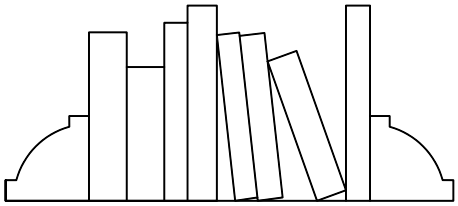
Environmental Science 101 *Fall 2012*

Energy

Lecture Outline:

8. RENEWABLE ENERGY RESOURCES
   - A. Improving Energy Efficiency
     1. Doing More with Less
     2. Case Study 1
     3. Case Study 2
     4. Reducing Energy Waste
     5. Saving Energy
     6. A Look at USA in 2008 and 2050
   - B. Geothermal Energy
   - C. Hydroelectric Energy
   - D. Ocean Energy Sources
   - E. Biomass Energy



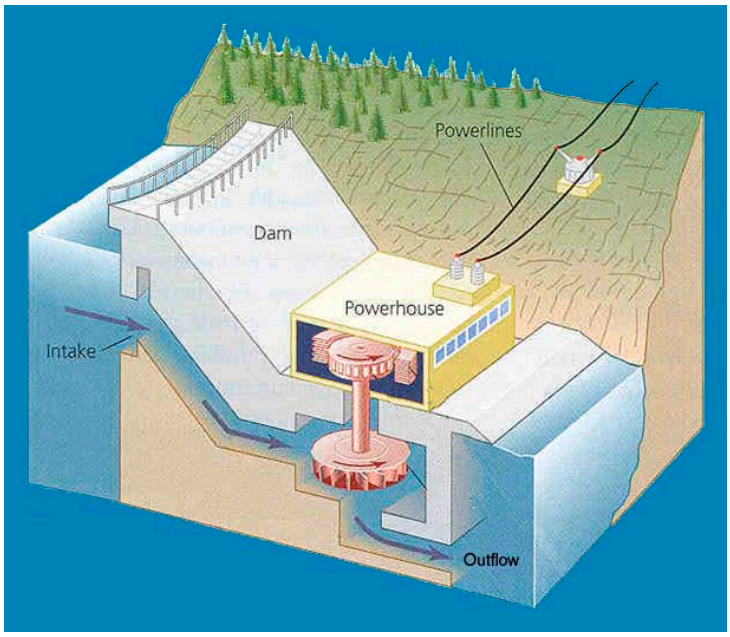
Learning Objectives:

When you are finished with this unit you should be able to:

1. Describe what can be done to improve energy efficiency in the USA.
2. List ways that you as an individual can save energy.
3. Describe the pros and cons of hydroelectric energy production.
4. List the pros and cons of tidal, geothermal, and biomass energy.
5. Rank renewable energy sources from greatest to least potential looking 50 years into the future. Justify your ranking.

Terms You Should Know:

- Hydroelectric energy
- Tidal energy
- Biomass energy
- Geothermal energy
- Gasohol
- Turbines
- Biofuel
- Conservation
- Cogeneration
- Energy Efficiency
- Penstocks



Reading Assignment:

Brennan and Withgott:
Chapter 20; pages 561-588.

8. RENEWABLE ENERGY RESOURCES

A. IMPROVING ENERGY EFFICIENCY

1. Doing More with Less

- 84% of all commercial energy used in the USA is wasted

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- Energy efficiency

ENERGY EFFICIENCY — the percentage of total energy input that does useful work

- Increasing energy efficiency — cars

cars	—	MPG
1975	—	
1988	—	
1992	—	
1994	—	
2001	—	
2004	—	

1 mpg on US cars =

2. CASE STUDY 1

Compact Fluorescent Lights (CFLs) vs. Incandescent Light Bulbs

- Efficiency:
  - incandescent lighting
  - fluorescent lighting

- CFL Sales:

  1988

  1992

  1996

  2004

-

- CFLs last 10X as long as incandescents

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- In 1999 incandescents out sold CFLs by 25:1

  –

- CFL technology continues to improve

  –

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3. CASE STUDY 2: THE CAR

   OPTIONS:

   - Internal Combustion Engine 10% Efficiency

   -

   -

OPTION A: Internal Combustion Engine

DO NOTHING! — keep internal combustion engine

- Fading oil reserves
-

OPTION B: Hybrid Car

- Consists of:
  –
  – small battery to provide energy for acceleration and hill climbing
- Hybrid Cars

Toyota Prius

  – on sale in the USA for 12 years
  –
  –

Hybrid availability in the USA

  –
  –
  – Lexus CT200h (42 mpg)
  –
  – Honda, Lincoln, Hyundai, and Kia all sell hybrids

OPTION C: Hydrogen Fuel Cells

  –
  – lower CO_2 emissions
  –

4. Benefits of reducing energy waste:

   - Making non-renewable fuels last longer
   -
   - Decreasing dependence on oil imports
   - Lessening need for military intervention in the Middle East (oil interests)
   -
   -
   -
     - USA—
     - Japan—

5. Saving Energy

   CONSERVATION—(1) using only what we need, and (2) using it efficiently

   - Roadblocks to energy conservation:
     -
     - federal programs subsidize fossil fuels

       oil cost = $36 per barrel

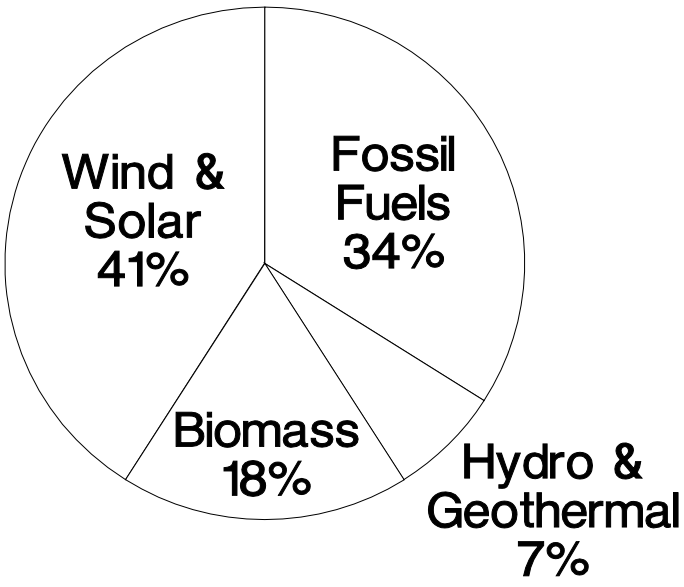
       real oil cost =

6.a A Look at USA in 2008

Use of renewable energy in the USA today (2008):

- % of our energy needs; split as follows:
  - % Hydropower
  - % Biomass energy
  - % Geothermal
  - % Solar
  - % Wind

6.b A Look at USA in 2050



6.c Current Renewable Options and Potential

Option	Status	Price
Geothermal		
Wind		
Solar – Thermal		
Solar – Photovoltaic		
Ocean Wave Power		

B. GEOTHERMAL ENERGY

- Using internal heat from the Earth

GEOTHERMAL ENERGY — heat from the Earth's mantle transferred to underground concentrations of dry steam, wet steam, or hot water

-

- 20 countries now use some geothermal energy
  - USA produces 44% of the world’s geothermal power
  - Iceland — heats capital city
- Wells can be drilled to extract the energy

PROS:

- –
- –
- –
- – can be used to turn turbines
- – use all the time

CONS:

- –
- – can degrade local environment:

  minerals, salts, toxic metals, hydrogen sulfide gas
- –
- –

C. HYDROELECTRIC ENERGY

- Rely on dams; environmental costs
- Stored reservoir water flows through *Penstock* (pipes) at controlled rates and turn turbines to produce electricity
- In 1925 — hydropower generated 40% of the world's electricity
- Today — World
  - –
  - –
- Today — USA
  - –
  - –
- In USA most of potential hydroelectric energy is already developed
  - – few new large dams will be built

- –
- –

- Hydropower is renewable, but adversely impacts:
  - –
  - –
  - –
  - – takes fertile land out of production

PROS:

- –
- –
- – well developed technology

CONS:

- –
- –
- – environmental impacts

D. OCEAN ENERGY SOURCES

-
-

1. Harnessing heat
   - Ocean's sun-warmed surface temperature is higher than deep water
   - Use temperature gradient to capture energy

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2. Harnessing Motion

   a. Tides

   - Tides come in and go out twice each day
   -
   - Potential sites:
     –
     –
     –

   b. Wave Motion

   - Harness the motion of wind-driven waves
   -
   -

E. BIOMASS ENERGY

1. Definitions

   - Organic substances produced by recent photosynthesis
   - BURNING:
     – wood
     – garbage
     – agricultural wastes
     – alcohol
     – oil seed crops

DECOMPOSITION:

- –
- –
- Can be used to produce electricity
-

1. Pacific Northwest Biomass Energy Examples
   a. Wood Chips
      –
      –
   b. Biodiesel
      –
      –
      –
   c. Energy Crops
      –
      –
   d. Waste to Energy
      – Spokane's Waste-to-Energy Plant
        ✓
        ✓
   e. Wood Stoves
      –
      –

f. Gasohol

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– gasohol is a gasoline-ethanol mixture

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2. National – Global Potential / Use

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• In LDCs biomass energy is 50% of energy use

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3. Renewable – but Sustainable?

• All biomass energy sources have environmental costs!

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