

## TECHNOLOGY BREAKTHROUGH PAPER

FEBRUARY 2008

COAL DRYING

### OVERVIEW:



GREAT RIVER  
ENERGY®

A Teichert Energy Cooperative

Great River Energy (GRE) in collaboration with its partners and as part of The Office of Fossil Energy's Clean Coal Power Initiative is undertaking an award winning coal drying process which increases efficiency and reduces emissions from high moisture coal feedstock used in power plants. The project is being conducted at Great River Energy's Coal Creek Station in Underwood, North Dakota. The Coal Creek Station project uses waste heat from the power plant as a drying agent to lower the moisture content of the lignite feedstock, which typically has up to 40 percent moisture. The reduction in moisture content of coal effectively allows the power plant to extract the same amount of energy from less coal, thereby reducing the emissions of mercury, sulfur oxides, nitrogen oxides, carbon dioxide and particulates.

### THE MARKET, ENVIRONMENTAL AND ECONOMIC BENEFITS:

In the United States alone, 279 power facilities burn high moisture coals such as lignite and Powder River Basin (PRB) subbituminous coal. Together these plants produce nearly a third of the coal fired electric generation in the United States<sup>1</sup>. It is also anticipated that over the next 20 years coal will continue to be one of the primary feedstock materials for electric generation in the U.S. Currently 52% percent of the United State's coal production is lignite or subbituminous<sup>2</sup>. Early projections showed that Lignite coal used at the Coal Creek Station project with a moisture content of nearly 40% could be reduced 10 percentage points with an



Great River Energy's Coal Creek Station -  
Underwood, North Dakota

estimated 2.8 percent to 5 percent efficiency improvement<sup>3</sup>. By one estimate, if this coal drying technology was installed on existing U.S. power facilities that produce over 10 gigawatts of electric power, the resulting annual emissions savings would be nearly 7,000 tons of nitrogen oxides, 18,000 tons of sulfur dioxide, more than 7 million tons of carbon dioxide, more than 9,000 tons of particulates, and nearly 300 pounds of mercury<sup>1</sup>. For lignite, PRB and other high moisture coal fired power plants, the coal drying process also increases their competitive position in relation to other power generation units.

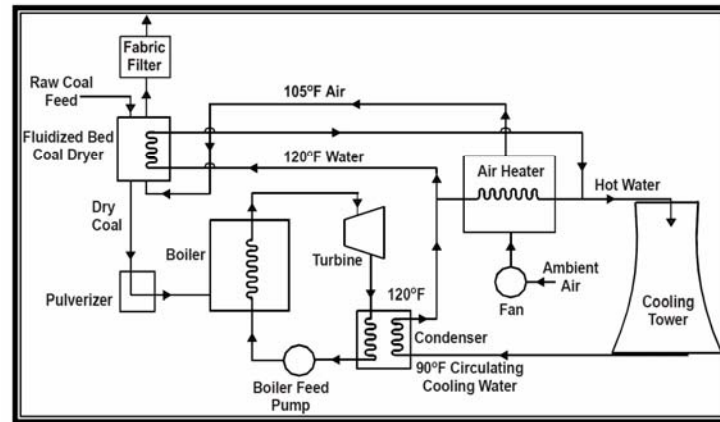
In addition to the benefits of improved efficiency and emissions reductions there are significant economic benefits. According to Edward Levy of Lehigh University cost benefit analysis concluded that the return on investment was also positive. By considering the costs of installation of equipment, operation and maintenance, increases or reductions in service power in comparison to savings from reduction in fuel costs, ash disposal costs, credits taken from emissions savings and savings in reduced maintenance costs, Levy found that the cost effectiveness of the technology increased as the moisture in the coal decreased with a break even point around 16% moisture reduction<sup>4</sup>. Levy emphasized that costs savings would depend on site specific factors including differences between retrofit applications versus new plant design.

## **THE PROCESS:**

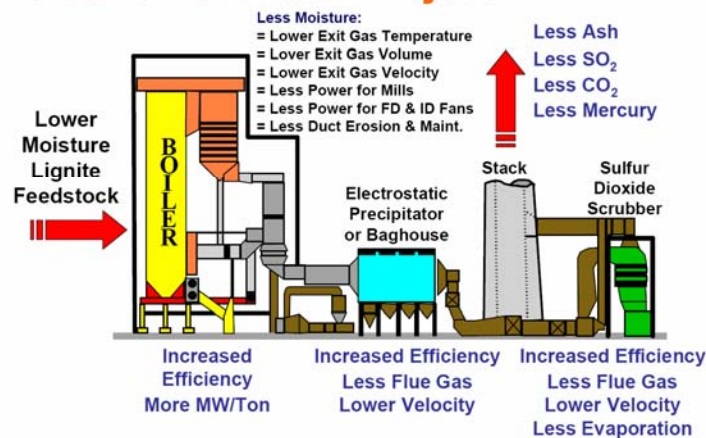
The GRE coal drying process is relatively simple in concept. High moisture coal has always been known to yield lower power efficiencies and higher emissions however, the cost to dry coal has been prohibitive because of the expense to generate the drying heat. GRE's innovative process effectively reduces the cost to dry high moisture coal by utilizing heat recovery. In the GRE system, heat that is normally discharged during the electric generation process is recovered and fed into a fluidized bed coal dryer. The recovered heat can work to dry high moisture lignite or PRB coals. The moist air is then discharged and the dried coal is fed back into the power generation process. GRE avoids spontaneous combustion problems of high moisture coals by inserting the drying process into the overall coal preparation process for electric generation. Great River has been testing one, in-situ 75 ton per hour Prototype since January of 2006. Design and installation of four commercial scale demonstration dryers for Unit#2 is currently underway. Four Unit#1 dryers are also being fabricated.

For a more detail click here - [http://www.lehigh.edu/~inen/research/EPG\\_electricpowergen.htm](http://www.lehigh.edu/~inen/research/EPG_electricpowergen.htm)

### Conceptual Diagram of Unit with Coal Drying System



### Lignite Fuel Enhancement: Incremental Moisture Reduction Project



### HISTORY AND DEVELOPMENT STATUS:

The preliminary studies and concept development for the coal drying technology began in 1997. Over the next four years testing and modeling proved that the process had great potential for cost effective efficiency benefits to high moisture coals. In 2003 the Department of Energy (DOE) awarded GRE an \$11 Million

cooperative agreement as part of their Clean Coal Initiative to help fund a large scale coal drying facility at their Coal Creek Power Station in Underwood, North Dakota. However, realizing the potential of the project early in the planning process GRE asked for and received a schedule extension and budget extension to \$13.5 Million from DOE so that they could integrate a common coal system into the construction planning for a dryer on Unit#1 module in parallel with the already planned Unit#2 commercial demonstration dryer. In 2005 construction began on the prototype facility and by 2006 performance testing was underway. By August 2006, GRE had successfully reached their phase 1 milestone and began the phase 2 process for a full scale commercial demonstration drying system on Unit#2 and extension to Unit#1 drying. In May 2007 construction began on new commercial demonstration dryer modules to fully power the Unit#2, 546 MW station. Data gathered from this unit will be used to help measure plant performance and determine the optimal operating conditions for the drying process. Construction of both Unit#1 and Unit#2 dryers is scheduled to be completed March 2009. As of November 2007, concrete foundations had been poured and the construction process is on schedule for completion.

[For More Information Visit](#) -

[http://www.netl.doe.gov/technologies/coalpower/cctc/ccpi/bibliography/demonstration/coal-processing/ccpi\\_lignite.html](http://www.netl.doe.gov/technologies/coalpower/cctc/ccpi/bibliography/demonstration/coal-processing/ccpi_lignite.html)

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#### **PARTNERS:**

- Great River Energy (GRE) - <http://www.greatriverenergy.com/>
- The Office of Fossil Energy's Clean Coal Power Initiative - <http://www.fossil.energy.gov/programs/powersystems/cleancoal/>
- Electric Power Research Institute (EPRI) - [www.epri.com](http://www.epri.com)
- Heyl & Patterson - <http://www.heylpatterson.com/>
- Lehigh University - <http://www.lehigh.edu/~inenr/research/researchactivities.htm>
- Barr Engineering - [www.barr.com](http://www.barr.com)

- Falkirk Mining Company - <http://www.nacoal.com/index.html>

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**REFERENCES:**

- 1 [http://www.netl.doe.gov/publications/press/2007/07049-GRE\\_Technology\\_Success.html](http://www.netl.doe.gov/publications/press/2007/07049-GRE_Technology_Success.html)
- 2 <http://www.eia.doe.gov/cneaf/coal/page/acr/table6.pdf>
- 3 <http://www.netl.doe.gov/publications/factsheets/project/Proj219.pdf>
- 4 [http://www.lehigh.edu/~inenr/research/EPG\\_electricpowergen.htm](http://www.lehigh.edu/~inenr/research/EPG_electricpowergen.htm)