WOOD to ENERGY

Fact Sheet

Using Wood Fuels in Existing Coal-Fired Power Plants

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As communities seek new solutions to the challenges of providing electricity that is both economically and environmentally responsible, they might consider using wood. Rather than constructing a new power plant or designing a facility that uses only wood, some coal-fired power plants may be able to supplement their fuel with locally available wood. There are several advantages to this approach that include keeping money spent on energy in the community and using wood as a cost-effective way to provide green power, reduce greenhouse gas emissions, and improve other emissions. Whether a power plant is a good candidate for using wood fuels depends on several factors: the cost of the wood, the permits needed to allow the use of wood, and the re-engineering needed in order for the facility to be able to use wood, among other things.

Fuel Cost

A typical coal-fired power plant is relatively large and can usually use as much wood as is locally available (Table 1). Some permits or other factors, however, may limit the amount of wood that can be burned. Usually up to 5 percent of the fuel used by a power plant can be wood when both fuels are fed together into the boiler.

Because fuel costs can account for roughly 70 percent of a utility's operating cost, this change is an important consideration for a utility. Fuel values are normally measured by utilities in dollars per million British thermal units (Btu). Utility companies currently pay between $2 and $3 per million Btu for coal, depending on the geographic location and the distance coal is shipped and the quality of the coal. At $2 per million Btu, coal costs are about $48 per ton. The same amount of energy produced from wood could cost about $34 per dry ton or $17 per green ton. The cost of wood will depend upon the source, availability, and location.

As a rule, one dry ton per hour or two green tons per hour of wood fuel can generate one megawatt (MW) of electricity. In practice, a dry ton means the wood has less than 10 percent moisture content. A green ton of wood contains more than 10 percent and usually refers to freshly harvested wood that has 40 to 50 percent moisture content.

Table 1. *Amount of Wood That Can Be Used for Commingling with Coal*

Net generating unit size, in megawatts (MW)	5 percent wood use, in green tons/day	Number of truckloads per day at 25 tons/truck
100	240	10
150	360	15
200	480	20
250	600	24
500	1,200	48

Permitting

Permits are also a factor when a utility is trying to decide whether or not to use wood fuels. Many facilities currently operate under permits that were grandfathered in when environmental regulations were strengthened. As long as they continue to operate as dictated by the original permit, they are not required to upgrade the facility. Such permits often limit the types of fuels they are allowed to burn. If changing the fuel requires a new permit, the utility may be required to comply with a variety of other new regulations. If these changes impose a significant financial burden on the utility, the leadership may not want to seek a new permit. Newer facilities that are already in compliance may be more likely to go through the permitting process because they already meet the current requirements.

Changes to the Facility

A number of changes to facility operations and physical structure may be necessary for a coal-burning power plant to also burn wood. For example, a coal-burning facility may have a contract to sell the coal-ash for making roads and concrete. When wood is burned with coal, however, the ash will not meet the specifications for that contract. Neither could it be disposed as pure wood ash since it contains undesirable substances from the coal. Thus the power plant would need to accommodate additional disposal costs for the ash or seek a new market.

In addition, burning a mixture of wood and coal may require changing the air emissions controls on the facility. Wood fuels may be high in potassium and sodium alkali metals (K_2O and Na_2O), two nutrients that are used by the tree for growth and are typically present in smaller quantities in coal. If these metals are present, they may interfere with the chemical process in the emission system that controls nitrogen oxide emissions from the coal.

Metals in wood ash are also a problem because they melt at relatively low temperatures and can form a hard coating on nearby surfaces. Facilities usually limit wood to 5 percent of the total fuel to avoid this problem. If the hard coating accumulates it can reduce the efficiency of the boiler. Cleaning the system then requires a temporary shutdown of the power plant, which is costly and undesirable.

Another consideration for retrofitting a facility is the wood handling. The physical space required to unload, store, and process wood fuels is significant. Wood has less energy per unit of volume than coal, so a bigger pile is needed to store the same amount of energy. A two-week supply of green wood to supply 5 percent of the fuel for a 500 MW coal-fired power plant would require a 2.6-acre pile, 30 feet high.

Most utilities receive coal by train. Since there are few railroads in the forests, virtually all wood must be transported by truck to a loading area or the utility. A utility may need to consider if the existing road system can accommodate the increased truck traffic that would occur.

Finally, the utility boiler may need some adaptation to utilize wood fuel. Most coal-fired power plants first pulverize coal to talcum-powder consistency and blow it into the boiler. A utility may commingle the wood with the coal in the storage pile, pulverize them together, and blow the mixture into the boiler. This system is effective only for small amounts of wood (less than 7 percent) because wood fibers are harder to pulverize than coal and the lighter wood particles tend to separate from the coal when they are blown through the pipes into the boiler. If the wood is pulverized and fed into the boiler separately, there is less constraint on the amount of wood that can be burned. However, this co-firing system has two disadvantages: increased costs due to the investment in two separate systems of grinding and blowing the fuel and reduced boiler efficiency due to the ash deposits from burning larger amounts of wood.

Two other options for adding wood to a coal-fired power plant involve converting the wood to a different type of fuel. With the addition of a wood gasifier, a utility could gasify the wood at the power plant and then feed the gas into the coal boiler's firebox. Alternatively, small satellite plants near the forest could convert wood to BioOil, a wood distillate product. The high-energy liquid would then be transported to the power plant (requiring fewer trucks than needed for wood) and injected directly into the boiler. These two systems would eliminate the issues related to wood ash since the wood is not burned directly in the boiler.

The term BioOil is used by the fast pyrolysis industry to differentiate the high quality, lightweight liquid product made by fast pyrolysis processes from the thick, viscous liquids produced by slow pyrolysis processes.

Summary

Across the South, coal-fired power plant operators are looking at the possibility of adding wood to their system so they can utilize carbon-neutral and locally available energy sources. For a utility to be able to use wood it would need to do the following: identify a source of nearby fuel that is economically competitive with coal, obtain the permits required to change the fuel source with little adaptation of the facility, and adapt the boiler to either co-fire wood with coal or convert the wood to oil or gas first. Utilities that choose to co-fire solid or gasified wood will need space to unload, store, and convey the wood and a combustion system that does not lead to metal deposits or air emission problems.

Several coal-fired power plants in the South have already made the switch to incorporate wood, and others are considering the opportunity. The Tennessee Valley Authority, Southern Company Services, Excel Energy, and other utilities co-fire with wood.

For more information about using wood to produce energy, visit http://www.interfacesouth.org/woodybiomass and read other fact sheets from this program, or http://www.forestbioenergy.net/ to access a number of other resources.

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