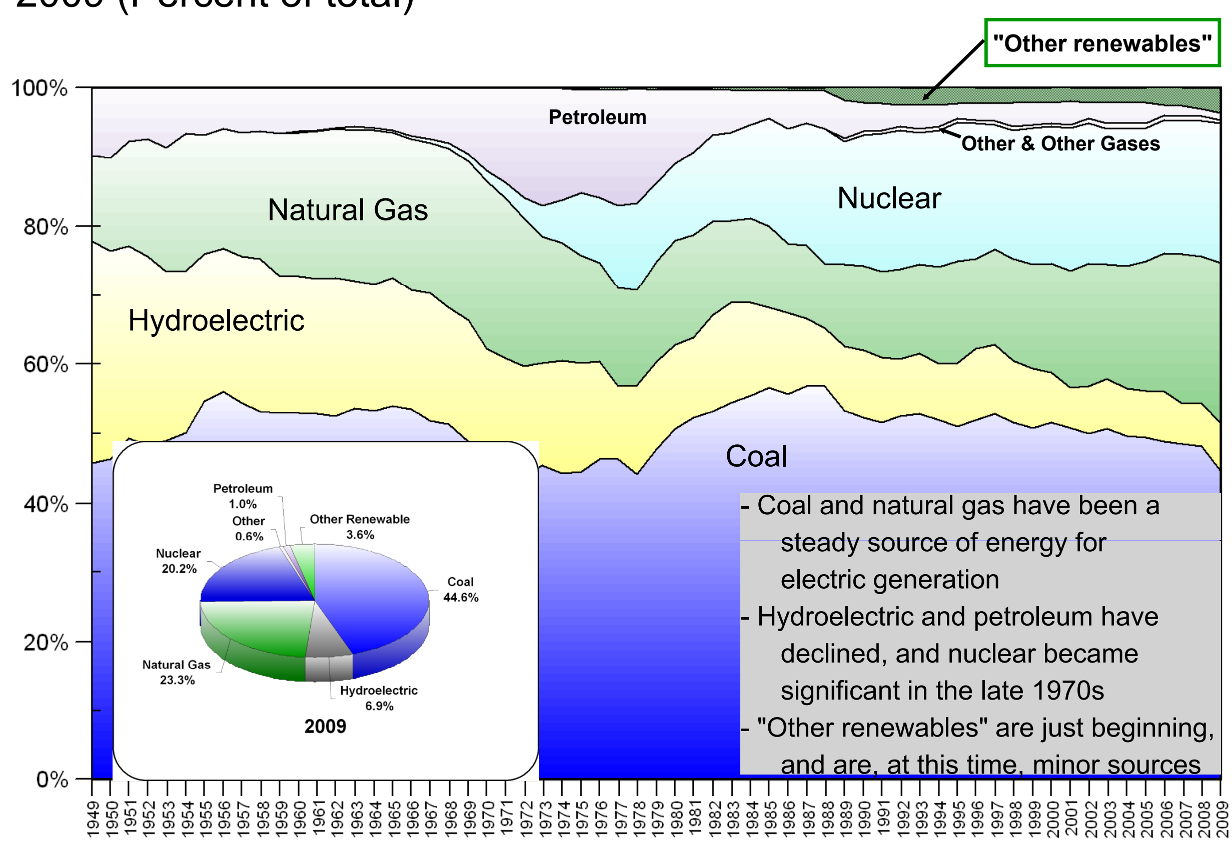
- This is bad news for conservation advocates who believe that technology improvements alone will save energy resources
- There are many examples of Jevons Paradox
  - per person cost of air travel decreased significantly as the industry developed, but fuel use by the airline industry would boggle the Wright brothers' minds
  - many appliances are much more efficient than just 20 years ago, but consumers have opted for larger and more units in their households (TVs, computers, refrigerators, etc.) and more people have them (air conditioning, for example)
  - early decades of the electric power industry, when larger central-station power plants increased fuel efficiency, and the real price decrease greatly expanded electricity use and helped spur economic growth in the U.S. and elsewhere
  - efficient lighting leads to more lighting being used in a house (if it leads to more power being used for lighting than before, that's sometimes called "backfire," see the book *Jevons' Paradox and the Myth of Resource Efficiency Improvements*)

Figure 3. U.S. Net Generation by Energy Source, 1949 through 2009 (billion MWh)



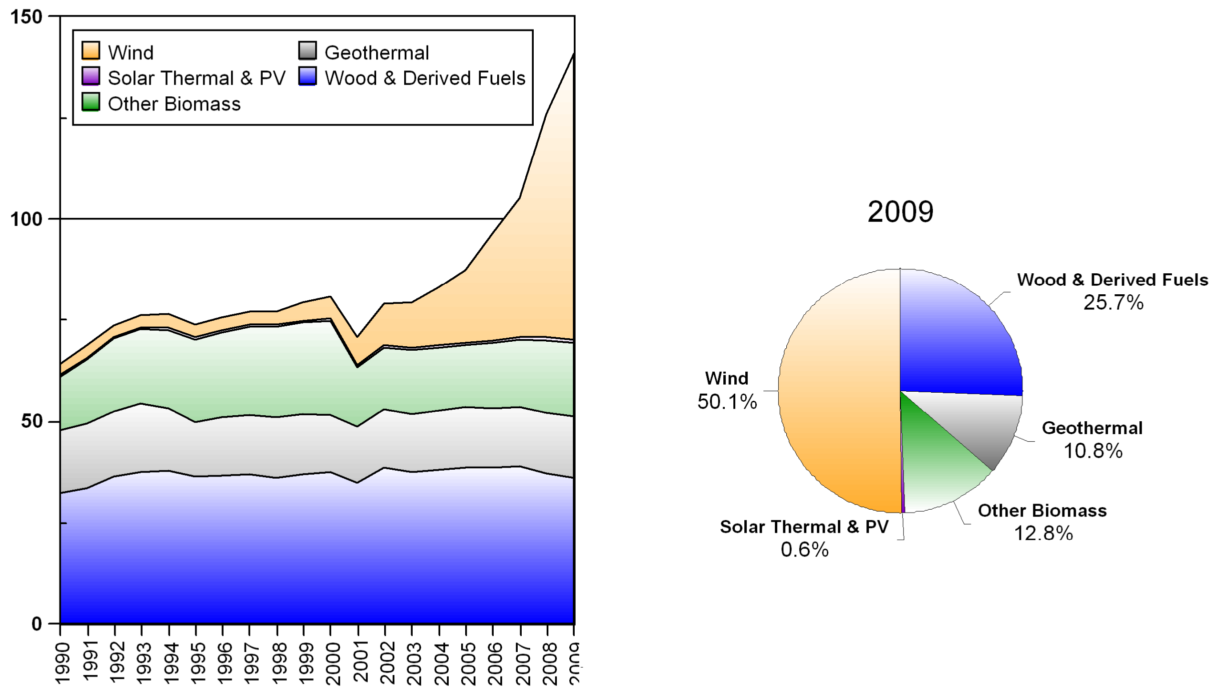
Data Source: U.S. Energy Information Administration, http://www.eia.doe.gov/

Figure 4. U.S. Net Generation by Energy Source, 1949 through 2009 (Percent of total)



Data Source: U.S. Energy Information Administration, http://www.eia.doe.gov/

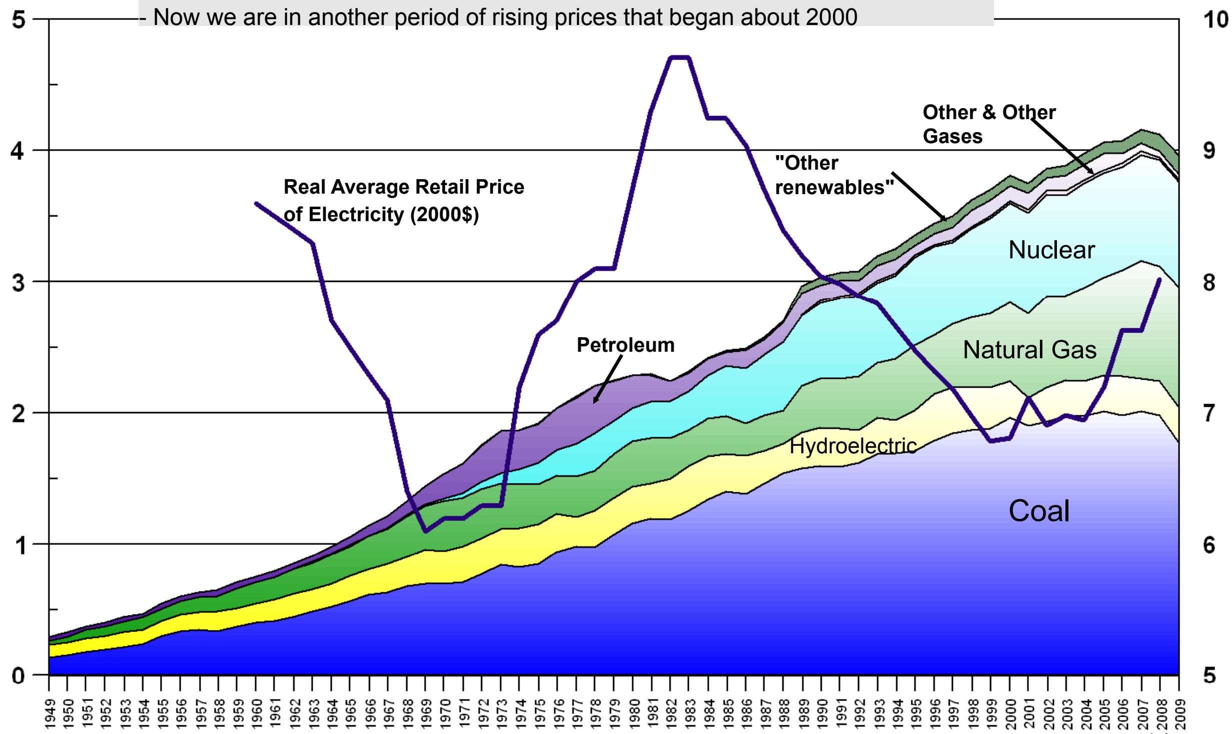
Figure 5. U.S. Net Generation by "Other Renewables" 1990 through 2009 (million MWh)



Data Source: U.S. Energy Information Administration, http://www.eia.doe.gov/

Figure 6. U.S. Net Generation by Energy Source, 1949 through 2009

- The real price for electricity declined significantly from early 20th century until the 1970s
- Fuel and construction costs pushed the price up in the 1970s
- This was followed by a significant decline through the 1980s and 90s
- Now we are in another period of rising prices that began about 2000



Data Source: U.S. Energy Information Administration, http://www.eia.doe.gov/

Unwelcome Feedback Loops

- For most of the last century and a half, Jevons Paradox would be seen as a positive feedback mechanism, resulting in greatly expanding our economy and providing undreamed of opportunities
  - if Jevons were writing today, he might say, *"it is the very economy of electricity use which leads to its extensive consumption."*
- But today, with concerns with climate change, other environmental damage, and resource scarcity --
  - Jevons Paradox is now an example of a negative feedback loop -- something that can have unintended consequences from the best intentions of policymakers and others

Unwelcome Feedback Loops *(continued)*

- Near continuous energy efficiency improvements for more than a century have increased our national output and standard of living
- But this has meant a near continuous increase in energy use (Figure 1)
- Not likely to be able to conserve our way to lower aggregate electricity use or lower emissions
- Technological solutions alone won't solve the problem -- and could lead to more consumption or do very little to reduce it
- We'll make ourselves poorer if we increase the cost of energy (creating a few jobs is hardly an offsetting factor)

Unwelcome Feedback Loops (continued)

- The dilemma is that the only way to get people to use less is to raise the price
  - but that means raising the costs for businesses and households -- reducing aggregate economic output
  - important that this is done as efficiently as possible, to limit the damage to economy
  - to suggest it will not have a cost (or that it would even be beneficial) is not very realistic
- Simply raising the price of electricity is not recommended -- since this will reduce usage, but not necessarily emissions
  - the focus should be on CO_2 emissions, not electricity usage
- Also not recommended would be to mandate the technologies used to generate electricity (such as with RPS)
- Emissions are the thing we want to control -- recommend focusing on that instead

A Way Out of the Dilemma?

- Examining the dilemma within the framework of mainstream economics (that is, standard environmental and energy economics) and an understanding that raising pricing will be harmful to consumers and the economy, but that something must be done to reduce CO_2 emissions,* leaves us with the following as the lowest cost means available (yes, it will have a cost)
  - focus on the emissions, not the technology (smart grid is fine, but do it because to makes sense to upgrade) and not on electricity usage
  - use emissions trading, as broadly as possible, leave the innovation to smart engineers to figure out the best way to do it (not legislative guesses) -- we've have had good results with the SO_2 allowance trading program
  - alternatively, use an emissions tax to do it -- but this is less desirable not only for political reasons (everyone hates taxes!) but it also makes the level of emission reductions uncertain

*If you don't believe that CO_2 emission should be or can be reduced, then you will ignore this advice anyhow. Have a nice meeting.

Our Dismal Energy Predicament

- But . . .
- The nature of the energy predicament we face is that many of the very things being considered to fix the problem, will make it worse
- We're relying on a system that requires an increasing infusion of BTUs from nature's endowment of nonrenewable resources to keep it going
- Increasing complexity will also increase energy use and costs
- Unless an economical fusion reactor, Mr. Fusion, or a matter/antimatter annihilation reactor regulated with dilithium crystals is invented anytime soon, our natural endowment will continue to dwindle