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U.S. Energy History
1945 to Present

ENG 300 – Energy Systems

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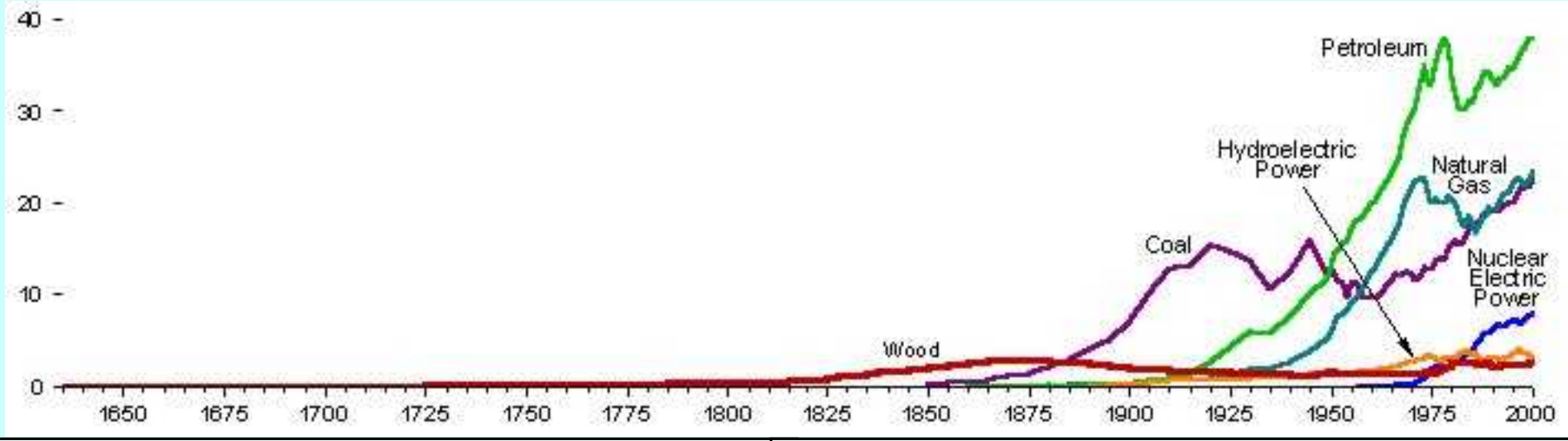
Energy History: 1945 – 1975

- Snapshot of the energy trends at the end of World War II
- Overview of US energy trends 1945-1975
- Importance of the change in US industry and the workforce as reflected in change in demand
    - *The example of energy use in agriculture*
    - *Electric power demand growth*
- Histories for the period by energy sector
    - *Oil*
    - *Natural Gas*
    - *Coal*
    - *Nuclear*
    - *Hydroelectric generation*
- Overview of the changes in the energy sector that have impacted the period from 1975 to present

Snapshot of the U.S. energy trends at the end of World War II



- In US inexpensive widely available energy is viewed as a public good and right
- Increase federal regulation and direct competition in the power sector (TVA and Bonneville PA)
- Energy supply globalized for economic rather than projection of force
- First nationalization of US owned production – PEMEX late 1930

- Development of regional rather than localized energy infrastructures – regional and nationally connected energy systems begin to emerge
- Growth in Interstate oil and gas pipelines, interstate electric transmission system

Importance of the change in US industry and the workforce reflects change in Energy demand

- After WWII draw to the city for higher paid manufacturing and industrial jobs
- Simple economics drives agriculture to fossil energy use
  - In 1970's, fossil fuel for farms was $15 per GJ
  - Labor for farms was $6000 per GJ at $3/hr wage
  - In 1940, 15% of land was used to support draught animals
  - From 1940-1970 the corn yield per hectare tripled
  - From 1940 –1970the farming population went from 12 million to 4 million
- Maurice B. Green, *Eating Oil: Energy Use in Food Production*, 1978, Westview Press

Example of changing energy use in agriculture

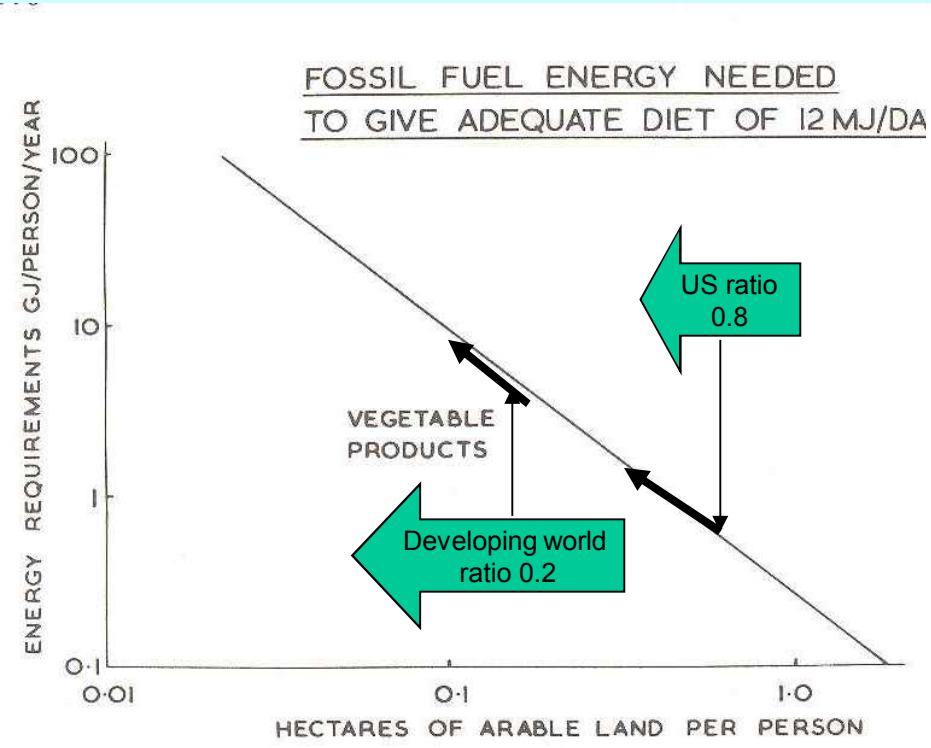


Figure 14. Fossil fuel energy needed to give adequate diet of 1 MJ/day. *Source:* Slesser 1973 and others.

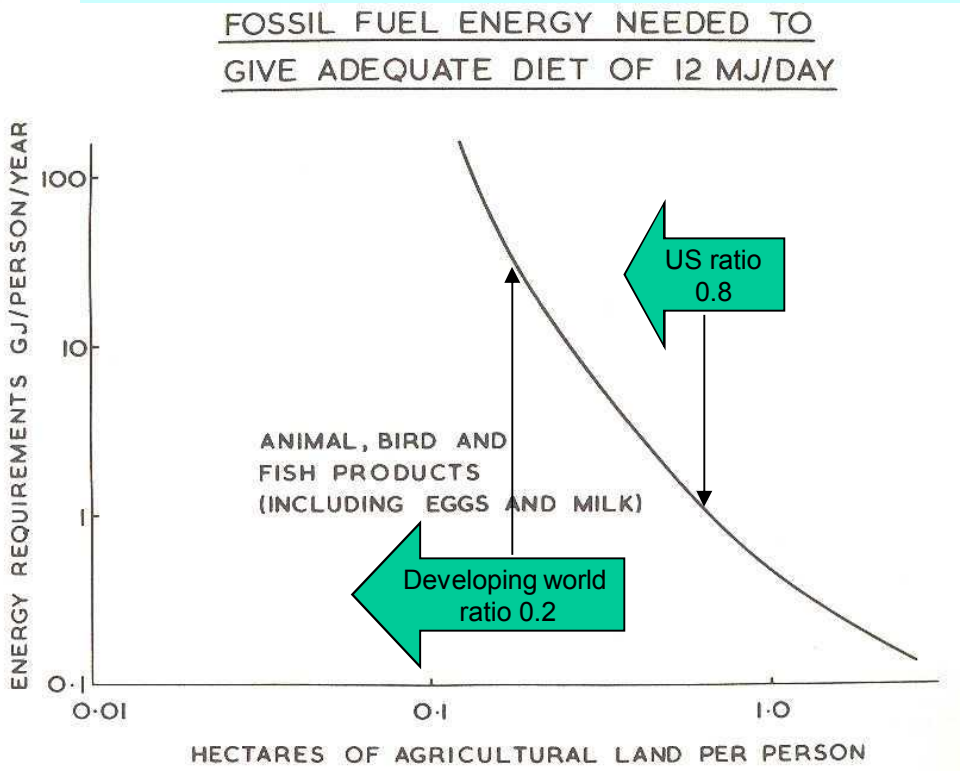
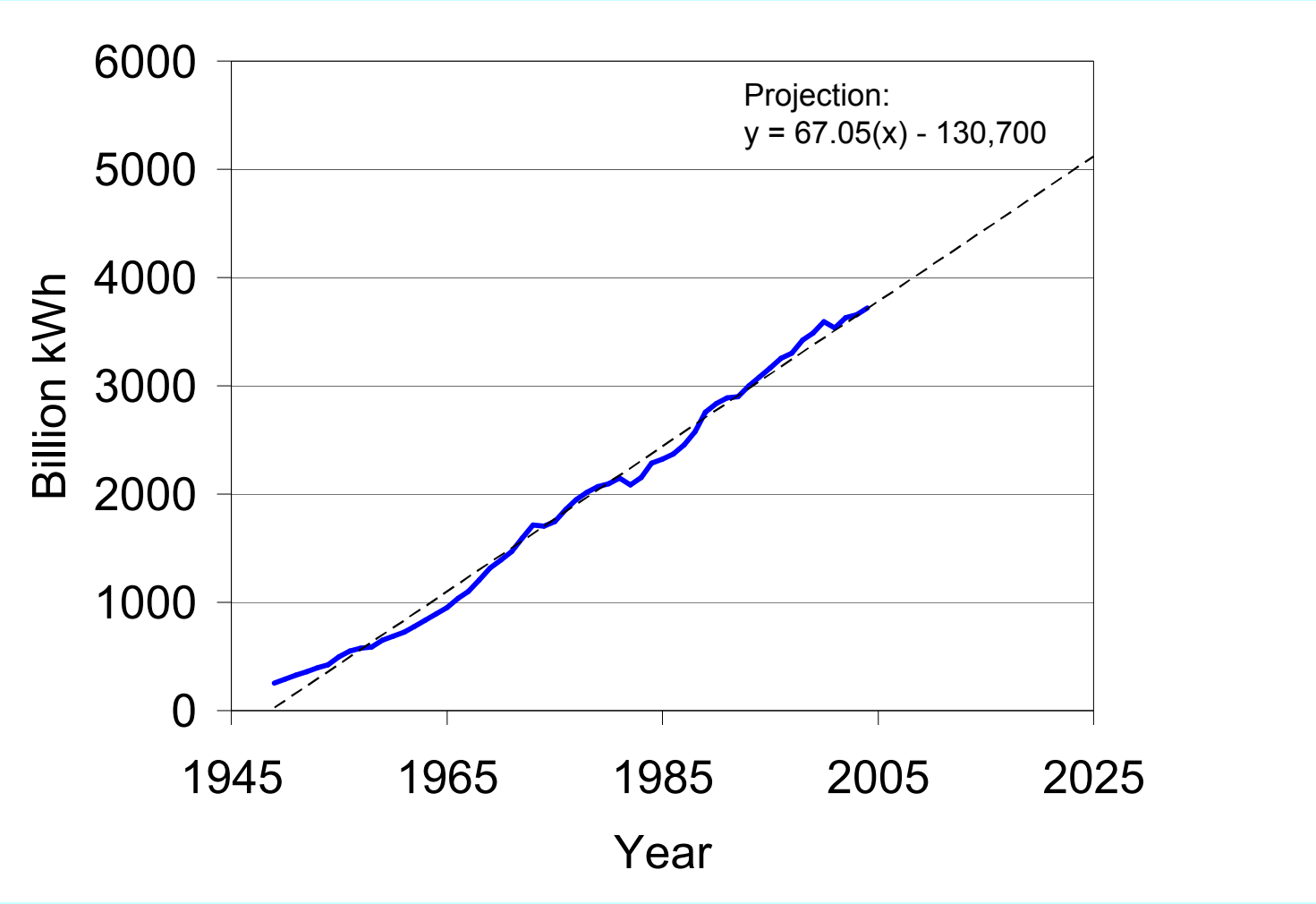


Figure 15. Fossil fuel energy needed to give adequate diet of 12 MJ/day. *Source:* Slesser 1973 and others.

Maurice Green, Eating Oil; Energy Use in Food Production, Westview Press Boulder, CO, 1978, 205p., ISBM 0-89158-244-4

Growth in Electric Power Demand

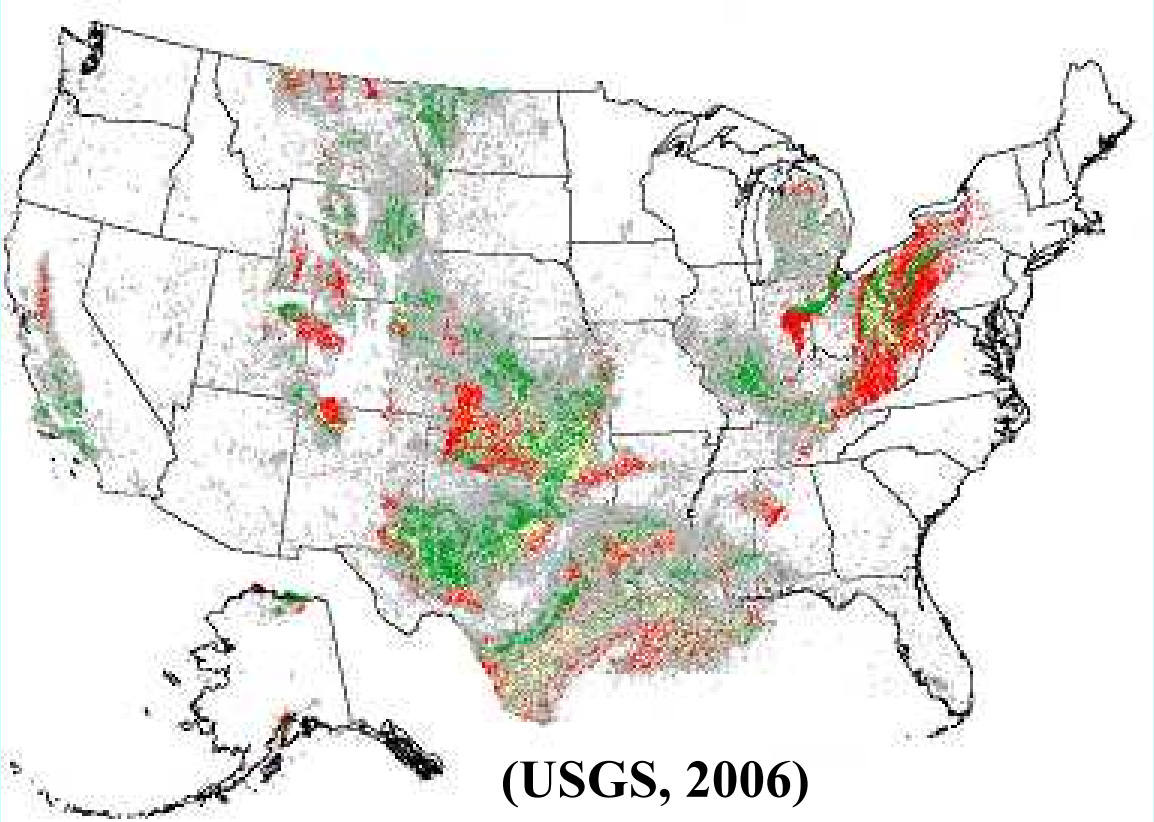


History of Oil Issues and Trends in the U.S.

1860	Kerosene $85/barrel
1946	SOCAL Texaco sold part of ARAMCO to Exxon with antitrust exemption
	Companies permitted to deduct from US taxes Saudi royalty payments
1946	Iran is the largest Middle East producer, Iran-Russia crisis flares, US direct and indirect involvement
1948	US became net importer due to influx of cheap Venezuelan crude
1950	**US produces 50% of the world oil**
	US had enough excess capacity to make up for lost production during SUEZ crisis
1950	Late 1950's – US starts restrictions on imports
1951	Iran nationalizes BP properties which initiates a boycott of Iranian production by major companies
1955	**US majors produce 70% of oil worldwide and in effect fix posted price**
1959	US companies tries to lower posted prices further leading to outrage from producing counties
	Influx of Russian oil at discounted prices
1960	**Iraq invites five producing countries to Baghdad forming OPEC (Iraq, Iran, Saudi Arabia, Venezuela, Kuwait)**
1970	Bulldozer breaks pipeline form Persian Gulf to Mediterranean Sea
	Pushes European reliance on Libyan oil
	Ghaddfi exploits Occidental Oil's reliance to push for successions
	Demonstrate political use of oil
1970	**US spare vanishes @ 11.3 Mbbl/day capacity**

U.S. Oil and Gas Resource Development

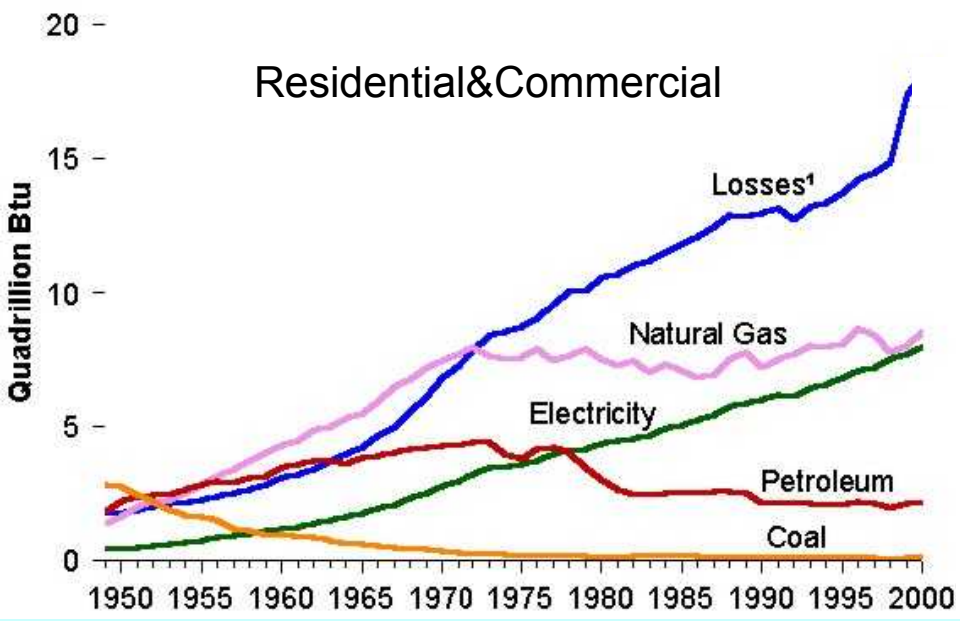
- **Easy access** to resources for many states
- Created **perimeter to interior distribution system** and interstate connectivity
- Initial development of local intrastate system
- Large development of **interstate oil and gas transmission system from 1950 - 1970**

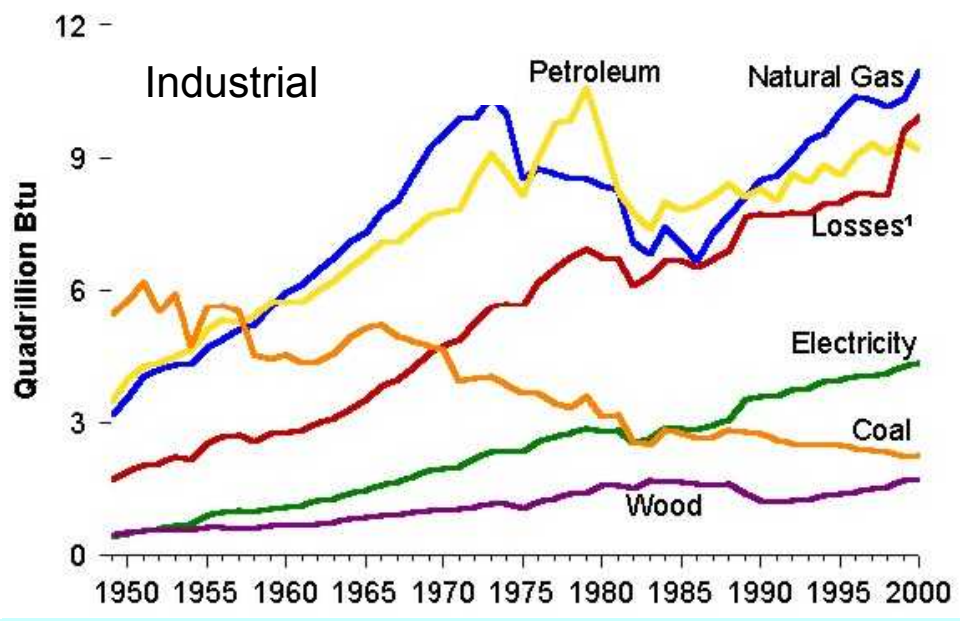


(USGS, 2006)

Green-oil, red-gas, yellow-mixed

Overview of U.S. Energy Demands 1945-1975





- Major growth in gas, oil, and electricity use,
- Major national infrastructure improvements
- Major increase in energy losses, less efficient systems, moving energy around takes energy

History of Natural Gas Issues and Trends

- Early Days
  - **First gas company established in Baltimore 1816**, using synthetic gas from coal **(Manufactured Gas Plants)**
  - Similar companies were established in other cities in the next two decades
  - Primarily for street lighting
  - Household uses such as cooking did not arise until the late 19th century
  - Competition of cheap oil based kerosene and electric arch lighting
  - Manufactured gas lost its market to natural gas found primarily in south and southwest and then west and Midwest
  - It remained a local fuel with **pipelines within 150 miles usually within one state**

- Major Transition
  - After **WWII it became economic to build long distance pipelines**
  - Natural gas evolved as a nationwide resource
  - Large growth in residential and commercial and industrial uses
  - Benefits in **combustion and emissions, large domestic supplies accelerate use**

Natural Gas Distribution and Regulation Issues

- *History of Natural Gas Political Stalemate*
- *Natural gas while is remained a local fuel was regulated by the state as public utility*

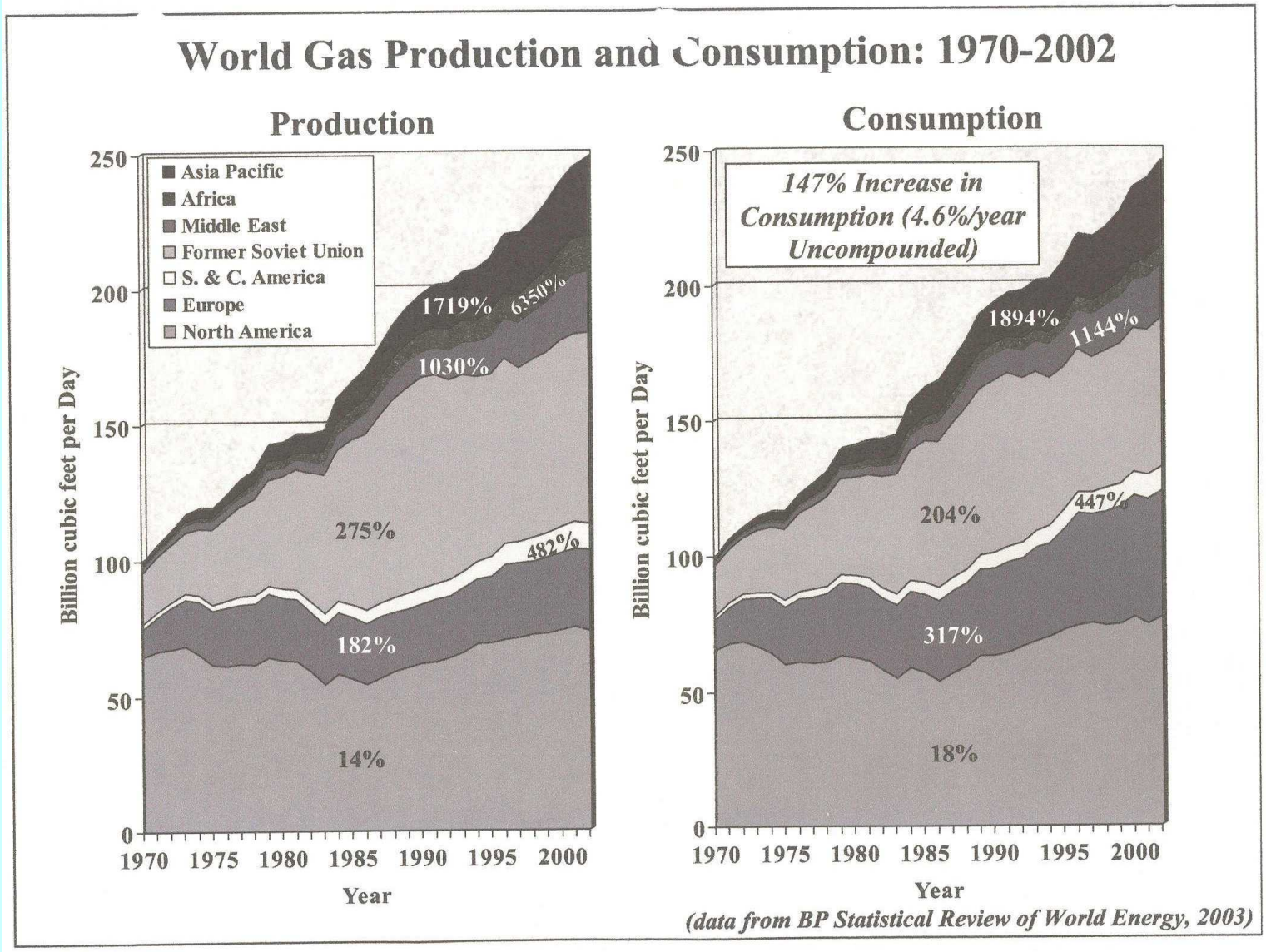
- *As pipelines started to cross state boundaries regulation by individual states became impossible*
  - *Natural Gas Act of 1938 created a new federal agency Federal Power Commission with authority to ensure prices are just and reasonable (Act was unfortunately ambiguous on who regulates the well head price)*
  - *FPC becomes FERC when DOE formed*
- *In 1954, the Supreme Court decided the landmark case, Phillips Petroleum Co. vs. Wisconsin, that FPC should regulate wellhead price to protect consumer*
  - *FPC interpreted that this ruling only applied to interstate gas*
  - *Congress set out to overturn the ruling*
  - *In 1956, House and Senate voted to deregulate wellhead price*
  - *Eisenhower favored deregulation*
  - *However Senator Francis Case, who favored the bill, found that a lobbyist left 25 $100 bills to be given to him. Eisenhower vetoes bill blaming the arrogant gas lobby*

Natural Gas Issues

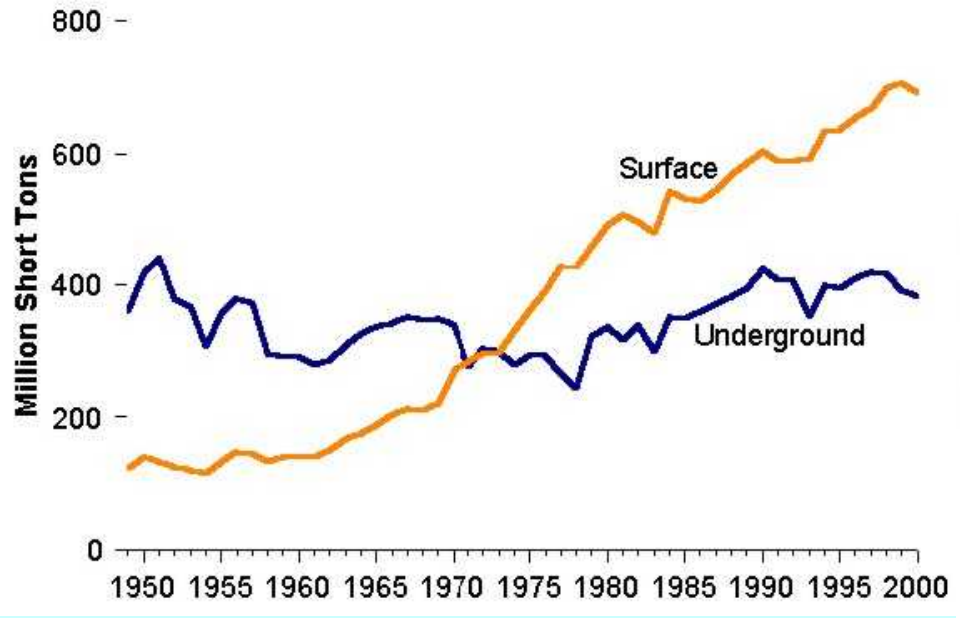
The Thirty-Year War
"When the Carter Administration brought its energy legislation to the Hill, it stumble into one of the great religious wars in American politics. The war over government regulation of natural gas prices goes back a full generation. The administration's talk about energy waste, their econometric models, and deeply entrenched positions of the warring camps" congressional staff member in 1978

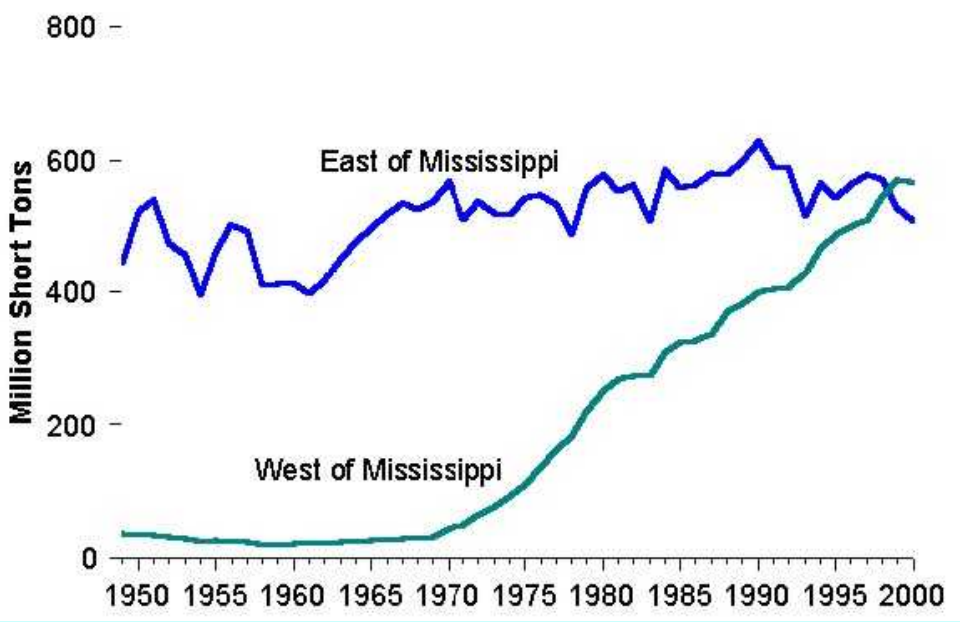
- ***Natural gas pricing posses a overwhelmingly difficult political issues objective conflict of interest among several groups and regions***
  - ***2/3 of gas was under federal price controls***
  - ***Two markets interstate and interstate***
  - ***Fundamental problem whether price is based on market or cost of production***
  - ***Natural gas production peaked in 1973 and dropped 12% by 1978 at 20tcf in 1970's***

Natural Gas Production Trends



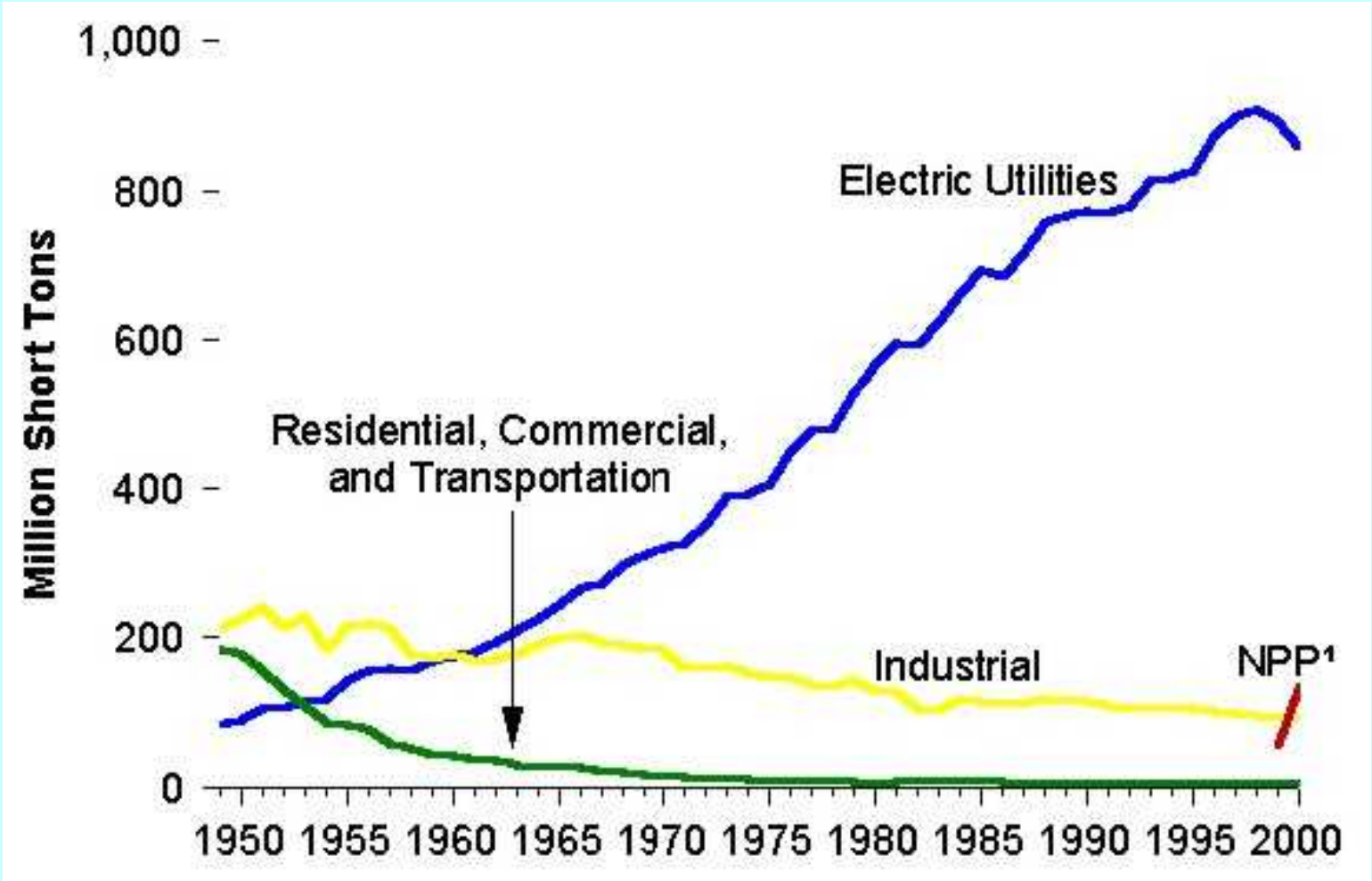
History of Coal Production 1945-Present





Move toward low-sulfur western coal in late 1960's
for environmental air emissions and acid rain considerations

History of Coal Use by Sector



Early History of Nuclear Power 1945-1975

"The hazards of waste disposal and nuclear weapons proliferation are the most recent in a long series of charges leveled against nuclear power" Stobaugh and Yergin, 1979

1950's
Shippingport, Pennsylvania, began operation in late 1957 as the first reactor connected to the electrical distribution network

Light water reactors survived through the early decades of development with only the CANDU reactor surviving as a heavy water system

1960's
1963, Jersey Central Power and Light Company purchased a 525-Megawatt light water reactor from GE, Oyster Creek basis:
GE and JCPL claim that Oyster Creek would generate power more cheaply than any other systems (First reactor without subsidy from AEC)

GE was also supplying Niagara Mohawk plant (GE maintains that the low price of Oyster Creek is not unique)

Early Nuclear Power History

Westinghouse quick to meet GE prices and so was Babcock and Wilcox

Nine initial turnkey plants delivered (turnkey plant, manufactures responsible for complete plant)

- Competition in terms of prices and confidential ancillary fuel price guarantees downward revision of prices
- Advocates announce that nuclear is the cheapest with astonishingly low cost projects without revealing the secret pricing

Reactor manufacturers absorbed huge financial losses from the original nine turnkey projects

- But the actual costs were not revealed to new buyers and other companies
- By the end of the 1960 there was increasing evidence that the cost estimates were unrealistically low

Incomplete development of light water reactor systems and related infrastructure resulted from conflict between the AEC and the congressional joint committee on atomic energy

- Milton Shaw a protégé of Rickover breaks with Lewis Strauss of AEC to push an aggressive government breeder reactor program with support of the committee
- This turned the government program away from supporting the next stages of development for the accepted commercial path reactors thus taking management attention and fiscal resources away from the unsolved problems for light water reactors such as the supporting infrastructure, only pieces of the massively interdependent enterprise were in place
- Government assumed that industry would finish this

Hydroelectric and Renewable Power Development

•Early 1900's Italy Develops Commercial Geothermal Electric Generation

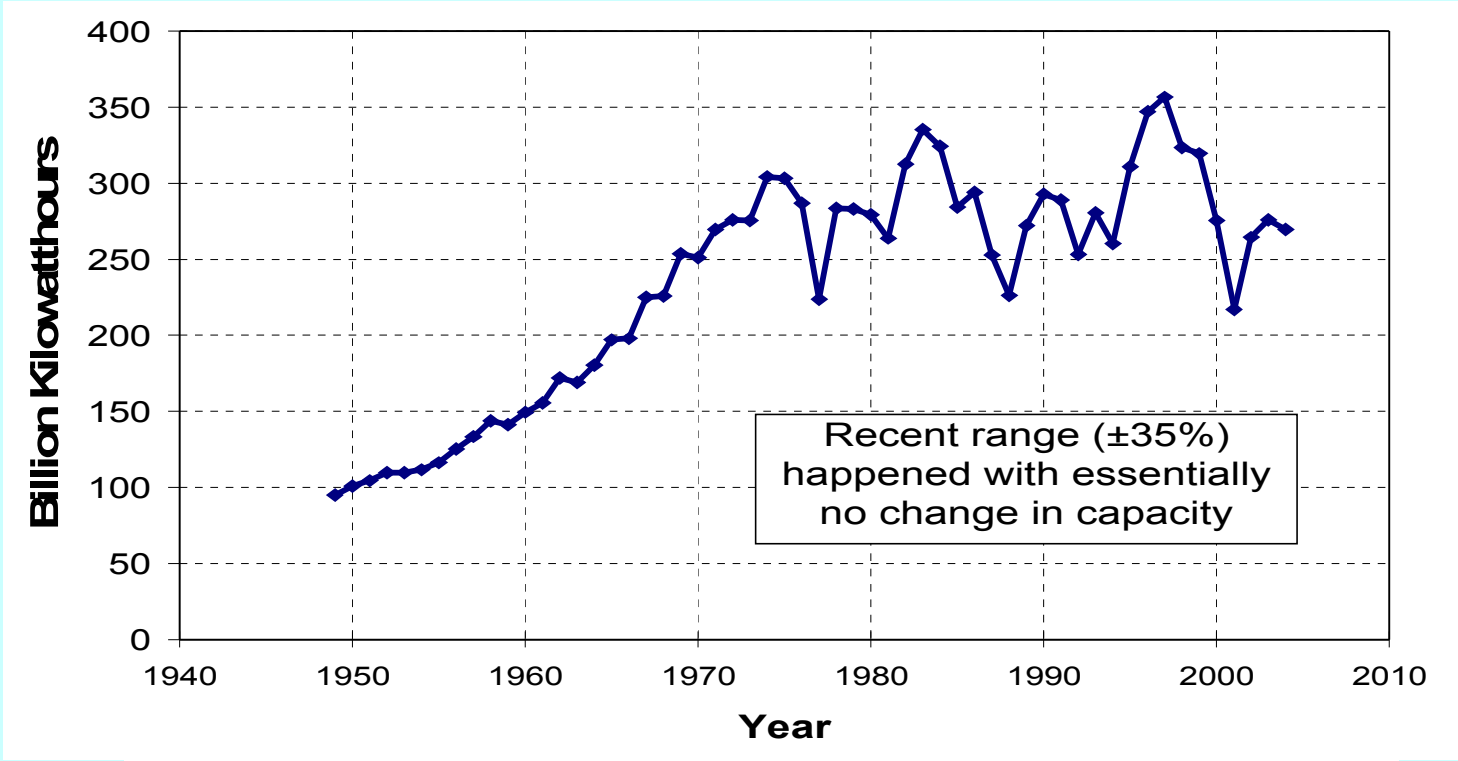
•1960's Countries such as New Zealand develop large scale geothermal facilities (Wairakei and Broadlands)

•Steady use of wood and other biomass

•In U.S. distributed Wind Generation drops with rural electrification

•The great expansion in the U.S. of hydroelectric power
- The Dam Race between the COE and Bureau of Reclamation
- The Completion of the High Columbia River Dams
- The Active Role of Government as Energy Producer and Regulator

Hydropower Growth



U.S. Hydropower Production

Energy History: 1945 – 1975 References

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