Capturing the Value of Waste Heat

Burgess Biopower is securing unique partners to help the 75-MW plant capitalize on all it has to offer.

By Anna Simet | June 25, 2019

When the idea of converting a shuttered paper mill in Berlin, New Hampshire, to a biomass power plant was first conceived by CS Operations Inc. in 2012, the developer had much more in mind than solely generating electricity from forest residue. Opportunity at the site was ripe, but added-value projects would come much further down the road, after several years of construction, operations and optimization. Fast-forward to today, and that point has finally reached.

The 75-MW Burgess BioPower plant is located at the site of a former pulp mill in Berlin, New Hampshire. Since it began commercial operations in 2014, it's estimated the biomass power facility injects over $63 million into the New Hampshire economy e

Being a new, large-scale, solid fuel power generation facility, there were some initial challenges during the ramp-up process, but for the past few years, the plant has been running at a 90-plus percent capacity factor. "That's pretty high for a solid-fuel power plant," says Dammon Frecker, executive vice president at CS Operations. "It's very efficient because of the boiler's bubbling fluidized bed design."

Babcock & Wilcox was awarded the engineering, procurement and construction contract for the conversion project, appropriate as the company had installed the existing boiler in 1993, replacing two aging black liquor recovery boilers. Other updates needed to transform Burgess BioPower into a fully functioning biomass power facility included a new turbine/generator, cooling towers, electrical switchgear with associated supporting auxiliaries, state-of-the-art air quality control systems, and a new wood yard.

As for fuel, the plant currently uses about 800,000 tons of forest residue a year, according to Frecker. "About 60 percent comes from New Hampshire, 20 percent from Maine, and the rest from other neighboring states and Canada," he says.

The site that Burgess sits on is a 65-acre parcel of land, half of which housed the prior pulp mill when it was in operation. "Between the wood fuel storage area and the plant operations itself, we consume a little over one-third of that total area," Frecker says. "The site was originally laid out with the notion we could attract other economic development that has synergies with Burgess Biopower's operations.

There is a significant portion occupied by a former warehouse that serviced the pulp mill when it was in operation—which we don't utilize—and there is a fairly large flat portion of land near the warehouse that makes a good spot for another commercial development."

Excess space aside, another factor in finding the right partners is the potential utilization of the plant's copious amount of waste heat, which is currently released via the plant's cooling tower. With these two components in mind, Burgess began spreading the word that it was interested in partnering with companies that might be a good fit for the location, and was introduced to a developer with intentions of building a greenhouse. "They will grow baby greens to be sold in regional produce markets," Frecker explains. "After conversations ensued, feasibility and market studies performed, and conceptual layouts with high-level costing, we determined the project has legs and could make sense. Now, now we're doing further design and engineering to bring the project to a permanent stage."

The state-of-the-art, $25 million hydroponic greenhouse will use both on-site acreage and waste heat for its operations. The project recently scored a $500,000 grant from the New Hampshire Public Utilities Commission, funds derived from the state's renewable energy fund. "What we're looking to do is recycle the water used to cool our steam condenser—about 50,000 gallons per minute that recirculates through the condenser and comes out at about 90 degrees Fahrenheit," Frecker explains. "It's low-grade heat, but there are lots of Btus there

because of the high volume of water that's recirculated.

We'll tie that extraction point into our cooling water loop, and build a little pump house that can send it across the site to the greenhouse location. When the water gets there, we'll utilize two centrifugal heat pumps to pick up the temperature above that 90 degree number that it comes out—somewhere around 120 or 140 degrees, where it's much more useful in a space heating application."

Detailed design and engineering is underway, and the partners hope to complete that stage within the next couple of months. Then, they will file a site plan approval application with the city of Berlin. "We hope to get through permitting by the end of Q3 or Q4 of this year, and enter into a final agreement with the greenhouse company," Frecker says. "Once all that's in place, we hope to get into construction as soon as the weather will allow, which will take six to eight months. We could be in commercial operating in the summer of next year, or early fall."

Frecker says codevelopment has been a goal since Burgess began the conversion process. "We're really excited about bringing this to fruition, as well as the environmental sustainability aspects of the project."

The thermal recovery project will avoid burning over half a million gallons of oil per year in a boiler to heat the greenhouse, help the state reach its thermal renewable energy generation goals, and substantially reduce water according to Frecker. "Because that water will not be evaporating out of the cooling tower and the heat will be rejected to the greenhouse, we'll reduce water consumption by about 6 million gallons of year."

While the greenhouse project is substantial, it will only utilize 10 percent of the total heat currently rejected out of the cooling tower, leaving plenty of room for additional projects—such as a sidewalk and street snow melting system for the city of Berlin. "We've been working with the city for over a year to help them evaluate the technical and economic feasibility of using some of our waste heat to heat a portion of the city's downtown streets and sidewalks," Frecker adds. "There is still plenty of heat available to do that, and it would have a similar energy demand as the greenhouse, so between the two projects, that will only account for 20 percent of our waste heat."

The city has found much value in Burgess since the plant came online, and City Manager Jim Wheeler says its impact on the community has been tremendous.

Another Potential Partner

"We've had the direct impact of jobs and tax revenue from the facility, and it's also had an indirect ripple effect well beyond its fenceline—it creates jobs in the forest industry, a traditional industry in this area," Wheeler tells Biomass Magazine. "The forest industry suffered a big blow when the pulp mill closed, but Burgess has really kept it alive."

Through tax revenue the city has received from Burgess, it has been able to directly fund infrastructure projects—a recent example being a major road reconstruction project. "It was about three and a half miles of primary artery through the city, with landscaping and beautification," Wheeler says. "This has been a project helping us convert our economy, which is diversified, and includes a tourist economy—we're in a beautiful area of northern New Hampshire."

Wheeler, who has an engineering background, says he can see the biomass plant from his office window, across the river. He has known about the tremendous amount of thermal energy sent through the cooling tower, and that it could be harnessed for beneficial uses. "We investigated those uses on a municipal level, and came across Holland, Michigan, a community of about 30,000. It turns out that they have been doing what we want to do since the 1980s, and extremely successfully."

The Holland BPW snowmelt system utilizes waste heat from power generation, to heat water that is circulated through 190 miles of tubing laid beneath the pavement and sidewalks, and back to the Holland BPW power plant. The system pumps over 4,700 gallons of water per minute at 95 degrees, and can melt about one inch of snow per hour at 20 degrees with winds of 10 mph, according to the city. It has been expanded several times over the past two decades, and provides heat to approximately 600,000 square feet of heated sidewalks and streets.

Berlin wants to emulate what Holland is doing. "Not everybody can do this," Wheeler points out. "First, you have to have a power plant near down town."

A location would also need to get a lot of snow for the financials to work out—i.e., significant expenditures on snow removal, salting, plowing, etc. Holland receives approximately 75 inches of snow each year, and though last year was about 25 percent above average, Berlin sees about 100 inches on average. "We're different than the southern part of New Hampshire—higher in elevation, further north, and we're up in the White Mountains. The conditions up here in the winter time can be tough."

With a compact downtown, snow removal is cumbersome. "We do it now with municipal forces, the old-fashioned way," Wheeler says. "We plow it, we snow blow it, we fill dump trucks and haul it miles away to a snow dump. We're spending money to do it, yet it's still icy and slippery. When we looked at Holland we thought, what a perfect fit for us."

The city commissioned a feasibility study with positive results, and is now looking at the next stage of development. "We now know it's feasible," Wheeler says. "But it's much bigger than just a snow melting system—it's a down town reconstruction project. The city is at a point where it needs that, as our infrastructure is aging, and it's time to renew it. So the time to do that would be when we're tearing up our streets and sidewalks."

A secondary project piece that the city is evaluating is sizing the system to not only serve the snow melting component, but some district heating. "We have a lot of buildings down town and adjacent to where these main transmission lines will be, and they could benefit from the heat," Wheeler says. "So we'd like to use that as an economic development tool as well."

Ideally, the system would service about 7 acres. "It does come with a hefty capital cost, but we'll save money each year," Wheeler says. According to the feasibility study performed by Wilson Engineering, the project would cost around $8.3 million for all components (not including the downtown reconstruction project with streetscape

improvements, which will cost around $4.5 million, according to Wheeler). The city currently spends around $117,000 on plowing and snow removal each year, and will experience similar annual savings.

And, Wheeler points out, that number doesn't consider the potential generation of thermal renewable energy credits, and the additional economic benefits. "One thing we know Holland experiences, and that we believe we'll get from it, too, is economic development that is really hard to quantify," he says. "This past winter, I took pictures of Main Street almost every day, and it was eye-opening to pay attention to. It's generally always icy, has snow on it, and it's a deterrent to activity downtown that lasts for six months."

Alleviating that issue would likely attract more people down town during winter months. "In Holland, it was unexpected, but people from surrounding communities would come in—for example, buses of elderly to walk and get exercise. We would love to be that. For our downtown businesses, six months of the operating season is affected by snow. With a melt system, all of that goes away."

Soon, the city will apply for federal funds to assist with project costs, but is determining the best path forward. "We're looking at how we can smartly apply—for construction dollars or planning dollars, and we'll figure out what makes the most sense to apply for."

In the meantime, Wheeler remains passionate about the project, and reiterates the impact Burgess has made on the city and surrounding community. "Burgess has been a great partner," he adds. "They love the idea, and we support each other."

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Boiler & Turbine Super Move
When Burgess Biopower's electrical generator and turbine arrived by ship in Searsports, Maine, two transport permits were required to haul them the 185 miles to Berlin, at a max speed of 25 miles per hour. Each load was carried on a 74-wheel, 19-axle transporter that was 228 feet long, and weighed approximately 255 tons, according to the New Hampshire Department of Transportation.
The circulating fluidized bed boiler is capable of firing whole tree chips at a minimum moisture content of 35 percent, and a design moisture content of up to 50 percent. The boiler is equipped with four No. 2 distillate oil -fired burners for use during startup. The steam turbine generator is designed for a steam inlet pressure of 850 psig and a steam inlet temperature of 900 degrees, with a maximum capacity of 66 MW.

Evaluating Economic Impacts
A study completed by PolEcon Research and released by Advance NH study in 2017 showed:
• Annual impact of Burgess BioPower in New Hampshire during 2016 was 221 jobs, $13.9 million in labor income, and $63.4 million in output of goods and services.
• In addition to 27 direct jobs, Burgess BioPower supported 184 jobs in Coos County, of which 43 percent were in the logging and sawmill industry; in total, the jobs in Coos County accounted for $11.5 million in labor income.
• Without the plant's payments-in-lieu-of-taxes to the city of Berlin—which totaled $1.15 million in fiscal year (FY) 2019—Berlin's tax rate would have increased by nearly 5 percent. Berlin taxpayers (median home value of $88,400) saved approximately $168 per year in property taxes, with savings expected to reach $300 per year in FY 2019.

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