

Chapter 18: Renewable Energy

Renewable Energy

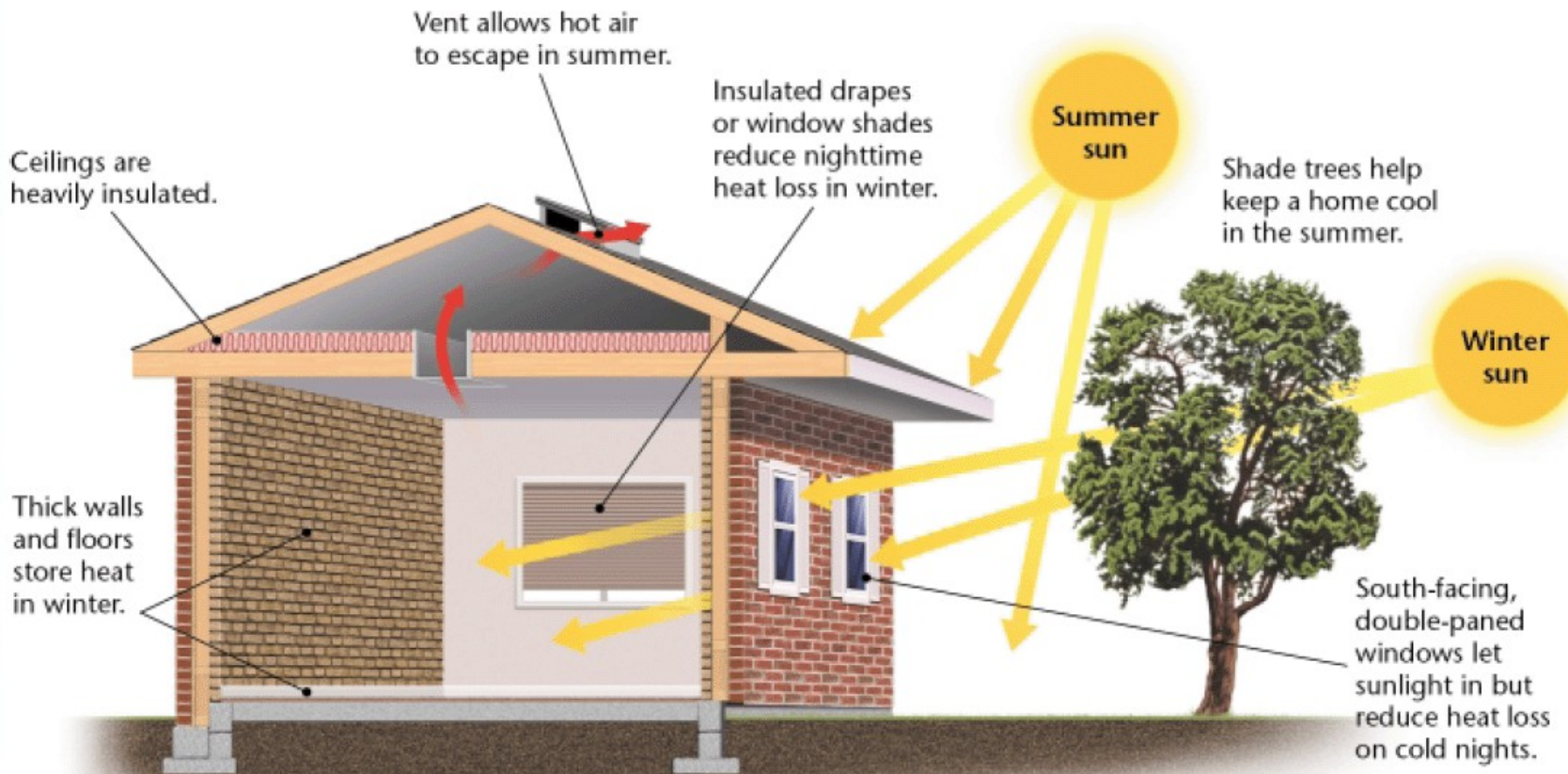
- Renewable energy is energy from sources that are **constantly** being formed.
- Types of renewable energy includes:
 - solar energy**
 - wind energy**
 - the power of moving water**
 - Earth's heat**
- Remember, all sources of energy, including renewable sources, affect the environment.

Solar Energy-Power from the Sun

- Nearly all renewable energy comes directly or indirectly from the **sun**.
- **Direct** solar energy is used every day, like when the sun shines on a window and heats the room.
- Solar energy can also be used **indirectly** to generate electricity in solar cells.

Passive Solar Heating

- Passive solar heating is the use of sunlight to heat buildings **directly**.
- In the Northern Hemisphere, **south facing** windows receive the most solar energy.
- Therefore, passive solar buildings have large windows that face south.
- An average household could reduce its energy bills by using **any** of the passive solar features shown on the next slide.

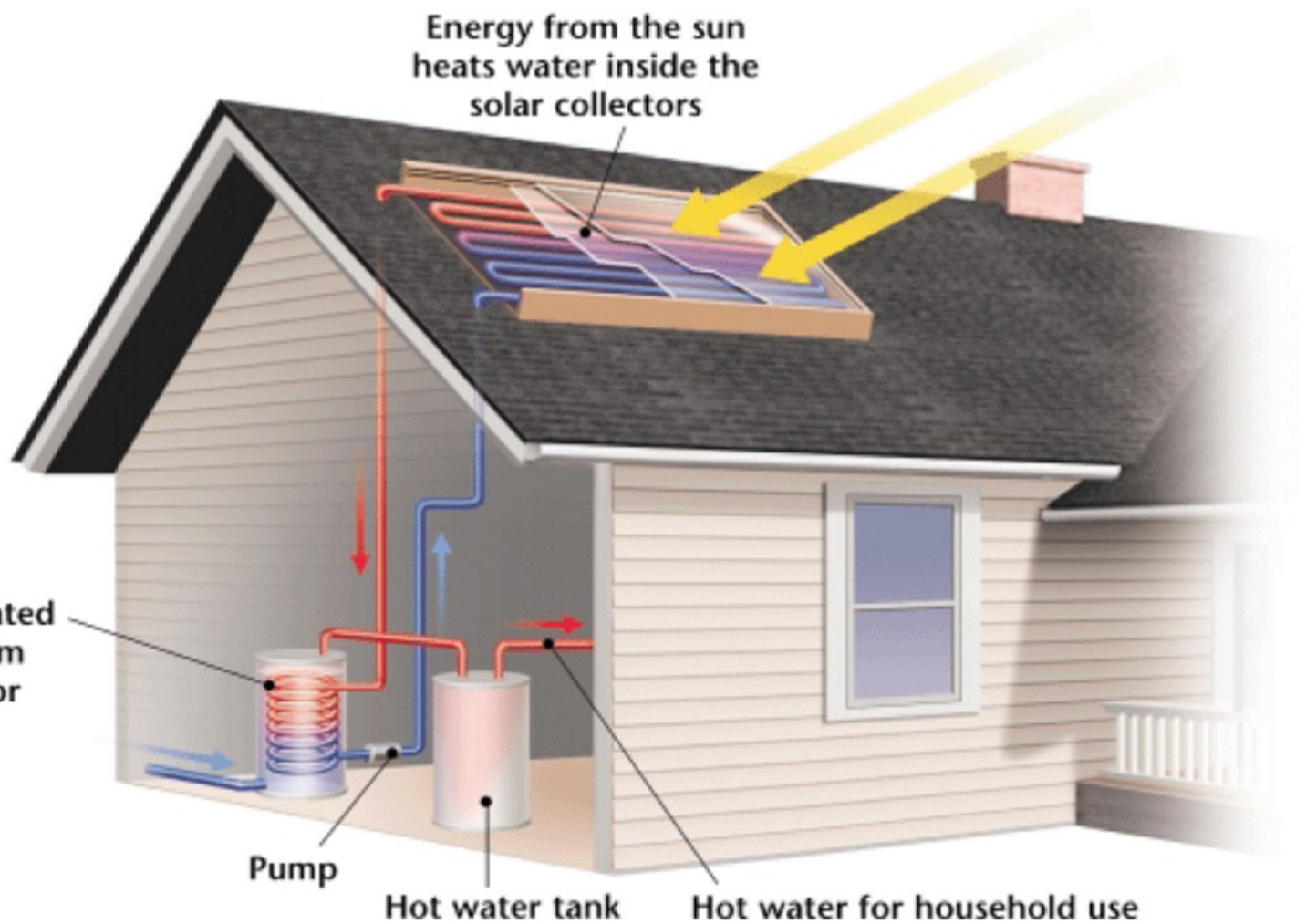


Active Solar Heating

- Active solar heating is the gathering of solar energy by **collectors** that are used to heat water or heat a building.
- More than 1 million homes in the United States use active solar energy to heat **water**.
- Solar collectors, usually mounted on a **roof**, capture the sun's energy.

Energy from the sun heats water inside the solar collectors

Cold water from water supply is heated by water from solar collector



Active Solar Heating

- A **liquid** is heated by the sun as it flows through solar collectors.
- The hot liquid is then pumped through **heat exchangers**, which heats water for the building.
- About **8%** of the energy used in the United States is used to heat water; therefore, active solar technology could save a lot of energy.

Photovoltaic Cells

- Photovoltaic cells are solar cells that **convert** the sun's energy into electricity.
- Solar cells have no moving parts, and they run on **nonpolluting** power from the sun.
- However, they produce a very **small** electrical current. Meeting the electricity needs of a small city would require covering hundreds of acres with solar panels.

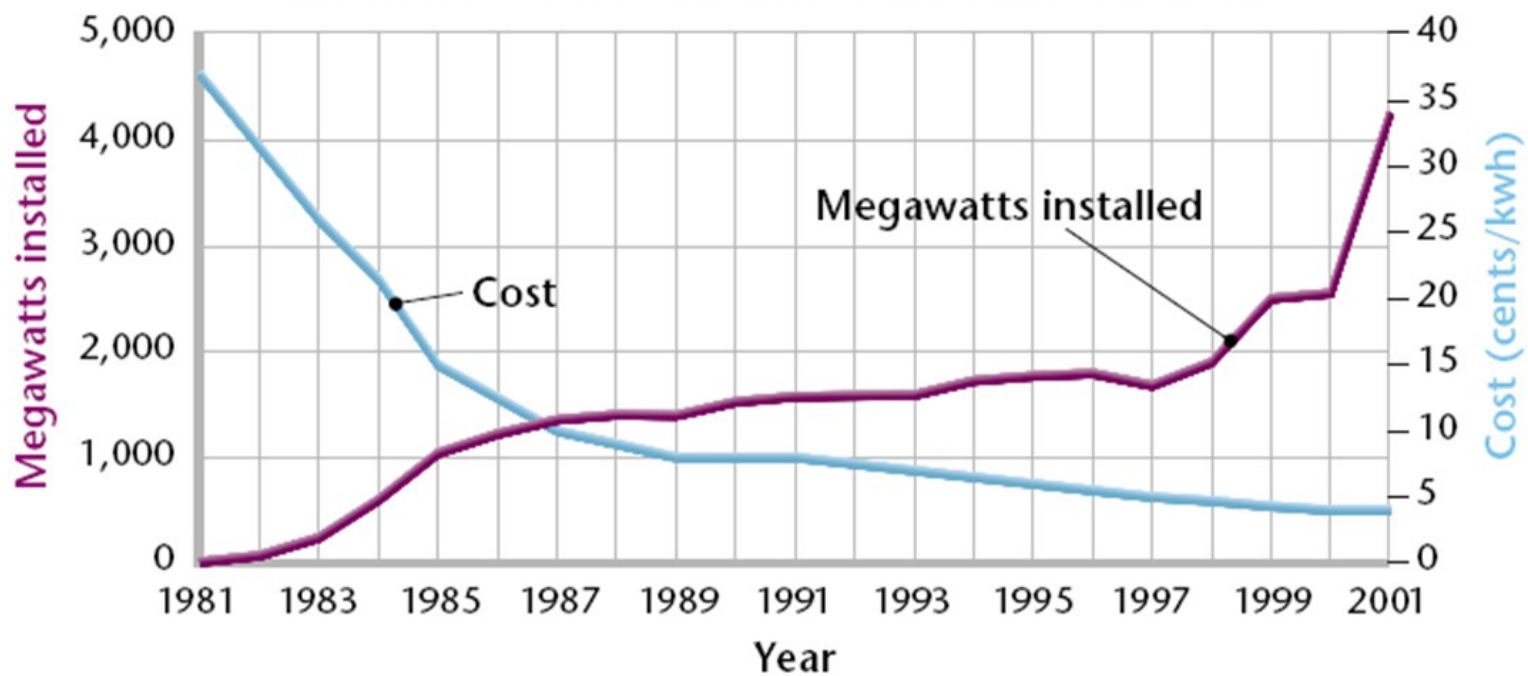
Wind Power

- Energy from the sun warms the Earth's surface unevenly, which causes air masses to **flow** in the atmosphere.
- We experience the movement of these air masses as **wind**.
- Wind power, which converts the movement of wind into electric energy, is the **fastest** growing energy source in the world

Wind Farms

- Wind turbines are used to **capture** the energy from the wind.
- Large arrays of wind turbines are called wind **farms**. Large wind farms supply electricity to thousands of homes.
- In windy rural areas, small wind farms with **20** or fewer turbines are also becoming common.
- Because wind turbines take up **little space**, some farmers can add wind turbines to their land and still use the land for other purposes.
- The **cost** of wind power has been steadily falling as wind turbines have become more efficient.

U.S. Wind Power Production and Cost: 1981-2001



Source: American Wind Energy Association.

Biomass-Power from Living Things

- Biomass fuel consists of **plant** material, **manure**, or any other organic matter that is used as an energy source.
- Fossil fuels can be thought of as biomass energy sources, although they are nonrenewable.
- Renewable biomass fuels, such as **wood** and **dung**, are major sources of energy in developing countries.
- More than half of all wood cut in the world is used as **fuel** for heating and cooking.

Methane

- When bacteria **decompose** organic wastes, one byproduct is methane gas.
- Methane can be **burned** to generate heat or electricity.
- In China, more than 6 million households use **biogas digesters** to ferment manure and produce gas for heating and cooking.
- Some **landfills** in the United States generate electricity by using the methane from the decomposition of trash.

Alcohol

- **Liquid** fuels can also be derived from biomass.
- For example, **ethanol**, an alcohol, can be made by fermenting fruit or agricultural waste. In the United States, corn is a major source of ethanol.
- Cars and trucks can run on ethanol or gasohol, a blend of **gasoline** and ethanol. Gasohol produces less air pollution than fossil fuels.
- Some states require the use of gasohol in vehicles as a way to reduce air pollution.



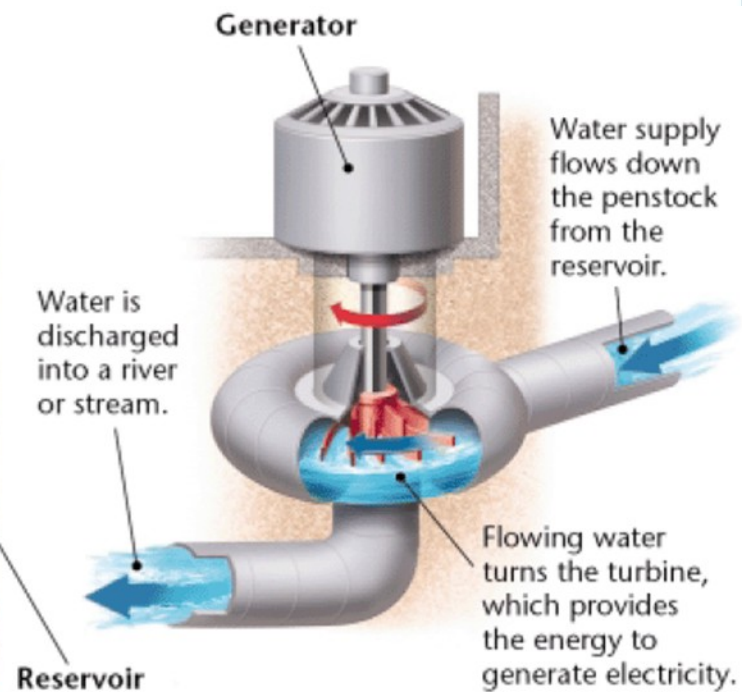
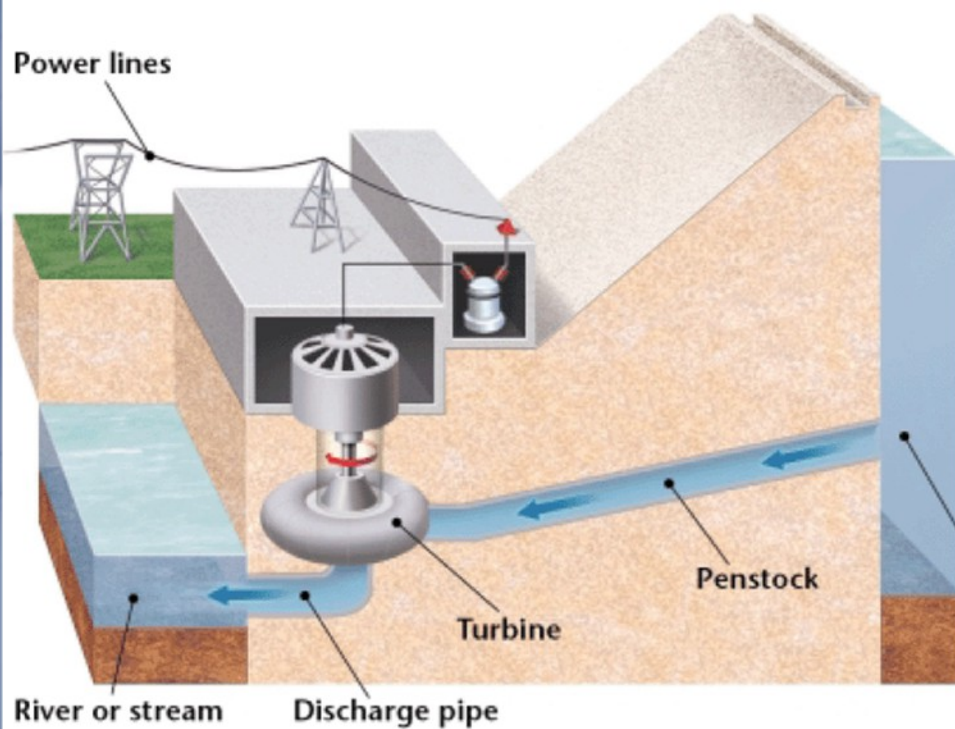
MINIMUM OCTANE RATING
93

ULTRA LOW SULFUR
HIGHWAY DIESEL FUEL
15 ppm Sulfur Maximum
Required for use in all
highway diesel vehicles
and engines. Recommended
for use in all diesel
vehicles and engines.

CONTAINS
UP TO 10%
ETHANOL

Hydroelectricity-Power from Moving Water

- Hydroelectric energy is electrical energy produced by **falling water**.
- Hydroelectric energy accounts for **20%** of the world's electricity.
- Large hydroelectric power plants have a **dam** that is built across a river to hold back a reservoir of water.
- The water in the reservoir is released to turn a **turbine**, which generates electricity.



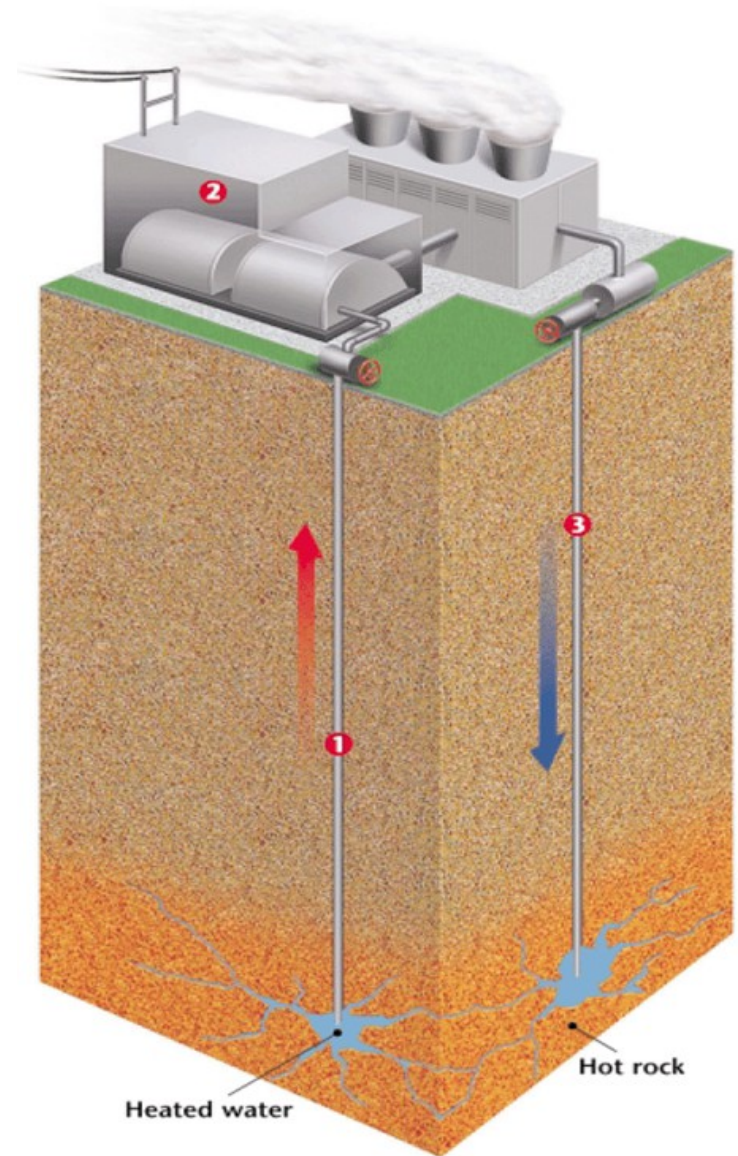
Modern Trends

- While in developing countries the construction of large dams continues, in the United States, the era of **large dam** construction is probably over.
- One modern trend is **micro-hydropower**, which is electricity produced in a small stream without having to build a big dam. The turbine may even float in the water, not blocking the river at all.
- Micro-hydropower is much cheaper than large hydroelectric dam projects, and it permits energy to be generated from **small streams** in remote areas.

Geothermal Energy-Power from the Earth

- In some areas, deposits of water in the Earth's crust are heated by **geothermal** energy.
- Geothermal energy is the energy produced by heat **within** the Earth.
- The United States is the world's largest producer of geothermal energy.
- Although geothermal energy is considered a renewable resource, the water that is used must be **managed carefully** so that it is not depleted.

- Geothermal power plants generate electricity using the following steps
- Steam rises through a **well**
- Steam drives **turbines**, which generate electricity
- Leftover liquid is pumped **back** into the hot rock
- The leftover liquid, water, is returned to Earth's crust because it can be **reheated** by geothermal energy and used again.



Geothermal Heat Pumps: Energy for Homes

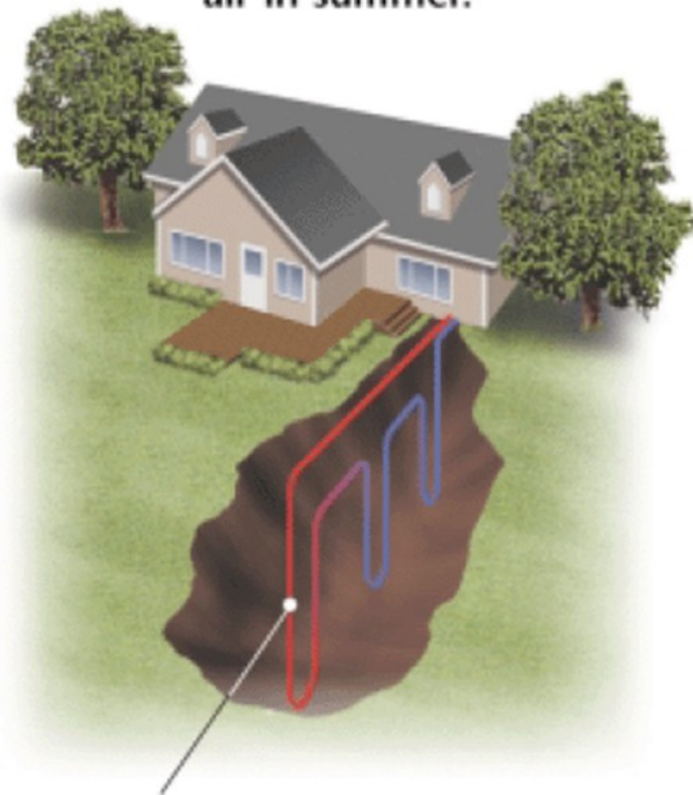
- More than 600,000 homes in the United States are heated and cooled using geothermal **heat pumps**.
- A geothermal heat pump uses **stable** underground temperatures to warm and cool homes because the temperature of the ground is nearly constant year-round.
- A heat pump is simply a loop of **pipng** that circulates a fluid underground.

The ground is warmer than the air in winter.



Heat is transferred from the ground to warm the house.

The ground is cooler than the air in summer.



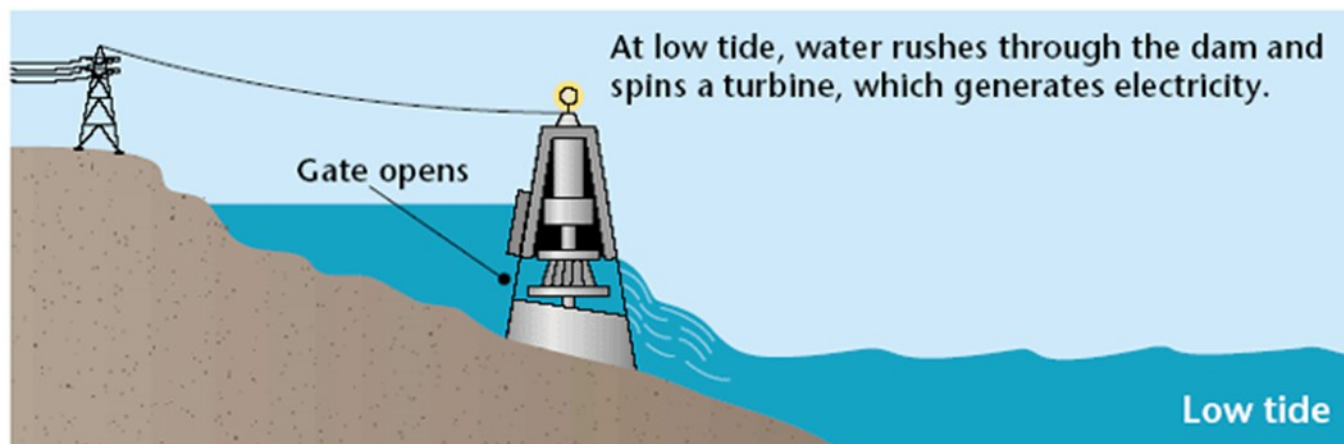
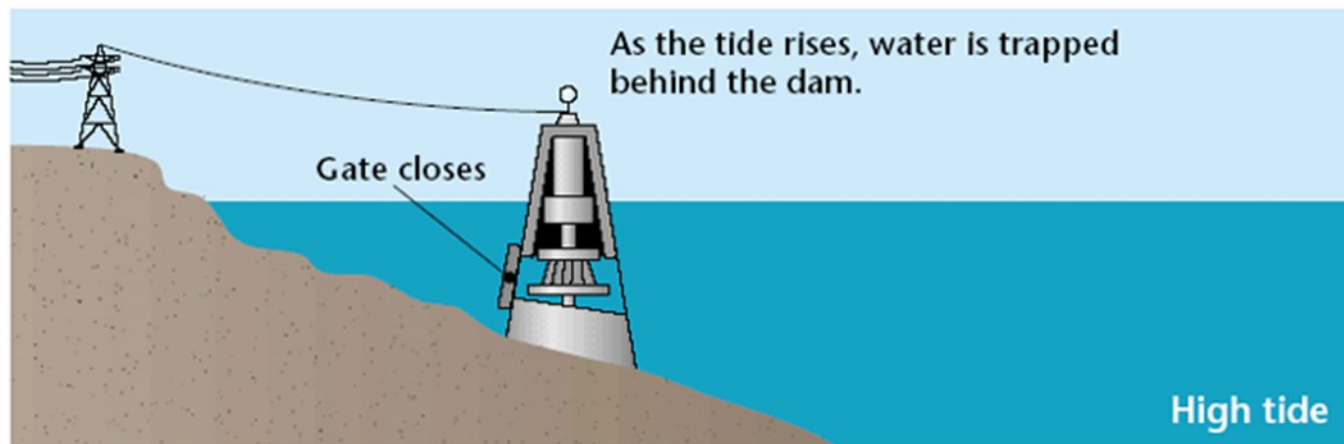
Heat is transferred from the house to the ground to cool the house.

Alternative Energy

- To achieve a future where energy use is sustainable, we must make the most of the energy sources we already have and develop new sources of energy.
- Alternative energy describes energy that **does not** come from fossil fuels and that is still in development.

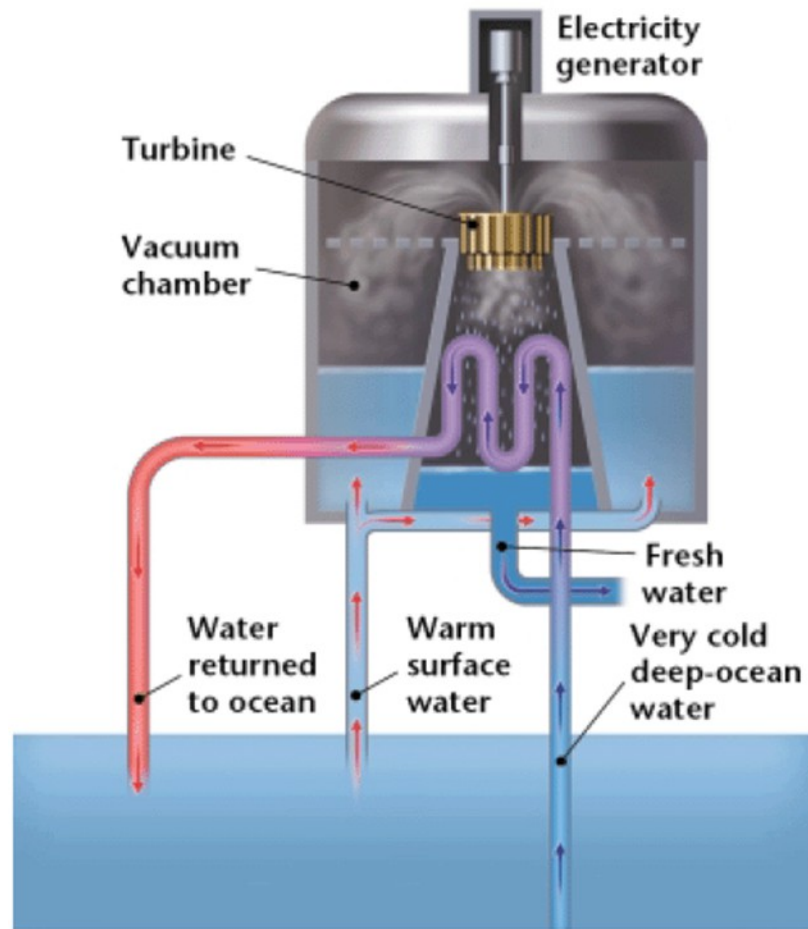
Tidal Power

- A tidal power plant works much like a **hydroelectric dam**.
- As the tide rises, water enters a bay behind a dam. The gate then closes at **high tide**.
- At low tide, the gate opens and the water in the bay rushes through, spinning a **turbine** that generates electricity.



Ocean Thermal Energy Conservation

- In the tropics, the **temperature** difference between the surface of the ocean and the deep ocean waters can be as much as 24°C (43°F).
- Ocean thermal energy conservation (OTEC) is the use of temperature differences in ocean water to produce **electricity**.



Hydrogen-A Future Fuel Source?

- Hydrogen, the most abundant element in the universe, can be burned as a **fuel**.
- Hydrogen does not contain **carbon**, so it does not release pollutants associated with burning fossil fuels and biomass.
- When hydrogen is burned in the atmosphere, it combines with oxygen to produce **water vapor**, a harmless byproduct, and small amounts of nitrogen oxides.

Fuel Cells

- A fuel cell is a device that produces electricity **chemically** by combining hydrogen fuel with oxygen from the air.
- When hydrogen and oxygen are combined, **electrical energy** is produced and water is the only byproduct.
- Fuel cells can be fueled by anything that contains plenty of hydrogen, including natural gas, alcohol, or even gasoline.

