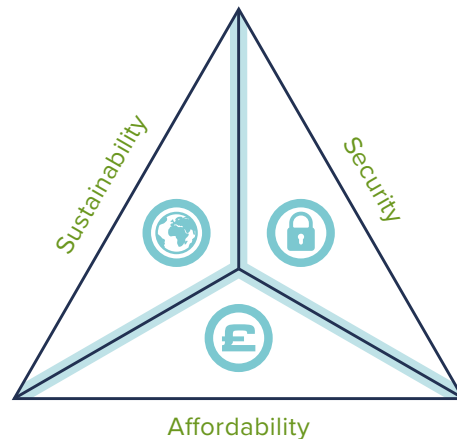


## Teacher Glossary



### Trilemma

The balance between security, affordability and sustainability of energy is often referred to as the energy trilemma. It is important to find a balance between all three points without sacrificing one to achieve another. For example, the USA is a large, fossil – fuelled country. Their energy is secure and affordable, but they have a large environmental footprint with high emissions. We can balance security, affordability and sustainability using a mix of different energy sources.



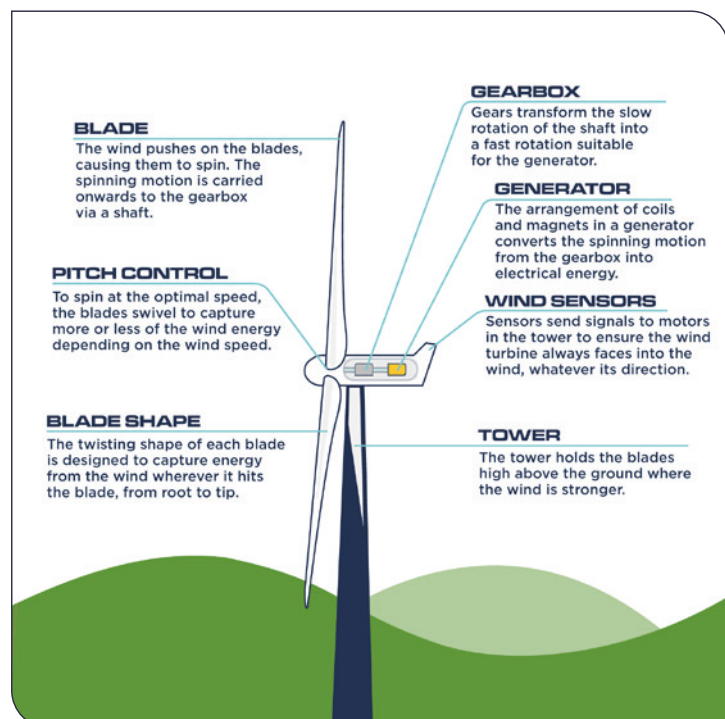
**Net Zero** – This refers to the balance between the amount of greenhouse gas produced and the amount removed from the atmosphere. We reach Net Zero when the amount we add is no more than the amount taken away. The UK government aims to reach Net Zero by 2050; Scotland has a more ambitious target of 2045.

**Decarbonisation** – This is the term used for the process of removing or reducing the carbon dioxide (CO<sub>2</sub>) output of a country's economy.

**Onshore wind** – Windfarms made up of many wind turbines can be found all over Scotland, including Whitelee Windfarm which is the UK's biggest onshore windfarm.

Wind turbines consist of a tower which hold spinning 'blades' above the ground. Wind pushes on these blades, causing them to spin as well as the central shaft. This slow spinning motion is transformed into a faster spin by a gearbox. Attached to this is an arrangement of coils and magnets called a generator, which is where electricity is generated.

Wind turbines need to be carefully placed across a site to harness as much energy as possible. To choose the best possible layout, planners must analyse the wind conditions of the landscape. To spin at the optimal speed, the blades swivel to capture more or less wind energy. Turbines also have sensors that send signals to the motors in the tower to ensure the turbine always faces into the wind, whatever its direction.





**Offshore wind** – Windfarms don't need to be built on land, they can also be built at sea. This brings its own set of challenges, such as protecting machinery from the corrosive salt water of the sea.

Electricity substations are built offshore and power lines installed under water to carry the electricity from offshore wind turbines to the national grid onshore.

Improved technologies are allowing operation and maintenance to take place regardless of the weather conditions.

**Floating offshore wind** – With floating turbines, we can go further out into the sea, as we don't need to stay in shallow water where the base of traditional wind turbines need to reach. The floating turbines are tethered to the bottom of the sea.

Being further out in the sea means stronger winds, and no buildings or other obstacles in the way to lessen the power of the wind available. In Scotland, the quality of wind available is huge.

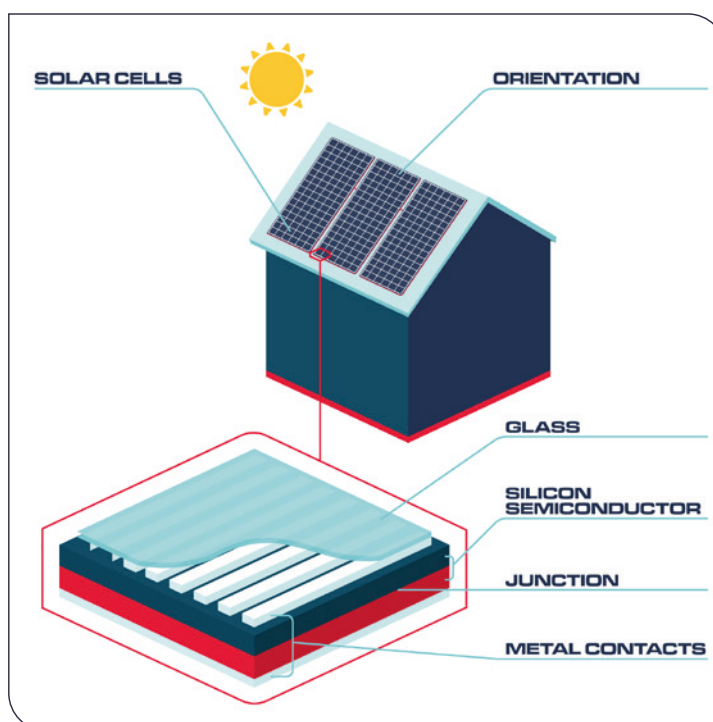
As the turbines are not fixed to the ground, they can be easily moved around by tow boats. This makes them easily moved around to other potential sites or towed in and out for maintenance.

**Solar** – We can harness light energy from the sun using photovoltaic (PV) panels, that convert light energy to electrical energy. Solar panels are made up from two layers of silicon semiconductor, sandwiched between metal contacts.

A layer of glass protects the solar panels and has an anti-reflective coating to stop sunlight being reflected away. The energy from the Sun knocks electrons free from the silicon atoms in the silicon semiconductor, generating a flow of electricity. The two different layers of silicon encourage the loose electrons to flow across the junction in only one direction. Sandwiched around the silicon semiconductor layers are metal contacts that capture the flow of loose electrons.

To harness as much light energy as possible, solar panels should face the Sun. In the northern hemisphere, panels are installed facing south. Solar panel installations can be as big or as small as necessary meaning that they can be fitted to rooftops, make up large solar farms, and be integrated into electronic devices.

Most solar panels in use today use silicon. Although silicon is abundant it is also expensive and in high demand as the solar and electronics industries compete for global supplies. Researchers are exploring different materials and manufacturing techniques to produce new, more efficient ways of producing solar panels.





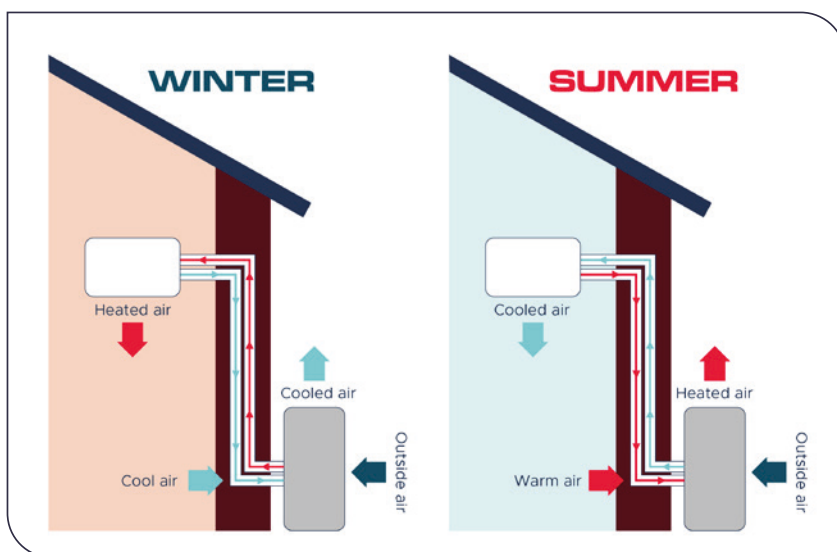
**Green hydrogen** – This technology is based on the generation of hydrogen – a universal, light and highly reactive fuel - through a chemical process known as electrolysis. This method uses an electrical current to separate the hydrogen from the oxygen in water. If the electricity is obtained from renewable sources, it can produce energy without emitting carbon dioxide into the atmosphere.

There are some questions about the viability of green hydrogen because of its high production cost; reasonable doubts that will disappear as the decarbonisation of the earth progresses and, consequently, the generation of renewable energy becomes cheaper.

**Electrifying/Electrification** – This refers to the process of replacing technologies that use fossil fuels with technologies that use electricity. If renewable energy sources are used to generate the electricity, electrification can reduce carbon dioxide (CO<sub>2</sub>) emissions from the transport, construction, and industrial sectors, which account for a large percentage of UK greenhouse gas emissions.

**Heat pumps** – This is a source of renewable heat. It takes heat from the ground, air or water and transfers it to a separate liquid. This liquid goes through a compressor, which causes it to warm further to between 20 - 30 °C. This heat can be used in the heating and hot water system of a building.

Heat pumps are useful for buildings that are not hooked up to the natural gas network, but do need electricity to work.



**Energy policy** – A policy is a plan or set of intentions that might be held by different groups of people, such as businesses, political groups, and governments. Scotland has several Governmental policies in place that relate to how energy is generated and used, such as Climate change, Energy efficiency, Renewable and low carbon energy etc. These policies set out the Policy Actions that detail how the policy is being achieved, as well as legislation that relates to the policy.

### Considerations

Alongside security, affordability and sustainability, there are other factors to consider when thinking about renewables technologies. You may want to discuss the following with your pupils:

- **Creation of jobs**
- **Community benefits**
- **Construction time**
- **Planning permission**
- **Environment**