



CO₂ Capture and Storage (CCS) for Domestic and International Markets

Challenge

As the global demand for energy grows, so does the concern over greenhouse gas (GHG) emissions.

Many countries have or are introducing legislation aimed at energy producers and large energy consumers to reduce GHG emissions. This is difficult; coal is abundant and commonly used, but is a major CO₂ source. Though cleaner, oil and gas generate substantial amounts of CO₂ and reserves are depleting quickly.

Governments and industry need long-term solutions to these energy challenges. It is in economic best interests that this be done at the lowest possible cost with maximum economic and environmental benefits.

One solution is CO₂ Capture and Storage (CCS). This technology captures CO₂ and stores it in hydrocarbon reservoirs or saline aquifers, thus reducing GHG emissions to the atmosphere. This, along with clean coal technologies, can lead to a cleaner environment and more efficient use of our energy resources.

No one company possesses all of the expertise essential to develop successful CCS projects. The Canadian CO₂ Capture and Storage Alliance (CCCSA) can address all parts of this challenging issue.

Opportunity

Potential geological storage resources are large and widely distributed across all continents. Saline aquifers have the greatest potential but are largely unproven, costly and revenue deficient. Siliciclastic, carbonate and coal reservoirs containing oil and gas have much smaller capacities. However, these reservoirs present an opportunity for dual benefit - the storage space is increased by displacing and recovering the oil and gas, hence creating a revenue stream as well.

Our alliance of Canadian companies is developing CCS throughout the world. CCS shows the greatest potential in developing countries such as China, India and South Africa (possibly through the Clean Development Mechanism, i.e. CDM) where CO₂ emissions are abundant, and production and use of fossil fuels is growing.

Clean coal technologies, such as coal gasification or oxyfuel combustion, provide a relatively concentrated CO₂ source for geological storage and generate cleaner power. Alternatively, natural gas can be used for cleaner power production and the CO₂ captured and injected into nearby geological reservoirs.

Solution

Maximizing the benefits of CCS requires expertise in all aspects of the technology, from capture to pipelining to injection. Our alliance has this expertise and will help you design a CCS process that offers the greatest benefits for the lowest possible cost.

Our expertise can be used for coal, oil and gas reservoirs and saline aquifers anywhere in the world. We can help you:

- Build capacity in CCS expertise through tailored courses for your specific needs, including public outreach.
- Design science and technology programs to aid in capacity building of CCS knowledge and skills.
- Match CO₂ sources with appropriate geological sinks.
- Select CO₂ pipeline routes and design pipelines.
- Select and design capture technologies for your CO₂ sources.
- Design and install CO₂ injection well equipment.
- Assess CO₂ geological/hydrogeological storage capacity at country, basin, regional, local and/or site scales.
- Assess injectivity and distribution of CO₂ at site scale through reservoir simulation.
- Optimize CO₂ storage with enhanced oil and gas production at site scale.
- Assess caprock stability and well integrity for long term containment of CO₂ in a storage site, and design and implement remedial/ mitigation measures if necessary.
- Assess long term trapping capabilities of specific geological storage sites.
- Recommend, design and provide cost estimates for micro-pilot testing, field demonstrations, and commercial operations for CCS.
- Implement micro-pilot and field-pilot CCS operations.
- Perform life cycle economics including emissions trading for CCS.
- Analyze performance and long term risk of leakage from the storage site and design the management plan.
- Design and implement long term monitoring programs to detect leakage and seepage of CO₂.

Canadian CO₂ Capture and Storage Alliance (CCCSA)

Alberta Research Council Inc. (ARC)

ARC has spent over 15 years advancing technologies and processes to store CO₂ in geological formations while enhancing resource recovery. Recent projects include:

- leading an international consortium for developing CO₂ enhanced coalbed methane recovery (ECBM) technology.
- leading or a participant in four of the six parts of the Weyburn EOR and CO₂ storage and monitoring project, sponsored by the International Energy Agency.
- lead partner for a CIDA-sponsored China CO₂ enhanced coalbed methane recovery project (with the China United Coalbed Methane Co. Ltd. and other partners).
- research provider for the CSLF-endorsed FRIO project, injecting CO₂ into a deep saline aquifer in Texas.
- delivering APEC-sponsored workshops in China and Mexico to build CCS capacity.

Calfrac Well Services Ltd.

Calfrac is an oil and gas well pumping service company specializing in fracturing stimulation, acidizing stimulation, coiled tubing, cementing, CO₂ and N₂ services. We have provided services to Canada, USA, Russia, China, Mexico and Argentina. Calfrac has business and technical alliances with numerous operators, internationally, for its services.

Computer Modelling Group Ltd. (CMG)

CMG is a numerical reservoir model developer. We provide software development, application, technology support and consulting services to help the petroleum industry increase their oil and gas production worldwide. CMG has unique simulators to (i) model CO₂ storage in coals in an ECBM process and (ii) model CO₂ storage in saline aquifers including the trapping by geochemical reactions.

DRG Resources Ltd. (DRG)

DRG has 35 years experience of consulting and technical training experience in the upstream oil and gas industry. We conduct consulting services and training programs in the U.K., Egypt, India, South America, as well as the Middle and Far East. DRG is known for its expertise in horizontal drilling and well completions, well stimulation, primary and remedial cementing, sand production management, and formation damage.

Energy Navigator

Energy Navigator supplies property evaluation software for the oil and gas industry which includes the effect of royalty regimes etc. in the assessment. Currently, we are working together with ARC on an integrated CCS package.

Sproule International Ltd.

Sproule is an international consulting company and provides expertise in geophysics, geology, hydrology, drilling, economics, and field and reservoir engineering. We perform oil and gas property evaluation for clients both locally and internationally.

SNC-Lavalin Inc. (SLI)

SNC-Lavalin is one of the leading engineering and construction groups in the world and a major player in the ownership of infrastructure, and in the provision of operations and maintenance services. The SNC-Lavalin companies have offices across Canada and in 34 other countries around the world, and are currently working in some 100 countries. We have extensive experience in designing facilities for capturing and transporting CO₂. SNC-Lavalin has undertaken studies of CCS facilities in Canada, China, United Arab Emirates, Europe and worldwide. Using their expertise in environmental management, SLI provided technical assistance to help India set up an environmental management department for an electric utility. We also managed the development of the Cleaner Production Strategy for China.

Weatherford

Weatherford International Ltd. (NYSE:WFT) is one of the largest global providers of products and services that span the drilling, evaluation, completion, production and intervention cycles of oil and natural gas wells. Weatherford employs approximately 35,000 employees worldwide, operates in more than 100 countries, and is committed to pursuing the highest standards of quality, health, safety and environmental performance. Technology is core to Weatherford. We have doubled research and development over the past six years. We also have spent more than \$0.5 billion acquiring technology. We have created a large inventory of intellectual property and encouraged a burgeoning technology culture. We are proud to apply this capability to help progress carbon capture and storage capability in Canada and globally.

The alliance has expertise in:

- combustion & gasification
- CO₂ capture & CO₂ credits
- surface facilities including pipelining
- carbonate, siliciclastic & coal geology
- groundwater & sedimentary basin hydrogeology
- geophysics, geomechanics & geochemistry
- drilling, logging & laboratory testing
- completions, stimulation & well testing
- reservoir engineering & reservoir modelling
- injection & production engineering
- monitoring & field validation
- risk and performance assessment
- database & project management
- life cycle economics
- environmental management
- training & regulatory

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