Carbon Capture Journal

CCUS in Canada

International CCS Knowledge Center - the business case for CCS

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'Crucial Role' of Oil and Gas Industry in meeting UK Net Zero targets

Making a business case for large-scale CCS

In a world dedicated to having both a safe, clean environment - represented in the COP21 Paris Agreement; and having economic progress – evident with the desire and drive for growth and prosperity, a consolidative and deployable approach that holds both these qualities with integrity is needed.
By Beth Hardy, VP Strategy & Stakeholder Relations, International CCS Knowledge Centre

"There is no silver bullet to a 2-degree-or-less future. We need to stop putting carbon dioxide (CO2) into the atmosphere, and for that we need to fire off at least three bullets at once: energy efficiency, renewables, and carbon capture and storage (CCS)," as citied in the DNV-GL article by Kaare Helle and Anne Louise Koefoed.

Shifting away from the world's dependence on fossil fuels for secure and reliable energy has been a slow process. In fact 81% of the world's energy supply is still sourced from fossil fuels (Total Energy Supply by Type, IEA). This has been the situation for over 30 years. As long as it is in the mix, CCS is needed to close the emissions gap. Experts from governments and industry continue to stress that carbon capture is nothing new – in fact it is well understood and operating, so the barrier to mobilization is not the technical know-how, but rather due to a lack of policy or policy uncertainty.

In a climate of ambitious emission reduction targets, CCS has been proven to be a reliable and adaptive technology which will realize significant cost reductions - in a study spearheaded by the International CCS Knowledge Centre, next generation CCS plants could see capture capital cost reductions of 67% per tonne of CO2, bringing the cost of capture down to USD$45/tonne.

Business Models for CCS

With technological certainty and reductions in risk and cost, policy drivers can be supported by strong business cases for CCS. For example, in Saskatchewan Canada retrofitting Unit 3 at the SaskPower Boundary Dam Power Station (BD3) had the benefit of federal and provincial government funding as a first mover; saw the retrofit add three decades of operation to an aging power plant, rather than decommissioning it; and, the sale of byproducts including CO2 to offset the cost of capture.

At BD3, which has now captured almost three million tonnes, CO2 is either stored in a deep geological sandstone formation or sold for enhanced oil recovery (EOR) where it is ultimately stored permanently in the depleted oil reservoir. As a first out-of-the-gate, BD3 is a pioneer project and a point of pride for Saskatchewan and Canada offering critical lessons for the world in areas of CCS, engineering, and emission reductions.

There are various types of business case models considering both the capture and the storage/utilization sides that an entity may choose when developing CCS. This article explains models in two parts of the process:

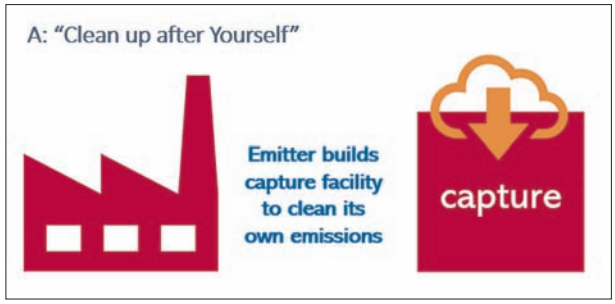
- Emissions Being Cleaned Up – CO2 Capture (Models A,B,C), and
- CO2 Permanently Stored (Models 1,2,3).

Emissions Being Cleaned Up – CO2 Capture

All industrial facilities release CO2 as part of their emissions. Emissions from fossil fuels, cement, iron and steel, or other large sources can all be cleaned up using post-combustion capture technology already in place today.

Model -A- Clean Up after Yourself

Model A represents a company who captures its own emissions. SaskPower used this model at BD3. In that case, Canadian coal regulations were looming, and at the time analyses showed that compared to natural gas prices, CCS would allow the coal plant to extend its life economically, while also having deeper cuts to greenhouse gas emissions. Due to its first-of-kind nature, the project was government subsidized, and was paired with Model 1 below to generate income from the sale of CO2 to an oil field for EOR (with the backup of having its own storage site as well). Other project developers may consider business Model A to simply clean up their emissions; to avoid carbon taxes; or if the CO2 content of the emissions is near pure and easier to capture, therefore reducing costs.



Model -B- The Janitor

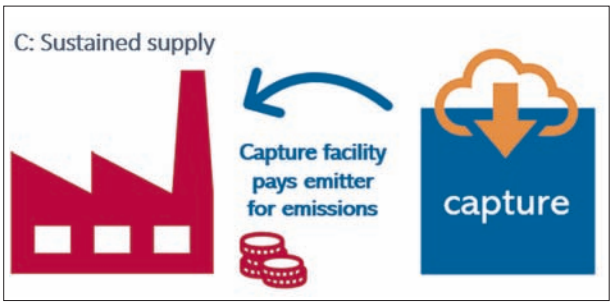
In Model B, the emitter would pay an outside party (CO2-capturer) to clean up their emissions. However, the amount that would be paid to the CO2-capturer would likely not suffice to cover the cost of clean-up. So eco-

nomically, with a price on carbon, that price would have to be lower than the cost to 'hire the janitor' in order for the emitter to act.

Model B is most useful, therefore, when paired with a secondary income from a CO2 off-taker such as Model 1 or 2 below.

Model -C- Sustained Supply

Model C represents a constant input of CO2 from the emitter. This can occur in two scenarios: First, when a CO2-capturer purchases CO2 from an emitter to sell on the market to an off-taker. The CO2-capturer may want a supply guarantee to avoid a penalty with its off-taker. The second scenario would occur if the capture design required a minimum or constant CO2 input level. A problem factor comes when the emitter is a power plant and there isn't enough power demand to generate the required level of emissions.

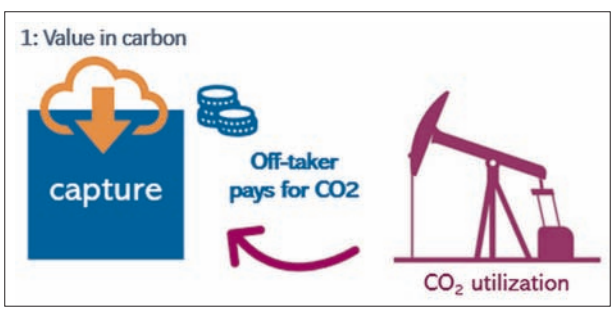


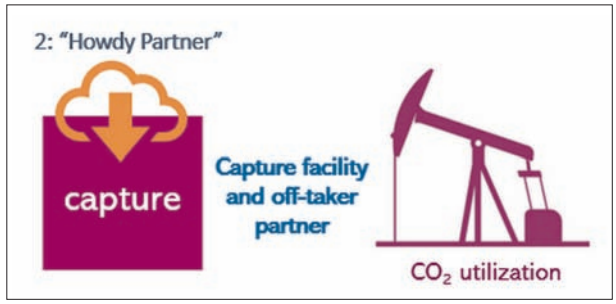
CO2 Permanently Stored

The permanent storage of large amount of CO2 is crucial to meeting objectives of the Paris Agreement. Alongside sequestration, CO2 utilization via EOR also falls into the category of permanent storage because in both instances large amounts of CO2 stay deep underground.

Model – 1- Value in Carbon

As briefly mentioned above, business Model 1 represents a party purchasing the CO2 from the capture facility. This could be any form of utilization, but in the case of the BD3, an oil company purchases CO2 from SaskPower. In this instance there is value in the CO2.





Model -2- Howdy Partner

A successful model for the Petra Nova CCS Project has a CO2 off-taker (like in Model 1) and paired it with a secured interest in the CO2 provided to them. In Model 2 having a partnership places a direct investment in the outcome and output of the CCS project.

There are logical and essential business models in utilizing CO2 in ways other than EOR such as value-add products like adding CO2 to concrete or other notable processes. However, as Imperial College London's Dr. Niall Mac Dowell highlights in his article "The role of CO2 capture and utilization in mitigating climate change", utilization other than EOR "should be encouraged when and only when CO2 is useful as a cheap feedstock, or when it can robustly and reliably shown that the CO2-derived product can reasonably displace the incumbent product, that is, deliver the same service at the same price, and also not result in an increase in the emission of CO2 associated with delivering that service." Dr. Mac Dowell also has an informative graph that shows these processes can only reduce minimal amounts of CO2.

Given the findings of that article, the need to reach mitigation targets, and the simple fact that the large-scale storage doesn't have the front-and-centre marketability of other utilization opportunities, the end-use models are critical business considerations for large-scale permanent CO2 storage. EOR is one method of recouping costs, however, not all locations can find profit in this way – which leads us to Model 3.

Model -3- The Garbage Man

In Model 3 the off-taker gets paid to be the ultimate end point in storing away the CO2. This concept is gaining interest for countries looking to limit emissions. For instance, a new hub at the Port of Rotterdam plans to create a CO2 transport hub to serve the Netherlands' industrial facilities with the potential to expand to serve industrial plants in other countries looking to dispose of their CO2 such as Belgium, Germany or the UK.

The pipeline network would transport the CO2 for injection in depleted oil and gas fields in the North Sea. It is a prime example of how non-EOR CO2 hubs can exist for storage. However, there is criticism that this can only exist if the price of carbon increases or there is significant subsidizing of development.

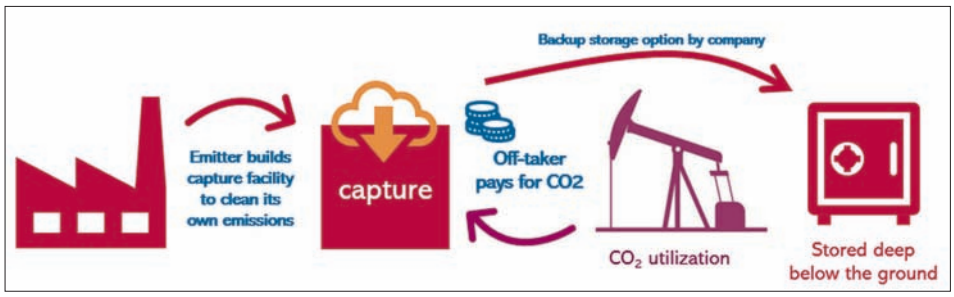
Combing Models Builds Better Business Cases

So how can these models be combined? Let's go back to Boundary Dam 3 CCS Facility. When the project was developed it was decided to take a full-scale approach to permanent storage of CO2. This means not only did it integrate a CCS facility into an existing coal plant (giving 30 years of clean life to the asset) but it also took the CO2 and used it for EOR with the backup option to permanently store it.

The Aquistore project, whose assets are owned by SaskPower, acts as a backup to permanently store CO2 if the off-taker doesn't need or want the CO2 produced. Therefore, captured CO2 isn't emitted into the atmosphere, if the oil company doesn't buy it. With over 30 monitoring technologies installed subsurface and above ground, the Petroleum Technology Research Centre's (PTRC) research program at Aquistore is the largest active field lab in the world for measurement, monitoring and verification proving safe deep geological storage of CO2.

In Alberta, Canada the Quest CCS facility, which is operated by Shell has over four million tonnes of CO2 permanently stored, uses this same sequestration option without the benefit of EOR. Even without EOR, the project makes a profit on its operations because of the provincial carbon price. The project has an operating cost in the mid-$20 per tonne and with a provincial carbon price of $30 per tonne it means the carbon price pays for the costs to operate.

The Alberta Carbon Trunk Line (ACTL) is another example combining models to build a better business case. It brings together multiple partners using proximity and the notion of a hub, the ACTL will aim to maximize the opportunities for capture, utilization in the oil fields, and permanent sequestration. ACTL will consist of a 240km pipeline that can transport up to 14.6Mt of CO2 per year at full capacity. The CO2 in intended to be transported from capture plants at different industrial facilities and then either injected into depleted oil reservoirs for permanent storage or sequestered directly into a permanent deep geological storage site.



Coupling Models & Policy

Climate change is a formidable challenge that requires a formidable, collaborative approach along all avenues for emission reductions. CCS needs to be an active part of the toolkit now and into the future. To reach our collective commitment in the Paris Agreement, the value of CCS goes up, not down.

Business models coupled with market shifts can actively ensure a pickup in CCS deployment – and definitive and clear policies, through a creation of a variety of CCS incentives or subsidies will help drive market shifts.

A convergence of industries, government along with policy mechanisms, to support strong investment in CCS is imperative. Ultimately, and ideally, the world can achieve more large-scale CCS facilities, which means more emission reductions, and a cleaner industrial future.

More information

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Boilermakers advocate for CCUS technology in Canada

The Boilermakers Union championed CCUS technology at two key energy and climate events in Saskatchewan and British Columbia in May. www.boilermakers.org

The Boilermakers union partnered with Saskatchewan Building Trades to host a town hall on CCUS in Estevan, Saskatchewan, and participated in a panel discussion with the International CCS Knowledge Centre during the global CEM10/MI-4 conference in Vancouver.

"Climate change isn't just a problem regionally or locally," said Boilermakers International Director for Climate Change Policy Solutions, Cory Channon, who spearheaded the Boilermakers' involvement in the events. "This is a global problem, and the Boilermakers are a part of the global solution."

The CCUS Town Hall in Estevan brought in leaders from the Global CCS Institute and International CCS Knowledge Centre on May 23 to share the latest information on CCUS, provide updates on costs and technology and advocate for local opportunities for additional CCUS projects.

Estevan has much at stake concerning the future of CCUS: Coal mining is among the largest employers in the town, which is also home to the Shand and Boundary Dam coal-fired power stations. Further, the Boundary Dam station is SaskPower's largest coal-fired station and was the first of its kind to have one of its units retrofit for CCUS technology.

"This is very important to us in our community," said Estevan Mayor Roy Ludwig, who works at the Westmoreland Coal Company's Estevan mines and is a member of the UMW. "I've had the privilege to work in a coal mine, and I'm sure all my brothers and sisters will attest that these are great paying jobs and we'd like to keep them going in the community. We want to continue to expand the clean coal technology we're so proud of, and we're going to continue to push for it."

Town hall attendees included trade union members from the Boilermakers, IBEW and United Mine Workers, among other trades; provincial media; provincial-level Member of

If we are serious about reducing emissions, then we better be serious about large-scale CCS.

You want substantial emission reductions.

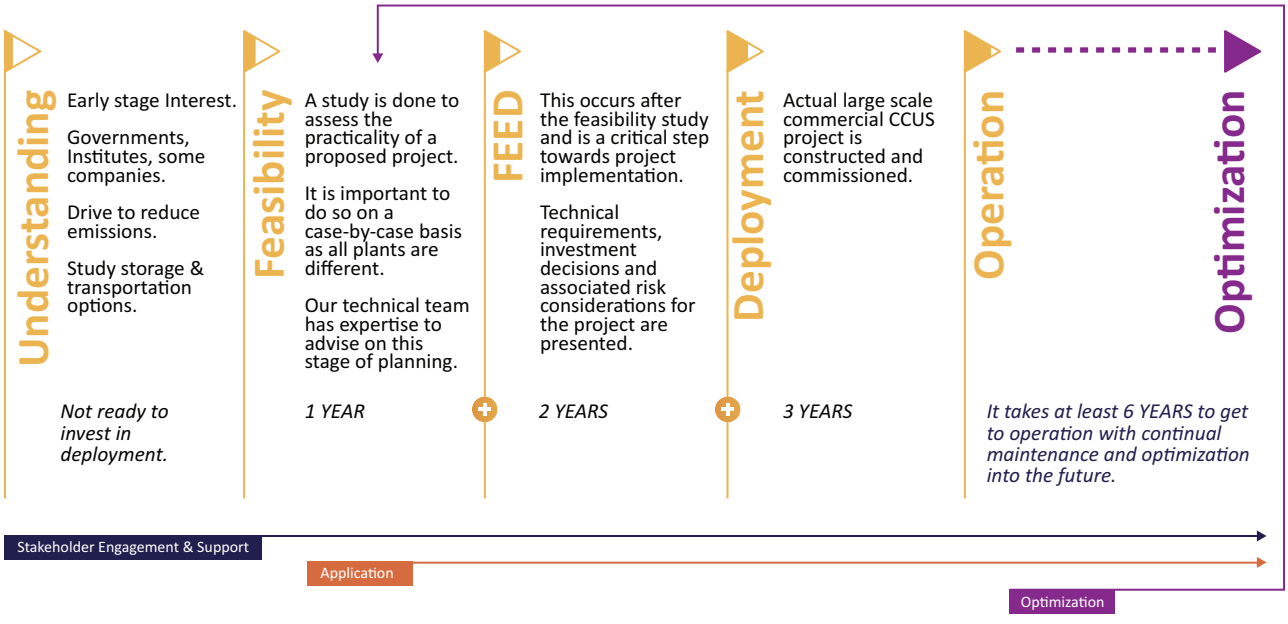
You need credible know-how.

Lessons learned can reduce risk and cost for CCS projects through-out their development.

This is our area of expertise. *And its substantial.*

Where are you on the path to CCS?

Aggressive Timeline to Deploy a CCS Project



Action will delineate and define our futures.
CCS is action, *designed for the world.*

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