Carbon Capture and Storage: Reducing Harmful Atmospheric Emissions

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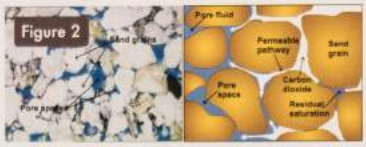
CAPTURE

Carbon capture and storage (CCS) involves the process of removing harmful emissions including carbon dioxide (CO_2) often given off by large industrial plants before they have the chance to enter the atmosphere. This prevents one of the causes of increased global warming [4]. CO_2 can be captured either before or after it has been combusted. Once it has been separated and captured, it is compressed under intense heat and pressure, altering its state so the CO_2 can be more easily transported via pipeline, ship or road to a suitable geological storage site (fig. 1).

STORAGE

Compressed CO_2 is injected into onshore or offshore rock formations at depths of 1km or more [4]. Depleted gas and oil fields are often used as storage sites. Conditions required for storage include porous (pore spaces) and permeable (links between pore spaces so the compressed gas can permeate through) rock such as sandstone (fig. 2) which is used as a trapping mechanism to prevent CO_2 migrating outside of the geological reservoir [1]. A caprock is also required to stop CO_2 moving upwards. These caprocks enable the compressed gas to be stored for potentially millions of years [4].



WHY CCS?

CO_2 is a harmful greenhouse gas, which, when emitted into the atmosphere in excessive amounts, causes global temperature rise. Surface temperatures need to not exceed 2°C (compared to pre-industrial years) so as to prevent worldwide catastrophic long-term consequences such as sea-level rise and drought [6]. CCS can be used as a mitigation strategy to face this problem [4].

It's been estimated that the world has a storage potential of 2 trillion tonnes of CO_2 and that the cost of mitigating against the harmful effects of climate change could be more than double without the inclusion of CCS processes [6]. To not exceed a 2°C temperature rise from pre-industrial times, CCS must be used for at least 14% of emission reduction processes alongside other renewable resources such as solar and wind power [7].

Fossil fuel use in 2013 represented 81% of global use. This will need to reduce to 40% by 2050 if we're to prevent excess temperature rise, meaning 95% of coal-fired plants and 40% of gas fired plants will need to be using CCS technologies [5].

ADVANTAGES

An opportunity for industries to continue using fossil fuel for power without harming the environment from their emissions [4].

Worldwide large CO_2 storage potential [6].

The technology required to safely operate, complete and close storage sites safely is available and has been demonstrated on a global scale [4].

DISADVANTAGES

A lack of public awareness of what CCS is and how it can positively contribute to a healthier planet [8].

A public perception of harmful gases being stored underground as dangerous due to potential leaks [8].

A lack of implementation of operating CCS technology around the world from shortage of investment from governments [3].

CCS FROM DOWN UNDER

CO2CRC IN AUSTRALIA

Australia's CO2CRC Otway Research facility is the world's biggest CCS demonstration project with over 80,000 tonnes of CO_2 stored in a variety of geological locations and formations [1]. 32 organisations and around 150 researchers and scientists are involved with the facility. Their main aim is to test technology and techniques for CCS whilst remaining cost-effective. This country has a huge amount of storage potential on and offshore (fig. 3). From 2004-2015 more than 65,000 tonnes of CO_2 were captured and compressed, transported through 2km of pipeline and stored in either a depleted gas field or a deep saline rock formation. Long-term monitoring provides researchers with information that can assure governments and communities of the safety levels of CCS [1].

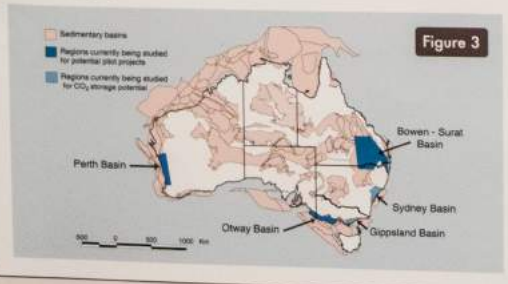


Figure 1

CONCLUSION

There's often a lack of public knowledge about CCS technology and the benefits it has [2]. People can often perceive CCS as negative because it involves the storage of a pollutant potentially near homes [8] but the risk of leaks vary depending on location and formation of rocks [6]. Australia's research programmes are highly useful in increasing awareness and knowledge of this climate change mitigation route.

CCS is a useful technique to lower the harmful effects of greenhouse gases whilst power plants can continue to burn fossil fuels for energy. Worldwide storage potential is high and, proven by the CO2CRC research facility, a feasible option. Alongside this though renewable energy such as solar and wind should be used to prevent surface temperature rise above 2°C in order to tackle climate change[7].

References:

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Figure 1: Taken from www.theenergyscollective.com

Figure 2: Taken from http://www.globalccsinstitute.com

Figure 3: Taken from www.co2crc.com.au