



Narrative – Power station or not?

Year group and curriculum area	Year 9 or 10. Science/physics.
Activity	Discussion on the merits of pumped storage systems in producing electricity to meet sudden high levels of demands in the National Grid.
Topic	Energy – renewable and non-renewable sources/generating electricity.
Possible strategy/solution	<p>Purpose of the activity</p> <p>To read an article about pumped storage systems with understanding and to be able to pick out common misconceptions which are made about hydro-electric systems.</p> <p>Requirements</p> <ul style="list-style-type: none">• Activity sheet and summary sheet 'Power station or not?'.• Recording sheet for noting discussion and final decisions on the interpretation of a document designed to provide scientific information about a system designed to generate electricity from a renewable source. <p>Possible strategy</p> <p>Task 1</p> <p>Learners are introduced to the problem/debate and provided with some basic knowledge of the system. The article and Siân's and Rhodri's comments need careful interpretation.</p> <p>Several misconceptions are embedded in the information.</p> <p>Learners are divided into groups and allocate roles to make the discussion purposeful.</p> <p>Learners are encouraged to think of a strategic approach to the problem.</p>

They use a placemat/source square or similar recording strategy in order to capture points that have been grouped under a strategic heading, e.g. incorrect science, calculations, etc. The headings could be supplied by the teacher or generated by learner groups.

Points made

The following are possible examples.

Siân

‘The station does not generate electricity’ – This is an incorrect statement. The scheme does generate electricity. The evidence comes from the article which states that the water drives turbines connected to generators which produce electricity when required. The unit for electrical power is Watts (W) and MegaWatts (MW). MegaWatts are a million Watts. The article states that the station produces 1,320MW in 12 seconds. This is evidence again to suggest that it does generate electricity.

Siân

‘ . . . it stores electricity, ready for use at peak times’ – This statement is incorrect. It does not store electrical energy. Water in the upper reservoir has potential energy, because it is high up in the mountain. When the taps are opened the water rushes down and the potential energy is changed to kinetic energy of the water, which is used to turn turbines and generate electricity when required. There is no mention in the article of any electrical storage system, e.g. a battery.

Rhodri

‘It changes **all** the moving water’s energy to electricity’ – Part of this statement is correct but not all. The scheme does change the moving water’s energy to electricity but not **all** of it to electricity; some is converted to sound, heat, etc. Only 70–75% of it is converted to electricity.

Efficiency is defined as:
amount of power out ÷ amount of power in.

It is expressed as a percentage. For it to change **all** the water’s energy to electricity it would need to be 100% efficient.

Rhodri

‘It is renewable energy and is free’ – This is incorrect. Energy is taken from other power stations (coal, nuclear, etc.) which are constantly running via the National Grid during night time and used to pump water back up the mountain. It would only be ‘free’ if the upper lake was constantly being topped up by rainfall after use and it did not need electricity from other power stations to pump the water back up to the top reservoir at low demand.

	<p>Rhodri ‘It does not need a source of energy like coal and nuclear stations do’ – This is incorrect. The principle of conservation of energy says that energy cannot be created or destroyed. The scheme converts the potential energy of the stored water in the upper lake when the taps are opened and the water begins to move to kinetic energy and then to the kinetic energy of the turbine which drives a generator to produce electricity. Therefore the source of energy is the potential energy of the water. It also needs electricity from other power stations to pump the water back up to the top reservoir at low demand.</p> <p>Task 2</p> <p>Provide the following information to the learners.</p> <p>Power of kettle = 3,000W To boil enough water to make 10 cups of tea.</p> <p>Total power supplied by the power station = 1,320MW</p> <p>Convert 1,320MW to Watts = 1,320,000,000W</p> <p>So how many kettles full of water can be used = $1,320,000,000 \div 3,000$</p> <p>This works out to be 440,000 kettles.</p> <p>440,000 kettles each making 10 cups of tea therefore this gives 4,400,000 cups. That’s a lot of cups of tea!</p> <p>The discussion then focuses on the so called ‘lost’ energy, i.e. the energy passed into the surroundings from the heating element and not into the water to bring it to the boil. This leads to higher amounts of energy being used to bring the water to boil than calculated. This means that the number of cups of tea from the total energy supplied is optimistically high.</p>
<p>Links with the LNF</p>	<p>Skills</p> <ul style="list-style-type: none"> • Generating and using a strategy to solve problems. • Working collaboratively to solve a problem. <p>Numeracy component</p> <p>Strand: Developing numerical reasoning (Year 9/10)</p> <p>Element: Identify processes and connections (Year 9/10) Learners are able to:</p> <ul style="list-style-type: none"> • transfer mathematical skills across the curriculum in a variety of contexts and everyday situations • select, trial and evaluate a variety of possible approaches and break complex problems into a series of tasks

- prioritise and organise the relevant steps needed to complete the task or reach a solution
- choose an appropriate mental or written strategy and know when it is appropriate to use a calculator
- identify what further information might be required and select what information is most appropriate
- select appropriate mathematics and techniques to use.

Element: Represent and communicate (Year 9/10)

Learners are able to:

- explain results and procedures precisely using appropriate mathematical language
- refine methods of recording calculations.

Element: Review (Year 9/10)

Learners are able to:

- select and apply appropriate checking strategies
- interpret answers within the context of the problem and consider whether answers, including calculator, analogue and digital displays, are sensible
- verify and justify results or solutions, including discussion on risk and chance where relevant
- interpret mathematical information; draw inferences from graphs, diagrams and data, including discussion on limitations of data
- draw conclusions from data and recognise that some conclusions may be misleading or uncertain.

Strand: Using number skills (Year 9/10)

Element: Fractions, decimals, percentages and ratio (Year 9)

Learners are able to:

- use equivalence of fractions, decimals and percentages to select the most appropriate for a calculation
- use and interpret different representations of fractions, *e.g. mixed numbers and improper fractions*
- express one quantity as a percentage of another
- calculate a percentage increase or decrease
- use ratio and proportion to calculate quantities.

Element: Calculate using mental and written methods (Year 9)

Learners are able to:

- use efficient written methods to add and subtract numbers and decimals of any size, including a mixture of large and small numbers with differing numbers of decimal places
- multiply and divide whole numbers and decimals.

Element: Estimate and check (Year 9/10)

Learners are able to:

- make and justify estimates and approximations of calculations
- choose the appropriate degree of accuracy to present answers
- recognise and define limitations on accuracy of measurements.

Strand: Using data skills (Year 9)**Element: Collect and record data, Present and analyse data, Interpret results (Year 9)**

Learners are able to:

- examine results critically, select and justify choice of statistics recognising the limitations of any assumptions and their effect on the conclusions drawn.

Literacy component**Strand: Reading across the curriculum (Year 10)****Element: Locating, selecting and using information (Year 10)****Aspect: Reading strategies (Year 10)**

Learners are able to:

- use their knowledge of:
 - word roots and families
 - grammar, sentence and whole-text structure
 - content and contextto make sense of words, sentences and whole texts.

Element: Responding to what has been read (Year 10)**Aspect: Response and analysis (Year 10)**

Learners are able to:

- compare and contrast themes and issues across a range of texts and make text-to-text connections
- synthesise and analyse information to gain in-depth understanding from sources which may have conflicting views
- understand and distinguish between facts/evidence and bias/argument commenting on both obvious points and inferences
- comment on different interpretations of issues and ideas, using the text to support opinions
- evaluate the purpose, impact and reliability of texts.

Strand: Writing across the curriculum (Year 10)

Element: Organising ideas and information (Year 10)

Aspect: Meaning, purposes, readers (Year 10)

Learners are able to:

- write both extended pieces, which include detailed evidence and information, and shorter pieces which summarise concisely, showing clear awareness of the reader or intended audience
- construct responses that connect and develop ideas to fully cover the topic.

Aspect: Structure and organisation (Year 10)

Learners are able to:

- improve the content, structure and accuracy of their writing through independent review and editing
- write independently in an appropriate form with increasing confidence, ensuring content is organised, detailed and relevant, *e.g. how best to present opinions, information and explanations*
- organise writing in an appropriate form, ensuring content is detailed within and between paragraphs or sections.

Element: Writing accurately (Year 10)

Aspect: Language (Year 10)

Learners are able to:

- use language to convey objectivity and impartiality, acknowledging that there may be more than one viewpoint, *e.g. arguably, it can be seen that ...*
- use a wide range of technical terms, appropriate vocabulary, and expression for different purposes and to create different effects, *e.g. to persuade, inform, entertain.*

Aspect: Grammar, Punctuation, Spelling, Handwriting (Year 10)

Learners are able to:

- vary sentence structures to engage and sustain the reader's interest and write with grammatical accuracy
- use the full range of punctuation in order to vary pace, clarify meaning, avoid ambiguity and create deliberate effects
- use a variety of strategies and resources to accurately spell an increasing range of familiar, unfamiliar and subject-specific words
- present their handwritten or on-screen work effectively, choosing form, images and graphics to enhance meaning
- Welsh-medium statement: write grammatically accurate sentences ensuring that the verb tense and person is correct in context

	<ul style="list-style-type: none">• Welsh-medium statement: use a range of mutations correctly (soft, nasal and aspirate mutations) in context.
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