

APES – Chapter 12 – Nonrenewable Energy Resources

Intro: All Energy Use Has Consequences

Oil Spills: 1969 - Santa Barbara, CA

1989 – Exxon Valdez (Alaska)

2010 – BP Deep Horizon, Gulf of Mexico

Refinery Accidents

Combustion....production of pollutants/greenhouse gases

Coal= the “dirtiest” fossil fuel...2x the GHG’s of natural gas, sulfur, particulates, Hg.

Coal Mining...mine explosions and cave-ins (2010 West Virginia)

Health concerns...respiratory system problems

Natural Gas = the “cleanest” fossil fuel...cheap energy for water/space heating

Exploration/extraction = risks to water, soil, air, health

I. Our Nonrenewable Energy Use

Fossil Fuels

Nuclear Fuels

A. Global Patterns – see fig. 12.1, 12.2

Be familiar with energy units: Joules, Gigajoules (GJ), Exajoules (EJ)

In the US, the Quad (1 quadrillion Btu = 1.055 EJ)

B. Patterns of Energy Use in the U.S.

Fig. 12.3 (History of Energy Consumption) 12.4 Energy Inputs/Outputs
And Total US Energy Use

1. Energy types of quality

2. Quantifying Energy Efficiency (see fig. 12.5)

3. EROEI = Energy Return on Energy Investment...compare fuel types

EROEI = $\frac{\text{Energy Obtained from the Fuel}}{\text{Energy Invested to Obtain Fuel}}$ Ex: for Coal EROEI = $\frac{100\text{J}}{5\text{J}} = 20$

4. Finding the right energy

5. Efficiency and mode of transportation...(convenience, comfort, style, safety and pollution produced are not figured in)

See CAFE standards in U.S. (fig 12.6)

II. Electricity – is a secondary source...from primary sources...energy carrier

A. Generation of electricity – know the functions/steps of electrical generation

B. Efficiencies of Producing Electricity from various Fossil Fuels

Coal = about 35%

Natural gas = 60% (in combined cycle)

Combusted gas turns gas turbine

Waste heat then used to boil water...turn steam turbine

Capacity in MegaWatts (MW)

Ex: typical plant produces 500MW X 24 hours/day = 12,000 MWh

Or 12,000,000 KWh

Home electricity is measured in KWh

A typical home might average 1000 KWh per month, so the typical plant could supply power to 12,000 homes.

III. The Fossil Fuels

A. Coal (a.k.a. "King Coal")

Types of Coal:

Peat

Lignite

Sub-bituminous

Bituminous

Anthracite

Coal Reserves: US, Russia, China, India, Australia

Advantages:

Disadvantages:

B. Petroleum (Bubblin' Crude...Black Gold...Texas Tea...Oil!)

1. Formation of Oil deposits

2. Extraction techniques

3. Processing / Refining

4. Petroleum Products

5. Advantages:

Disadvantages:

6. Future Sources of Oil

C. Natural Gas

1. What is it? A natural mix of...
2. Formation of Gas deposits
3. Extraction methods
4. Processing
5. Major uses of natural gas – Electricity generation and industrial fuel
Other uses: Household water/space heating, cooking, clothes drying
6. Products:
CNG

LPG

Fertilizer production
7. Advantages

Disadvantages:
8. The Concerns about Fracking (Hydraulic Fracturing) for Gas

Marcellus Shale

Utica shale

D. Other Fossil Fuel Sources:

- Oil Sands – contain bitumen
- Coal to Liquid Fuel (CTL)...Coal Gasification

IV. Fossil Fuels – A Finite Resource

- A. Energy Intensity...Energy Use per unit of GDP...dropping since 1950

Will use drop due to supply or concerns about GHG's and Climate Change?

- B. The Hubbert Curve

Peak Oil

V. Nuclear Energy

- A. Fission reactors – know the basics of U235 fission, products, by-products along with how a reactor works:

Converting nuclear energy to electrical energy

Controlling the reaction with control rods

Mining and chemical enrichment of U235

- B. Advantages:

Disadvantages:

Notable Accidents:

- C. Radioactive Wastes
High-level

Low-level

Uranium mine tailings

- D. Radiation measurement (Becquerels and Curies)

- E. Calculating Half-lives (Do The Math)

- F. Fusion Power ...fusing H nuclei into He

Technological challenges:

VI. Working Toward Sustainability: Meet TED= The Energy Detective

Monitoring your in-home electrical energy use

Reducing “phantom loads” ...a.k.a. power vampires!