CCUS Project Developments and Policy Drivers in Canada

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Main Areas of Current CCS Development in Canada
## Current Government Funding of CCS Projects: Alberta and Saskatchewan

<table>
<thead>
<tr>
<th>Project</th>
<th>Federal</th>
<th>Provincial</th>
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</thead>
<tbody>
<tr>
<td>Quest Project</td>
<td>120 MM</td>
<td>745MM</td>
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<tr>
<td>Swan Hills</td>
<td>----</td>
<td>285 MM</td>
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<tr>
<td>Enhance (ACTL)</td>
<td>63 MM</td>
<td>495MM</td>
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<tr>
<td>Boundary Dam</td>
<td>240MM</td>
<td></td>
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<tr>
<td>Aquistore</td>
<td>14 MM*</td>
<td>5 MM</td>
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<tr>
<td>Weyburn-Midale</td>
<td>+15 MM**</td>
<td>3.5 MM</td>
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</tbody>
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* 5 million from Sustainable Development Technology Canada (stand-alone federally funded agency) and 9 million ECOeti

**Includes NRCan and USDOE (Canada and USA)
PTRC’s CO$_2$ Capture and Storage Activities
Aquistore Project

Project Objectives:

– Demonstrate CO$_2$ storage in deep saline formation is a safe, workable solution to reduce greenhouse gas (GHG) emissions

– Develop best methods & technologies to monitor GHG

– Involve research institutions, policy makers, industry, and public
Project Overview

- CO₂ storage research monitoring project
- Designed to inject 2000 tonnes CO₂/day
- $22.3M in sponsorship secured to date
- Buffer protection and long-term storage option for SaskPower’s Boundary Dam Carbon Capture Project
Phase 1: Demonstration & Evaluation

• site selection, permits, agreements, community engagement

• risk assessment, seismic surveys, monitoring programs

• evaluation/injection well
• observation/monitoring well

• test injection trucked in CO₂
Ground level view towards Boundary Dam Power Station

Well location remains largely free of water during the 1:500 year flood in Saskatchewan 2011
Injection Well Design

- Well depth 3300m to reach Deadwood in Estevan area
- Surface 13-3/8” casing to ~500m
- Production 7-5/8” casing to ~3300m
- 7-5/8” production casing for operability with 4.5” tubing
- Achieves evaluation and potential injection objectives
- Coring, DST, Logging program
IEAGHG Weyburn-Midale CO$_2$ Monitoring & Storage Project (WMP) 2000 to 2012

- Commercial EOR operations in Weyburn and Midale oilfields utilise anthropogenic CO$_2$
- Over 20Mt of CO$_2$ injected and stored since 2000
- WMP has used these sites to study technical aspects of CO$_2$ geological storage
Weyburn Unit Oil Production

- Primary & Waterflood
- Vertical Infills
- Pre CO2 Hz Infills
- CO2 EOR

Production through YE 2009
Quest Project

Quest Location Map

ALBERTA

Fort McMurray

Edmonton

Calgary

CO₂ Pipeline

Storage Complex 2 km deep

Storage Site

Compressor

Amine Unit

Alberta Industrial Heartland

Gulf Edward 8-26

North Saskatchewan River

Smoky Lake

Radway

Newbrook

Scotford

Willingden 14-14

West Willingden 14-14

Fort Saskatchewan

North Saskatchewan River

Shell Scotford CO₂ Appraisal Well
Quest CCS Project - Overview

Quest CCS Project - Joint Venture among Shell (60%); Chevron (20%); and Marathon (20%)

Quest is a fully integrated CCS Project: capture, transport, inject, store & monitor CO₂

Capacity to capture over one million tonnes of CO₂ per year or 35% of Scotford Upgrader direct emissions

Equivalent of taking 175,000 vehicles off the road

CO₂ will be transported by pipeline and stored approximately 2 kms underground
ACTL is the Enabler to Large Scale CCS

- ACTL is there for all emitters
- Will be extended throughout Alberta
- Starts in Alberta’s Industrial Heartland east of Edmonton
- Initial CO₂ supply comes from:
  - Upgrading
  - Petrochemicals
Enhance’s Current CO₂ Suppliers

- Agrium
  - The only EOR suitable CO₂ source available today
- North West Upgrading’s gasifier
  - Next available pure source
- Combined volume 5,000 Tonnes per day
  - Sufficient to start construction
Swan Hills Clean Gas For Clean Power – Project Overview

CO₂ for Enhanced Oil Recovery (third party):
CO₂ captured by ISCG Facility sold to Swan Hills area customers for enhanced oil recovery and permanent sequestration

1.3 million tonnes per year CO₂ sequestration

- CDN $1.5 billion overall capital (CDN $1 billion SHS portion)
- 2015 in-service date

ISCG Facility (Swan Hills area):
Converts deep coal in-situ into synthesis gas (syngas); processes raw syngas at surface to remove CO₂

Power Generation Facility (third party) (Whitecourt area):
High efficiency combined cycle power plant, syngas fuel

300 MW low-emissions clean electricity

Syngas Pipeline (third party):
Conventional buried pipeline transports clean, low-carbon syngas from ISCG Facility to Power Generation Facility for use as primary fuel
Thank You