Rewarding Learning

A2 LEVEL

FACT FILE

Environmental Technology

For first teaching from September 2014

For first award in Summer 2015

Emerging Technologies:

Carbon capture and storage, Geo-engineering and Bio-photovoltaics

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Carbon capture and storage, Geo-engineering and Bio-photovoltaics.

Specification Content

Carbon capture and storage (CSS)

Students should be able to:

- explain what is meant by 'carbon capture' and its potential for reducing carbon dioxide emissions from fossil fuel power plants;
- discuss the three phases identified in the carbon capture process: trapping and separating, transport, and storage (underground and underwater);

Geo-engineering

Students should be able to:

- debate the advantages and risks associated with geo-engineering as the deliberate modification of the Earth's atmosphere to offset the effects of climate change; and

Bio-photovoltaics

Students should be able to:

- describe the use of green algae to generate electricity in biological solar cells.

Course Content

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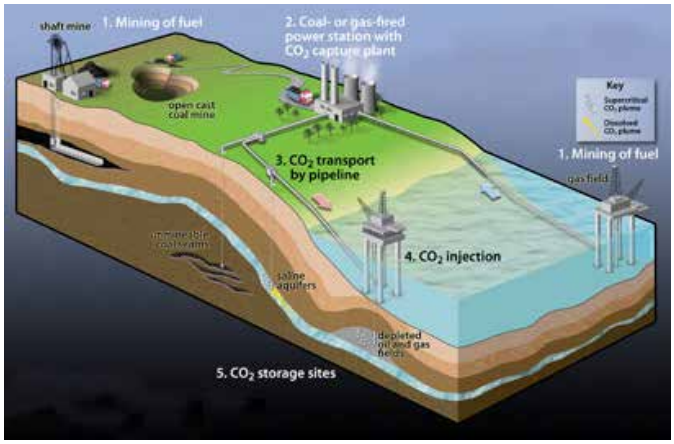
Carbon capture and storage (CSS) is the name given to the technology designed to prevent carbon dioxide CO2 exhaust, produced when burning fossil fuels, from entering the atmosphere. Capturing the CO2 reduces the impact of the combustion of fossil fuels on climate change by reducing the amount of greenhouse gases in the atmosphere.

In basic terms the exhaust gas from the combustion of fossil fuels is "captured" and then stored rather than being released into the atmosphere. The process has three distinct stages which involve collecting the waste gases, called trapping and separating, transporting the captured gas and then storing it.



Planetearth.nerc.ac.uk

Trapping and separating entails taking the gas emitted from the process and separating CO2 from the other gases which are present. There are three main ways in which this is currently done:

- Post-combustion capture;
- Pre-combustion capture; and
- Oxy-fuel combustion capture.

The first two as their names imply are carried out at different stages of the combustion process, whilst oxy-fuel combustion requires the fossil fuel being used and burnt in oxygen.

Transporting involves moving the isolated CO2 (usually in a liquefied state) to a location for its storage. This is most efficiently done through a system of pipes which transports the CO2 to a dis-used oil well or under the sea. The technology required to do this is similar to that used in oil extraction and refining.

Storage refers to the long term location for the captured CO2. As mentioned previously this can be done either underground or underwater.

Activity

Using the link www.sourcewatch.org/index.php/Carbon_Capture_and_Storage , or others of your choice;

- Research the topic of carbon capture and storage.
- Provide detailed information on each of the three distinct stages in the process. Outline in your response the main characteristics of each stage and some of the hazards and risks involved.
- Indicate the likely savings in terms of greenhouse emissions and the capacity need to store CO2 captured in this way.

Geo-engineering is the name given to a range of processes which use scientific and technological principles and techniques to intervene with the earth's natural systems in order to counteract climate change.
Some examples of possible strategies include;

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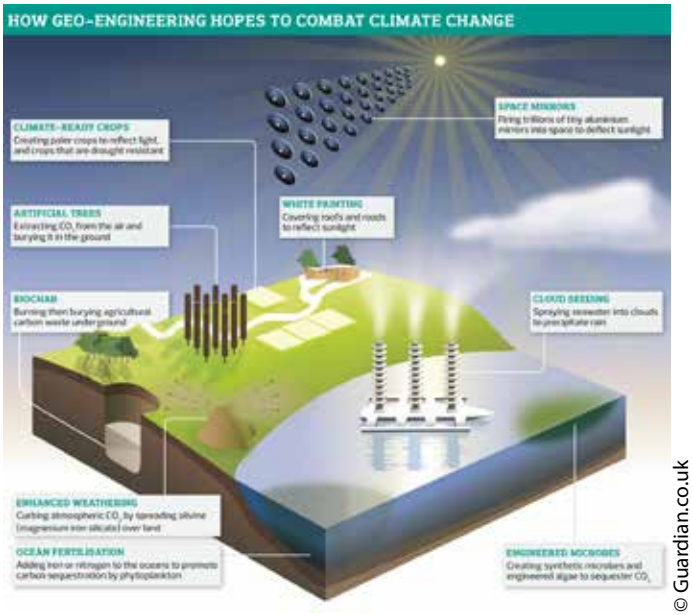
- ***Cloud seeding*** – Injecting clouds with substances which encourage the formation of ice crystals, heavy enough to fall so producing rain "on demand".
- ***Space reflectors*** – These are intended to block a proportion of the sun's rays from entering the atmosphere of the earth thus reducing the increase in the earth's temperature.



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- ***Afforestation***. This would involve engaging in a global-scale tree planting effort, resulting in trees naturally absorbing CO2 from the atmosphere,
- ***Biochar***. This process requires 'Charring' biomass and then burying it so that any carbon it contains is locked up in the soil.

Activity

Using the diagram above and the link http://royalsociety.org/policy/publications/2009/geoengineering-climate/ compile a list of possible geo-engineering techniques and provide an evaluation of their likely effect and any moral or ethical issues surrounding their use.

Bio-photovoltaics involve the use of green algae to generate electricity in biological solar cells. One of the most well known demonstrations of this technique is the so-called "moss table". This is a concept product which aims to demonstrate the future potential of bio-photovoltaic technology. The amount of energy generated by the table is very small, not even enough to power the lamp. However technology is at an early stage of development and with the additional development of devices with low energy requirements there could be a promising future for the concept.

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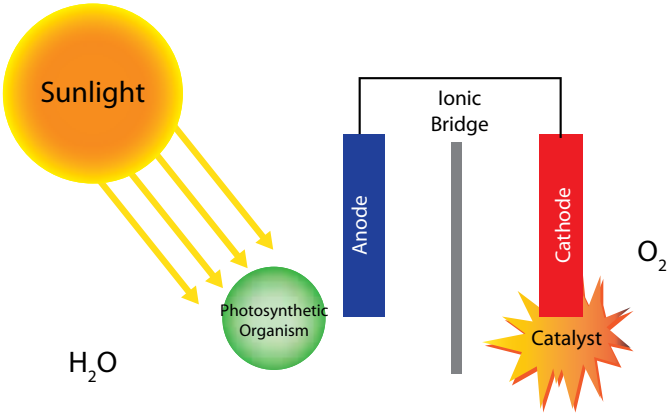
The technique uses the fact that plants convert carbon dioxide from the atmosphere into organic compounds using energy from the sun's light in the process known as **photosynthesis**.



Activity

Use the two links and the diagrams above to provide a summary of the bio-photovoltaic principle. You should include in your summary;

- a description of the process by which a bio-photovoltaic device produces electrical energy;
- the likely output from such a device;
- the limitations of the technology in its current form; and
- possible applications of the technique in the future.