Energy

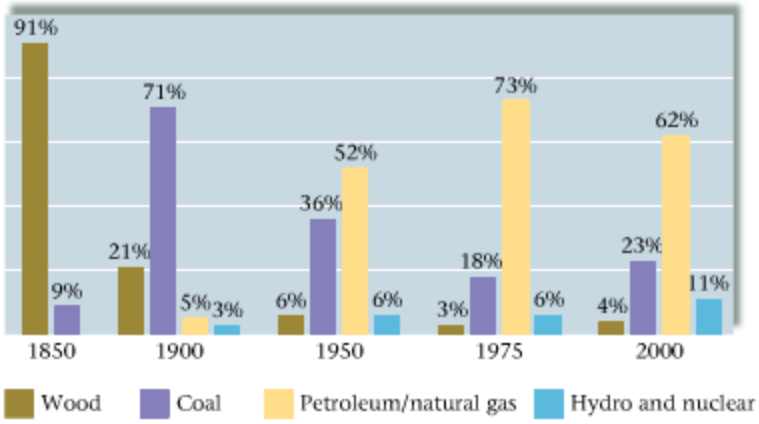




Using Energy in the Real World

Energy and Our World

- **Fossil fuel** → fuel that consists of carbon-based molecules derived from the decomposition of once-living organisms.



- The U.S.'s heavy dependence on petroleum for energy is a relatively recent phenomenon.



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Petroleum and Natural Gas

- Most likely formed from the remains of marine organisms that lived approximately 500 million years ago.
- **Petroleum** → a thick, dark liquid composed mostly of hydrocarbon compounds (contain carbon and hydrogen).

Table 10.2
Names and Formulas for Some Common Hydrocarbons

Formula	Name
CH_4	Methane
C_2H_6	Ethane
C_3H_8	Propane
C_4H_{10}	Butane
C_5H_{12}	Pentane
C_6H_{14}	Hexane
C_7H_{16}	Heptane
C_8H_{18}	Octane




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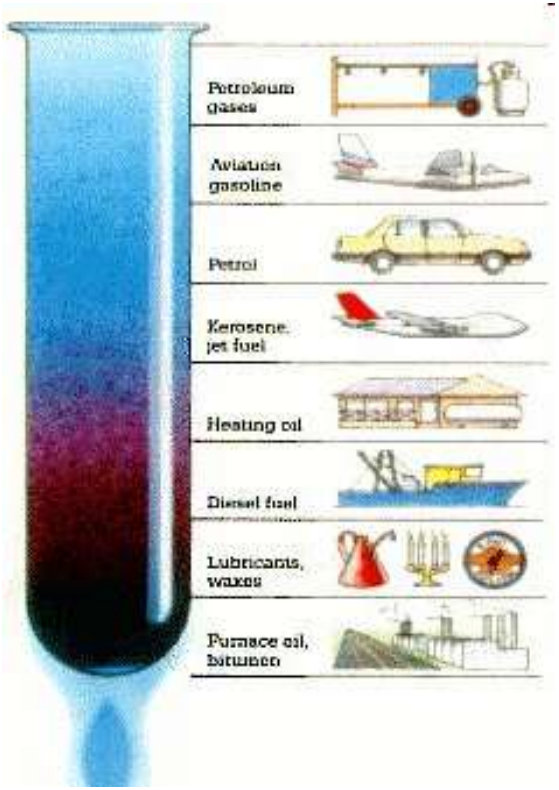
- **Natural gas** → a gaseous fossil fuel, mostly consisting of methane (with some ethane, propane, and butane) and usually associated with petroleum deposits.
- Petroleum must be separated into fractions by boiling.
- The lighter molecules (lowest BP) can be boiled off, leaving the heavier ones behind.





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- The commercial uses of various petroleum fractions:

Table 10.3

Uses of the Various Petroleum Fractions

Petroleum Fraction in Terms of Numbers of Carbon Atoms	Major Uses
C_5–C_{10}	Gasoline
C_{10}–C_{18}	Kerosene Jet fuel
C_{15}–C_{25}	Diesel fuel Heating oil Lubricating oil
$>C_{25}$	Asphalt

- **Coal**

Coal → a solid fossil fuel mostly consisting of carbon.

- Formed from the remains of plants that were buried and subjected to high pressure and heat over long periods of time.






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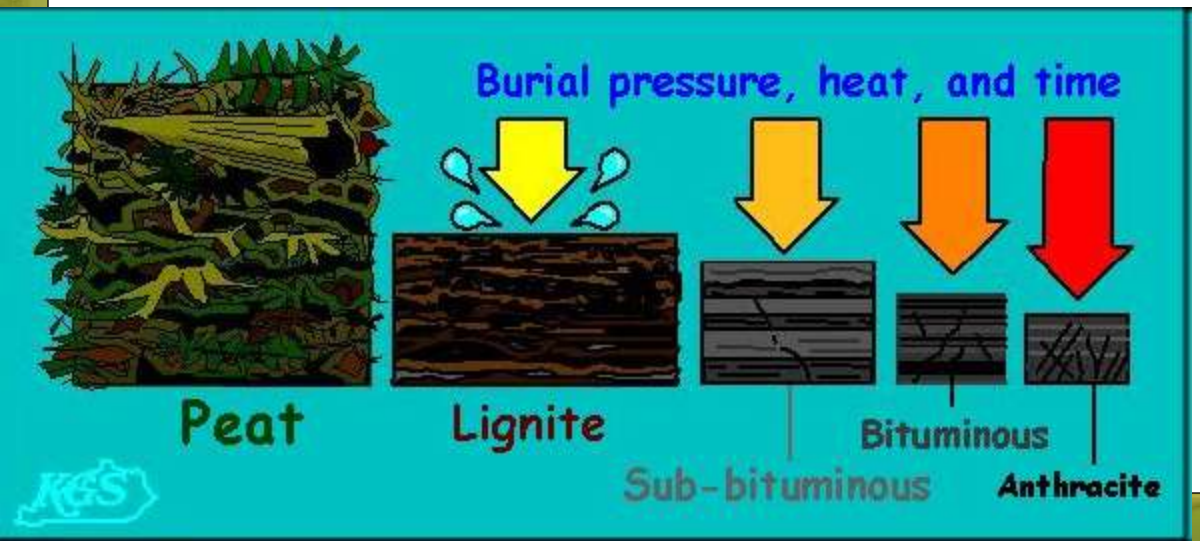
- Coal "matures" through 4 stages:
  - Lignite
  - Subbituminous
  - Bituminous
  - Anthracite

Table 10.4

Element Composition of Various Types of Coal

	Mass Percent of Each Element				
Type of Coal	**C**	**H**	**O**	**N**	**S**
Lignite	71	4	23	1	1
Subbituminous	77	5	16	1	1
Bituminous	80	6	8	1	5
Anthracite	92	3	3	1	1



The relative carbon content gradually increases.

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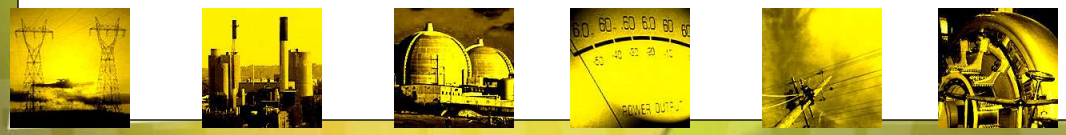
- The energy available from the combustion of a given mass of coal increases as the C content increases.
- **So, which type of coal gives the most energy and is the most valuable?**
  - Anthracite is the most valuable coal, and lignite is the least valuable.

- Coal currently supplies approximately 20% of our energy.



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- Coal has variable composition depending on its age and location.
- Coal is expensive and dangerous to mine underground, and strip-mining causes problems as well.
- Burning coal, especially high-sulfur coal, produces pollutants such as SO_2, which can lead to acid rain.

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Effects of Carbon Dioxide on Climate

- The earth receives radiant energy from the sun.
- About 30% of the radiant energy from the sun is reflected back into space by the earth's surface.
  - The remaining energy passes through the atmosphere to the earth's surface.
    - Some is absorbed by plants for photosynthesis and oceans to evaporate water.
    - Most is absorbed by soil, rocks, and water, increasing the temperature of the earth's surface.

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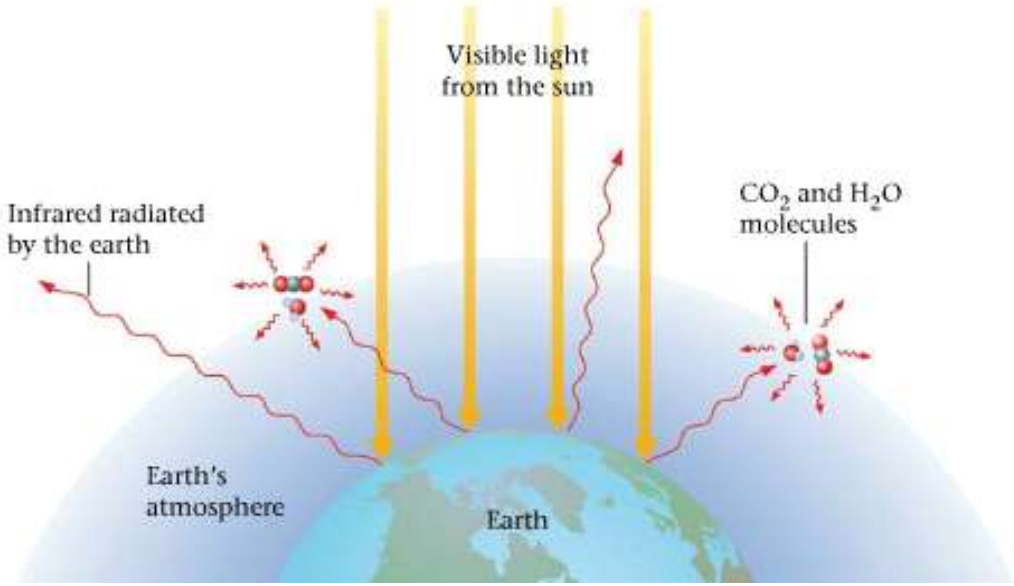
- The energy from the earth's surface is then radiated as *infrared radiation* (*heat radiation*).

Greenhouse Effect

- The atmosphere does not allow all the infrared radiation to pass back into space.



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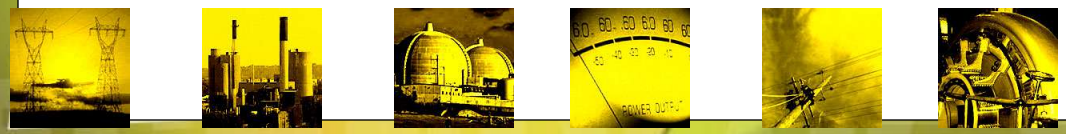
- Molecules in the atmosphere (H_2O and CO_2) strongly absorb infrared radiation and radiate it back toward the earth.
- **Greenhouse effect** → the process by which an atmosphere warms a planet.

Atmospheric CO_2

- As fossil fuels have been used more extensively, the CO_2 concentration has increased (up about 20% since 1880).



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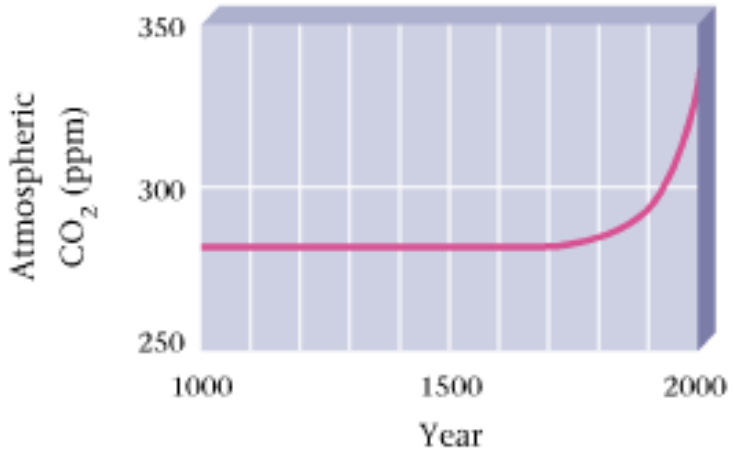
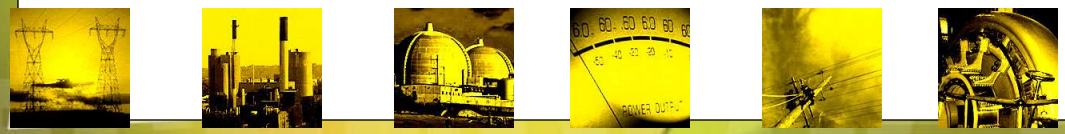
- If the CO^2 content in the atmosphere continues to rise, this trend *could* increase the earth's average temperature, causing dramatic changes in climate.



- The exact relationship between the CO_2 concentration in the atmosphere and the earth's temperature is not known at present.



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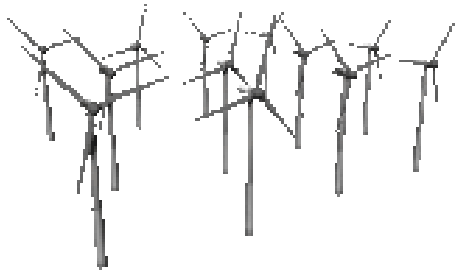
New Energy Sources

- We need to consider economic, climatic, and supply factors as we search for energy sources in the future.
- Potential energy sources:
  - The sun (solar),
  - Nuclear processes (fission and fusion),
  - Biomass (plants),
  - Wind,
  - And synthetic fuels.



- The End