THE PHYSICS QUESTION BANK · AQA GCSE PHYSICS

Power the Island – Energy Resources

A one-hour lesson. You will find out where our electricity comes from, decide which energy resources are best, and practise real exam questions.

Name: _____ Class: _____ Date: _____

How to use this worksheet: work through the steps in order and write your answers in your exercise book. Copy every blue 📝 box neatly – these are your revision notes. When you have finished a step, check your work against the **Answers** at the end and correct anything in a different colour.

📝 COPY INTO YOUR BOOK

By the end of this lesson I will be able to:

1. name the main energy resources and say which are renewable

2. compare them for reliability and their effect on the environment

3. answer a "compare" and an "evaluate" exam question.

Step 1: Starter (5 minutes)

Think about the last time you charged your phone. The energy didn't start at the plug socket – so where did it come from?

Your task: trace the energy back as far as you can. Write it as a chain of arrows, starting from the plug socket. Try for at least 4 steps.

Stuck? What's at the other end of the cables? What turns a generator?

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Most power stations use an energy resource to turn a turbine, which turns a generator to make electricity.

Step 2: Read and write (12 minutes)

Copy these three questions into your book. Then read the text and answer them in full sentences.

1. How do fossil fuel power stations make electricity?
2. Give two problems with burning fossil fuels.
3. Pick two renewable resources. For each, write one advantage and one disadvantage.

📖 READ

Where does our electricity come from?

Fossil fuels – coal, oil and gas – are burned in power stations. The energy released heats water to make steam. The steam turns a turbine, which turns a generator to make electricity. Fossil fuels are reliable, but burning them releases carbon dioxide, which contributes to climate change, and sulfur dioxide, which causes acid rain. They will also run out one day.

Renewable resources won't run out. **Wind turbines** produce no carbon dioxide while

generating, but only work when the wind blows and some people think they spoil the view. **Solar cells** produce no emissions, but give no electricity at night and less on cloudy days. **Hydro-electric dams** are reliable and can be switched on quickly, but flooding a valley destroys habitats. **Tidal barrages** are predictable, but change estuary habitats. **Geothermal** power stations use hot rocks underground, but only work in a few places.

📝 **COPY AND COMPLETE**

Burning fossil fuels releases _____ _____, a greenhouse gas that contributes to _____ _____. It also releases _____ _____, which causes acid rain.

Step 3: Sort it (5 minutes)

📝 **COPY INTO YOUR BOOK**

Renewable resource: one that is being (or can be) replenished as it is used, so it will not run out.

Non-renewable resource: one that will run out, because it is not replaced as fast as it is used.

Your task: draw two columns labelled Renewable and Non-renewable. Sort these: coal · wind · nuclear fuel · solar · oil · tidal · gas · hydro-electricity · bio-fuel · geothermal · water waves

Ask yourself: "Could we ever run out of this?"

Step 4: Fact cards (10 minutes)

📝 **COPY INTO YOUR BOOK**

Reliable: it can generate electricity whenever it is needed.

Your task: copy the table headings below and fill in one row for each of the 9 resources, using the fact cards.

Resource	Renewable?	Reliable?	CO_2 when generating?	Other effects
e.g. Wind	Yes	No – needs wind	None	Noisy, spoils view

Fossil fuels (coal, oil, gas): burned to heat water; not renewable; reliable; release CO_2 (climate change) and sulfur dioxide (acid rain).

Nuclear fuel: fission heats water; not renewable; reliable; no CO_2 while generating; radioactive waste must be stored for a very long time; small risk of a major accident; expensive to build and shut down.

Wind: wind turns the blades; renewable; not reliable; no CO_2; noise and visual impact.

Solar: cells turn sunlight into electricity; renewable; not reliable (nothing at night); no CO_2; big farms use a lot of land.

Hydro-electricity: water from a dam flows through turbines; renewable; reliable and can be switched on very quickly; no CO_2; flooding valleys destroys habitats.

Tides: a barrage traps water at high tide; renewable; predictable; no CO_2; expensive and changes estuary habitats.

Water waves: up-and-down motion drives a generator; renewable; not reliable; no CO_2; can affect sea life and boats.

Geothermal: hot rocks heat water; renewable; reliable; very little CO_2; only works in a few places.

Bio-fuel: plant material or waste is burned; renewable; reliable; releases CO_2 but plants absorbed it while growing; uses land that could grow food.

Step 5: Quick check (5 minutes)

Cover your table and answer from memory.

Q1 Name the three fossil fuels.

Q2 Why is nuclear fuel non-renewable?

Q3 Which renewable resource can be switched on quickly when demand suddenly rises?

Q4 Why is tidal power more reliable than wind power?

Q5 Give one problem that hydro-electric dams cause for the environment.

Q6 Why don't we use geothermal power everywhere?

> 📝 **COPY AND COMPLETE**
>
> Wind and solar power are unreliable because _____ and _____. Hydro-electricity is useful because it can be _____ _____ _____ when demand suddenly rises.

✅ Score out of 6. 4 or less? Re-read the fact cards for the ones you missed.

Step 6: Main task – Power the Island (10 minutes)

You've been hired as the island's energy adviser! A small island gets all its electricity from diesel generators. The diesel is shipped in and costs **£6 million a year**. The island is very windy and sunny. The council has **£80 million** and three goals: 1. cut carbon dioxide emissions; 2. cut yearly running costs; 3. keep the lights on day and night.

Option	Cost to build	Running cost per year	Reliable?	CO_2	Other
Wind farm	£45 million	£1 million	No – depends on wind	None	Noise, visual impact, birds
Solar farm	£20 million	£0.5 million	No – none at night	None	Uses farmland
Tidal barrage	£90 million	£1 million	Predictable	None	Damages estuary habitat
Undersea cable to mainland	£60 million	£3 million	Yes	Depends on mainland	Could be damaged by storms
Keep diesel generators	£0	£6 million if used all the time	Yes	High	Fuel must be shipped in

> 📝 **COPY INTO YOUR BOOK**
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> **How to evaluate:**

FOR – at least 2 reasons, using data

AGAINST – at least 2 problems

JUDGEMENT – "Overall, the best choice is… because…"

Your task: write your advice to the council using the frame. Start with "My choice:" – which option(s) and the total cost (no more than £80 million).

Which option keeps the lights on when there's no wind and no sun?

Step 7: Exam practice (11 minutes)

📝 **COPY INTO YOUR BOOK**

COMPARE = talk about both options in every point. Use the word "whereas".

EVALUATE = give points for and against, then a judgement.

Q1 (2 marks) Explain why a town cannot rely on a solar farm as its only supply of electricity.

Q2 (4 marks) A country could build a gas power station or an offshore wind farm, both with a maximum output of 800 MW. The gas station's average output is 90% of maximum, can generate whenever needed, must buy gas and releases CO_2. The wind farm's average output is 40% of maximum, only generates when windy, needs no fuel and releases no CO_2. Compare the two options.

Q3 (6 marks, Higher) Some people want to replace the UK's remaining fossil fuel power stations with nuclear power stations. Evaluate this plan.

✅ Add up your marks out of 12 (or out of 6 if you skipped Q3).

Step 8: Exit ticket (2 minutes)

- The most important thing I learned today is…
- If I were in charge of the UK's electricity, I would use… because…
- One thing I'm still not sure about is…

Answers

Only look at these once you have written your own answer!

Step 1: Starter (5 minutes)

Plug socket ← National Grid cables ← generator at a power station ← turbine turned by steam, wind or water ← energy resource (e.g. gas burned to boil water, or the wind).

Step 2: Read and write (12 minutes)

(1) The fuel is burned to heat water into steam, which turns a turbine connected to a generator.

(2) Any two: they release carbon dioxide (climate change); they release sulfur dioxide (acid rain); they will run out.

(3) e.g. wind – no fuel or emissions, but unreliable when the wind drops; solar – no emissions, but no output at night.

Gaps: carbon dioxide · climate change · sulfur dioxide

Step 3: Sort it (5 minutes)

Non-renewable (4): coal, oil, gas, nuclear fuel. Renewable (7): wind, solar, tidal, hydro-electricity, bio-fuel, geothermal, water waves. Watch out – nuclear is NOT renewable.

Step 5: Quick check (5 minutes)

Q1 Coal, oil and gas. Q2 The uranium is mined and will run out. Q3 Hydro-electricity. Q4 Tides happen at times we can predict; wind depends on the weather. Q5 Flooding a valley destroys habitats. Q6 It only works where hot rocks are near the surface.

Gaps: the wind doesn't always blow · there is no sunlight at night · switched on quickly

Step 6: Main task – Power the Island (10 minutes)

Model: wind + solar (£65 million), keeping diesel as backup. FOR: no CO_2 when generating; running costs only £1.5 million a year instead of £6 million; the island is windy and sunny. AGAINST: neither is reliable, so diesel is still needed sometimes; noise, visual impact, uses farmland. JUDGEMENT: best choice – cuts CO_2 and costs the most within budget, and diesel backup keeps the lights on. (The tidal barrage is over budget.) Any choice is good if you use the data and finish with a clear judgement.

Step 7: Exam practice (11 minutes)

Q1: Solar cells produce no electricity at night / less when cloudy (1), so there would be times with no supply – a reliable backup is needed (1).

Q2: Gas average output 720 MW whereas wind only 320 MW (1); gas generates whenever needed whereas wind only when windy (1); gas must buy non-renewable fuel whereas wind is free and renewable (1); gas releases CO_2 whereas wind releases none (1).

Q3: FOR – no CO_2 or sulfur dioxide when generating; reliable. AGAINST – non-renewable; radioactive waste stored for a very long time; small risk of accident; very expensive; slow to build and can't respond quickly to demand. JUDGEMENT – e.g. a good plan for reliable low-carbon electricity if combined with renewables.