

## Coal-to-Biomass Cofiring at the Boardman Pulverized Coal Plant

Cofiring biomass with pulverized coal is a feasible candidate for CO<sub>2</sub> mitigation. This analysis examines the economic and fuel supply feasibility to co-fire up to 5% of Boardman's capacity. The Boardman plant is a pulverized coal boiler with a nameplate capacity of 560 MW that entered into service in 1980. Cofiring 5% biomass at Boardman would equate to approximately 28 MW<sub>e</sub> biomass capacity. This cofiring rate would result in the reduction of approximately 223 thousand metric tons of CO<sub>2</sub> per year.

Because the project utilizes the existing boiler system, no new capital outlay for a biomass boilers is required. However, retrofitting a pulverized coal boiler to handle more than 1-2% biomass on an energy basis requires a separate injection port into the boiler for the biomass. While retrofitting a pulverized coal boiler is more expensive than retrofitting other boiler types, NREL notes it has been done successfully; "Biomass cofiring has been successfully demonstrated in nearly all coalfired boiler types and configurations, including stokers, fluidized beds, pulverized coal boilers, and cyclones." (NREL/FEMP, 2004). Another added cost to pulverized cofiring is additional treatment of the feedstock to make it suitable for injection into the boiler. The feedstock for a pulverized coal biomass cofiring system needs to be ¼" in diameter or less (Demeter, et al, 2003). Other demonstration projects have double ground the biomass to reduce it to the required diameter and improve the firing characteristics in the pulverized coal boiler.<sup>1</sup>

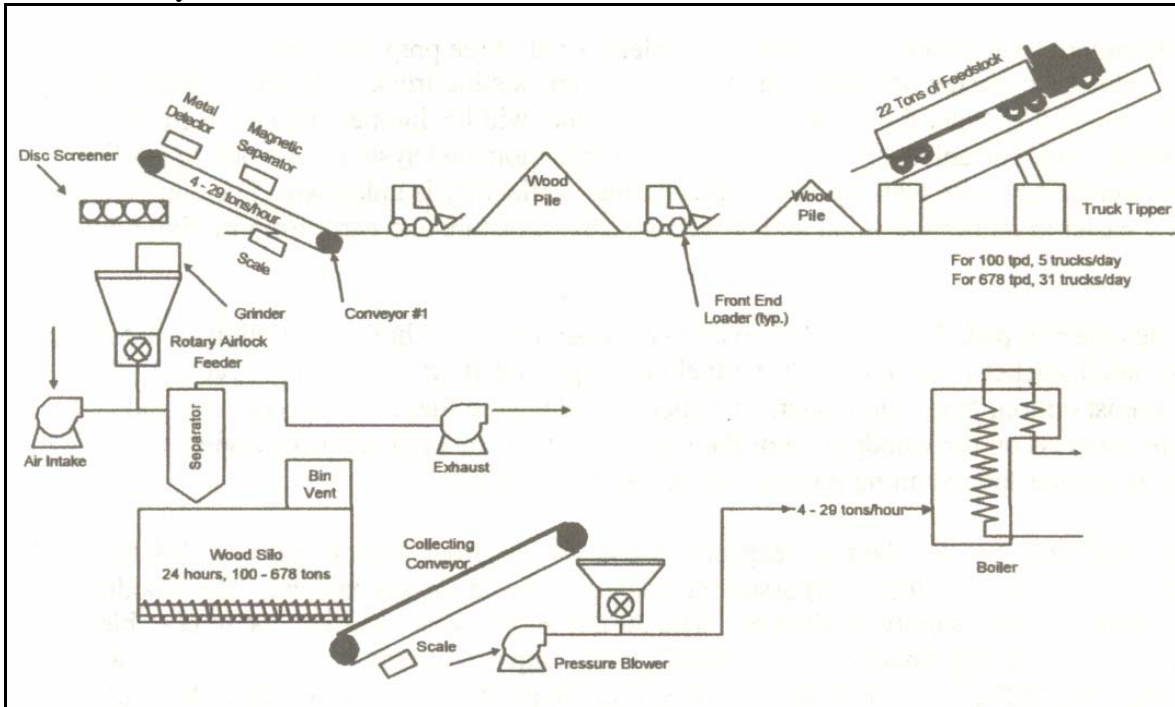
The two biggest hurdles to developing biomass cofiring are securing adequate and cost effective feedstocks, as well as developing a biomass preparation yard that can handle the volume of biomass required to meet the renewables target. Biomass resources typically have significantly higher moisture contents than coal which reduces their effective heating value and thus increases the quantity of fuel required for a given renewables target. Biomass also takes up much more volume for a given energy value; the biomass fuels examined here have an average bulk density of 15 lb/ft<sup>3</sup> compared to sub bituminous coal with a bulk density of 80 lb/ft<sup>3</sup>. The combination of these two factors means that the preparation yard needs to handle significant quantities of fuel. To replace 5% of Boardman's coal generation with biomass requires over 50% of the coal fuel handling capacity on a bulk basis. Because of the fuel handling requirements, the prep yard represents the major capital outlay for a biomass cofiring project. The prep yard consists of front end loaders, conveyors, screeners, grinders, and storage facilities to process the material. Capital costs for a large prep yard (15 MW) range from \$67 - \$400 / kW per year (\$ 2005 from Demeter et al, 2003).

The other primary cost of fuel handling component are additional labor and supplemental inputs to operate the system. The sum of these costs range from \$160-365 / kW per year for a 15 MW system. The Boardman project would most likely come in on the low end

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<sup>1</sup> <http://www.treepower.org/cofiring/main.html>

of this range since it is significantly larger than the 15 MW project analyzed in the Demeter study.



Source: Demeter et al (2003)

The other significant cost component to biomass cofiring is fuel costs. Boardman has several potentially advantageous fuel supplies nearby. One potential source is the Potlach hybrid poplar farm that has significant quantities of waste wood. Potlach harvests 1000-1200 green tons of poplar a day, of which 20-25% is waste wood. This amount of waste could represent a 1-2% cofire depending on how it is dried. Potlach is expected to develop a finishing mill near the farm which could further increase the supply of wood waste.<sup>2</sup> The other potential sources of supply for Boardman are agricultural crop residues and dedicated energy crops such as switchgrass. There is plenty of marginal land near Boardman that could be converted to energy crops. The use of agricultural residues is also feasible given the dominant position agriculture plays in Morrow County's economy. A more detailed assessment of the costs and supply of these fuels needs to be undertaken in order to better understand the potential cost structures for this project.<sup>3</sup>

Ensuring an adequate supply of feedstocks is an integral part of the project. A 5% cofire would require approximately 700 tons of biomass fuel per day. Given that the waste

<sup>2</sup><http://www.oregonlive.com/environment/oregonian/index.ssf?/base/news/114075156295510.xml&coll=7>

<sup>3</sup> A dedicated energy crop or residue collection program in Morrow County might be able to utilize rural development funds for distressed areas. Morrow County is categorized as a distressed county with a distress index of .83 (<http://www.econ.state.or.us/distlist.htm>). Economic development grants could offset part of the initial capital outlays for the prep yard. A 5% cofiring project could create 15 jobs just at the prep yard, depending on the amount of capital versus labor employed. Additional jobs would be created for hauling the biomass, as well as even a greater number of jobs that could be generated by growing switchgrass or collecting agricultural residues.

wood from the Potlach farm represents only a 1-2% cofiring rate, other sources of fuel would need to be secured. The cost of virgin poplar is likely to be too high (\$4.00/MMBTU) to make the project economical, so energy crops and agricultural residues would need to be secured to meet the GHG reduction target. For agricultural residues to be cost effective, they need to be available within a 25 mile radius of the Boardman plant. Given the proximity of the plant to the Columbia River, it is possible that residues could be barged in at a lower cost than traditional diesel transport and this could expand the radius of cost effective feedstocks. More research on the availability of agricultural residues needs to be done, but given the large volume of fuel necessary for the target, it is likely that *dedicated energy crops would need to be grown around the plant for any large scale biomass cofiring* at Boardman.

The total levelized cost for the cofiring portion of the project depends on two factors; the type of fuel secured and the availability of tax credits. If the Renewable Energy Production Tax Credit is extended to the project period could significantly reduce the costs of biomass power. The tax credit includes \$9/MWh for open loop biomass like crop residues and \$19/MWh for closed loop fuels dedicated to power use such as energy crops.

The costs of the fuel are dependent on their availability as indicated above. This analysis assumes that poplar residues are the cheapest feedstock, but its supply is limited to 15% on a BTU basis. The fuel mixture is shown below along with costs and moisture contents used in the analysis. The medium capital cost estimates for a large capacity project from Demeter et al (2003) are employed.

	Fuel Ratio	Moisture Content	Fuel Cost
Untreated hybrid poplar	30%	15%	\$ 3.96
Poplar residues	15%	30%	\$ 1.27
Energy Crops	40%	30%	\$ 1.06
Agricultural residue	15%	15%	\$ 2.59

The estimated net cost of electricity from coal and biomass are \$33.60 and \$46.15 respectively. Given the relative emissions ratio using the above costs, the cost per metric ton of CO<sub>2</sub> reductions for the project is approximately \$13.

## References

Demeter, C.P.; Knowles, D.F.; Olmstead, J.; Jerla, M.; Shah, P. (2003). *Assessment Of Power Production At Rural Utilities Using Forest Thinnings And Commercially-Available Biomass Power Technologies*. Antares Group, Inc: Landover, MD.

NREL/FEMP (2004). *Biomass Cofiring in Coal-Fired Boilers. Federal Energy Management Program (FEMP) Federal Technology Alert*. June. DOE/EE-0288.