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# Carbon Capture & Storage

## COAL21 Fact Sheet No.2

*COAL21 is a partnership of governments, industry and the research community aimed at reducing greenhouse gas emissions from coal.*

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Carbon capture and storage (sequestration) is one of the most promising ways for reducing the buildup of greenhouse gases in the atmosphere.

Even under the most optimistic scenarios for energy efficiency gains and the greater use of low- or no-carbon fuels, carbon capture and storage will likely be essential if the world is to stabilize atmospheric concentrations of greenhouse gases at acceptable levels.

## What is carbon sequestration?

Carbon sequestration is the capture and storage of carbon dioxide (CO<sub>2</sub>) that would otherwise be emitted to the atmosphere. CO<sub>2</sub> can be captured at the point of emission (or point source), or removed from the air in the process of photosynthesis. The captured gases can be stored in underground reservoirs, converted to rock-like solid materials, or absorbed by trees, grasses, soils, or algae.

## How is carbon captured and separated?

Before CO<sub>2</sub> from power plants or industrial sources can be stored, it must first be captured as a relatively pure gas.

CO<sub>2</sub> is routinely separated and captured as a by-product from industrial processes such as synthetic ammonia production, natural gas and hydrogen production, and limestone calcination. However, existing capture technologies are expensive, representing up to three-quarters of the total cost of carbon capture, transport, and storage. Considerable opportunities for cost reductions exist since comparatively little research has been devoted to CO<sub>2</sub> capture and separation technologies for power plants.

A major global research effort is now underway aimed at improving processes and lowering costs.

## What is geological storage of CO<sub>2</sub>?

Carbon dioxide can be stored in geological formations including oil and gas reservoirs, unmineable coal seams, and saline formations. It can also be used in creation of valuable by-products.

**Oil and gas reservoirs:** In some cases, production from an oil or natural gas reservoir can be enhanced by pumping CO<sub>2</sub> gas into the reservoir, under pressure, to allow oil and gas that would otherwise not be produced to be recovered. This is known as enhanced oil recovery (EOR) or enhanced gas recovery (EGR).

There are around 70 EOR projects using CO<sub>2</sub> currently underway, mainly in North America. Enhanced oil recovery represents an opportunity to store carbon at low net cost, due to the revenues from recovered oil/gas. It is also possible to inject CO<sub>2</sub> into depleted oil and gas fields for storage only.

**Unmineable coal seams:** Certain coal seams contain large amounts of methane adsorbed onto the surface of the coal. The current practice for recovering coal bed methane is to depressurize the bed, usually by pumping water out of the reservoir. An alternative approach is to inject carbon dioxide gas into the bed. CO<sub>2</sub> is roughly twice as efficient at adsorbing on coal as methane, giving it the potential to efficiently displace methane and remain stored in the bed.

CO<sub>2</sub> displacement of coal bed methane has been demonstrated in limited field tests, but much more work is necessary to understand and optimize the process. The recovered methane could provide a revenue stream to offset the costs of the carbon sequestration process. Coal bed methane can be used in gas turbines to produce electricity.

**Saline formations:** Storage of CO<sub>2</sub> in saline formations does not produce value-added by-products, but it has other advantages.

First, the estimated carbon storage capacity of saline formations is large, making them a viable long-term solution. Second, many existing large CO<sub>2</sub> emission point sources in Australia are assessed to be within reasonable access of a potential saline formation injection point.

Understanding the environmental implications and safety of CO<sub>2</sub> storage in saline formations is a key component of current R&D effort. The oil industry routinely injects brines that were associated with recovered oil into saline reservoirs, and the US Environmental Protection Agency (EPA) has permitted some projects that inject liquid wastes into deep saline formations.

The Norwegian oil company, Statoil, is injecting approximately one million tonnes per year of recovered CO<sub>2</sub> into the Utsira Sand, a saline formation around 800 meters beneath the sea floor associated with the Sleipner West Heimdel gas reservoir. The amount being stored at Sleipner is equivalent to the output of a 150-megawatt coal-fired power plant. This is the only commercial CO<sub>2</sub> geological sequestration facility in the world.

## Will injected carbon dioxide stay underground?

Only certain geologic formations are considered suitable for carbon dioxide storage.

In general, CO<sub>2</sub> can be stored in a layer of permeable rock that has a layer of impermeable rock above it. Permeable rock has pores through which fluids can flow and gather. Fluids cannot pass through impermeable rock, and so the top layer traps CO<sub>2</sub> that is injected into the permeable formation.

Such sites are the same type of formation that have trapped crude oil and natural gas over millions of years, providing a natural precedent for long-term CO<sub>2</sub> storage.

## Does storage of carbon dioxide underground risk contaminating drinking water supplies?

Much research is currently focused on understanding and addressing this risk. Sites would be selected where there are no natural connections between shallow drinking water aquifers and much deeper potential carbon dioxide storage formations. If there were naturally occurring conduits between the two layers of rock, then the brine or hydrocarbons in those formations would have already contaminated the water over millions of years.

The possibility that carbon dioxide could escape where other fluids did not is considered to be very low. Further research is being undertaken to develop technologies to monitor the movement of CO<sub>2</sub> once it is injected underground to confirm that it is being safely and securely contained.

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