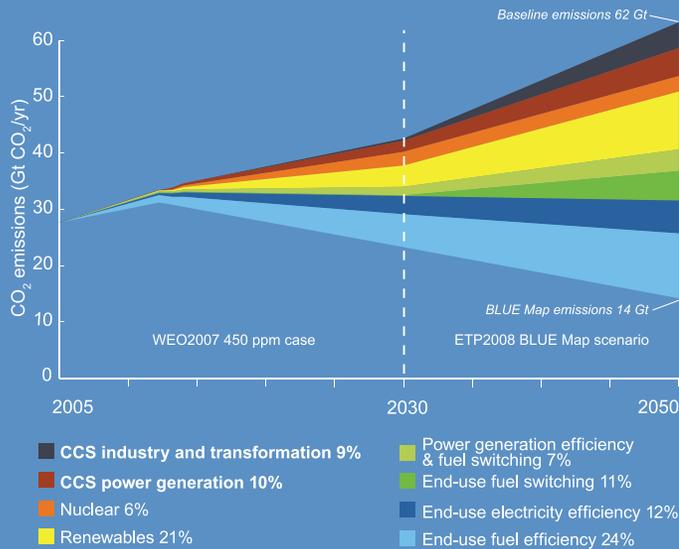


CO₂ CAPTURE AND STORAGE IN DEPTH



The world currently relies on fossil fuels to meet 80% of its energy needs. The demand from a growing population for energy is increasing and cannot be met in the medium term solely by renewables. To address the challenges of rising demand for energy and the need to rapidly reduce CO₂ emissions a portfolio of solutions is needed including greater energy efficiency, increased renewable energies and decarbonization of fossil fuel-based power generation, using CO₂ Capture and Storage technologies.

Already, large scale CCS projects such as at **Weyburn-Midale** (Canada), **In Salah** (Algeria), **Sleipner** (Norway) and **Snøhvit** (Norway) are preventing millions of tonnes of CO₂ from entering the atmosphere. But CCS is capable of much more. The IEA roadmap, assessing strategies for reducing greenhouse gas emissions by 50% by 2050, concludes that CCS will need to contribute one-fifth of the necessary emissions reductions to stabilize GHG concentrations in the most cost-effective manner.

CCS delivers one-fifth of the lowest-cost greenhouse gas reduction solution in 2050

Source: IEA, Energy Technology Perspectives (2008a)

SHARING DECADES OF EXPERIENCE

The oil and gas industry has a history of managing CO₂ underground in a process called Enhanced Oil Recovery (EOR). EOR involves injecting CO₂ into a reservoir to extract trapped oil and gas, with some CO₂ stored underground in the process. In the US over 3,000 miles of CO₂ pipelines exist to aid EOR, a secure process that has been around for more than three decades.

The industry has a unique understanding of what is happening under the surface of the earth—gained from more than 100 years of oil and gas exploration. This experience has

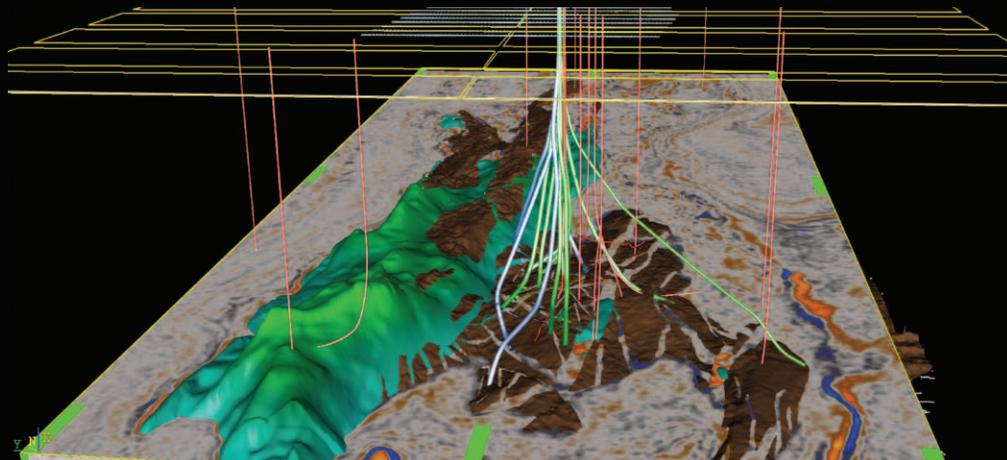
enabled oil and gas companies to characterize and monitor geological formations kilometers deep under the ground.

For more than 50 years natural gas has been injected and stored underground. In addition to managing liquids and gases underground the industry has the experience of safely transporting them vast distances, via land and sea. The oil and gas industry has the technology and the knowledge to assess geological formations, ensure safe storage and develop the frameworks needed to deploy CCS rapidly to reduce emissions.





Brutus platform, USA
Image courtesy of Shell



Seismic modeling to characterize a site, Clair field, Shetland UK
Image courtesy of BP



BTC pipeline project, Azerbaijan
Image courtesy of BP



Collecting seismic data
Image courtesy of BP

CO₂ Capture Project



CCP3 Participating organizations

THE CO₂ CAPTURE PROJECT

The CO₂ Capture Project (CCP) is a partnership of several major energy companies working together to advance the technologies and to improve operational approaches in order to reduce costs and accelerate the deployment of CO₂ Capture and Storage (CCS). The CCP is dedicated to advancing and sharing the industry's knowledge to ensure that CCS makes a rapid impact on CO₂ emissions. CCS has a significant role to play in reducing emissions from power plants and heavy industrial processes

such as oil and gas refining and cement manufacture.

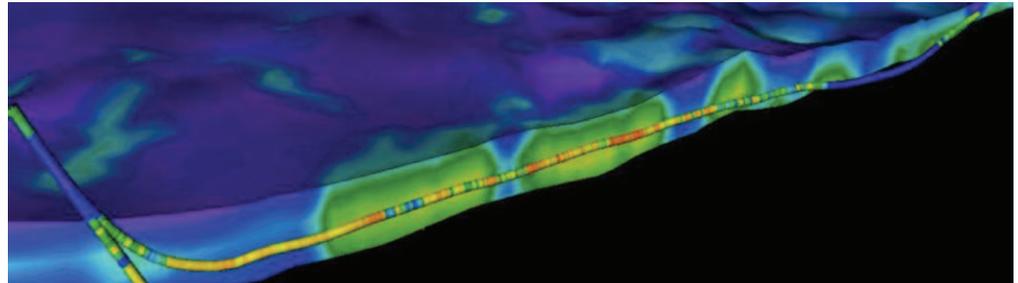
Since its formation in 2000, the CCP has undertaken over 150 projects to increase understanding of the science, economics and engineering applications of CCS. The group has been working closely with government organizations — including the US Department of Energy, the European Commission and more than 60 academic bodies and global research institutes.

The CCP is currently in the third phase of its work. Its areas of focus include:

- Driving down the cost of existing CO₂ capture technologies for use by the oil, gas and power generation industries, through further technology R&D as well as demonstrations of next generation technology
- Advancing knowledge of well integrity, the performance of well materials and site certification
- Adapting subsurface monitoring technologies to track CO₂ underground



Oil refinery - one of the industries for which capture technologies are being developed
Image courtesy of Suncor



Horizontal drilling of CO₂ injection pipe to target reservoir, In Salah CCS project, Algeria
Image courtesy of BP

WHAT IS NEEDED TO MAKE WIDESPREAD CCS HAPPEN?

The International Energy Agency (IEA) road map for CO₂ Capture and Storage (CCS) estimates that around 100 operational demonstration projects are needed by 2020 and over 3000 by 2050 to make an impact on climate change. Although the technologies and knowledge largely exist already, these targets will require:

Firm Long-Term Policy Commitment +

It is widely acknowledged that CCS can play a significant role in reducing greenhouse gas emissions. This role needs to be formally recognized, with CCS included in international agreements on greenhouse gas mitigation.

A Regulatory Framework +

Widespread deployment of CCS will require standards and criteria to provide assurance of the long-term effectiveness of geological storage of CO₂. Regulations must include agreement on site certification, operation, and long-term responsibility. The CO₂ Capture Project is committed to working with government and NGOs to share its expertise in these areas.

Market Conditions to Stimulate Growth +

Finance is the greatest barrier to seeing more integrated CCS projects in operation. CCS currently represents an additional cost, so for business to invest in CCS as a commercially viable venture long-term, a policy framework to support the market is needed.

+ Public Acceptance

For CCS to be deployed on the scale required, public acceptance and support is essential. Industry and government need to work together to build confidence in CCS as essential and effective, with a key role to play alongside other climate mitigation technologies.

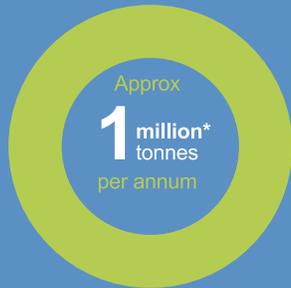
KEY LARGE SCALE CCS PROJECTS

CO₂ Capture and Storage (CCS) is already preventing millions of tonnes of CO₂ from entering the atmosphere. Currently there are four industrial scale CCS projects in operation across the world, and many more are planned. These projects are capturing and storing millions of tonnes of CO₂ every year. They all have a direct relevance to the application of

CCS in the wider world. For example the In Salah CCS project in Algeria is storing millions of tonnes of CO₂ in a deep saline formation, made up of low-permeability carboniferous sandstone. This formation mirrors the geology of potential storage sites commonly found in the USA, northwest Europe and China – regions with high CO₂ emissions.

In Salah

Algeria
Natural Gas field, onshore
Established 2004

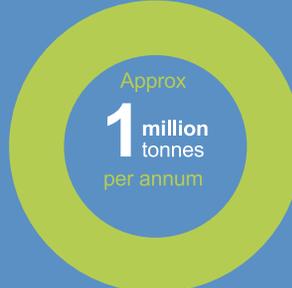


In Salah is a pioneering, industrial-scale CCS project that has been operating in Algeria since 2004. The project is operated by a consortium of BP, Sonatrach and Statoil. More than 3 million tonnes of CO₂ have already been geologically stored at Krechba in a deep saline formation 2 kilometers below the earth's surface that has been characterized to oil and gas standards. The storage formation at Krechba mirrors those commonly found in the USA, northwest Europe and China.

www.insalahco2.com

Sleipner

Norway
Natural Gas field, offshore
Established 1996

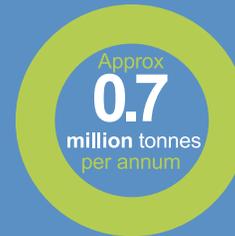


Sleipner began storing CO₂ in 1996, making it the world's first industrial scale CCS project. Sleipner is a natural gas field in the North Sea; CO₂ has to be separated from the gas before it can be sold. Around 1 million tonnes of CO₂ are stored every year in a saline formation located 1 kilometer below the seabed. Sleipner is operated by Statoil.

www.statoil.com

Snøhvit

Norway
Natural Gas field, offshore
Established 2008

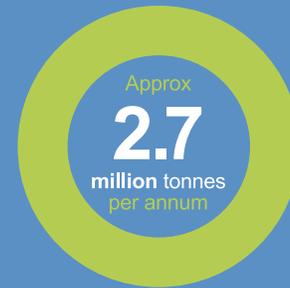


The project sees 700,000 tonnes being stored in a depleted natural gas reservoir deep below the seabed every year. Statoil operates the CCS project at the Snøhvit Liquefied Natural Gas (LNG) plant, where CO₂ is separated from natural gas before the gas is liquefied. The CO₂ is injected into a sandstone formation called Tubåsen, located 2,600 meters below the seabed.

www.statoil.com

Weyburn-Midale

Canada
Oil fields, onshore
Established 2000



A 330 kilometer pipeline connects a coal gasification plant in North Dakota, USA, to depleted oil fields in Weyburn, Canada. Since 2000, approximately 1 million tonnes of CO₂ a year have been stored in these oil fields. Two Weyburn projects exist: a commercial CO₂ enhanced oil recovery (EOR) project at the Weyburn oil field and the research project managed by the Petroleum Technology Research Centre that is being conducted in two phases.

www.ptrc.ca/weyburn_overview.php

* 1 million tonnes of CO₂ is equivalent to the annual emissions from about 200,000 cars

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More detailed resources on the topics covered in this publication can be found at the CCP website.

www.co2captureproject.com