



Electricity

Lesson 2

This guide is designed to accompany and complement:

- Presentation: **Electricity**
- Single page lesson plan: **Electricity**
- Worksheet: **Electricity** (including activities and possible extension tasks or homework)

The guide goes into greater detail than the single page lesson plan and includes suggested resources and elaborates on each slide in the presentation.

Presentation Tips:

- When opening the PDF presentation, you can select how it is displayed. If you wish to **click through** as opposed to scrolling (which gives you more control as you progress and is more like a conventional ppt) it is best to show it in **'full screen mode'** (press 'escape' to exit).
- All associated documents are attached to the presentation. To find these, click on the **paperclip icon** in the left-hand toolbar.
- When viewing the presentation, presenter notes from this delivery guide are also available for reference if you hover the cursor over the small orange callout icon in the top left corner. **Fig.1**

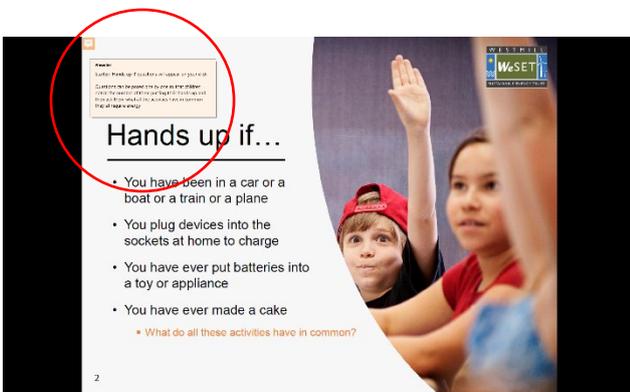
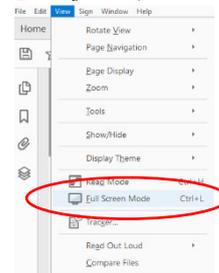


Fig.1

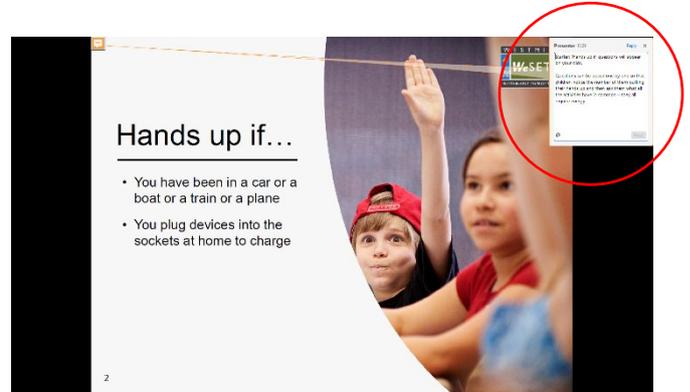


Fig.2

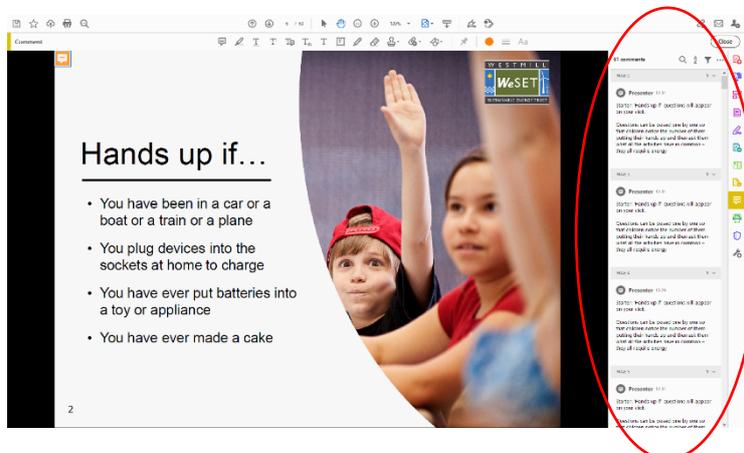


Fig.3

- If you **right click** on that icon it will open a small window showing presenter notes in the top right of the page. **Fig.2** If you right click and scroll down, you can also choose to click **'show comment app'** which opens a panel on the right of the page showing all the presenter notes as you scroll through. **Fig.3**

20 minutes to fill?

You could show the video clips 'Fossil fuels' [2m42s] and then 'Renewable energy' [3m16s] to start a discussion about non-renewable and renewable energy sources

Slide 12
Slide 16

Slide number refer to the numbers on the slides themselves

This presentation is designed to allow the presenter/teacher to pitch it as appropriate to higher KS2 or lower KS3 (approximate age range 6 – 12 years). Questions that are on the slides have been differentiated by colour in this guide, with **red** being most challenging.

 Those marked with this icon **may not appear on the slide** and are optional, higher level questions.

 Points marked with this icon **may not appear on the slide** but can be used as a starting point for a personal investigation activity and for extension where appropriate.

Advisory! All videos are linked to external players (usually YouTube) these have been chosen to complement and reinforce learning and have been chosen carefully. However, we would **advise that you watch them yourself prior to showing them** to ensure that you are happy that the content is right for your children or class.

Suggested resources

WeSet resources

2

This first question should help revise types of energy and terms featured in lesson 1

- **Start by asking children what other types of energy electrical energy can be transformed into – examples may include but are not limited to the answers which will come up one-by-one on the click of the mouse. Children can be encouraged to give examples: Thermal energy e.g. electric heaters, sound energy e.g. a radio, light energy e.g. a desk lamp, kinetic energy e.g. a desk fan, mechanical energy e.g. an electric car**
- **How would your life be different if you didn't have easy access to electricity? – no electric light, no phone charging, no TV/computers, no electric appliance etc. You may like to elaborate with questions like how would you feel if you couldn't charge your phone? Do you think you would be able to cope without electrical appliances etc.**
-  **What type of current do we use in our homes and why, AC (alternating current) or DC (direct current)? – AC, it loses less current as it travels through the power lines and it is also easier to change the voltage of AC**

There are still countries in the world, particularly in sub-Saharan Africa with very limited access to electricity for example, in South Sudan only 5.1% of the population have access to electricity!

PDF presentation, worksheet and lesson plan

<p>3</p>	<p>We now take electric lighting for granted, it is available at the flick of a switch but even as recently as 1970s people in Great Britain lived with the threat of regular power outages due to combinations of political unrest and striking and high oil prices, it was commonplace to keep a jar of candles to hand!</p> <ul style="list-style-type: none"> • Ask children if they can suggest any problems that might have arisen from using light sources with a naked flame – fires and even explosions. Gas lights were volatile and used to light public places like theatres; on 4th September 1887, a fire broke out during a production at the Theatre Royal in Exeter. The fire claimed 150 lives • Other than light energy, what types of energy does a flame generate? – heat or thermal energy, kinetic energy and to a small extent, sound energy 	<p>A candle and example of any other pre-electric light e.g. an oil lamp or gas camping light</p>	
<p>4</p>	<p>There is sometimes an assumption that Thomas Edison was solely responsible for the development of the electric light bulb, so it is good to remind children that, as with so many landmark inventions, many people are involved in creating a working solution.</p> <ul style="list-style-type: none"> • In an arc light, the arc is a bright electrical discharge that jumps between metal two electrodes through a gas (this will be an inert gas that will not create a reaction) inside a vacuum, in this case a glass bulb. • Incandescent light is produced by heating a metallic filament which then radiates light (there has recently been a resurgence in popularity for their aesthetic qualities however a clever LED version can create a similar effect). <p>☞ Humphry Davy was a Chemist, Frederick de Moleyns was an inventor, Joseph Wilson Swan was a physicist and Thomas Edison an inventor.</p> <p>☞ Davy, de Moleyns and Swan were British, and Edison was an American.</p> <p>☞ Edison's patented idea used a carbon coated bamboo filament where previous materials like charcoal, paper and cotton had failed.</p> <p>Edison's bulbs could last around 600 hours.</p> <p>👉 How does 600 hours compare with the expected life of an LED bulb? – You would expect an equivalent LED bulb today to last about 25,000 hours</p>	<p>https://www.youtube.com/watch?v=Q4rQDN6Z4s</p>	

5	<p>Task 1 This slide can be used alone or in conjunction with the differentiated worksheet where children can write their answers in the table provided for recorded formative assessment.</p> <ul style="list-style-type: none"> • Ask children to use the words in the list to fill in the gaps in the sentences – once you have gone through the task, the answers will appear one by one on the click of the mouse <p>There is a brief extension task on the worksheet.</p>		Worksheet 2 Electricity
6	<p>Introduce the idea of renewables and non-renewables starting positively with renewable sources as these are going to be the focus</p> <ul style="list-style-type: none"> • What is a commonly used term for non-renewable sources like gas, coal and oil? – Fossil fuels • Ask children whether they think nuclear energy is a renewable or non-renewable source – it is non-renewable as it relies on the mining of Uranium, a resource found in the earth’s crust; however, Uranium, whilst ultimately finite, is still an abundant resource. That being said, there are other issues with the sustainability of Nuclear which will be discussed later 		
7	<ul style="list-style-type: none"> • Why is the term ‘fossil fuels’ used? - the term relates to deposits of organic matter that are formed from the decayed animals and plants over 1000s of years which burn easily <p>Note: fossil fuels are burnt to heat water to make steam that is used to turn generators or put in engines (like those in some cars) to turn generators</p> <p>Cosmetics that are oil based include lipsticks, lotions, perfumes, Vaseline</p> <ul style="list-style-type: none"> • What type of energy do fossil fuels contain? - potential chemical/chemical energy 	A collection of fossil fuel derived products e.g. plastic and cosmetics	

<p>8</p>	<p>Explain that coal is still both surface (in quarries) and pit mined (underground). Both are dirty and potentially dangerous processes.</p> <p><i>☞</i> We have been mining coal for fuel for hundreds of years. You may like to ask children to consider how it might have been to be a pit miner before the invention of battery/electric lighting – they used gas lamps which were volatile and caused fumes. Miners spent long hours down the pits and in winter month often didn't see the light of day. As well as physical injury from the hard labour, miners often had vitamin deficiencies (D from lack of sunlight) and lung diseases/breathing problems.</p> <ul style="list-style-type: none"> • How do we use coal at home? - Coal is used for domestic fires and in multifuel stoves as well as on BBQs <p><i>🔥</i> What is the process of burning a fuel to generate electrical energy called? – Combustion</p>	<p>https://www.youtube.com/watch?v=iN6LVH_4O3g [2m49s]</p>	
<p>9</p>	<p>Crude oil has been called 'black gold' such is its value, and access to oil reserves has caused conflicts throughout history. Seismic survey ships are used to detect potential oil reserves at sea. This is important as the process of drilling and extracting oil is expensive and so a viable source has to be identified first.</p> <p><i>🔥</i> Where is crude oil sent to have the contaminants removed? – A refinery</p> <ul style="list-style-type: none"> • How is crude oil transformed into mechanical energy? - Oil is refined to create petroleum and diesel which we use in combustion engines in some cars 	<p>https://www.youtube.com/watch?v=UPAqFTNiats [2m16s]</p>	

10	<p>Natural gas is found in the pores in sedimentary rock along with oil and water. In recent years developments in methods of natural gas extraction, especially fracturing or fracking have caused controversy as the drilling required can cause tremors like low level earthquakes.</p> <ul style="list-style-type: none"> • What other type of energy do we use processed natural gas for in our homes? - Types of refined natural gas may be purified and used for heat and electric energy <p>Natural gasses are also used in refrigerants and to make some plastics and sometime natural gas is used as a fuel for vehicles.</p> <ul style="list-style-type: none"> • 🔦 Why could a natural gas leak be particularly dangerous? – Natural gas is highly flammable but cannot be seen or smelt (colourless and odourless) and so leaks are hard to detect 	<p>https://www.youtube.com/watch?v=-nimidiWu8 [3m38s]</p>	
11	<p>Task 2 This slide can be used alone or in conjunction with the differentiated worksheet where children can write their answers in the table provided for recorded formative assessment.</p> <ul style="list-style-type: none"> • Ask children to match the fossil fuels, products and extraction methods – arrows will appear one by one on the click of the mouse 		Worksheet 2 Electricity
12	<p>You can choose whether to show the video clip as it will only commence once you have clicked on the ‘play’ icon.</p> <p>The clip runs for [2m42s] and is a factual explanation of fossil fuels and non-renewables.</p>	<p>https://www.youtube.com/watch?time_continue=4&v=zaXBVYr9ji0&feature=emb_logo [2m42s]</p>	Embedded clip in ppt
13	<p>We have been relying on fossil fuels for hundreds of years, but we cannot continue to ignore the problems this has caused. Not only are these resources depleted, the damage we have caused to the planet by drilling, digging, extracting, refining and using them is now very evident.</p> <ul style="list-style-type: none"> • What problems are caused by the release of carbon dioxide into the atmosphere? – What is known as the ‘greenhouse effect’, which is where heat is able to get in but unable to escape our atmosphere. This has raised the average temperature of the Earth which has in turn caused changes including the melting of the ice caps and a rise in sea levels. 		

14

🔥 What is the process of the splitting of Uranium atoms called? – Fission

Uranium is naturally radioactive - very small particles in the Uranium emit energy. There are different levels of radioactivity, and exposure to radioactivity can cause harm.

As of 2017, nuclear power supplied about 10% of global electricity.

Nuclear energy is sometimes known as a **low-carbon power source** as it is **less obviously polluting** however, **greenhouse gases (GHGs) are emitted throughout the lifecycle of a nuclear reactor - during construction, operation, the production of fuel and when the plant is dismantled and any waste materials are disposed of!**

- **Where does Uranium comes from? – Uranium is mined from rock in the Earth's crust**

https://www.youtube.com/watch?v=440vdxOvP_A [2m56s]

<p>15</p>	<ul style="list-style-type: none"> • What does sustainable mean? – for something to be sustainable it must be able to be maintained at a level that does not use up the world’s resources or cause damage <p>In 1987, The Brundtland Report defined sustainability as:</p> <p>"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."</p> <p>☞ Renewable energy is not a new concept. Why type of renewable energy source was harnessed by the Romans to heat their houses? - Geothermal energy and we are still using it today; where underground steam or hot water can be brought to the surface it can be used for heating and to generate electricity, <u>however</u> the Romans also cut down trees and burned timber as a fuel, if tree felling is unregulated of they are felled at a faster rate than they can be re-grown this leads to deforestation. Forestry must be carefully managed to be sustainable</p> <p>Introduce the idea of clean energy, remember to explain that, whilst renewables may be called ‘clean’ there may still be some pollution caused by their manufacture, transport or installation however in many cases this is ‘offset’ by the clean energy they produce during their lifetime. In the long-term engineers and manufacturers are continually looking at ways of making these processes cleaner.</p> <p>Whilst we still need to introduce and use more renewable energy it is good to point out that it is predicted that by the early 2020s the UK will be generating over half of its energy from renewable energy sources.</p> <ul style="list-style-type: none"> • Do you know whether your energy supplier uses renewable energy? – they may or may not be aware of this however it is a positive point to make that some suppliers including Ovo, Bulb and Octopus now supply electricity from 100% renewable energy sources 	<p>https://www.are.admin.ch/dam/are/en/dokumente/nachhaltige_entwicklung/dokumente/bericht/our_common_futurebrundtlandreport1987.pdf</p>	
<p>16</p>	<p>You can choose to show the video clip as it will only commence once you have clicked on the ‘play’ icon.</p> <p>The clip runs for [3m16s] and is a positive introduction to renewable energy.</p>	<p>https://www.youtube.com/watch?time_continue=2&v=1kUE0BZtTRc&feature=emb_logo [3m16s]</p>	

17	<p>The kinetic energy of the wind has been harnessed throughout history to provide mechanical energy. We will look at wind energy in much more detail in a later lesson.</p> <ul style="list-style-type: none"> • Where do you find wind turbines? – You find turbines both on land and at sea. Onshore wind farms are often built on high or open ground <p>Unlike fossil fuels which are burnt to heat water to make steam that is used to turn generators or put in engines (like those in some cars) to turn generators, the wind is directly used to turn generators!</p>	<p>A handheld toy windmill and a hairdryer</p> <p>https://www.youtube.com/watch?v=Z5c50-hcD0 [1m46s]</p>	
18	<p>Solar energy can be used to generate electricity but is also used for thermal energy too. We will look at solar energy in much more detail in a later lesson.</p> <ul style="list-style-type: none"> • In the UK which direction do solar panels need to face to capture the most sunlight? – They should all be facing south <p><i>☞</i> Does this apply to all countries? – No! In southern hemisphere countries, panels should be facing north</p> <p>Solar PV https://www.youtube.com/watch?v=ql5tY5Noacc [1m51s]</p> <p>Solar thermal https://www.youtube.com/watch?v=FgjfJGfudE [2m47s]</p>	<p>A product with a small solar panel like a calculator</p> <p>https://www.youtube.com/watch?v=yFwGpic3s [1m00s]</p>	
19	<p>Hydro power has been used since ancient times to grind flour and provide mechanical energy for other tasks.</p> <p>The flow and strength of running, moving or falling water is harnessed to generate power. Sources include rivers, streams, the sea's tides or man-made systems like dams.</p> <ul style="list-style-type: none"> • What is the name used for a manmade lake held back by a dam? – A reservoir 	<p>You can use a handheld windmill as a turbine and put it under a tap to show it turning</p> <p>https://www.youtube.com/watch?v=q8HmRLGgDAI [3m12s]</p>	

20	<p>Historically, geothermal energy use has been limited to areas where there is evidence of natural reserves near the Earth's surface (these are near the point where tectonic plates meet). Unfortunately, when drilled, geothermal wells release greenhouse gases trapped inside the earth however these emissions are much lower than those released by the extraction and use of fossil fuels.</p> <ul style="list-style-type: none"> • Can you think of any places in the UK where there are natural hot springs? – Bath in Somerset has natural hot springs however there are also warm springs in other places including Buxton, Matlock, Bristol and Rhondda Cynon Taff in Wales 	<p>https://www.youtube.com/watch?v=DFQrE91kZwk [2m08s] The same as above but with the steam from a kettle</p>	
21	<p>Biomass 'heat logs' are now readily available for sale in supermarkets. The advantage of biomass is that it is a byproduct of industry that utilises a resource that would otherwise be wasted.</p> <ul style="list-style-type: none"> • What does the term 'byproduct' mean? – A byproduct is a material that is left over after the process of a product, material or food for example, woodchip left over from the conversion of trees to timber. Wool is also a byproduct of farming for food • Do you think there are any disadvantages to burning biomass? - Burning biomass does still release some CO₂ so it is not as clean as other renewables 	<p>https://www.youtube.com/watch?v=yHWcddUZ35s [3m38s] A domestic biomass heat log</p>	
22	<p>The site at Westmill is an arable farm and the high, flat open landscape is ideal for a wind farm.</p> <ul style="list-style-type: none"> • How many homes do you think benefit from this power? – the solar park generates enough electricity to supply around 1,500 average homes and the wind farm generate enough electricity to supply approximately 3,000 average homes • What are the benefits of community run renewable energy sites like Westmill? – Local people have the opportunity to invest and get involved, a large proportion of profits go back into the local community, the local community benefits from sustainable energy 		

23	<p>Task 3 This slide can be used alone or in conjunction with the differentiated worksheet where children can write their answers in the table provided for recorded formative assessment.</p> <p>An example has been given to help children understand the activity.</p> <ul style="list-style-type: none"> • Ask children to identify the types of renewable energy from the sources pictured and describe how the sources are harnessed– answer bubbles will appear one by one on the click of the mouse <p>Answers may vary in detail depending on the age group</p>		
24	<p>The image shows the ‘Supertree Grove Trees’ at the Gardens by the Bay in Singapore https://www.gardensbythebay.com.sg/en.html</p> <p>The 2050 target</p> <p>“The Climate Change Act commits the UK government by law to reducing greenhouse gas emissions by at least 100% of 1990 levels (net zero) by 2050. This includes reducing emissions from the devolved administrations (Scotland, Wales and Northern Ireland), which currently account for about 20% of the UK’s emissions. The 100% target was based on advice from the CCC’s 2019 report, ‘Net Zero – The UK’s contribution to stopping global warming’.”</p> <p><i>Taken from Committee on Climate Change website</i> https://www.theccc.org.uk/tackling-climate-change/the-legal-landscape/the-climate-change-act/</p> <ul style="list-style-type: none"> • How can you help make this happen? – being more mindful of the energy you consume for example by turning off lights and appliances and choosing rechargeable as opposed to single use batteries or using low energy light bulbs. Choosing not to buy ‘fast fashion’ (see attached resource video), reducing food miles. The 6 Rs: Recycling, re-using, rethinking, refusing, reducing and repairing. Reducing air miles. Car sharing etc • What type of jobs do you think are available to you in renewable energy? – remind them that there are a wide range of jobs in areas from science and engineering to design, marketing, programming, construction, ecology, farming and development etc. This is a fast-growing area! <p> How do you think a job in RE would compare to the kinds of jobs traditionally done in the non RE industries, for example that of a coal miner?</p>	<p>The lifecycle of a T-shirt https://www.youtube.com/watch?v=BiSYoeqb_VY Food miles/food footprint https://www.youtube.com/watch?v=k7DQ0EEgXV4</p>	

25

You can choose to show the video clip as it will only commence once you have **clicked on the 'play' icon**

The clip runs for [2m20s] and was produced in 2018 review progress over the 10 years since the 2008 Climate Change Act

2019 amendment to the Climate Change act requiring net zero in 2050 - On 12 June 2019 the Government laid the draft Climate Change Act 2008 (2050 Target Amendment) Order 2019 to amend the Climate Change Act 2008 by introducing a target for at least a 100% reduction of greenhouse gas emissions (compared to 1990 levels) in the UK by 2050

Critical thinking opportunities

- 👉 How did we get to this stage?
- 👉 Are all countries the same?
- 👉 What more can governments do?
- 👉 Do we all have responsibility as individuals?
- 👉 What more can we do?

As a possible extension task or homework, **Task 4** on the worksheet asks children to write a short paragraph describing how you think the landscape could **look** in future if we meet the targets set by the **Climate Change act 2008 and 2019 amendments**

26

Plenary Quiz - What have you learnt?

This can be done as a quick-fire hands up quiz or pupils can be given time to write down their own answers for formative assessment.

- **In 1880, who patented a commercially viable incandescent bulb? - Thomas Edison**
- **What do we call the two types of source of electrical energy? – Non-renewable and renewable**
- **Coal and crude oil are also known as ----- fuels - Fossil**
- **Fossil fuels are finite resources what does this mean? - They will not last forever and will ultimately run out**
- **Can you name the sources of renewable energy? – Wind, solar, hydro, geothermal, biomass**
- **Where can you find two of these sources located together? – Westmill (Watchfield, Shrivenham, Swindon)**

26	<p>All images used are royalty free, 'Creative Commons' and free to use for non-commercial purposes</p> <p>Sources include: https://www.freeimages.com https://pixabay.com https://unsplash.com http://westmillsolar.coop/ http://www.weset.org/</p> <p>Microsoft online pictures search (Creative Commons only)</p> <p>To arrange a site visit, please go to http://www.weset.org/?page_id=126</p> <p>Or email education@weset.org</p> <p>These materials are free to use and reproduce however we respectfully ask that you do not edit them</p>		
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