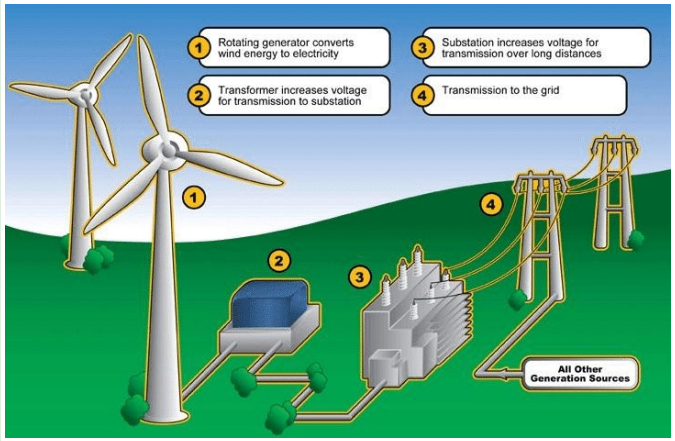
Core Technical Principles
Energy generation and storage

A: Energy generation

There are many ways to convert energy and these can be separated into two main categories: **non-renewable** and **renewable**. Non-renewable sources such as fossil fuels are consumed and will eventually run out, whereas renewable sources are naturally replenished.

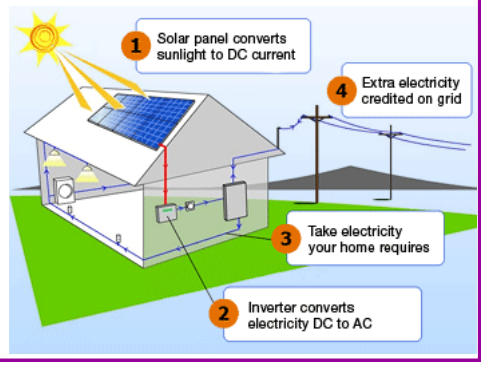
B: Wind turbines (renewable)



Wind turbines produce more power in the winter months when the demand is higher, but they have some drawbacks: They do not produce power when it is not windy or it is too windy; they can harm wildlife, especially birds; they are considered an eyesore by many people.

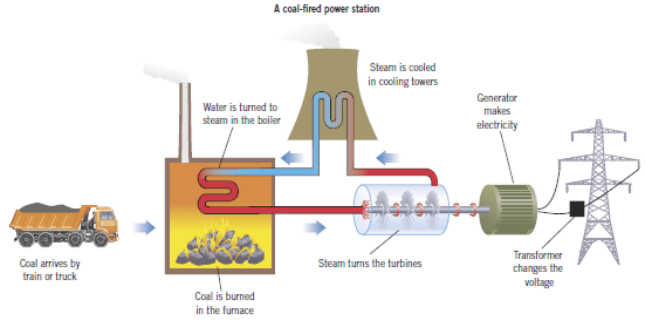
C: Solar energy (renewable)

Solar cells capture the sun's rays and convert them into electrical energy. The cells only produce energy during the daytime and production is less in the winter months, owing to the shorter daytime length and the reduced angle of the sun's rays.



D: Fossil fuels (non-renewable)

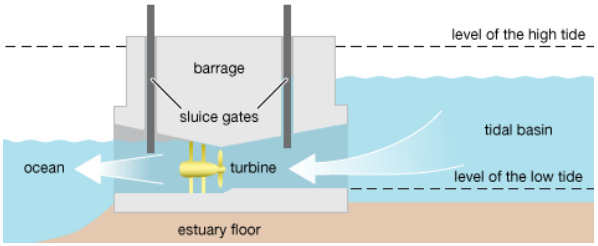
Traditionally, Britain has relied on fossil fuels such as coal, gas and oil to provide its energy. Fossil fuels were formed over millions of years from dead organisms - coal from trees and oil and gas from marine organisms.



Burning fossil fuels to generate electricity produces CO_2, which adds to the greenhouse effect and possible global warming.

E: Tidal energy (renewable)

Tidal energy devices rely on the movement of water to turn turbines which drive the generators that produce electricity. The benefit of tidal energy is that it is more predictable and consistent than wind and solar. Disadvantages are the harsh conditions, making repair and maintenance difficult. There may also be problems related to the loss of habitat for birds.



F: Nuclear power (non-renewable)

A process called nuclear fission produces heat to create the steam to turn the turbines and generate electricity.

Advantages:

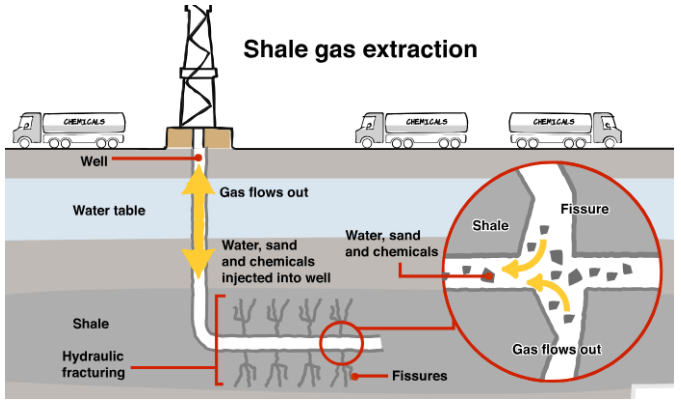
- Reliable, inexpensive, clean, low levels of greenhouse gas emissions

Disadvantages:

- Uses uranium which is a finite resource, high set up and shut down costs, the waste produced is dangerous and difficult to dispose of, there is a risk of major catastrophe e.g. the Fukushima disaster in Japan.

G: Shale gas (non-renewable)

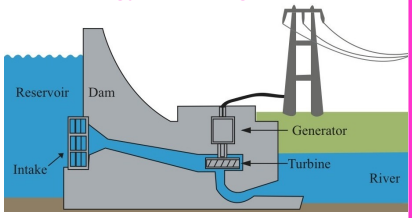
Shale gas is a natural gas that is trapped within areas of shale in the earth's crust. Fracking is the controversial process of extracting the gas from the shale. It involves drilling a well down into the earth's crust and then sending a high-pressure water, sand and chemical mixture into the rock to release the trapped gas. The gas then travels back up the drilled shaft and is collected at the well head.



Environmental campaigners believe fracking can damage the environment by releasing gases and other toxic particles into the water table. There are also concerns that fracking can cause earth tremors.

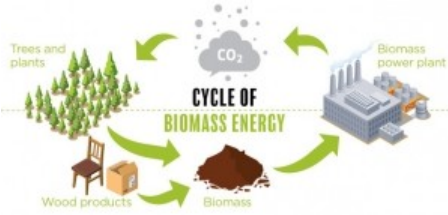
H: Hydroelectric (renewable)

This is a very reliable source of energy. It has high initial setup costs, both financially and environmentally, as vast areas need to be flooded to create a reservoir. However, the reservoirs usually become leisure facilities such as boating lakes and nature reserves which can have a positive effect on the local area.



I: Biomass (renewable)

Biomass involves burning waste wood or crop material to turn water into steam which turns turbines and generates electricity.



Core Technical Principles
Energy generation and storage

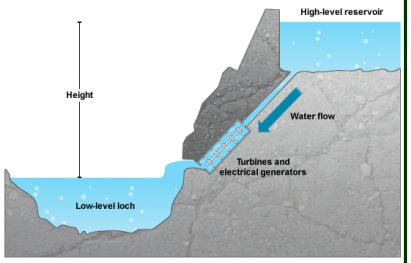
J: Key words

- Renewable: a source of energy that can replenish itself quickly and therefore will not run out
- Non-renewable: a source of energy that cannot replenish itself quickly and therefore will eventually run out

K: Kinetic pumped storage systems

A similar system to hydroelectric power generation is used in pumped storage systems. Here, a hydroelectric dam system is used with two reservoirs, one at low level and one at high level. This is a good way of dealing with sudden high demand for electricity. The pumped storage system instantly releases electricity into the system by opening valves to allow water to flow from the high reservoir to the lower one through turbines.

This can't be run for long but is enough to prevent power cuts. Cheaper night time electricity from coal and nuclear power stations is used to pump the water back up.



Test yourself

1. What are the main differences between fossil fuels and renewable fuels?
2. Explain the process of burning fossil fuels to generate electricity.
3. Explain the steps of the fracking process used to release natural gas from shale.
4. What are positive impacts of hydroelectric power?
5. Explain why rechargeable batteries are better for the environment than alkaline batteries.

L: Batteries

Electrical power can be stored in batteries. Batteries contain electrochemicals that react with each other to produce electricity. They come in many different shapes and sizes and provide a wide range of different voltage outputs and power levels.

Alkaline batteries

Alkaline batteries have a higher capacity for their size than traditional acid-based varieties, as the dense manganese oxide inside them uses less space to produce the same power, making them more efficient. Alkaline batteries tend to hold their charge well.

Re-chargeable batteries

These are available in many forms and are used in a wide range of products including mobile phones, portable power tools and laptops.
Rechargeable batteries are capable of being charged and discharged many hundred, if not thousands of times. This reduces the quantity of resources needed to produce new disposable batteries and also reduces the number of batteries needing disposal.

Disposal of batteries

Batteries need to be disposed of correctly because they contain toxic electrochemicals and some metals that can be harmful to the environment. In landfill a battery will degrade over time and chemicals and metals can leach into the soil and eventually end up entering the water table and river systems. These increased levels of toxins can harm wildlife and potentially humans too.

Revision Checklist	
I understand how power is generated from coal gas and oil	
I know how nuclear power is generated	
I am aware of the arguments for and against the selection of renewable energy	
I am aware of the arguments for and against the selection of fossil fuels	
I am aware of the arguments for and against the selection of nuclear power	
How energy can be stored using kinetic pumped storage systems, alkaline batteries and re-chargeable batteries	