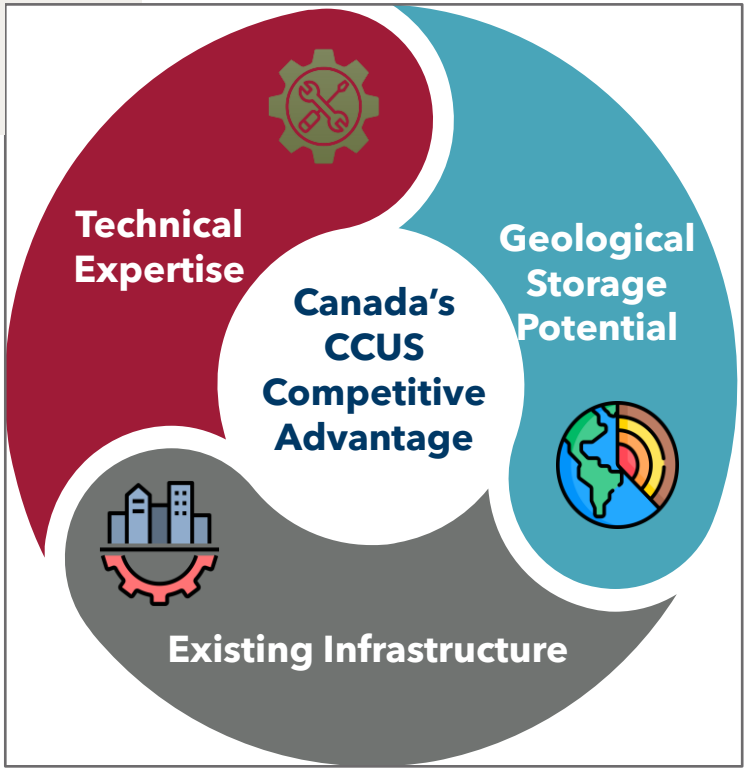
Carbon Capture, Utilization and Storage in Canada

March 2025

Summary

- **Carbon Capture, Utilization, and Storage (CCUS) is critical to Canada's oil and gas industry**
  - CCUS is vital for maintaining the global competitiveness of Canada's oil and gas industry.
- **Canada is a global leader in CCUS**
  - Canadian projects represent 11.5% of planned global CCUS storage capacity.
  - Major contributors to CCUS in Canada include oil refining and chemical production sectors.
- **Technological advancements are expanding opportunities to capture CO_2 across industries**
  - Innovations include post-combustion, pre-combustion, direct air capture, and bioenergy CCS expand CO_2 capture opportunities.
- **Canada has a significant footprint of operational and planned CCUS projects**
  - There is established infrastructure including the Alberta Carbon Trunk Line (ACTL).
  - There are successful projects operating in both Alberta and Saskatchewan.
- **CCUS in Western Canada has world-leading growth potential**
  - Total sequestration capacity is growing significantly through planned projects: Ambition to scale CCUS capacity fivefold by 2030.
  - Abundant geological storage and world-class technical expertise are driving expansion.

Canada has Significant CCUS Advantages



Existing Infrastructure

- Leading operational network including Alberta Carbon Trunk Line (14.6 Mt/year capacity) and multiple active hubs
- Eight major operational projects across Alberta and Saskatchewan with proven track records
- Integrated pipeline systems connecting capture sites to storage locations

Technical Expertise

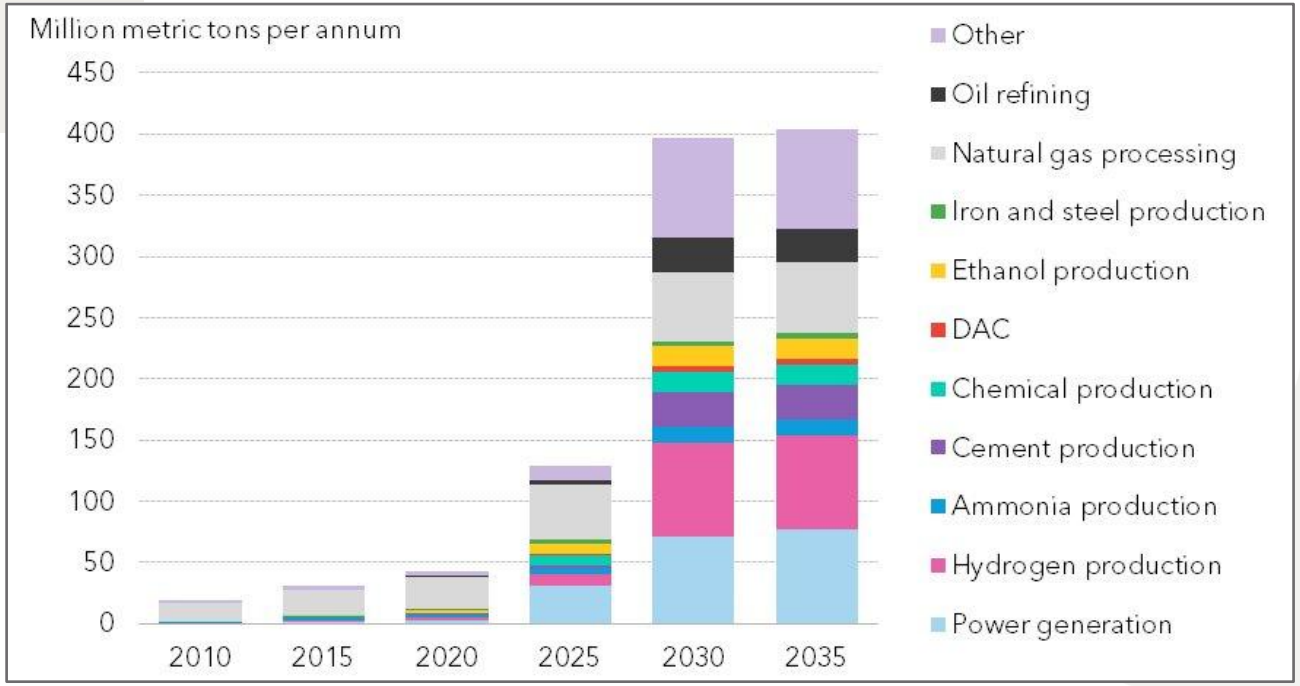
- World's first commercial coal CCS (Boundary Dam, 2014)
- Over 7 Mt successfully stored in deep saline formations (Quest)
- 40+ years of CCUS operations, starting with Joffre EOR in 1984

Abundant Geological Storage

- Roughly 389 Gt potential storage capacity (primarily in Alberta, Saskatchewan, Manitoba)
- Extensive Deep Cambrian Sands formations ideal for CO_2 storage
- Multiple proven storage zones (saline aquifers, depleted reservoirs, Enhanced Oil Recovery)

CAPP

Global CCUS Projects



Source: BloombergNEF, Global CCS Institute, MIT, ZeroCO2, IEA

- Canada is ranked fourth globally for planned CCUS capacity (45.6 Mt of CO_2 by 2030), accounting for 11.5% of the global total
- Over 60% of this capacity is linked to the upstream oil and gas sector.

Carbon Capture Technologies

Post-Combustion: This established technology extracts CO_2 from industrial exhaust streams using chemical solvents or specialized membranes, demonstrated successfully at facilities like Alberta's Boundary Dam.

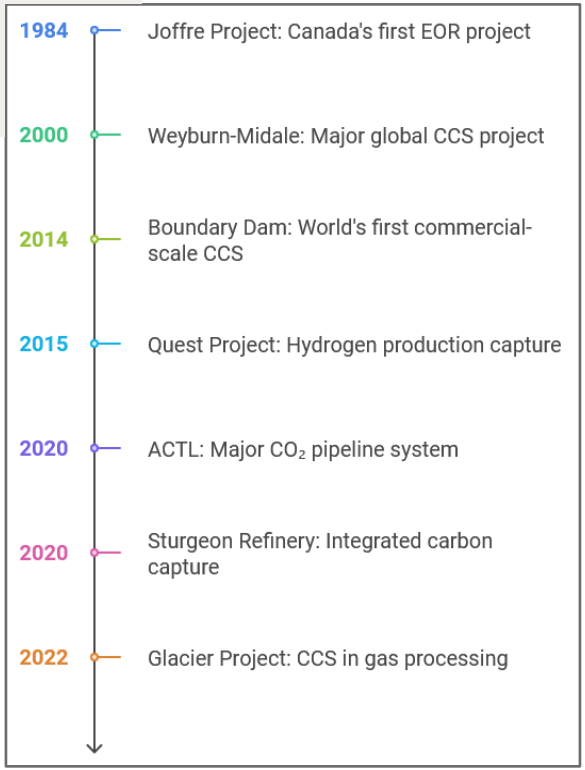
Pre-Combustion: By converting fossil fuels into synthetic gas before combustion, this method efficiently separates CO_2 while producing hydrogen fuel, as implemented in the Alberta Carbon Trunk Line system.

Direct Air Capture: Innovative facilities pull CO_2 directly from the atmosphere using chemical processes, with Canadian company Carbon Engineering leading development and planning major installations across Alberta.

Bioenergy CCS: This dual-purpose approach captures CO_2 while generating renewable energy from biological waste. This approach particularly suits Canada's agricultural and forestry sectors.

- Western Canada is at the forefront of global CCUS innovation, leveraging advanced carbon capture technologies.
- Alberta and Saskatchewan are leading the way in developing and deploying integrated systems for the capture, transport, and storage of CO_2. These efforts support economic growth and competitiveness.

Canada's Journey in CCUS

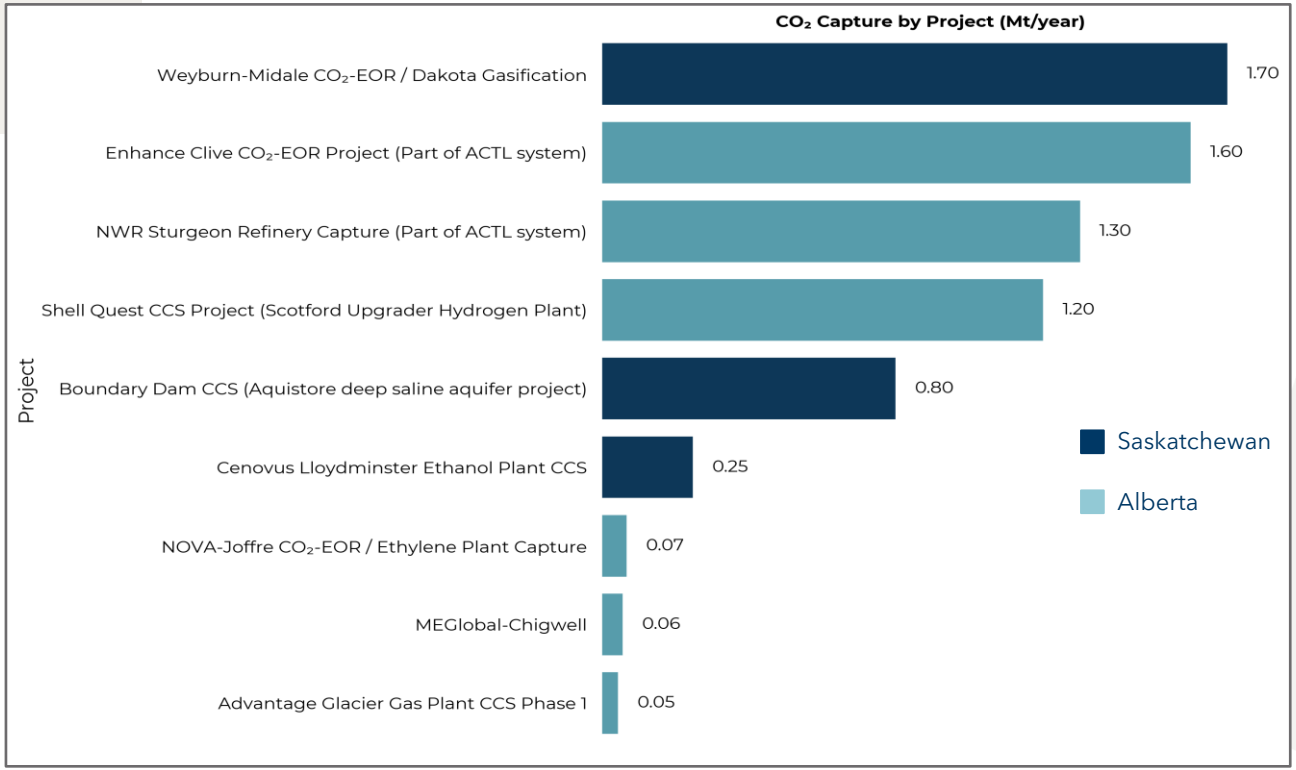


MAJOR PROJECTS

- **Joffre (1984)**: Canada's first Enhanced Oil Recovery (EOR) project at NOVA Chemicals' ethylene plant in Alberta, capturing approximately 0.04 Mt CO_2/year.
- **Weyburn-Midale (2000):** One of the world's largest carbon capture and storage projects, sourcing CO_2 from the Dakota Gasification Company's coal gasification plant in North Dakota and transporting it via pipeline to Saskatchewan.
- **Boundary Dam (2014):** The world's first commercial-scale CCUS facility on a coal-fired power plant, located in Saskatchewan, capturing about 1 Mt CO_2/year.
- **Quest (2015):** Located at Shell's Scotford Upgrader near Edmonton, Alberta, capturing CO_2 from a hydrogen production facility and storing it in a deep saline aquifer.
- **ACTL (2020):** A 240 km pipeline system with a design capacity of 14.6 Mt CO_2/year, connecting CO_2 sources in Alberta's Industrial Heartland to EOR fields.
- **Sturgeon Refinery (2020):** Part of the North West Redwater Partnership, it's the first refinery designed with integrated carbon capture, connected to the ACTL system.
- **Glacier (2022):** Advantage Energy's carbon capture project at the Glacier gas plant in Alberta, demonstrating a CCUS application in natural gas processing.

CAPP **Source:** https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2019/market-snapshot-carbon-capture-utilization-storage-market-developments.html

Operating CCUS Projects in Canada



Criteria for inclusion in this list:

1) The project must include a carbon capture component.

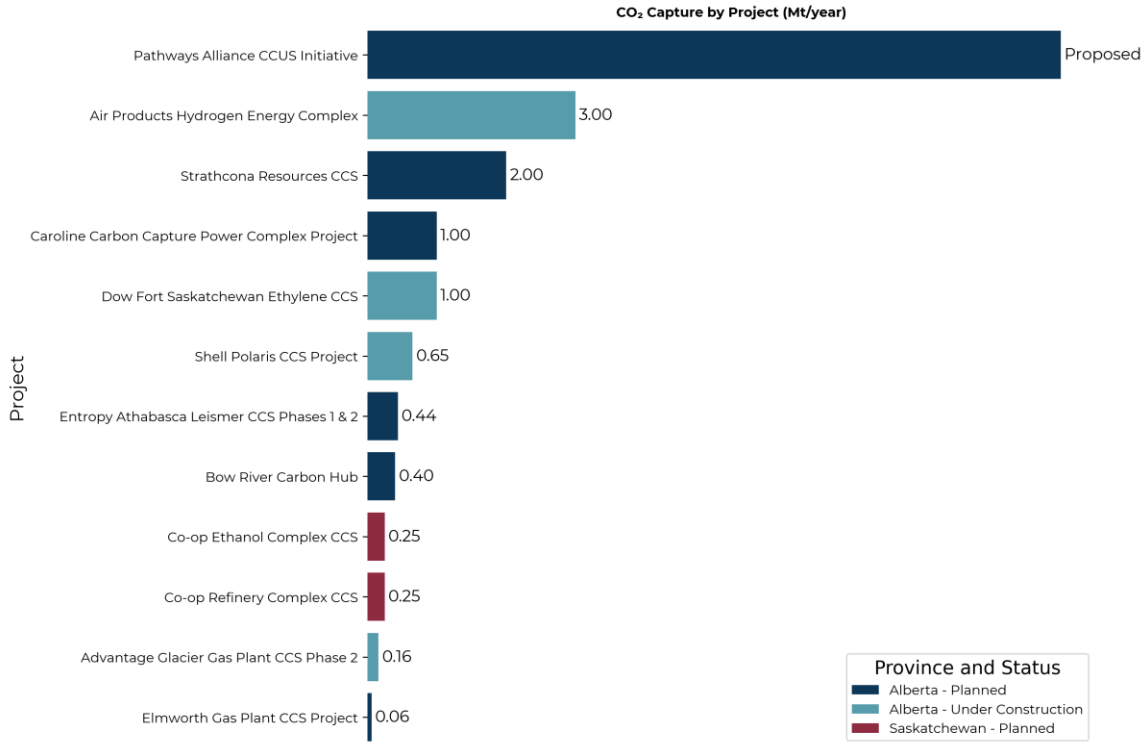
2) The project must be connected to fossil fuels in some capacity.

3) Only major projects with an injection capacity of ≥ 0.05 Mtpa are considered.

4) The project must be a commercial venture.

CAPP **Source:** BloombergNEF

Future CCUS Developments in Canada



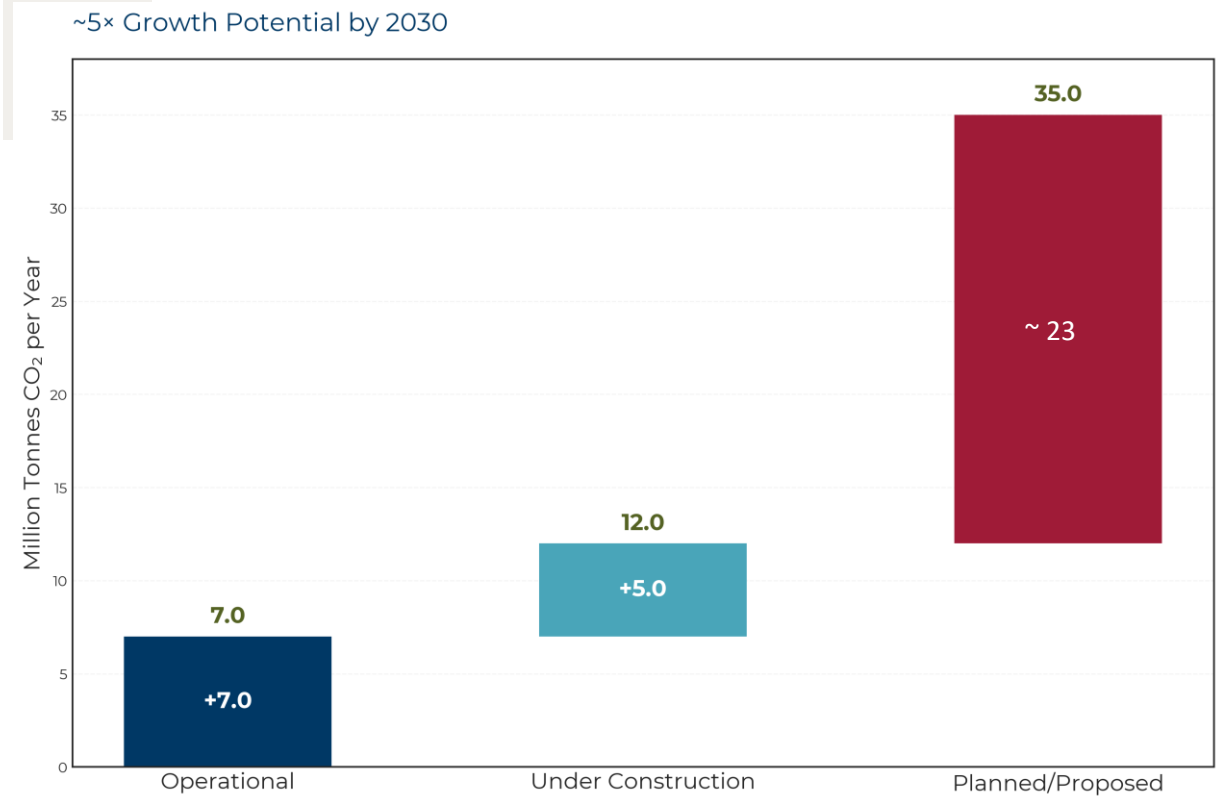
- Planned CCUS projects in Canada aim to significantly expand carbon capture capacity.
- The proposed Pathways Alliance CCUS project plans to transport captured CO_2 to a hub for permanent underground storage. The project is contingent on sufficient fiscal and policy support and regulatory approval.

Criteria for inclusion are :

1) The process must include a carbon capture component.
2) The process must be connected to fossil fuels in some capacity.
3) Only major projects with an injection capacity of ≥ 0.05 Mtpa are considered.
4) The project must be a commercial venture.

Source: BloombergNEF

Western Canada's CCUS Ambition



30+ projects in the pipeline:

- Operational Projects: **9**
- Under Construction Projects: **4**
- Planned/Proposed Projects: **9**
- Other[1]: **10+**

[1]Other refers to additional projects that are in early development stages, awaiting feasibility studies, or publicly announced but with insufficient available data for full inclusion in the detailed breakdown above. The summary focuses on projects with clear timelines and data on CO_2 capacity

Glossary

Project Phases Definitions:

- **Construction**: Physical construction is underway.
- **Operational**: Project is actively capturing and storing CO_2.

Type of Capture:

- **Post-combustion**: Capturing CO_2 from flue gases after combustion.
- **Pre-combustion**: Capturing CO_2 before combustion (e.g., hydrogen production via Steam Methane Reforming).
- **Gas Processing**: Capturing CO_2 from natural gas processing facilities.
- **Direct Air Capture**: Capturing CO_2 directly from ambient air.

References

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