



CCUS: PRIORITIES AND PATHWAYS WORKSHOP

Summary Report

Abstract

On Sept. 25, CMC Research Institutes and the Pembina Institute co-hosted a Carbon Capture, Utilization and Storage (CCUS) workshop that was planned together with CanmetENERGY, Natural Resources Canada. This document presents the results of that workshop.



Corresponding Authors:

Sandra Odendahl: Sandra.Odendahl@cmcghg.com; Jason Switzer: jasons@pembina.org

SUMMARY REPORT

CCUS: PRIORITIES AND PATHWAYS WORKSHOP

September 25, 2018 in Calgary, AB

SUMMARY

On Sept. 25, CMC Research Institutes and the Pembina Institute co-hosted a Carbon Capture, Utilization and Storage (CCUS) workshop that was planned together with CanmetENERGY, Natural Resources Canada. This workshop brought together approximately 40 technology developers, funders, industrial end-users, government bodies and other key stakeholders to discuss ways to position Canada as a global leader in the development, commercialization, adoption and export of CCUS technologies.

The event began with three plenary panels focused on finance, climate policy, and challenges in technology development. After group discussion, participants were invited to join one of three breakout sessions to identify challenges and discuss potential solutions in the areas of policy, finance and market demand. In an end-of-the-day plenary session, findings from each breakout were presented and a list of action items was generated.

Several crosscutting themes emerged throughout the workshop. Carbon pricing, consistent and stable political support for carbon policies, clear communications with a strong narrative, and a national strategy for CCUS were all cited as necessary elements to further innovation and commercialization in carbon capture, utilization and storage.

BACKGROUND

The Intergovernmental Panel on Climate Change (IPCC) has been unambiguous in its message – we must cut global emissions 45% by 2030 and hit net zero by 2050 or risk an unprecedented global crisis.¹ All credible pathways to hitting this or any other climate target include technology or practice to remove and permanently store carbon dioxide.^{2 3 4} Carbon capture, utilization and storage is regularly cited as an important tool for reducing industrial CO₂ emissions; however, large-scale

¹ Global Warming of 1.5°C: An IPCC Special Report, Summary for Policymakers. Intergovernmental Panel on Climate Change. Section C1.

² IEA Energy Technology Perspectives 2017, June 2017.

³ IEA World Energy Outlook, 2017.

⁴ Shell Scenarios – Sky: Meeting the Goals of the Paris Agreement. 2018.

deployment of CCUS has been limited by economic, financial, human capacity, public acceptance and institutional constraints.

That may be about to change. The global market for capture and utilization technologies is increasing and it is estimated by the Global CO₂ Initiative that the market for CO₂-based products could grow into an \$800 billion industry by 2030. There's a new wave of effort to drive down the cost of carbon capture by technological advancements, and as CCUS stakeholders build the business case to use CO₂ in valuable products. On the carbon storage front, Canada has decades of experience developing carbon storage sites - but the country's momentum has slowed even though geological storage of carbon dioxide remains one of the world's greatest hopes for averting catastrophic climate change.

With indications pointing to an increasing demand for CCUS, stakeholders in Canada believe the country needs to act quickly to capitalize on opportunities in the CCUS market. Many participants in the CCUS ecosystem believe that a more coordinated effort is needed among Canadian innovators and market players if Canada is to ultimately play a global leadership role in the development, deployment and export of cost effective carbon capture, utilization and sequestration technologies.

On March 15, 2018, CMC Research Institutes, CanmetENERGY Ottawa, with support from CarbonCure and Delphi Group, co-hosted a breakfast roundtable event that brought together approximately 24 CCUS funders, technology developers, end-users and other key stakeholders to discuss the creation of a network focused on building a strong CCUS industry in Canada. The March 2018 CCUS Innovators Breakfast asked participants to share their views on opportunities and barriers to CCUS development and deployment in Canada, and use those insights to identify potential objectives of a national CCUS network.

The result of the CCUS Innovator's Breakfast was a clear articulation of issues that need to be addressed to enable Canada to lead in CCUS, and therefore what the objectives of a CCUS network could be. These include:

1. Recommend effective policy and funding frameworks;
2. Identify and then bring demonstration projects online to show success and build a business case for CCUS; and
3. Develop communication strategies and a consistent narrative to raise awareness of the industry to a non-technical audience of politicians, policy makers and the public.

Participants expressed interest in a follow-up meeting to help identify priorities and pathways for a Canadian CCUS Network, with the ultimate objective of securing Canada's spot as a leader in CCUS. This led to the larger September 25, 2018 Workshop in Calgary.

SEPTEMBER 25 WORKSHOP

Participants:

The approximately 40 participants at the workshop represented a healthy cross-section of the CCUS industry, ranging from small technology development companies, funders from government and the banking industry, non-government organizations, and industry representatives. A wide variety of opinions were expressed about obstacles along the technology development pathway, illustrating how complex the landscape is, and how important consultation will be to moving solutions forward.

Discussion

The objective of the day was to drill into the challenges and opportunities associated with Canada becoming a global leader in CCUS, and identify specific activities needed to address the challenges, and leverage the opportunities.

The event began with three plenary panels focused on finance, climate policy, and challenges in technology development. In the afternoon, participants were invited to join one of three breakout sessions to identify challenges and discuss potential solutions in policy, finance and increasing market demand. In an end-of-the-day plenary session, findings from each breakout were presented, and a list of action items was generated.

The summaries below incorporate discussion from the morning panels and the afternoon breakout sessions which covered: Policy and Regulation, Finance, and Navigating to Commercialization.

POLICY AND REGULATION

Good regulation is crucial:

Stable government policy and regulation can help industry end users, SMEs and technology developers justify the business case for adopting and operating new carbon technologies and can help SMEs build sales pipelines for domestic and global markets. Participants also noted that absent or inadequate regulations can create barriers that make it difficult for operators to plan for multi-year capital-intensive CCUS projects. The absence of policy also makes it hard to penetrate both domestic and international markets.

Predictability is important:

A common theme throughout workshop discussion was how unstable climate policy makes it difficult for long-term planning, economic forecasting and major capital investment in CCUS for any sector. Without predictable government policy, regulations and incentives, capital providers are reluctant to fund research and development, scale up or commercial adoption of emission reduction technologies.

This effect is heightened as political cycles move toward elections and climate change action – or lack thereof - is used to appeal to a party’s base. The recent Ontario provincial election was used as an example: a new government is elected, policy priorities change, and some capital investments are rendered worthless while others are no longer economical. This can also occur when the priorities of key trading partners change, forcing a shift in domestic policies.

Federal-Provincial coordination would be beneficial:

The policy landscape is also complicated by differences in approach to policy and regulation between Ottawa and the provinces. There is no uniformity across jurisdictions, which is challenging for industries operating at multiple sites across Canada.

“Nobody Understands Us”:

Participants in the workshop perceive that CCUS, and the necessary role it plays in delivering climate change solutions, is not well understood or appreciated by politicians, government administrators, policy influencers or the public. If CCUS technologies are not well-understood or their potential appreciated, governments are likely to prioritize support for technologies such as renewables which are more easily understood and popular with the public, but which may not be sufficient to address the climate change challenge.

Proposed Activities:

1. Workshop participants suggested several approaches the federal government could take to support growth in CCUS, including:
 - a. Establish a federal/national investor tax credit program;
 - b. Develop a regional carbon management system that would include pipeline development;
 - c. Amend tax policy to allow for accelerated capital depreciation; and
 - d. Enable the use of flow through shares to stimulate investment.

2. Some technology developers saw value in developing a working group to support or inform the development of CCU technology testing protocols for quality assurance programs such as the Canadian Standards Association, the International Organization for Standardization, Intertek Canada and others. It was reported that these organizations struggle to apply verification and certification processes because CCU is a new technology category without established quality standards. This results in delays in certification and inconsistencies across standardization organizations, thereby impacting technology developers’ ability to sell to customers who require these certifications as part of their procurement practices. A group setting national standards could help streamline the process.

FINANCE

Securing capital and operating funds is difficult for the developer of any innovative new technology, but it is especially the case for capture, storage and utilization developers. Key reasons are the high-risk nature of the business, long time horizons for any return on investment, and the weak business case for many of the CCUS technologies.

Carbon Capture:

Capture is a necessary first, but expensive, step in utilizing CO₂ for commercial products or storing it in geologic formations. Carbon capture processes are energy intensive and can account for up to 80% of the total operating cost of using CCS at a power plant. More early stage research is needed to discover next-generation methods that bring energy requirements down. Bench-stage research is reliant on government funding because it is too risky for investors. However, investors are reluctant to fund scale-up projects and other later stages of development for a variety of reasons, including the lack of business case for capture technologies.

A critical advance would be the emergence of a consortium of heavy industrial partners across the sectors of cement, oil and gas, steel, aluminum, fertilizers and chemicals to accelerate capture technology development. Canada's current competitive position on capture technology development and commercialization is unclear, but anecdotally a number of leading developers call Canada home –for example CO₂ Solutions, Carbon Engineering and Inventys – with several additional ventures in play.

Carbon Storage:

Although carbon storage is a well-developed technology and has the potential to sequester significant amounts of carbon dioxide in a short time period, it is also very expensive to build and operate. Carbon storage projects capable of storing 1 Mt CO₂ per year or more require the development of major infrastructure and typically require industry-government partnerships. With carbon prices low or non-existent, the only way to currently make a business case for storage is to combine it with enhanced oil recovery.

Liability is also a factor in siting CCS operations. There are questions around who will be responsible for environmental or health damages associated with the site, who will be responsible in the event of a leak, and who takes over long-term liability for the site once active injection ceases. Alberta has led development of a widely-credible framework for regulation of deep aquifer storage. Additional frameworks should be developed in other provinces.

Carbon Utilization:

The development and commercialization of carbon utilization technologies has the potential to deliver a return on investment; however, it is still an uncertain market. Workshop participants noted there is not always market pull for carbon-derived

products and that new products might be more expensive than existing products, making it difficult to compete with current commercial products.

Furthermore, there is no guarantee that the technology will perform as expected at scale. Investors are reluctant to finance early stage technologies that might not deliver results. Venture capital firms have moved away from investment in early stage technologies in cleantech, as well as from investment in 'hard' tech. CCUS plays are primarily in the latter - novel materials and chemical processes that have a slower commercialization cycle than information technology-based ventures, and so are particularly hard hit. To fill the financing gap, it was suggested that government funding bodies across the country need to provide specific support for early stage CCUS technology development, as Alberta and the federal government have done.

In addition, entities like Business Development Bank of Canada and Sustainable Development Technology Canada can potentially play more collaborative roles with technology accelerators like Evok Innovations and Foresight Cleantech Accelerator to move promising technologies forward. Critically, they can also work in consortia with industrial partners who view CCUS favorably and want to be part of the technology development process to ensure the resulting products are aligned with industrial needs. As an example, Capital Power has invested in one early stage NRG COSIA Carbon XPRIZE finalist, and the Oil and Gas Climate Initiative of international oil majors has made CCUS a core area of investment. Commercial validation is critical to enable commercial lenders like banks to participate. In sum, to be successful, CCUS in Canada requires a mix of commercial, public and philanthropic funding at each stage, and a mechanism to enable collaborative engagement by all finance actors at each stage of venture maturation.

Proposed actions:

Participants recommended several solutions that could make CCUS innovations more appealing to investors.

1. Early partnering of technology developers with end-users so both parties can collaborate on the development of a technology that solves an industrial need and can be easily integrated into an industry's facilities.
2. A stable political landscape where investors and industry can be assured carbon and climate policies won't change every political cycle.
3. Investment stimulated through a stable price on carbon, tax credits, grants, support for facilities, load and export guarantees, and the clear articulation of ancillary benefits of carbon technologies.
4. Incentives for the development of corporate technology accelerators (building on the model of Tundra's ACE program) and technology venture funds (building on the model of EVOK Ventures and the Natural Gas Innovation Fund), both of whom have taken positions in startups in this space).

NAVIGATING TO COMMERCIALIZATION

In the morning panel, CarbonCure, LafargeHolcim and Foresight CleanTech shared their perspectives on taking CCUS technologies to commercialization. Collectively they provided the input from a technology developer, a potential technology end-user and a technology accelerator.

Technology developers should work with Industry end users as early as possible: Participants noted that end user/technology developer teams need to collaborate early in the development process so that developers can be “laser focused” on solving problems identified by industry. The market demand for new CCUS technologies should be verified as early as possible.

Developers must know their value proposition:

It was also suggested that when approaching potential industry partners, technology developers be prepared to answer the following questions: what the technology does; what it will do for industry; funding/investment needs; and the non-financial aid or assistance the technology developer needs from the company.

Policies can help accelerate commercialization and adoption:

Industry representatives and technology developers agreed that policy options need to be put in place to advance technology adoption, and also that strategies and/or policies be implemented to motivate both public and private procurement.

Several barriers will need to be addressed:

During the afternoon breakout session, participants identified and discussed several barriers impeding the growth of CCUS, including:

- finding or creating markets for new conversion products,
- the high cost of new products that utilize CO₂,
- finding investors to support new conversion technologies, and
- lack of coordination and collaboration between players in the supply chain.

Communication between SMEs and industry was an identified issue. SMEs struggle to find key contacts in industry to whom they can pitch their technologies. In addition to talking to innovation teams within corporations, entrepreneurs also need access to facility operators who can assess whether and how new technologies would integrate into existing infrastructure.

CROSS-CUTTING ISSUE: COMMUNICATION AND ENGAGEMENT

The need for more communication, engagement and knowledge dissemination on CCUS emerged as a recurring theme in the panels and breakout sessions.

Low awareness of CCUS opportunities and limitations:

Participants felt there is little public awareness about and support for carbon capture and storage (CCS), which means reduced pressure on governments to

implement policies or funding that will stimulate investment or encourage technology developers. It was also felt that a lack of understanding within government about the extent to which CCS technologies support climate mitigation was negatively impacting the development of policies and funding mechanisms.

One participant noted that there is growing interest in and support for carbon capture and utilization, as utilization is viewed as an opportunity to create new businesses while addressing climate change. However, many policy-makers do not understand the relatively limited contribution that utilization technologies can make to climate change mitigation, compared to CO₂ storage.

A need for better communication with non-technical audiences:

Education and communication were seen as important ways to increase awareness and support within the public and governments. Participants admitted that too frequently CCUS is communicated in highly technical terms to non-technical audiences, making information difficult to access and understand. It was felt plain, non-technical language should be used to engage the public and deputy ministers, as well as foundations and other donors about the link between CCUS, energy and climate change. It was also suggested that the sector needs to communicate carbon utilization success stories to publicize examples of what can be achieved.

CONCLUSION AND NEXT STEPS

Whether the group was discussing policy, finance, or growing the CCUS marketplace, several themes crosscut all discussions throughout the workshop. Participants repeatedly pointed to four factors that could help to accelerate innovation and commercialization of CCUS:

- Carbon pricing,
- Consistent political support for carbon policies,
- A national CCUS strategy, and
- Clear communications using plain, non-technical language to engage the public and policy-makers.

In addition, some specific actions were put forward by workshop participants as necessary to position Canada as a global leader in the development, commercialization, adoption and export of CCUS technologies. They included better mechanisms for funding, an investor tax credit, national codes and standards, and a national CCUS strategy.

A national strategy would set realistic objectives for sector development, domestic and international investment, and export growth. It would also enable shared understanding that CCUS is an implementable solution to climate change through CO₂ emission reduction.

Through the Workshop and the March 2018 Innovators breakfast, it has become abundantly clear that ongoing collaboration is needed to undertake the range of actions that will accelerate CCUS innovation and commercialization and enable Canada to be a global leader in this important area. Following feedback during the end-of-day discussion at the September 25 workshop, CMCRI, Pembina Institute and CanmetENERGY will lead the development of a draft plan for a National CCUS Network in early 2019 and will seek input on its objectives, design and governance.

PANELS & SPEAKERS

CCUS Network Workshop

Sept. 25, 2018, Calgary

Financing innovation in a high-risk sector

Moderator:

- Sandra Odendahl, President and CEO, CMC Research Institutes

Speakers:

- Sarah Romanuck, Director Technology and Innovation, Royal Bank
- Brian Vaasjo, President, Capital Power
- Mike Biddle, Managing Director, Evok Innovations

Policy options for success

Moderator:

- Jason Switzer, Managing Director, Pembina Institute

Speakers:

- Tim Wiwchar, Business Opportunity Manager, Shell
- Brett Henckell, Vice-President, Strategic Accounts and Government Affairs, Inventys
- Jaeson Cardiff, CEO, CleanO2 Carbon Capture

Navigating to commercialization

Moderator:

- Eddy Chui, Director, CanmetENERGY, Natural Resources Canada

Speakers:

- Jonathan Moser, Head, Environment and Public Affairs, LarfargeHolcim
- Jeanette Jackson, Managing Director, Foresight Cleantech Accelerator
- Robert Niven, CEO, CarbonCure

Special Presentation

Canada's Competitive positioning in CCUS

- Ali Talaei, Research Fellow, Pembina Institute