Source: Chris Standiford, NREL

Biomass Fuel Foibles

Fuel-supply risks stunt the growth of biomass power.

By Elizabeth Striano

Biomass has enormous potential as a renewable source of power in the United States, and it might be poised for explosive growth.

Burning biomass fuel—either in stand-alone plants or in co-firing with other solid fuels—can help utilities meet state renewable portfolio standards (RPS), while reducing greenhouse-gas emissions. Biomass is a particularly attractive option for meeting RPS mandates, because it produces power reliably and consistently, at relatively competitive rates—7 to 9 cents a kilowatt-hour.

Whether utilities are prepared to jump into the biomass game, however, depends on how effectively they can manage fuel risks.

"There is no such thing as a long-term fuel contract in the biomass business," says Bill Carlson, once the operator of several biomass plants, and now an independent consultant and chairman of the USA Biomass Power Producers Alliance.

Most sources of biomass fuel will not make a commitment to deliver a certain quantity or type of fuel because fuel supply is not their core business. "They'll sign a contract that says, 'I'll sell you all I have at a certain price,'" Carlson says. "But they won't guarantee any quantity over time, because they really can't."

Source: NREL

Success in the biomass market requires flexibility and creativity in selecting fuels, developing supplier relationships and designing plants to operate competitively over the long term.

Growth Market

U.S. utilities increasingly are seeking power supplies from all different kinds of renewable fuels. RPS and supporting policies are driving this increasing interest in many states.

"The RPS definitely is adding fuel to the fire of biomass," says Jeff Bodington, principal of San Francisco-based investment advisory firm Bodington & Co. "We see interest in biomass even in states that don't have RPS."

Biomass is the single largest source of renewable electricity after hydropower in the United States. The DOE estimates the potential biomass fuel stream totals 512 million dry tons annually, including urban wood waste; paper- and forestry-industry waste; forest residue; and agricultural waste. Biomass power plants also burn municipal solid waste, manure and waste from farm animal operations, landfill gas, and digester gas from wastewater treatment.

The majority of biomass facilities in operation today, however, use wood chips and other forest-waste residues as their primary source of fuel. And liquid fuels from agricultural crops, including ethanol and biodiesel, are growing quickly as alternative supply options.

Unfortunately, even with this seemingly ample and diverse supply, securing reliable sources of fuel poses the biggest challenge for project sponsors.

Going Upstream

As a fuel, biomass suffers from low energy density. Because of high transportation costs, the relative bulk and

Source: Warren Gretz, NREL

Fermenting tanks at an NREL research facility in Colorado convert agricultural wastes into liquid fuels.

Source: National Renewable Energy Laboratory

Waste wood such as railroad ties are chipped and used to fuel Wheelabrator's Shasta power plant in Anderson, Calif.

high-moisture content of biomass makes facility siting particularly critical. Ideally, plants are located less than 100 miles from the fuel source.

"In conjuction with that first-level analysis, you've got to do the complete fuel study because that's the deal breaker on these projects," says Kim Crossman, team leader of the EPA's Combined Heat and Power Partnership. "For a good-sized project, it's absolutely essential to work with a fuel-sourcing expert who can go through the whole process."

Because contracts can and do fall through, ensuring a consistent supply requires contracting with 10 or 20 different providers, from small mulching operations all the way to large forest-products plants. Plant operators must study fuel-supply issues at the micro level. "It's on-the-ground work, actually talking to your neighbors who have waste streams," Crossman says.

The most successful biomass-generation strategies rely on a variety of feedstocks. Conversely, the riskiest projects are built to use a single fuel source. A plant that burns wood shavings, for example, could end up at a loss when markets change and suppliers fetch higher prices in the animal-bedding market. "You often lose your best fuel sources because they have a higher use," Carlson says.

In some cases, plant operators address fuel risks by processing, or even growing their own fuel. "The further upstream you can go in the fuel sourcing the better," Carlson says. While the economics of this may not make sense at this point—waste fuels remain cheaper than cultivating and harvesting biomass—dedicated fuel crops might become a more attractive option as demand rises for waste fuels and growers gain experience with such crops as fast-growing trees and grasses.

Unfortunately, even the best plans can fail if another facility is built between a plant and its source of fuel. This exact situation already has happened in California, according to Bodington, and is now happening in the Northeast. In these cases, facility operators must try to find new sources of feedstock, and often will refurbish or retrofit plants to increase the diversity of fuels they can burn. Such situations likely will increase as the market grows.

Creating a Bioenergy Campus

Project developers find some of the best opportunities in co-firing biomass with coal at existing coal-fired plants (*see sidebar, "Co-Firing: Low-Hanging Green Fuel"*), or converting formerly coal-fired plants to burn biomass exclusively. "That's another niche that's never been exploited but should be," Carlson says. In many urban settings, for example, small, defunct coal-fired boilers might be refurbished to use urban sources of biomass fuel. "Those two line up very well," Carlson says. For example, Northeast Utilities recently repowered a coal-fired plant in Portsmouth, N.H., to burn biomass.

Cogeneration also provides opportunities for biomass development. Cogeneration plants offer a major efficiency advantage, delivering 60 percent to 80 percent efficiency rates versus the typical 25 percent to 27 percent for a

Co-firing: Low-Hanging Green Fuel

Coal co-firing is probably the most economic near-term option for utilities looking to get into renewable fuels, because much of existing power plant equipment can be used without major modifications.

"From a utility standpoint, they've already got the capital invested," says Alex Hobbs, associate director of renewable technologies at N.C. State University's North Carolina Solar Center. "So the question is, can they blend wood with coal, and at what percentage?"

Facilities considering co-firing usually plan to use about 5 percent to 15 percent biomass. Using 15 percent biomass at a coal-fired plant can result in an 18-percent reduction in greenhouse gases, according to a 2001 study (Mann, MK, Splath PL, "A life cycle assessment of biomass cofiring in a coal fired power plant," *Clean Products and Processes 3*: 81-91, 2001).—***ES***

large, decentralized plant. Additionally, they can benefit from an income stream for highly valued steam and all the synergies of locating at an existing industrial site, removing many permitting and transmission issues.

"In an ideal situation, any kind of convergence of siting a plant like this near a fuel source and a thermal load—that is the perfect configuration," says EPA's Crossman. "Once you start putting all those pieces together, the projects become so attractive they stop you in your tracks."

Finding these opportunities for cogeneration can prove challenging, however. Identifying and implementing a more integrated "bio-energy campus" of public and private interests can yield successful projects. Grain mills, ethanol plants and wastewater treatment facilities represent possible options for partners. Others include farm-based methane or digester gas at wastewater treatment facilities.

Maturing Crop

As the biomass-fired power industry grows, better harvesting, collection, transport, and other techniques will allow greater exploitation of agricultural, forest, and other residues, and should provide ample volume for the biomass industry to continue developing. In the long term, as the industry matures, projects likely will burn more dedicated crops, and will expand the types and sources of other fuels they use.

Until then, however, project operators must rely on existing sources of fuel to meet their day-to-day needs. Securing such fuel sources requires a thorough, micro-level evaluation, and a siting process that places the plant close enough to the fuel supply, and far enough away from the next plant.

In addition, utilities must have realistic expectations about plant size. Biomass facilities simply won't be nearly as large as centralized power stations, and that represents a practical limitation for the potential of biomass-fired power generation. "The sweet spot for biomass is 20 to 30 MW," Bodington says. "It kind of levels off when you get to 30, 40, 50 MW." F

Elizabeth Striano (estriano@agreenfootprint.com), principal of A Green Footprint LLC, is a writer and consultant on sustainability and the environment.

Leveling the Playing Field

Internal Revenue Code Section 45 provides an income tax credit for production of electricity produced from renewable energy sources. Critics argue, however, that wind energy is unfairly subsidized under Section 45. According to the code, wind energy facilities can claim a credit of 1.8 cents per kilowatt-hour, while biomass plants get only 0.9 cents/kWh.

Biomass proponents are working to change this disparity. "The number-one priority of the open-loop biomass power industry is to achieve parity in the PTC [Production Tax Credit] rate," said Bill Carlson, chairman of the USA Biomass Power Producers Alliance, in his testimony before the House Committee on Ways and Means earlier this year.—***ES***

U.S. Biopower Capacity

Fuel	Cogen Sites*	Capacity (MW)	Power-Only Sites**	Capacity (MW)
Agricultural Waste	17	262.0	-	-
Biogas (digester gas)	130	216.3	-	-
Biomass (unspecified)	15	106.0	2	42.2
Black Liquor	64	3,782.2	3	85.5
Gasified Wood	2	2.4	-	-
Landfill Gas	38	187.0	172	851.7
MSW	37	769.2	60	2,337.0
Wood/Wood Waste	150	1,721.1	52	1,429.7
Other	4	36.3	8	122.8
Total	**457**	**7,082.4**	**297**	**4,868.9**

Sources: *EEA CHP Database and **Energy Information Administration