Energy Efficiency & Renewable Energy Resources

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Outline

1. Energy efficiency
2. Solar energy
3. Producing electricity from water
4. Producing electricity from wind
5. Producing energy from biomass
6. The solar–hydrogen revolution
7. A sustainable energy strategy

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1. Energy Efficiency

What is it?

the percentage of total energy input that does useful work in an energy conversion system

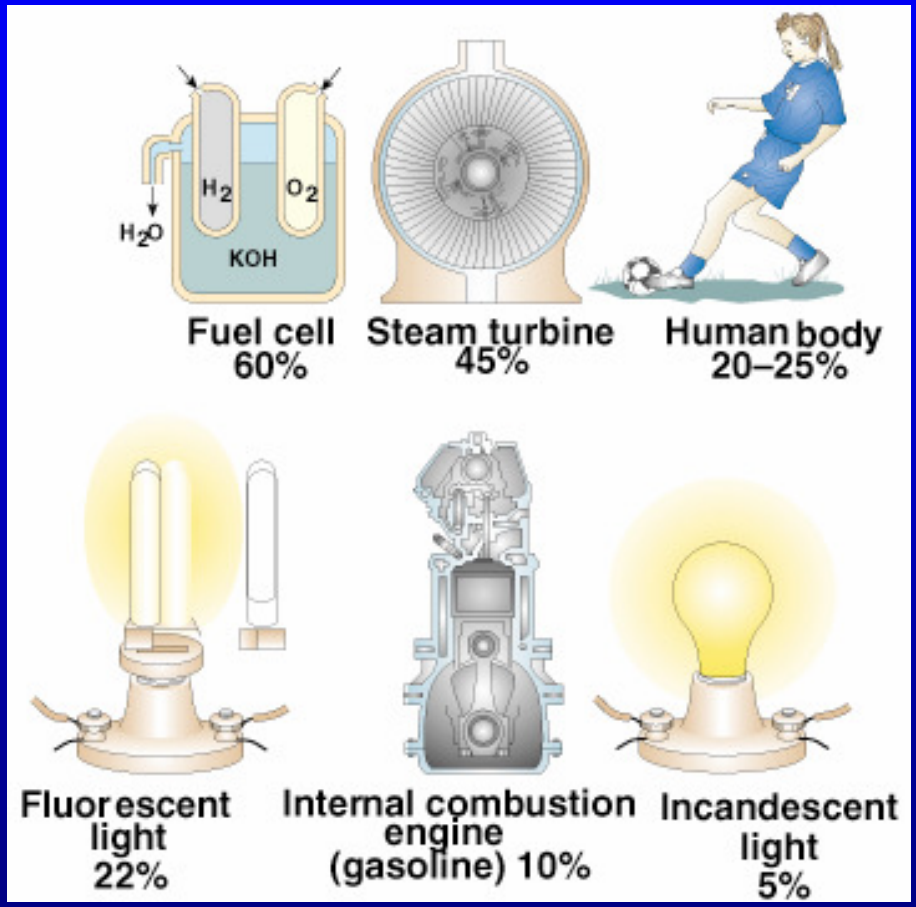

Fig. 16–3

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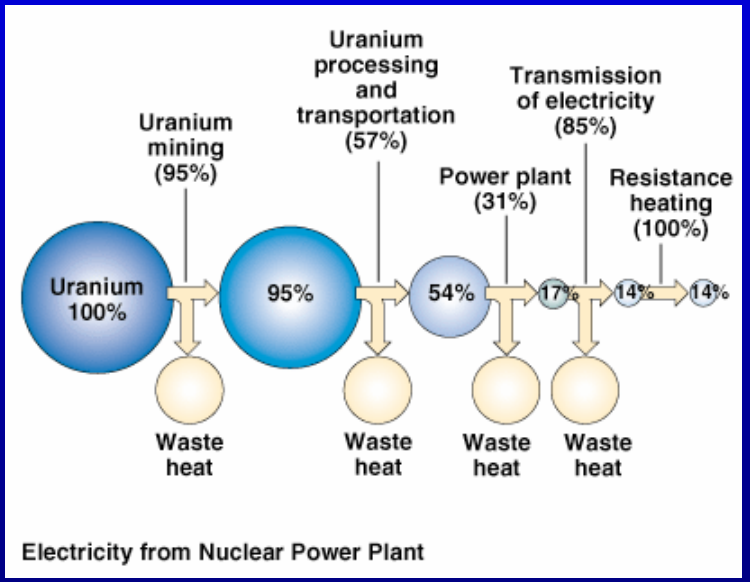
Energy Efficiency

Net energy efficiency

the net efficiency of the entire energy delivery process is determined by the efficiency of each step in the energy conversion process



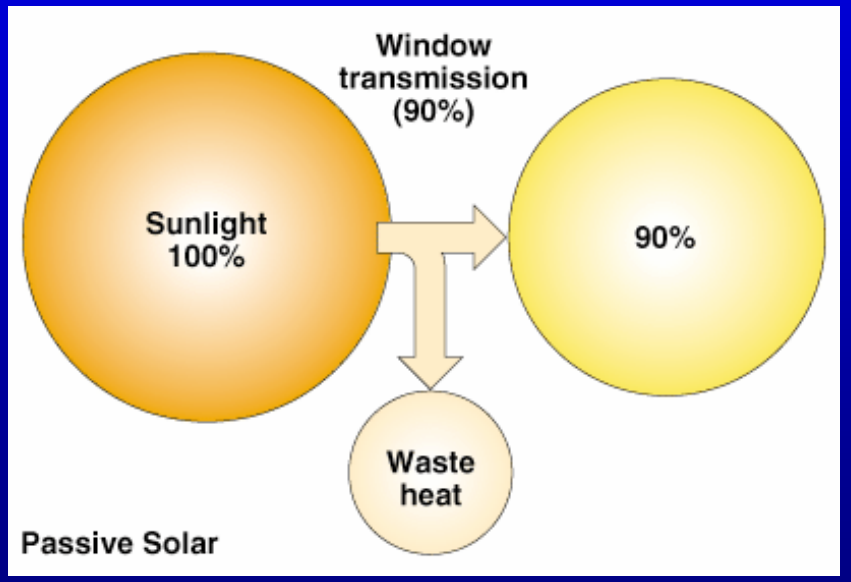


Fig.16–4

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Energy Efficiency

Energy waste

43% of the energy used in the U.S. is unnecessarily wasted by using inefficient methods to produce electricity, heat our homes, & drive our cars

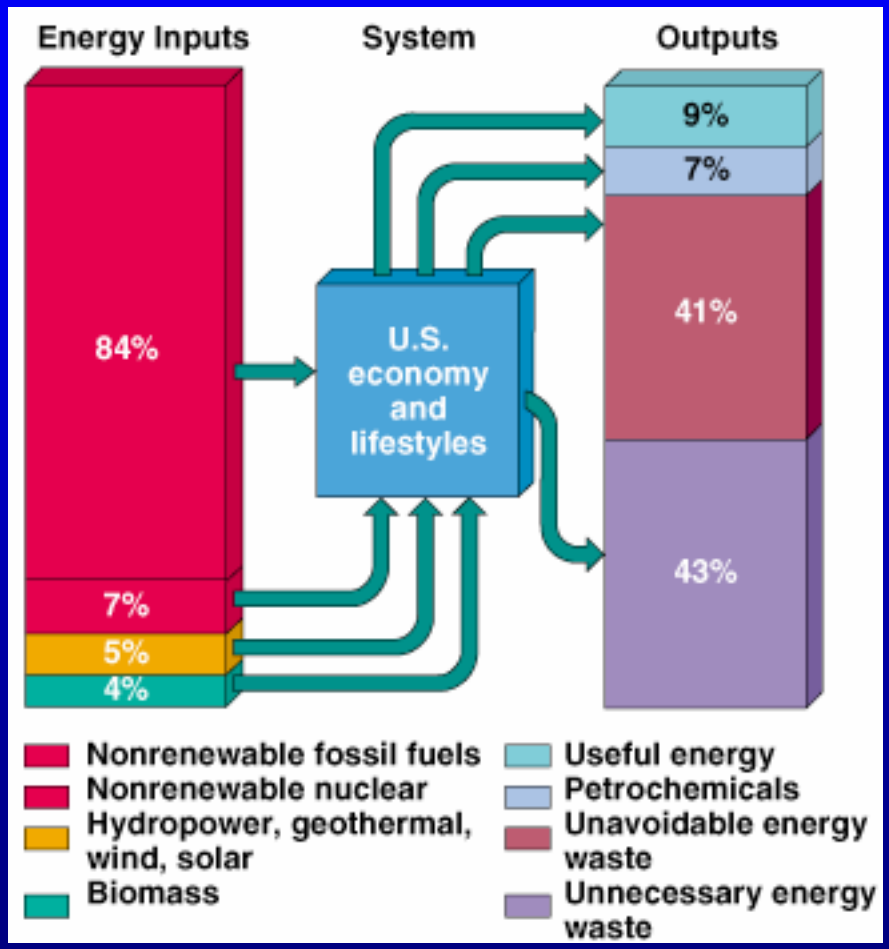

Fig. 16–2

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Energy Efficiency

The importance of reducing energy waste

- nonrenewable fuels last longer
- time to phase in renewable energy resources
- decrease dependence on oil imports
- reduce local & global environmental damage
- slow global warming
- save money

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Energy Efficiency

Improving energy efficiency

- cogeneration
  the production of two useful forms of energy from the same fuel source
- energy conservation & use of energy efficient lighting & appliances
- increases in the fuel efficiency of motor vehicles or use of alternative fuel vehicles
- better insulated homes

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2. Solar Energy

Passive solar heating

- Sunlight is captured directly within a structure & converts it into low–temperature heat for space heating.
- Heat is stored in walls & floors made of materials like concrete, brick, stone, or tires & is released slowly throughout the day.

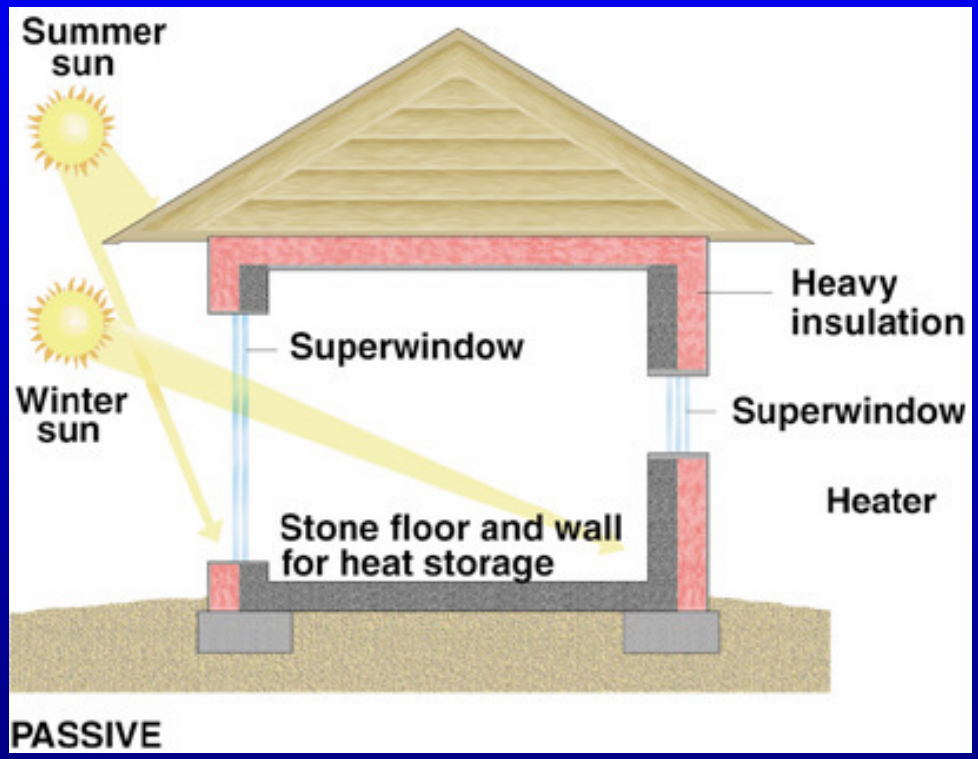

Fig. 16–12a

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Solar Energy

Passive solar heating

- A passive solar & superinsulated design is the cheapest way to heat a home in regions where sunlight is available more than 60% of daylight hours.

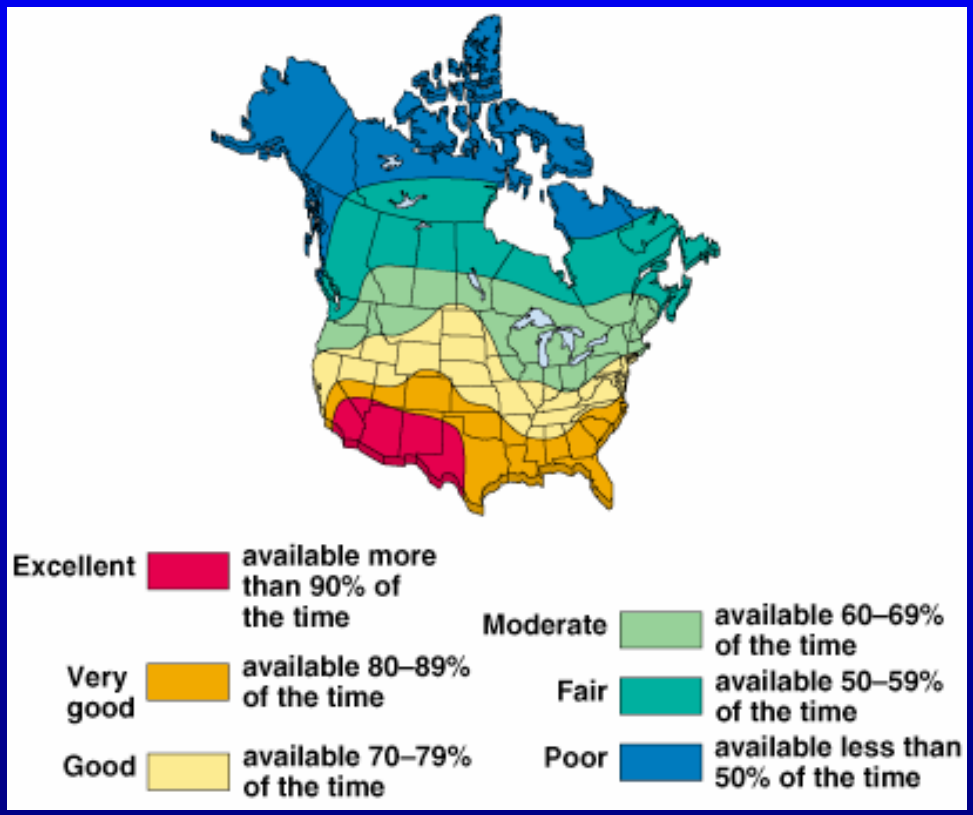

Fig. 16–15

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Solar Energy

Active solar heating

- solar collectors absorb solar energy & a fan or pump supplies the building's space or water heating needs

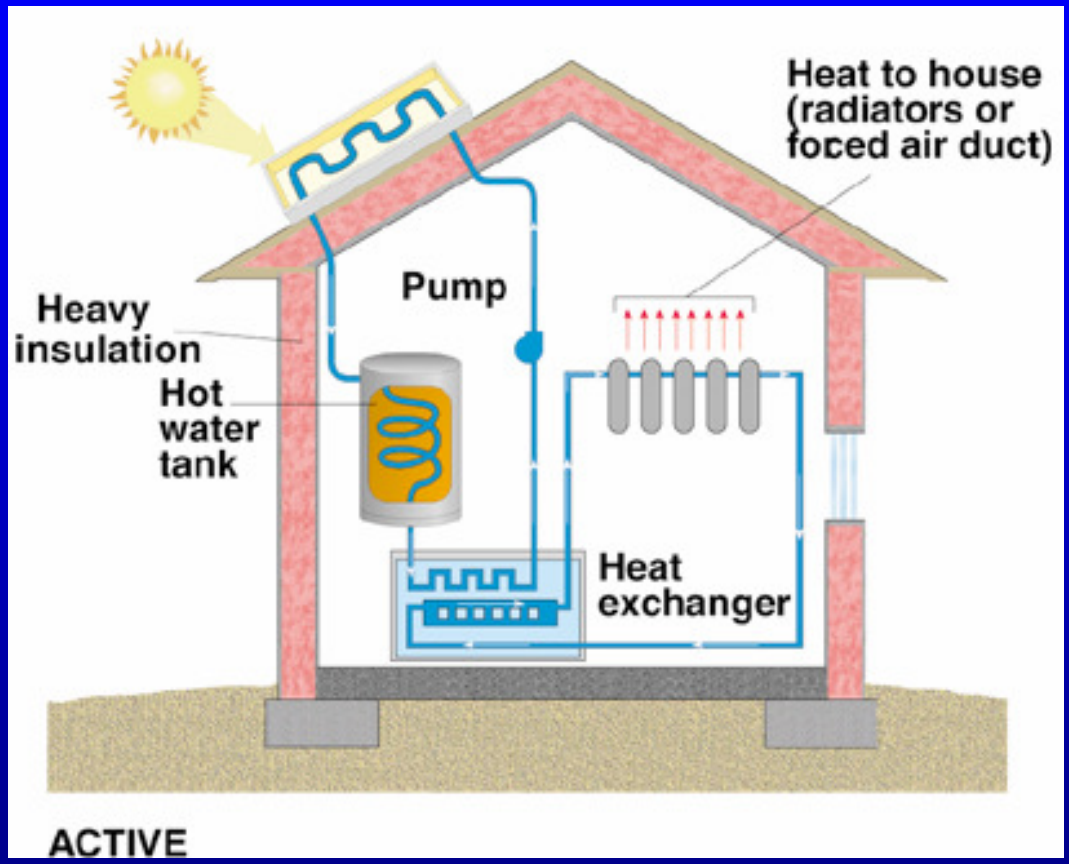

Fig. 16–12a

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Solar Energy

Active & passive solar heating

Pros

- solar energy is free
- net energy yield is high for passive & moderate for active
- technology is well developed & easily installed
- takes up little land space
- does not emit polluting or greenhouse gases

Cons

- need to secure solar rights
- solar collectors are ugly to some people
- active systems are costly

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Solar Energy

Producing electricity

- solar energy can be converted directly into electrical energy by photovoltaic cells
- sunlight striking silicon atoms creates an electrical current
- electrical energy is stored in batteries for use when the sun is not shining

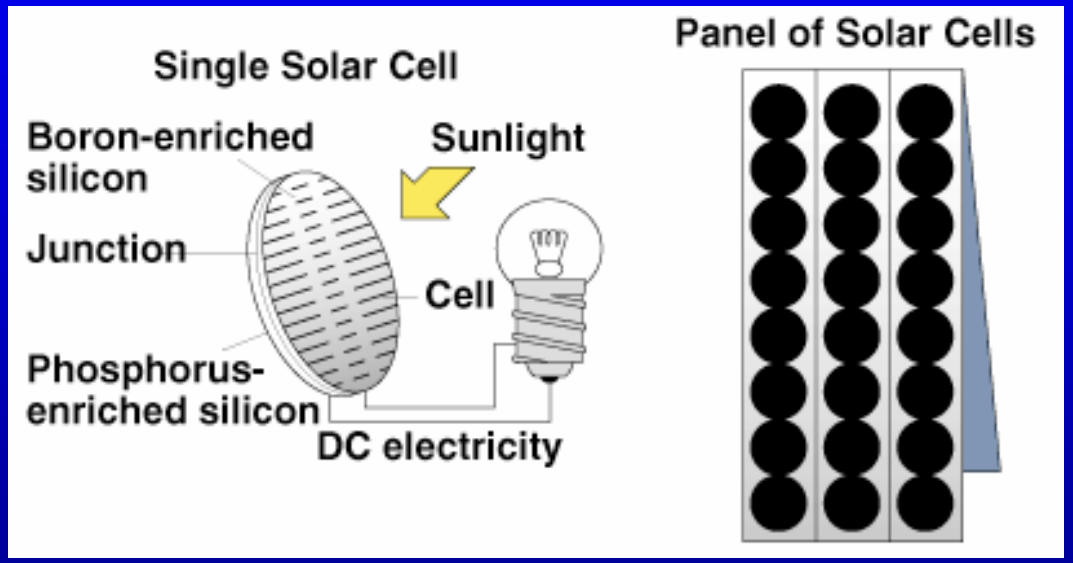

Fig. 16–17a

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Solar Energy

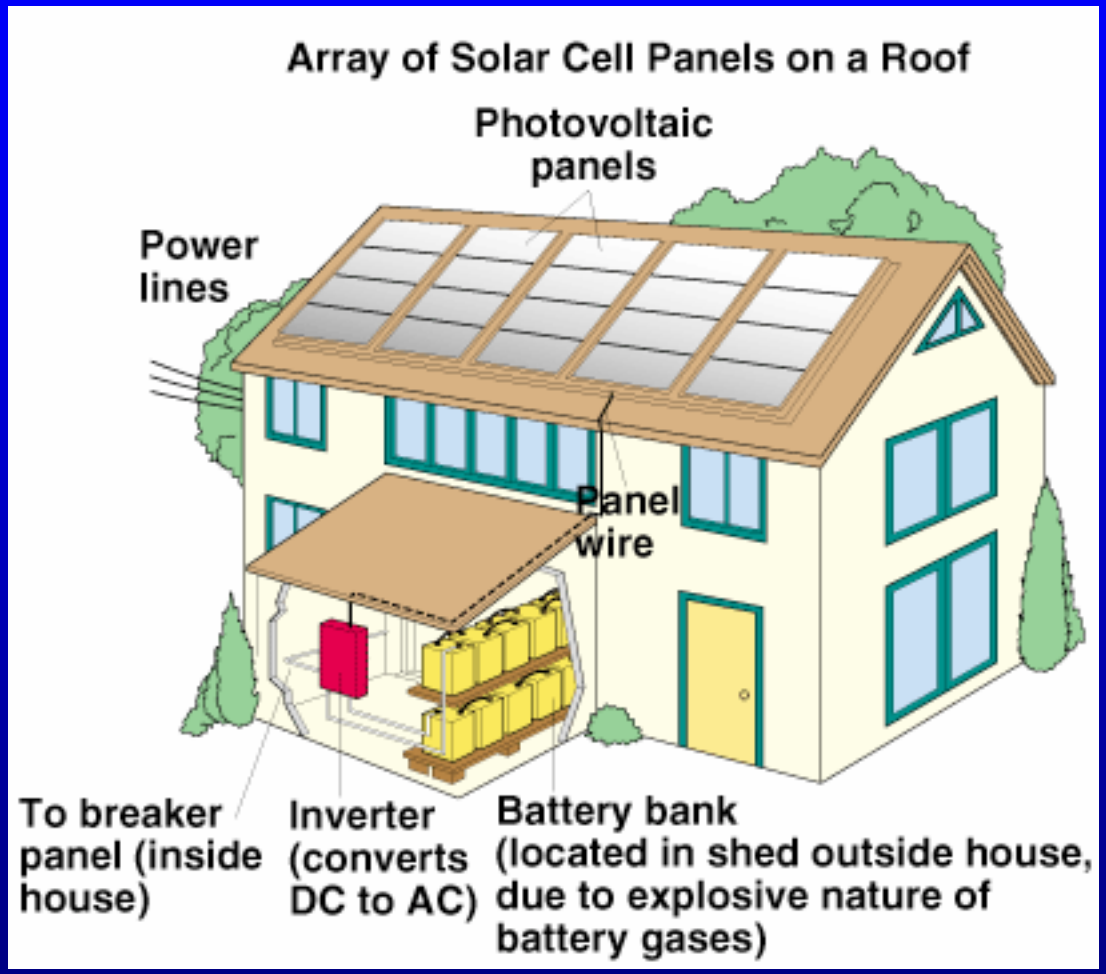

Fig. 16–17b

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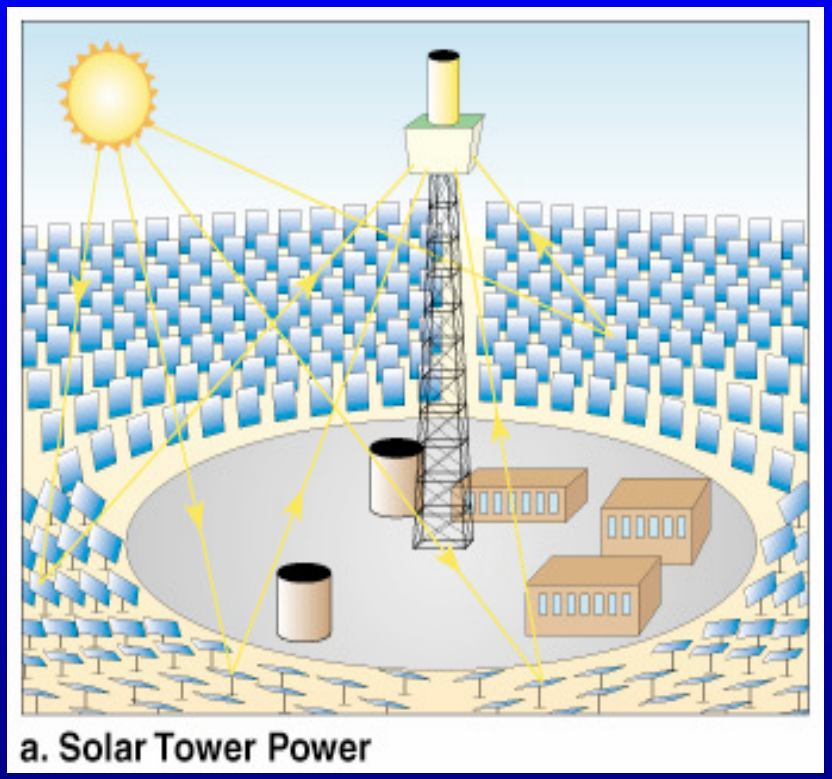
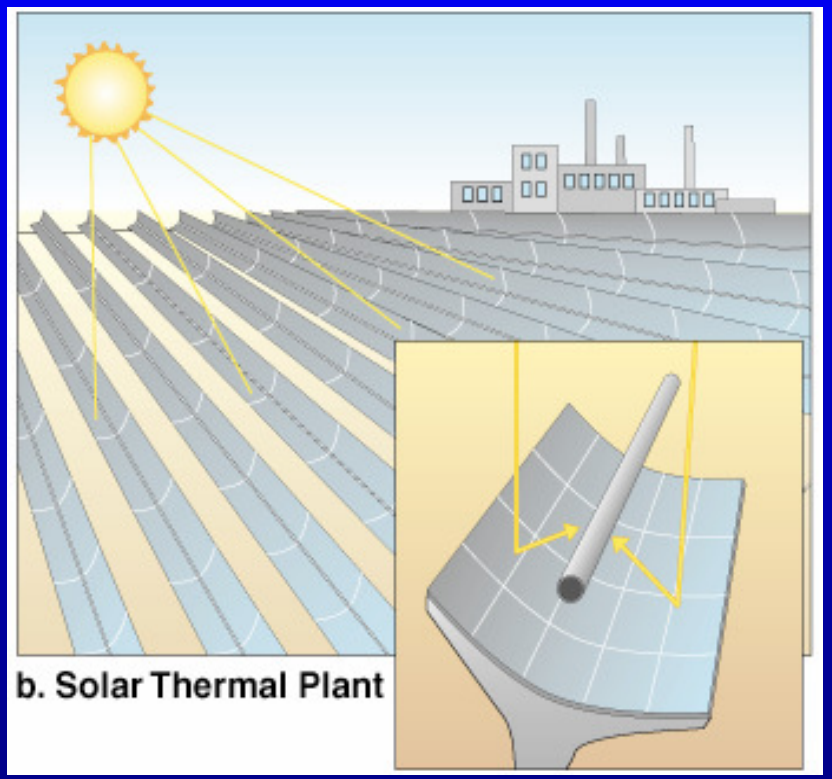
Solar Energy

Generating high temperature heat & electricity



a. Solar Tower Power



b. Solar Thermal Plant

Figs. 16a–16b

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3. Producing electricity from water

- hydroelectric dams
- tides & waves
- ocean thermal energy conversion & solar ponds

(see Fig. 16–18)

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Producing electricity from water

Pros

- none of the technologies emit greenhouse or polluting gases
- high net energy yields for dams & moderate yields for solar ponds

Cons

- Dams flood upstream habitats & alter downstream habitats
- few areas have the right conditions to use tides & waves
- thermal energy from bodies of water cannot compete economically

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4. Producing electricity from wind

Pros

- unlimited source of energy at favorable sites
- moderate to high net energy yield
- easy to build & expand
- emit no pollutants or greenhouse gases
- land can also be used for agriculture

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Producing electricity from wind

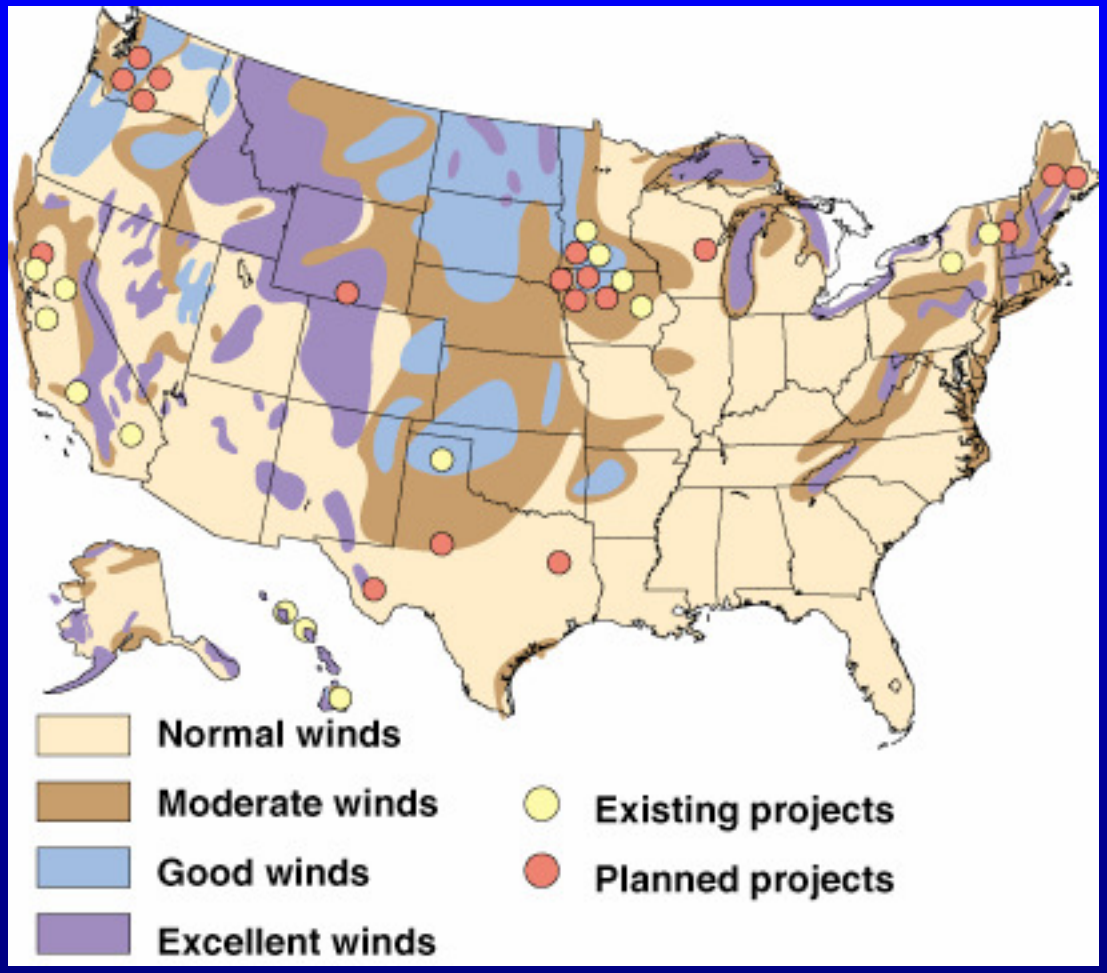

Fig. 16–19

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Producing electricity from wind

Cons

- economical only in areas with steady winds
- back–up energy sources are necessary
- mass production takes up a great deal of land space
- noise pollution
- may interfere with migrating birds

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5. Producing energy from biomass

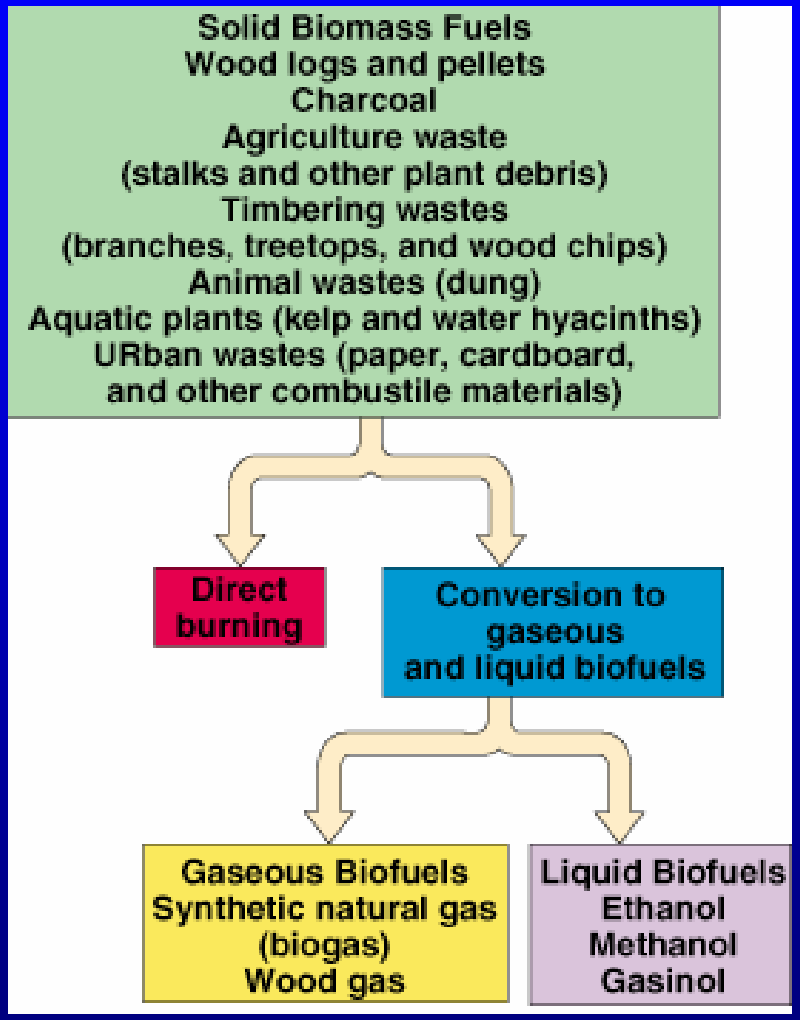

Fig. 16–20

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Producing energy from biomass

Using wood

Pros

- a potentially renewable energy resource
- high net energy yield if burned near source

Cons

- currently exploited in nonrenewable & unsustainable ways
- single–species biomass plantations reduce biodiversity
- burning wood produces air pollutants such as particulates

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Producing energy from biomass

Biofuels as alternatives for gasoline

(see Table 16–1, ethanol & methanol)

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Producing energy from biomass

Burning wastes

- crop residues & animal manure can be burned or converted into biofuels

  can be efficient if small–scale & local

- urban wastes can be burned in incinerators to produce electricity & heat

  concerns about emissions of toxic gases released from burning of hazardous materials

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6. The solar – hydrogen revolution

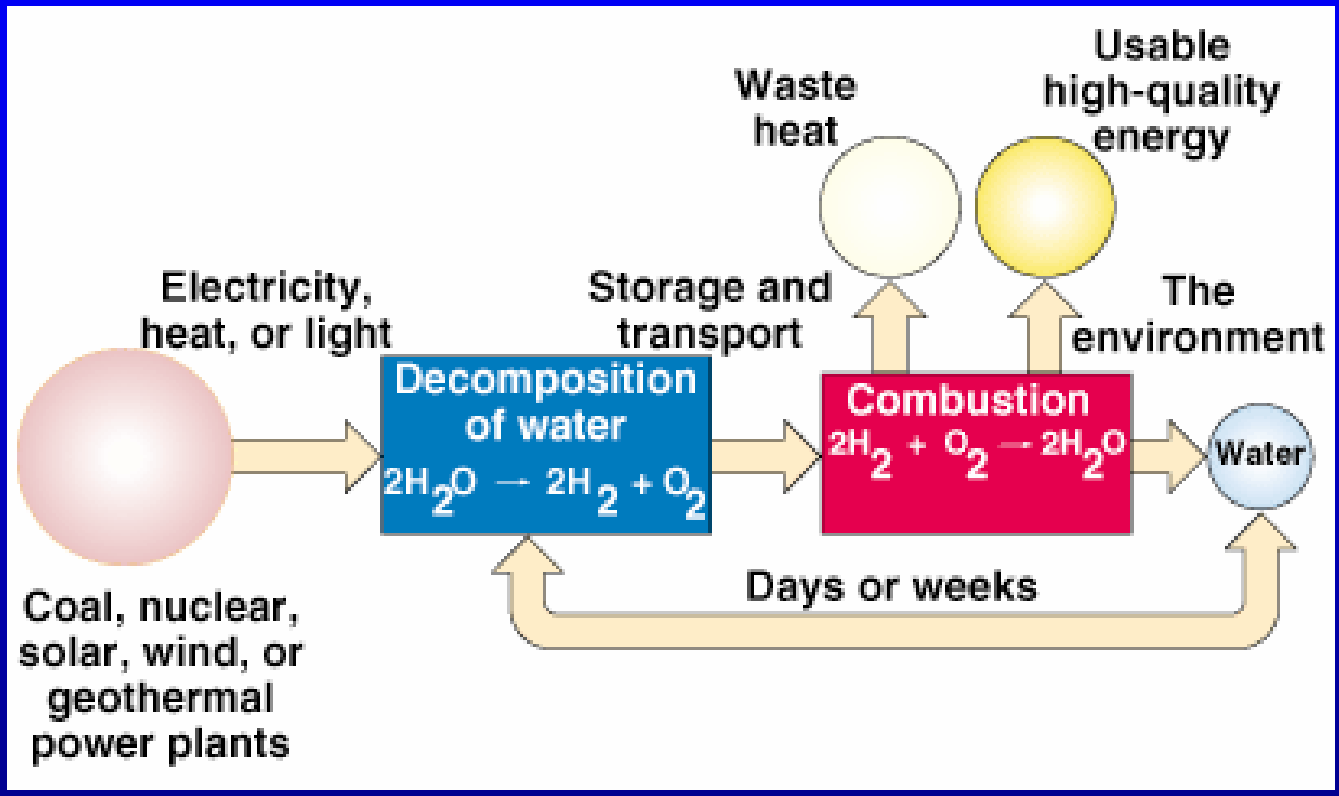

Fig. 16–21

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The solar – hydrogen revolution

The benefit of using hydrogen

- the source of hydrogen, water, is plentiful
- when burned, hydrogen produces no carbon dioxide, but instead water vapor & nitrogen oxides
- using hydrogen for fuel would eliminate most air pollution problems & reduce greenhouse gas emissions

The problem

- hydrogen is really only a way to store energy; requires energy source to split hydrogen from water
- currently nonrenewable energy sources are used to produce hydrogen, negating many benefits

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The solar – hydrogen revolution

The solution

- use renewable sources of energy, most notably solar, to produce hydrogen for combustion
- currently it costs more to use solar energy than other energy sources, but could be phased in over time

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7. A sustainable energy strategy

(see Fig.16–23)

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