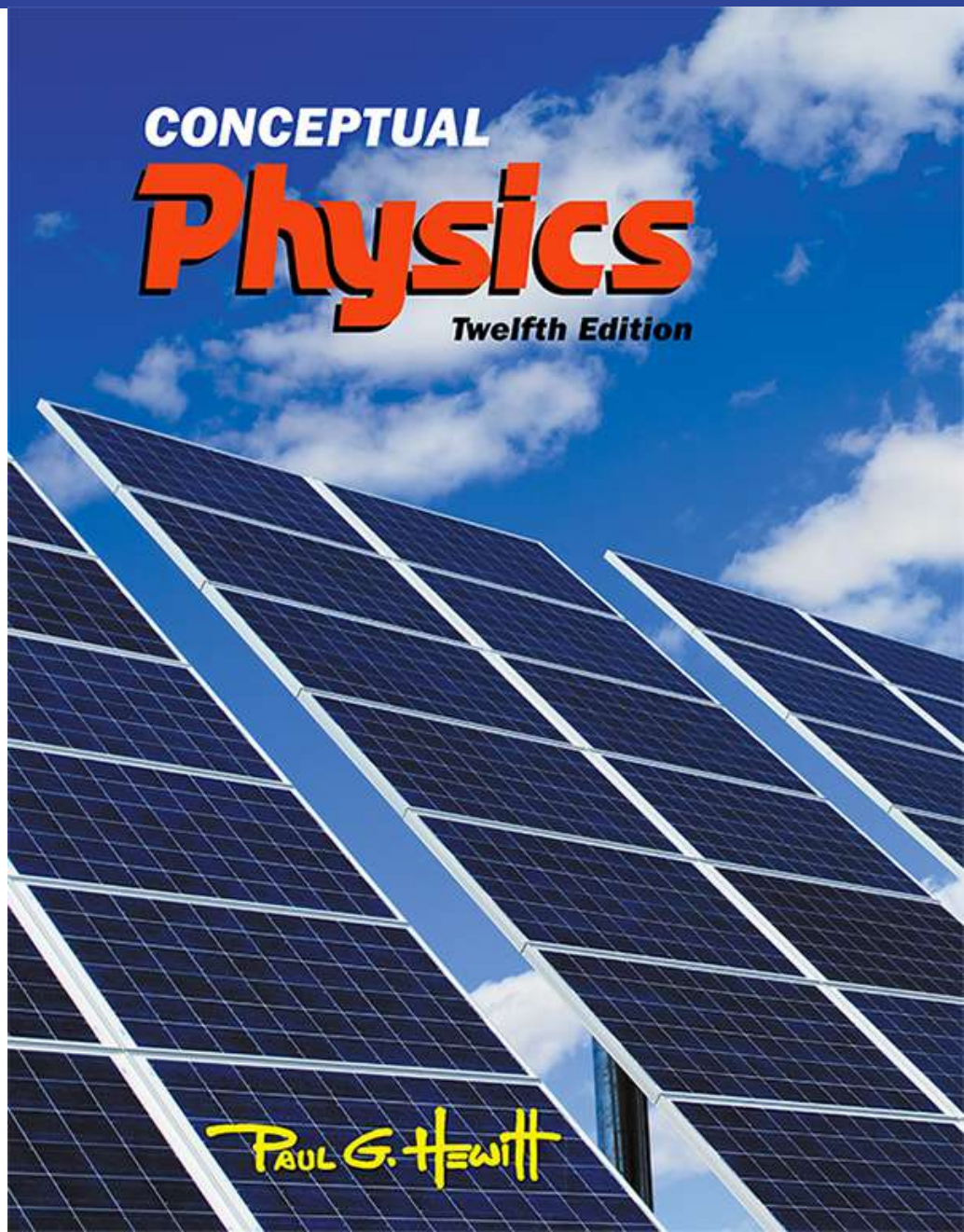
Lecture Outline

Chapter 7: Energy

Sources of Energy



Sources of Energy

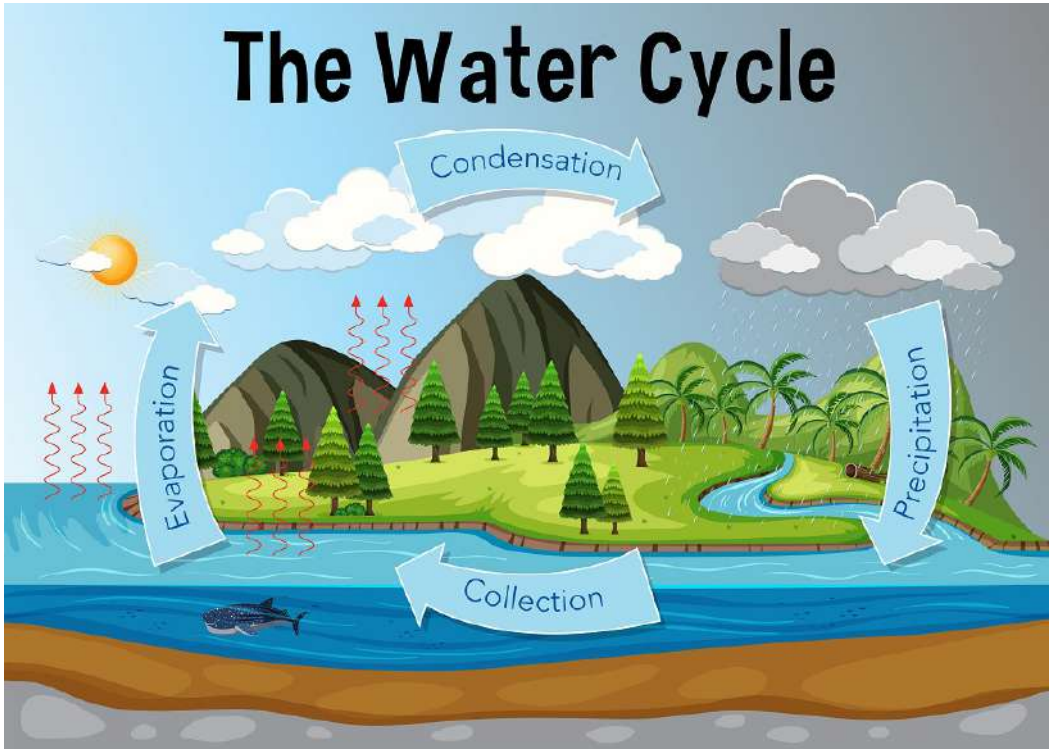
The water cycle:

Water evaporates.

It condenses and falls as rain.

Rain flows into rivers, then back to the sea.

The cycle repeats.



What provides the energy to do this?

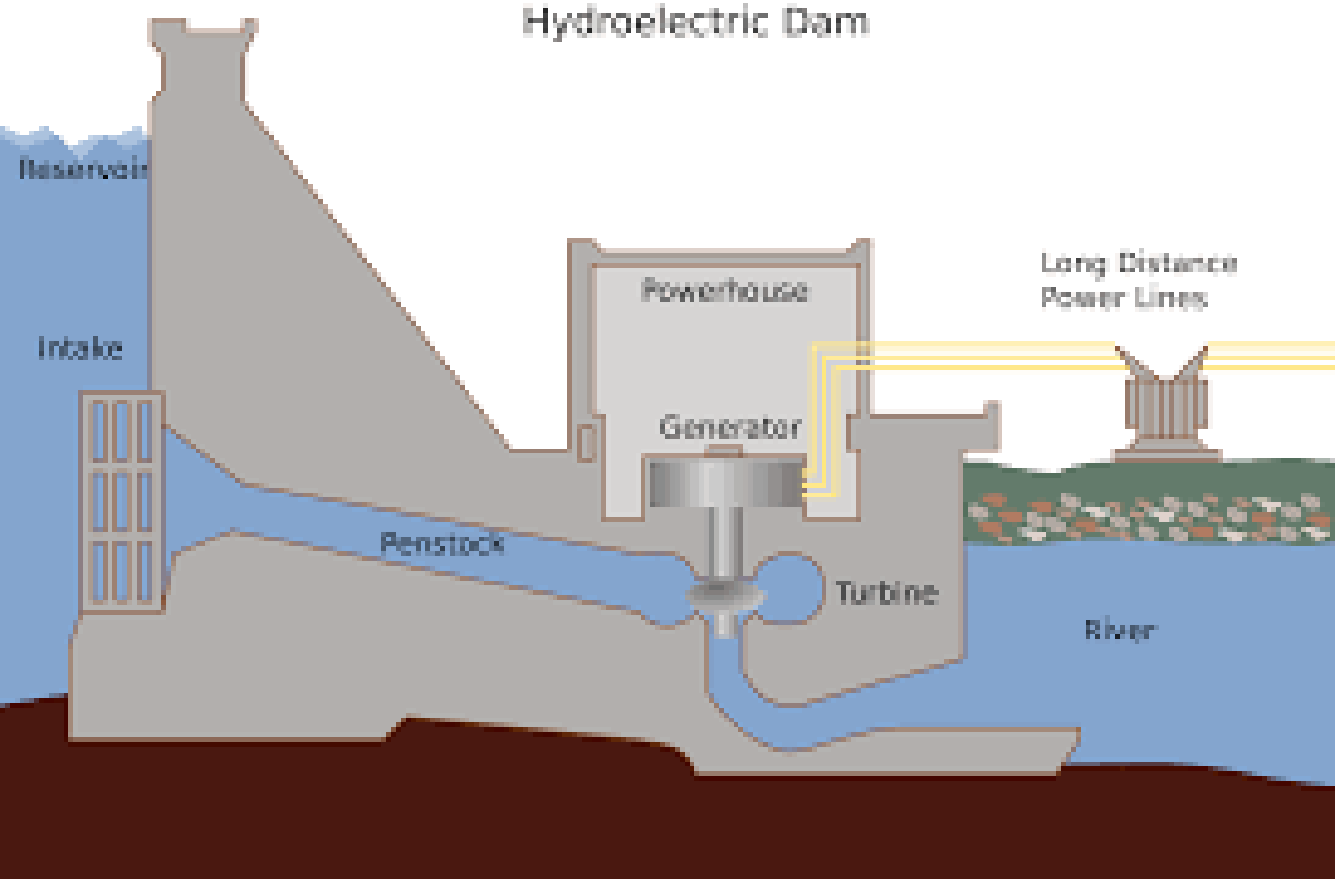
The Sun.

Solar Energy.

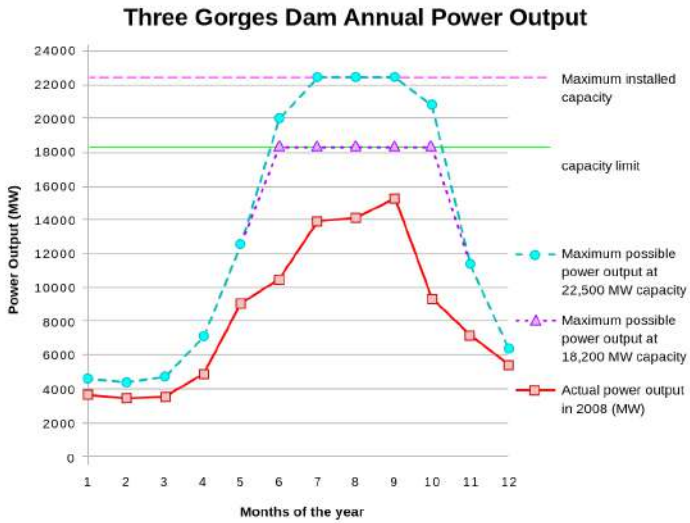
Hydroelectric energy:

Where does the energy come from?

Sun



3 Gorges Dam in China:

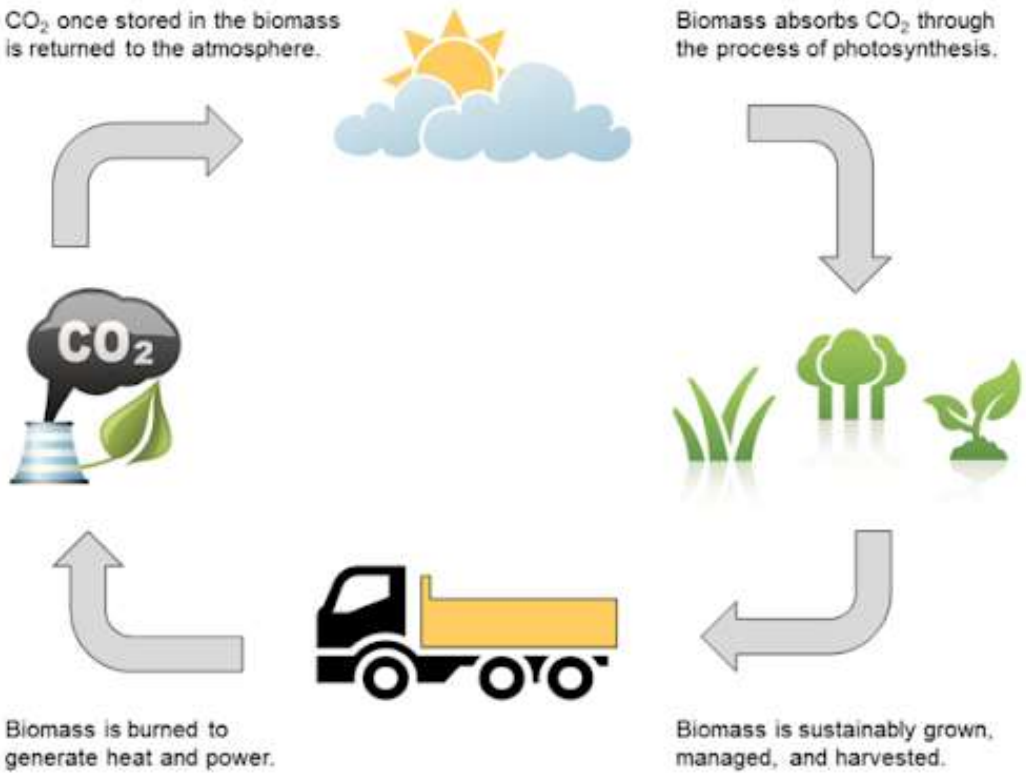


Why is the power output highest in months 7-8?

Most rain in June and July due to rain evaporation and condensation.

Biomass energy:

Where does the CO_2 go?



Photosynthesis

In the process of photosynthesis, plants convert radiant energy from the sun into chemical energy in the form of glucose—or sugar.

(water)		(carbon dioxide)		(sunlight)		(glucose)		(oxygen)
$6\,H_2O$	+	$6\,CO_2$	+	radiant energy	→	$C_6H_{12}O_6$	+	$6\,O_2$

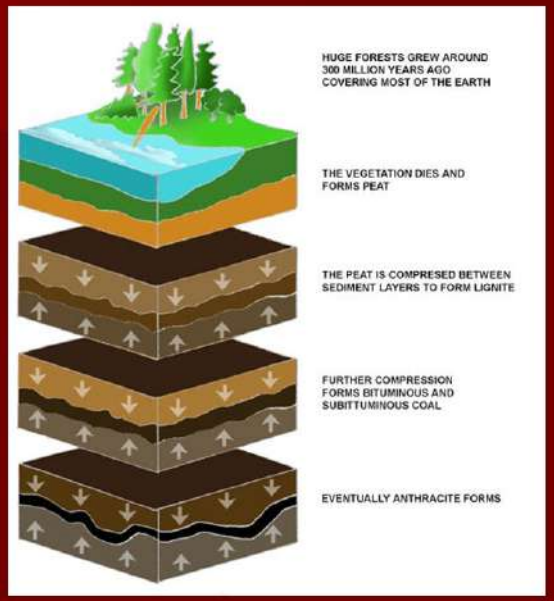
solar energy

Fossil fuels – Old energy from the sun

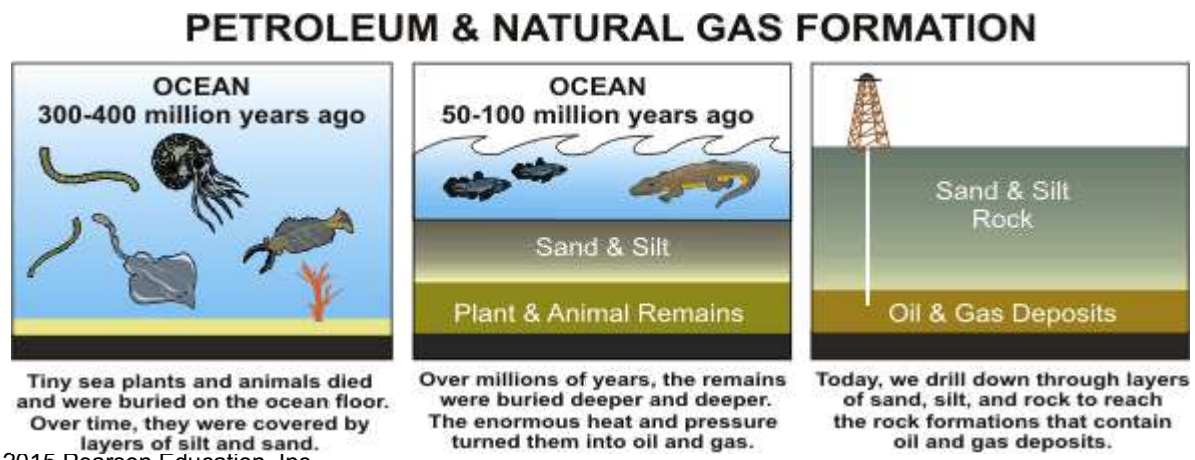
Normally, when a plant dies it decomposes. If there is not enough oxygen, it can't completely decompose, thus we get a slow accumulation of energy.

In a swamp, the bacteria that decompose the plants also use up the oxygen.

Coal found today formed between 1 and 440 million years ago.



Why are fossil fuels called "nonrenewable?"

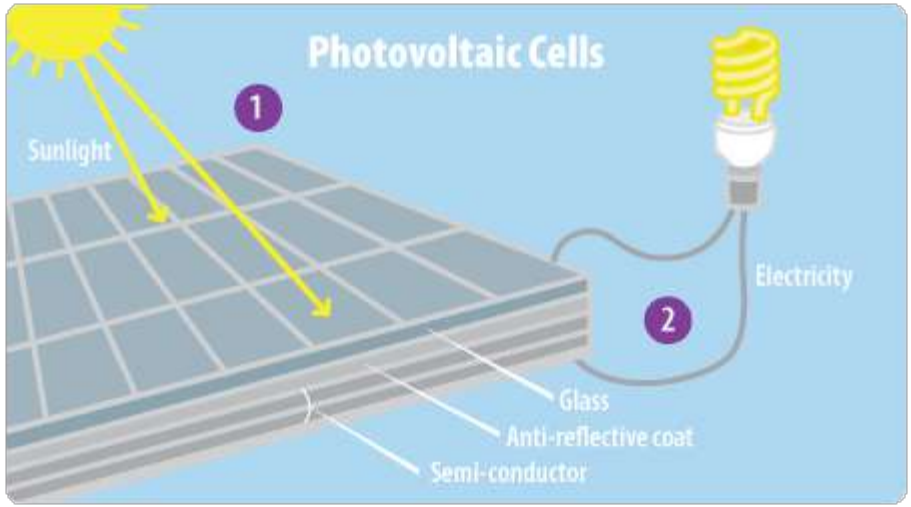


Sources of Energy, Continued

- Sources of energy
  - Sun
    - Example:
      - Photovoltaic cells on rooftops catch the solar energy and convert it to electricity.

- More energy from the Sun hits Earth in 1 hour than all of the energy consumed by humans in an entire year!

Photovoltaic cells and flexible power sheets directly convert sunlight energy into electricity:

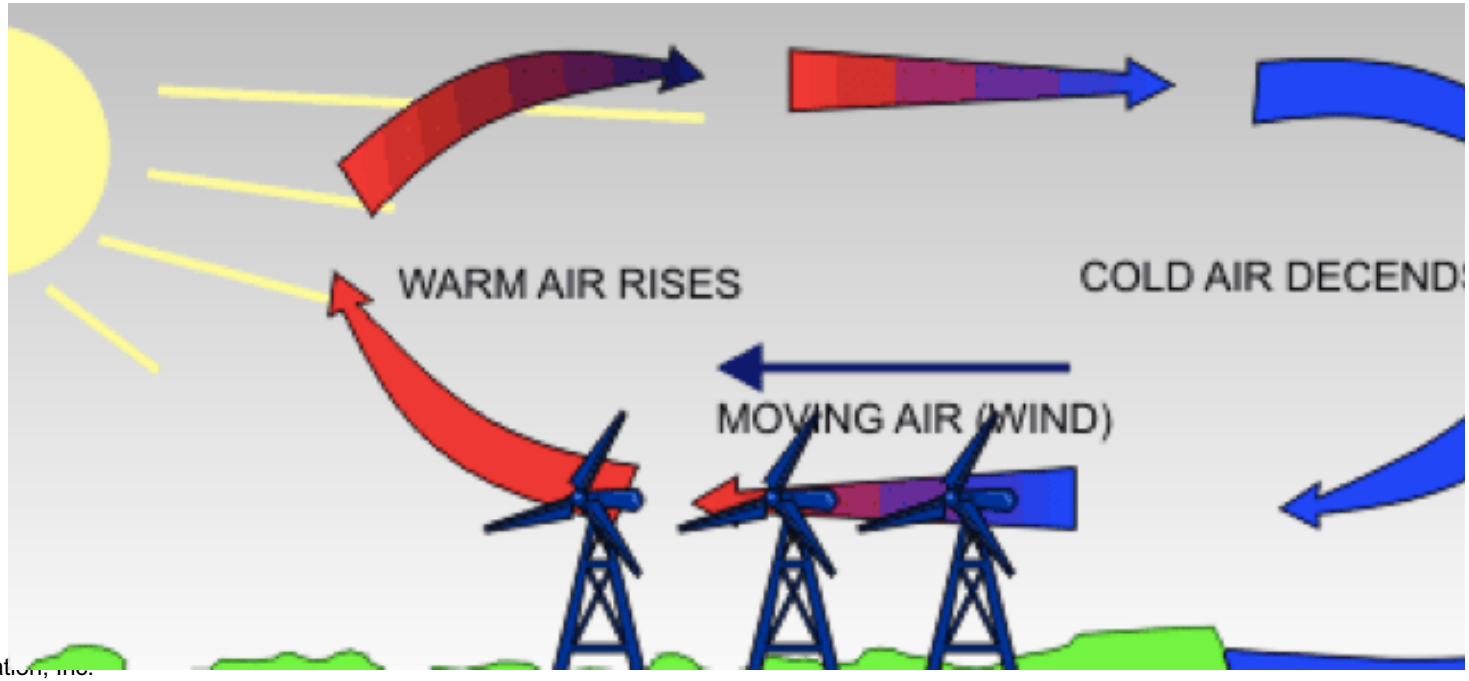


Solar: Using mirrors to focus sunlight:

- Crescent Dunes Solar Array: 10,000 mirrors to heat salt to boil water…

What powers the wind?

The Sun!

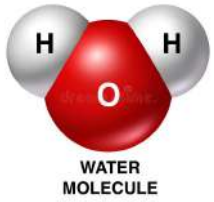


Sources of Energy, Hydrogen

- Electrolysis: The separation of water H_2O into hydrogen gas H_2 and oxygen gas O_2:

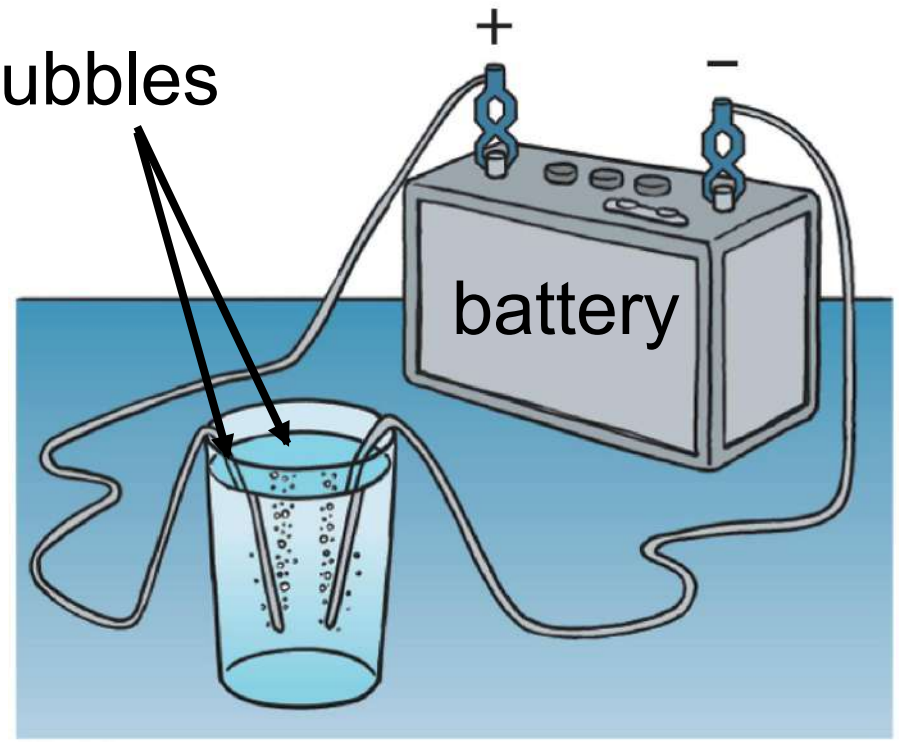
Why is more H_2 gas produced than O_2 gas?

H_2O



$2H_2O$ + energy → $2H_2$ + O_2

Where does the energy come from?



Hydrogen is the least polluting of all fuels:

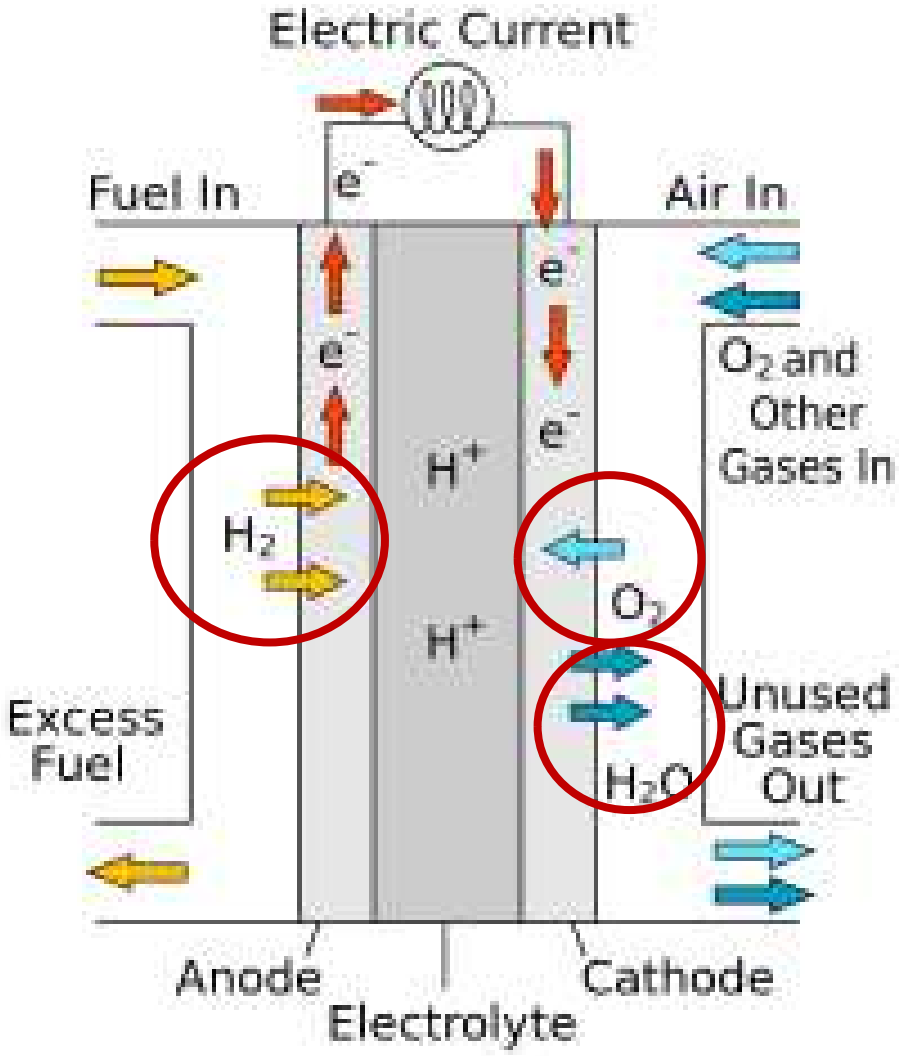
Hydrogen Fuel cell

Runs opposite to the electrolysis.

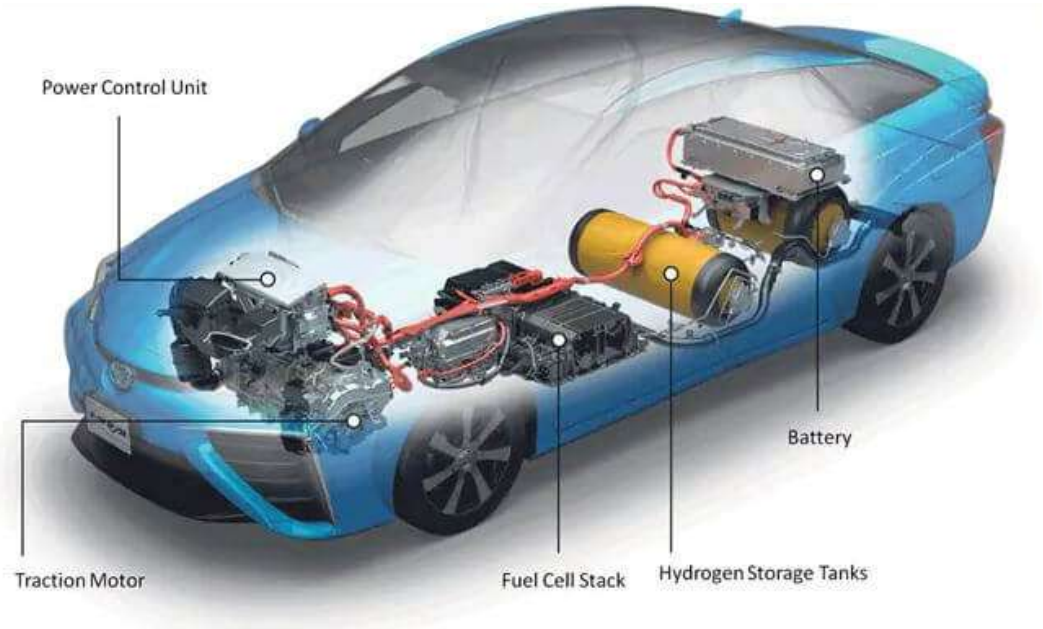
$2H_2 + O_2 \rightarrow 2H_2O$ + energy

In a fuel cell, hydrogen and oxygen are compressed at electrodes and electric current is produced at electrodes.

Is hydrogen a source of energy or a way of storing energy? way of storing

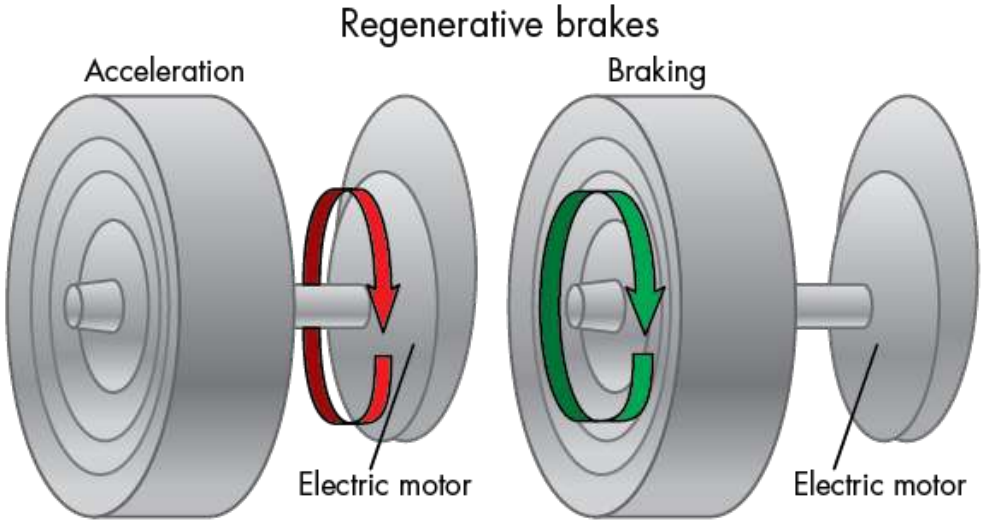


Fuel cells in a car:



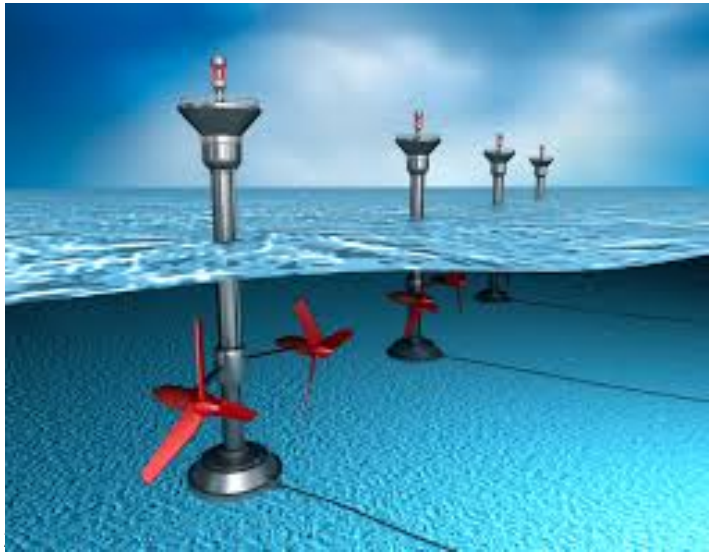
Traction motors can use regenerative braking:

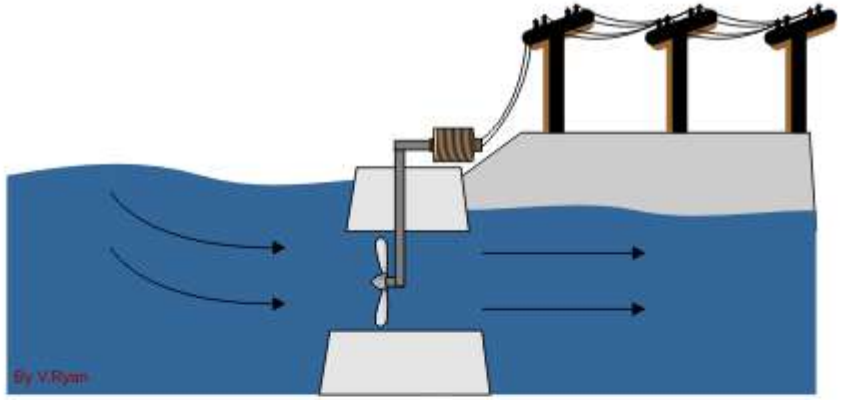
During braking, the electric motor works as a generator. It sends energy back to the battery.



Tidal Power: As tides come and go….

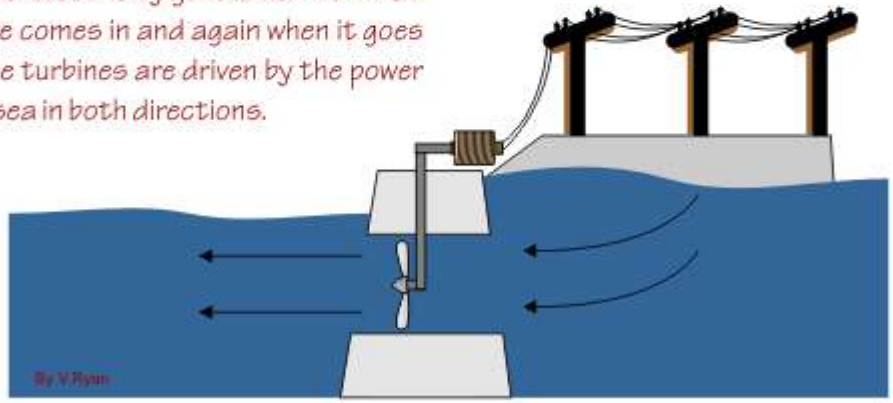
- Water has KE.
- It does **work** on the turbine blades.
- This generates electric energy.





TIDE COMING IN

This tidal electricity generation works as the tide comes in and again when it goes out. The turbines are driven by the power of the sea in both directions.



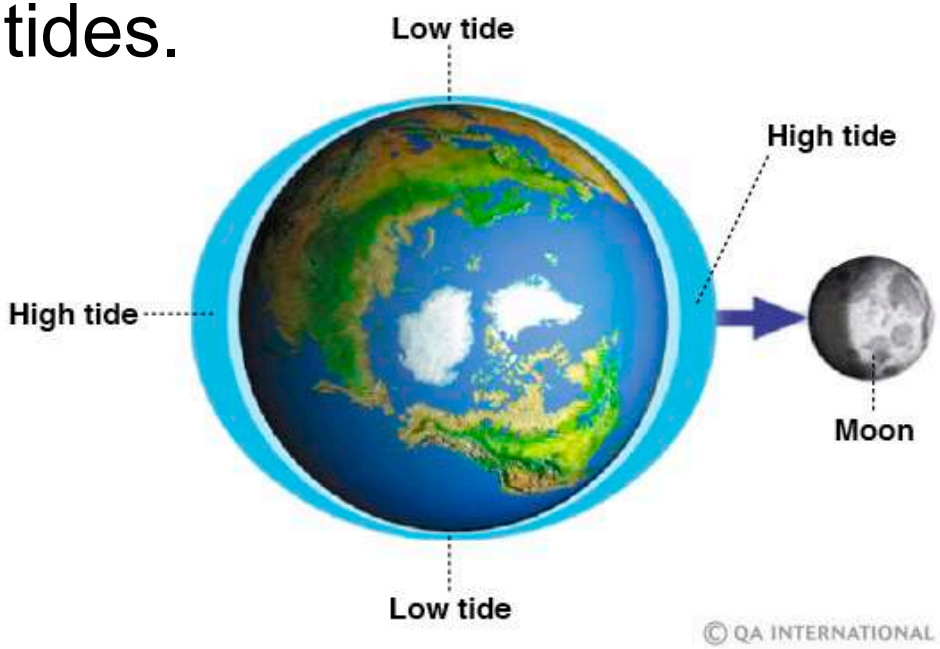
TIDE GOING OUT

Where do tides get their energy?

The Moon's gravity stretches out Earth's oceans. Earth rotates. A place on Earth rotates into and out of high and low tides.

How much time between high and low tides?

¼ day = 6 hours



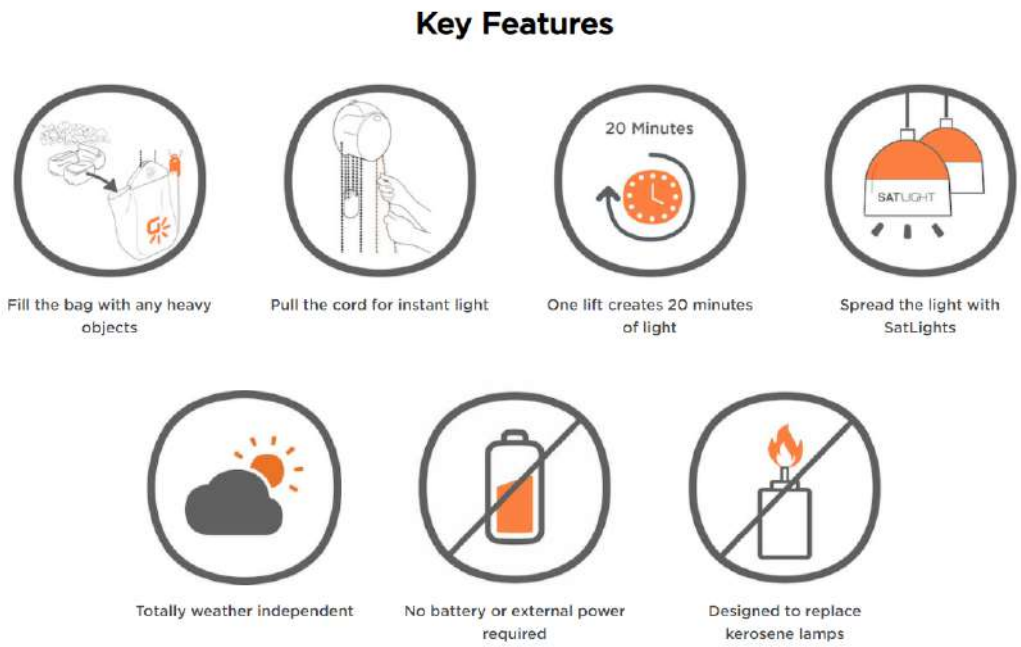
The energy of the tides comes from the *rotational* energy of Earth.

Tides comes in different shapes and sizes:

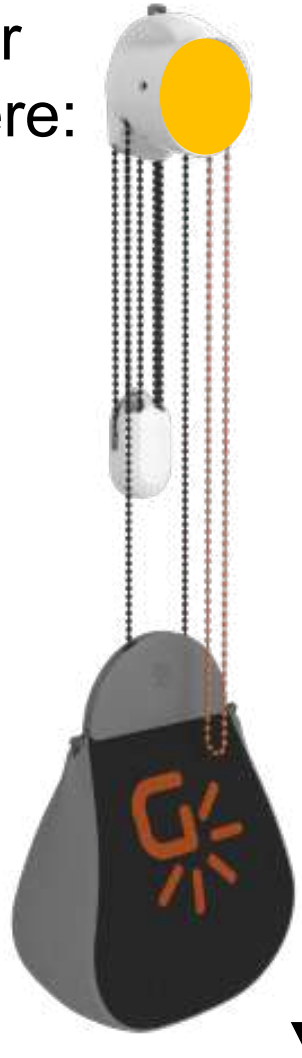
- Typical tides:

- Extreme tides:

Gravity light:



turns a generator inside here:



that lights a light

bag full of rocks falls

What kind of energy is converted to electrical, and then to light energy?

gravitational PE

Sources of Energy, Continued-2

- Concentrated energy
  - Nuclear power
    - stored in the nucleus of uranium and plutonium atoms
    - → little fossil fuel emissions

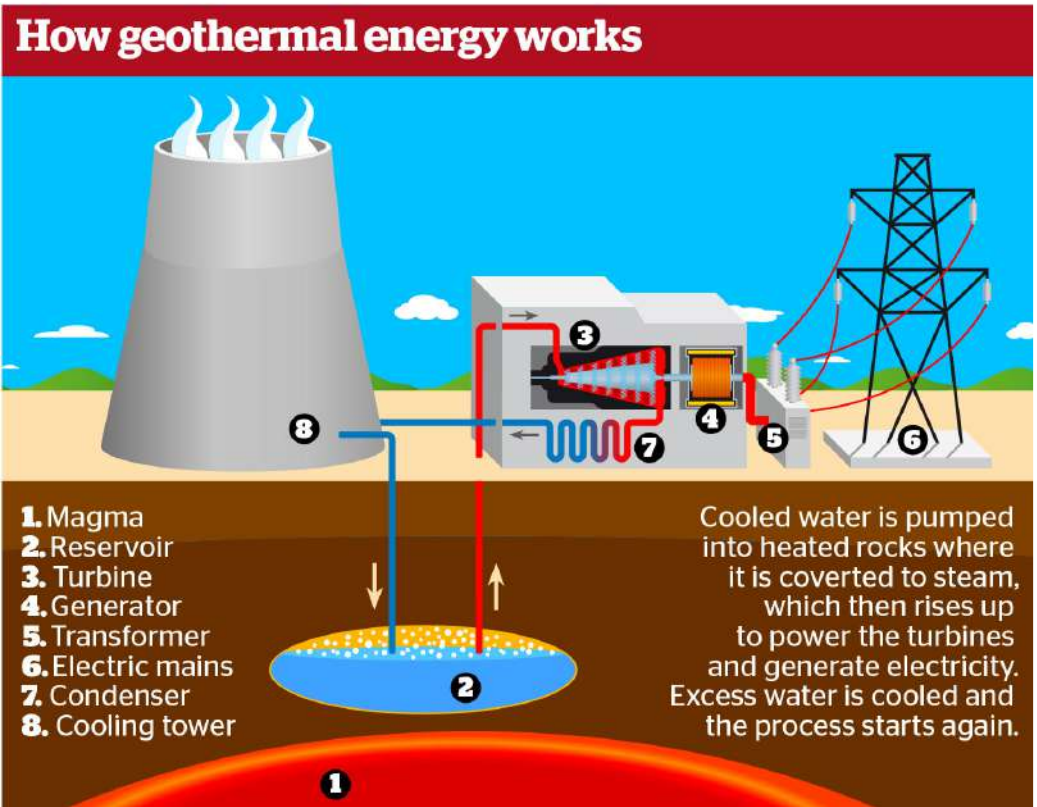
- Monticello nuke plant

- Prairie Island:

Sources of Energy, Continued-2

Nuclear power

- by-product is geothermal energy
  - held in underground reservoirs of hot water to provide steam that can drive turbogenerators



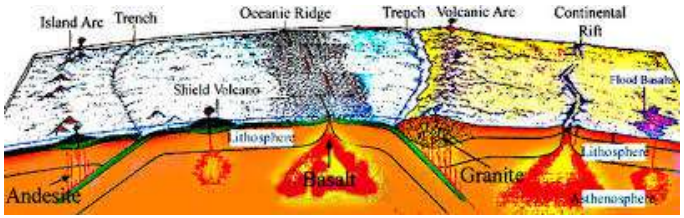


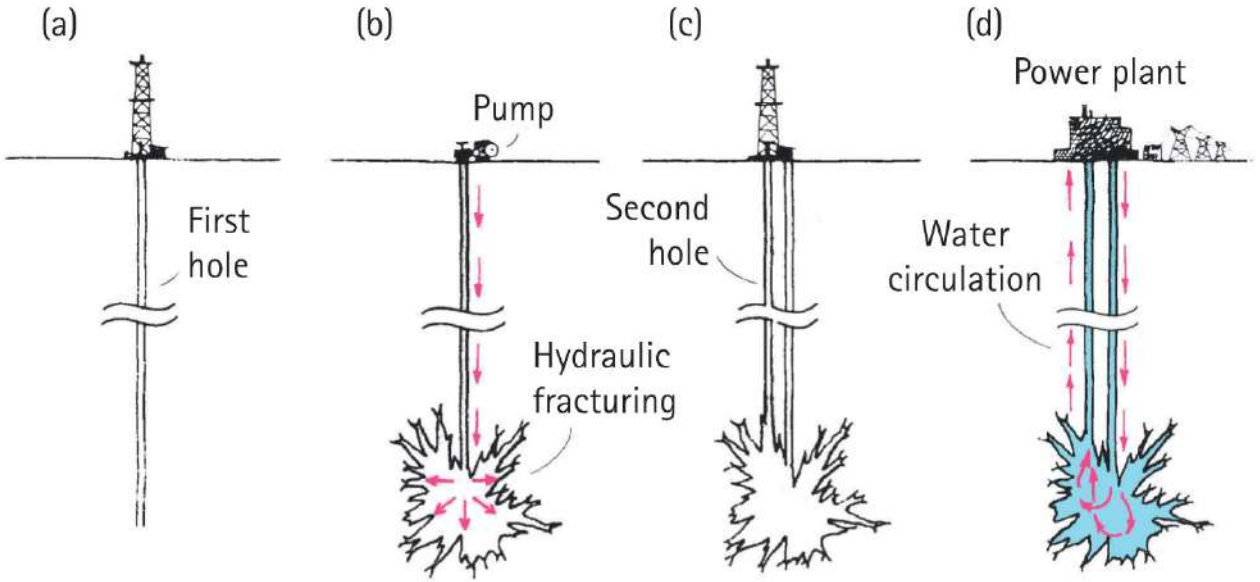
Plate tectonics:

Driven by the radioactive decay of atoms: **nuclear energy**

Dry-rock geothermal power

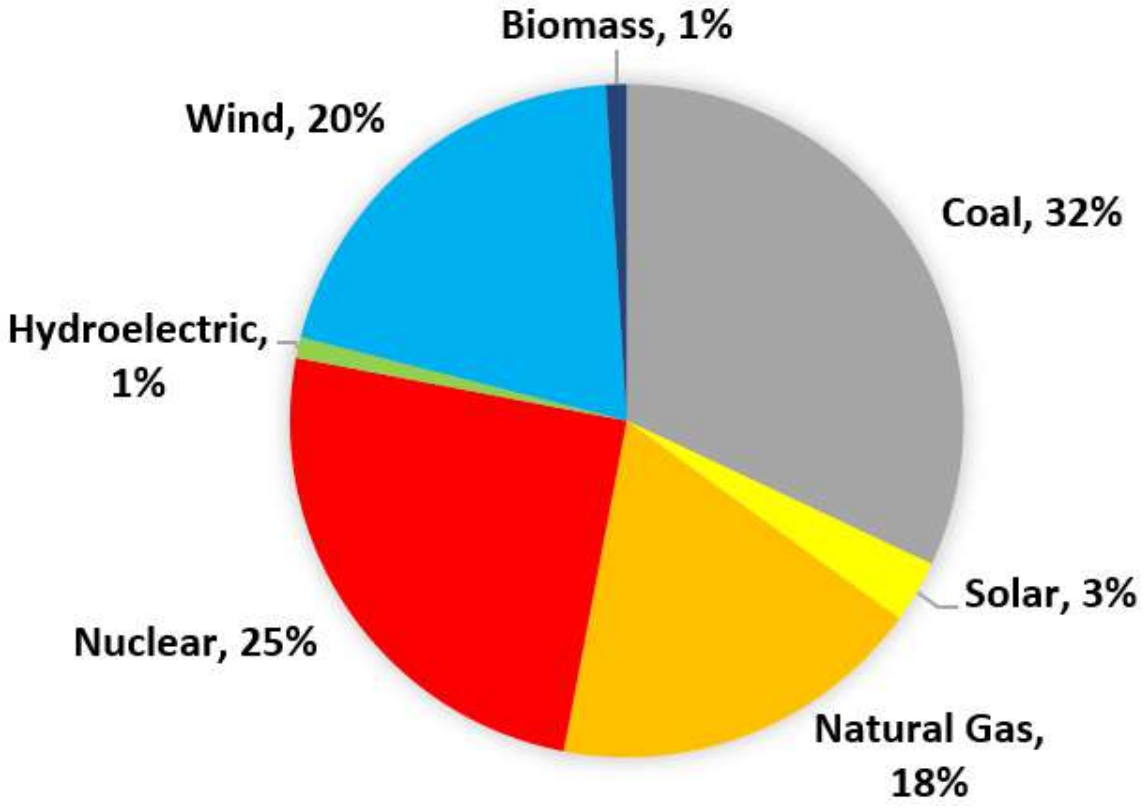
-- Water is put into cavities in deep, dry, hot rock.

- Water turns to steam
- It is piped to a turbine at the surface.
- The turbine generates electricity.
- After exiting the turbine, it is returned to the cavity for reuse.



MINNESOTA GENERATION SOURCE 2019

U.S. Energy Information Administration



What percentage is fossil fuel?

coal 32%
gas 18%

fossil 50%

What percentage is either directly or indirectly from the Sun?

solar 3%

coal 32%
gas 18%

biomass 1%
wind 18%
hydro 1%

total solar: 73%

Questions:

23. What is the ultimate source of energy for fossil fuels, dams, and windmills?

Sun

24. What is the ultimate source of geothermal energy?

nuclear decay

25. Can we correctly say that hydrogen is a new source of energy?

no

Why or why not?

it is a way to transfer energy

Test Tomorrow on Chapter 7 plus a few questions from old chapters.

Homework:
Study old homework.
Get old assignments turned in.