

Using Biomass in Minnesota



Case Study

Highlights



Facility

- 2197 Nature Center Drive NW, Hackensack, MN 56452
- 56,240 square feet heated using biomass

Biomass System

- 2 wood gasification units: GARN WHS3200 and a Wood Gun E500
- Provide heating and hot water
- Main lodge and 3 energy centers heated with biomass (56,240 square feet)
- 600,000 Btu/hour each gasifier
- 1.2 million Btu total
- Provides 95% of facility's heat load
- Propane backup system

Fuel

- Cordwood: Oak, birch, red maple, black ash, aspen, red pine, jack pine
- Fuel costs \$12,000-\$15,000 per year (\$50-\$160 per cord)

-Continued on last page

Case Study

Deep Portage Learning Center

Authored by **Adam Zoet** of Dovetail Partners, www.dovetailinc.org

Deep Portage is a non-profit residential environmental education and outdoor recreation center. Open to the public, it is a place where community, education, and the environment come together. Hiking trails, an interpretive center, and educational programming are available year round. The facility is located on 6,307 acres of glacial hills, lakes, rivers, and bogs in Cass County in north-central Minnesota.

The campus includes a fifty thousand square foot Resources Heritage Center that houses two great halls, a giant climbing wall,

a library, classrooms, theater, food service area, and overnight accommodations for up to 175 people. There is a main lodge that is divided into two parts, each of which is served by a separate energy center.

In determining the best way to heat its facilities, Deep Portage was constrained by its rural location. One option would have been to go with a ground source heat pump, but they are limited to how much electricity they can use. Natural gas was also out of the question because it is not available where they are located.

Deep Portage relied on propane to heat its buildings back when it was inexpensive, but when propane prices began to steadily rise, management began to seriously consider switching fuel sources. In the winter of 2009, the cost of propane rose to \$2.14 per gallon. As Deep Portage's Executive Director Dale Yerger explains, "Propane is a commodity that bounces all over in price, and this great variability makes it very hard for us put together a five-year plan."

Deep Portage's board discussed the rising cost of energy and whether they could pass this cost along to customers. They also considered closing down Deep Portage for the winter and only operating from May through October. They knew they had to do something.

Deep Portage is located in a heavily forested area and it was felt that switching to a biomass fuel system would benefit the local economy. Eventually, it was decided that heating with biomass made the most sense. According to Yerger, "One of the greatest advantages of using biomass is that we are able to plan over the long-term because of its more stable supply and price." Biomass is also a very flexible fuel source, and there are many options available for which type of wood to use and how to use it.

There were also a number of considerations outside of increasing fuel prices that led to Deep Portage's decision to switch to biomass. As an environmental center, carbon reduction was an important objective that influenced their decision to adopt biomass. Yerger explains that the Deep Portage staff "thought that climate change was widely accepted by scientists, that our days on propane were numbered, and that we would need an alternative fuel source." Another project objective was to help the local economy. Deep Portage worked to establish markets for cordwood and hired part-time workers to help fire the system.

After careful thought, it was decided to purchase two wood gasifiers to heat the main

lodge and three energy centers and to provide domestic hot water for Deep Portage. The gasifiers include a GARN WHS3200 (manufactured by a Minnesotan company Dectra) and a Wood Gun E500 (manufactured by Alternative Heating Manufacturers). Each gasifier burns one hundred pounds of wood per hour and has a 600,000 Btu output (1.2 million Btu combined output). One of the selling points of the GARN is that it includes hot water storage, and the Wood Gun is very efficient and able to provide substantial heat output.

Installation of the new gasifiers began in Spring 2010 and were first fired October 6, 2010, just in time for the harsh winter that followed. From start to finish, it took six months to complete the project. The gasifiers currently heat 56,240 square feet of Deep Portage's facilities. Biomass provides ninety-five percent of the heat load with propane acting as a backup system.

To help fund the biomass project, Deep Portage applied for a Department of Employment and Economic Development (DEED) grant in March 2010. They quickly received approval for a grant and it covers \$136,000 of the project's total cost. They also received a grant from the Department of Energy (DOE) for \$38,000 that will help cover fuel storage for the Wood Gun unit with a requirement that the project help the local economy. The remaining balance of the project will be paid in loans and cash by the Deep Portage Foundation.

"One of the greatest advantages of using biomass is that we are able to plan over the long-term because of its more stable supply and price"

The total cost of the entire project was about \$410,000. The cost for the equipment was \$305,000 and maintenance costs are approximately \$1,000-\$2,000 per year (for chemicals and testing for the GARN unit and refractory bricks for the Wood Gun). Several part-time workers fuel the system. The system is expected to be paid off in around ten years assuming propane costs remain around \$2.00 per gallon. This is good news because the system should last for twenty years, so Deep Portage is likely to enjoy many years of heating cost savings.

The source of fuel for the gasifier boilers is lower quality cordwood that is left behind after harvest. The boilers are able to use a wide variety of wood types including oak, birch, red maple black ash, aspen, red pine, and jack pine. Deep Portage does not process or treat their fuel before using it, they just stack and season it until it dries to twenty to thirty percent moisture content.

Deep Portage is surrounded by wood resources, so there is little worry about running out of fuel supply. To help the local economy and maintain a low carbon footprint, they try to buy certified wood (primarily from public land) that comes from local suppliers within the county. Overall, Deep Portage buys about one hundred cords per year during the summer. Generally, twenty cords out of the hundred are salvaged after harvests. They buy a minimum of ten cords from local suppliers, and fuel prices range from about \$50.00 to \$160.00 per cord. Deep Portage's annual fuel costs ranges from \$12,000-\$15,000.

Deep Portage has saved money every year through reduced heating costs using wood rather than propane. The first year they operated the system, propane was \$1.60 a gallon and they saved approximately \$10,000 in heating costs. Last year (year two), they saved around \$25,000 because propane prices increased. This year, with propane at \$2.00 per gallon, they will save about \$35,000.

Wood ash is handled by the Wood Gun's fifty-five gallon container, which is filled 1.5 times per year. The GARN unit produces four hundred to five hundred pounds of ash per winter. They use the ash waste as forest fertilizer.

The gasifiers require minimal hands-on maintenance. Last winter about ten staff members regularly helped maintain the system; some watched during a four-hour period once a week, and five others spent about twenty hours a week keeping an eye on the system. There is staff on hand to watch the system pretty much 24/7.

When it is twenty-five to thirty degrees F below zero, both burners require a hundred pounds of wood per hour, and it takes only a minute or two to feed that quantity of wood each hour. Generally, it takes about twenty minutes per eight-hour shift to maintain the gasifiers but around an hour when it is very cold. In total, around one thousand hours of maintenance are needed per year. Even though the gasifiers are more hands-on compared to conventional heating systems, Yerger stated that he does not find taking care of the system frustrating or bothersome.

There were a few frustrations that Deep Portage ran into when adopting a biomass system. As Yerger explains, "Alternative energy is just that—still alternative. The

“Heating with wood is kind of like taking care of children or a pet; you need to keep an eye on it and take care of it”

novelty of biomass gasification made construction frustrating because of its somewhat steep learning curve and we had to troubleshoot problems that came up.”

Overall, Yerger says that they have been very pleased with their biomass gasification center: “Here in Northern Minnesota, we’re surrounded by wood and couldn’t install wind turbines or solar. To heat hot water and our buildings, we needed something with punch, and biomass works great. We can say that we are doing the right thing and are saving money, helping the local economy, and fighting climate change.” By using biomass, Deep Portage is able to plan on fixed costs, which helps when they are trying to make long-term plans.

The most important lesson that Yerger says Deep Portage learned while developing the biomass system is to “be patient and realize that you are doing something that’s alternative so expect some hiccups. If you keep your eye on the original goal, things will work out.” For people who are considering whether or not to convert to biomass, Yerger recommends that they first “add storage as quickly as you can because you need to have it. Also, try to engage local wood suppliers.”

As far as a future outlook is concerned, Deep Portage is committed to biomass. Currently, they are adding a six thousand square foot Interpretive Center and they are building another energy center that will house a new biomass gasifier. According to Yerger, “The new biomass gasifier promises to be the most technically advanced and clean burning unit they have installed.” Once completed, Deep Portage will have 62,240 square feet heated using biomass.

Case Study

Highlights

Fuel

- Purchase ~100 cords per year; ~20 cords salvaged
- Burn at 20-30% moisture content
- GARN produces 400-500 lbs of ash per winter; Wood Gen produces 82.5 gallons of ash per year

Funding

- DEED grant covers \$136,000 of project's cost
- Department of Energy grant covers another \$38,000 for storage add-on cost
- Balance of project covered by loans and cash by the Deep Portage Foundation

Costs/Savings

- Saved ~\$10,000 first year, last year saved ~\$25,000, and this year will save ~\$35,000 using biomass
- Maintenance costs ~\$1,000-\$12,000 per year
- Total cost of project ~\$410,000
- Expect a 10 year payback period

Operations

- 10 staff regularly watch the system, 5 people watch for 4 hour periods once a week and 5 others watch 20 hours per week
- With 25-30 degree F below zero temperatures, both burners fed at 100 lbs. per hour
- Generally, 20 minutes per 8-hour shift required for maintenance. When it's very cold, about 1 hour required. ~1,000 hours of maintenance per year