

1.7 National and global energy resources

Name: _____ Class: _____ Date: _____

Total: 20 marks

KEY WORDS renewable • non-renewable • fossil fuels
• nuclear fuel

Objective

Distinguish renewable from non-renewable resources, match resources to uses, argue about reliability and environmental impact, and read trends in resource data. Original questions for spec statement 4.1.3.

1 Key knowledge and worked examples

A renewable resource is one that is replenished (or can be) as it is used. Fossil fuels and nuclear fuel are **non-renewable**.

- Nine resources to know: fossil fuels (coal, oil, gas), nuclear fuel, bio-fuel, wind, hydroelectricity, geothermal, the tides, the Sun, water waves.
- Three uses to compare: transport, electricity generation, heating.
- You do **not** need to explain *how* electricity is generated.

Resource	Renewable?	Reliability	Environmental points
coal, oil, gas (fossil fuels)	no	very reliable	CO ₂ → climate change; sulfur dioxide → acid rain
nuclear fuel	no	very reliable	radioactive waste; no CO ₂ when running
bio-fuel	yes	reliable	land taken from food; CO ₂ when burnt, reabsorbed if replanted
wind	yes	not reliable	no CO ₂ ; noise; large area; birds
hydroelectric	yes	reliable	floods valleys; habitat loss
geothermal	yes	reliable	few suitable places
tides	yes	reliable (timetable)	changes estuaries; cost
the Sun (solar)	yes	not reliable	no CO ₂ ; needs large area; night/clouds
water waves	yes	not reliable	storm damage; hard to build

Reliability means the output is there when needed. Wind and solar depend on weather; nuclear and fossil can run on demand; hydro pumps on demand; tides follow a known timetable.

The credited ending for big-mark discussions: science can *identify* environmental problems, but dealing with them depends on **political, social, ethical or economic** decisions. Use this when asked “why hasn’t the problem been solved?”.

Comparing resources for a use (the exam’s favourite 4-marker): choose the criterion the question names (cost, reliability, environment), apply it to *both* options with a number or fact, and finish with a conclusion sentence.

Worked example (data reasoning). A graph shows a turbine’s power rising with wind speed up to a limit.

- Trend sentence: “as wind speed increases, power output increases, up to 15 m/s where it becomes constant.”
- Evidence sentence: “power doubles from about 0.4 MW at 6 m/s to 0.8 MW at 9 m/s.”
- Limitation sentence: “above 15 m/s the turbine shuts down for protection, so power falls to zero.” Three sentences = a complete “give two conclusions” answer.

2 Practice

2.1 State what is meant by a renewable energy resource. [1]

2.2 Sort these into renewable and non-renewable: wind, coal, nuclear fuel, tides, natural gas, bio-fuel. [2]

2.3 Give one energy resource whose output does not change with the weather, and one whose output does. [2]

3 Exam-style questions

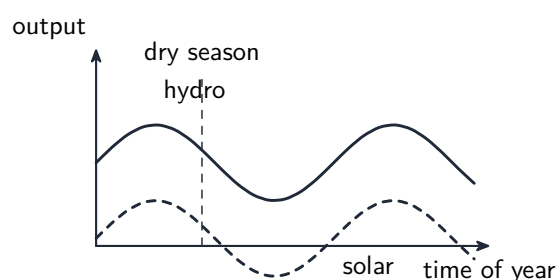
3.1 The UK generated electricity in 2018 using a mix of resources. Transport and electricity generation released the largest amounts of carbon dioxide.

Explain **one** change that would reduce carbon dioxide released by transport, and **one** change that would reduce carbon dioxide released by generating electricity. [4]

3.2 A remote village uses a hydroelectric generator. A graph of its power output across a year shows deep dips in the dry season. Solar panels are added.

(a) Explain why adding solar panels improves the reliability of the village's electricity supply. Use the pattern of the two outputs in your answer. [2]

(b) Give one reason, other than reliability, why the village might prefer hydroelectric to solar power. [1]



3.3 A tidal barrage and a nuclear power station are both proposed to supply 1.6 GW to a coastal city.

(a) Compare the two proposals for reliability of supply. [2]

(b) Compare the two proposals for environmental impact. [4]

(c) The planning decision is delayed for years even though the physics of both is well understood. Explain why the decision is not a scientific one. [2]

Solutions

2.1 A resource that is replenished as it is used.

2.2 Renewable: wind, tides, bio-fuel. Non-renewable: coal, nuclear fuel, natural gas.

2.3 Weather-independent: nuclear / fossil-fuel / hydroelectric / geothermal / tidal (any one, B1). Weather-dependent: wind / solar.

3.1 Transport: use electric vehicles instead of petrol/diesel – charged from electricity generated without fossil fuels, so less CO₂ from engines. Electricity generation: replace coal/gas power stations with renewable generation or nuclear – those release no CO₂ while running, so the same demand is met with fewer fossil-fuel emissions. (Cycling/public transport/walking also credit in the first pair; reducing demand for appliances also credits in the second.)

3.2 (a) Hydro dips in the dry season while solar output peaks in the same sunny months; the two resources fail at different times, so a supply gap in one is covered by the other and the combined output varies less. (b) Any one: hydro generates at night and on dull days; solar panels need large roof/land area; hydro's cost per unit can be lower at village scale; hydro output is steadier minute-to-minute.

3.3 (a) The nuclear station is fully reliable – it runs continuously on demand and does not depend on weather; the barrage's output follows the tide's timetable – predictable but not constant, with no output at slack tide, so it cannot alone meet demand at every hour. (b) Nuclear: no CO₂ while running but produces radioactive waste that must be stored safely for many years. Barrage: no CO₂ and renewable, but permanently changes the estuary – flooding mudflats upstream and altering habitats for birds and fish. (Either order; a paired comparison scores.) (c) The science identifies the environmental effects and the engineering of each option; choosing between them weighs cost, jobs, local opposition, safety policy and ethics – political, social, ethical and economic decisions that scientists alone cannot settle.