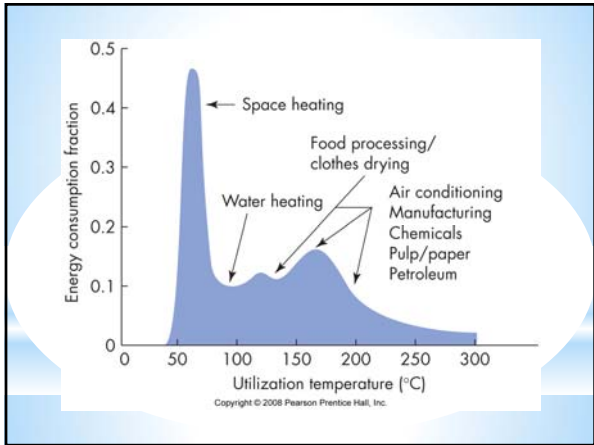
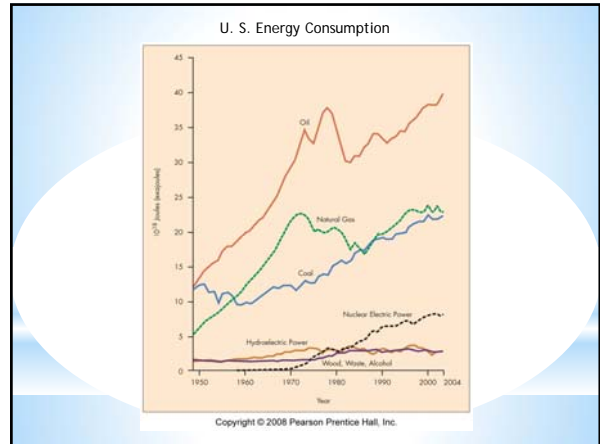
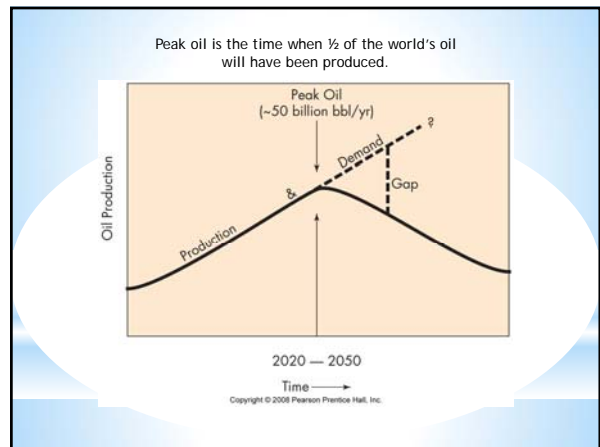
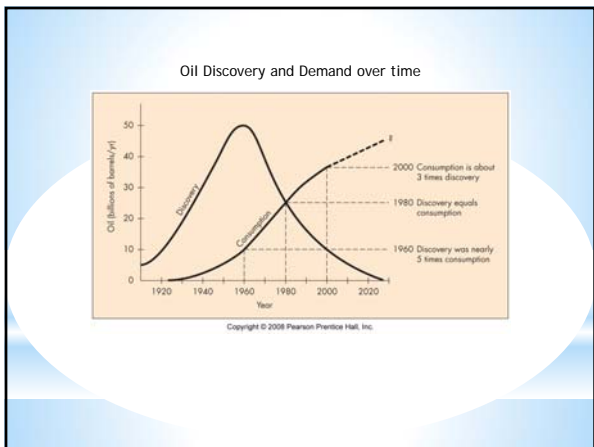


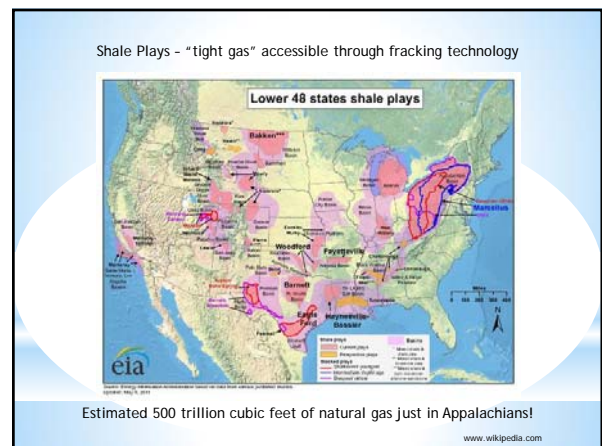
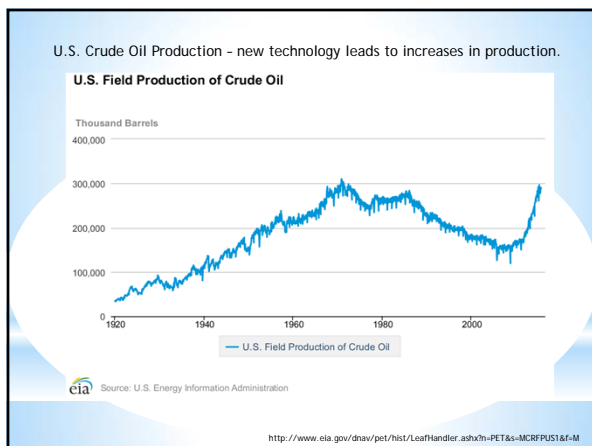
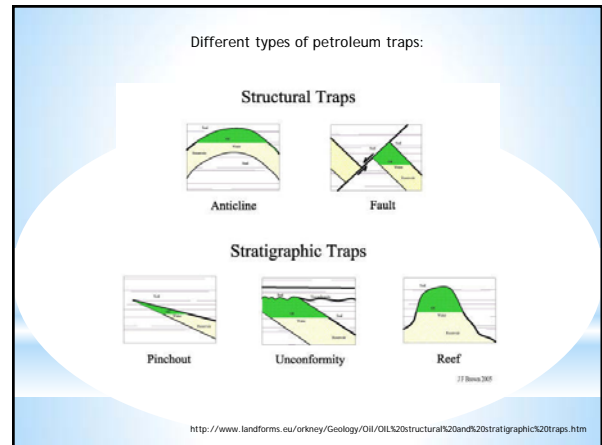
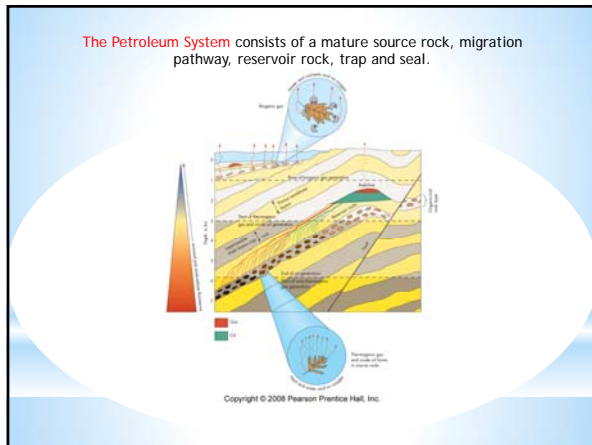
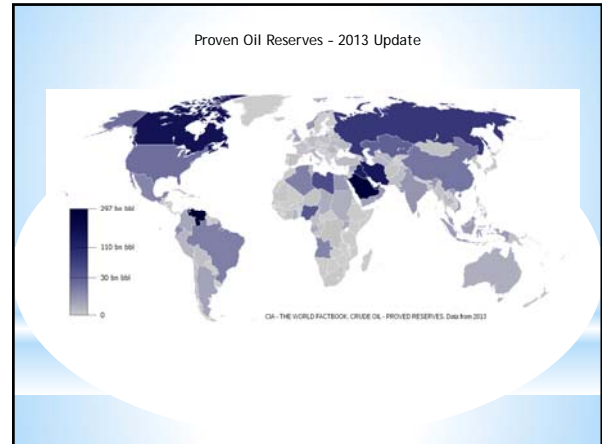
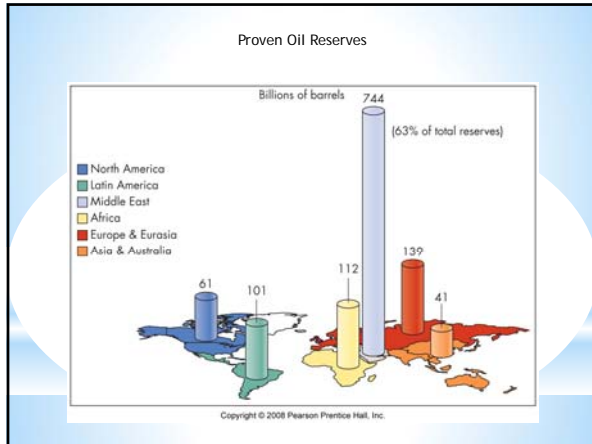
# \*Chapter 15

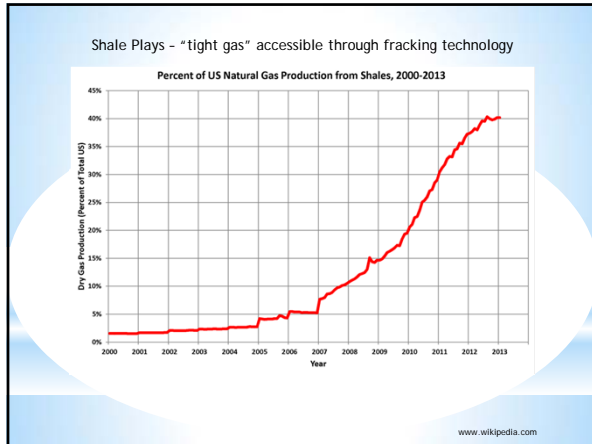
## Energy Resources



- Energy Policies being discussed:
- Promote conventional energy sources
  - Encourage alternative energy
  - Provide for energy infrastructure
  - Promote conservation
  - Consider Nuclear Energy as a serious alternative
  - Promote research







### Impacts of Oil/Gas Production

Oil Spills

Hazards Circle

Brine Production

Oil Production alters Land

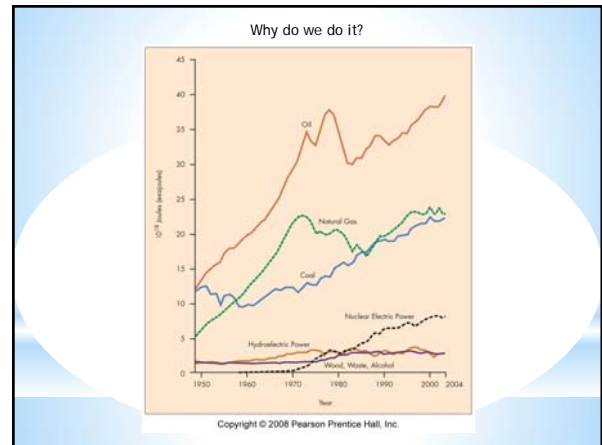
Atmospheric Effects

oilandgasbmps.org / Wikipedia / USGS / EIA

### Impacts of Oil Production

20 IMPACTS OF SHALE OIL/GAS

http://track-off.org.uk



### The Formation of Coal:

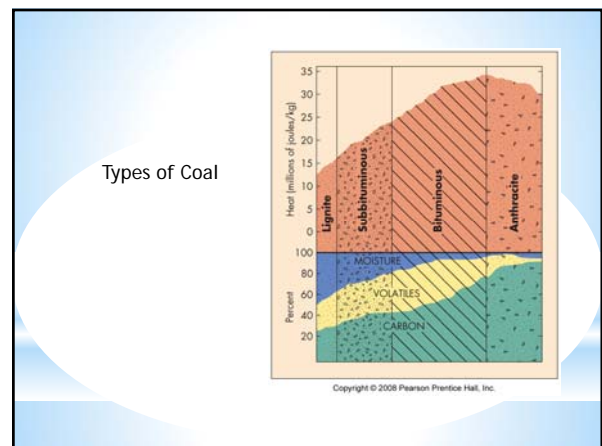
- Coal swamps bogs create peat
- Organic-rich materials buried
- Materials converted into coal over time

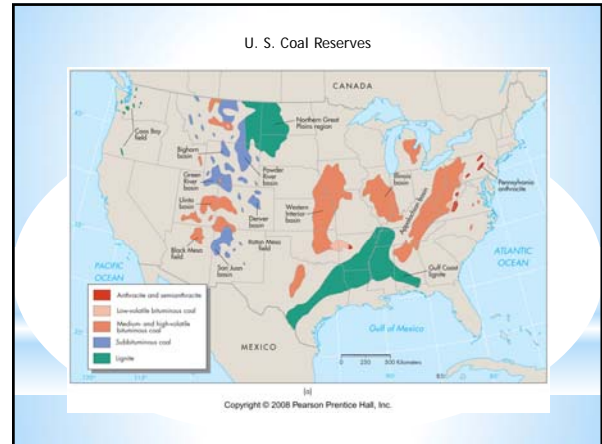
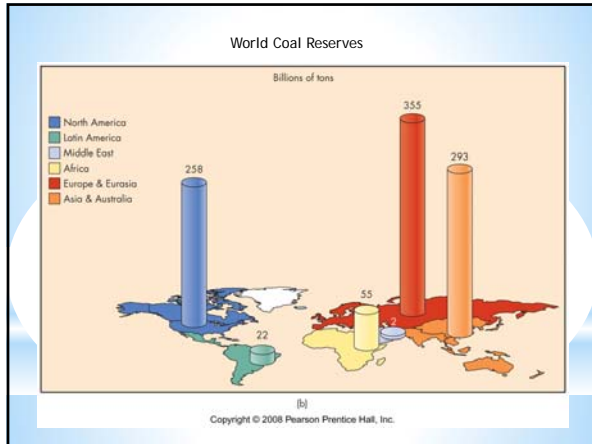
(a) Coal swamp forms.

(b) Rise in sea level buries swamp in sediment.

(c) Compression of peat forms coal.

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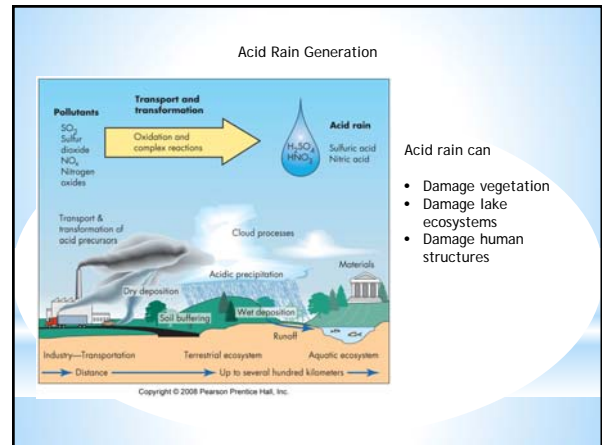


**TABLE 15.2** Distribution of United States Coal Resources According to Type and Sulfur Content (Low, Medium, or High).

For example, 97 percent of anthracite is low sulfur content, and 43 percent of bituminous coal has a high sulfur content.

Type	Sulfur Content <sup>1</sup>		
	Low	Medium	High
Anthracite	97.1	2.9	—
Bituminous coal	29.8	26.8	43.4
Subbituminous coal	99.6	0.4	—
Lignite	90.7	9.3	—
All ranks	65.0	15.0	20.0

<sup>1</sup>Low = 0–1% sulfur; Medium = 1–3% sulfur; High = >3% sulfur.  
Source: U.S. Bureau of Mines Circular 8312, 1966.  
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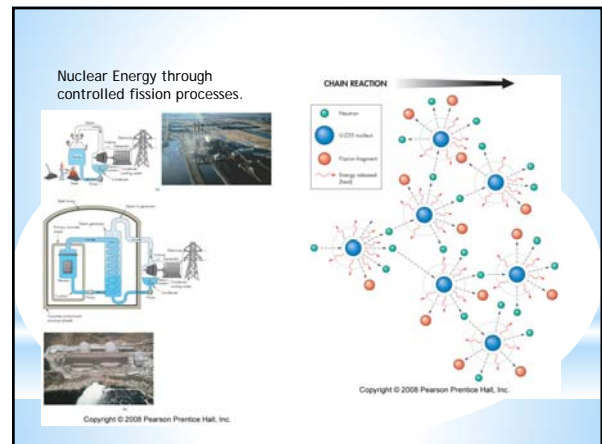
### Impacts of Coal Mining

Acid Mine Drainage

Mining Process

Coal Sludge Spills

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Radioactive decay produces other radioactive isotopes.

Fission also produces many radioactive isotopes that have to be stored for 10,000 years or more before they are "safe".

How do we deal with the waste?

- Temporary on-site
- Long-term storage for low-level (solidify and store in special landfill sites)
- Long-term storage for high-level waste (Salt domes; western states)

Radioactive isotope	Half-life	
Uranium-238	4.5 billion years	
Thorium-234	24.1 days	
Protactinium-234	1.2 minutes	
Uranium-234	247,000 years	
Thorium-230	14,000 years	
Radium-226	1,602 years	
Radium-228	3.8 years	
Polonium-214	3.0 minutes	
Lead-214	36.8 minutes	
Bismuth-214	19.7 minutes	
Polonium-214	0.00016 seconds	
Lead-210	22.3 years	
Bismuth-210	5.0 days	
Polonium-210	138.4 days	
None	Lead-206	Stable

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### Geothermal Resources

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### Vapor-dominated vs. hot water Geothermal systems

Environmental Impacts include gas emissions, hot wastewater, saline and/or mineralized waters (highly corrosive)

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### Renewable solar-related energy generation

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### Conservation, Efficiency and Cogeneration

We will need to become accustomed to living with uncertainty with the availability, cost and environmental effects of energy use, and we can expect serious social, economic and political issues that will disrupt the flow of energy to various parts of the world.

We will need to practice:

- **Conservation** - moderate our energy demand
- **Efficiency** - designing and using better equipment that yields more power per unit energy
- **Cogeneration** - capturing and using waste heat energy produced by power generation and industry

### Hard Path vs. Soft Path: Sustainable Energy Policy

**Hard path** - continue to increasing use of fossil fuels, aka "business as usual" as new reserves continue to be found (shale plays, tar sands, etc.)

**Soft path** - energy alternatives that are renewable, flexible, decentralized and environmentally friendly. Accomplished through increased efficiency, increased use of alternative energy, transition away from coal, and a reduction on our dependency on foreign oil.

A **sustainable energy policy** would be one that can supply our energy needs while slowly transitioning from fossil fuels for power generation to renewables without endangering the planet. This should include investments in technology to produce more alternative forms of energy while making existing fossil fuel energy production "cleaner".