Environmental Studies
FACT SHEET
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Carbon capture and storage

This Factsheet summarises the process of carbon capture and storage (CSS), which many governments believe will help us to reduce our carbon emissions.

True or False?

1. Coal is our most abundant source of fossil-fuel energy
2. Carbon-capture and storage is already being done. For example, CO_2 can be stripped out of natural gas and pumped back down into sandstone aquifers underneath the sea.
3. The CO_2 can be pumped back down into oil - filled rocks and used to help extract more oil
4. Annually, human activity emits about 28 million tonnes of CO_2

(*Answers in bottom courner of Page 1)*

Coal is our most abundant and cheapest fossil fuel. For the first time in 30 years, the UK government has decided to build new coal-fired power stations. However, we are committed under international law to cut our CO_2 emissions, not increase them! But emissions are increasing and power stations are already far and away the biggest source of industrial CO_2 emissions (Fig 1 and 2).

Fig 1. World CO_2 emmisions from fossil fuels

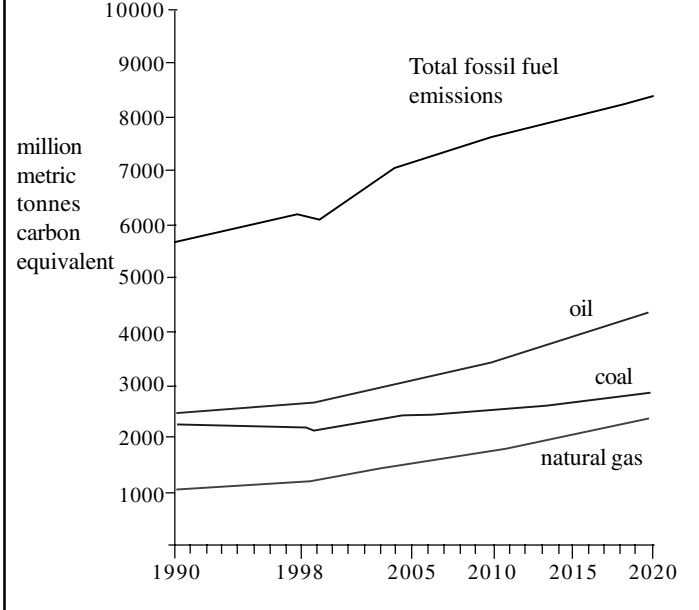
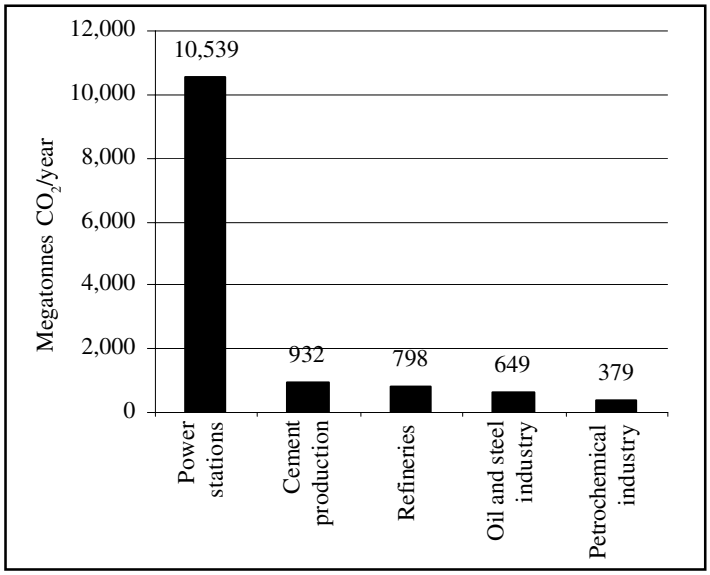


Fig 2. Industrial CO_2 emmision source



This is where carbon capture and storage (CCS) come in. Carbon can be removed from coal before, during or after the coal reaches the combustion chamber.

1. Coal turned into a mixture of gases
   ↓
   H_2 extracted
   ↓
   H_2 fed into a gas-turbine generator
   ↓
   CO_2 buried

2. Coal burned in pure O_2
   ↓
   CO_2 extracted from combustion chamber

3. Coal burned
   ↓
   Flue gases pass through scrubber containing amines
   ↓
   CO_2 reacts with amines and is removed
   ↓
   . CO_2 buried, amines recycled

The last one is the simplest, the only one that can be retrofitted (fitted to existing power stations) and the one that the UK is planning to use in its pilot projects.

True or False answers

1. *True*
2. *True*
3. *True*
4. *False It's more like 28 billion tonnes!*

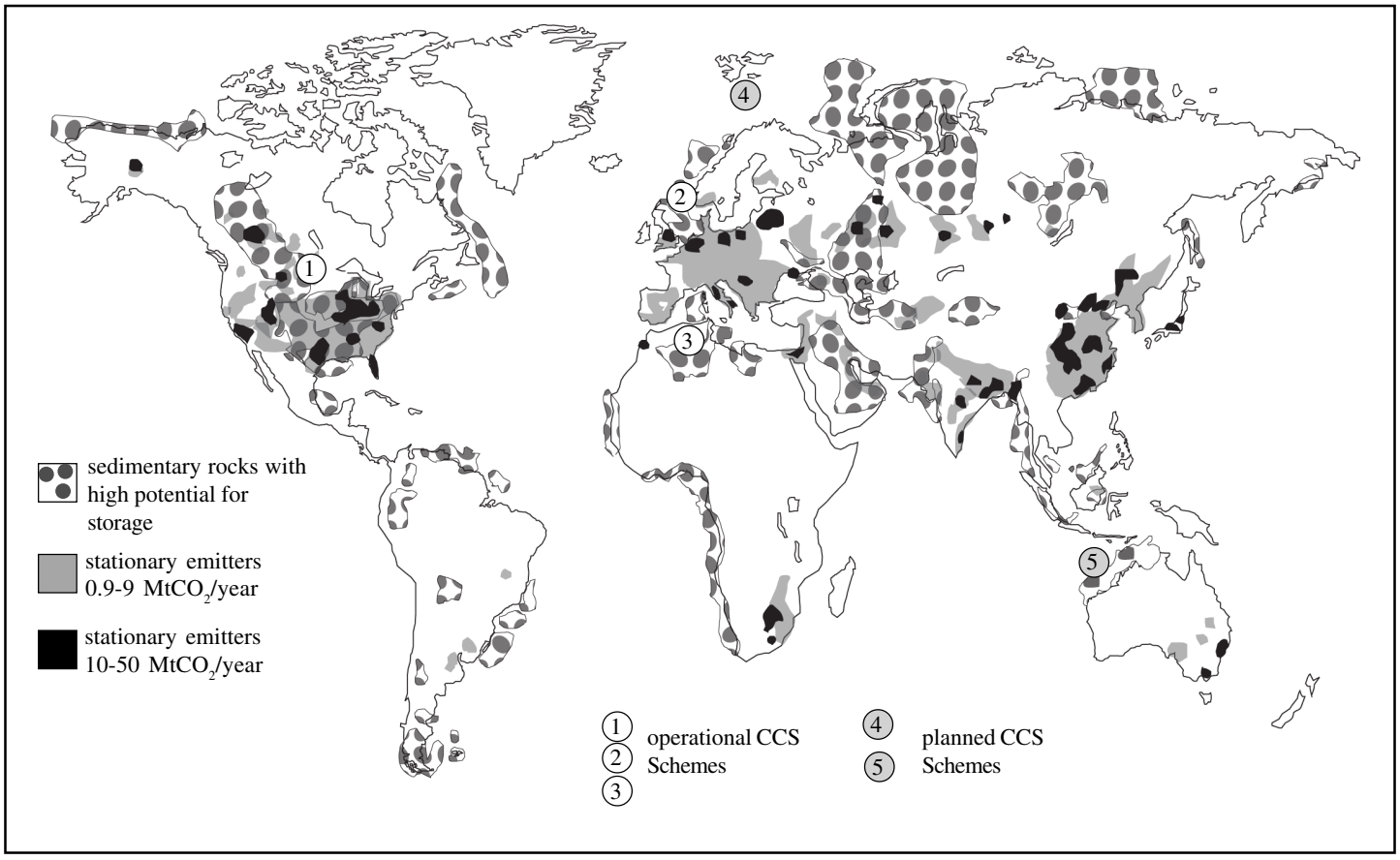
Technical challenges

Coal produces three times its own weight in CO_2. This must be pressurised and liquefied before it can be transported. It needs to be buried at a minimum depth of about 1km, where pressure will be so high that it remains liquefied.

Suitable sites?

- Worked - out oil fields e.g. the Miller oilfield in the North Sea has been shown to have held CO_2 for the last 120 million years
- Worked - out gas fields
- Unmineable coal seams – the CO_2 is absorbed on to the surface of the coal
- Deep sandstone formations capped by impermeable shales. There are extensive areas of these on both the continents and under the oceans (Fig 3).

Fig 3. Potential CO_2 storage rock formations



Arguments against

1. Most experts agree that it will take 20-30 years to develop full-scale, working CCS plants
2. The CO_2 might escape. In 1986, a million tonnes of CO_2 escaped from the bottom of Lake Nyos in Cameroon. CO_2 is denser than air and so it spread over the surrounding villages, killing more than 1700 people. Potentially, earthquakes could destroy any traps we used. Even very slow seepage would be a huge problem.
3. Who is responsible for looking after the traps?
4. There is no accepted technique for working out how much CO_2 can be pumped into a rock
5. Huge pipelines will need to be built to transport the CO_2 from the power stations to the burial grounds

In summary, CCS is technically difficult and will take 20 or so years to develop. It is also risky and very expensive. Is it sensible then to commission new coal – fired power stations when we are committed to reducing carbon emissions?

Practice Exam Questions

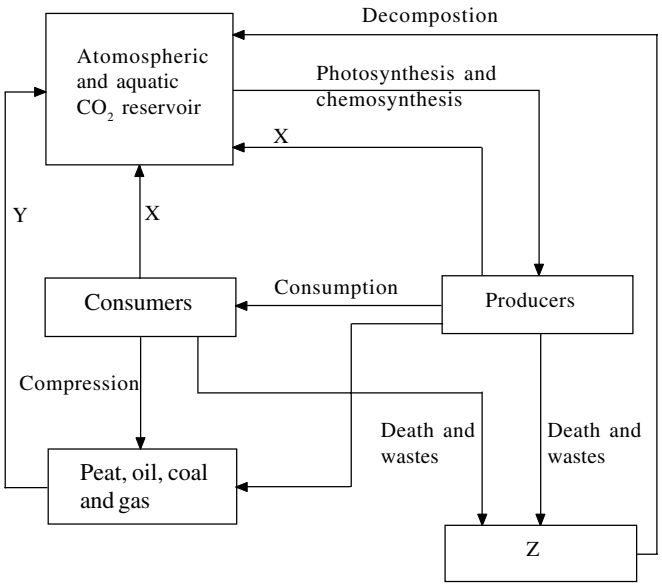
1. Complete the table by choosing the most appropriate answer from the following list:
Nitrogen fixation absorption transpiration combustion decomposition photosynthesis respiration excretion

Description	Process
Carbon dioxide released from proteins that a fox has eaten	
Carbon dioxide released from coal in a power station	
Carbon dioxide gas converted into wood	
Dead leaves converted into substances which are absorbed by fungi	

2.. (a) Explain why coal reserves represent a carbon sink (2)

(b) Explain why burning wood is described as 'carbon neutral', unlike the burning of fossil fuel.

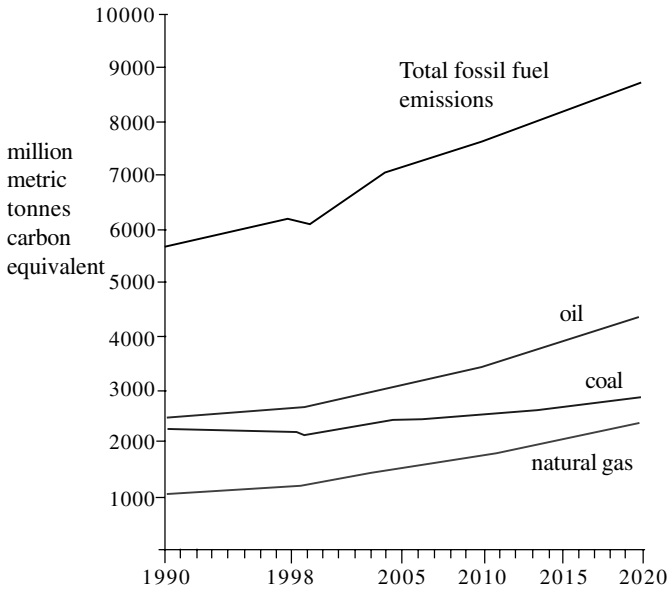
3. The diagram below represents the carbon cycle.



Identify:
(i) Process X
(ii) Process Y
(iii) Organisms labelled Z

4. The Forestry Commission has calculated that, in order to remove the carbon dioxide produced by an average family car during an average driver's lifetime, it would be necessary to plant 0.5 hectares (5000 m^2) of new forest.
Comment on the likely effectiveness of this approach to long-term reductions in carbon emissions. (2)

5. The graph shows world CO_2 emissions.



Which of the following statements are True and which are False?
(i) In 2020, the single greatest source of CO_2 from fossil fuels is expected to be natural gas
(ii) Between 1990 and 2020, total fossil fuel emissions of CO_2 are expected to increase by approximately 70%
(iii) Burning one tonne of coal will release 1 tonne of CO_2.

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Markscheme

1.

Description	Process
Carbon dioxide released from proteins that a fox has eaten	***respiration***
Carbon dioxide released from coal in a power station	***combustion***
Carbon dioxide gas converted into wood	***photosynthesis***
Dead leaves converted into substances which are absorbed by fungi	***decomposition***

2. (a) Coal contains carbon that has been taken from the atmosphere in the past;
Carbon that has been taken out of circulation;

(b) Burning wood does not cause a net increase;
Volume released on combustion = volume absorbed during photosynthesis;
Burning fossil fuels releases CO_2 trapped a long time ago;

3. (i) Respiration
(ii) Combustion
(iii) Decomposers/fungi/bacteria;

4. Insufficient land available;
Only growing forest is net fixer/ mature forest is C neutral;
Forest may eventually be removed/burned/die;

5. (i) False (ii) True (iii) False