Canada's net zero economy will need carbon capture and storage

Canada has committed to achieving net zero greenhouse gas emissions by 2050. This means that in 2050 no emissions will be released into the atmosphere unless equivalent emissions are removed elsewhere. To understand what will be required to fully decarbonize our economy over the next three decades, we simulate possible net zero pathways for Canada. In these simulations, carbon capture and storage (CCS) is one technology that consistently stands out as an important component of Canada's net zero future. Our results indicate that:

- **Achieving net zero emissions in Canada will likely require significant use of CCS technology (and not only in western Canada), and**
- **Net zero climate policy presents a significant opportunity for development of a CCS industry in Canada.**

What is carbon capture and storage (CCS)?

The key drawback of using fossil fuels for energy is not that their combustion produces carbon dioxide (CO_2), but that this CO_2 is subsequently emitted into the atmosphere, where it contributes to climate change.

CCS is a process that reduces the amount of CO_2 that is released into the atmosphere by 80-90%[1]. Industrial facilities equipped with CCS capture CO_2 that is emitted during power generation (such as at natural gas-fired power plants) or industrial activity (such as during bitumen upgrading, oil refining, and steel, cement and fertilizer production) and store it underground, rather than letting it enter the atmosphere.

CCS involves three main steps:

1. **Capture CO_2** at the source, either post-combustion (such as from the exhaust at a power plant) or pre-combustion (such as from syngas before combustion is complete during an industrial process);
2. **Transport the CO_2** to an area with suitable storage, often by pipeline;
3. **Inject the CO_2 underground** to prevent it from entering the atmosphere.

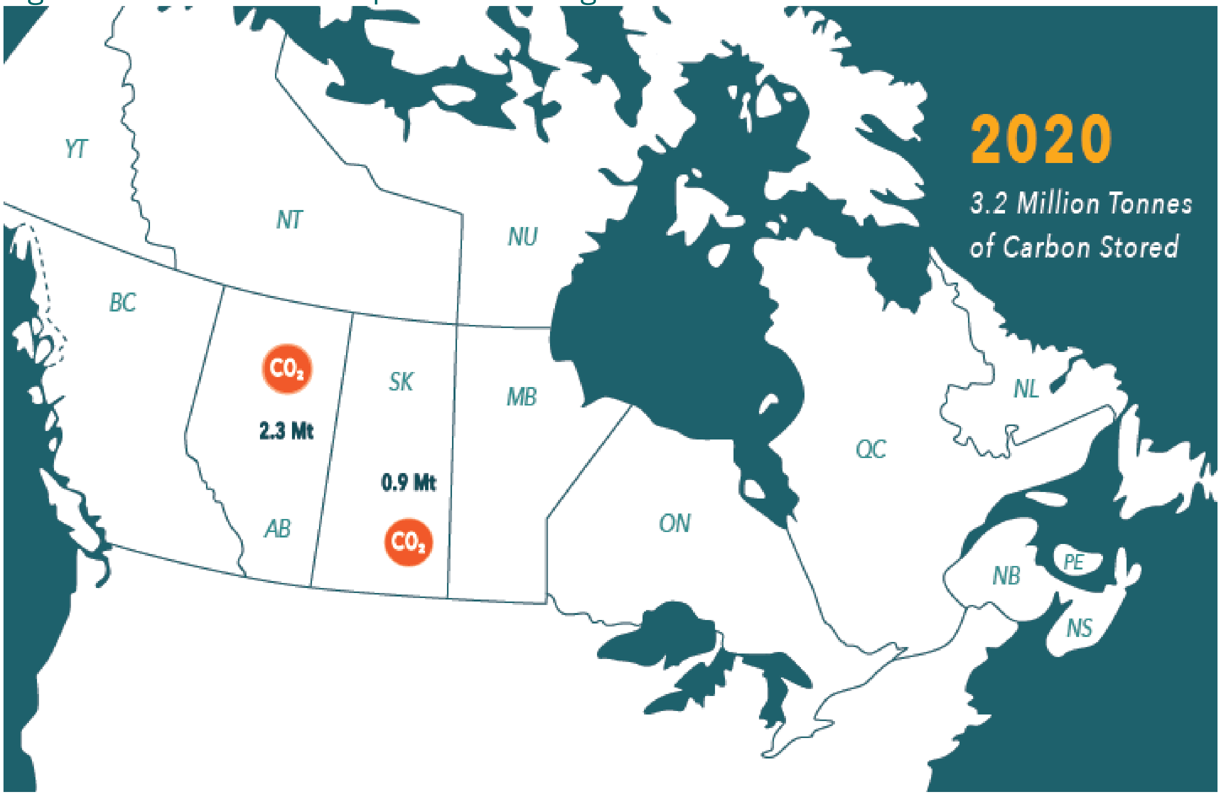
Why is CCS important?

CCS is already deployed in Canada to capture and store 3.2 million tonnes of CO_2 each year from three operating CCS projects – Shell's Quest project and the Alberta Carbon Trunk Line in Alberta, and Saskpower's Boundary Dam project in Saskatchewan (Figure 1). Growth of this industry is expected over the next three decades to allow Canada to achieve net zero emissions, and to achieve interim climate targets along the way.

CCS will be needed to decarbonize industries with few cost-effective alternatives to fossil fuels or a lack of alternative abatement options. As Canada moves toward net zero emissions by 2050, not only will carbon neutral technologies be needed, but negative emission technologies (NETs), which remove CO_2 from the atmosphere, will likely be required to ensure deep reductions are achievable at the lowest possible cost. CCS can be combined with renewable fuels to provide negative emissions – this is called bioenergy with CCS, or BECCS.

Because of the ability of this technology to reduce otherwise costly or unabatable emissions, CCS is expected to play an important role in helping to decarbonize Canada's economy.

Figure 1. Current carbon capture and storage in Canada



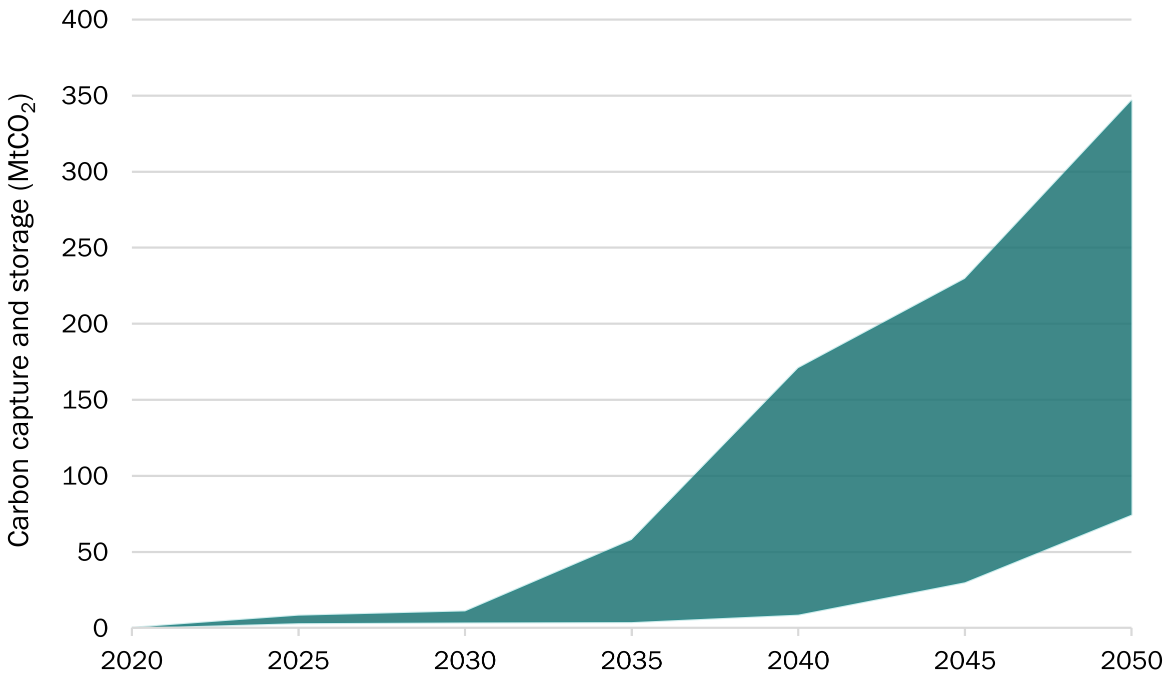
Canada's future CCS opportunity

Our simulations indicate potential for significant growth of Canada's CCS industry under deep emission reductions (Figure 2). Based on over 100 simulations in which Canada achieves net zero emissions in 2050[2], we find that:

- **Total carbon capture and storage in Canada ranges from 93-365 million tonnes in 2050**
- **Canada's CCS industry grows to be at least 30 times the size it is today and up to 100 times its current size by 2050**

As Canada's economy approaches net zero emissions between 2045 and 2050, demand for CCS increases across all scenarios. This is because BECCS is being used to achieve negative emissions to offset remaining emissions that are hardest to mitigate (such as emissions from steel, cement and fertilizer production).

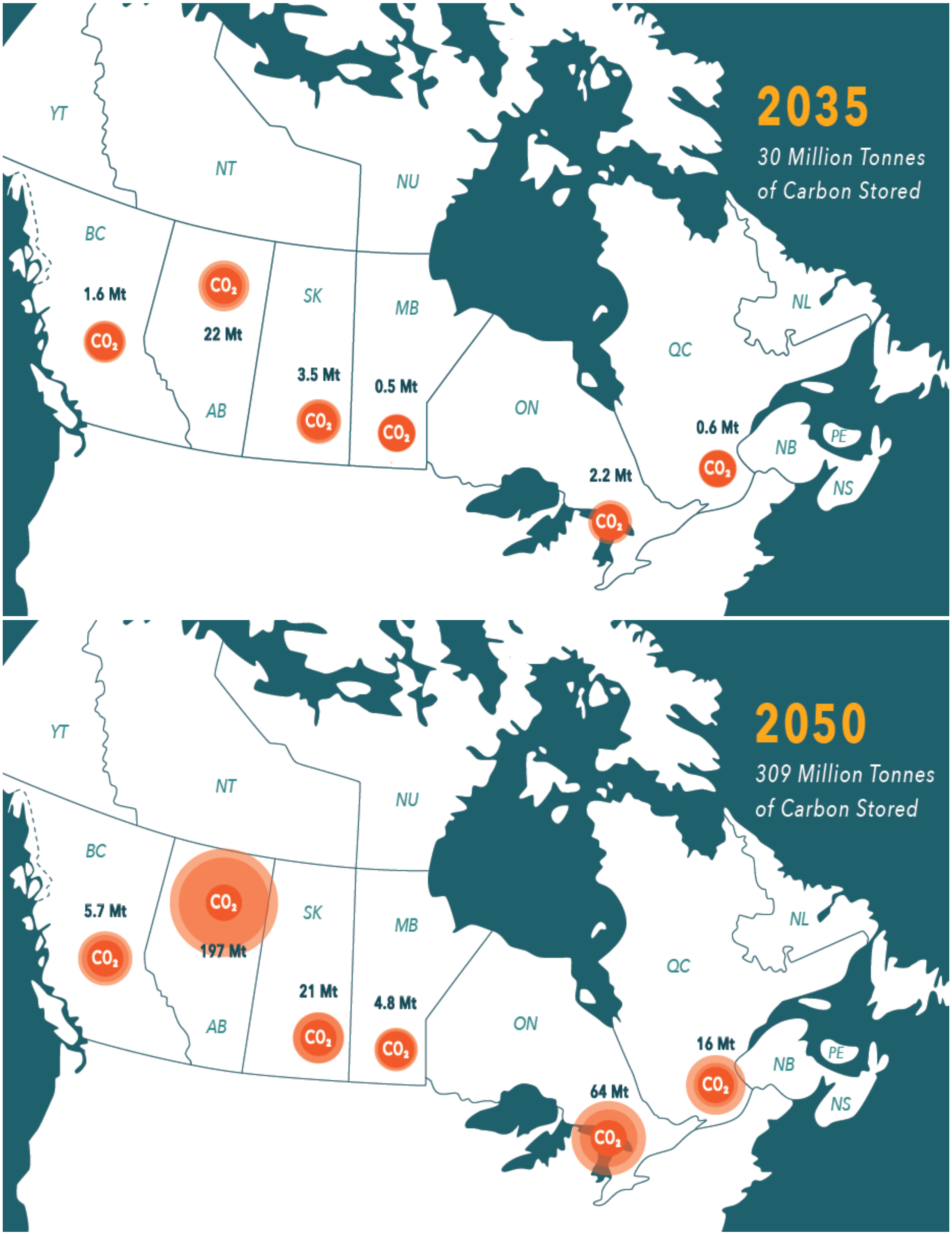
Figure 2. Range of carbon capture and storage in Canada across 102 net zero scenarios



The opportunity for CCS is not limited to western Canada, which has the largest and best characterized geological storage. There is also a significant opportunity for CCS in Ontario and Québec, enabled by storage potential in sedimentary basins in bordering US states.[3, 4]

Looking at one net zero pathway[5] as an example, we see a significant CCS industry developing across the country. This scenario sees capture occurring in almost every province across Canada by 2035. By 2050, this scenario indicates Canada's CCS industry could grow by over 100 times its current size, to 309 million tonnes of CO_2 captured (Figure 3).

Figure 3. One possible scenario for carbon capture and storage as Canada moves towards net zero emissions



What does this mean for Canada's CCS industry?

Our simulation of Canada's net zero economy suggests two key takeaways:

- **Achieving net zero emissions in Canada is likely to require a significant CCS industry**. Implementation of climate policy in line with Canada's target of net zero emissions by 2050 is likely to lead to significant growth of the CCS industry compared to today. CCS technology provides an important opportunity for Canada to achieve deep reductions at the lowest possible cost.
- **The opportunity for CCS in Ontario and Québec should not be overlooked.** Conversations about CCS in Canada are often centered around western provinces where the best geological storage exists. Although we see the greatest CCS occurring in Alberta, our simulations indicate a large CCS industry may emerge in Ontario and Québec by 2050. This outcome is possible because of the significant storage potential that exists in bordering US states. This would require international cooperation to enable CO_2 exports.

Despite the potential benefits of CCS, there are significant challenges ahead in unlocking this opportunity and developing Canada's CCS industry, which should not be understated. Policy will be required to achieve decarbonization of Canada's economy and incentivize the use of abatement actions like CCS. Furthermore, investment in the pipeline infrastructure needed to support a CCS industry of this scale is one of the most significant challenges we foresee and will need to be addressed to help enable Canada in achieving its net zero commitment.

For more information about this analysis, please contact Brianne Riehl

Brianne@NaviusResearch.com

References

[1] Global CCS Institute. (2020). Global Status of CCS 2020. Available at: https://www.globalccsinstitute.com/wp-content/uploads/2021/03/Global-Status-of-CCS-Report-English.pdf

[2] Navius' gTech model was used to conduct this analysis. gTech is an energy-economy model that combines technology, macroeconomic and fuel system modeling to simulate the impacts of climate and energy policy across Canada. gTech was used to simulate a cap on emissions at 511 Mt in 2030 (Canada's 2030 target of a 30% reduction in emissions from 2005 levels) and net zero emissions in 2050. Differing assumptions about uncertainties such as future commodity prices, technology availability and technology costs were varied across scenarios to simulate a total of 102 different net zero pathways for Canada.

[3] International CCS Knowledge Centre. (April 2021). Canada's CO2 landscape: A guided map for sources and sinks. Available at: https://ccsknowledge.com/pub/Publications/CO2_Sources_Sinks_Canada_April2021.pdf

[4] Carter, T., Gunter, W., Lazorek, M., & Craig, R. (2007). Geological Sequestration of Carbon Dioxide: A Technology Review and Analysis of Opportunities in Ontario. Available from: http://www.climateontario.ca/MNR_Publications/276925.pdf.

[5] An example pathway is used to demonstrate one potential future of Canada's CCS industry. This scenario uses the best available information to make assumptions about the most likely future oil price, clean technology costs, including CCS costs, and assumes direct air capture technology does not become widely available.