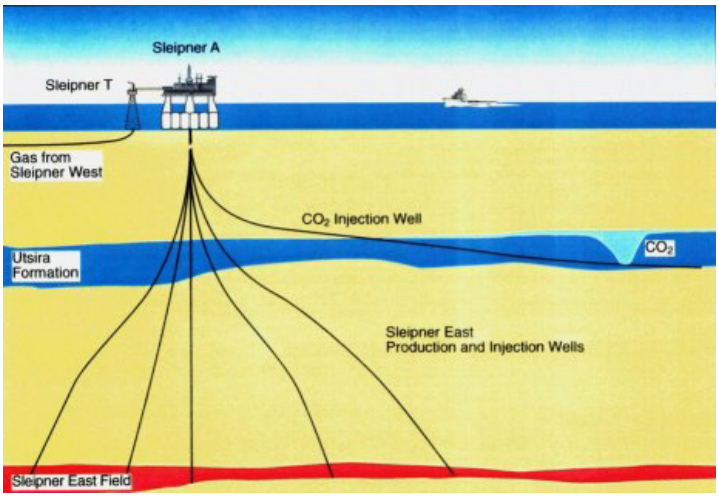
3.1.2 CO_2 STORAGE IN GEOLOGIC FORMATIONS

Technology Description

Sleipner North Sea Project



Large amounts of CO_2 (about a billion tons per year) may need to be stored as a part of a future global atmospheric stabilization strategy. CO_2 can be injected into depleting oil wells and unmineable coal-bearing formations to enhance resource recovery. A portion of the CO_2 remains underground, although current industry practices are geared strongly toward minimizing the CO_2 left underground – and little or no attention is paid to the CO_2 that is not recovered. R&D is focused on revamping conventional enhanced oil recovery and enhanced coalbed methane processes so that they can serve a dual purpose: resource recovery and CO_2 storage. Saline formations, organic-rich shale beds, and other nonconventional geologic structures have potentially enormous CO_2 storage capacities. Research is focused on learning more about these formations and developing the capabilities needed to use them as CO_2 repositories.

System Concepts

- CO_2 is captured from a large point source of anthropogenic emissions, transported, and injected into a depleting oilwell, unmineable coal seam, saline formation, depleting gas well, shale formation, or other geologic structure amenable to CO_2 storage.
- Storage may entail geochemical reactions that tend to form carbonates in silicic host rock, enhancing containment.
- In an oil well, the CO_2 decreases the viscosity of the oil, enabling more of it to be recovered. A portion of the injected CO_2 remains stored in a reservoir as a free gas, brine or oil solution, or carbonate.
- In a coal bed, CO_2 displaces methane absorbed onto the surface of the coal, enabling it to be recovered. The CO_2 remains absorbed on the coal and, thus, is securely stored.
- Components in the CO_2 stream (e.g., sulfur, nitrous oxides, nitrogen) could have a positive impact on certain storage applications.

Representative Technologies

- Natural gas storage in saline aquifers provides relevant capability.
- Technologies will borrow extensively from the petroleum industry in the areas of drilling simulation; completion of injection wells; processing, compression, and pipeline transport of gases; operational experience of CO_2 injection for enhanced oil recovery; and subsurface reservoir engineering and characterization.

Technology Status/Applications

- The Mount Simon reservoir underlying Illinois, Indiana, Michigan, Kentucky, and Pennsylvania has been approved for industrial waste disposal and underlies a region with numerous fossil energy power plants.

- Industry has experience with more than 400 wells for injecting industrial wastes into saline formations.
- The petroleum technology is readily adaptable to subsurface CO_2 storage.

Current Research, Development, and Demonstration

RD&D Goals

- Develop domestic CO_2 underground storage repositories capable of accepting around a billion tons of CO_2 per year.
- Demonstrate that CO_2 storage underground is safe and environmentally acceptable.
- Demonstrate an effective business model for CO_2 enhanced oil recovery and enhanced coalbed methane, where significantly more CO_2 is permanently stored than under current practices.
- Develop publicly accepted monitoring protocols.

RD&D Challenges

- Develop the capability to inject CO_2 into saline formations with low permeability.
- Harness geochemical reactions to enhance containment.
- Develop injection practices that preserve cap integrity.
- Develop an understanding of the CO_2 properties of shales and other unconventional hydrocarbon-bearing formations.
- Develop the ability to track CO_2 transport.
- Develop field practices that optimize CO_2 storage and resource recovery.
- Develop the ability to predict the CO_2 storage capacity and potential resource recovery of a particular formation.
- Develop the ability to track the fate and transport of injected CO_2.
- Develop a better understanding of the chemistry of coal and CO_2, and conduct comprehensive R&D program on all physical and chemical aspects of CO_2 interactions with reservoir phases.

RD&D Activities

- Study geochemical reactions involving CO_2 in a laboratory.
- Study the natural analogs of geochemical CO_2 conversion. Study rock samples from CO_2 bearing geologic formations to better understand in situ geochemical/geobiological reactions.
- Develop CO_2 tracking technology, e.g., sonic, chemical tracers.
- Study CO_2 transport in the Sleipner Vest gas field, via the International Energy Agency's Greenhouse Gas Programme.
- Novel injection techniques to increase CO_2 storage in saline formations.
- CO_2 storage in coal beds. ARI and industry consortium, commercial-scale field demonstration in the San Juan Basin; Consol – horizontal drilling, Alabama geologic survey, screening model for Black Warrior.
- CO_2 storage in oil reservoirs. Weyburn, reservoir mapping, West Pearl Queen, CO_2 monitoring and simulation.

Recent Progress

- Major saline formations underlying the United States have been identified.
- Initiated a pilot-scale test of CO_2 storage in a depleted oil reservoir.
- Initiated several field tests with key industrial companies participating and providing cost-share: Consol Inc. CBM,-Appalachia ARI, CBM-San Juan Basin; Strata Production C. – Permian Basin; Pan Canadian Resources EOR-Canada.