Kansas Energy Systems and the Future in a Global Environment

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Humanity's Top Ten Problems Next 50 Years

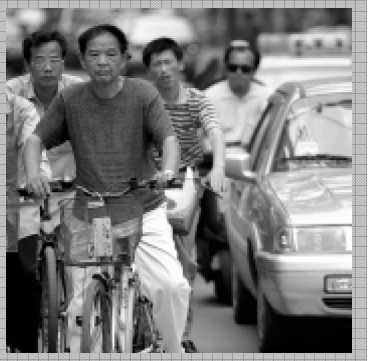
Richard Smalley, 2003 (1996 Noble Laureate in Chemistry)

1. **ENERGY**
2. **WATER**
3. **FOOD**
4. **ENVIRONMENT**
5. **POVERTY**
6. **TERRORISM & WAR**
7. **DISEASE**
8. **EDUCATION**
9. **DEMOCRACY**
10. **POPULATION**

2003 6.3 Billion People
2050 8-10 Billion People

Overview

The Energy Challenge



China Energy Consumption increased 15% in 2006

Coal 18%

OECD Energy Consumption increased 1% in 2006

- Today* - 211 MMBOE/D
  - US 48 MMBOE/Day
  - China 28 MMBOE/Day
- 2030 - 331 MMBOE/D
  - US 62 MMBOE/Day
  - China 69 MMBOE/Day
- Energy 2099 – 600+ MMBOE/D
- Energy – Basis for Civilization
- The Resource Is Adequate
- The Challenge Is Environment

*2004

The Need for Action

Today, 1.6 billion people – one quarter of the world population have no access to electricity.

In 2030, 1.4 billion people 17% of the world population will still not have electricity.

2.4 billion people rely on traditional biomass – wood, agricultural residues and dung – for cooking and heating.

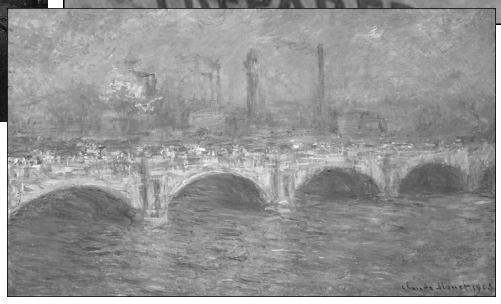
Pittsburgh, circa 1910

Donora, PA noon, 10/29/1948

20 DIED. THE GOVERNMENT TOOK HEED.
IN 1948, A KILLER FOG SPURRED AIR CLEANUP

Philadelphia Inquirer

www.pitt.edu/~mrosenme/north_america.htm

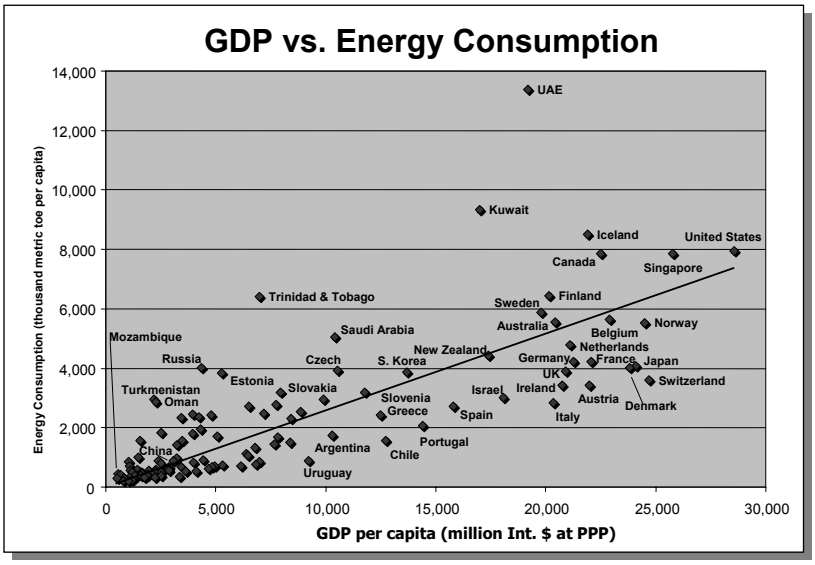


On Friday 5 December 1952 a dense smoke-filled fog shrouded London and it hung over the city for the next four days. London came to a standstill. Over 4,000 people died, motor vehicles were abandoned, trains were disrupted and airports were forced to close.

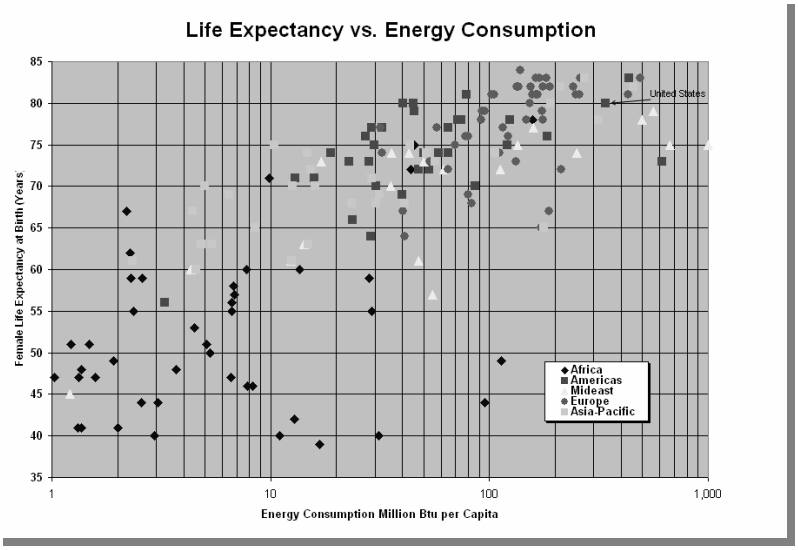
http://news.bbc.co.uk/2/hi/uk_news/england/2546563.stm

Carnegie Museum of Art
Claude Monet's "Waterloo Bridge, London" (1903).
http://www.cmoa.org

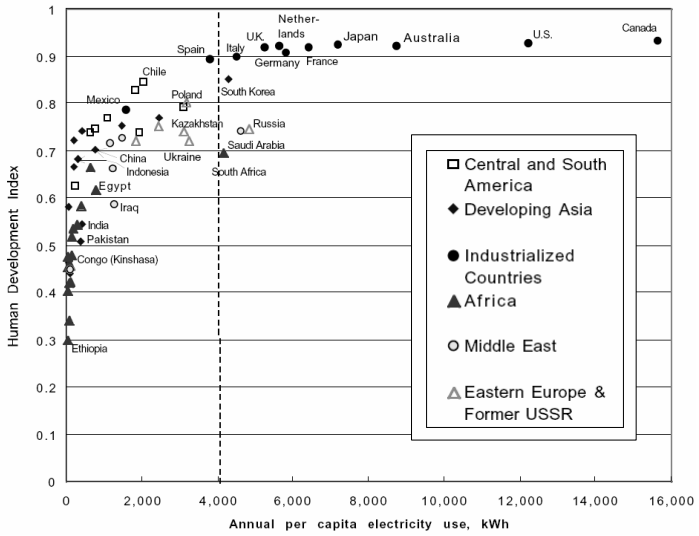
World Energy



World Energy

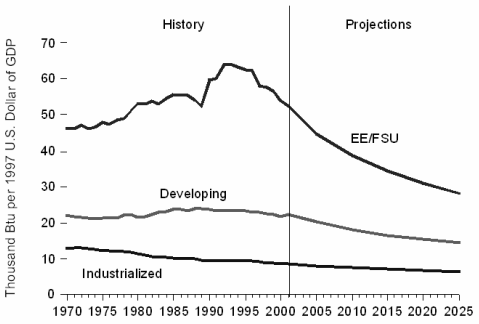


World Energy



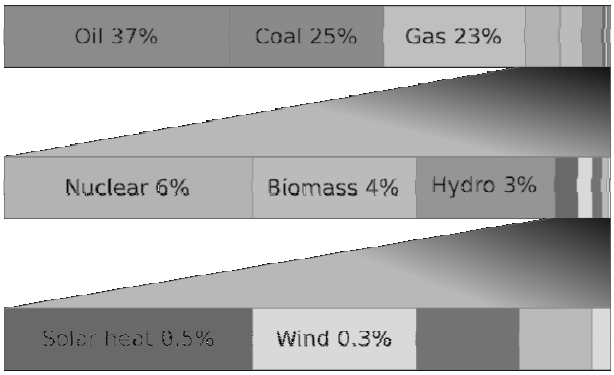
World Energy

Energy Intensity by Region, 1970-2025



Source: EIA, *International Energy Outlook 2004*

World Energy Usage



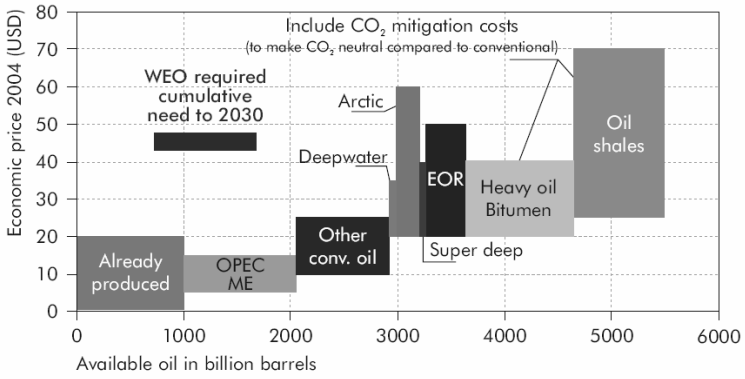
Geothermal 0.2%

Biofuels 0.2%

Solar photovoltaics 0.04%

Resources Are Adequate

Figure 7.1 • *Oil cost curve, including technological progress: availability of oil resources as a function of economic price*



Source: IEA.

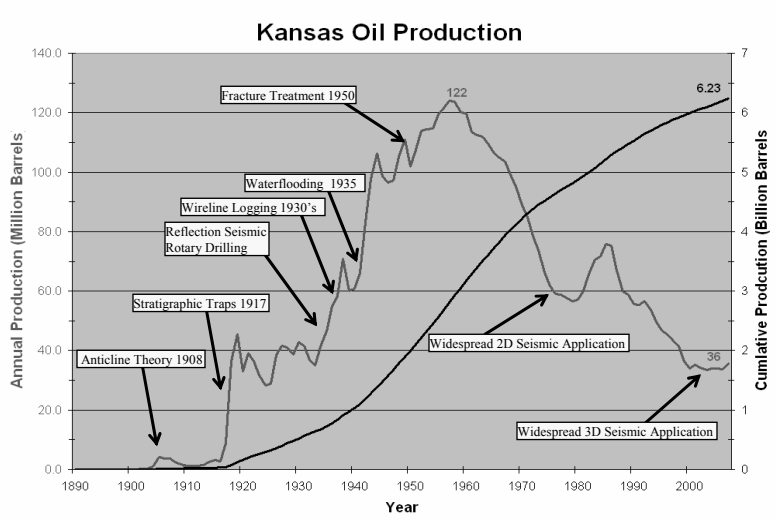
Strategies to Increase Energy Utilization and Reduce CO_2 Emissions

- Social behavior changes
  - Energy conservation
- Increased use of renewables
  - 11,603 Mw Wind Energy
    - 40% dispatch ~ 41 million Kwh
  - 15 billion gallons grain ethanol
    - 5 billion gallons consume 17% of entire corn production
  - 60 billion gallons cellulosic ethanol
- Increased levels of efficiency
  - Integration of large scale energy systems
- Capture and underground storage of carbon dioxide

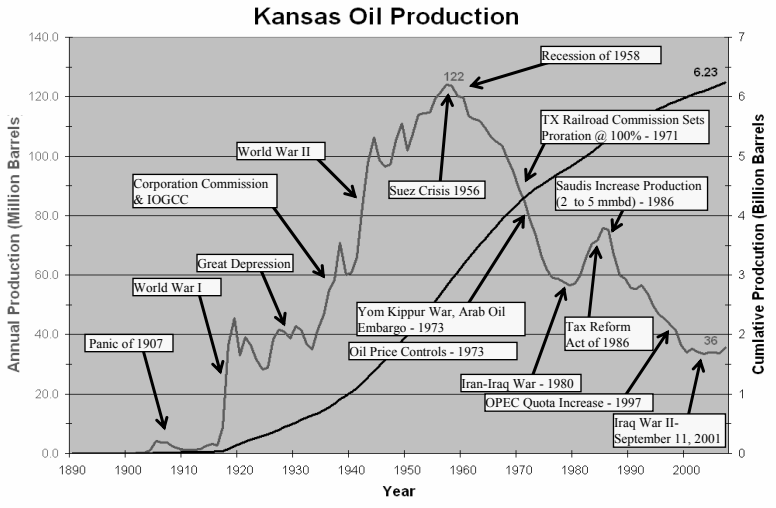
Kansas Energy Activity (Oil and Gas)

- 1860 - First Well Miami County
- 1889 – Initial Production
- 1916 – Number One Producing State
- Production Today
  - 9th Oil
  - 9th Gas
- Multiple Stages of Production History
- Controlling Parameters
  - Technology
  - Policy
  - Price

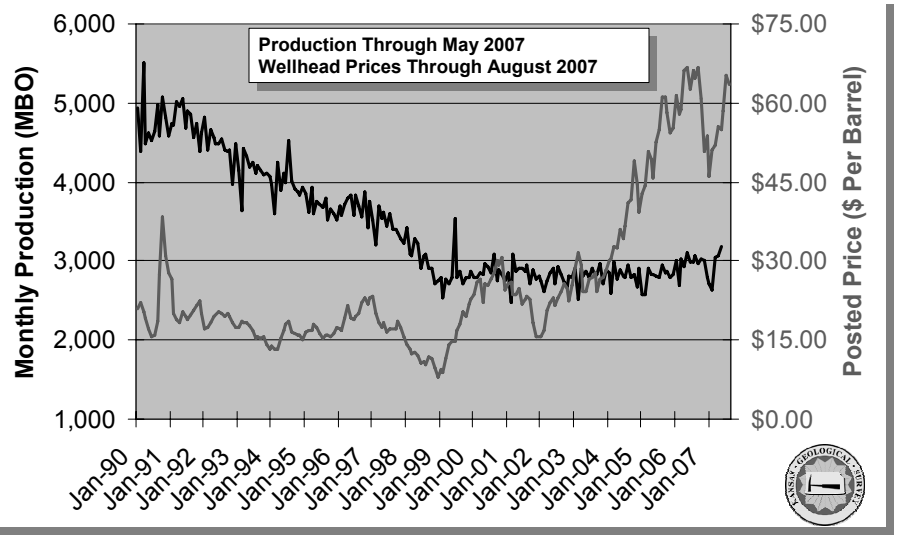
Kansas Oil Production
Technologic Events



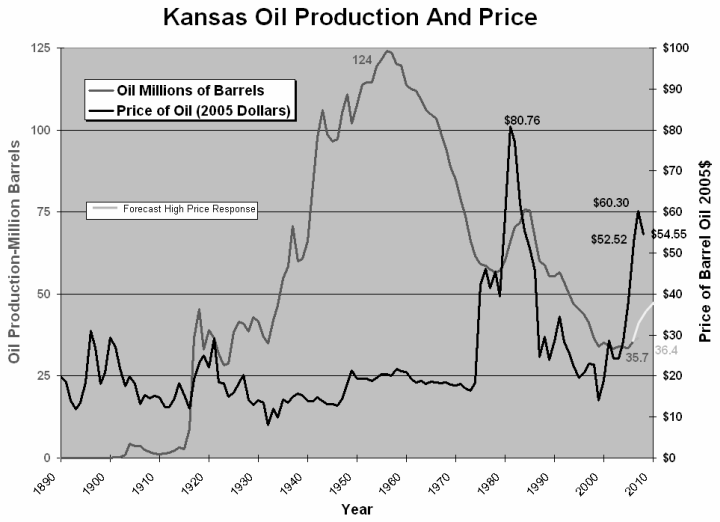
Kansas Oil Production
Political & Policy Events



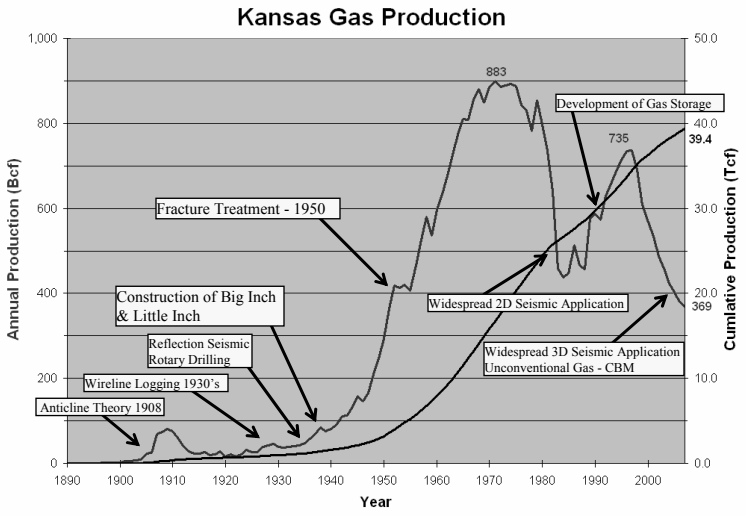
Kansas Oil Production



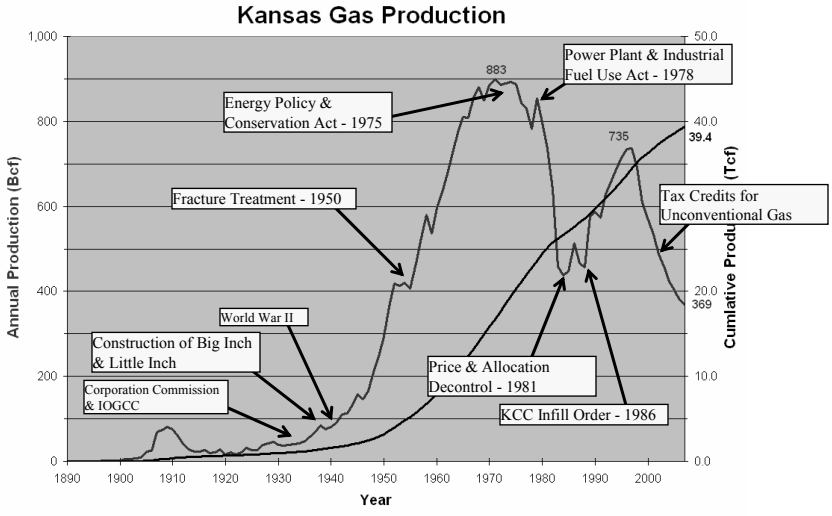
Kansas Oil Production & Price



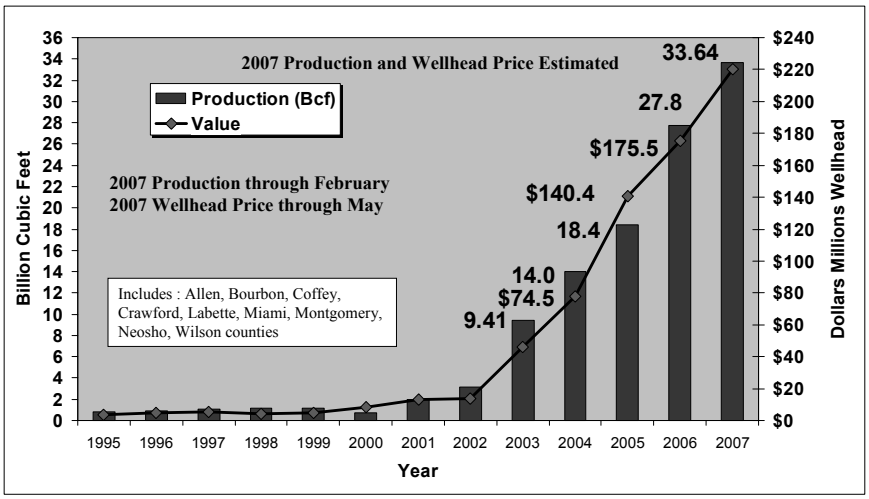
Kansas Gas Production Technologic Events



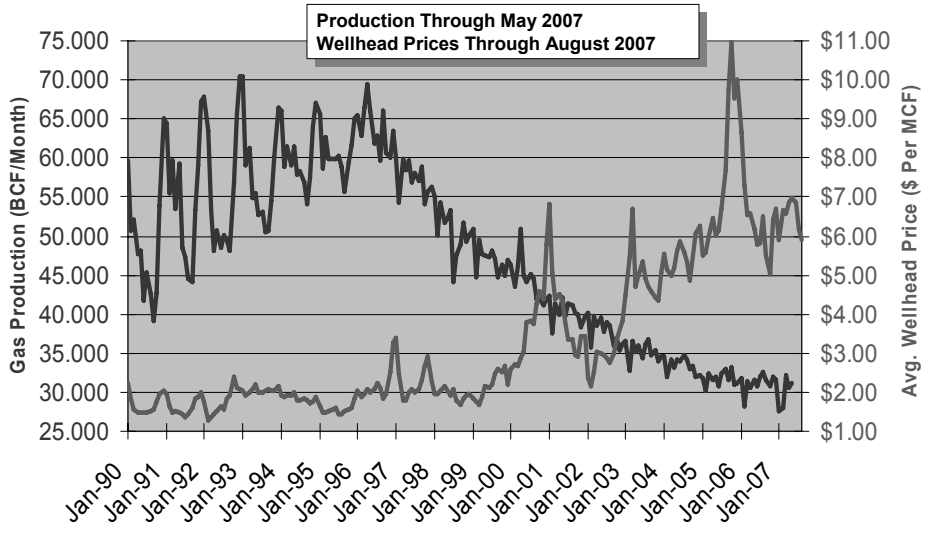
Kansas Gas Production Political & Policy Events



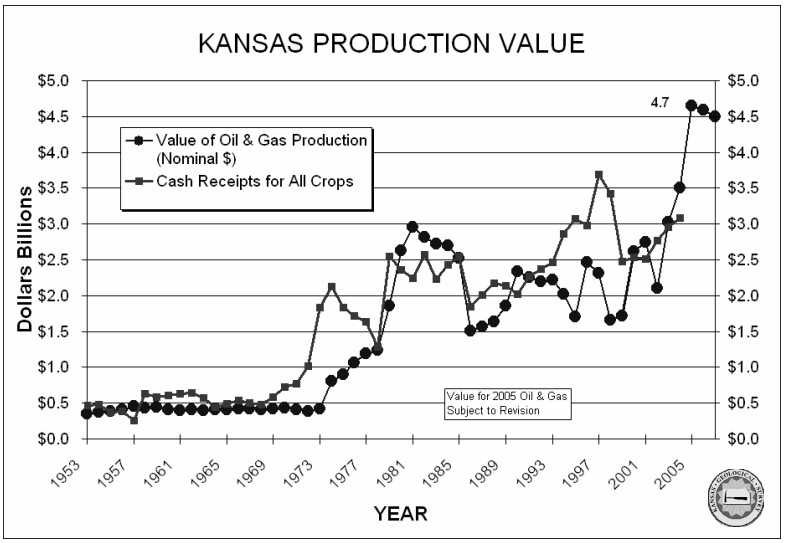
Eastern Kansas Unconventional Gas Production



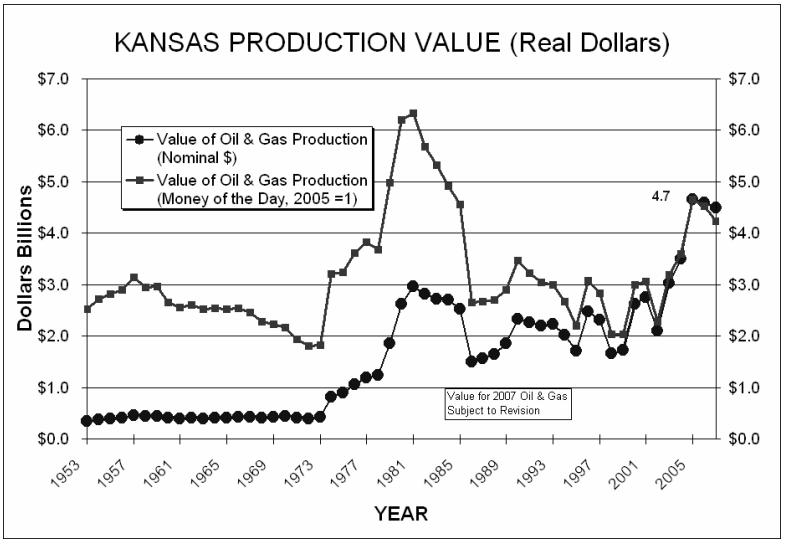
Kansas Gas Production



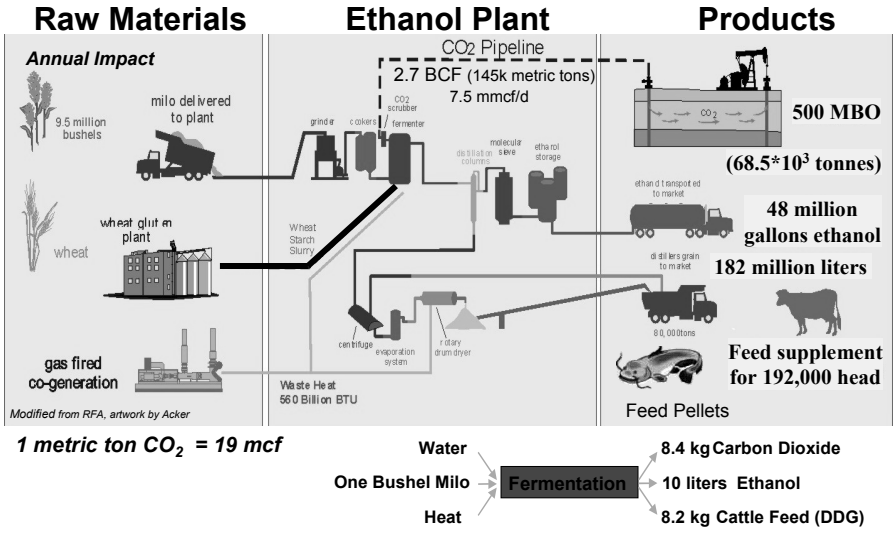
Value of Oil & Gas



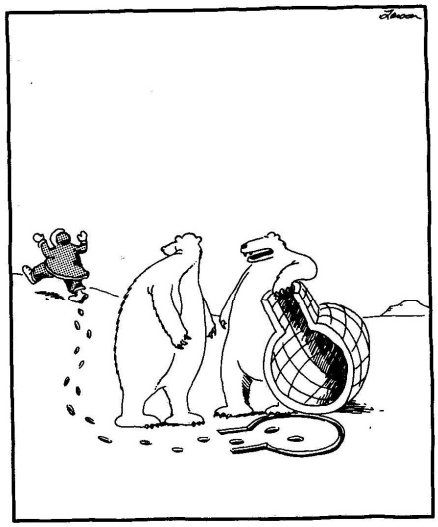
Value of Oil & Gas



Integrated Energy Systems



1 metric ton CO_2 = 19 mcf



"I lift, you grab. ... Was that concept just a little too complex, Carl?"

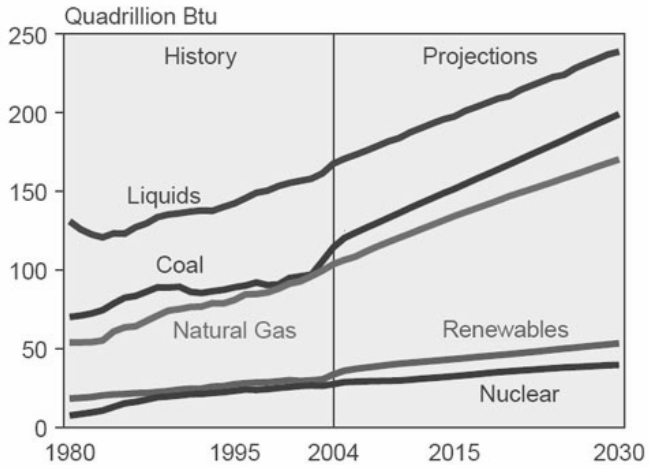
Perhaps integration of energy systems represents too many complexities for standard business approaches and regulatory regimes

Energy Forecasts

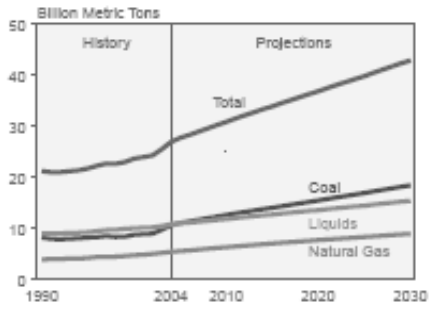
- Mid-term Forecast (IEA)
  - Growth
    - 2.6 million BO/D (2004-2006)
      - Average 1 million BO/D (1990-2004)
  - 2.2% Increase in Oil Demand (2007-2012)
    - 86.1 ➔ 95.8 million BO/D
  - No Increased Production
    - Iran, Iraq & Venezuela
    - Nigeria (500,000 BO/D remains offline)
- Long-term Forecast (EIA)
  - 447 ➔ 702 Quadrillion Btu's (2004-2030)

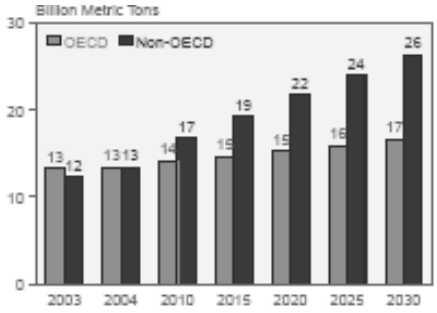
World Energy

Figure 4. World Marketed Energy Use by Fuel Type, 1980-2030

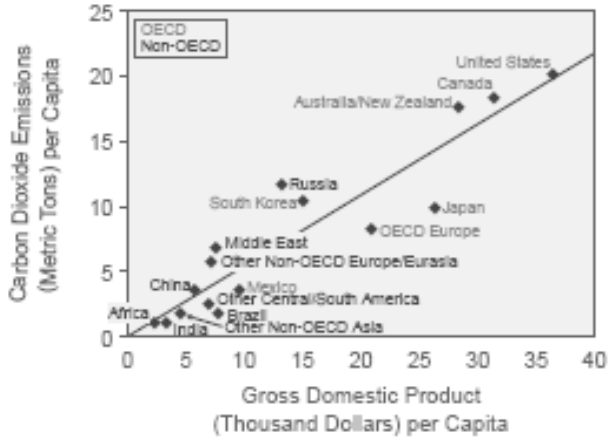


World Energy CO_2 Emissions Forecast





CO2 Emissions and GDP



Implications for Kansas

- Strong Market for Energy
  - Increase in Traditional Hydrocarbon Production
    - Increased Application of Technology
    - Increased Revenues/Taxes
  - Increase in Unconventional Hydrocarbon Production
    - Increase in Coal and Shale Gas
    - Enhanced Oil Recovery Using Anthropogenic CO_2
  - Increase Effort to Integrate Energy Systems
  - Increase of Production of Energy from Kansas Coal
  - Increase in Energy Production from Renewables
    - Will Remain a Small Share of the Energy Portfolio

The Need for Action

- Portfolio of Energy/Environmental Options
  - Technically Sound
  - Economically Sustainable
  - Significant in Size
  - Minimize Environmental Impact
- Develop basic research and enabling technologies for unconventional energy production and subsurface carbon storage to reduce CO_2 in the atmosphere.
- Need for Investment
  - Technology
  - Education
  - People

The great expectations held for DDT have been realised. During 1946, exhaustive scientific studies have shown that, when properly used, DDTs a host of destructive pests, and is a benefactor of all humanity.

Pennsalt produces DDT and its products in all standard forms and is now one of the country's largest producers of this amazing insecticide. Today, everyone can enjoy added comfort, health and safety through the insect killing power of Pennalt DDT products...and DDT is only one of many chemical products which benefit industry, farm and home.

KnoxOut for the home--helps to make healthier, more comfortable homes...protects your family from dangerous insect pests. Use KnoxOut DDT powders and sprays as directed...then watch the bugs 'bite the dust'.

KnoxOut for Dairies---Up to 20% more milk...more butter...more cheese...tests prove greater milk production when dairy cows are protected from the annoyance of many insects with DDT insecticides like KnoxOut Stock and Barn spray

http://www.whale.to/vaccines/ddt_spraying.html