

Teacher's Pack

**STEM
BOX**

Wind Power in Falkirk



Falkirk Council



Falkirk
Community
Trust



Scottish Government
Riaghaltas na h-Alba
gov.scot



Wind Power in Falkirk: Lesson Objectives



To understand that **electricity** today is **generated** in **power stations** from **renewable** and **non-renewable energy sources**



To identify and evaluate some of the **advantages** and **disadvantages** of wind farms in my local area



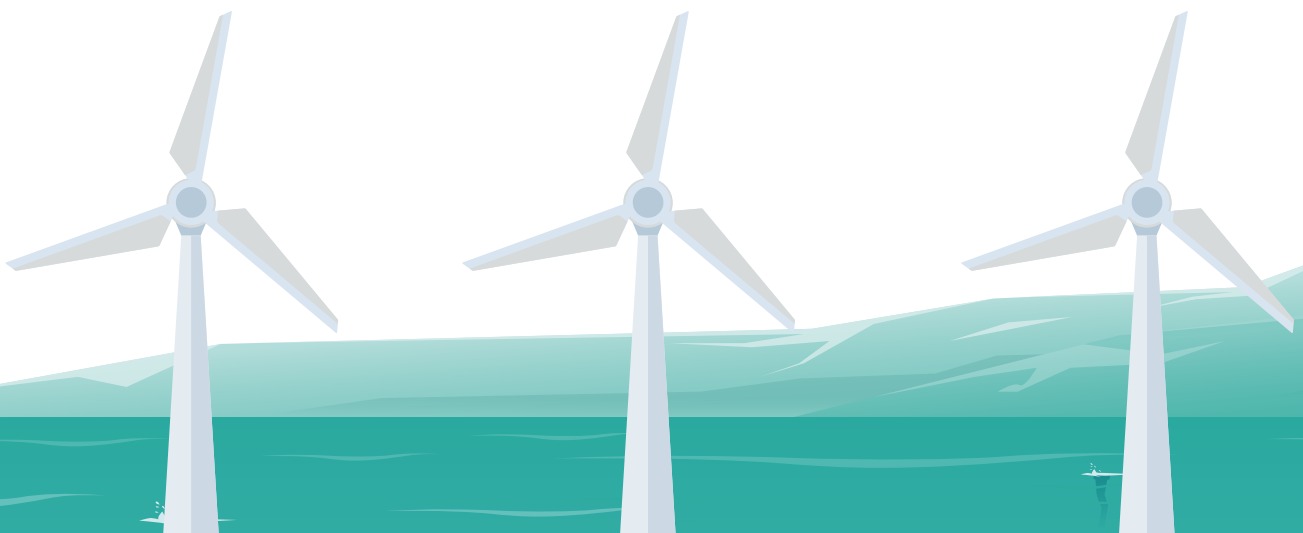
To begin to make comparisons about the use of **coal** and **wind** as **energy sources**



To consider the **legacy** (good and bad) of **coal mining** in the Falkirk area



To have a greater awareness of current and future **higher education, training and career opportunities** in green/**renewable** energy in the wider Falkirk area



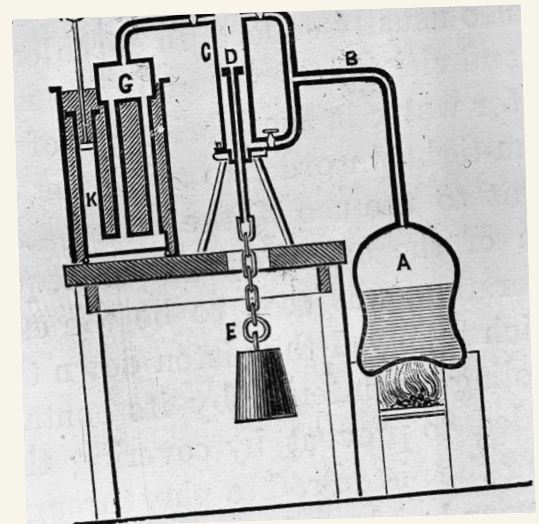
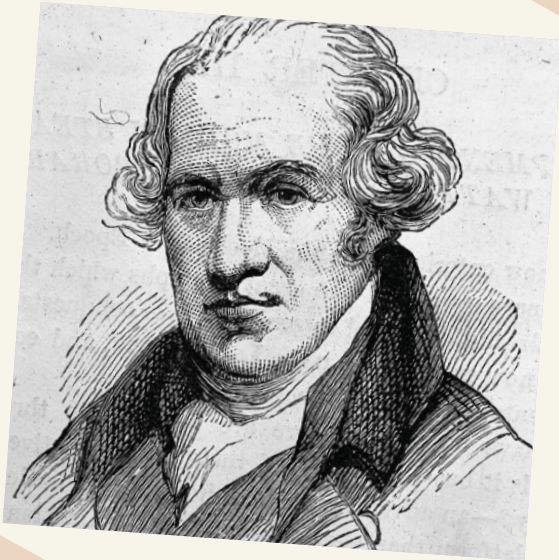
STARTER: Two truths and a Lie?

Can you spot which two local facts are true and which is a lie?

TRUTH OR **LIE**

1

In 1769, pioneering mechanical engineer James Watt developed his model for a coal-powered steam engine in a cottage in Bo'ness



Credit: Falkirk Archives

TRUTH

OR

LIE

2

The first EVER electricity pylon was put up at Bonnyfield near Falkirk in Scotland in 1928!

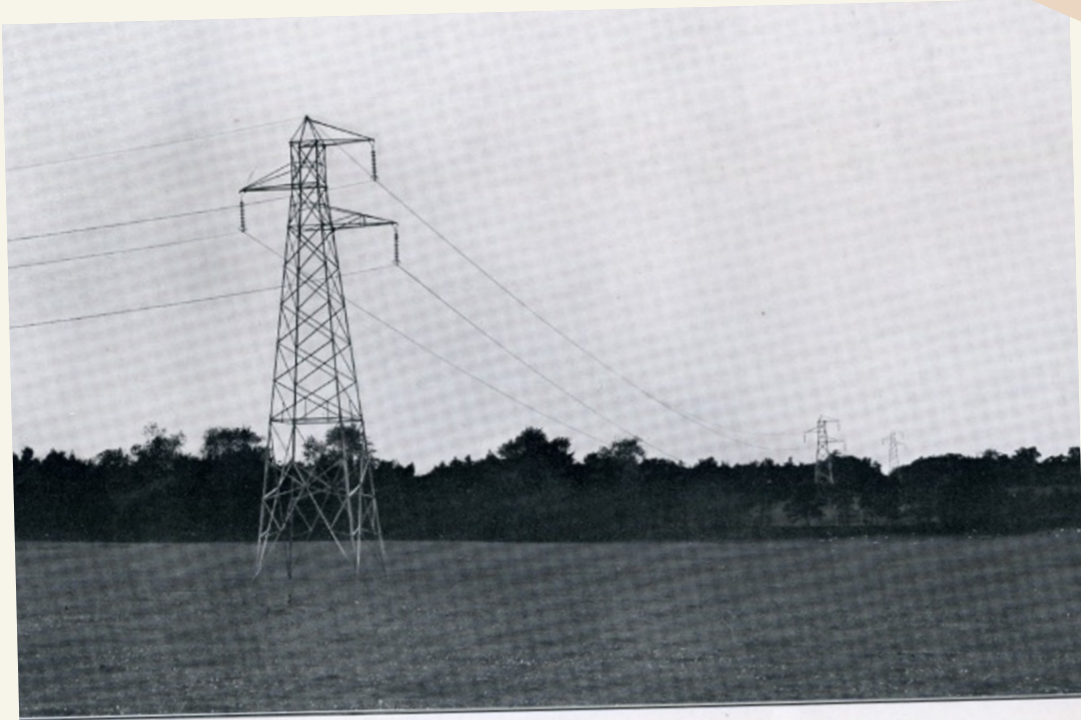


FIG. 2. PRIMARY TRANSMISSION LINE—SINGLE CIRCUIT—IN SCOTLAND.

Credit: Image sourced from scienceandindustrymuseum.org.uk

TRUTH

OR

LIE

3

New Falkirk area (Lionthorne) wind turbine completed this year will provide power for over 70 homes



<https://www.falkirkherald.co.uk/news/environment/new-falkirk-area-wind-turbine-to-power-more-than-700-homes-each-year-3332534>

LIE

New Falkirk area (Lionthorne) wind turbine completed this year will provide power for over 70 homes



LIE

.....Statement 3 is a lie!

The new wind turbine in Lionthorne will actually power over **700** homes!

<https://www.falkirkherald.co.uk/news/environment/new-falkirk-area-wind-turbine-to-power-more-than-700-homes-each-year-3332534>

over 700 Homes!

Can you work out what links all these facts together?

Energy, Power & Electricity

Class Questions

Let's now recap what we know about energy, power and electricity

Q

What do we need power for at home/school and elsewhere in Falkirk (e.g. factories, businesses)?

Q

Where do we get our power from here in Falkirk?



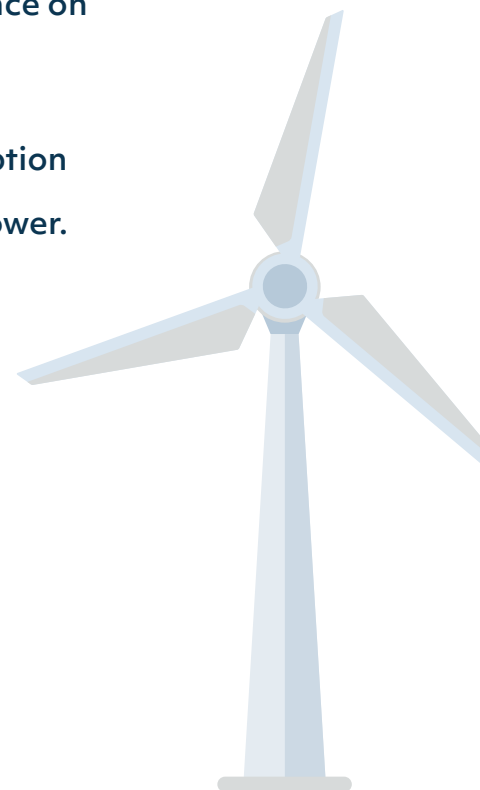
Most of our electricity here is supplied by generators in power stations. All generators need an energy source to create electricity.

At the moment, we still get some of our energy from gas and oil but increasingly in Falkirk, Scotland, the UK and the world, we are turning to WIND POWER

Wind power is a clean and renewable source of energy. Many people think it is the answer to the UK's energy needs and our reliance on fossil fuels such as oil, coal and gas.

In Scotland currently upwards of 90% of electricity consumption comes from renewable energy sources, mostly from wind power.

Well done, Scotland!



OPTIONAL

Watch the following video and create a mind map of any key facts about wind energy

<https://www.youtube.com/watch?v=tsZITSeQFR0&safe=active> (2.16 mins)

Source: Green Mechanic

Wind power is the fastest growing renewable energy technology in Scotland & the UK. There are two types of wind farm: offshore (turbines installed in bodies of water) and onshore (located on land)

How does wind energy generate electricity?

<https://www.energy.gov/eere/wind/animation-how-wind-turbine-works>



**Interactive Animation
Click Here**

Animation: How a Wind Turbine Works.

Credit: US Department of Energy, www.energy.gov/eere/wind/animation-how-wind-turbine-works

Wind Farms in Falkirk

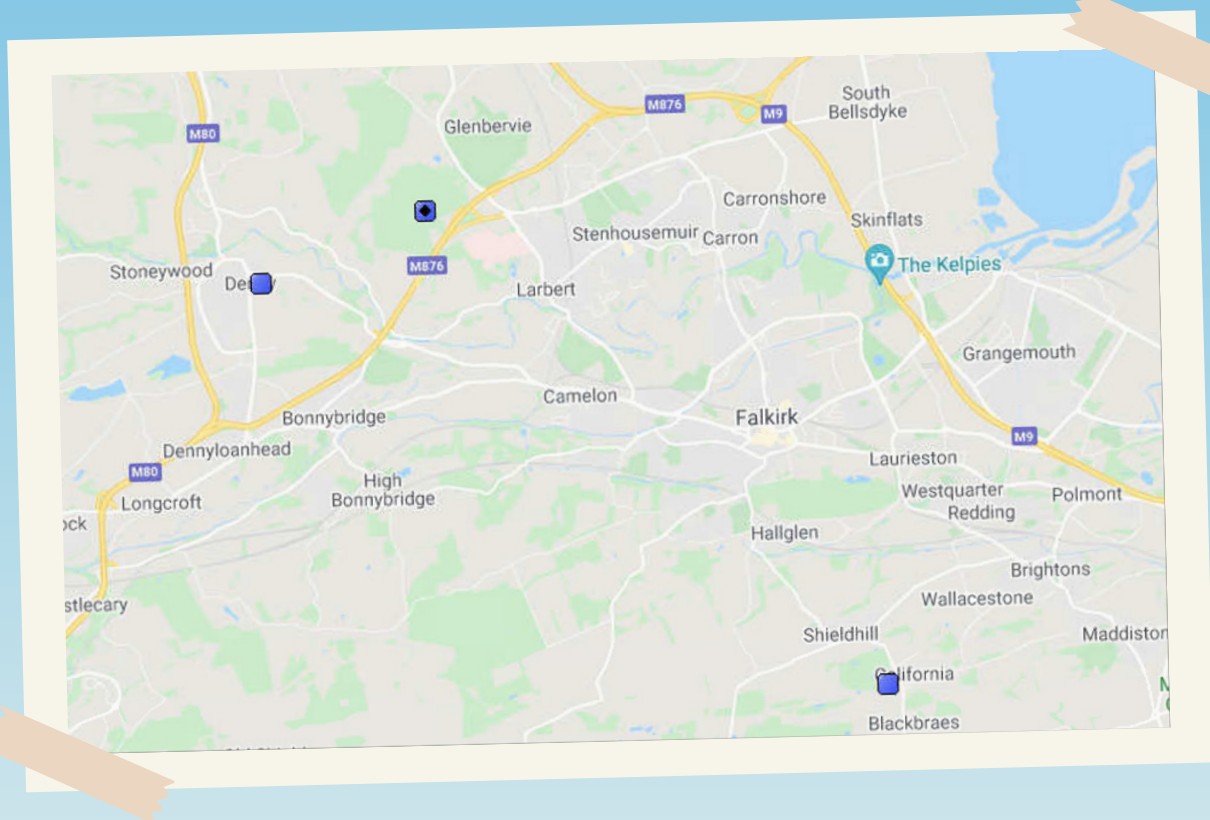
Now let's take a closer look at wind power in Falkirk...

Show this map

Screenshot of Interactive Map showing Wind Farms in Falkirk.

Credit: https://www.thewindpower.net/zones_en_8_663.php

URL Click Here



- Have you noticed the turbines before?
- What do you know about them?
- What do you think?
- What do your family members think?

Class Discussion



Burnhead Moss wind farm at Avonbridge. Credit: EDF Renewables



Turbines at Todhill Farm from above. Credit: Photographer: © Andy Horne via Facebook.

Class Discussion

Why do you think Falkirk is a good place to harness wind power as an energy source?

But what energy sources were used to power homes and farms in Falkirk before wind turbines?

Powering the Industrial Past

As we have discussed, wind power is the main energy source supplying electricity in Scotland today.

But for centuries Falkirk relied and thrived on a very different kind of energy source.

Do you know what the most important energy source in Falkirk was before wind power?

COAL!

Coal was THE fuel of the Industrial Revolution, and the Falkirk area had it in abundance – just like here today, we are able to harness the wind power because Falkirk has plenty of wind, 250 years ago coal took off as the main energy source simply because there was so much of it to be found right here beneath our feet.



Source: Unsplash

Iron Foundries

Coal was used to power the Iron Foundries. The Carron Iron Company here in Falkirk was one of the largest foundries in the world for over 200 years and made many iron products that were exported and sold internationally. Coal was also essential for fuelling brick-making, sieve-making industries and many more.

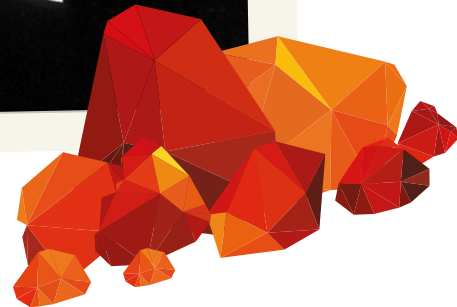


Carron Iron Goods, Early 20th century.
Credit: Falkirk Archives. Maker: Unknown

People used coal to fuel fires in their homes – before electricity became available, this was their only source of light, heat and means of cooking.



Two Falkirk women by a coal-fuelled fire in their home, 1907.
Credit: Photographer: Thomas Easton via Falkirk Archives



Power Stations

Coal-fired power stations were eventually built to generate electricity for homes and businesses.

Eventually the most efficient of these power stations were linked up to feed into the National Grid, to standardise the nation's electricity supply via electricity pylons (**and where was the first ever electricity pylon built.....Falkirk!**)

This coal-fired power station was located near to the Forth & Clyde canal in Falkirk, which made it easy to bring in large supplies of coal .



Discuss

Do you know if anyone in your family worked in the coal mines?



Coal-fired power station, Etna Road, Falkirk, 1920s.
Credit: Falkirk Herald via Falkirk Archives



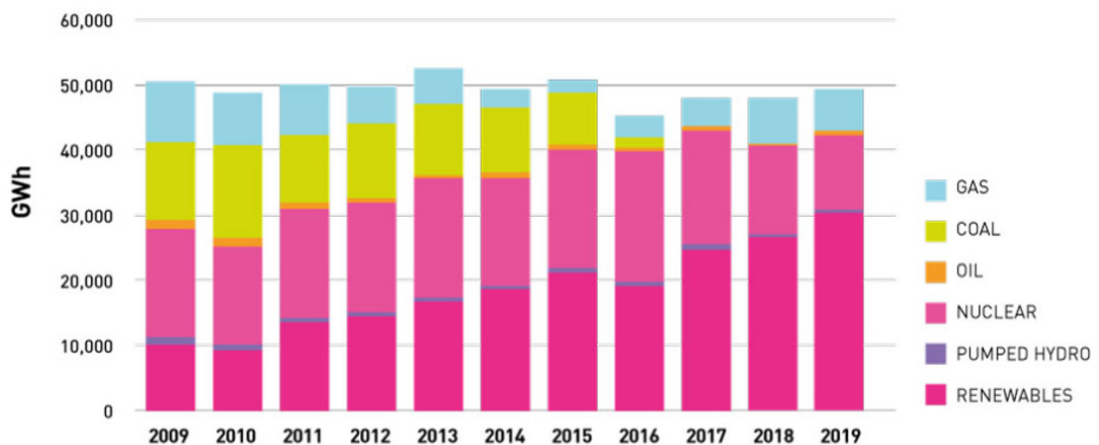
Homes, businesses and entire industries relied on coal for many years, before the switch to gas/oil in the mid-20th century.

QUESTION

Why have we now moved away from fossil fuels towards cleaner energy sources?

Dunipace Pylons, 1984. Credit: Falkirk District Council: Planning & Environment via Falkirk Archives

ELECTRICITY GENERATION IN SCOTLAND BY FUEL (GWh)



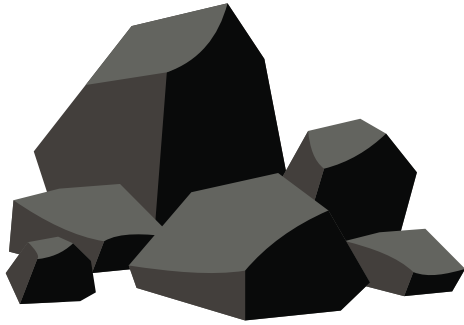
Did you know, Scotland hasn't used coal to produce electricity at all since 2016?

<https://www.scottishrenewables.com/our-industry/statistics>

Graph to show Electricity Generation in Scotland by Fuel

Credit: <https://scotland.shinyapps.io/Energy/> via <https://www.scottishrenewables.com/our-industry/statistics>

COAL



WIND



Sorting Activity

There are pros and cons to all energy sources – even the ‘clean’ renewable sources most of us favour today.

Let’s take a closer look at the two energy sources discussed in the lesson so far.

We are going to look at some of the key facts about these two sources through 3 different lenses: **Social**, **Economical** & **Environmental**.

Which energy source comes out top, socially, economically and environmentally?

Can you sort the statements into the correct place in the boxes?

Wind farms could add £2.3 billion to the economy by 2050.	Collieries were “dirty, ugly blots on the landscape, with steam, smoke and dust flying about.”	Extensive mining in the area has left scars on the landscape visible today
Energy from coal and other non-renewable fossil fuels is now linked to global warming and pollution on a global level.	Many people, including in Falkirk, oppose wind farms due to impact on landscape, wild life etc.	Recent technological developments mean that there is less noise now than there once was with wind turbines.
Many Wind energy companies sponsor local events and local schools, claiming to provide many benefits for the community	Coal literally fuelled the industrial revolution all over the world creating jobs and expanding villages, towns, cities and communities, transforming the rate of industrial production creating new, highly profitable industries. The economy would never be the same again.	Community-driven wind farm projects are on the rise, where members of a community come together to utilize wind energy to support and reduce energy costs to the local community.
Wind turbines which create electricity mean that large pylons would need to be built across the landscape to transport electricity.	Wind turbine blades cannot be recycled	Wind farms could add £2.3 billion to the economy by 2050.
Coal was abundantly available all across the Falkirk area (and much of Scotland).	Some people think wind farms are pretty.	It can encourage tourism in the area. A lot of people are interested in wind farms.
Coal was for many years the cheapest and most efficient energy source available.	In the 19th Century collieries (coal mines) then popped up all over Falkirk and provided thousands of local people (men, women and children) with reliable incomes.	Many collieries established various social, educational and leisure activities and groups for miners and their families to take part in.
The coal mines were a central aspect of everyday social and communal life in Falkirk’s towns and villages.	After a wind farm is built, full time, permanent jobs to maintain the turbines and keep them safe become available to local residents.	There is a lot of wind in Falkirk which makes it an ideal place to build wind turbines. It would be a pity not to take advantage of our natural resources.
While a wind farm is built, lots of full time jobs are created temporarily in the area to build the turbines	The parts of the turbines, made of steel, are often manufactured abroad.	Turbines cannot be used if the winds are too low or too high, so they can be unreliable.
Today, the Falkirk area’s strong links to coal and the Industrial Revolution means Falkirk is a site of historical interest, which in turn creates jobs in heritage sector and generate tourism	Wind energy is cheap to produce—it costs roughly 3 to 4 pence to create every unit of electricity—similar to coal prices but less than nuclear.	Wind is clean, low-carbon and renewable energy source which leaves no pollution.
Building wind farms can create thousands of jobs a year in Scotland.		

Coal



Wind



Social

(impact on people,
community, everyday life)

Economical

(impact on jobs
business, money &
resources)

Environmental

(impact on the natural
environment, including how
things look and sound)

STEM Story Challenge

...low enough.

Pupils at Kelpie High School in Falkirk have been learning all about wind power!

Many pupils think it would be a good idea to have a wind turbine installed on school premises. In harnessing the wind to generate all of the electricity the school needs, a wind turbine would potentially save them hundreds of pounds in energy bills every year while also reducing their carbon footprint.

Unfortunately their head teacher, Mr Mackie, isn't convinced it's a good idea.

He's not sure that a mini wind turbine would be able to generate enough energy to power an entire school and is worried about how much it would cost to design, build and install.

Therefore it's up to you to design and create a prototype wind turbine from low-cost classroom resources to demonstrate how easy it is to generate energy from the wind.

The team that designs the turbine that lifts the most weight will win!

For most



Are you up to the challenge?

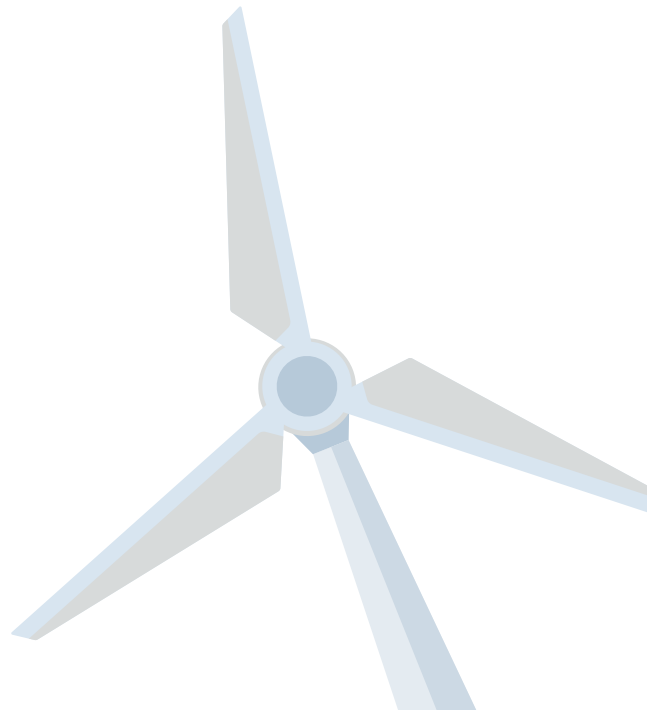
STEM Challenge Breakdown

Aim: To design a wind powered machine that lifts the most weight off the floor using a hairdryer and the following materials:

Complete Kit list

Kit list per team:

- A4 Card
- 1x roll of sticky tape
- 1x pencil
- 1x paper cup
- 1x pair of scissors
- 60cm of string
- Weights
- Hair dryer (1 per class)



Let's take a look at some different kinds of wind turbine...

What is the same about these turbines? What is different?

Different Types of Wind Turbines



Wind turbine used to pump ground water in Kenya



Wind turbine from a small scale wind power scheme in Peru



In development is an idea for wind turbines that can be placed over roads to capture wind generated from passing cars



Vertical axis wind turbine which takes wind from any direction and can be used in areas where there are buildings and trees



Roof top turbine which sends the electricity it produces straight into the house to be used



Wind farm turbines that have blades which turn at six times the speed of the wind



Traditional windmill used to grind flour

Can you explain these differences – why did the designers make these different design decisions?

practicalaction.org/STEM



The main difference in design is that turbines producing electricity need to spin fast so have fewer (typically three), thinner blades. Those that harness wind power to drive machinery, such as water pumps and windmills, **need a higher torque** and to be more stable. They generally have a higher number of larger blades.

Group Discussion

Group Discussion

- Get into groups of 2 or 3
- In your groups, discuss the variables that will be involved in making your design decisions.

Think about:

- shape of the blades
- size of the blades
- thickness of the blades
- number of blades
- how the shaft is attached to the desk

Optional

Discuss how the design could be made in as sustainable a way as possible, e.g:

- by reusing scrap material rather than new
- by reducing waste to a minimum (card, sellotape, string)
- do you need to use a hairdryer? Is there anything less energy intensive that could be used as a wind source?

Optional: Planning sheet worksheet



Let's get to it!

Instructions

Your task is to work together to use these resources to design and create a wind powered turbine. The winning team will be the one producing a machine that lifts the most weight off the ground using a hairdryer!

You have just 20 minutes to complete your wind turbine

When time is up you will be asked to demonstrate your machine and tell the rest of the class why you made your design choices and how you did it!



Good
Luck

Optional

Here is an example of a possible Wind Turbine you could create using the materials provided:

It's up to you if you wish to show this to your pupils before they try to come up with their own design.

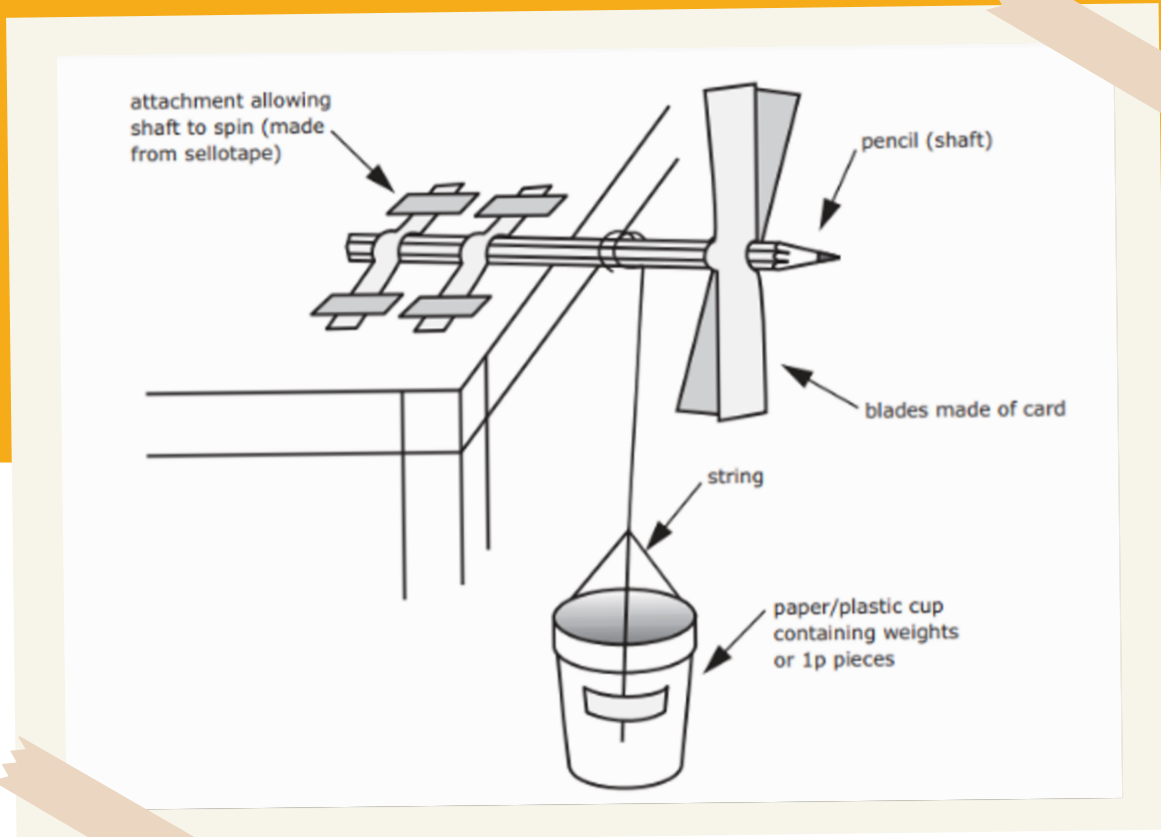
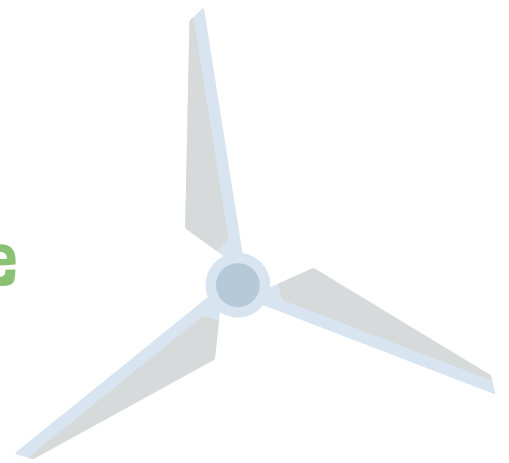


Diagram Source: Practical Action <https://practicalaction.org/stem/>

Now you have completed your wind turbines, let's see how they work...



You have 10 minutes to prepare a quick presentation to the class where you demonstrate and explain the following :

- how your turbine works
- how much weight it can lift
- why you made your design decisions.
- If you had the chance to do it again, what improvements would you make and why?

Plenary: Team-work reflection:

WWW:
What Went Well?

EBI: Even Better If
we....?

STEM Heritage Quiz



Q1. Which energy source is the fastest growing technology in Scotland today?

- a) Hydro b) Gas c) Coal d) Wind

Q2. What are the two types of wind farm found in Scotland?

.....

Q3. Why is Falkirk a good place to harness wind power?

.....

Q4. Which energy source powered the industrial revolution?

- a) Oil b) Wind c) Coal

Q5. What kind of engine did James Watt develop in Bo'ness in 1769?

a) Steam-powered coal engine

b) Coal-powered steam engine

Q6. Name two industries in Falkirk that relied on coal to provide power the heavy machinery:

.....

Q7. Give one pro / one con of coal as an energy source

.....

Q8. Give one pro / one con of wind power as an energy source

.....

Answers

Q1. d)

Q2. (onshore / offshore)

Q3. Windy/rural area

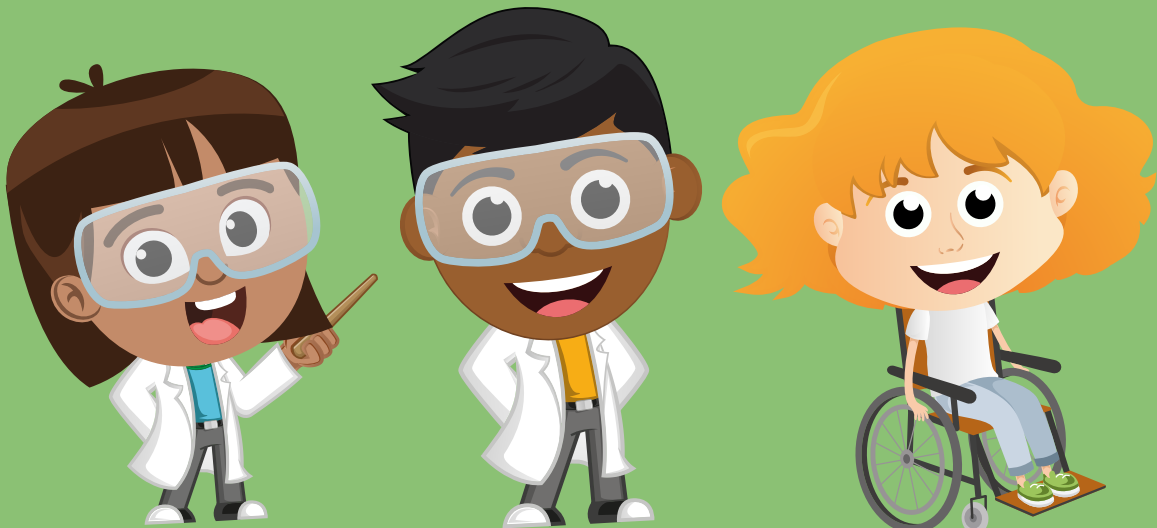
Q4. c)

Q5. b)

Q6. (brick-making, iron foundries,
sieve-making, file-making)

Q7. see sorting activity for
range of answers

Q8. see sorting activity for range
of answers



Well Done!

