INTERNATIONAL CCS KNOWLEDGE CENTRE

Knowledge Transfer from Commercial Scale Projects – Boundary Dam CCS Facility

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Our Organization

THE INTERNATIONAL CCS KNOWLEDGE CENTRE

Facilitates in an advisory role

Based on expertise and lessons learned

Mandate:
Advance the understanding and use of CCS as a means of managing greenhouse gas emissions

Sponsored jointly by global resource leader, BHP and CCS pioneer, SaskPower

Sharing lessons learned from hands-on operations ensures for experienced-based decision making

Our Story for CCS

Large Scale Deployment (Boundary Dam 3)

↓

Operational & Policy Understandings

↓

Second Generation Application

↓

Trends & Gaps for Large-Scale Deployment

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Driving Future Opportunities

BOUNDARY DAM

LEARNING STARTS HERE
THE WORLD'S 1ST INTEGRATED LARGE SCALE POST-COMBUSTION CCS FACILITY

Large Scale Deployment (Boundary Dam 3)

- Post-combustion chosen from several studies
- CCS on coal-fired power operating since 2014
- Projected 90% capture rate & 30 yr life extension
- Initial investment = approximately CDN$1.5 billion
- CO_2 is used for EOR or sequestered at Aquistore

CCS at Boundary Dam Power Station allowed for long-term production of over 110 MW of clean, base-load electricity in a fully integrated and full chain process

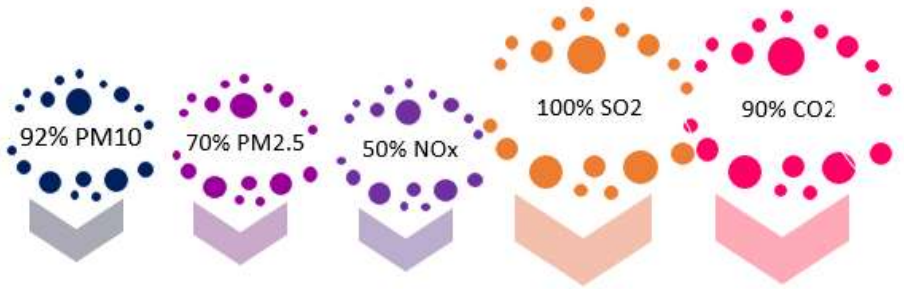
Overview of BD3 Project

The project consisted of two major parts:

Refurbishment included a complete replacement of the steam turbine and generator, which were at their end of life.

Capture involves taking out other components before the amine removes the CO_2.

- Design deficiencies and construction quality issues had to be managed, as well as amine issues.
- *Trend of higher capture rate and reduced outages over time*
- Has captured & stored over 2Mt



Operational Understandings: Exceeding Federal Regulations

1100 t/GWh = Lignite Coal Plant

550-500 = Current Natural Gas Plant

420 = Canadian Regulations on Coal Plant

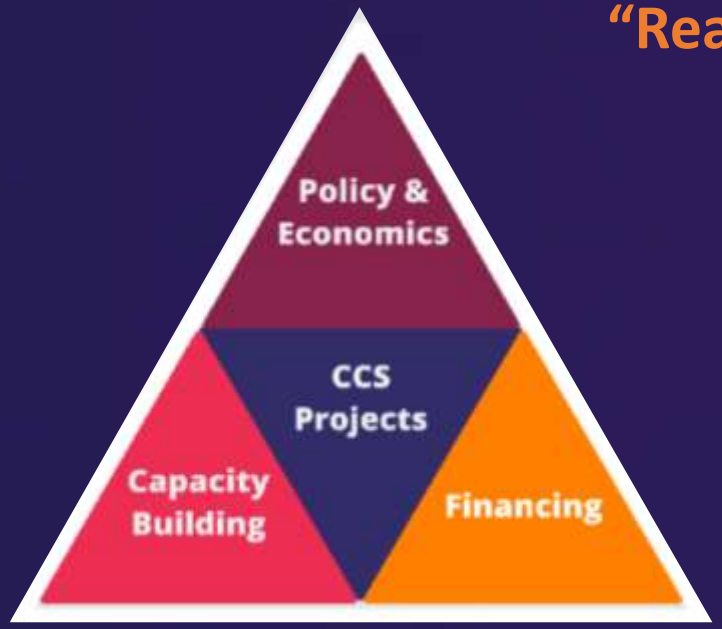
375-400 = New Natural Gas Plant

300-325 = Wind (with peakers)

120-140 = CCS on Boundary Dam 3*

*Name plate capacity

Operational Understandings: Sharing Lessons Learned



"Real world" considerations for using CCS are important.

We must COLLABORATE -
Not just talk about collaborating.

- Stimulate development
- Bring down costs
- Promote greater knowledge exchange

SECOND GENERATION DESIGN

SASKPOWER SHAND POWER STATION

HIGHLIGHTS OF FEASIBILITY STUDY:

- Designed to capture 2Mt
- 67% cost reduction (per tonne CO_2)
- Can capture up to 97% and integrates well with renewables

About the Shand Feasibility Study

Feasibility Study evaluates the economics of a CCS retrofit & life extension on 300MW coal fired power plant in Saskatchewan

- Projected capture capacity of **2Mt/yr**
- Capital cost to be **67% less** per tonne of CO_2 captured
- Cost of capture at **$45US/t CO_2**
- Capture rate can reach **up to 97%** with reduced load (i.e. renewables on grid)
- Fly ash sales can further reduce CO_2 (potential 125,000t CO_2/yr reduced)

Carbon neutral?

HOW DID COSTS COME DOWN?

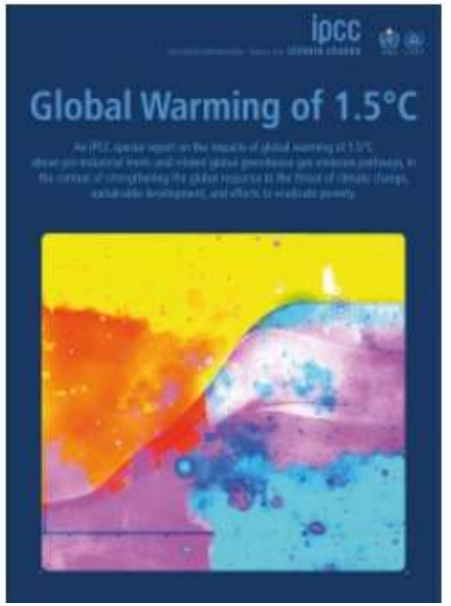
- Lessons learned from building and operating BD3
- Construction at a larger scale using extensive modularization
- Integration of the bigger unit's steam cycle

Second Generation Application to Coal and Other Sources

- IPCC's 5th Assessment Report: median increase in mitigation cost is 138% without CCS
- Almost all IPCC 1.5°C pathway scenarios include CCS

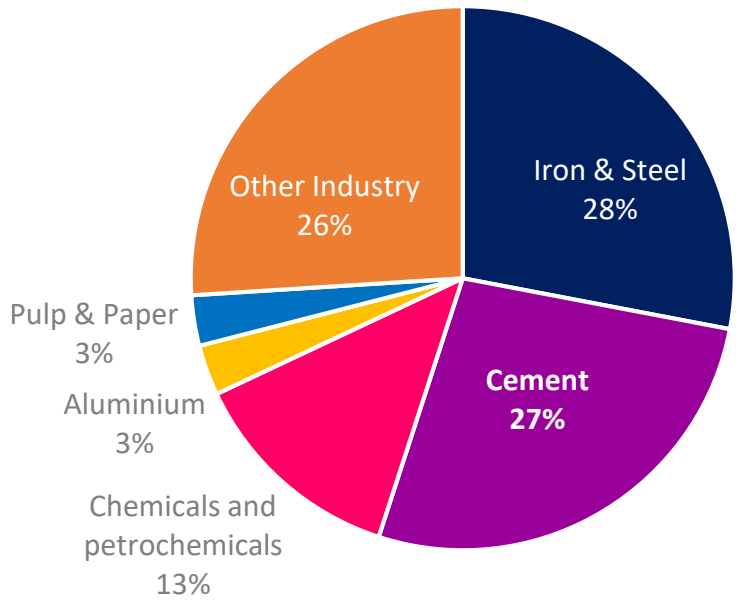
CCS technology is proven;
so de-risked deployment can occur

- *Reliable* and *affordable* energy with reduced emissions are imperative for energy security.
- Implementation of CCS can:
  - allow existing generating assets to operate cleanly and
  - aid to decarbonize industrial emissions.



Second Generation Application to Industrial Emissions

Direct industrial CO_2 emissions (2014)



Industrial CO2 emissions represent 24% of global CO2 emissions at 8.3 Gt CO_2 (2014)

- Lessons learns from operational experience at Boundary Dam CCS Facility and findings from the Shand CCS Feasibility Study can be applied to other industrial sources of emissions
- Size and layout considerations / integration are key considerations
- Costs can be saved with CO_2 infrastructure hubs, cost recovery with EOR, modularization and byproduct sales decisions
- Optimization is still required for particular flue gas characteristics to save operating costs

Information on this slide is sourced from International Energy Agency, Energy Technology Perspectives 2017

Driving Future Opportunities

Cooperative Approaches:

- Multi-stakeholder initiatives are important to drive development
- Government funding goes farther when leveraged with private funding
- **Don’t reinvent the wheel!**

Business Case:

- Account for economic considerations and energy security issues
- Find value in by-products
- Use enhanced oil recovery & align with oil companies where possible

Reduce Administrative Burden:

- Build on existing regulations as much as possible
- Create flexible enforcement regulations

Incentives & Financing:

- Enable support for first-movers
- Create a variety of financial incentives for projects
- Drive policy parity with other clean energy technology (ex. subsidies)
- Multilateral Development Bank involvement is critical for Asia

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Thank You

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