Biomass co-firing: Feasibility studies for low-rank coal and district energy cogeneration

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Through funding from the Biomass Cofiring Program of the Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy, administered by the National Energy Technology Laboratory, the Energy & Environmental Research Center (EERC) at the University of North Dakota (UND) is completing two feasibility studies involving low-rank coal. These studies address two primary areas of cofiring research: demonstrating applications of lignite coal and biomass cofiring and promoting cofiring at colleges and universities through feasibility studies. The EERC has teamed with two North Dakota State institutions: UND and the North Dakota State Penitentiary (NDSP).

DOE has, in the past, cooperated with power producers to test and analyze biomass cofiring in coal-fired boilers that use bituminous and some subbituminous coals. However, the program has not tested cofiring biomass in a lignite-fired boiler or extensively demonstrated subbituminous coals. The United States has a significant resource base of low-rank coal, with a major lignite resource base in North Dakota. Cofiring lignite with biomass can be significantly different than cofiring subbituminous or bituminous coals because of the ash chemistry, moisture content, and other factors. A potentially attractive feature of cofiring biomass with lignite is that the boilers are designed for a fuel with a low heating value and high moisture content that is consistent with the properties of biomass. The EERC is conducting experimental research to determine the effects of cofiring biomass with lignite specifically targeted at stoker and utility-scale systems. The EERC has teamed with NDSP and the North Dakota Division of Community Services (DCS) to demonstrate cofiring biomass with lignite coal for cogeneration in a stoker owned by the penitentiary.

Universities throughout the United States generally have existing infrastructure and small combustion systems that could utilize local biomass resources. Although cofiring at the utility scale can consume large amounts of biomass, there are a limited number of existing facilities that are located near large biomass resources. Generally, most large power plants are located in remote areas away from urban centers, which may generate significant quantities of useable biomass. As reported, biomass can become more expensive than coal when transported long distances. Because of these economic factors, it makes cofiring at electric utilities unfeasible. Thus, smaller facilities requiring smaller quantities of biomass located closer to useable biomass resources may have an advantage. Additionally, most smaller-scale facilities pay more for their fuel, thereby creating a larger economic incentive to evaluate alternative fuel options. Potential markets include stokers (paying upwards of twice the cost of coal than a large-scale utility) and fluidized-bed combustors that are utilized by colleges and universities throughout the United States. The size of these units may permit the useage of biomass because of the relatively high fuel cost and location within a reasonable transportation distance, thus allowing more to be spent on obtaining and transporting more centrally located biomass. The EERC has teamed with UND and DCS to complete a feasibility study for UND to investigate cofiring biomass with low-rank subbituminous coal.

Both projects began in October 2000 and are due to be completed in September 2001. Final project results will be presented at the conference. The task structure for both projects is as follows:

- Task 1 – Resource Assessment
- Task 2 – Fuel-Handling Issues

- Task 3 – Fireside Issues
- Task 4 – Environmental and Energy Production Investigations
- Task 5 – Engineering Economic Evaluation

In addition, for NDSP, laboratory testing and modeling of fuel blends will be completed, and a follow-on full-scale demonstration with DOE support is expected.

North Dakota State Penitentiary Cofiring and Cogeneration Using Municipal Wood and Lignite Coal

Through this unique effort, NDSP, located in Bismarck, North Dakota, may be able to reduce overall facility operating costs on the order of $200,000 per year. Results from the resource assessment have identified a minimum of 7500 tons/yr of municipal wood residue currently being landfilled. Meetings with fuel suppliers suggest that there is potentially three times this quantity actually available within 20 miles of the site. NDSP would convert from a 2800-ton/yr, 7-month lignite-fired operation to a year-round biomass-cofired cogeneration facility. Research data relative to combustion ash properties of various cofired blends will be generated and presented with respect to NDSP stoker and utility applications. Considering the monetary value of environmental costs associated with clean air and landfilling, the benefit of the proposed project is estimated at $854,000 annually. Preliminary economic targets are an investment of $1,500,000, generating 650 kW, firing 10,000 tons/yr of biomass, and obtaining a 15% to 25% return on investment. This project should benefit taxpayers, provide economic growth (waste haulers avoid a $10/ton tipping fee), reduce landfill burden, increase energy use efficiency, reduce pollution, and continue the application of local lignite resources.

University of North Dakota Cofiring Using Biomass and Subbituminous Coal

UND, located in Grand Forks, North Dakota, operates a steam facility that currently fires 50,000 tons/yr of subbituminous coal, providing 75,000 Btu/hr of 130-psig saturated steam to the campus. A recently completed resource assessment has identified several very promising biomass fuels, including sunflower hulls, turkey manure, sawdust, and municipal wood. The most significant resources in terms of quantity are sunflower hulls and sawdust at over 50,000 tons/year each. Turkey manure and municipal wood are available at less than 50% of UND's total consumption. Most likely, UND will choose to fire sunflower hulls or sawdust based on delivered costs in the $15 to $25/ton range (Coal $30/ton). Municipal wood presents fuel preparation and handling difficulties, and turkey manure, despite the attractive low cost, presents odor control issues. UND will be completing a test burn of sunflower hulls and sawdust under this program. Data will be collected concerning handling issues and combustion performance, which could affect the percentage of biomass cofired. The economic target is to achieve a 25% return on investment. The final analysis will be presented at the conference. A potential case for UND could be cofiring sunflower hulls at 50%, with a $500,000 investment, generating $125,000 per year in fuel cost savings.