Carbon Capture and “Saskatchewan”

John Gale
General Manager
IEA Greenhouse Gas R&D Programme
2014 SaskPower CCS symposium
Regina, Saskatchewan, Canada
Long History of joint CCS activity

- IEAGHG has a long association with Canada and Saskatchewan in particular
  - Canada founder member of programme in 1991
    - Saskatchewan Energy and Mines one of the early associate members
  - IEAGHG Weyburn – Midale CO2 monitoring and storage project, started in 2002 and ran to 2012.
    - Broad communication and international co-operation
    - Peer reviews of project outcomes goals and objectives
    - Special seminar at GHGT-11 in Kyoto and Special issue of IJGNC
  - 2000 Regina hosted the seminar that led to the IPCC Special report on CCS being approved, published in 2005
  - 2006 GHGT-6 in Vancouver Canada
    - Partners: National Resources Canada, and University of Regina
The first Boundary Dam CO2 Capture Pilot plant

- Originally built in 1987, upgraded with bag house in 2000
- 4 tonnes/day CO2
- Major Equipment
  - Absorber-18”-64’ high
  - Stripper 16”-59’ high
  - Anderson 2000 SO2 removal Unit
  - 2 million Btu/hr boiler
International Capture Test Centre opened in 1999/2001

- Centre of excellence on post combustion capture based at University of Regina
- Laboratory and pilot facilities – Boundary Dam
- Extensive list of publications
  - Amine based capture; degradation, cost reduction, etc
  - Capture plant flexibility studies
  - Etc., etc.,
- Commercial development with HTC Pure Energy
IEAGHG Weyburn-Midale Project

- First fully monitored CO2-EOR project
- Second major international collaborative storage research project
- Established best practise for monitoring
- Demonstrated fate of CO2 using seismic monitoring
- Demonstrated importance of baseline monitoring
  - Supposed leak from site was disproved based on baseline monitoring
  - New technique by University of Texas based on C isotope analysis showed baseline data not critical
Lets not forget!

- 1st cross border CO2 pipeline
- Impurities present H2S and mercaptans
- Permitted and constructed without issue
- No operational issues reported – continuous supply to Cenovus

350km overland pipeline
Boundary Dam – the first commercial scale CCS demonstration Project
IPCC AR5 WGIII Negativity to CCS

- “Components in use but not applied at large scale!”
  - What about; Sleipner, InSalah, Air products etc etc.,
- “No commercial scale CCS power plant”
  - A fair comment would have been;
  “No commercial scale CCS power plant in operation but several under construction and close to operation”
PCC Scale up

- China building 1GW ultrasupercritical pf boilers in 2010
  - Yuhuan plant at 45% efficiency

- Belchatow, Poland largest lignite fired ultrasupercritical pf boilers at 858MW
  - 42% efficiency

- At appropriate scale for partial capture market in USA
- Need another scale up operation in due course for EU/Asian markets
- Scale up well within chemical engineering norms
Reducing cost is key

- Reducing cost via technology learning/replication

- Experience from other technologies could reduce costs by up to 20%

![Bar chart showing capital cost per unit of capacity across different stages of design and development.](chart.png)
Cost reduction

- Competitive market situation
  - Some 20 technology vendors which is a healthy situation
  - Vendor in China – demonstrated capture costs about 50% lower than US/EU costs

- Technology innovation
  - Key to driving down costs significantly
  - Major research activities underway coupled with scale up testing
Reducing PCC energy penalty and costs

USDOE Carbon Capture Programme

- Develop 2nd-Generation technologies that:
  - Ready for demonstration in the 2020–2025 timeframe
  - Achieve capture costs of approximately $40/tonne of CO2 captured
- Develop Transformational technologies that:
  - Are ready for demonstration in the 2030–2035 timeframe
  - Achieve capture costs of less than $40/tonne of CO2 captured

Source: USDOE/NETL
Next Generation post combustion capture options

- Material improvements such as resistance for impurities present in flue gas
- Lowering material Cost
- Pilot plant testing using real flue gas
- Environmental impact
- Process integration and dynamics
- Suitability in power generation & heavy industries
Scale up of new generation capture technology

International Test Centre Network

Carbon Capture Test Facility

National Carbon Capture Centre

Test Centre Mongstad

International Test Centre Network
Assessing the potential for cost reduction

Note: The extent of the each bar indicates the projected cost reduction for each technology and not the range of expected cost reductions.
Can we go any faster?

- Scaling up capture technology at a rate consistent with good Chemical Engineering practise
- Solved issues with solvent degradation as we have scaled up
- Pipeline scale up not an issue
- CO2-EOR is good for now but we must move beyond that soon
- Availability of geological storage globally is the rate determining step
- Issues re storage could be present challenges along the way
  - Integrity/environmental impacts
  - Induced seismicity – the new public battleground?
Summary

- SaskPower/Saskatchewan have been at the forefront of CCS development for ~15 years
- They will continue in that mode in the future
- They eyes of the world will not move from Saskatchewan for months to come.
- What do we need from you:

A SUCCESSFUL START UP AND DEMONSTRATION

NO PRESSURE MIKE!!!!!
Co-operation continues

Save the Date: PCCC3
Regina, Canada, 8th – 11th September 2015

IEAGHG is proud to announce next PCCC3 conference to be hosted by SaskPower, Saskatchewan, Canada. The conference will build on the success of PCCCs1 and 2 and will focus on current PCC issues, developments and future trends in CO₂ post combustion capture technology. PCCC3 will also host a special session to showcase the first year operation experience from CO₂ capture facility at Boundary Dam. Delegates will also have the opportunity to visit the CO₂ capture facilities at Boundary Dam and Shand Power Stations.

Topics to be covered at PCCC3:

- Amine based solvent development
- Biphasic solvents
- 2nd/3rd generation capture technology
- Capture process modelling
- Process integration & economics
- Process scale up, operational flexibility and risk analysis
- Pilot plant & demonstration projects
- Demonstration project regulatory issues & lessons learnt
- Environmental impacts
- Equipment corrosion issues
- Industrial application

For more information contact: john.gale@ieaghg.org
Or visit our website: www.ieaghg.org

Boundary Dam, Saskatchewan, Canada
Thank you

Contact me at: john.gale@ieaghg.org

Website: www.ieaghg.org
LinkedIn: www.linkedin.com/groups/IEAGHG-4841998
Twitter: https://twitter.com/IEAGHG