International Association of Oil & Gas Producers

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FINDING AND PRODUCING OIL AND GAS— SOME BASIC FACTS

What is CCS?

Carbon Capture and Storage (CCS) is a technology that captures carbon dioxide (CO_2) from power stations or major industrial plants and then injects it deep underground for long-term storage.

Capture and reinjection of CO_2 into oil reservoirs to increase pressure and recover more hydrocarbons (so-called EOR, or enhanced oil recovery) has been done safely for more than 40 years. In the future, CCS may help satisfy a growing energy demand (much of which will be from fossil fuels), while at the same time avoiding greenhouse gas emissions[1].

What does CCS involve?

CCS consists of three different processes:

Capture: Isolating the CO_2 produced by power generation and industrial processes (including, for instance, hydrogen production, CO_2 separation from produced natural gas, and fuel combustion for heat generation) before it is emitted to the atmosphere.

Transportation: Moving the captured CO_2 by pipeline or potentially by ship to a secure storage site.

CO_2 injection/storage: Injecting the CO_2 into carefully selected and managed deep geological formations, some of which previously contained hydrocarbons for millions of years. The techniques used to inject CO_2—similar to those used for oil and gas production and natural gas storage—are already proven from decades of experience in rejuvenating oil production in maturing oil fields and significantly extending their productive lives. The first large scale CO_2 injection project for EOR purposes, SACROC (Scurry Area Canyon Reef Operators Committee) in West Texas, has been operating since 1972. Worldwide, there are over 140 sites where CO_2 is injected underground.[2]

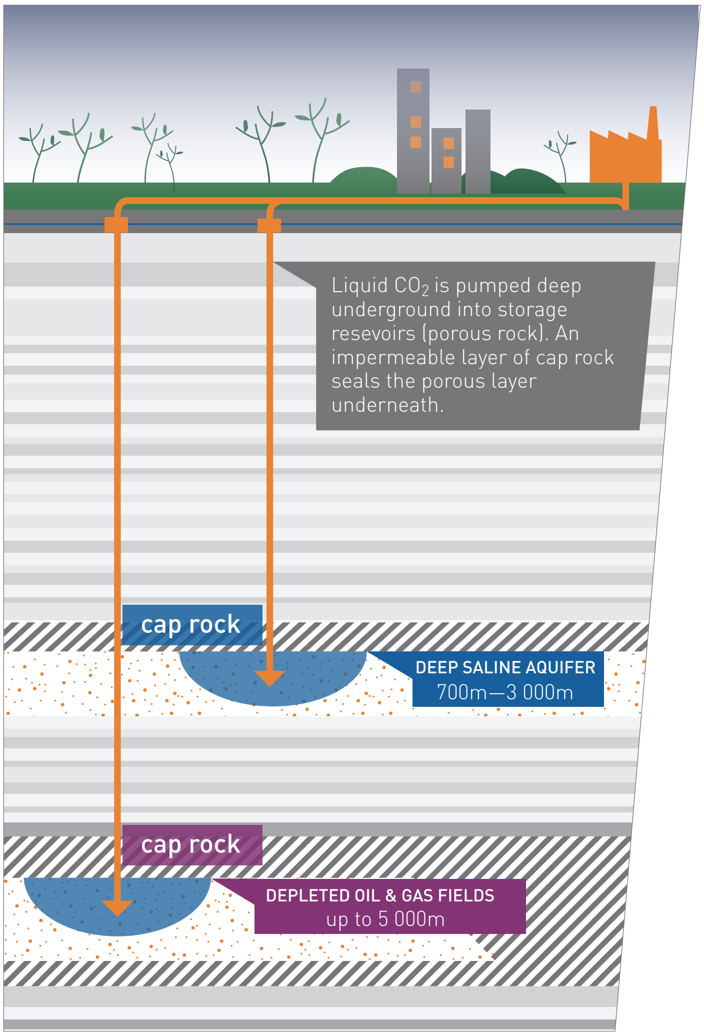

Figure 1: Storage of liquefied CO_2 takes place between 700 m and 5 km below ground

[1] According to IEA World Energy Outlook 2013, 'Carbon capture and storage (CCS) has been identified as an essential technology to meet the internationally agreed goal of limiting the temperature increase to 2°C.' International Energy Agency, World Energy Outlook 2013, p.53.

[2] *Harnessing Coal's Carbon Content to Advance the Economy, Environment, and Energy Security*, Nat'l Coal Council, 6-22,12, http://www.nationalcoalcouncil.org/report/NCCES_2012.pdf

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What are the benefits of CCS?

CCS can help reduce emissions while maintaining energy supply security.

CCS can permanently store CO_2 emissions resulting from production and use of fossil fuels in key sectors for our economy such as power generation, petroleum refining, and steel and cement production.

CCS can effectively make hydrocarbon use a very low-carbon option. Given the challenge of a growing population globally, all fuel sources and technologies will be needed to keep energy supplies secure and costs to a minimum. In the longer term, CCS could be one of the most effective technologies for achieving substantial reductions in emissions of CO_2.

Is there enough space to store CO_2?

Geoscientists believe that there may be enough capacity for CO_2 storage in deep geological formations to accommodate several decades of CO_2 emissions at current production rates.

The EU GeoCapacity project estimated that the overall permanent availability of geological storage capacity in Europe is over 300 Giga tonnes (Gt) of CO_2. More conservative estimates are over 100 Gt CO_2.[3] Additional storage capacity in the North Sea has been estimated at over 200 Gt CO_2.[4] Nevertheless, subsurface storage space is inevitably finite and should be used in a well-thought-out manner.[5]

Are there any examples of storing CO_2 in Europe?

In 1996, oil and gas companies initiated the world's first large-scale CO_2 storage-only project in the Sleipner gas field in the North Sea (Norway). Since then, the project prevented more than 10 million tonnes of CO_2 from getting into the atmosphere.

The second important CCS development in Europe is the Snøhvit gas field in the Barents Sea (Norway), the world's first to feature a gas liquefaction plant. In operation since 2008, the plant has a capture and storage capacity of 700,000 tonnes of CO_2 per year.

Are IOGP members involved in CCS projects?

Many IOGP members have been contributing geological, engineering, commercial and legal expertise for developing the three main components of CCS (capture, transport and CO_2 injection/storage). This has been based on extensive experience in the UK and Norwegian Continental Shelves and elsewhere.

For years, oil and gas companies have been developing and applying technologies to deal with the carbon dioxide resulting from the production of natural gas. This is because producers must ensure that CO_2 concentrations meet pipeline and consumer consumption requirements. Many of the technologies used for this are applicable to the separation of CO_2 from flue gases emitted in power or heat generation.

The upstream industry's experience in using CO_2 for EOR provides important knowledge for the development of CCS. EOR begins with CO_2 that is produced from natural sources or captured at a nearby power plant or other industrial facility. The CO_2 is compressed and injected into an oil reservoir, making it easier to move the oil to nearby production wells.

The industry has a unique understanding of what happens under the surface of the earth— gained from more than 100 years of oil and gas exploration and production. This experience has enabled oil and gas companies to characterise and monitor geological formations kilometres below the ground.

The oil and gas industry also has the experience of safely transporting liquids and gases over long distances, via land and sea.

IOGP members are engaged in a number of CCS projects in the USA, Canada, Africa, Australia and Europe. Examples are outlined in the annex.

[3] http://www.geology.cz/geocapacity: http://www.cgseurope.net/UserFiles/file/1st%20Kickoff%20meeting/Presentations/17-Vangklide-Pedersen.pdf
[4] Commission Communication on the Future of Carbon Capture and Storage in Europe, p.18
[5] Per megawatt hour, gas-fired plants produce over 50% less CO_2 than coal plants, IEA Energy Technology Perspectives 2014.

IOGP members' involvement in CO_2 injection projects (EOR and/or storage) based on publicly available information

PROJECT NAME	LOCATION (city/ town+country)	PARTIES INVOLVED IN THE PROJECT	PROJECT TYPE (pre/post combustion capture, Oxyfiring or gas clean-up/separation)	SOURCE/STORAGE OF CO_2 (e.g. Power station/offshore aquifer)	SIZE (tonnes CO_2/yr)	DURATION (START/FINISH)
Shute Creek	Southwestern Wyoming, USA	ExxonMobil (100%)	Precombustion capture – Natural gas processing: Capture and transport for EOR	Enhanced Oil Recovery	7 million	1986 onwards
Weyburn-Midale	Canada	Cenovus Energy (Weyburn Field) and Apache Canada (Midale Field)	Pre-combustion capture from a synfuel gasification plant and transport for EOR	Enhanced Oil Recovery	3 million	2000 onwards
Gorgon Project	Barrow Island, Western Australia, Australia	Chevron (47.3%) ExxonMobil (25%) Shell (25%) & others	Pre-combustion capture – LNG development and natural gas processing; capture, transport and storage	Separation of CO_2 from reservoir gas from various offshore fields, then injected into a deep saline formation under Barrow Island.	3–4 million	Expects project life of approximately 40 years
Lost Cabin	Wyoming, USA	ConocoPhillips	Pre-combustion capture – Natural gas processing: Capture and transport for EOR	Enhanced Oil Recovery	1 million	2013
In Salah	Krechba, Algeria	Joint Venture operation: BP, Sonatrach, Statoil	Pre-combustion capture - Natural gas processing: Capture, transport and storage	Onshore Deep Saline Formations	1 million	2004– November 2012
Sleipner	250 kilometres west of Stavanger, Norway	Statoil (operator) ExxonMobil Total	Pre-combustion capture – Natural gas processing: Capture, transport and storage	Sleipner gas field/Offshore deep saline formations	1 million	1996 – onwards
Quest	Edmonton, Canada	Shell (operator) 60% Marathon 20% Chevron 20%	Pre-combustion capture – Capture & storage in aquifer Pre-combustion	Scotford Upgrader—capture from 3 hydrogen manufacturing units	1 million	2015 (10/25 yr)
Peterhead	Peterhead, Aberdeenshire, Scotland, United Kingdom	Shell (operator), Scottish and Southern Energy (SSE)	Post-combustion capture – Capture, transport & storage in depleted gas field (Goldeneye)	Gas fired power station	1 million	2018-2020 for 10 yrs
Lula Oil Field	300 km off the coast of Rio de Janeiro, Brazil	Petrobas 65% (operator) BG 25% & other	Pre-combustion capture – Natural gas processing: floating production, storage, and offloading (FPSO) facility with CO_2 separation	Enhanced oil recovery at the Lula Oil Field	0.7 million	2013
Snøhvit	Melkøya, Norway	Statoil; Petoro; Total; GDF Suez; Norsk Hydro; Hess Norge	Pre-combustion capture LNG production and natural gas processing; Capture, transport & storage	Snøhvit offshore gas field/Offshore deep saline formations	0.7 million	2008– onwards
TCM	Mongstad, Norway	Gassnova (on behalf of the Norwegian gvt) 75, 12% Statoil 20% & others	Post-combustion capture Test centre: Capture only, using Aker amine technology and Alstom chilled ammonia technology	Capture from flue gases from gas-fired CHP and from refinery catalytic cracker	100,000 tonnes	2012 (5+years)
Lacq	Capture: Lacq, France Storage: Rousse, France	Total 100%	Oxy fuel combustion – Capture, Transport and Storage	Onshore sequestration in depleted natural gas field at Rousse (Pyrenees), 30 km from Lacq, at 4.5 km underground	CO_2 captured and stored > 50,000 tonnes	2009–capture and storage phase ended on 15/03/2013+ 3 years observation phase