CO₂-Capture and Storage

CO₂-capture and storage (CCS) is a common term for the capture, transport and safe storage of CO₂. 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.

CO₂-Capture

Due to practical and economic reasons, capture of CO₂ 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 CO₂ content, and the CO₂ have to be separated from the rest of the flue gas before CO₂ can be deposited.

There are a number of technologies available for capturing CO₂. The post-combustion CO₂ capture technology can be added to existing plants to clean CO₂ from their flue gas. For new power plants, the cleaning process of the CO₂ could be integrated into the power production. The CO₂ 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 CO₂ 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 CO₂). The absorbent is cooled down before it is brought into contact with the flue gas. CO₂ will then be attached to the absorbent, and in a second process, the liquid solution is heated to release concentrated CO₂ and regenerate the absorbent. Approximately 80 to 90 percent of the CO₂ can be captured using post-combustion technologies.

In pre-combustion CO₂ capture the CO₂ 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 (H₂) and carbon monoxide (CO). Then, the CO-gas and steam is converted into H₂ and CO₂. Finally, the H₂ and CO₂-gas is separated in the same way as when cleaning flue gas, however a smaller installation is necessary. The remaining H₂ can be used as fuel for power plants or vehicles. Using pre-combustion CO₂ capture, around 90 percent of the CO₂ 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 CO₂ and steam. The steam is separated from the flue gas through condensation, thus pure CO₂ remains. 100 percent of the CO₂ can be removed using oxy-fuel combustion.

CO₂ Transportation

Transportation of CO₂ from source to storage site can be carried out through pipelines or by ships for oceanic transport. The CO₂ is usually compressed into dense phase where the gas behaves like a liquid. The CO₂ can then easily be pumped through pipelines. Transportation by ship requires compression and/or cooling of the CO₂.

CO₂ Storage

The deposit of CO₂ 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 CO₂ at the bottom of the sea have been put forth. However, this is not safe and is no longer an option for CO₂ 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$_2$ stable 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.

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.

**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.

**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/file_CO2_report_English_Ver_1B-06022006.pdf


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