

## 1.6 Energy resources

We require energy resources to provide us with electricity, to heat our homes, and to power our vehicles.

World energy resources can be divided into:

- fossil fuels – coal, crude oil, natural gas
- nuclear – uranium (extracted from rocks)
- renewables – wind, wave, tidal, geothermal, solar, hydroelectric, biomass

Fossil fuels are formed from the fossilised remains of plants and animals that lived millions of years ago. As they take millions of years to form, they are non-renewable. Once we have used them up, they can't be replaced.

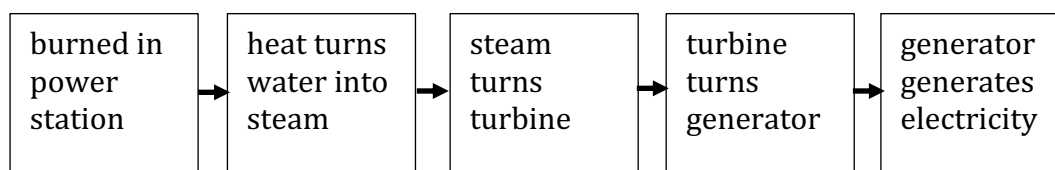
Uranium is extracted from uranium rich rocks. Considerable amounts of energy can be extracted (through nuclear fission) from a small amount of uranium. This means that not much uranium is required to produce a lot of energy (it is 'energy dense'). Although uranium is non-renewable, there are plentiful supplies.

Renewable energy is limitless. However, some of the renewable energy resources are unreliable.

### The fossil fuels

Apart from the problem of fossil fuels running out (they are 'non-renewable'), they also release carbon dioxide into the atmosphere when they are burned. This enhances the 'greenhouse effect' leading to higher global temperatures. This is known as 'global warming'.

#### Coal

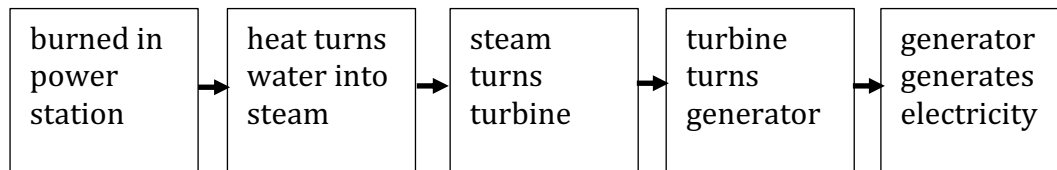


Coal is a concentrated store of chemical energy and burning coal is a reliable source of energy. However, coal often contains sulphur, which burns to produce sulphur dioxide. This dissolves in rainwater to produce acid rain.

#### Crude oil

Crude oil contains a mixture of hydrocarbons which can be fractionally distilled. This produces a range of very useful products, some of which we can use as fuels (e.g. petrol, diesel and aviation fuel). Burning diesel in combustion engines can release harmful pollutants, such as small particles (particulates) and nitrous oxides.

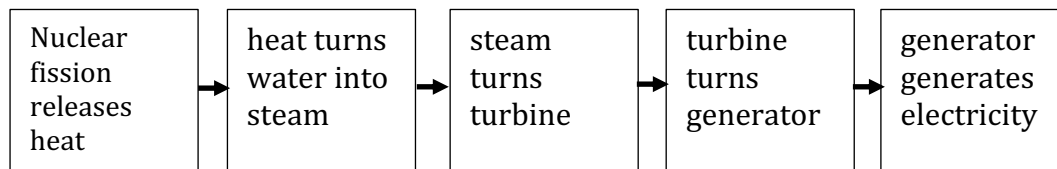
## Natural gas



Natural gas has the advantage over coal in containing very little sulfur. Natural gas power stations can also respond quickly to changing demand for electricity, because they can be started and stopped relatively quickly.

## Nuclear

Uranium-235 is used in nuclear power stations. This isotope of uranium is extracted from uranium rich rocks. Energy is released when the nucleus of uranium splits. This is called 'nuclear fission'.

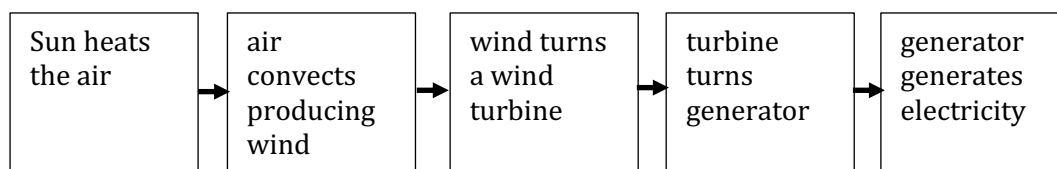


The bits that remain after the nucleus of uranium splits are extremely radioactive. They continue to release heat and radiation for many years after they are produced and must be removed and stored safely. Once a nuclear power station has come to the end of its life, there is a lot of radioactive material left that needs to be carefully disposed of. This is very expensive. Accidental releases of radioactive materials into the environment can be extremely hazardous to health.

## Renewables

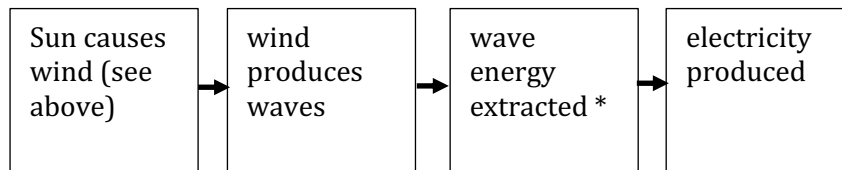
The advantage of renewable energy sources is that they will not run out.

### Wind



The drawback of wind as an energy resource is that it is not always windy. Also, the windiest places (out at sea, tops of mountains) are often far from centres of population, and so they often need long power lines to connect them to the National Grid.

## Wave

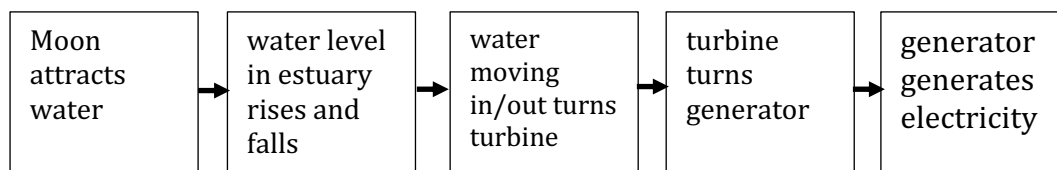


\* There are different designs being tested.

[https://en.wikipedia.org/wiki/Wave\\_power](https://en.wikipedia.org/wiki/Wave_power)

The main drawback of wave energy is that it is not reliable. There aren't always waves.

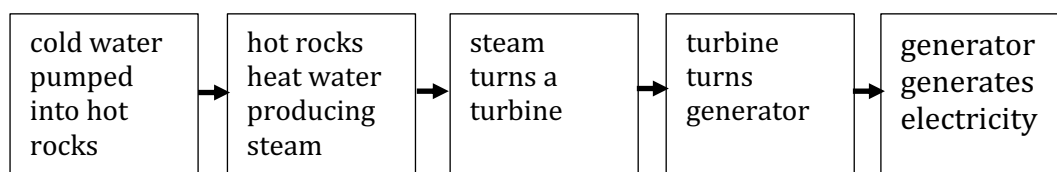
## Tidal



There are two tides a day caused by the gravitational attraction of the Moon on the water. This causes the sea to rise and fall twice a day. The energy of water moving in and out of a tidal estuary can be captured, either by placing water turbines in the water flow or building a dam (called a 'barrage') across an estuary. Turbines can be placed in gaps in the barrage to harness the energy of water rushing through.

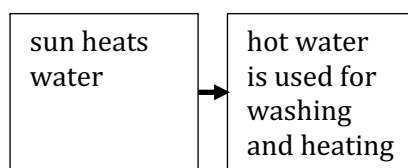
Tidal energy is reliable because the tides are predictable. However, tidal barrages are expensive to build. Damming an estuary changes the natural flow of water which can affect habitats (e.g. tidal flats where wading birds feed).

## Geothermal



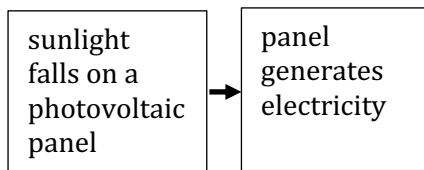
In some volcanic regions in the world (e.g. Iceland), hot rocks are found just below the surface. This heat can be used to generate electricity. Geothermal energy is reliable. However, some minerals from the hot rocks can dissolve in the water. Some of these minerals can be toxic.

## Solar heating



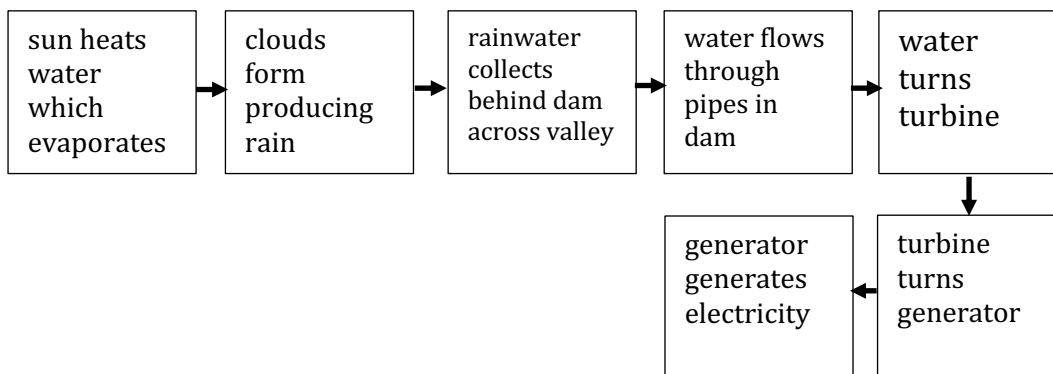
Solar heating can provide hot water for heating a house or for heating water for washing. This can reduce the use/cost of electricity or gas for heating.

## Solar voltaic



In many countries, solar can be considered as an unreliable energy resource as it is not always sunny. There can be a large seasonal difference in output. Solar voltaic panels are expensive to make.

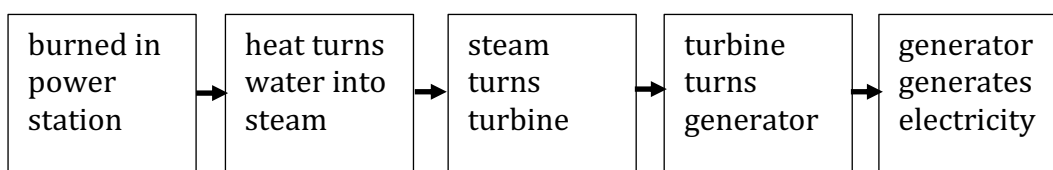
## Hydroelectricity



The main advantage of hydroelectricity is that electricity can be generated when there is increased demand for electricity, because it can be switched on/off almost instantly, by controlling water flow through the pipes in the dam. Hydroelectricity stations are sited in hilly areas where a dam can be built across a valley, creating a reservoir of water behind. Dams are expensive to build, and they flood a valley which can destroy valuable habitats and displace people who live there.

## Biomass

Biomass fuels are fuels derived from biological materials. One example is wood.



The advantage of biomass fuels over fossil fuels is that they are 'carbon neutral'. For example, when trees grow they absorb carbon dioxide to produce plant tissue. When the tree is burned as a fuel, carbon dioxide is produced, but it is only returning the carbon dioxide it absorbed from the atmosphere when it was growing. The main disadvantage of biomass fuels is that land needs to be set aside for growing them. This is land that could be used for growing food.

(1) ✎ Name the three fossil fuels.

(2) ✎ Why are they called fossil fuels?

(3) ✎ List the main advantages and disadvantages of coal and natural gas in the generation of electricity:

<i>energy resource</i>	<i>advantages</i>	<i>disadvantages</i>
coal		
natural gas		


(4) ✎ Nuclear fission can be used to generate electricity. What is nuclear fission?

(5) ✎ How is a nuclear power station similar to a gas-fired power station?

(6) ✎ How is a nuclear power station different to a gas-fired power station?

(7) ✎ What is the main advantage that renewables have over non-renewables?

(8) ✎ Most of the energy resources (both renewable and non-renewable) have the Sun as the ultimate origin of the energy (ignoring the Big Bang!). Which ones don't? Explain.

(9)  List the main advantages and disadvantages of the renewable energy resources:

<i>energy resource</i>	<i>advantages</i>	<i>disadvantages</i>
wind		
wave		
tidal		
geothermal		
solar		
hydroelectricity		
biomass		