



INTERNATIONAL
CCS KNOWLEDGE
CENTRE

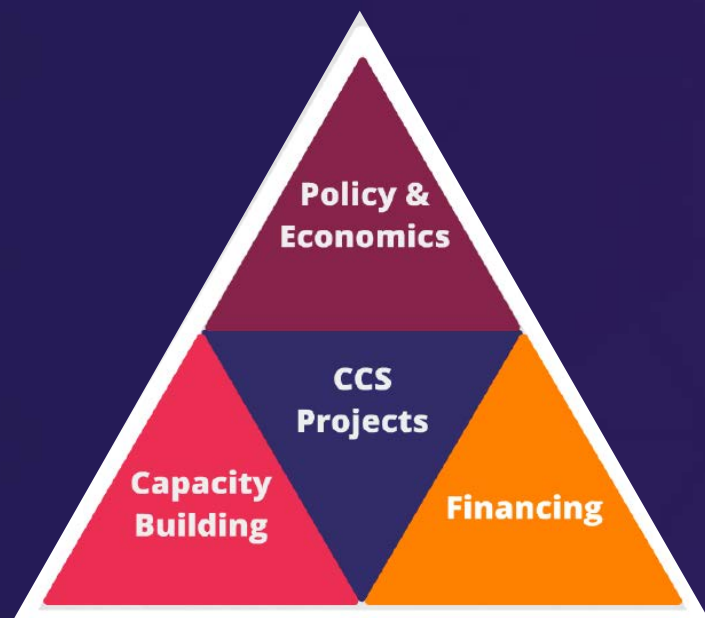


Update on CCS Progress in Canada

Corwyn Bruce, Vice-President, Project Development and Advisory Services

The International CCS Knowledge Centre

The International CCS Knowledge Centre is dedicated to advancing the understanding and use of large-scale carbon capture and storage (CCS) as a means of managing greenhouse (GHG) emissions.



- Staff are available to provide experience-based considerations for CCS projects.
- Guidance for planning, design, construction and operation.
- Guidance on cost reductions of 2nd generation CCS, for better positioning in de-risking investments decisions.
- Active engagement with financiers, decision makers, and business case partners.

**THE INTERNATIONAL
CCS KNOWLEDGE
CENTRE**



Facilitates in an
advisory role
Based on expertise
and lessons learned

An aerial photograph of the Boundary Dam power plant. The central building is a large, light-colored industrial structure with "SaskPower Boundary Dam" written on its side. Several tall, red-and-white striped smokestacks are visible behind the main building. To the left, there is a large electrical substation with numerous power lines and transformers. In the foreground, there are several large parking lots filled with cars and trucks, along with various smaller industrial buildings and storage areas. The facility is situated next to a large body of water, with green fields and more water visible in the background.

BOUNDARY DAM

LEARNING STARTS HERE

- World's 1st Large Scale Post-Combustion CCS Facility
- Over 3 million tonnes of CO₂ captured & stored since 2014

The BD3 ICCS Project

- World's first post-combustion coal-fired CCS project **fully integrated** with a power station.
- Life extended the 45-year-old Boundary Dam Unit 3.
- Favored by economics at the time.
- **Aided by \$240 CAD million-dollar federal grant.**
- Executed as a two-part project:
 - Power island upgrade
 - CCS retrofit
- **Capture operations began October 2014.**
- CO₂ used for EOR or stored in the Aquistore Project.

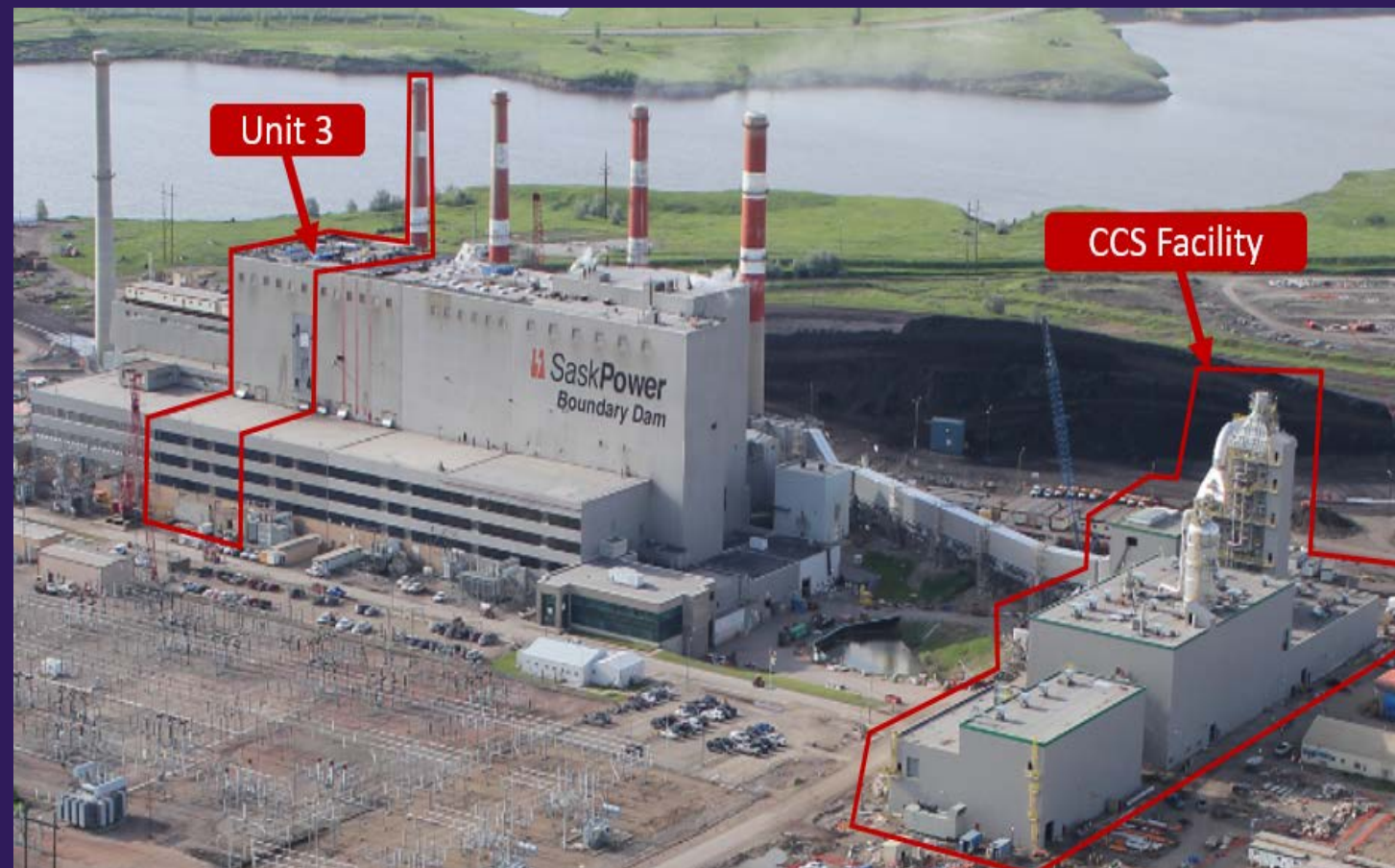
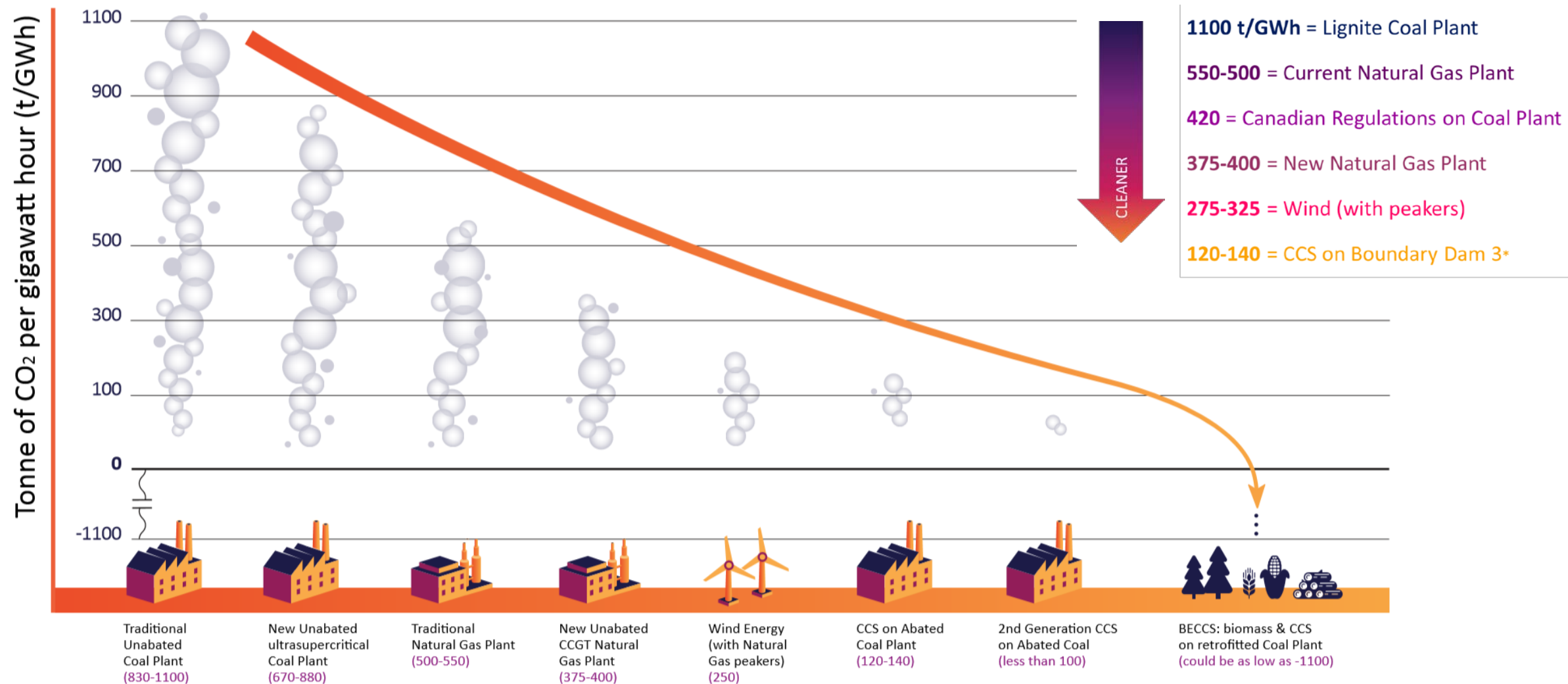


Figure 1. Boundary Dam Power Station and the ICCS Facility

Performance: Exceeding Standards

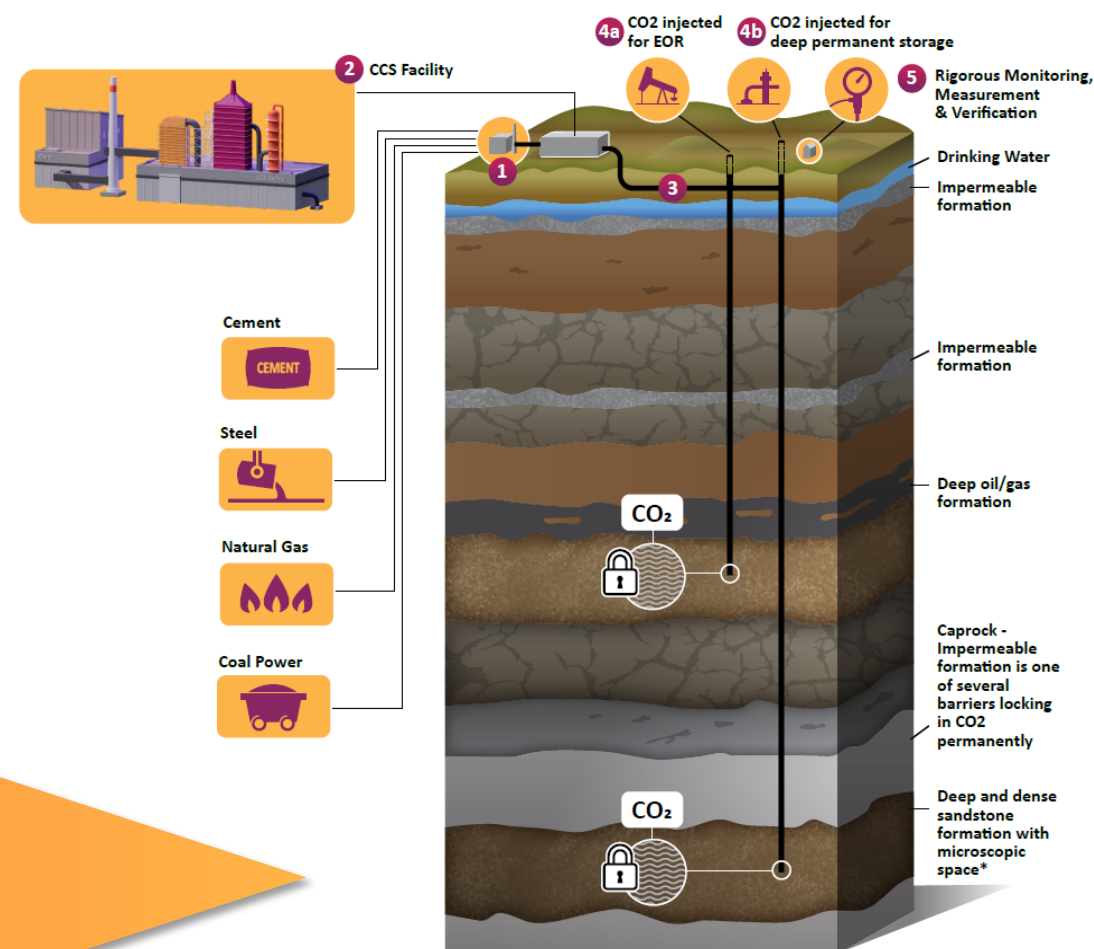


Saskatchewan Lessons Learned

Full Chain Experience for carbon capture and storage

- Retrofitted existing coal unit
- Capture CO₂ and other particulates
- Transport via pipeline
- Sale & use of CO₂ for enhanced oil recovery
- Sale of other by-products
- Storage site for CO₂ at Aquistore
- Regulation, policy and royalty structures

Canada, with its world-class geological storage potential for CO₂, is doing its part to demonstrate CCS technology. The Weyburn project in Saskatchewan was launched in 2000.



Introduction: The Shand CCS Feasibility Study

- The Shand CCS Feasibility Study was undertaken to evaluate the economics of a CCS retrofit and life extension on what was believed to be the most favorable host coal-fired power plant in SaskPower's fleet.
- Demonstrates the value of lessons learned.
- Collaboration between Mitsubishi Heavy Industries (MHI), Mitsubishi Hitachi Power Systems (MHPS), SaskPower and The International CCS Knowledge Centre (Knowledge Centre).

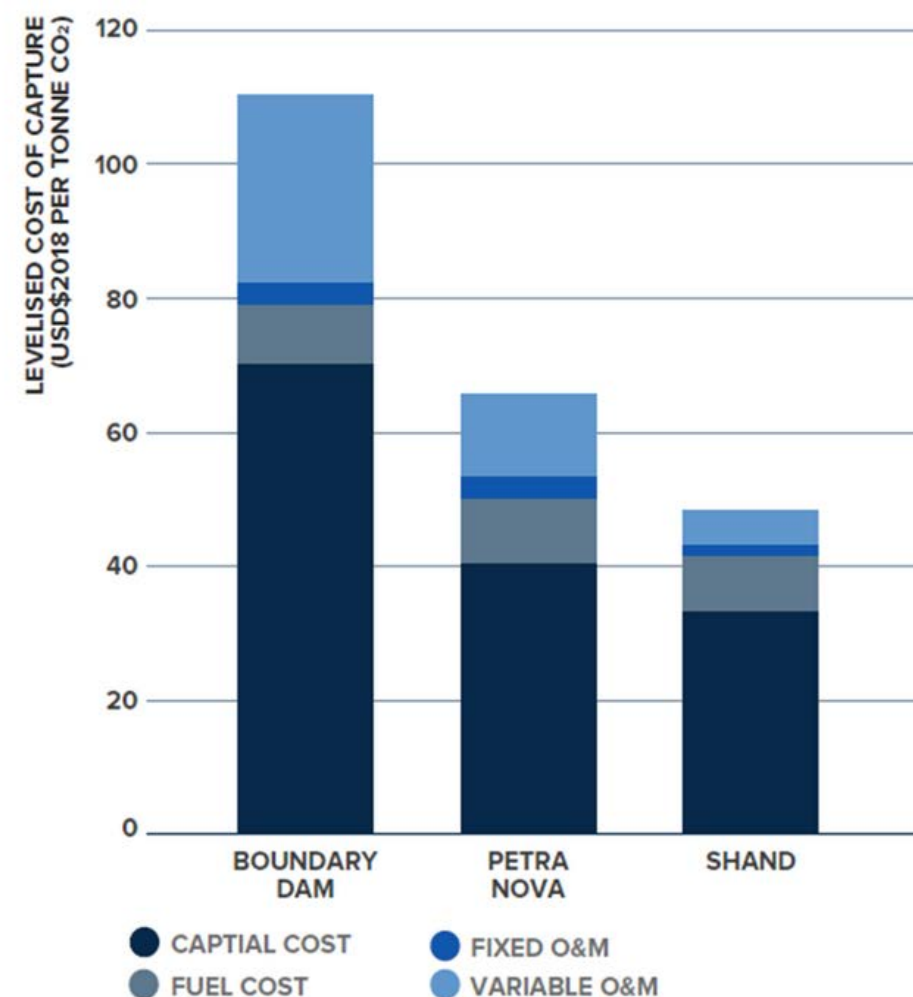


About the Shand Feasibility Study

Key findings of feasibility study evaluates the economics of CCS on a 300MW coal-fired power plant in Saskatchewan

- Projected capture capacity of **2Mt/yr**
- Capital cost to be **67% less** per tonne of CO₂ captured
- Cost of capture at **\$45US/t CO₂**
- Capture rate can reach **up to 97%** with reduced load (i.e. renewables on grid)
- Fly ash sales can further reduce CO₂ (potential 125,000t CO₂/yr reduced)

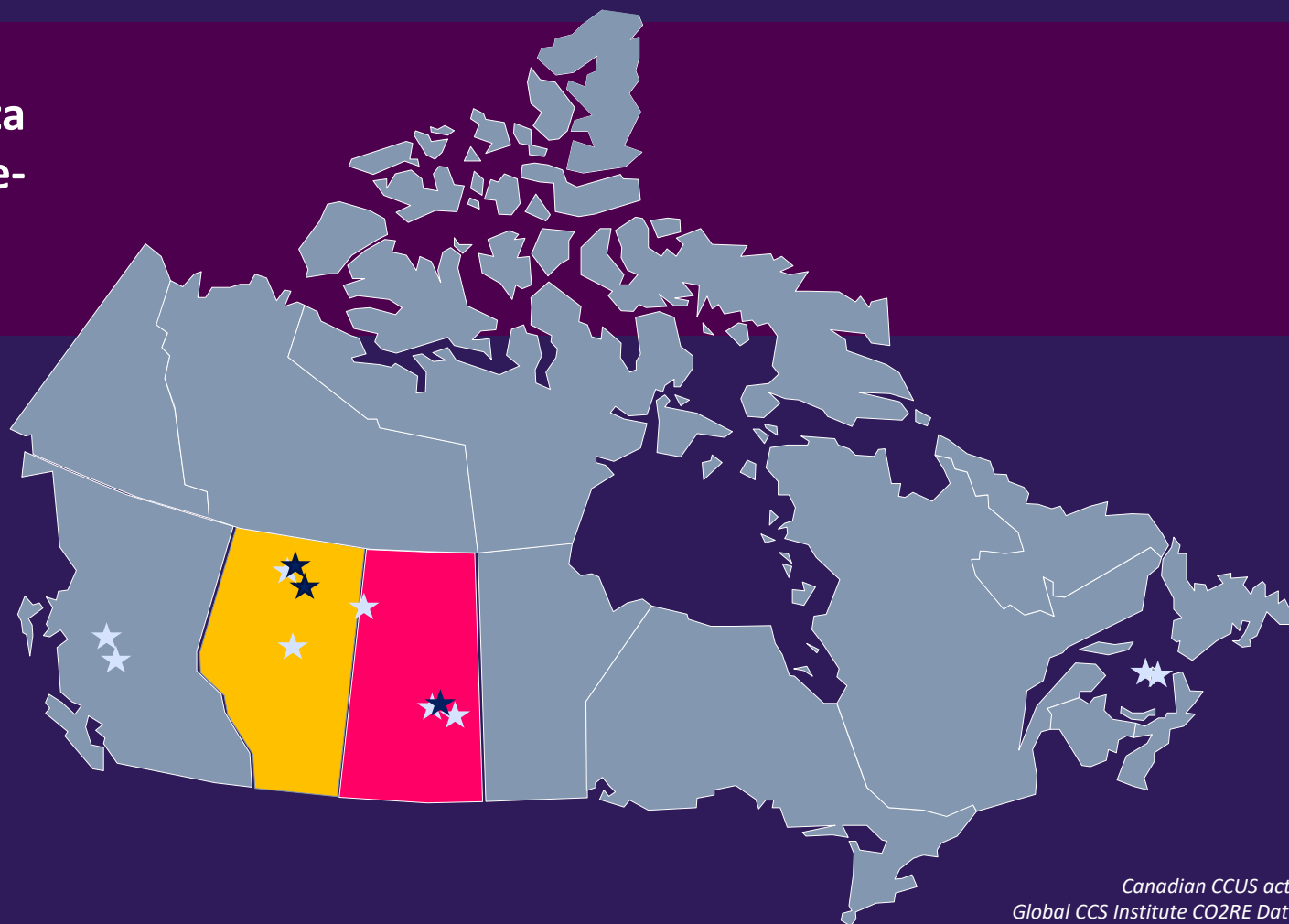
Break Down of Levelized Cost of Capture



Canada Current CCUS Activities

Boundary Dam, Shell Quest and two Alberta Carbon Trunk Line projects are notable large-scale CCS actions in Canada.

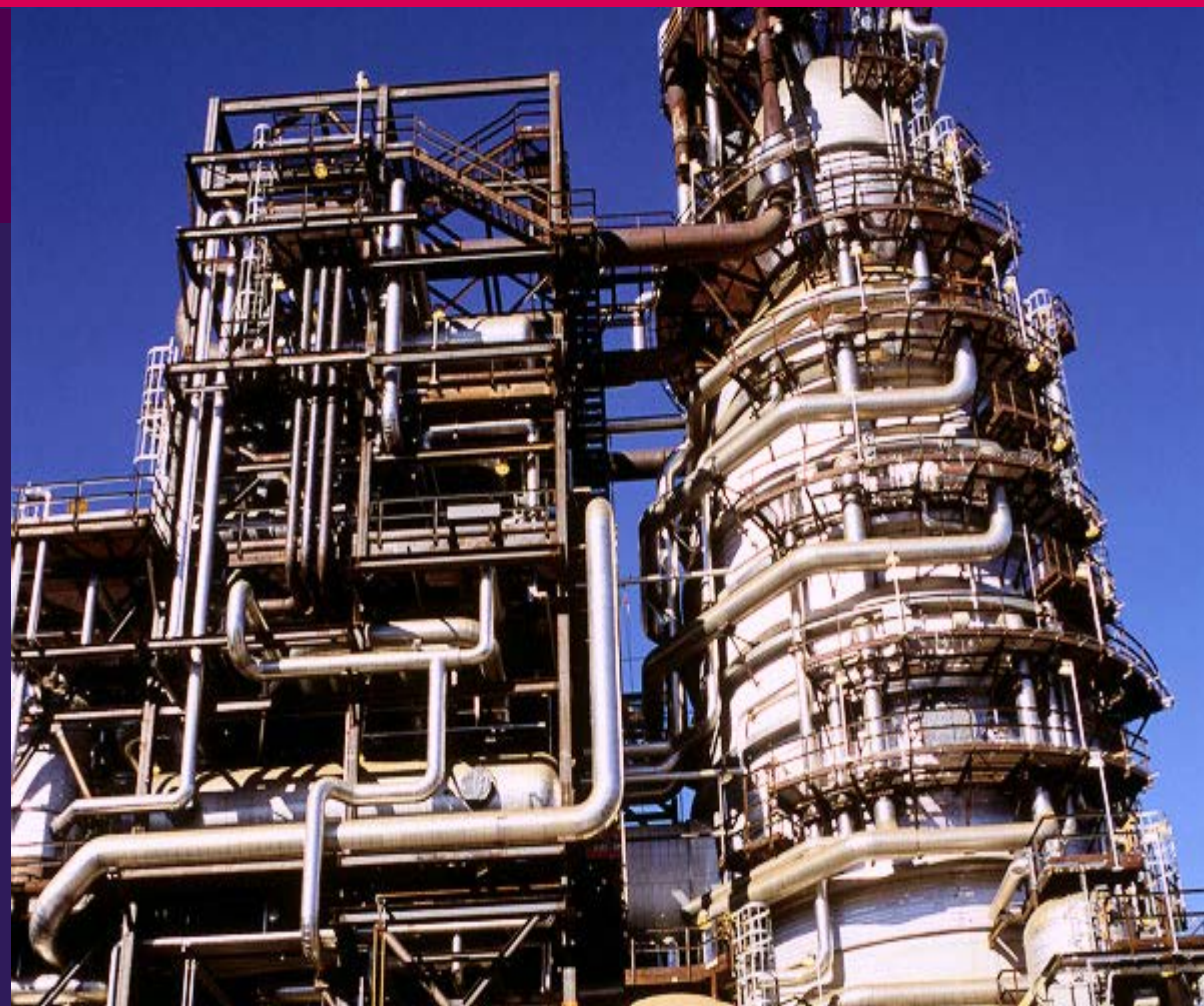
- Weyburn EOR operations (SK)
- Direct Air Capture – Carbon Engineering (BC)
- Lehigh Cement feasibility study (AB)
- Lafarge CCU operations (BC)
- Svante-Husky testing (SK)
- Carbon Capture Test Centre (SK)
- XPRIZE (AB)
- Capital Power (AB)
- Carbon Cure (NS)



QUEST Carbon Capture & Storage Project in Alberta

To date, Quest has captured and stored over 5 million tonnes of CO₂

- One million tonnes CO₂ per year capacity
- Equivalent to emissions from ~250,000 cars
- 35% reduction of Scotford upgrader CO₂ emissions
- CO₂ capture at the upgrader from 3 hydrogen manufacturing units
- CO₂ transported by 12-inch pipeline to storage
- Permanent storage 2 km underground



The Alberta Carbon Trunk Line (ACTL)

The ACTL is a 240-kilometre pipeline that carries CO₂ captured from the Sturgeon Refinery and the Nutrien Redwater fertilizer plant to EOR projects in central Alberta.

- the ACTL system captures industrial emissions and delivers the CO₂ to mature oil and gas reservoirs for use in EOR and permanent storage.
- the ACTL can transport up to 14.6 million tonnes of CO₂ per year; licensed for 5.5Mt CO₂/year.
- Able to unlock 1 Billion barrels of light oil (initially 30 Mt in Clive oil field)
- Storage of 2Gt CO₂



Weyburn-Midale CO₂ Monitoring & Storage Project

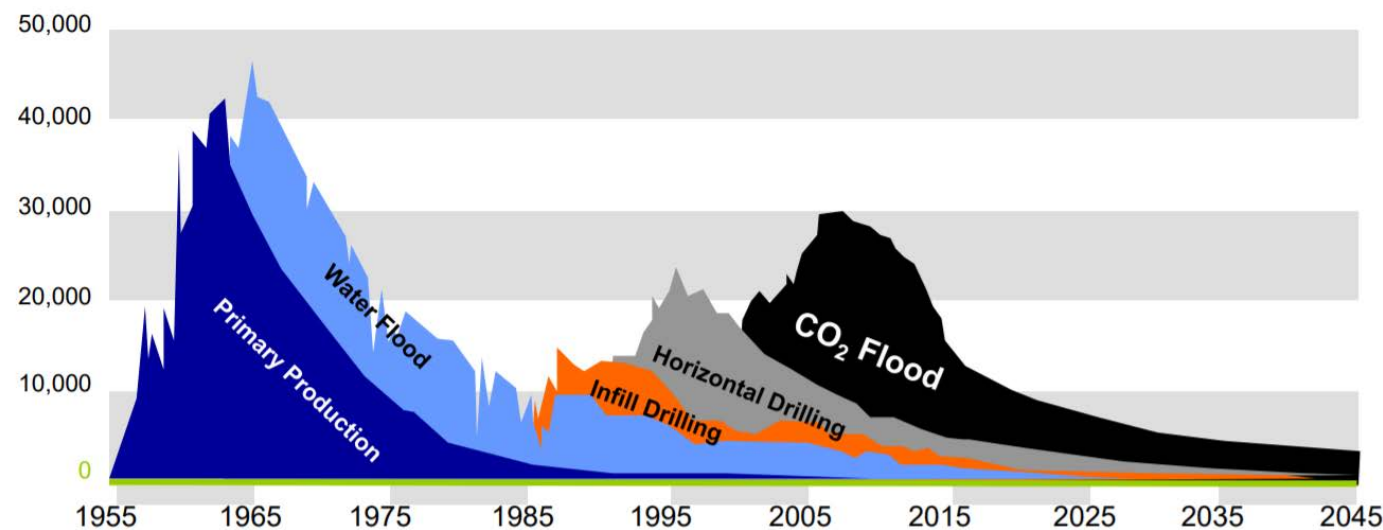
Largest Carbon Capture & Utilization Storage (CCUS) project in the world

- CO₂ injection commenced in October 2000
- Have safely captured more than 30 million tonnes of CO₂
 - An additional ~2 million tonnes of CO₂ are captured each year
- Estimated CO₂ storage potential of 55 million tonnes in the Weyburn Unit
- Site of an international research project, IEA GHG Weyburn- Midale CO₂ Monitoring & Storage Project; led by the Petroleum Technology Research Centre (PTRC) in Regina
- Have hosted over 300 groups from 20 countries



Weyburn Production

bbl/d



Sequestration 45 million tonnes CO₂

Lehigh Hanson Edmonton Post-Combustion CO₂ Capture Pre-Feasibility Study

- On Nov. 28, 2019, Lehigh Cement and the Knowledge Centre announced a joint feasibility study of a commercial-scale CCS project.
- The study targets the feasibility to capture the majority of the carbon dioxide (CO₂) from the flue gas of Lehigh's Edmonton, Alberta cement plant.
- Capture rate is estimated at 600,000 tonnes of CO₂ annually.
- Emissions Reduction Alberta (ERA) has invested \$1.4M in the feasibility study of CCS on an industrial cement facility.



Lehigh Hanson Edmonton Post-Combustion CO₂ Capture Pre-Feasibility Study
<https://ccsknowledge.com>

Direct Air Capture – Carbon Engineering in British Columbia

- Constructed by Carbon Engineering (CE), the Direct Air Capture (DAC) pilot plant began operation in 2015, in Squamish, BC.
- CE's DAC technology can remove CO₂ directly from the atmosphere for use or storage.
- CE's equipment was designed to accurately replicate the performance of commercial-scale modules.
- Government of Canada invested \$25M in Carbon Engineering



Direct Air Capture – Carbon Engineering
carbonengineering.com

Thank You



For more information please
visit our website at:

ccsknowledge.com



Contact us by email:

info@ccsknowledge.com



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