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CO_2-Capture and Storage

CO_2-capture and storage (CCS) is a common term for the capture, transport and safe storage of CO_2. The use of CCS, combined with a large scale effort to promote energy efficiency, and increased use of renewable energy sources, is a prerequisite to limit climate change and ocean acidification.

CO_2-Capture

Due to practical and economic reasons, capture of CO_2 is only viable for large point sources, such as fossil-fuel based power plants and large industrial installations. Usually, the flue gas from such sources has a low CO_2 content, and the CO_2 have to be separated from the rest of the flue gas before CO_2 can be deposited.

There are a number of technologies available for capturing CO_2. The post-combustion CO_2 capture technology can be added to existing plants to clean CO_2 from their flue gas. For new power plants, the cleaning process of the CO_2 could be integrated into the power production. The CO_2 capture technologies are usually divided into three main-categories:

- Post-combustion
- Pre-combustion
- Oxy-fuel combustion

Post-combustion means end-of-pipe separation of the CO_2 from the flue gas. To do this, chemical cleaning through the use of an absorbent is carried out, often in combination with mechanical cleaning. (An absorbent is a chemical substance, such as amines or carbonates that attracts CO_2). The absorbent is cooled down before it is brought into contact with the flue gas. CO_2 will then be attached to the absorbent, and in a second process, the liquid solution is heated to release concentrated CO_2 and regenerate the absorbent. Approximately 80 to 90 percent of the CO_2 can be captured using post-combustion technologies.

In pre-combustion CO_2 capture the CO_2 is removed from the fuel prior to combustion. The process is carried out in a traditional steam reformer where the fuel is converted to hydrogen (H_2) and carbon monoxide (CO). Then, the CO-gas and steam is converted into H_2 and CO_2. Finally, the H_2 and CO_2-gas is separated in the same way as when cleaning flue gas, however a smaller installation is necessary. The remaining H_2 can be used as fuel for power plants or vehicles. Using pre-combustion CO_2 capture, around 90 percent of the CO_2 can be removed.

Under oxy-fuel combustion, the exact amount of oxygen is added during combustion instead of air. The oxygen must be separated from air before the combustion starts, and the flue gas then contains only CO_2 and steam. The steam is separated from the flue gas through condensation, thus pure CO_2 remains. 100 percent of the CO_2 can be removed using oxy-fuel combustion.

FIGURE 1. INSTALLATION FOR POST-COMBUSTION CAPTURE OF CO_2 FROM FLUE GAS. SOURCE: IPCC.

CO_2 Transportation

Transportation of CO_2 from source to storage site can be carried out through pipelines or by ships for oceanic transport. The CO_2 is usually compressed into dense phase where the gas behaves like a liquid. The CO_2 can then easily be pumped through pipelines. Transportation by ship requires compression and/or cooling of the CO_2.

CO_2 Storage

The deposit of CO_2 in geological formations is mainly done in depleted oil- and gas-reservoirs and subsurface aquifers (geological formations containing water). There is a large storage potential in geological formations both onshore and offshore.

Some theories concerning storing CO_2 at the bottom of the sea have been put forth. However, this is not safe and is no longer an option for CO_2 storage.

A study carried out by the European Commission in 1996 demonstrated that two thirds of the total European storage capacity, i.e. 476 billion tonnes, can be found on the Norwegian shelf. An additional 10.3 billion tonnes can be deposited in depleted oil and gas reservoirs. In comparison; the current CO_2 emissions in the EU are approximately 4 billion tonnes per annum.

CO_2 needs to be stored about 800 meters underground, as the pressure then makes CO_2 stabile in the dense (*i.e.* liquid-like) phase.

It is critical that each CO_2 storage site is chosen carefully, to ensure safe storage. Several international processes are initiated, to identify necessary criteria and procedures for injection and storage of CO_2.

Currently, CO_2 storage is happening at the Utsira-formation in the Northern Sea. As the natural gas in the Sleipner field contains a higher percentage of CO_2 than what is permitted as per sales specifics, the CO_2 is separated from the flue gas and deposited.

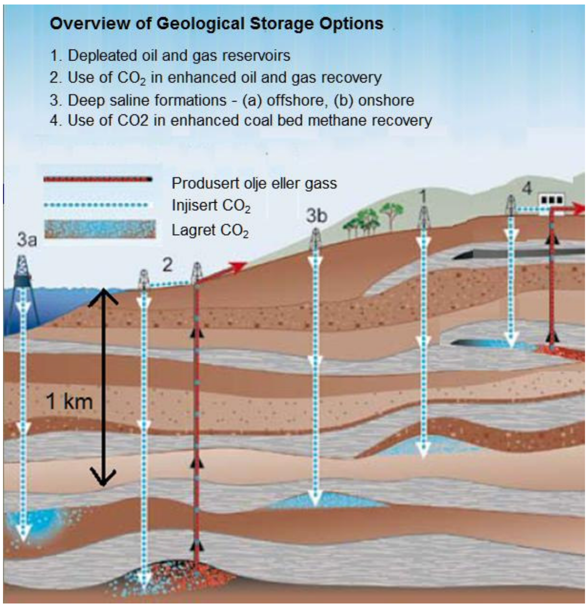

FIGURE 2. STORAGE OF CO2. SOURCE: IPCC.

CO_2 for Enhanced Oil Recovery

A cost-efficient strategy for storage of CO_2 is using the CO_2 for Enhanced Oil Recovery, EOR. Injected CO_2 will reduce the viscosity of the oil still inside the reservoir, thus CO_2 injected (natural gas or water can also be used) can ensure increased oil production, thereby prolonging the field lifespan. This technique is well tested in *e.g.* The United States.

Similarly, as under EOR, CO_2 can be injected into gas fields to increase gas production. This is referred to as Enhanced Gas Recovery, EGR. Additionally, CO_2 can be injected into deep unmineable coal mines, to increase methane production, as methane is naturally found alongside of coal in geological formations. This is called Enhanced Coal Bed Methane recovery, ECBM.

Such uses of CO_2 give CO_2 a financial value for oil, gas and coal companies. Consequently, it could be a contribution towards ensuring profitability in infrastructural development for CO_2 storage.

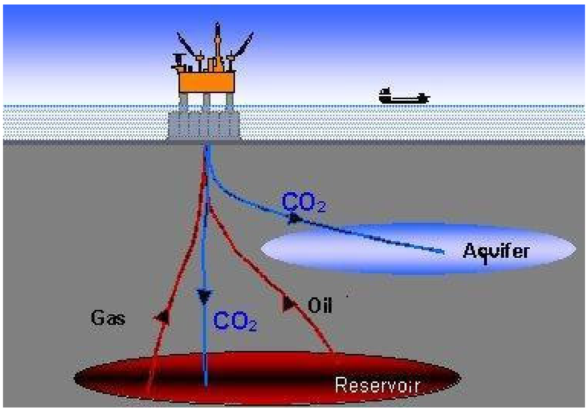

FIGURE 3. AQUIFER STORAGE AND CO2 USED FOR EOR.

External links:

Bellona Web om CO_2-håndtering,
http://www.bellona.no/subjects/1138831369.22/section_5min_view

Bellona, "CO_2 for EOR on the Norwegian Shelf",
http://www.bellona.no/filearchive/fil_CO2_report_English_Ver_1B-06022006.pdf

The European Technology Platform for Zero Emission Fossil Fuel Power Plants,
http://www.zero-emissionplatform.eu/

International Panel on Climate Change (IPCC),
"Carbon Dioxide Capture and Storage",
http://www.ipcc.ch/activity/ccsspm.pdf

CO_2 Capture Project (CCP),
http://www.co2captureproject.com/index.htm

CO2NET
www.co2net.com:

The IEA Greenhouse Gas Programme
www.ieagreen.org.uk

The Intergovernmental Panel on Climate Change (IPCC)
www.ipcc.ch

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