



Physics Scheme of Learning

P3: Energy Resources

Intent – Rationale

This term students tackle the general operating principles of different energy sources. Energy sources are organised into two categories: renewable (e.g. wind, tidal, hydroelectric, solar energy) and non-renewable (fossil fuels, nuclear energy). Advantages and disadvantages of different sources are discussed, covering many areas such as cost, geographical location and environmental impact.

In addition to the types of energy resources used, students analyse the UK’s energy usage to identify the most suitable sources to use for e.g. baseload power. Students discuss the history of nuclear energy, in particular past nuclear disasters and arguments for and against its use.

Sequencing – what prior learning does this topic build upon?	Sequencing – what subsequent learning does this topic feed into?
KS3 Topic 1 Energy transfers KS3 Topic 3 Energy resources KS3 Topic 8 Waves and sound KS3 Topic 11 Heat transfer KS4 P1 Conservation and dissipation of energy KS4 P2 Energy transfer by heating	<ul style="list-style-type: none"> • P5 Electricity in the home • P6 Molecules and matter • P7 Radioactivity
What are the links with other subjects in the curriculum?	What are the links to SMSC, British Values and Careers?
<ul style="list-style-type: none"> • Geography – suitability of renewable resources for particular areas of land/coast/sea, impact of these sources on the area (wildlife habitats, human populations, etc). 	<ul style="list-style-type: none"> • Use the coded help guides to complete this section
What are the opportunities for developing literacy skills and developing learner confidence and enjoyment in reading?	What are the opportunities for developing mathematical skills?
FROM THE LIBRARY <i>A Dictionary of Physics</i> -530.03 <i>Energy From Fossil Fuels</i> -620 <i>Energy</i> ; Louise Spilsbury-530 <i>Energy</i> ; Chris oxlade-531 <i>Energy and Chemical change</i> ; Brian Knapp-531 <i>Energy and Cells</i> ; C Gayford-571.6 <i>Energy Alternatives</i> ; Robert Sneddon-620 <i>Chernobyl and Other Nuclear Accidents</i> ; Judith Condon-363 <i>Elements of Nuclear Physics</i> ; W.E. barcham-539 <i>Introduction to Atomic and Nuclear Physics</i> ; H Semat-539 <i>Nuclear Disaster</i> ; A Wolf-363	<ul style="list-style-type: none"> • Reading tables and graphs of data for the purposes of comparison • Calculating cost effectiveness of different energy sources • Unit prefixes



Physics Scheme of Learning

P3: Energy Resources

Intent – Concepts

What knowledge will students gain and what skills will they develop as a consequence of this topic?

Know

- Know which fuels are renewable and which are non-renewable.
- Identify activities that require large energy transfers.
- State that biofuels are carbon neutral whereas fossil fuels are not.
- State that wind turbines, wave generators, hydroelectric systems, and tidal systems are renewable energy resources.
- State some simple advantages or disadvantages of renewable energy systems.
- Outline the operation of a renewable energy source.
- State one difference between solar cells and solar heating systems.
- State that radioactive decay is source of heating in geothermal systems.
- State some environmental problems associated with burning fossil fuels.
- Identify the waste products of fossil fuels and nuclear fuel.
- Rank the start-up times of various power stations.

Apply

- Outline the operation of a fossil fuel burning power station.
- Outline the operation of a nuclear power station.
- Explain why biofuels are considered carbon neutral.
- Describe the operation of a wind farm, a hydroelectric system, solar cells, and a geothermal plant.
- Suggest the most appropriate energy resource to use in a range of scenarios.
- Compare and contrast the operation of solar cells (photovoltaic cells) with solar heating panels.
- Describe the effects of acid rain and climate change.
- Describe techniques to reduce the harmful products of burning fossil fuels.
- Compare a wide range of energy resources in terms of advantages and disadvantages.
- Use base load and start-up time data to explain why some power stations are in constant operation whereas others may be switched on and off.
- Compare energy resources in terms of capital and operational costs.

Extend

- Compare energy use from different sources and different societies from available data.
- Compare fossil fuels and nuclear fuels in terms of energy provided, waste, and pollution.
- Discuss some of the problems associated with biofuel use and production.
- Compare the operation of hydroelectric, wave, and tidal systems in terms of reliability, potential power output, and costs.
- Explain in detail the purpose, operation, and advantages of a pumped storage system.
- Justify the choice of an energy resource by using numerical and other appropriate data.
- Analyse the power output of a variety of energy resources.
- Calculate the energy provided by a solar heating system by using the increase in water temperature.
- Plan in detail an investigation into the factors that affect the power output of a solar cell.



- Discuss in detail the problems associated with nuclear accidents and the public perception of nuclear safety.
- Evaluate the suitability of an energy resource for a range of scenarios, taking into account a wide range of factors.
- Use capital and operational costs of energy resources to evaluate their usefulness.
- Debate the construction of a power plant in local area by using a wide range of information, much of which is independently researched.

What subject specific language will be used and developed in this topic?	What opportunities are available for assessing the progress of students?
<ul style="list-style-type: none"> • Alternator An alternating current generator. • Biofuel Any fuel taken from living or recently living material, such as animal waste. • Carbon neutral A biofuel taken from a living organism that taken in as much carbon dioxide from the atmosphere as is released when the fuel is burned. • Moderator Substance in a nuclear reactor that slows down fission neutrons. • National Grid The network of cables and transformers used to transfer electricity from power stations to consumers e.g. factories, homes, shops, offices, etc. • Nuclear fission reactors Reactors that release energy steadily due to the fission of a suitable isotope. • Nuclear fuel Substance used in nuclear reactors that releases energy due to nuclear fission. • Radioactive contamination The unwanted presence of materials containing radioactive atoms on other materials. • Reactor core The thick steel vessel used to contain fuel rods, control rods and the moderator in a nuclear fission reactor. • Renewable energy Energy from natural sources that is always replenished so it never runs out. 	<ul style="list-style-type: none"> • Assessed homework 1 (Fuel for transport) assesses students' ability to: <ul style="list-style-type: none"> ○ Use numerical data to make observations and make inferences about the suitability of different fuels for a specified purpose ○ Compare the properties of different fuels (economic factors, sustainability, environmental impact) and make a judgement about the best fuel for a particular situation ○ Convey physics ideas using suitable terminology and good, clear prose. • Assessed homework 2 (Generating electricity) assesses students' ability to: <ul style="list-style-type: none"> ○ Suggest suitable energy sources for a particular area based on given information ○ Explain why suggested sources are the most suitable for that area, with reference to how they operate ○ Convey physics ideas using suitable terminology and good, clear prose. • Assessed homework 3 (Solar panels) assesses students' ability to: <ul style="list-style-type: none"> ○ Discuss advantages and disadvantages of a renewable energy source ○ Use numerical data to make inferences about the suitability of renewable energy sources for domestic use ○ Convey physics ideas using suitable terminology and good, clear prose.



Intent – Concepts

Lesson title	Learning challenge	Higher level challenge	Suggested activities and resources
P3.1 Energy demands	<ul style="list-style-type: none"> • Can I identify which fuels are renewable and which are non-renewable? • Can I state that biofuels are carbon neutral whereas fossil fuels are not? • Can I outline the operation of a fossil fuel burning power station? • Can I outline the operation of a nuclear power station? 	<ul style="list-style-type: none"> • Can I compare energy use from different sources and different societies from available data? • Can I compare fossil fuels and nuclear fuels in terms of energy provided, waste, and pollution? 	
P3.2 Nuclear and hydroelectric energy	<ul style="list-style-type: none"> • Can I describe the operation of a hydroelectric system? • Can I identify the waste products of fossil fuels and nuclear fuel? 	<ul style="list-style-type: none"> • Can I explain in detail the purpose, operation, and advantages of a pumped storage system? • Can I use base load and start-up time data to explain why some power stations are in constant operation whereas others may be switched on and off? 	
P3.3 Energy from wind and water	<ul style="list-style-type: none"> • Can I state that wind turbines, wave generators and tidal systems are renewable energy resources? • Can I state some simple advantages or disadvantages of renewable energy systems? • Can I describe the operation of a wind farm? 	<ul style="list-style-type: none"> • Can I compare the operation of wave and tidal systems in terms of reliability, potential power output, and costs? 	
P3.4 Power from the Sun and the Earth	<ul style="list-style-type: none"> • Can I state one difference between solar cells and solar heating systems? • Can I state that radioactive decay is source of heating in geothermal systems? 	<ul style="list-style-type: none"> • Can I describe the operation of a geothermal power plant? • Can I compare and contrast the operation of solar cells (photovoltaic cells) with solar heating panels? 	
P3.5 Energy and the environment	<ul style="list-style-type: none"> • Can I list some environmental problems associated with burning fossil fuels? • Can I identify the waste products of fossil fuels and nuclear fuel? • Can I state simple advantages and disadvantages of a variety of renewable energy resources? 	<ul style="list-style-type: none"> • Can I evaluate methods of reducing damage caused by waste products of fossil fuels and nuclear fuels? • Can I evaluate the suitability of an energy resource for a range of scenarios, taking into account a wide range of factors? 	
Revision			
Assessment			