**OMNRF Discussion Paper: Regulating Commercial-Scale Geologic Carbon Storage Projects in Ontario Comments and Observations**

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In response to the Ministry's call for feedback pertaining to their development of a legislative and regulatory framework for commercial-scale geologic carbon storage (CS) in the Province of Ontario, I am providing the following comments and observations. They are based on 40 years of oil and gas production and storage experience as a geoscientist in Ontario and our own policy research into other jurisdictional policies and practices in the CS space. I will be organizing these comments and observations by discussion question as stated in the Ministry's discussion paper.

**1. Would initially scoping the framework to only allow commercial-scale projects to store $CO_2$ within saline aquifers and depleted oil and gas wells in southwestern Ontario at depths of at least 800m or more meet industry's current needs and maintain public comfort in the development of these projects?**

*This question requires a three-part answer:*

1. ***Only allow commercial-scale projects to store in saline aquifers and depleted oil and gas wells (reservoirs)?***
   *$CO_2$ can be sequestered in any sub-surface reservoir with sufficient porosity and permeability surrounded by impervious material or high-pressure fluid to hold the injected fluid (gaseous or liquid form) in place.[1] This can include salt caverns[2] and mine shafts.[3]*
2. ***Choice of a minimum depth of 800 meters or more to meet industry's current needs?***
   *The presumption here is that the minimum depth must be 800 meters (the estimated depth and pressure required for $CO_2$ in a supercritical state) in order to meet industry's current needs. Depth is not a condition for the physical ability to inject in a sub-surface reservoir but it does play a role in enhancing volumetric requirements that may allow for the commercial-scale required to be economically feasible. However, if commercial-scale can be technically and economically supported by a Proponent at a depth less than 800 meters then the framework should not limit their ability to do so. Sequestration of $CO_2$ projects have occurred at depths as shallow as 630 meters at sites in Europe.[4]*
3. ***Choice of a minimum depth of 800 meters or more to maintain public comfort in the development of these projects?***
   *It is logical to assume that the public would be more comfortable with a higher depth number than a shallower one but ultimately public comfort rests with the level of communication regarding the technical safety of the project being proposed.[5] The storage of a gas or liquid in the sub-surface is not a novel technology and examples of natural gas*

[1] Lau, H. C., Ramakrishna, S., Zhang, K., & Radhamani, A. V. (2021). The role of carbon capture and storage in the energy transition. *Energy & Fuels*, *35*(9), 7364-7386.
[2] Mwakipunda, G. C., Mgimba, M. M., Ngata, M. R., & Yu, L. (2024). Recent advances on carbon dioxide sequestration potentiality in salt caverns: A review. *International Journal of Greenhouse Gas Control*, *133*, 104109.
[3] Dieudonné, A. C., Cerfontaine, B., Collin, F., & Charlier, R. (2015). Hydromechanical modelling of shaft sealing for CO2 storage. *Engineering geology*, *193*, 97-105.
[4] Paluszny, A., Graham, C. C., Daniels, K. A., Tsaparli, V., Xenias, D., Salimzadeh, S., ... & Zimmerman, R. W. (2020). Caprock integrity and public perception studies of carbon storage in depleted hydrocarbon reservoirs. *International Journal of Greenhouse Gas Control*, *98*, 103057.
[5] Court, B., Elliot, T. R., Dammel, J., Buscheck, T. A., Rohmer, J., & Celia, M. A. (2012). Promising synergies to address water, sequestration, legal, and public acceptance issues associated with large-scale implementation of CO 2 sequestration. *Mitigation and Adaptation Strategies for Global Change*, *17*, 569-599.

*storage operations or brine storage operations in the sub-surface in Ontario (at depths less than 800 meters) can provide comfort to the public. In fact, the first gas storage pool began operations in 1942 - Dawn 47-49 Pool - and there are now 35 active natural gas storage pools in Ontario.*

**2. Would you support using a competitive process to select projects looking to store carbon dioxide on Crown land? Why or why not?**

*The short answer is "no" in terms of an open seemingly competitive bid for pore space rights on Crown Land. Provincial Crown land gives the province the right to choose how it wishes to provide its ownership of pore space underneath that land. However, there remains matters of practicality that need to be considered before choosing to utilize a competitive process for allocating the pore space rights to store carbon dioxide in Ontario. These matters include:*

1. *Crown lands in Ontario are located either in the northern section of the Province, far removed from significant production of $CO_2$ emissions, or in and under the Great Lakes where natural gas operations and related sub-surface pore space identification have been restricted to Lake Erie only. On shore oil and gas exploration has occurred proximal to the Lake St. Clair and Lake Huron shorelines which have allowed for extension of potential pore-space identification under these lakes but a lack of actual data limits the practicality of development.*
2. *Accordingly, Lake Erie presents the most attractive option for $CO_2$ sequestration on Crown lands with an estimated carbon sequestration potential of 442 million tonnes[6] but when compared to Alberta, where estimates of carbon sequestration potential exceed 100 billion tonnes[7] or more than 225 times the volume available for the Lake Erie Crown lands, similarities to the Alberta model for competitive development of a $CO_2$ sequestration regime are constrained.*
3. *Historical development of the oil and gas industry has been limited to very few industry players when compared to Western Canada due principally to the smaller size of the sedimentary basins contained within Southwestern Ontario.*

*Accordingly, it is less likely that a competitive market for carbon sequestration project development would develop in Ontario as it might in Alberta suggesting that a more practical process to select projects should be limited to receiving proposals from interested parties on a first come, first served basis to initially enter into evaluation agreements with the Province of Ontario to explore a designated project area on Crown lands. The evaluation process would demonstrate the technical, economic and environmental feasibility of providing permanent $CO_2$ storage. Upon completion of that evaluation, and subject to the approval of the MNRF, the interested parties would be granted the right in the form of a $CO_2$ storage lease (similar to the existing Crown natural gas storage lease) with permission to inject and sequester $CO_2$ in the designated project area.*

[6] Shafeen, A., Croiset, E., Douglas, P. L., & Chatzis, I. (2004). CO2 sequestration in Ontario, Canada. Part I: storage evaluation of potential reservoirs. *Energy Conversion and Management*, *45*(17), 2645-2659.
[7] https://albertainnovates.ca/wp-content/uploads/2023/06/AI-CCUS-WHITE-PAPER_2022_WEB-1.pdf pg. 3

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**3. How should proponents obtain rights to pore space? What are the benefits and challenges associated with adopting the models currently being used in western Canada and US States?**

*As noted in the MNRF's discussion paper, numerous jurisdictions have approached the ownership and assignment of pore space differently. Each have their own benefits and challenges, but the one common element of all jurisdictional approaches is the primacy of existing oil and gas rights holders, whether they be privately owned or leased to a third party. This is similarly noted in this MNRF discussion paper on Pg. 9, last paragraph. In the U.S., those states with significant CS potential such as Texas, Oklahoma, Montana and Wyoming have enacted legislation to address carbon capture* and *sequestration, all of which establish the primacy of mineral rights over CS operations.[8] In Alberta, The Carbon Sequestration Tenure Regulation enables the Government of Alberta to issue evaluation permits, agreements, and leases for carbon sequestration, however the Oil and Gas Conservation Act (OGCA) only permits the Alberta Energy Regulator to approve $CO_2$ schemes if the $CO_2$ injection will not interfere with the recovery or conservation of oil and gas, or an existing use of the underground formation for storing oil and gas.[9] In British Columbia, the Petroleum and Natural Gas Act protects the primacy of holders of Crown Petroleum and Natural Gas leases by providing the right of those leaseholders to store $CO_2$ in the pore space contained within that leased acreage.[10] According to a recent legal interpretation[11] of the differences between Alberta and British Columbia in terms of their respective CS frameworks:*

> *"Alberta's chosen approach is to encourage the development of a relatively small number of strategically-located carbon storage "hubs" that would accommodate CO2 captured in a geographic area. While Alberta's Mines and Minerals Act seems to contemplate that any number of parties can commence the process for obtaining the subsurface tenure needed to operate a CO2 storage hub, as a practical matter, the Alberta government's policy approach appears to be to limit the issuance of those tenure rights. By contrast, BC appears to be taking a more decentralized approach, leaving all PNG rights holders with the subsurface tenure needed to develop CO2 storage reservoirs and leaving open the possibility for other non-PNG rights holders to acquire CO2 storage tenure."*

*Accordingly, a stipulation for obtaining rights to pore space and receiving authorization to begin $CO_2$ sequestration activities should be the acquisition of any surface and mineral rights, privately owned or leased to a third party. As this MNRF discussion paper observes, the development of natural gas storage in the Province of Ontario is not dissimilar to developing $CO_2$ sequestration projects in that it involves the use of available pore space in a sub-surface reservoir. Before the proponents of a gas storage project are granted leave to construct and the right to inject they are required to have secured the surface and mineral rights, either from the landowner or a third party who has leased the rights, typically in the form of a Petroleum and Natural Gas lease. This process is negotiated privately between parties prior to any application to designate an area for gas storage. A similar approach should be used for $CO_2$ storage, following the existing "tried and true" underground storage process currently in existence and under which many natural gas storage projects have been developed in Ontario.*

[8] https://www.wyoleg.gov/Interimcommittee/2017/09-0629appendixg-1.pdf
[9] https://www.aer.ca/providing-information/by-topic/carbon-capture
[10] BC Petroleum and Natural Gas Act Sections 50 (2)(b) and 129.1(a)
[11] https://www.dentons.com/en/insights/articles/2023/february/6/a-new-frontier-carbon-storage-in-british-columbia

**4. Would a staged approach to authorizing carbon storage projects be desirable? If so, how should authorizations be staged?**

*Given the similarities with natural gas storage in the province, there could be either a one stage approach or a two-stage approach depending on the proponent's preferences and whether the project is on private or Crown lands. If they have attained the surface, mineral and $CO_2$ storage rights on private lands through negotiation and purchase, they should be allowed to apply for approval to designate an area for $CO_2$ sequestration where they would prove the feasibility of the reservoir and the extent of the required area. Should they be prepared to also construct facilities and inject they may choose to seek approval to do so at the same time requiring only a single stage approach. In many cases involving natural gas storage, proponents have sought approval for designation before applying later for leave to construct and store. Under similar circumstances a proponent of a $CO_2$ sequestration project might seek to take that two-stage approach.*

*For Crown lands where surface, mineral and storage rights have not been obtained, a two-stage approach would be appropriate as discussed in Q.2.*

**5. When and how should potential impacts to the agricultural land base and the agri-food network (e.g., operations, infrastructure, agribusinesses, etc.) be considered?**

*Similar to the development of natural gas storage projects in Ontario, an environmental assessment including impacts on agriculture would form part of the application to designate and develop a $CO_2$ sequestration project. For projects under Lake Erie, any assessment would require consideration of impact on fisheries.*

6. How should proponents of commercial-scale geologic carbon storage projects notify and engage with Indigenous communities and other parties who may be affected by their proposed projects?

*Again, the similarity with the development of natural gas storage projects in Ontario would inform the required stakeholder engagement process with Indigenous communities and other affected parties.*

7. What operational controls should be put in place to help ensure commercial-scale carbon storage projects would be developed, operated, and decommissioned in a safe and responsible manner?

*The application of the CSA Z741:12 (R2022) Geologic storage of carbon dioxide would provide direction to operators and would inform all applications for leave to construct and operate a $CO_2$ sequestration project. This is not inconsistent with the use of CSA Z341 Series:22 Storage of hydrocarbons in underground formations when developing and operating natural gas storage projects in Ontario.*

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**8. Would allowing proponents to transfer responsibility for the long-term monitoring and stewardship of carbon storage projects to the Crown help ensure carbon storage projects, including the wells, geologic storage areas and carbon stored in geological formations, would be adequately cared for over the long-term?**

*Various jurisdictions such as Alberta and certain U.S. states have established closure certificate processes whereby the $CO_2$ sequestration operator may seek such a certificate which would permanently transfer the liability of the stored $CO_2$ to the Crown or state. To fund this liability the Crown or state establishes a post-closure fund mechanism to provide for the cost of long-term monitoring and stewardship. This would seem to be the appropriate route to take with operators so that completed $CO_2$ sequestration projects will be cared for over the long term. The regulating authority chosen by the Province of Ontario could require proponents to file an anticipated completion date and post-closure funding requirement for approval.*

**9. Would you support components of this framework being delivered by an external entity and if so, what components?**

*I am not aware of any evidence to date that would support the delivery of components of a $CO_2$ sequestration framework by an external entity. Given this activity, like natural gas storage, is in the public interest it would be appropriate for governmental agencies to be responsible for the delivery of components of this framework.*