

Quest Carbon Capture and Storage

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Tim Wiwchar AOSP Portfolio Manager

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Introduction

Tim Wiwchar, AOSP Portfolio Manager

How did Quest come to be?

In 2000, Shell Canada established an external Climate Change Advisory Panel.

In mid-2000, CCS took on new importance for Royal Dutch Shell.

Quest was already positioned to lead amongst Shell's various opportunities.

Government Support

- Total Cost of Quest \$1.35 billion, FEED,
 Capital + 10 years OPEX
- The governments of Alberta and Canada contributed CAN \$745M and CAN \$120M respectively to Quest, for a total of \$865M
- As a result of the funding, Quest is required to have:
 - extensive knowledge sharing
 - stringent reporting and MMV plan
 - net revenue neutral requirement



Quest Overview

- Quest CCS fully integrated CCS (capture, transport & storage)
- One million tonnes CO₂ per year capacity for 25 years
- Equiv to emissions from ~250,000 cars
- JV with Shell (60%); Chevron (20%); and Marathon (20%)*
- 35% reduction of Scotford Upgrader CO₂ emissions
- Permanent storage 2 km underground in the Basal Cambrian Sands



Hardware

- 65-km pipeline from the upgrader to 3 injection wells
- CO₂ transported by 12 inch pipeline to storage, with 6 inch laterals
- Route selected to meet stakeholder requirements:
 - 28 km follows existing ROW
 - Drilled under North Saskatchewan River



First Year's Performance



- Observed a daily average injection rate around 1.2 Mtpa
- Captured first 1 million tonnes in August 2016
- 99% reliability
- Excellent porosity in the storage reservoir

Questions and Answers





A BETTER LIFE WITH A HEALTHY PLANET. PATHWAYS TO NET-ZERO EMISSIONS

Shell's latest thought piece builds on its 2013 New Lens Scenarios to illustrate choices, challenges and ideas for society to decarbonise the global economy in a way that might address both the challenge of climate change and the desire for broader economic growth.

The Shell Scenarios, *Mountains* and *Oceans*, provide a detailed analysis of current trends and their likely trajectory into the future. They dive into the implications for the pace of global economic development, the types of energy we use to power our lives and the growth in greenhouse gas emissions. The two scenarios also highlight areas of public policy likely to have the greatest influence on the development of cleaner fuels, improvements in energy efficiency and on moderating greenhouse gas emissions.

To learn more, visit: www.shell.com/scenarios

MOUNTAINS This is the world with status quo power locked in and held tightly by the currently influential.



OCEANS Influence stretches far and wide in the world of Oceans. Power is devolved, competing interests are accommodated and compromise is king.



World demand for energy is growing:

- Population growth and economic development could double energy needs by 2050
- The mix of energy sources will change gradually – fossil fuels will still be a big part of the energy mix



Shell and the CO₂ Challenge

- Shell's role is to meet our customers' growing need for reliable, affordable energy
- Our response to the CO₂ challenge focuses on cost effective solutions available now



- Our priorities are:
 - Natural Gas
 - Biofuels
 - Carbon Capture and Storage
 - Energy Efficiency

Equipment



Basal Cambrian Sand Storage Complex



Storage Lease Area



IW 7-11 IW 5-35 IW 8-19 7.0 km 5.5 km 0.81 0.74 0.67 0.59 0.52 0.45 0.38 34 m 0.31 0.24 Gas 0.17 Saturation 0.10

Sequestration Lease area=3670km²

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Quest MMV Plan



Quest Stakeholder Engagement

- Engaged Pembina Institute to help develop stakeholder engagement plan
- Stakeholder engagement program initiated Jan 2010
 - 20 open houses from 2010 through 2015
 - 2 Quest Café's in2011
 - 3 Community coffee sessions in 2014
 - Bi-annual municipal council updates
 - Community Advisory Panel (CAP) started in 2012



YOU'RE INVITED FOR A COFFEE ON SHELL

ELL CANADA QUEST CCS PROJECT - COMMUNITY UPDATE

In 2015, the Queur Cerbon Cognum, B. Storzage project bragon Tojecting architendocide cogniture from our Scofford Upgender into a next solution none than two kilometers underground for permonent strange. Queur will reduce emistions from the Liggender by more than one million stores a year. With injection advecting harded. Statel would like to existe sure any questions you may have are an answered.

We would like to invite you for a coffee on us where Shell representatives will be at hand and available to answer any questions you may have regarding the Quest CCS Project.

Free coffee and baked goods will be available: When: Thursday, January 14, 2016, $1-2;30~{\rm p.m}$ Where: The Comer Store, 102 6 Ave, Tharhild, AB



Quest Costs

Project Capital Costs – Reported in 2015 Annual Report

- Capture \$623 mln CAD
- Transportation \$127 mln CAD
- Storage \$40 mln CAD

Total Capital Cost : \$790 mln CAD

Expected Operating Costs - 2015 Annual Report

- Average \$42 mln CAD / year (incl. TA, Sustaining Capital)
- 2016 costs trending significantly lower



- Reduced venture costs
- Reduced capture costs
- Reduced pipeline/subsurface costs

20-30 % reduction possible



Cost and Revenues

Project Costs

- Capital \$791M million (excl. Feasex)
- Operating \$23 million in first year (No sustaining capital or TA)

Funding Status

- \$6.7 million Alberta Innovates
- \$120 million NRCan Clean Energy Fund
- \$447 million GoA Agreement (Milestones #1 7 and Commercial Operation)
- Total funding to date \$573.7million

Remaining Funding

\$298 million – GoA Agreement based on net tonnes of CO2 sequestered / yearover 10 years

Revenues

Zero revenue in 2011, 2012, 2013, 2014, 2015

CCS Installations Currently Operating

There are currently 15 large-scale CCS project operating globally with another 6 under construction



Source: Global CCS Institute

Climate Change Challenge

Case Study: Desert Sunlight Solar Farm

- Opened in 2015
- Displaces 300,000 tonnes CO₂ per year
- Size: Covers equivalent of 32 WEM (16 km²)
- Cost: \$2 billion USD, aided by \$1.46 billion government loan

Case Study: Quest CCS

- Opened in 2015
- Displaces 1,00,000 tonnes CO₂ per year
- Size: Covers equivalent of Wal-Mart parking lot
- Cost: \$1.35 billion (incl. 10 years operation) aided with governments grants of \$865M

