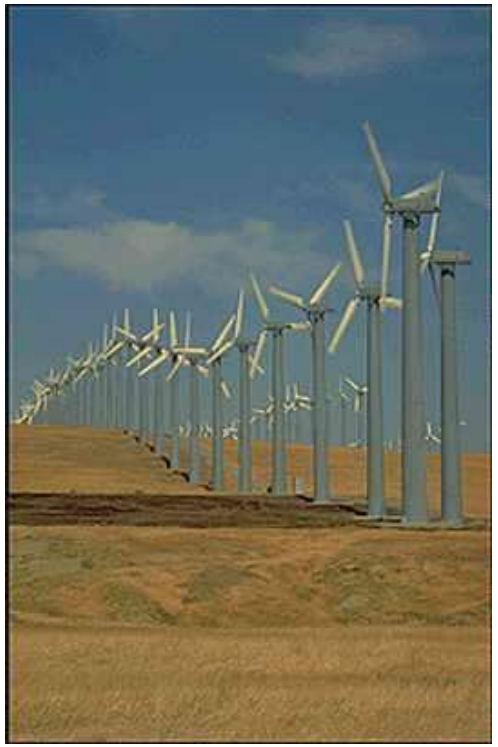
Energy Sources



Define the following terms:

Non-renewable – **Resources that can not be replenished**

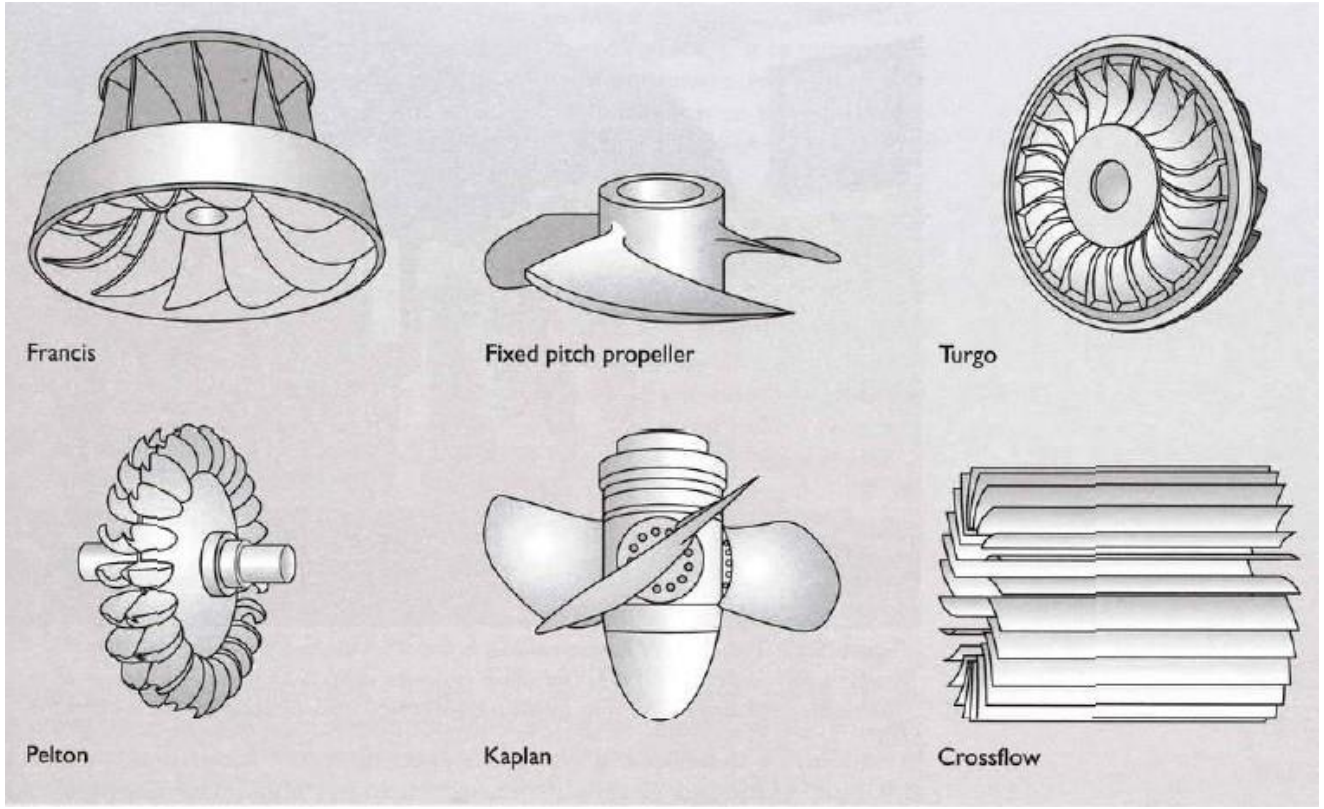
Renewable – **Resources that can be replenished**

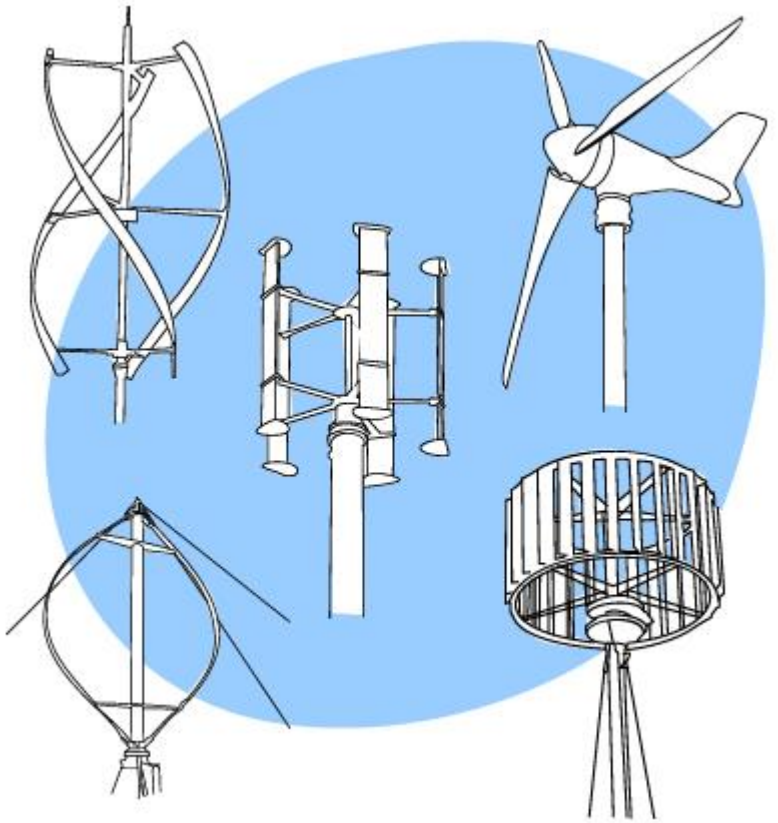
Sustainable use – **Using resources at a responsible conservative rate**

Clean energy – **Energy sources that do not produce greenhouse gas and air pollution**

Turbine – **part of a generating unit which spins by the force of water or steam to drive an electric generator**

Types of Turbines

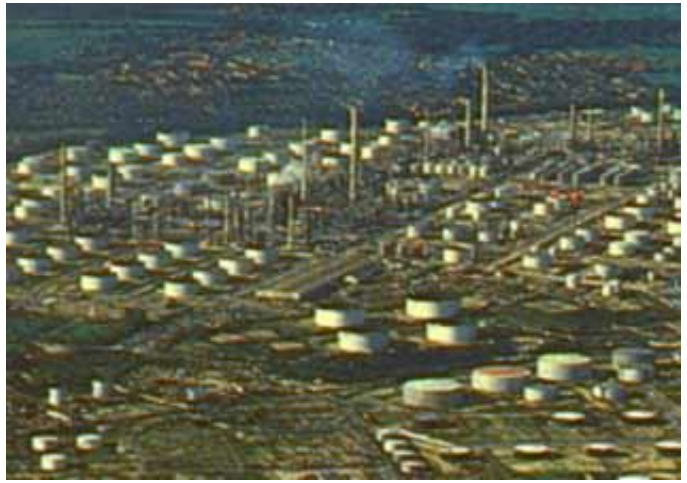




Steps for Generating Electricity

Video - Generating Electricity

Burn _fuel_ → heat water to make _steam_ → steam turns a _turbine_ → turbine turns a _generator_ → electrical power sent around the country

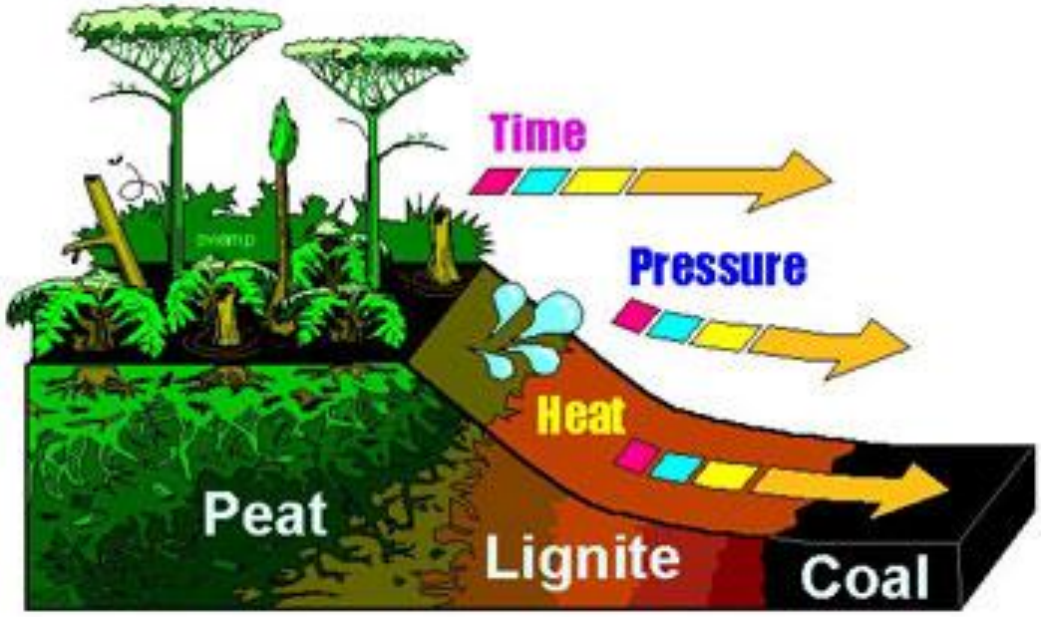


- Coal is crushed to a fine dust and burned.
- Oil and gas can be burned directly.

Fossil Fuel Energy Sources

(Non-renewable)

- formed from the fossilized remains of prehistoric plants and animals
- provide around 66% of the world's electrical power, and 95% of the world's total energy demands



Coal provides 28% of our energy, oil provides 40%.

Crude oil (called "petroleum") is easier to get out of the ground than coal, as it can flow along pipes. This also makes it cheaper to transport.

Natural gas provides around 20% of the world's consumption of energy

Advantages of Using Fossil Fuels

- Found in many places
- Easy to transport (pipelines, ship, rail)
- Relatively cheap

Disadvantages of Burning Fossil Fuels

- **Produces CO_2, a greenhouse gas, which contributes to global warming**
- **Produces sulfur dioxide, a gas that contributes to acid rain**
- **Oil spills harm ecosystems**
- **Mining coal can be difficult and dangerous**
- **Hydraulic Fracturing ("fracking"), a high pressure drilling technique to recover gas from shale rock, requires the use of large quantities of water**
- **Destroys landscape**
- **Limited supply**

Is it Renewable?

Fossil fuels are NOT a renewable energy resource

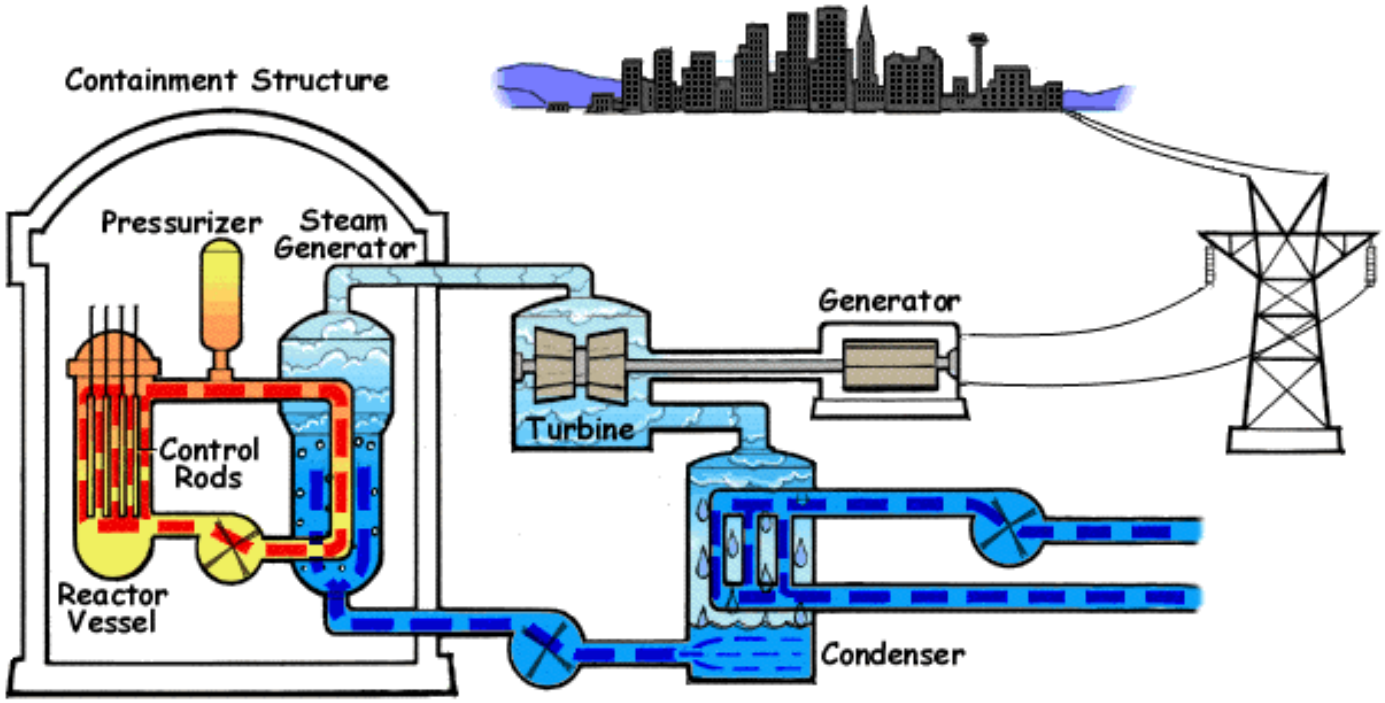
- Once we've burned them all, there aren't any more
- Our consumption of fossil fuels has nearly doubled every 20 years since 1900.
- This is a particular problem for oil, because we also use it to make plastics and other products.

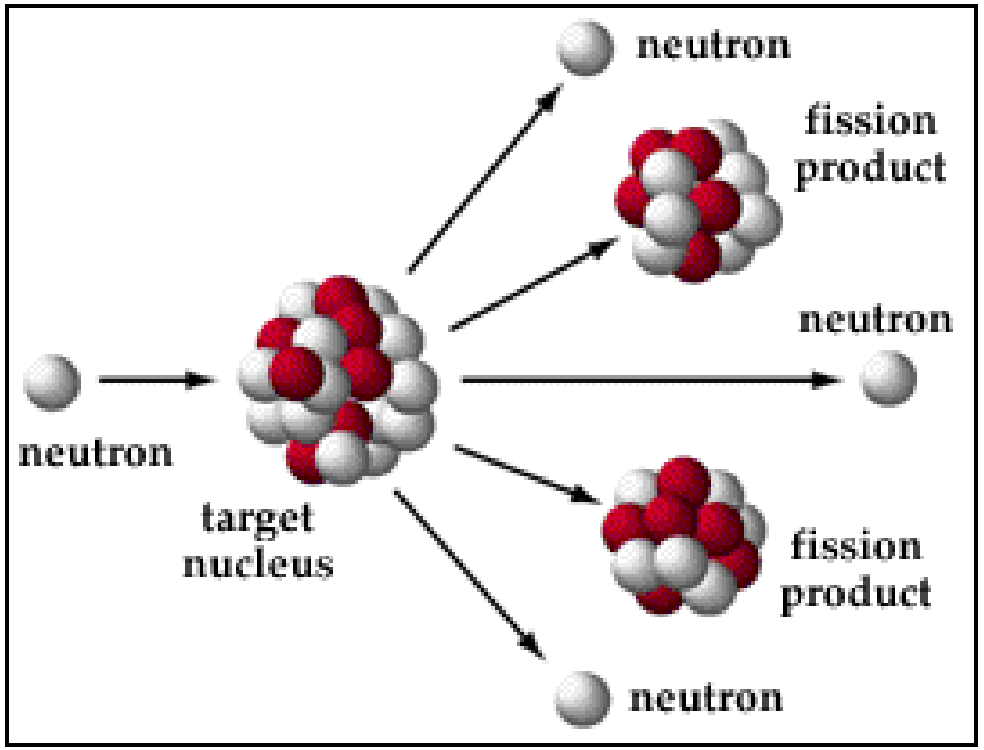
Nuclear Power

- generated using Uranium, a metal mined in various parts of the world
- produces lots of energy from small amounts of fuel, without the pollution that you'd get from burning fossil fuels

How Nuclear Power Works

Nuclear fission makes heat → heated water makes steam → steam turns turbines → turbines turn generators → electrical power is sent around the country

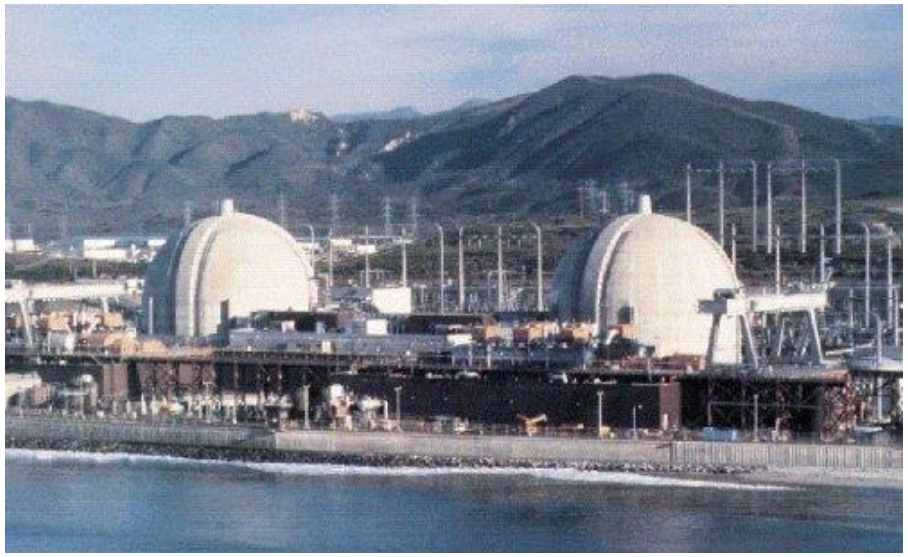




- The reactor uses Uranium rods as fuel, and the heat is generated by **nuclear fission** (splitting an atom).
- Neutrons smash into the nucleus of the uranium atoms, which split roughly in half and release energy in the form of heat.

Advantages to Using Nuclear Power

- Costs about the same as coal, so it's not expensive to make
- Does not produce smoke or carbon dioxide, so it does NOT contribute to global warming
- Produces huge amounts of energy from small amounts of fuel
- Produces small amounts of waste
- Nuclear power is reliable



Disadvantages of Nuclear Power

- Waste produced is very dangerous, radioactive
- It must be sealed up and buried for many years to contain the hazardous radioactivity
- Nuclear power plants may be targets for terrorist attack

Is it Renewable?

- **Nuclear energy from Uranium is NOT renewable.**

•Once we've dug up all the Earth's uranium and used it, there isn't any more.

What are some drawbacks of using **renewable** forms of energy (ex. solar power)?

- Expensive
- Difficult to maintain
- It may eliminate jobs in fossil fuels
- Availability & distribution problems

POSITIVES?

- Can create new jobs!
- Can help decrease emissions and lessen air pollution
- Can help decrease carbon dioxide levels reducing global warming

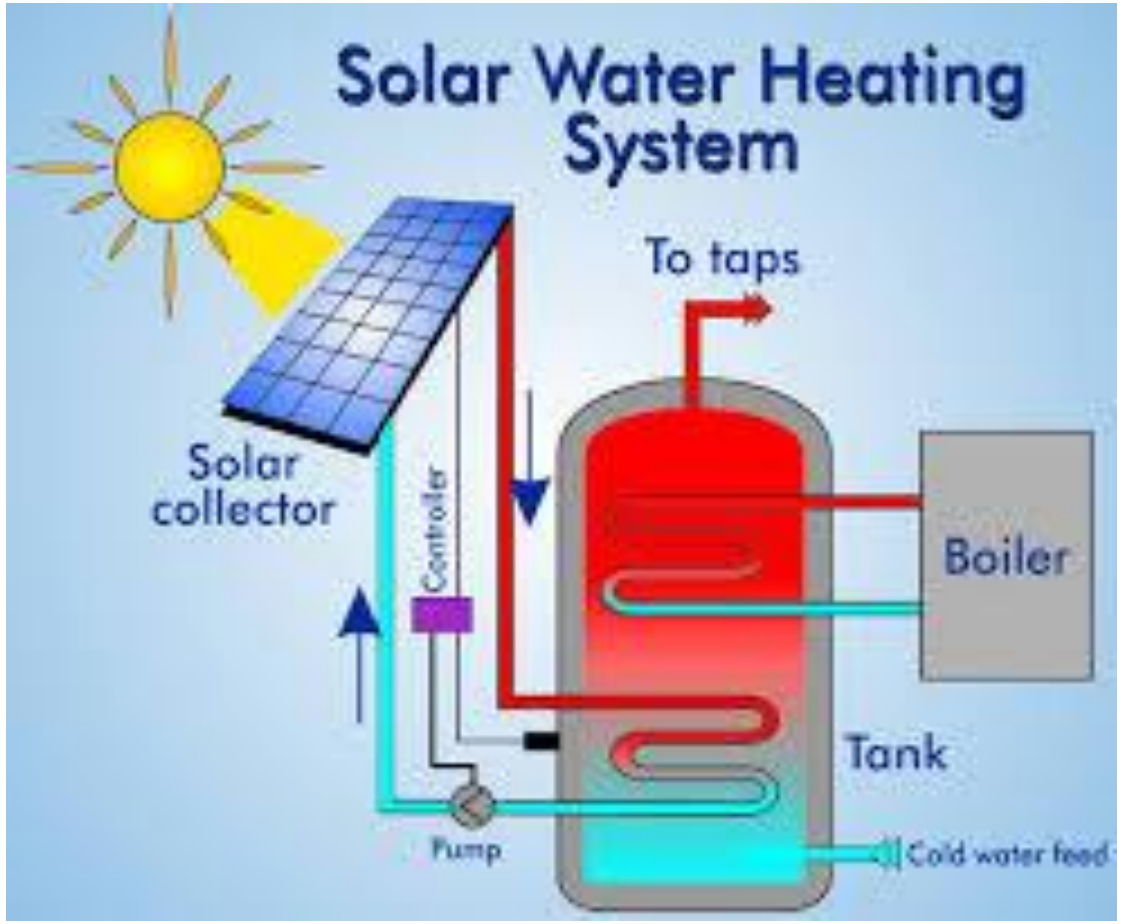
Solar Power

- **Solar Cells** (“photovoltaic” or "photoelectric" cells) convert light directly into electricity.

- In a sunny climate, you can get enough power to run a 100W light bulb from just one square meter of solar panel.

Solar Water Heating

- heat from the Sun is used to heat water
- Useful in places like California and Australia, that get lots of sunshine.



Solar Furnaces

- use a huge array of mirrors to concentrate the Sun's energy into a small space and produce very high temperatures.

Advantages of Solar Power

- Energy is free - needs no fuel
- Produces no waste or pollution
- Can get electricity to a remote place (if sunny)
- Low-power uses such as solar powered garden lights and battery chargers

Disadvantages of Solar Power

- Doesn't work at night
- Very expensive
- Can be unreliable unless you're in a very sunny climate

Is Solar Power Renewable?

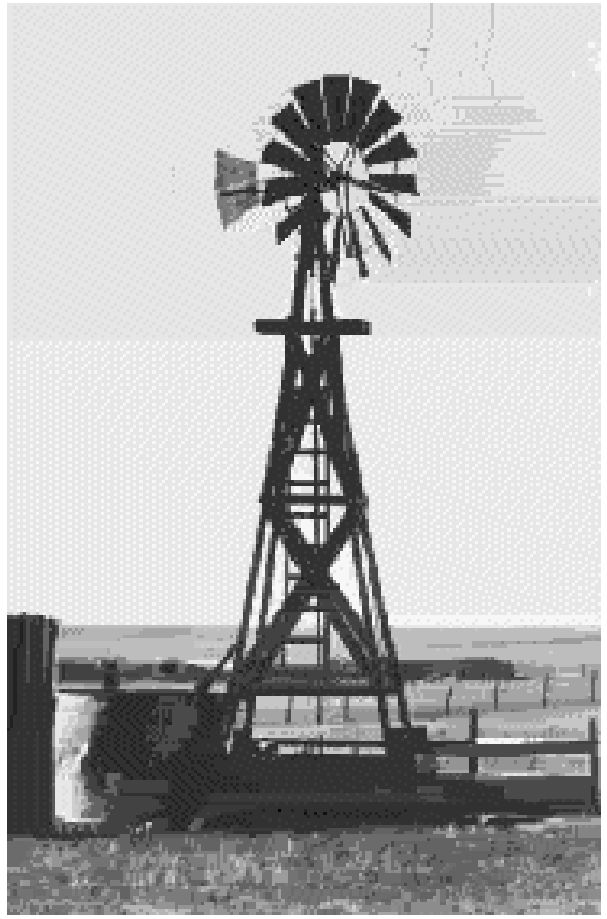
- **Solar power is renewable.**

•The Sun will keep on shining anyway, so it makes sense to use it.

Wind Power

We've used the wind as an energy source for a long time. The Babylonians and Chinese were using wind power to pump water for irrigating crops 4,000 years ago, and sailing boats were around long before that.

- Wind power was used in the Middle Ages, in Europe, to grind corn, which is where the term "windmill" comes from.



Video - New Wind Turbine Powers Hydrogen Car (Long Island)

How Wind Power Works

- The Sun heats our atmosphere unevenly, so some patches become warmer than others.
- These warm patches of air rise, other air blows in to replace them - and we feel a wind blowing.
- We can use the energy in the wind by building a tall tower, with a large propeller on the top

Advantages of Wind power

- wind is free, wind farms need no fuel
- no waste or greenhouse gases
- land beneath can still be used for farming
- wind farms can be tourist attractions
- can supply energy to remote areas

Disadvantages of Wind Power

- Not always predictable / available
- Most suitable areas for wind farms are often near the coast, where land is expensive
- Unsightly to aesthetic views
- Can kill birds - migrating flocks tend to like strong winds. Splat!
- Can affect television reception
- Noisy. A wind generator makes a constant, low, "swooshing" noise day and night.

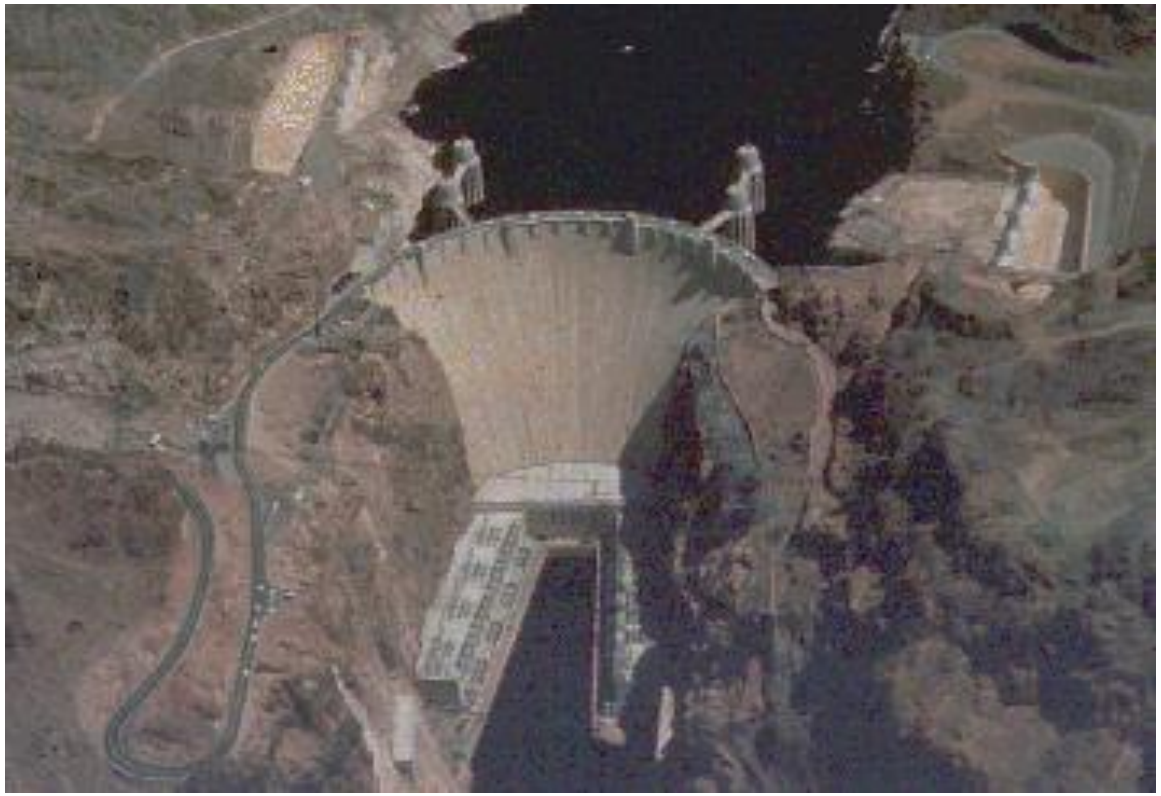
Is Wind Power Renewable?

- **Wind power is renewable.**

•Wind will keep on blowing, it makes sense to use it.

Hydroelectricity

- A dam is built to trap water, usually in a valley where there is an existing lake.
- Water is allowed to flow through tunnels in the dam, to turn turbines and thus drive generators.
- Hydro-electricity provides 20% of the world's power



Advantages of Hydroelectricity

- Once the dam is built, the energy is virtually free
- No waste or pollution produced
- More reliable than wind, solar or wave power
- Water can be stored above the dam ready to cope with peaks in demand
- Hydro-electric power stations can increase to full power very quickly, unlike other power stations
- Electricity can be generated constantly

Disadvantages to Hydro-electricity

- Dams are expensive to build
- Leads to flooding upstream, disrupting habitats
- Finding a suitable site can be difficult - the impact on residents and the environment may be unacceptable.
- Water quality and quantity downstream can be affected, which can have an impact on plant life.

Is it Renewable?

- **Hydro-electric power is renewable.**

Water travels in a cycle, evaporation, condensation, precipitation.

Tidal Power

(similar to Hydroelectricity)

- Tidal power works rather like a hydro-electric scheme, except that the dam is **much** bigger.
- A huge dam (called a "barrage") is built across a river estuary. When the tide goes in and out, the water flows through tunnels in the dam.
- The ebb and flow of the tides can be used to turn a turbine, or it can be used to push air through a pipe, which then turns a turbine. Large lock gates, like the ones used on canals, allow ships to pass

Advantages to Tidal Power

- Once you've built it, tidal power is free.
- It produces no greenhouse gases or other waste.
- It needs no fuel.
- It produces electricity reliably.
- Not expensive to maintain.
- Tides are totally predictable.

Disadvantages to Tidal Power

- Barrage across an estuary is very expensive to build
- Can alter the ecosystem
  - Ex. Many birds rely on the tide uncovering the mud flats so that they can feed.
- Very few suitable sites
- Only provides power for around 10 hours each day, when the tide is actually moving in or out.
- Underwater turbines can add thermal pollution

Is it Renewable?

- **Tidal energy is renewable.**

•The tides will continue to ebb and flow, and the energy is there for the taking.

Biomass

Video - Biodiesel

- Plant and animal waste is burned
- We can use rubbish, animal manure, woodchips, seaweed, corn stalks and other wastes

Ex. Sugar cane is harvested and taken to a mill, where it is crushed to extract the juice. The juice is used to make sugar, while the left-over pulp, called "bagasse" can be burned in a power station.

Advantages of Biomass

- Uses materials that are otherwise waste
- Fuel tends to be cheap
- Less demand on the Earth's non-renewable resources

Disadvantages to Using Biomass

- Collecting the waste in sufficient quantities can be difficult
- Burning releases greenhouse gases
- Some waste materials are not available all year round
- Growth of crops for burning instead of food sources is wasteful

Is It Renewable?

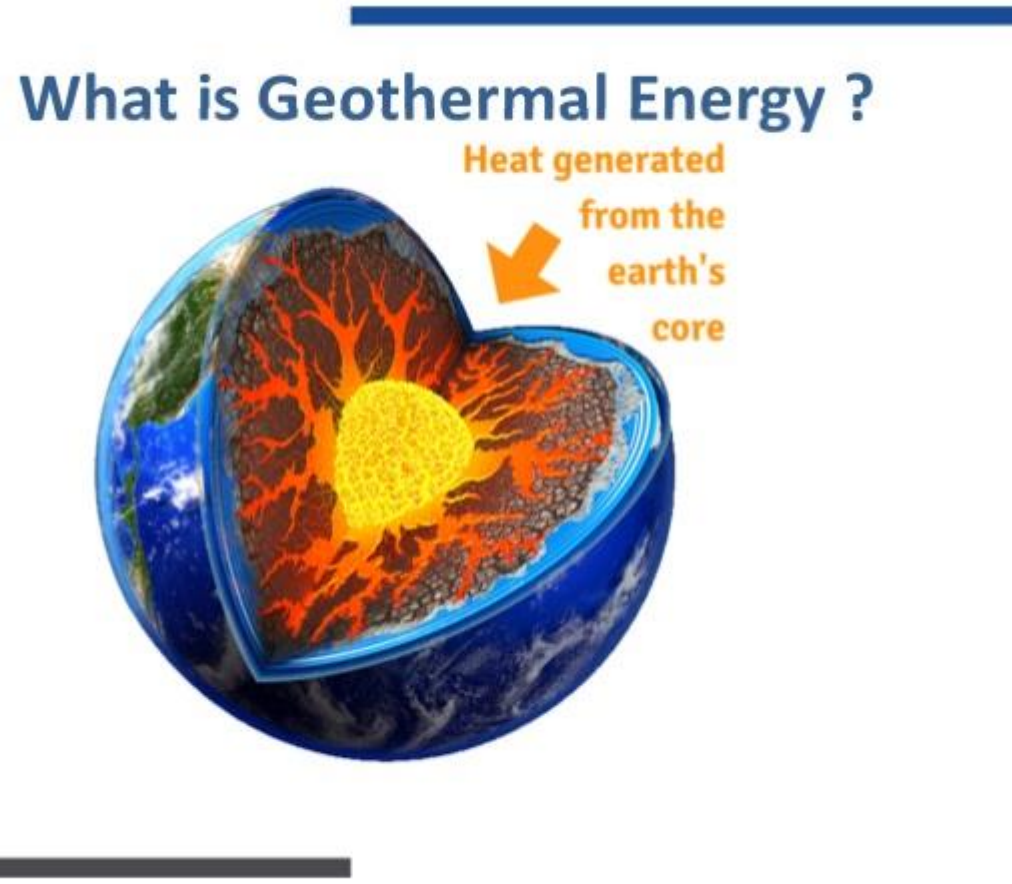
- **Biomass is renewable**

•We will always make waste products.
We can always plant & grow more sugar cane and more trees, so those are renewable too.

Geothermal Power

- Hot rocks underground heat water to produce steam.
- We drill down to the hot region, releasing steam, used to spin turbines, which drive electric generators.

- There may be natural "groundwater" in the hot rocks anyway, or we may need to drill more holes and pump water down to them.

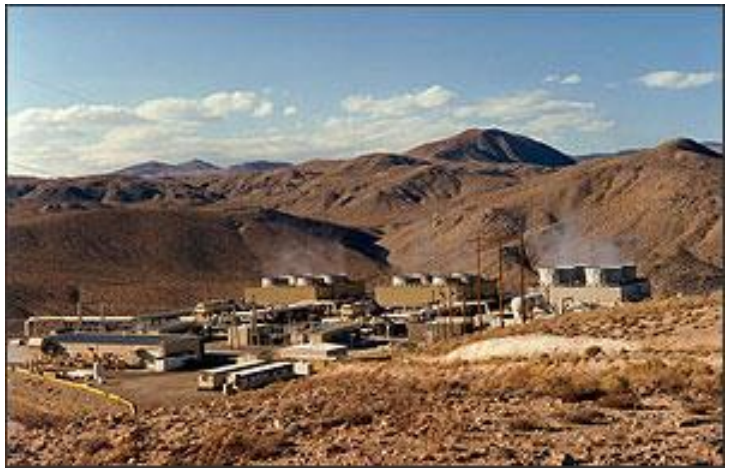


Advantages to Geothermal Power

- No pollution, no greenhouse gases
- No fuel is needed
- Once geothermal power station is built, the energy is almost free
- It may need a little energy to run a pump, but this can be taken from the energy being generated

Disadvantages to Geothermal Power

- Not widely available, need hot rocks of a suitable type, at a depth where we can drill down to them. The type of rock above is also important, it must be of a type that we can easily drill through.
- Sometimes a geothermal site may "run out of steam", perhaps for decades.
- Hazardous gases and minerals may come up from underground, and can be difficult to safely dispose of.



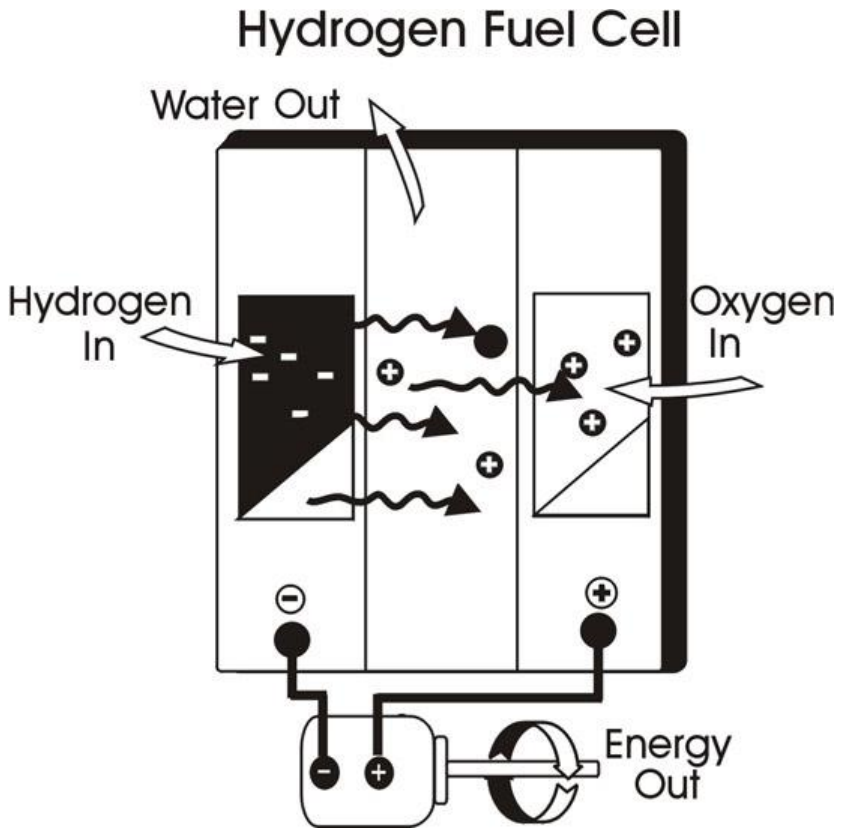
Is it Renewable?

- **Geothermal energy is renewable.**

•The energy keeps on coming, as long as we don't pump too much cold water down and cool the rocks too much.

Hydrogen Fuel

- Colorless odorless gas, found in combination with other elements, must be separated to use as energy
- Can be made by applying electric current to separate water



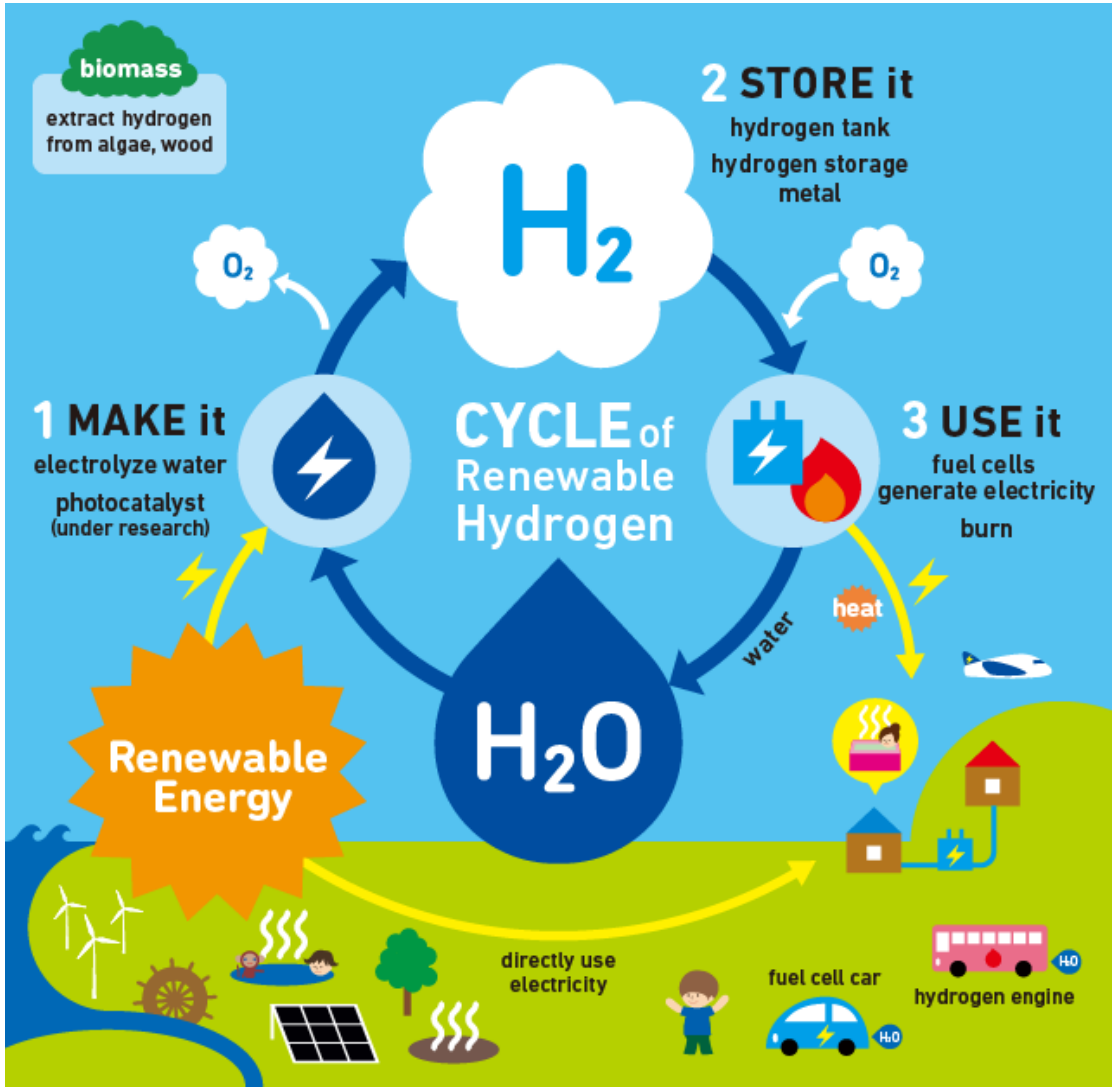
Advantages to Hydrogen Fuel

- Almost pollution free (emits water)
- Reliable and quiet
- High in energy

Disadvantages to Hydrogen Fuel

- More expensive than other energy sources
- Little infrastructure to accommodate it
- Difficult to store and distribute
- Extracting Hydrogen may require fossil fuels

Is it Renewable?



- **Hydrogen Fuel is renewable.**

•Hydrogen is found in 75% of the mass of the universe