FACTSHEET CCS

INFORMATION ABOUT CCS – CARBON CAPTURE AND STORAGE

CARBON DIOXIDE AND THE GREENHOUSE EFFECT

The air that we breathe is a mix of different gases. The largest part is nitrogen with 78% and then the vital oxygen with 21%. The noble gas argon is present at a rate of about 0.9% and the fourth largest component in air is carbon dioxide, CO_2, with about 0.04%.

About half of the CO_2 in the air is needed by green plants when converting carbon dioxide to oxygen in photosynthesis. Exhaled air has a CO_2 concentration of about 4%.

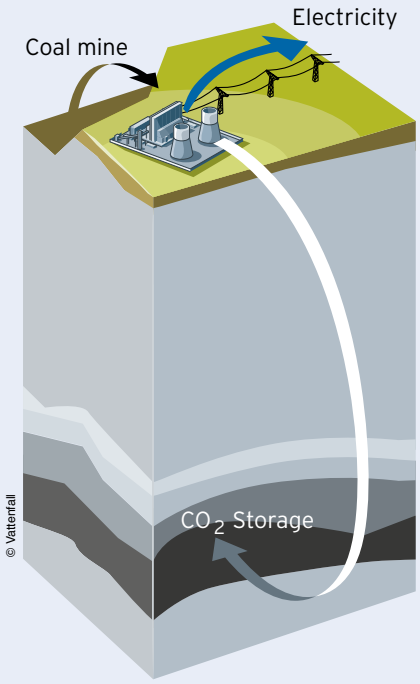
CO_2 is present in a gaseous state at normal ambient temperatures. Depending on the prevailing pressure and temperature, however, it may also be found in liquid or solid state. The compound consists of one carbon and two oxygen molecules. CO_2 is colourless and odourless and is 1.5 times heavier than air in a gaseous state. The compound is produced when carbon-containing substances are completely burnt, or as a byproduct of cellular respiration in living beings.

CO_2 is highly non-reactive; it requires substantial amounts of energy to enter into chemical combinations with other substances. Its advantage in comparison to various other substances is therefore its predictability.

CO_2 occurrence in nature

Besides being present in the atmosphere, large volumes of carbon dioxide are found in the oceans and the earth's crust. Similarly to volcanic springs,

CARBON CAPTURE AND STORAGE (CCS)



CCS stands for the technologies used to capture and store the carbon dioxide (CO_2) generated in combustion processes, for example in a power plant. Essentially, three different processes are available: Oxyfuel, Postcombustion and Precombustion (IGCC). Today, all three technologies are available in the Vattenfall Group. The common aim of all these processes is to produce a concentrated stream of CO_2, compress it and then store it underground instead of releasing it into the atmosphere.

naturally occurring CO_2 may come to the surface both in a gaseous state and in connection with water. In Europe, such CO_2 accumulations can for example be found in the Vichy region of France, where a consequence of the CO_2 in the ground is naturally sparkling water.

In many natural gas fields, too, for example in the Thuringian basin in Germany or the Sleipner gas field off the coast of Norway, the natural gas contains considerable amounts of CO_2. These natural deposits are often located close to, or even below, human settlements, bearing witness to the fact that many types of rock can store the gas safely over millions of years.

The greenhouse effect

CO_2 is one of the so-called greenhouse gases. By absorbing some of the thermal radiation from the sun, instead of reflecting it all, the earth is warmed to a level fit for humans to live in. If there were no greenhouse effect, the mean temperature on earth would be about -18°C instead of about +15°C as it is today. Second to steam, CO_2 is the greenhouse gas with the highest impact due to its volume share, even though other greenhouse gases such as methane and ozone have a higher impact per unit.

The share of CO_2 in the earth's atmosphere has been subject to considerable fluctuations in geological history, which have various biological, chemical and physical causes. The share of CO_2 in the atmosphere consistently remained below 280 ppm* for at least 650,000 years. Over the last 10,000 years, the CO_2 concentration has remained relatively constant at that level.

However, since industrialisation began in the 19th century, the CO_2 concentration in the atmosphere has risen to 380 ppm (2006), continuing along its upward curve at a rate of 1.5 to 2 ppm p.a. on average.

This rise in CO_2 levels in the atmosphere has led to an increase in the earth's mean temperature of around 0.7 °C in the period 1906–2005. This might seem insignificant, but even small changes in the mean temperature are likely to lead to rising sea levels and more extreme weather with heavier rainfalls, longer dry periods and more intense hurricanes.

To prevent too large changes in the climate and the effects that follow, world leaders have agreed to limit the rise in mean temperature to two degrees Celsius. In order to reach this goal, the emissions of CO_2 must decrease drastically and fast.

The energy sector with its generation of electricity and heat is partly responsible for emissions of CO_2. One way to cut emissions from fossil fuel-fired power plants is to capture the CO_2 and store it underground.

380 ppm	CO_2 concentration in the atmosphere
1000 ppm	Typical office level of CO_2
4 %	CO_2 concentration in exhaled air
10 %	Fatal CO_2 concentration at long-term exposure
19 %	CO_2 concentration in flue gas from lignite-fired power plant

* ppm means parts per million; 10,000 ppm equals 1%.

As at: April 2010

Read more about Vattenfall's CCS project at www.vattenfall.com/ccs

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