Natural Resources Canada | Ressources naturelles Canada

Intentions Paper

Offshore Carbon Dioxide Storage in Sub-Seabed Geological Formations

March 2025

Canada

Overview

Carbon management technologies – including point-source Capture, Utilization, and Storage (CCUS) and Carbon Dioxide Removal (CDR) – can provide a significant opportunity for clean and inclusive growth. *Canada's Carbon Management Strategy* (the Strategy) was launched in 2023 to help Canada develop a world-class, multi-billion-dollar carbon management industry that is mindful of regional differences and supports inclusive, high-value jobs and a more sustainable economy, all while helping Canada to achieve its climate objectives.

In Canada, Western provinces have been operating large-scale CCUS projects for decades due to suitable geology and robust provincial legislation and regulations. Canada has vast potential offshore sub-seabed geological storage resources, which could present opportunities to store carbon dioxide (CO_2) sourced domestically and internationally. This could be an opportunity to leverage existing offshore expertise, boost economic growth, and create high-quality jobs particularly in regions such as Atlantic Canada where onshore geology suitable for CO_2 storage is limited.

The Strategy noted Canada does not have a comprehensive regulatory framework specific to CO_2 storage in areas of federal jurisdiction. In order to advance offshore CO_2 capture and storage projects, Canada would need to address this gap through legislative changes and regulatory development, as well as further foundational science. In the marine environment, the federal government has jurisdiction over the seabed and subsoil of the territorial sea, which begins at the low tide and extends to the 12 nautical miles (nm) offshore, and the Exclusive Economic Zone (EEZ), which extends from 12nm to 200nm offshore. However, provincial jurisdiction includes all land to the low tide mark as well as inland waters including the seabed in those areas. Additionally, some of the offshore in Canada is under an Accord Agreement, which ensures joint management and regulation of petroleum resources (e.g. Atlantic Accords and Western Arctic Accord). It is the view of the Governments of Newfoundland and Labrador and Nova Scotia, that the Accord Acts (*Canada–Newfoundland and Labrador Atlantic Accord Implementation Act and Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act*) should be expanded to include CO_2 storage in the existing joint-management regime and that the mandate of the existing offshore regulator be expanded to include this activity. The Government of Canada is willing to explore this as a potential option for the legislative framework.

The purpose of this intentions paper is to provide information and an early engagement opportunity to seek views and input. This and future engagement activities will provide Indigenous groups, provincial and territorial governments, stakeholders, and the public the opportunity to provide their views.

1. Introduction

Climate change has and will continue to have significant impacts on Canadians' health, the economy, and the environment. Future climate-related risks may be reduced by adaptation, mitigation, and new and existing technologies such as carbon capture, utilization, and storage (CCUS). In 2022, greenhouse gas (GHG) emissions were 708 megatonnes (Mt) with carbon dioxide (CO_2) being the largest contributor by volume at 551 Mt. The Government of Canada remains committed to taking action to address GHGs, protect the environment, spur clean technology adoption and innovation, and help Canadians and communities adapt to the impacts of climate change.

Canada's Carbon Management Strategy (the Strategy) outlines priority areas for federal action, which include advancing supportive policies, addressing gaps in legislation and regulations, as well as further foundational science. The Government of Canada is exploring approaches to addresses these gaps given that permanent storage of CO_2 in the offshore could support the longer-term objective of a net zero economy and the decarbonization of hard to abate sectors. Canada has been an early leader in carbon management and has world-renowned expertise in regulation, innovation, and technology and project development onshore. Supportive policies and regulations are driving investment and project advancement in Western Canada where large-scale CCUS projects have been operating for decades. These projects have demonstrated safe and secure onshore geological CO_2 storage within the oversight of robust provincial regulatory regimes.

Identified, high quality CO_2 storage capacity onshore in Eastern Canada is limited; however, based on data, research, and petroleum production there is significant offshore storage capacity. Therefore, the Governments of Newfoundland and Labrador (NL) and Nova Scotia (NS) have raised the need to assess the applicability of CO_2 storage in the offshore.

If pursued, legislative changes and regulatory development for offshore storage projects would position Canada in line with its international counterparts. The framework would put in place rigorous safety, environmental and operational requirements to allow for the permanent storage of CO_2 in sub-seabed geological formations. Provisions within existing Acts and regulations would continue to apply to potential offshore projects (e.g. *Canadian Environmental Protection Act, 1999*; *Species at Risk Act, 2002; Oceans Act 1996*; *Fisheries Act,1985* etc.).

The framework would seek to:

- Set out the roles and responsibilities in relation to CO_2 storage in sub-seabed geological formations in the offshore;
- Provide clarity on operational requirements of the proposed regime;

- Enable the safe, environmentally sound, and permanent storage of CO_2;
- Provide criteria for monitoring and verification;
- Develop a regime that is sufficient for the offshore to be approved as eligible for CO_2 storage under the CCUS investment tax credit; and,
- Accelerate the deployment of CCUS technologies and projects in the offshore area.

2. Rationale for Establishing a Legislative Regime

Path to net-zero

According to the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA), among others, any credible path to net-zero emissions should include combinations of new and existing technologies and practices such as carbon capture, carbon removal, and storage. These technologies and processes can offer the potential for new economic opportunities to create sustainable jobs, unlock new import and export markets, and attract foreign direct investment in Canada and in Canadian solutions providers that can serve a rapidly growing, multi-billion-dollar global market.

Additionally, the Canada Energy Regulator (CER)'s Global Net-Zero Scenario, in which Canada and the rest of the world achieve net-zero emissions by 2050, CCUS sequesters nearly 60 Mt annually in Canada by 2050, 25 Mt of which occurs in heavy industry. In an alternative Canada Net-Zero Scenario, in which Canada reaches net-zero emissions by 2050, but the rest of the world moves more slowly, the CER estimates that CCUS costs are likely to fall more slowly and result in higher captured emissions of 80 Mt due to the greater global demand for fossil fuels. In their 2023 CCUS Outlook, McKinsey estimates that global annual investment in CCUS could reach $175 billion by 2035.

Reducing emissions in hard-to-abate sectors

Point-source CO_2 capture can be used to reduce and capture emissions from hard-to-abate industries, like cement, steel, and chemicals. Fixed-process emissions and high-temperature heat requirements make reducing emissions in these industrial sectors especially challenging often due to high costs or unavailability of effective abatement technology. CO_2 from any of these sources, or from oil and gas activities onshore and offshore, once captured and location permitting, could be transported and permanently stored in Canada's offshore.

Supporting CDR Approaches

CDR approaches like direct air capture or direct ocean capture can be used to offset unavoidable or hard to abate emissions (i.e., residual emissions) by enabling the removal of CO_2 from the atmosphere. In addition to rapid and deep emissions reductions, climate scientists project a significant need for CDR, even after net zero,

to balance unavoidable emissions and address historical emissions. CDR projects such as DAC or bioenergy with carbon capture paired with sub-seabed geological CO_2 storage could be an industry developed in Canada, given the offshore storage potential, the plans for offshore renewable energy project development (DAC requires electricity), and the ocean expertise of Canada's coastal communities.

Storage capacity

Canada has vast sub-seabed geological storage potential in its offshore, including former oil and gas reservoirs, deep saline formations and coal beds. This could provide storage resources critical to enabling CO_2 capture and removal projects, supporting Canada's GHG emission reduction targets. Research shows that there is likely significant CO_2 storage potential in Canada's offshore, with nearer-term opportunities in Atlantic Canada due to geology and offshore oil and gas sector expertise and data[1]. The Government of NS estimates indicate that sub-seabed geological formations in the offshore have a median 177 Gt CO_2 storage, with a possibility of up to 1,280 Gt CO_2 storage potential.[2] Although the Atlantic offshore has relevant seismic data due to oil and gas production and exploration, additional research and analysis will be needed to verify the estimates and actual storage potential of each formation.

Well-established offshore expertise

Offshore Oil and Gas

Canada can leverage its offshore oil and gas technology, infrastructure, and expertise to advance CO_2 storage in sub-seabed geological formations in the Canada-NL and Canada-NS offshore areas (the Atlantic Accord Areas). There is significant overlap in assessment and development practices used by both oil and gas and CO_2 storage. Geoscience data collected by the oil and gas sector can be leveraged to inform potential storage sites. Measuring, monitoring, and verifying technologies and engineering considerations from the oil and gas sector can also inform carbon storage technology development. In the case of the oil and gas sector, CO_2 is injected to enhance oil and gas recovery whereas storage projects inject CO_2 for the purpose of permanent storage. Enhanced oil recovery is currently allowed in the offshore and is outside the scope of this paper.

The federal government and the provincial governments of NL and NS jointly manage offshore oil and gas activities in the Atlantic Accord Areas. The Canada-Newfoundland and Labrador Offshore Petroleum Board and Canada-Nova Scotia Offshore Energy Regulator (i.e., the Offshore Boards) are the regulators responsible for activities specified in the Accord Acts in their respective areas.

---

[1] Carey, J.S., Skinner, C.H., Giles, P.S., Durling, P. Plourde, A.P., Jauer, C., and Desroches, K., 2023. Preliminary assessment of geological carbon-storage potential of Atlantic Canada; Geological Survey of Canada, Open File 8996, 1. zip file. https://doi.org/10.4095/332145

[2] Government of Nova Scotia. June 2024. *Carbon capture, utilization, and storage in Nova Scotia.* https://natural-resources.canada.ca/climate-change/canadas-green-future/capturing-the-opportunity-carbon-management-strategy-for-canada/carbon-capture-utilization-and-storage-nova-scotia/26126.

Offshore Renewable Energy Projects

The Government of Canada with the provinces of NL and NS recently established a new legislative framework for offshore renewable energy projects, through their respective Accord Implementation Acts.

Blue Economy

Canada's blue economy is an important part of regional economies and the broader national economy. Fisheries and Oceans Canada is leading the development of a Blue Economy Strategy, which will position Canada to seize emerging, sustainable, and inclusive economic growth opportunities while helping to regenerate ocean health and build resilience in Canada's Indigenous and coastal communities.

Between February 8 and June 15, 2021, a comprehensive public engagement process was conducted to inform the development of the Blue Economy Strategy. Concerns were raised regarding Canada's regulations being out of date, slow to adapt and overly cumbersome. The importance of regulations being agile and responsive to innovation and emerging sectors was also emphasized. Through the Blue Economy Regulatory Review, carbon capture and sequestration in the offshore was identified as an example of a future-oriented ocean sector activity that is bottlenecked by regulatory structures that impede innovation. It was recommended that a legal and regulatory framework be developed to enable offshore carbon capture and storage projects.

Discussion questions:

1. Do you see offshore CO_2 storage as an economic/transition opportunity and what are the limits to helping achieve decarbonization targets?
2. Are onshore sectors (e.g., cement) interested in storing emissions in the offshore area?
3. What sectors could you see benefitting from CO_2 storage in Canada's offshore area?
4. Please flag, any potential negative impacts in relation to specific industries or stakeholder groups of offshore CO_2 storage.
5. Please flag any potential barriers in relation to specific industries or stakeholder groups for offshore CO_2 storage.
6. What key considerations need to be addressed to build a more robust understanding of the CO_2 storage potential specific to the Atlantic, Arctic and Pacific offshore areas?

3. Legislative and Regulatory Authorities and Gaps

Canada is a party to the London Protocol and the older London Convention, two international treaties on the control and prevention of marine pollution. Canada implements the treaties and regulates disposal at sea through the Disposal at Sea Provisions in Part 7, Division 3 of the *Canadian Environmental Protection Act,*

1999 (CEPA). Disposal includes storage of waste or other matter on or in the seabed. Environment and Climate Change Canada is the lead department for regulating the disposal of wastes or other matter at sea to ensure that the environment and human health is protected, and that marine pollution is avoided. Only a small list of low-risk wastes or other matter listed on Schedule 5 of CEPA can be assessed and receive permits for disposal at sea. Carbon dioxide streams are not currently listed and therefore cannot be permitted. CEPA also prohibits the import or export of waste or other matter for disposal at sea.

If pursued, the addition of CO_2 to Schedule 5 would enable sub-seabed storage projects to be assessed and permitted within a science-based framework designed to protect the marine environment in the same manner as other wastes on the schedule. Additional changes to CEPA are needed in order to create an effective environmental regulatory system for sub-seabed permanent storage of CO_2 and to allow for the transportation of CO_2 streams for sequestration under the Canadian seabed. These changes would need to be done in alignment with additional considerations outlined below to allow for permanent CO_2 storage.

In Canada, provinces own their subsurface resources on land—including the pore space underground where CO_2 will be stored—and hold responsibility for regulating CCUS activities. However, this is not the case for Canada's offshore. Aligning with potential amendments to CEPA, as well as other applicable legislation, the Government of Canada (through the department of Natural Resources Canada) is examining the legislative changes and regulatory development to operationalize CO_2 storage in sub-seabed geological formations in Canada's offshore. Even with the establishment of a life-cycle regulator, other Canadian authorities have complementary responsibilities in the offshore that will have a significant role, such as Transport Canada, Fisheries and Oceans Canada, and Environment and Climate Change Canada.

The legislative framework could include components such as:

a) Oversight
    - Establishing the independent life-cycle regulator to oversee CO_2 storage projects. This may require expanding the mandate of existing regulators to account for these new activities.
b) Site selection and characterization
    - Separate to the requirements required under the Disposal at Sea regulations by ECCC, the life-cycle regulator could also:
        - Outline requirements for operators conducting site selection and characterization activities.
        - Evaluate interaction with other surface and subsurface resources and other ocean users.
        - Establish the information to be provided by a proponent in a risk assessment of any potential project and review the completed assessment.

c) Consultation and Engagement
   - The Government of Canada will establish requirements for consultation and engagement with the Indigenous groups, fisheries, offshore petroleum industry, ENGOs, other stakeholders and the public who may be impacted at the various phases of a proposed project.

d) Evaluation, leasing, and authorization regime
   - Establish the regulatory requirements a proponent must meet prior to the life-cycle regulator issuing leases, permits and/or authorizations.

e) Design and development of facility and/or site
   - Establish the regulatory ability to authorize aspects required of the project lifecycle, such as site design and facility development.

f) Operations, maintenance, and monitoring of facility and/or site
   - Establish monitoring requirements for potential CO_2 storage projects.
   - Ensure compliance with occupational health and safety requirements.
   - Establish the ability for the life-cycle regulator to conduct site inspections and audits of the facility and operations.
   - Establish the liability regime for the life-cycle of a project.

g) Monitoring and verification
   - Establish the requirements of a measuring, monitoring and verification program, the plan should be updated on a regular basis throughout all stages of a project.

h) Enforcement
   - Establish an enforcement regime.

i) Reporting
   - Require operators to report monitoring results to the relevant regulator and department.

j) Site closure, decommissioning and abandonment
   - Outline clear site closure requirements, encompassing well abandonment, infrastructure decommissioning, and post-closure monitoring and verification.
   - Develop the requirement for audits and inspections conducted by project operator and the regulators responsibility to audit and inspect activities on a regular basis.

Discussion questions:

7. Are there other measures that would be needed to complement success of an offshore CO_2 storage regime?
8. What aspects should be considered in relation to the transportation and storage of CO_2 onshore prior to being permanently sequestered in the offshore?
9. How could a CO_2 storage regime consider Canada's marine conservation goals among other traditional and emerging ocean uses?
10. What do you consider the environmental risks of CO2 storage in the offshore? How can these be mitigated?

4. Key Considerations

Environmental risks of CO2 storage in the sub-seabed

Injecting pressurised CO_2 deep below the seabed and for long periods of time can pose environmental risks. A risk could include the potential for CO_2 migration and induced seismicity. CO_2 or other fluids migrating into the surrounding environment could have harmful consequences, including reduced oxygen levels which may lead to suffocation of marine organisms, the release of potentially toxic compounds into the sediment or water column and ocean acidification.

Knowledge Gaps

Although the offshore in Eastern Canada has seismic data due to oil and gas production and exploration, additional research and analysis is needed to verify the estimates and actual storage potential of each formation. This analysis will need to take place prior to an area being identified as a potential storage site. There is significant research and experience in induced seismicity in the unconventional oil and gas industry that can be applied to CO_2 storage. Further research will be needed in this and other areas of study.

Technology advancement

A broad suite of technologies are needed to support Canada's transition towards a net-zero economy and storage of CO_2 in sub-seabed geological formations could be an important part of the solution. This is an opportunity for Canada to leverage its existing ocean technology strengths and ocean innovation ecosystem to harness the economic opportunity CO_2 storage presents.

Enable Eligibility for Carbon Capture, Utilization, and Storage Investment Tax Credit

With momentum expected to grow in the fields of CCUS and DAC given new policy supports such as the CCUS investment tax credit, Canada is well positioned to deploy these technologies to support climate objectives. The CCUS investment tax credit is a refundable tax credit that applies to eligible expenditures incurred for a qualified project, from January 1, 2022, to December 31, 2040 (though with a reduced credit rate from January 1, 2031, to December 31, 2040). Current eligible uses are:

- The storage of captured carbon in dedicated geological storage; and,
- The use of captured carbon in producing concrete using a qualified process.

Canada has a wealth of geology suitable for CO_2 storage, including vast storage resource potential in the offshore. Sub-seabed geologic storage sites could be developed to service CO_2 capture projects, particularly where onshore storage potential is limited. Canada will aim to design the offshore legislative regime to ensure that it is sufficient for the Minister of the Environment to designate the offshore jurisdiction thereby allowing projects with offshore storage to be an eligible form of CO_2 storage under the CCUS investment tax credit. Enabling storage in the offshore will also open new opportunities for point-source carbon capture and direct-air capture and capture equipment, which will likely further incentivise CO_2 capture and achievement of Canada's economic and climate objectives.

Interaction and impacts on other ocean users and industries and Government of Canada Alignment

The Government of Canada will need to evaluate the interaction of CO_2 storage projects and storage infrastructure with other subsurface and surface resources such as oil and gas, fisheries, offshore wind, and other renewable energy projects. Canada will need to ensure that these new approaches do not impact the growth and prosperity of other sectors.

Discussion questions:

11. What research is needed in this field?
12. How should CO_2 storage interact with coastal communities, other ocean users, and industries?

5. International Legislation and Activity

There is a significant volume of CCUS activity internationally, with many countries having already enabled the potential of CO_2 storage projects by enacting legislative and regulatory regimes and providing financial

incentives to support new projects. In the EU, the Directive 2009/31/EC on the offshore (exclusive economic zones and continental shelves) geological storage of CO_2 establishes a legal framework for the environmentally safe geological storage of CO_2. This directive is then transposed or used as a framework for adoption by individual countries. For example, the Netherlands has fully transposed the EU directive largely through amendments to its mining legislation on the Norwegian Continental Shelf. This has enabled significant advancements in CCUS projects and funding. Over the last few years, the Government of Netherlands announced approximately USD 10 billion to be allocated to CCUS projects and storage hubs.

In November 2021, the US amended key parts of its regulatory framework to allow for the offshore storage of CO_2 in federal waters. Additionally, the 2021 Bipartisan Infrastructure Law (BIL) allocated $12 billion for programs such as carbon management, research, demonstration, and deployment up to 2026. These amendments have allowed for Texas to grant the first offshore storage permit for the Bayou Bend CCUS project. The project is expected to begin injection in early 2027.

In the Asia-Pacific region, Australia implemented a national offshore CO_2 storage legislative framework (2003-2008). More recently, Japan set a target for the first commercial facilities to commence operation by 2030 and is considering nine candidate transport and storage networks targeting offshore geological formations (four expected to store CO_2 outside of Japan in the Asia Pacific region) on a trajectory towards the target 120-240 Mt CO_2/yr capacity by 2050. More generally, Singapore, South Korea and Japan are considering options for exporting CO_2 for storage in other countries with large storage resources such as Australia, Malaysia, and Indonesia.

Discussion question:

13. Are there features from other jurisdictions' offshore CO_2 storage regimes that Canada should explore? Are there elements that Canada should avoid?

6. Next steps

The department is interested in hearing your views on the potential development of a framework to regulate sub-seabed geological CO_2 storage in the offshore. This and future engagement activities will provide Indigenous groups, stakeholders, Provincial and Territorial Governments and the public the opportunity to provide their views. Please provide your perspective and feedback on each of the discussion questions listed throughout the document by May 30, 2025.

Annex A: Definitions

Carbon capture: The capture of CO_2 from a process emission stream, the atmosphere or seawater to produce a highly pure stream that is amenable for conversion or storage. In some cases, CO_2 capture may include purification and compression that is needed to prepare the CO_2 for transportation.

Carbon capture, utilization, and storage (CCUS): Process including the separation of CO_2 from point source emissions streams such as fuel combustion, or industrial processes; CO_2 transport via ship, rail, truck, or pipeline; and its use either as a resource to create products or its permanent storage via methods such as in geological formations.

Carbon Dioxide Equivalent: (CO2e) The amount of carbon dioxide that would have the same global warming impact as a given quantity and type of GHG. Commonly expressed as million metric tons of carbon dioxide equivalents (MMTCO2Eq).

Carbon Dioxide Removal (CDR): Activities that deliberately remove CO_2 from the atmosphere and durably store it in natural carbon reservoirs (e.g. rock formations, soils, plants, oceans), or in long-lived products. CDR approaches can be nature-based or technological-based approaches (e.g., Direct Air Capture (DAC)), or a combination of the two (i.e. a hybrid approach). Examples include direct air capture to carbon storage, biomass carbon removal and storage, and enhanced carbon mineralization.

Carbon Management: Carbon management refers to an ecosystem of technologies and approaches that help to reduce and remove CO_2 emissions. It encompasses any activities that capture, utilize, or store CO_2, or that connect these activities. It includes (but is not limited to) CCUS and CDR.

Continental Shelf: The continental shelf of Canada is the seabed and subsoil of the submarine areas, including those of the Exclusive Economic Zone (EEZ) of Canada, that extend beyond the territorial sea of Canada throughout the natural prolongation of the land territory of Canada.

Direct Air Capture (DAC): Any technology or technological process that captures CO_2 from ambient air. When paired with carbon storage strategies, (e.g., DAC), it results in CDR.

Direct Ocean Capture (DOC): Any technology or technological process that removes CO_2 from saline water which consequently results in also being removed from the atmosphere. When paired with carbon storage strategies, it results in CDR.

Enhanced Oil Recovery (EOR): The recovery of oil additional to that produced naturally by fluid injection or other means. CO_2 - EOR involves the injection of supercritical CO_2 (i.e. high temperature and pressure CO_2

that has properties of both a gas and liquid) into oil reservoirs for the purpose of increasing the amount of oil recovered beyond primary (conventional) extraction.

Greenhouse Gas (GHG): GHGs are those gaseous constituents of the atmosphere, both natural and anthropogenic, which absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, by the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapor (H2O), CO_2, nitrous oxide (N2O), methane (CH4), and ozone (O3) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere (also called synthetic gases), such as the halocarbons and other chlorine- and bromine-containing substances. CO_2 is the primary GHG emitted by human activities.

Life-Cycle Regulator: A life cycle regulator is a regulator who is responsible for enforcing the applicable regulations over the life of a project from exploration to decommissioning. A federal example of a life-cycle regulator is the Canadian Energy Regulator (CER).

Offshore: The area 200 nautical miles (nm) from the low water line along the coast. The 200 nm zone is generally divided into two areas: the territorial sea (12 nm from the low water line) and the EEZ (waters situated beyond territorial sea up to 200 nm). In these areas Canada has sovereign rights to explore, exploit, conserve and manage living and non-living natural resources of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the EEZ of Canada.

Offshore renewable energy project: Any of the following works and activities:

a) any research or assessment conducted in relation to the exploitation or potential exploitation of a renewable resource to produce an energy product, unless it is conducted by or on behalf of a government or educational institution,

b) any exploitation of a renewable resource to produce an energy product,

c) any storage of an energy product produced from a renewable resource, and,

d) any transmission of an energy product produced from a renewable resource.

Offshore sub-seabed geological storage: The injection and storage of CO_2 under the seabed into geological strata.

Storage hub: The central collection of CO_2, serving multiple emitters with CO_2 capture projects, often using shared infrastructure.