

Chapter 15—Miller

ENERGY RESOURCES

Types of Resources

Non-Renewable Resources

- Cannot be replenished quickly
- Ex: Coal, Oil, Natural Gas, Nuclear

Renewable Resources

- Can be replenished
- Ex: Solar, Hydroelectric, Tidal, Geothermal, Biomass, Wind

Thermodynamics Review

- ⦿ 1st Law of Thermodynamics:
 - ⦿ Energy cannot be created or destroyed
- ⦿ 2nd Law of Thermodynamics:
 - ⦿ Every time energy is converted, it is reduced to a lower quality
- ⦿ Kinetic Energy:
 - ⦿ Active, in motion, doing work
- ⦿ Potential Energy
 - ⦿ Stored, ability to do work

High Quality vs. Low Quality— p.53

- ⦿ High quality: Concentrated and can perform more useful work
 - Examples: electricity, chemical energy stored in coal and gasoline, concentrated sunlight, nuclei of uranium-235 (nuclear fuel)
- ⦿ Low quality: Dispersed and has little ability to do useful work.
 - Examples: heat moving through a body of water/air

Matter & Energy Flow

- ◎ ***High-throughput***—*High waste economy*—typical of today's advanced industrial. Attempt to sustain ever-increasing economic growth by increasing the flow of matter and use of energy resources through their economic systems.
 - Source and sink (water, air, soil, organisms)
- ◎ ***Low-throughput***—*Low waste economy*—the sustainable ideal, uses best long-term solutions to our environmental and resource problems, maximize matter and energy flow

Energy Resources Superlatives

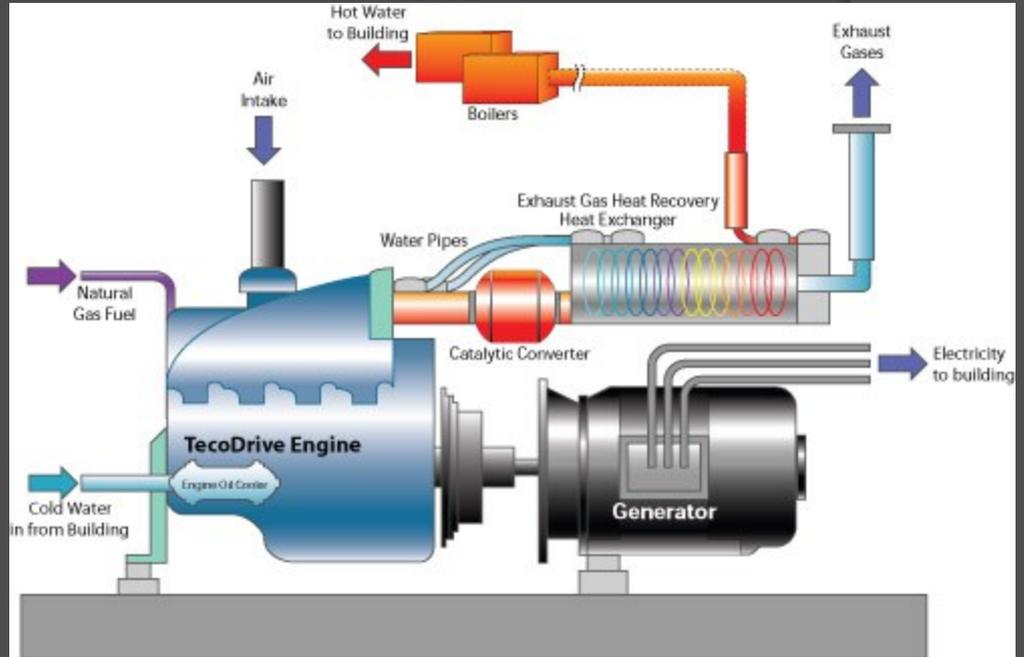
- ◉ Dirtiest?
- ◉ Most abundant?
- ◉ Controlled by solar?
- ◉ Most efficient?
- ◉ Most expensive?
- ◉ Most long-lasting?
- ◉ Coal
- ◉ Depends, US? Coal/Wind/Solar
- ◉ All but geothermal
- ◉ **MOST EFFICIENT?**
- ◉ Set-up costs... nuclear?
- ◉ Solar/Wind—always there

Efficiencies

- Total energy delivery for each thing. Must factor in energy loss during conversion (more lost, less efficient)
- Steam turbine: 45%
- Fluorescent light: 22%
- Incandescent light: 1% (5%)
- Gas engine: 10%
- Human body: 20-25%
- Fuel cell: 60% (make H₂O)
- Coal: 30%
- If 2nd law is followed perfectly...what is efficiency?

Cogeneration

- Production of 2 useful forms of energy, such as high-temperature heat or steam and electricity from the same fuel source



- http://en.wikipedia.org/wiki/Midland_Cogeneration_Venture

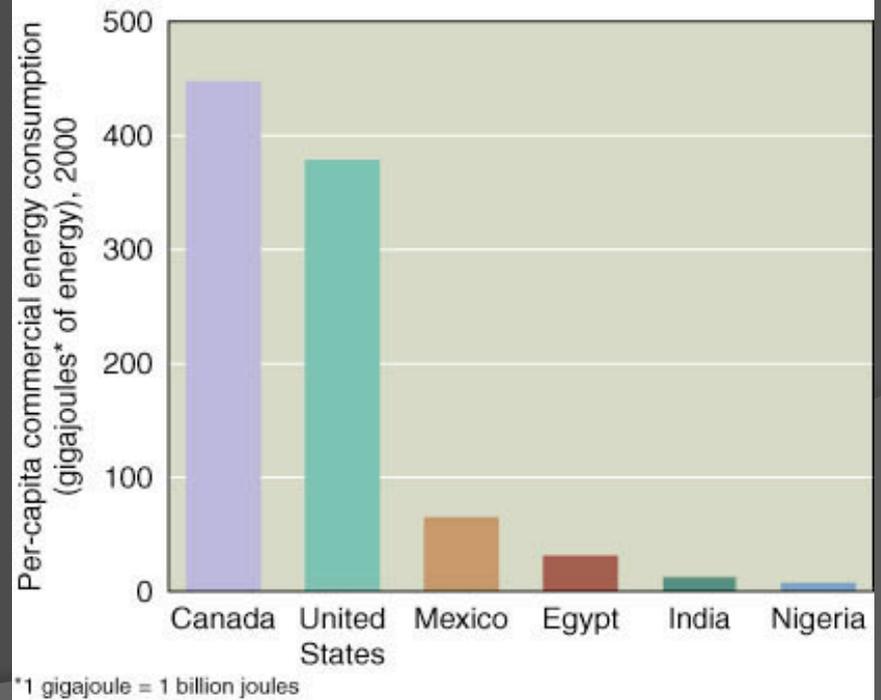
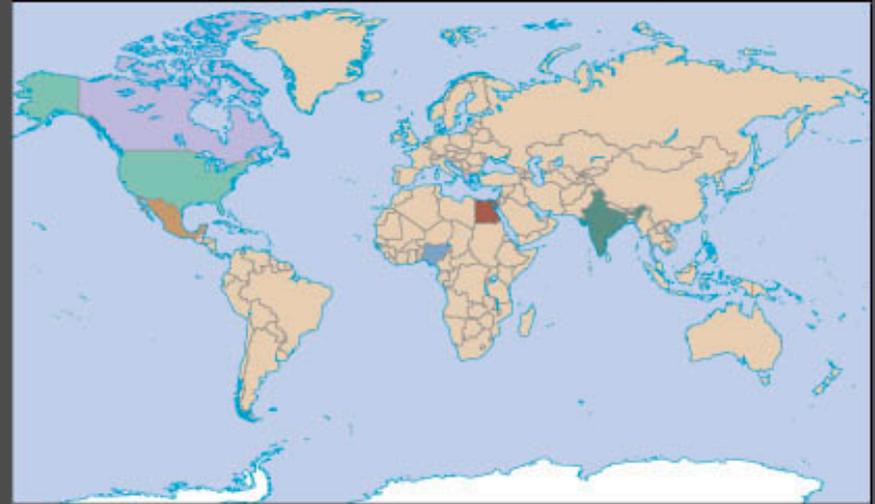
Developed vs. Developing

- 20% of the world's population lives in highly developed countries in 2000, these people used 60% of the commercial energy consumed worldwide.

That means...

Each person in highly developed countries uses approximately eight times as much energy as each person in developing countries.

Annual per-capita commercial energy consumption in 2000.



DEVELOPING

- Farmers rely on their own physical energy or animal energy.
- Goal of Developing Countries: *improve the standard of living*.
- Boost economic development?
- Will be followed by a rise in per-capita energy consumption.

DEVELOPED

- **High-energy input**
 - Fertilizers, machinery, pesticides, etc.
- Makes the agricultural productivity higher!
- Developed nations have a more stable population, so per-capita energy consumption may be close to saturation.

Must increase energy efficiency!!!

HOW DO WE MAKE ENERGY?

