Choosing a CO_2 storage location

When developing carbon capture and storage (CCS) projects, before injection of carbon dioxide (CO_2), a suitable storage site needs to be carefully identified based on five key factors— surface location, depth, containment, capacity and injectivity. Enbridge's site selection process for CO_2 storage is being developed in collaboration with leading subsurface experts.

Location and depth

For CO_2 storage, location is key. Ideally, CO_2 capture points, injection wells and storage locations are located close together. If there are several industrial sites from which to capture CO_2, they all might use the same storage hub. In either case, pipelines connect CO_2 capture points and CO_2 injection wells to form a CO_2 or CCS hub. The storage formations used by the hub must be of sufficient depth (usually greater than 800 metres or over 2,600 feet, depending on the region) and contain porous rock full of microscopic, interconnected holes so that CO_2 can be easily injected and trapped beneath impermeable caprock formations. Sedimentary rocks like sandstones, dolostones and limestones are ideal for CO_2 storage.

Containment

A CO_2 storage location must have dense layers of impenetrable rock above it, often referred to as caprock. Caprock provides a barrier that prevents movement of liquids and gases from the storage reservoir. In many CO_2 storage sites, there are several layers of caprock resting above the storage formation, offering multiple layers of protection preventing upward movement of CO_2. Shales and anhydrite rocks make good caprocks.

Capacity

The capacity of a location to store large volumes of CO_2 is determined by:

- Formation thickness and lateral extent
- Porosity and permeability of the rocks in the storage formation
- Reservoir pressures
- Extent and characteristics of the caprock

Injectivity

Injectivity is the ease that CO_2 flows into the pore space of storage formation. It's mainly related to the permeability and thickness of the storage formation. CCS project planners establish injectivity through a variety of means, including by injecting water into the storage formation and carefully analyzing the results prior to injection of any CO_2.

Ensuring a CO_2 storage site is safe

Site characterization

In developing a potential CO_2 storage site, CCS project planners like Enbridge work with geologists and engineers to collect and analyze publicly available information from existing wells in the area of interest, along with survey and visualization methods called 2D and 3D seismic data. This information helps to identify promising CO_2 storage locations. Once this early characterization work has been done, CCS project planners will drill their own evaluation wells and conduct seismic shoots using geophones and other subsurface imaging devices to determine the depth and breadth of a storage location. This additional activity will help determine the extent and thicknesses of different caprocks above the planned storage formation. The location of possible faults – both ancient and active – are also pinpointed.

Computer modelling and simulations

Once available data has been collected, CCS project planners use computer models and simulations to determine the expected location and movement of the CO_2 once injection begins. These models help estimate maximum injection pressures for the CO_2, identify ideal locations for injection wells and simulate expected behavior of CO_2 in the reservoir.

How CO_2 stays in the geological formation

Here are four ways that CO_2 becomes permanently stored within an underground formation:

Structural trapping

Caprocks above the formation prevent the upward movement of liquids and gases. In fact, such caprocks have kept oil and gas trapped below ground for millions of years.

Mineral trapping

Over time, some injected CO_2 may change within the reservoir to form a new, solid mineral. This is a very effective form of permanent storage.

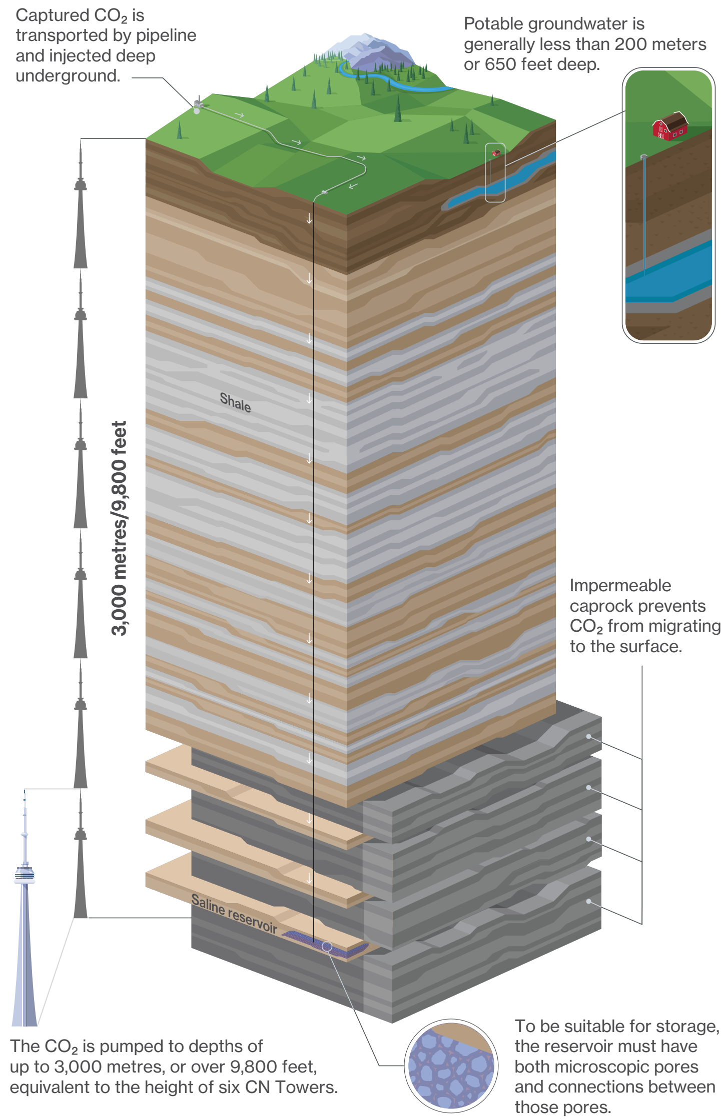
Dissolution trapping

Over time, some of the injected CO_2 dissolves into the saline, non-potable water contained in the micropores of the rock. The quantity of CO_2 trapped this way depends on many factors, such as the pressure in the reservoir and how salty the water is.

Residual trapping

When CO_2 moves through porous rock, it can get stuck in different holes in the rock. This is called residual trapping and is another effective means of storage.

Illustrative CO2 storage site



Storage locations must be deep enough, be permeable and porous, and have suitable caprocks above them to keep the CO_2 permanently stored.

Enbridge is advancing CCS projects across North America as a key enabler to reaching national and international emissions reduction goals. This is one of a series of Enbridge fact sheets intended to provide an overview of the many facets of CCS.