



MEETING THE EMISSION REDUCTION CHALLENGE

Many national and international policymakers, scientists and business leaders are working on ways to mitigate man-made contributions of carbon dioxide to the atmosphere.

The economies of the world and the United States, as well as quality of issues, depend on affordable and reliable energy produced from fossil fuels, of which a significant amount is from coal. New technologies that lead to greater energy efficiency are consistently being discovered. However, technologies to produce electricity from coal while capturing and storing carbon dioxide are still in the developmental stages and may take years before economically feasible and commercially available.

To protect the health of our nation's economy and its national security interests, Partners for Affordable Energy (PAE) and its members believe additional actions to address climate change and reduce carbon dioxide emissions are necessary.

PAE recognizes climate change as a global issue, and supports emission reduction policies that emphasize global solutions. While striving for this global answer, a national approach should be followed rather than a patchwork of regional or state regulations. In our view, a national emission reduction policy should:

- Regulate emissions from all sectors of the economy, not just power plants
- Take precedence over state and local laws and regional compacts
- Give credit for early actions and investments in greenhouse gas mitigation

PAE also strongly supports public and private investment in research and development of new, cost-effective emission reduction technologies. As we explore these new technologies, our energy policy should:

- Make compliance with new regulations contingent on the availability of cost-effective, commercially proven technologies
- Dedicate revenue generated from climate change regulation to continue research and development of clean coal, carbon capture and storage technology

As state and national energy policies begin to address the global climate change challenge, PAE member utilities have taken aggressive voluntary action to reduce emissions in a number of ways, using currently available technology, participating in research and testing of new emission reduction technologies.



CURRENT EMISSION REDUCTION INITIATIVES

There is no cost-effective technology available at present that separates carbon dioxide from other emissions at power plants. Technical experts agree that it may be some time before current research and testing programs yield results that would make carbon dioxide capture techniques available to utilities and their customers at a reasonable cost.

However, this doesn't mean energy companies aren't taking action now. Many utilities are voluntarily using other new, state-of-the-art technologies to reduce carbon dioxide and other greenhouse gas emissions. Here are just a few examples.

CARBON SEQUESTRATION—GREAT PLAINS SYNFUELS PLANT

Every year, about 2.7 million metric tons of carbon dioxide from North Dakota's Great Plains Synfuels Plant (www.dakotagas.com) are captured and transported via pipeline to the oil fields near Weyburn, Saskatchewan, where the gas is stored, or sequestered, in partially depleted underground oil reserves. Approximately 17.4 million metric tons of carbon dioxide have been captured from the Synfuels Plant through 2009.

The carbon dioxide is shipped from the plant outside Beulah, North Dakota, through a 205-mile pipeline to the Weyburn field, where it is used for enhanced oil recovery. It is combined with water and injected into depleting reservoirs, where it displaces oil residue. The resulting mix is pumped to the surface, where the crude oil is separated. The water and CO₂ are recycled back into the reservoir. The permanently sequestered carbon dioxide is monitored by the International Energy Agency Weyburn CO₂ Monitoring and Storage Project.

The 8,500 tons of CO₂ from the Great Plains Synfuels Plant that is injected daily into the oil reservoir near Weyburn, Saskatchewan, is the equivalent of CO₂ emissions from 600,000 cars each day.





CURRENT EMISSION REDUCTION INITIATIVES

CARBON SEQUESTRATION—GREAT PLAINS SYNFUELS PLANT (CONT.)

Oil and gas reservoirs are suitable places for carbon dioxide storage. Because the fossil fuels that originally accumulated in these reservoirs did not escape over geological time, we can expect the same will be true of carbon dioxide. In addition, the geologic structure and physical properties of most oil and gas reservoirs have been characterized extensively, so the availability of existing data can help lower the cost of implementing carbon dioxide sequestration projects.

COAL REFINING—COAL CREEK STATION

Great River Energy's innovative coal-refining technology -- called DryFining™ -- had its first full-scale demonstration in 2008. In Phase I of the project, Great River Energy operated a prototype dryer to remove moisture content from 14 percent of the coal fed to a 546-megawatt unit at Coal Creek Station, near Underwood, ND. Moisture removal allows the coal to burn more efficiently and allows for greater complete combustion. This, in turn, increases efficiency and reduces greenhouse gas emissions.

Great River Energy's coal-refining technology differs from previously considered methods because it does not require burning additional fuel to generate heat. Instead, they have developed a system that captures and re-uses excess heat from the existing generation process. The process also separates particles by density and sorts out high density compounds containing sulfur and mercury. Due to the success of the initial prototype results, Great River commercialized the DryFining™ technology for both of its units. The process became operational in December 2009 and all the lignite used at Coal Creek Station and is resulting in reduced emissions and increased power plant efficiencies.





CURRENT EMISSION REDUCTION INITIATIVES

FLY ASH SALES—COAL CREEK AND STANTON STATIONS

In 2009, Great River Energy sold 360,000 tons of fly ash from its two-unit Coal Creek Station. Fly ash is used across the region in many structures including the Minnesota I-35W bridge built across the Mississippi River in 2008. In 2007, Great River Energy used 75,000 tons of fly ash to build a rail bed out of concrete adjacent to the Coal Creek Station. Using fly ash to replace cement in concrete production decreases carbon dioxide emissions from the production process and also enhances the desirable physical properties of the final concrete product. Every ton of fly ash used in place of cement reduces carbon dioxide emissions by approximately one ton.

Great River Energy also sold 13,000 tons of fly ash in 2009 from its Stanton (ND) Station plant. The fly ash from Stanton Station has different physical properties from the ash produced at Coal Creek Station. It is not used in concrete production, but for beneficial soil stabilization projects. Using ash for soil stabilization and mine fill reduces the need for using natural resources such as clay. Great River Energy used some of its own fly ash in building its new, environmentally friendly headquarters facility in Maple Grove, Minnesota.

Fly ash as a replacement for cement makes concrete stronger, last longer and is easier for finishers. It can be used bridges, sidewalks, curbs, foundations and even homes.



The storage dome collects fly ash from Coal Creek Station in the winter months to meet peak demands during the summer construction season. The beneficial use of fly ash reduces greenhouse gas emissions and the amount of ash disposal at plant site landfills.



THE PROMISE OF NEW TECHNOLOGIES

Researchers and technical experts are investigating a suite of technologies to both capture carbon dioxide and also store it for long periods of time. The focus of this research is to develop new processes for capturing carbon dioxide and to do so less expensively. Capturing CO₂ can occur at three points in the production process: before combustion, with coal gasification technologies; during combustion, which takes place in pure oxygen creating a purer stream of CO₂; and after combustion, where technologies focus on separating the CO₂ from the gas stream.

After the CO₂ is captured, it can be stored in geological formations, including unminable coal seams, hydro-carbon bearing formations and saline formation reservoirs. However, field tests are needed to develop the expertise and gain real-world experience.

COAL GASIFICATION—U.S. DEPARTMENT OF ENERGY

Coal gasification with carbon capture and sequestration is widely regarded as one of the most promising technologies for meeting future environmental challenges, especially with respect to carbon dioxide.

North Dakota lignite coal producers (www.lignite.com) undertook a joint project with the U.S. Department of Energy to test whether a generating process that converts coal into gas would produce greater efficiencies with fewer emissions than conventional pulverized coal generation technologies currently used by most power plants in North Dakota and Minnesota. The tests confirmed that lignite could be successfully gasified and that the process produced acceptable gas heating values and very good carbon conversion.



Lignite from both the Falkirk and Freedom Mines has been tested at this Power Systems Development Facility in Alabama using a coal gasification process that would increase efficiencies and reduce emissions.



THE PROMISE OF NEW TECHNOLOGIES

COAL GASIFICATION—U.S. DEPARTMENT OF ENERGY (CONT.)

Since 2003, more tests have been conducted with equally encouraging results. In 2007, about 800 tons of North Dakota lignite were shipped from the Freedom Mine near Beulah, North Dakota, to Alabama. A major difference between this test and others was the introduction of Kaolinite sorbent material along with the lignite. Testing lignite in gasification technologies is important as new plants might use this type of coal conversion process because it more readily allows for the capture of carbon dioxide.

CARBON REDUCTION—CANADIAN CLEAN POWER COALITION

North Dakota lignite producers have joined forces with Canadian public and private stakeholders to work on clean coal generation technologies that include CO₂ reduction strategies. The Canadian Clean Power Coalition (www.canadiancleanpowercoalition.com) is conducting research on clean coal technologies such as coal gasification and post-combustion CO₂ separation. The Lignite Energy Council has joined the coalition to support its research into gasification, advanced combustion and retrofit carbon dioxide capture technology.

Canada, like the United States, is heavily dependent on coal, and both nations have huge coal reserves, so there is shared interest in developing new clean coal technologies. Since Canada accepted the Kyoto Treaty, utilities there are under special pressure to develop and employ new emission reduction technologies. Although the U.S. Senate voted not to sign the Kyoto Treaty, many utilities in Minnesota and North Dakota are voluntarily pursuing CO₂ reduction strategies.

By participating in the CCPC, lignite industry members will contribute to and have access to the results of the coalition's research, enabling regional utilities to integrate the new data into existing operations to further reduce CO₂ emissions.



THE PROMISE OF NEW TECHNOLOGIES

CARBON CAPTURE—BASIN ELECTRIC

Basin Electric Power Cooperative is conducting a Front-End Engineering and Design (FEED) study to evaluate a demonstration project that would capture carbon dioxide at the Antelope Valley Station, a lignite-based power plant at Beulah, ND. The carbon dioxide captured by the demonstration project would be injected into Dakota Gasification Company's Great Plains Synfuels Plant's existing carbon dioxide pipeline system. It is hoped that the project will lead to a commercially viable, cost-effective carbon capture system that can be used by conventional coal-based power plants.

Basin Electric chose a technology provider after evaluating technical feasibility, commercial feasibility, financial strength, participation of the technology provider, project business model, contracting approach and environmental considerations.

The concept is that exhaust gases from the Antelope Valley Station go through a carbon dioxide capture system before exiting the plant. The captured carbon dioxide would then be delivered by pipe to the adjacent Great Plains Synfuels Plant and injected into a 205-mile pipeline system. The proximity of Antelope Valley to the Synfuels Plant provides the advantage for the demonstration project at this location.



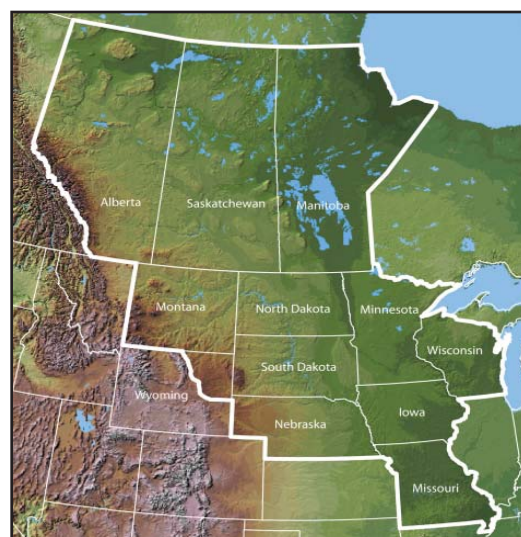
Basin Electric Power Cooperative's Antelope Valley Station has launched an effort to demonstrate carbon dioxide capture.



THE PROMISE OF NEW TECHNOLOGIES

CARBON REDUCTION—PLAINS PARTNERSHIP

The Plains CO₂ Reduction Partnership (PCOR) is comprised of more than 70 diverse public and private stakeholders (www.undeerc.org), including PAE members Basin Electric Power Cooperative, BNI Coal, Ltd., Great River Energy, Minnkota Power Cooperative, Minnesota Power, Montana-Dakota Utilities Co., North American Coal Corporation, Otter Tail Power Company and Westmoreland Coal Company. PCOR is working to identify cost-effective carbon sequestration (capture and storage) systems for the partnership region. The PCOR region includes Minnesota and eight other states, plus four Canadian provinces. There are six other such partnerships in the nation, all funded by the participating partners and the U.S. Department of Energy's Regional Carbon Sequestration Partnership Program.



More than 80 diverse stakeholders, including regional electrical utilities and mining companies, belong to the Plains CO₂ Reduction Partnership, which is one of seven regional carbon sequestration partnerships funded by project partners and the U.S. Department of Energy.

Phase I of the PCOR program focused on characterizing the major carbon dioxide sources and sites with potential for CO₂ sequestration. Phase II featured several sequestration field projects that developed the real-world experience and business models needed to implement major, full-scale long-term carbon sequestration projects in the region. These full-scale projects demonstrated the options to store the carbon at the earth's surface or store carbon dioxide gas in zones located deep underground.

In late 2007, the PCOR Partnership was selected by the U.S. Department of Energy for a 10-year, multimillion-dollar Phase III program focused on actual implementation of a commercial-scale geologic carbon sequestration demonstration project in the region. The program will be managed by the Energy and Environmental Research Center in Grand Forks, North Dakota, and will feature at least two commercial-scale demonstration activities.