Wind Power

www.greenenergytrail.com

Why does the wind blow?

Like nearly all energy used by humans, wind energy comes ultimately from the Sun.
Heat from the Sun warms up the Earth's surface, which in turn warms the air above it.

Warm air rises.

But cold air, which is denser, sinks.

Cooler air moves in, to take the place of warm air.

This movement of cool and warm air is one reason the wind blows.

This process is known as convection.

What's so good about wind energy?

It's clean, it's available right here in Scotland and it's never going to run out - it's renewable
Many other forms of energy - such as oil, coal and gas - are in limited supply.
Plus they have to be burned to release energy and so contribute to climate change.
Did you know?
Renewable energy such as wind, waves and solar power already accounts for nearly 20% of the world's electricity supply.
This is why we are playing our part in increasing the amount of wind energy we use
Of course, using the wind to make our lives easier is nothing new
Windmills have been around for thousands of years.
Did you know?
In the 18th century there were 10,000 windmills across Britain.
Their mechanical energy was used for things like grinding flour and pumping water.

But in 1831 along came one very bright spark...

Scientist Michael Faraday discovered how to convert mechanical energy into electricity
Modern windmills - or 'wind turbines' - use this principle.
Their mechanical energy is converted to electricity and transported to where we need it to power our homes, schools and offices.
This means they can be located in areas that have the most wind.
Did you know?
Turbines can even be located at sea.
Did you know?
All power stations use Faraday's discovery as a basis for generating electricity.

A collection of wind turbines is known as a wind farm

The more turbines there are, the more electricity they make

Where do we build wind farms?

Where it's windy, of course!
Wind consistency is probably the biggest factor - places with a strong, steady wind are best.
But planners also have to consider the environment - and the neighbours
Wind farms are usually located close to a road and electricity network.
Experts oversee the management of the habitat.
Did you know...
Planners have to make sure wind farms don't interfere with planes' radar systems.

SSE supports research on how wind farms affect the environment and is a lead contributor to industry knowledge

SSE's Griffin wind farm has 68 turbines. How many kettles do you think it can power?

That's right, 50,000 kettles!
based on an average kettle consumption of 2kWh

Getting to know the wind turbine

Turbines are tall

Wind speed increases with height
So the taller the tower, the more electricity it produces

At 78 metres, this tower even has a lift installed to help engineers work on it.
Edinburgh's Scott Monument

They are heavy

The blades of the turbine are made from wood that is coated with fibreglass - similar to the material used in yachts and light aircraft.
Together with the central hub they are known as the rotor.
Did you know?
A typical turbine used by SSE has blades about 45 metres long, meaning the rotor diameter is longer than a jumbo jet.

How many buses will it take to balance out a single turbine rotor?
That's right, 5 buses!

They're aerodynamic

Like the wings of an aeroplane, they are designed to be highly responsive to the flow of air.
This maximises the speed of rotation when the wind blows.
Did you know?
Aerodynamic objects like these blades are known as 'aerofoils'.

You may think that the best time to operate a turbine is when it is blowing a gale, but in fact very strong winds can damage it.
The blades will only turn at wind speeds of between 10 and 55 miles per hour.

Did you know?
When a turbine shuts down, each blade is rotated ('feathered') to minimise the force on it from the wind, to protect the whole turbine - it's a bit like lowering the sails on a yacht in a storm.

Turbines are also clever

An anemometer detects the direction of wind ... and when it changes, the turbine rotates too
Did you know?
The system that turns the turbine to face the wind is known as the yaw system.
Did you know?
An anemometer detects wind speed too. It is the anemometer that tells the turbine to shut down in very strong winds.

Where is the electricity generated?

Inside the weatherproof housing, known as the 'nacelle'
Let's take a look →

Main shaft
Connected to the central hub, the main shaft turns at the same speed as the turbine's blades, between five and 15 times a minute.
Gearbox
The main shaft is also connected to a big gear wheel, which in turn spins a smaller gear wheel - around 90 times faster.
Generator
The smaller gear wheel is connected to the generator shaft, which spins at the higher speed.
The generator shaft turns a series of magnets inside an electric coil and this, in line with Faraday’s principle, produces an electric current.
A cable carries the current down the tower as it starts its journey towards your home.

The journey to your home

The turbine generates electricity at 690 volts.
This is stepped up to a massive 275,000 volts via a series of electricity substations.
Did you know?
On average, turbines produce about a third of their maximum power over the year, but most are generating electricity 80% of the time.
Voltage is the force that pushes electricity through a wire.

The grid - a motorway for electricity

At 275,000 volts, the electricity that started as gusts of wind is now ready to join the country's high-voltage transmission network, known as 'the grid'
The grid carries electricity generated in all kinds of ways - by wind, hydro, coal, oil, gas and nuclear - in one huge electricity melting pot.
Did you know?
The reason electricity is transported over long distances at such a high voltage is to reduce the amount of energy lost along the way.

Stay safe
Because of the high voltages involved, substations are extremely dangerous places for the public to enter.
If you accidentally throw something into a substation, call your local electricity distribution

company using the telephone number on the enclosure - they will recover it for you.

But at such a high voltage, it's much too powerful to be used in homes, schools and businesses

So after passing through a number of substations, the voltage is reduced again - this time to 240 volts

The electricity now travels underground in cables laid throughout urban areas - or, in very rural areas, in overhead lines.
Stay safe
If there are any overhead lines nearby, you should be very careful if you are fishing, flying kites and model aircraft or putting up tents as electricity will pass through many objects that touch the lines with a serious risk of injury to anyone holding the object.

A wind farm like SSE's Clyde, with 152 turbines, is capable of powering a city the size of Glasgow
Did you know?
If you look at the labels on the plugs for your appliances, they will tell you what voltage they use.

Just think - what started out as a gust of wind now lights up your house at the flick of a switch...

Did you know?
A whopping 90% of the energy used in washing clothes goes into heating the water - you can save energy simply by reducing the temperature setting, or washing your clothes less often. Click here for some extra tips on saving energy.
And it isn't only lights that use electricity...now we've reached the end of our journey - it's time to put the kettle on!

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