SaskPower CCS Global Consortium – Bringing Boundary Dam to the World
Mike Monea, President Carbon Capture and Storage Initiatives
Purpose of Today

A. CCS around the world
B. What SaskPower is doing
C. Sharing the Knowledge
Operational April 2014
World Reliance on Fossil Fuels

By 2030...

- Global demand for power increases 40%
- Green house gas emissions increase 40%
- Fossil fuels expected to account for 80% of world energy production

Source: International Energy Association
World Energy Outlook - OECD/IEA 2009
Regulations Around the World

- 2012: Canada announces regulations on CO₂ emissions (420 tonnes CO₂/GWh)
- On the verge of finalizing CCS regulations for oil and gas industry

- EU Emissions Trade Directive enters 3rd Phase; includes single-EU wide cap
- Expanding to include more industries, refineries, chemical plants, airlines

- 2011: Launched Clean Energy Package to cut 159 million tons of CO2 by 2020
- 2012: Announces agreement to link emissions trading system with EU by 2018

- 2010: Signed the National Climate Change Policy (PNMC) on reducing greenhouse gas emissions into a national law
- Requires Brazil’s mitigation actions be quantifiable and verifiable
"No one technology can be relied upon to balance the triple challenge of... reducing carbon emissions, maintaining supply. . . at an affordable cost"
~ EON
Wind is getting stronger

- Will more than double by 2020
  - 3% in 2013
  - 8% by 2018

- **Intermittent** technology . . . supplies only when it wants to

- Consumers need **24/7**
Growth in Context

Electricity Production in the USA (TWh)

- Hydro
- Nuclear
- Fossil
- Renewables

*Source: US Energy Information Association*
Global Energy Consumption by Source

Cost of Generation

- **Coal w CCS**: $105/\text{MWh}
- **Nuclear**: $87/\text{MWh}
- **Biomass**: $147/\text{MWh}
- **Wind**: $138/\text{MWh}
- **Coal**: $60/\text{MWh}
- **Natural gas**: $79/\text{MWh}

Source: 2010 EPRI, Program on Technology Innovation: *Integrated Generation Technology Options*
• GCCSI identified 75 CCS projects underway in 2012
• 16 are large-scale integrated CCS projects, active or in construction
• 2 off those are on power plants

Image Source: Complements of zeroCO2.no
What SaskPower is Doing

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SaskPower Energy Mix

- 482,000 customers
- 152,000 km of transmission lines
- 4,094 MW generation

2011 GROSS ELECTRICITY SUPPLIED – 21,611 GWh

- Coal 54%
- Gas 19%
- Hydro 21%
- Wind 3%
- Imports 2%
- Other 1%
Economic Feasibility

- A first project of its kind is usually the most expensive

- Cost of $1.24 billion for net 110 MW
  - $240 million provided by the Federal Government

- Feasibility defined as at least meeting the costs of a natural gas plant (combined cycle)
Comparing Costs

BASE LOAD NATURAL GAS COST OF ELECTRICITY

BD3 CLEAN COAL COST OF ELECTRICITY

- CAPITAL INVESTMENT
- FUEL EXPENSE
- O & M
Baseline is cost of new natural gas generation.

BD3 Error Bar Disappears in October
Coal and CCS

According to US Energy Department...

- Coal-fired plants with CCS require 24% - 42% more energy to operate\(^1\)
- Our facility anticipated to be 21%!

1 Reuters, Nov 27, 2012
Cost Breakdown of $1.24 B

- CO₂ Capture: 50%
- Plant Refurbishment: 30%
- Emission Controls Efficiency Upgrades: 20%
Coal Generation in Canada – Projected Trend without CCS

- **Ontario 2010 Voluntary Shutdowns**
- **Ontario Voluntary Shutdowns by 2015**
- **Shutdowns Due to Regulations Begin**
- **4% of Canadian Generation 2025**
- **14% of Canadian Generation**
2012 – Canadian government announced CO₂ regulations

- Limit of 420 tonnes CO₂/GWh (equivalent to natural gas combined cycle)
- Existing units must comply at 50 years of age or shut down
- Effective 2015
- Installed in 1969
- Comprised of 6 units
- Present output 140 MW/s

- Unit 3 emits 1.1 million tonnes CO₂ / year
- Construction of CO₂ and SO₂ capture facility underway
- Refurbished Unit #3 operational Q1, 2014
Status Update

- On time and on budget
- BD3 now offline for retrofit
- Average 450 to 900 workers
- 1,100 person-years of work
- Approximately 60% complete

- Reclaimer
  - 496,400 pounds
  - 81 feet tall
  - 24 feet diameter
1. **Life Extension**
   - Rebuild for 30 more years of operation

2. **Meet New Standards**
   - Reduce green house gas emissions
   - Prepare for new regulations

3. **Competitive Cost**
   - At or below combined cycle natural gas

4. **In-Service Q1 2014**
   - 60% complete
Environment Impacts

1. To keep temperature from rising 2°C by 2050, emissions must drop to 80% of 2000*

2. SaskPower’s CCS facility will capture 90% of emissions (1 million tonnes of CO₂)

3. Equivalent to taking 250,000 cars off the road each year

*Source: UN’s InterGovernmental Panel on Climate Change
Virtual Tour of Boundary Dam
Storage

- Storage is a key part of CCS

- Aquistore is an independent research and monitoring project managed by the Petroleum Technology Research Centre

- Pipeline to site less than 2 km west of the Boundary Dam Power Station.

- BD3 will transport some captured CO$_2$ to Aquistore for testing

- Petroleum Technology Research Centre will monitor the CO$_2$
• Around 30,000 bbl/day: a 35-year high
• 20,000 bbl/d are due to the CO₂ flood

CO₂ stored equivalent to removing more than 8 million cars off the road for a year
Carbon Capture Test Facility

- Located at SaskPower’s 276-MW coal-fired Shand Power Station

- Neutral platform for vendors to verify and improve post-combustion technologies in commercial setting

- Primary test unit CO₂ capture capacity of 120 tonnes per day

- Hitachi Ltd.’s proprietary amine technology will be the first tested
• SaskPower Boundary Dam Integrated Carbon Capture and Storage Demonstration Project

• SaskPower Carbon Capture Test Facility

• International Energy Agency GHG Weyburn-Midale CO₂ Monitoring & Storage Project

• Aquistore Deep Saline CO₂ Storage Project

• Petroleum Technology Research Centre (PTRC)

• International Performance Assessment Centre for Geological Storage of CO₂

• International Test Centre for CO₂ Capture
Bringing Boundary Dam to the World

A. The future of CCS
B. What SaskPower is doing
C. Sharing the Knowledge
SaskPower CCS Global Consortium

- Knowledge platform

- Participants gain access to CCS expertise in:
  - Technology
  - Research
  - Procurement
  - Supplier management
  - Project management
  - Training
  - Regulatory affairs
  - Government relations
Why You Would Join

Cost of Project | $1.2 Billion
- design
- engineering
- construction
- project management

Performance Data
- parasitic load
- cost of electricity
- cost to operate
- revenues from by-products
- operations and maintenance
- projected cost for future builds
SaskPower CCS Global Consortium

Variety of membership options
• Basic
• Intelligence
• Premium

Variety of Membership benefits
• Monthly project reporting
• Annual technical symposiums
• Access to executive summaries and detailed reporting via secure website
• Participation in technical discussion forums
• Participation in forums on other collaborative projects such as the Carbon Capture Test Facility and Aquistore Project
• Annual non-technical presentation to CEOs and Executives
• Best Practices Manual
Info & Planning Symposium

- May 21 – 23
  - Conference
  - Banquet
  - Tour of Boundary Dam, Aquistore

- Areas of Knowledge
  - Find out what knowledge you can access
  - Inform which areas you’re interested in

- Interested . . .
  - If you’d like to attend, visit our website and submit a formal expression of interest
  - www.saskpowerCCSconsortium.com
More Information

www.saskpowerccsconsortium.com

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