Basin Electric Power Cooperative’s Approach to CO2 Capture, Transport and Sequestration Technologies

Fred Stern – DGC Executive Business/Technology Advisor

BASIN ELECTRIC POWER COOPERATIVE

A Touchstone Energy® Cooperative
Climate Change
Coal is ‘King’ of Electrical Generation

- Coal-fired plants account for 50% of US production now
- Projected coal demand increase of 4% per year
- Projected electrical demand increase of 39% by 2030
- By 2030, coal will fuel 57% of US electrical production
Coal’s Image

- Viewed as ‘dirty’ in the past
- Now viewed as the #1 contributor to GHG and global warming
- Regardless of our beliefs, the debate is largely over – the public and policy makers demanding action
- BEPC believes CO2 regulations are imminent
- BEPC believes carbon management techniques are necessary to continue use of coal
• BEPC’s subsidiary, Dakota Gasification, began capturing and sequestering CO2 in 2000

• To date, captured 10 million tons and transported for EOR recovery process at Weyburn and Midale Oil Fields in Saskatchewan, Canada

• DGC expects to capture in excess of 3 million tons CO2 per year

• BEPC’s next step – Pursue a demonstration project to capture CO2 at the Antelope Valley Station and sequester the CO2 by leveraging DGC’s pipeline and knowledge
CO₂ Capture and Sequestration at Dakota Gasification Company
49% Reduction in CO$_2$ Emissions Since 1999!

HOW?
CO₂ Emissions Reduction at DGC’s Synfuels Plant

49% reduction in CO₂ emissions

2000 2007

150,000 cars
CO$_2$ Compressors

- Manufactured by GHH BORSIG (now MAN Turbomaschinen AG).
- Serial Numbers 1 & 2.
• Three 19,500 hp motors
• 55 million scf per day each
• 2700 psig discharge pressure
Compression Challenges

- Mechanical integrity and balancing
- Materials of construction for seals
- Control system
- Interstage cooling
- Contaminants in gas stream
CO$_2$ Pipeline

- 205 miles
- 14” and 12” carbon steel pipe
- MAOP 2700 psig & 2964 psig
- Strategically routed through Williston Basin oil fields
Carbon Dioxide - 153 mmscfd

Used in enhanced oil recovery
Transport Challenges

• Permits for pipeline
• Selection of lubricants and gaskets
• Safety requirements of CO2 transport
• Importance of proper routing and pipeline design
Stack to Storage

Industrial Emissions to Value Creation

CO₂

CO₂
AVS CO2 Capture Demonstration
Project Concept

• Capture about 55 mmscfd of CO2 post combustion

• Treat CO2 at AVS to pipeline quality

• Compress CO2 at AVS or DGC

• Use existing DGC pipeline and operation to transport CO2

• Issued Request for Proposals in June 2007
Capture Technology is Major Hurdle

• Proven capture technology not yet available commercially

• Several companies in various R&D phases

• BEPC seeking to develop partnership or alliance with a promising technology vendor
Technologies to Consider

- MEA (amine) absorption
- Chilled ammonia absorption
- Membrane separation
- Oxy-fuel combustion
- Physical adsorption
- Cryogenics
- At this time, MEA and chilled ammonia are only viable choices
Transport Challenges

• Permits for pipeline
• Selection of lubricants and gaskets
• Safety requirements regarding to CO2
• Importance of proper routing and pipeline design
• DOT requires monitoring of pipeline integrity every 5 years (smart pig)
Vendors Responding to RFP

- Alstom Environmental – chilled ammonia and amine based
- PowerSpan Corp. – chilled ammonia
- HTC Purenergy – amine based
- CanSolv Technologies – amine based
- Mitsubishi Heavy Ind. – amine based
- Fluor – amine based
Challenges

- Additional Sox removal may be required
- Process cooling and heating will be very parasitic
- Water balance issues
- Solvent replacement
- Materials of construction
- High capital and operating costs
- Estimated cost of capture range from $20 to $60 per ton
Cost and Risk Reduction

- With DGC pipeline location, ability to sell additional CO2 for EOR to new customers or existing customers is very good
- Seek DOE funding
- Seek support or participation from State of ND and other area lignite users and producers
- Seek to have the project recognized as a PCOR– Phase III project
Regional Carbon Sequestration Partnerships
Plains Carbon Dioxide Reduction (PCOR) Phase III Project

• Implementation of large volume sequestration tests to demonstrate the safe, effective, and permanent storage of CO2 in different geological formations in North America that could offset 50% of current CO2 emissions in each region for the next 100 years.

• DOE funded

• Funding of up to $67 million for each region
Coal Fields

Evaluated Wyodak–Anderson, Ardley, and Harmon-Hanson coals.

CO₂ sequestration capacity estimated to date: >8 billion tons

17 Tcf of methane potential from ECBM in these seams.

Don’t need supercritical CO₂, and purity of stream isn’t an issue (significant N may be good).
• CO₂ in a deep oil reservoir – CO₂ will be injected into an oil-bearing zone at great depth in the Beaver Lodge oil field.

• Minimum of 3000 tons of CO₂ will be injected during demo period.
CO₂ in an unminable lignite seam – CO₂ will be injected for both CO₂ sequestration and enhanced coalbed methane production.

State of North Dakota is providing surface and mineral rights access; drilling scheduled spring 2007.
Phase III Target Formations

- Saline formations are primary target
- Oil, gas, and coal are secondary—Must be regionally significant
- Representative of the region’s geology—Capacity and availability must be high
- Competent seals are a must
- Structure must be conducive to trapping
Next Steps for AVS CO2 Capture Project

• Complete Review of Six Proposals
• Make a ‘Go’ or ‘No Go’ Decision Based on Economic and Technical Issues
• If Project is a ‘Go’, Select Project Partner in December and Conduct Feasibility and FEED Studies
• Project Could be On-Line in 2011
Summary

• The CO2 capture train has already left the station

• BEPC believes it is only a matter of time until CO2 regulations are enacted

• CO2 capture and sequestering will be costly and proven capture technology is not available

• BEPC is seeking to demonstrate capture technology in an economic manner

• CO2 capture – not a question of who and what, but rather when and how?
Thank you for your kind attention!

Questions ?????