Lecture #23: Energy Crises

Suggested Readings:

Martin Melosi, *Coping with Abundance: Energy and Environment in Industrial America*, 1985.
Vaclav Smil, *Energy at the Crossroads: Global Perspectives and Uncertainties*, 2003.
Alfred Crosby, *Children of the Sun: A History of Humanity's Unappeasable Appetite for Energy*, 2006.
Kenneth S. Deffeyes, *Hubbert's Peak: The Impending World Oil Shortage*, 2003.
Vikram Rao, *Shale Gas: The Promise and the Peril*, 2012; Tom Wilber, *Under the Surface*, 2012.
Russell Gold, *The Boom: How Fracking Ignited the American Energy Revolution & Changed the World*, 2014
Daniel Yergin, *The Prize*, 1991; Yergin, *The Quest*, 2011.
D. Ford, *Cult of the Atom*, 1982; G. T. Mazuzan & J. S. Walker, *Controlling the Atom*, 1984.
J. Samuel Walker, *Three Mile Island: A Nuclear Crisis in Historical Perspective*, 2004.
Gwyneth Cravens, *Power to Save the World: The Truth About Nuclear Energy*, 2007.
Wendy Williams & Robert Whitcomb, *Cape Wind: Money, Celebrity, Class, Politics, and the Battle for Our Energy Future on Nantucket Sound*, 2007.
Amory Lovins, *Soft Energy Paths*, 1977; *Winning the Oil Endgame*, 2004.
David Nye, *Consuming Power: A Social History of American Energies*, 1997.

Outline

I. The Fossil Fuels Era Approaches Its End

much of U.S. economic & technological growth since 1800 predicated on cheap energy
variant on Potter's *People of Plenty* theme, & Habakkuk's replacement of people with "labor-saving" devices: replace organic with inorganic energy sources
M. King Hubbert 1956 paper predicted US would reach peak production in lower 48 in 1971
restating Malthus for industrial society: not food but energy would limit growth; energetics as new metaphor for ecosystem analysis too: Raymond Lindemann and G. Evelyn Hutchinson at Yale study ecosystem energy flows; Howard and Eugene Odum analyze trophic levels of ponds using radioactive isotopes
note long series of transitions in basic energy sources for US: from fuelwood to coal to oil, each with virtues and problems. wood entailed deforestation; coal polluting, occupational hazard, dirty, destructive to landscape, polluting, inconvenient to transport & use
oil = great 20th century energy source. 1st well Titusville, PA, invested in by New Haven RR conductor, Edwin L. Drake, struck oil 8/27/1859. replaced whale oil for light; eventually ended classic urban pollutions of 19th century city: horse manure, coal smoke
western gushers transformed Texas and California economies, later Oklahoma: 1/10/1901, Spindletop strike sends 100' gusher skyward; Texas Co. founded 1902; Gulf Oil 1907
fossil fuels at base of virtually every aspect of 20th c life: automobile transport (smog), suburb/skyscraper division of urban form: vertical office and commercial space downtown, horizontal residential suburbs, linked by increasingly energy intense transport systems
skyscraper services as microcosm of modern city (water, sewage, light, heat, power)
cf air conditioning: 19th century residential cooling all natural: awnings, curtains, porches, trees
mechanical refrigeration invented 1851; first room cooling device by W. H. Carrier in 1902; by 1920s, air conditioning units for elite bldgs; explosion in demand 1950s
telltale shift of peak electrical load from midwinter to midsummer reveals new energy economy; energy consumption not just to heat but to cool: control of and separation from nature
agriculture: transition from human and animal power to oil-powered tractors, increasing labor efficiency of food system also decreasing energy efficiency (Habakkuk thesis again)
tractors only the most visible symbol of increasing energy input to whole agricultural system; compare energy intensity of feedlot beef: from range-fed to grain-fed cattle
by 1970, 7-8 calories of fossil fuel invested to yield 1 calorie of heat-dried corn
correlation of GNP per capita with energy per capita: US standard of living based on oil: by 1970, average American used 3 times more energy than grandparent

II. Crisis

trouble signs: 1947, US becomes net importer of oil; imports rise as % of U.S. production from 3% in 1940, 9% in 1950, 14% in 1960; 1956, 1st decline in new U.S. drilling; 1968, more natural gas consumed than found; 1971, U.S. no longer world's largest producer
1960: Organization of Petroleum Exporting Countries, OPEC, formed: Iran, Iraq, Kuwait, Venezuela, Saudi Arabia; controlled 75% of world oil reserves by 1970
1973 Yom Kippur War: Saudi Arabia demands price rise from $3-$6/bbl, Arabs boycott US oil shipments for US airlifts to Israel, U.S. price up 130% to $11.65/bbl by year's end

prices stable at new level until 1978, when Shah of Iran fell, Iranian exports drop, prices rise once again to as high as $45 on spot market by end of 1979; cf. $3 at decade's start
domestic effects: massive price increase for gasoline, fuel oil, etc., shortages, lines; helped fuel inflation of 1970s (but don't forget Vietnam & Great Society deficits
Carter's Moral Equivalent of War; fear of foreign oil power; intense resentment of oil companies' increased profits (2.6% per year 1956-72, 20.8% per year 1973-80); widespread anxiety that US no longer in control of own destiny
but note explosion of growth in TX, CO, OK, Alaska, followed by bust when OPEC lost control of prices in 1982; TX lost 1 million oil jobs in 1982, savings and loan crisis of late 1980s, early 1990s partly triggered by this
oil inflation as political economic crisis made possible by underlying shift from abundance toward scarcity of U.S. domestic reserves
oil crisis prompted large-scale rethinking of energy system: conservation (insulated houses, smaller cars) vs. new supply (domestic oil, shale oil, coal)
but energy conservation might conflict with pollution control & other environmental concerns: shift back toward coal consumption away from oil also a shift toward greater pollution; automobile emission controls also often decreased engine's energy efficiency
Alaska Pipeline controversy made this point clearly: Arco discovers Prudhoe Bay's 10 billion bbls reserve in 1968, pipeline proposed 1969; opposed by Wilderness Society, Environmental Defense Fund, demanding environmental impact statement on tundra effects; Congress approves pipeline 1973
if pollution control and back to nature were themes of late 1960s & Earth Day, cost-benefit analysis was theme of 1970s and 1980s: how to make tragic choices

III. The Nuclear Alternative

Atomic Energy Commission, then Nuclear Regulatory Commission had promoted nuclear power as "Atoms for Peace": reactors could produce electricity "too cheap to meter", no real environmental/health hazards
public anxiety persisted: fears of bomb, fallout, proliferation, accidents, wastes
1957 Price Anderson Act sets ceiling on utilities' liability for reactor accidents: bad sign
early 1970s saw increasing hostility to nuclear power, protests oriented toward stopping construction (Seabrook, Diablo Canyon); stopping transport of wastes (Jerusalem, NY)
increasing use of courts and administrative regulatory hearings to throw up obstacles to construction, with experts on both sides testifying about safety or risks of reactor design: paradoxical reliance on professional expertise coupled with delegitimation of expert authority in increasing perception of experts as hired guns: no objective knowledge?
industry fought back with argument that nuclear power cleaner & safer than fossil fuel
March 28, 1979, Three Mile Island Unit 2 reactor experienced loss-of-coolant accident, partial meltdown, through series of human errors, small radiation releases: the invisible accident
became symbol of untrustworthiness of nuclear technology, fanned public concerns
Chernobyl accident in the Ukraine on 4/26/1986 much more serious in widespread radioactive release, widespread fallout in Europe, $200 billion property damage, 56 direct deaths, estimated 4000 extra cancers in exposed primary population of 600,000 people
Worst nuclear accident until March 11, 2011 tsunami led to meltdowns of 3 reactors at Fukushima in Japan
1980 polls show public hostile to new reactor construction; environmentalist manipulation of regulatory process delaying new plants; construction costs rising, new orders end
as we'll see in final lectures, growing concern about global climate change would revive interest in nuclear

IV. Soft Energy Paths

Amory Lovins' *Soft Energy Paths*, 1977: distinguish between hard (high tech/env damaging/nuclear) and soft (low tech/env safe/solar) technology: technocratic version of E. F. Schumacher's *Small is Beautiful*
reinforced by Harvard Business School's *Energy Futures*, 1979: oil crisis coming, nuclear blocked by regulatory failure, so conservation and solar the best immediate alternatives
arguments seemed to suggest that tragic choices could be evaded: but on what time scale?
note Farralones Institute's Integral Urban House, New Alchemy Institute as experimental solar communes: utopian vision persists, solar and soft energy as symbols not just of low-tech solution, but of choices driven by fundamentally different values
coal vs nuclear vs hydropower vs solar vs wind: which path?