FACTSHEET

CCS101

Common Questions about CCS

How long before we start storing carbon dioxide (CO_2)?

Injection of CO_2 for permanent geological storage is already underway in Canada. As of the end of 2010, the IEA GHG Weyburn-Midale CO_2 Monitoring and Storage Project, the world's first and largest CO_2 storage project, has injected over 18 million tonnes into the Weyburn-Midale oilfield surrounding Weyburn, Saskatchewan. By the end of operations these depleted oilfields are expected to hold approximately 40 million tonnes of CO_2 that would have otherwise been vented into the atmosphere. That's over a tonne of CO_2 for every Canadian.

How do we know the CO_2 is where it has been injected and not going somewhere else?

The Measurement Monitoring and Verification (MMV) of stored CO_2 traces fluids and injected carbon dioxide during a storage project. These technologies include seismic measurements using advanced three and four dimensional methods that can show where the CO_2 is deep underground.

The purpose of MMV is:

- To determine if CO_2 migrates out of the injection zone
- To verify the storage and movement of CO_2 over geologic time
- To verify there is no vertical movement of CO_2 through caprock and aquitards towards the surface

The potential for leaks is something that researchers, scientists and engineers take very seriously and are key focuses of CCS project planning and monitoring. Every conceivable scenario for stopping a leak and remediation of any damage caused by a leak is taken into consideration as a part of CCS project planning.

Is CO_2 storage safe?

Injection of CO_2 involves technologies that have been used since the 1960's, most commonly in oil fields where the CO_2 acts as a solvent to increase oil production. Scientists have decades' worth of data to guide present day storage projects. The subsurface already stores a myriad of gases, including large volumes of naturally occurring CO_2, and natural barriers have held these gases in place for millions of years. They are proven safe storage zones that will, nonetheless, require monitoring and measurement (particularly of wellbores) to assure their ongoing safety. Through decades of injecting and storing other gases in the subsurface, like natural gas, researchers are very confident that CO_2 storage is safe.

How can CO_2 be Stored?

CO_2 can be stored in deep saline formations, unmineable coal seams, depleted oil and gas wells, and other deep geological formations.

It is important to note that CO_2 storage takes place very deep underground, one to two kilometres or more below the surface. This means that storage of CO_2 occurs over ten times deeper than the deepest

potable water wells, which do not exceed 100 metres in depth.

What are the elements of a good storage site?

A good storage site is typically more than one kilometre (1000 metres) below the surface so that CO_2 can be compressed and injected as a liquid. CO_2 in a liquid state is more predictable and easier to contain, and at depths of over 1000 metres the geological pressures ensure much of the CO_2 remains as a liquid.

Porous rock formations or deep saline formations offer the best storage mediums for CO_2. Contrary to many people's perception of storing CO_2 in the subsurface, it does not occupy some giant cave underground, but rather the microscopic pores in porous rock. Most deep saline or oilfield formations are made up of porous rock, such as sandstone. The chemical interaction between liquid CO_2 and the liquids and minerals in the sandstone over thousands of years, will see a significant part of that CO_2 transformed to calcium carbonate - a solid. In areas where pre-existing fluids are present, like in deep saline formations, much of the injected CO_2 will absorb into the saline water over long periods of time.

No matter what storage medium is utilized, a good injection site requires one or more cap-rock formations above the injection zone to ensure the CO_2 does not migrate back up to the surface. Most formations, in fact, have more than one aquitard (barrier to the horizontal movement of fluids) above the injection location. These cap-rocks and aquitards have kept naturally occurring gases and fluids underground and separated from each other for millions of years.

How is CO_2 trapped underground?

There are 4 main trapping mechanisms used to keep the CO_2 underground:

- **Structural or Cap Rock Trapping** - The cap rock is a thick, dense layer of rock, anywhere from 20 to 200 metres thick. The liquid CO_2 is trapped in pore spaces below the cap rock and is prevented from seeping to the surface by this thick impermeable barrier of rock above it. Project developers often prefer more than one layer of dense cap rock or aquitards to be present above an injection zone.
- **Residual Traps** – Capillary forces keep the CO_2 in the pores of the formations where they are injected. That's a fancy way of saying a portion of the liquid CO_2 is trapped in the small pores of the injection formation itself and do not migrate upwards because of the trapping spaces within the injection site.
- **Solution Traps** – This is where CO_2 mixes well with the formation fluids, or forms ionic bonds with the fluids (such as in the brine of a saline formation or with the oil that saturates the pore spaces within an oilfield). The CO_2 remains in the formation with the trapped fluids.
- **Adsorption** – This is where the CO_2 bonds with formation rocks that contain organic material, such as coal or shale, and remains in the formation. This includes mineral traps, where the CO_2 precipitates out as a carbonate mineral, like when CO_2 interacts with sandstone or limestone. The carbon dioxide solidifies and makes its escape an impossibility.

For more information about CCS, or to pose a specific question that you would like answered, please visit CCS101.ca.