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Community Biomass Energy Feasibility Study

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CAP Community Biomass Energy Feasibility Study

Table of Contents

Executive Summary

The citizen's group known as the Cook County Local Energy Project (CCLEP), in conjunction with the Cook County Board of Commissioners, is exploring the feasibility of community-based biomass energy production within Cook County. This group is especially interested in understanding the short and long-term environmental, social, and economic impacts of utilizing woody biomass. The CAP-Biomass project was initiated to help inform the feasibility study and guide the future direction of biomass energy in northeastern Minnesota. Five distinct case studies were produced as the project's final deliverables and include different sites within Minnesota that utilize biomass through different applications. They provide a narrative of individual biomass application as well as technical detail to help inform the decision-making of others who are considering biomass for energy or heating usage. The project's results will be presented to CCLEP members and posted on the project webpage.

Despite the fact that this project's case studies are fairly distinct from one another, they do share commonalities that can help illustrate some general lessons endemic to other biomass projects. All of the interviewed sites described heating with biomass (regardless of the type of the heating technology, fuel, and capacity used) as being significantly more "hands-on" compared to conventional gas or oil fired heating systems. Assessing whether adequate staffing and technical resources are available is critical when determining the success of biomass projects. Having a local supply of fuel is vital to keep heating costs manageable. Reducing heating costs was one of (if not *the*) primary impetus for all five of the sites choosing to adopt biomass. Lastly, the developed case studies illustrate that there is no one-size-fits-all method for choosing the right biomass system. It takes extensive research and years of improvements to develop a system that meets the individual needs of an organization.

Process Overview and Goals

The project's first step involved completing a literature review of the environmental, economic, and social impacts of utilizing biomass energy and heating. Information was gathered from peer-reviewed articles, government databases, and other sources. This information was used to inform the design of the case studies and the interview questionnaire (Appendix A).

In addition to the background research, a diverse set of reports was collected regarding biomass energy and heating applications within Minnesota, the US, and abroad. Over a hundred case studies were examined, and a summary list was created containing potential case studies that could be developed further. The criteria used to select candidate case studies included those that were of different scales, included different biomass heating technologies/fuels, and were in similar climates to that of Cook County. The summarized list was presented for team feedback and the final five case study candidates were chosen.

The following is a list of the five sites that were chosen to develop into case studies:

- Hedstrom Lumber
- Wolf Ridge Environmental Learning Center
- Birch Grove Community School
- Deep Portage Learning Center
- Len Busch Roses

After selecting biomass sites that were most relevant to the study, an interview questionnaire was drafted containing both qualitative and quantitative questions. The questionnaire's objective was to collect detailed information from selected case study sites. The questionnaire's topics included general background, implementation, biomass system specification, biomass fuel type, project funding, costs/savings statistics, environmental impacts, operations and maintenance, and concluding questions. A draft of the questionnaire was submitted for review by Dovetail Partners staff, professors in related fields at the University of Minnesota, and by CURA. The feedback from these reviewers was incorporated into the final draft of the survey.

Before conducting the case study interviews, time was spent gathering as much information as possible about the five sites and their use of biomass in order to cut down the time the phones interviews would require. Sources of this information included newsletters, company websites, web blogs, press releases, and previous case studies.

Phone interviews were then carried out to gather qualitative and quantitative information used to develop the five biomass case studies. Initial emails were sent out to the sites to make introductions, to describe the study, and to request that interviews be scheduled regarding their experience utilizing biomass. Follow up emails requesting interviews were sent out after one week for those sites that had not yet responded. After initial contact was made, interviews were scheduled and interviewees were emailed a list of technical questions that would be part of the interview but that they might not know off the top of their heads. Overall, five hour-long interviews were conducted with sites utilizing biomass for heating within Minnesota.

During the course of the project, two visits were made to the project region in Cook County. The first trip to Cook County was with team members from Dovetail Partners and the University of Minnesota involved in the biomass feasibility studies. The team met with representatives of the Grand Portage Tribal Council and with the Cook County Local Energy Project Steering Community. The meetings provided an update on the key findings of phase I of the Biomass Energy Feasibility Studies. The second trip to Cook County was made to tour three of the case study sites, take pictures, and gather more information.

The information collected through interviews and site visits was used to develop five case studies describing the biomass applications and experiences at the different sites. These case studies provide a narrative of individual biomass applications as well as technical details to help inform the decision-making of others who are deciding whether to adopt biomass for energy or heating usage. After the case studies were drafted, the biomass sites were contacted to clarify and expand certain points. At the end of the project the case studies were submitted for review and then final drafts were completed and submitted.

Results

The results of this project are five distinct case studies illustrating different applications of biomass heating.

The case studies were developed from the following sites:

- Wolf Ridge Environmental Learning Center
- Deep Portage Learning Center
- Birch Grove Community Center
- Len Busch Roses
- Hedstrom Lumber

Wolf Ridge Environmental Learning Center

Founded in 1971, Wolf Ridge Environmental Learning Center was the first such learning center in the nation to be accredited as a K-12 school. It is recognized nationally and internationally as a leader in environmental education.

Each year, more than 15,000 children, teachers, and parent chaperones travel to Wolf Ridge's 2,000-acre campus. They serve an additional 3,000 people annually through a broad spectrum of environmental and outdoor learning programs for children, families, seniors, and college students.

The Wolf Ridge facilities include three classroom buildings, two dormitories, a dining hall, a raptor aviary, a library, two auditoriums, two rock-climbing walls, two outdoor ropes courses, and an administration building. The facility has 380 beds, 16 for staff and 364 for program participants.

Since they moved into their current campus in 1987, Wolf Ridge has relied on four GARN cordwood boilers to produce heat and hot water for five of its main buildings totaling 84,000 square feet. Each boiler has 3,200 gallons of hot water storage which circulates through a closed-loop system.

When they were first installed, the GARN system was cutting edge technology, and there were not a lot of other biomass boilers to choose from that could meet Wolf Ridge's heating needs.

The GARNS provide a flexible heating system. The individual boilers can be fired independently and also act as backups for one another. Generally, two or three of the boilers are operational at any given time. The system is designed for temperatures around thirty below zero, fitting for cold winters typical at Wolf Ridge's location. Heating is required nine months of the year. Because the system was manufactured and installed by a local company (Dectra Corporation) based in Saint Paul, Minnesota, an engineer can easily visit Wolf Ridge for any technical assistance that might be needed.

Northern Minnesota is heavily forested, making biomass a very secure source of energy for Wolf Ridge. The Center's cordwood fuel source has periodically been harvested from their 2,000 acres.

If Wolf Ridge were not located near such a rich fuel source, they would have to use propane, a very costly alternative for heating their large campus.

Any fuel that is not gathered onsite comes from within a 45-mile radius of the facility. Birch costs around $80.00 per cord at logging sales and then another $75.00 per cord for processing. On average, about fourteen truckloads (160 cords) are needed per year for heating, at a cost of approximately $25,000. Overall, Peter Smerud, Executive Director of Wolf Ridge, believes they are paying a fair price compared to other regions in the US.

Operating the GARN system is simple but a very hands-on experience that requires a lot of work. Chemicals occasionally have to be added to help prevent oxidation of the boilers. Someone always has to be onsite attending the system. Before the cordwood can be burned, loggers cut and haul the birch so that it can be stored in eight-foot lengths to dry for up to a year. Wolf Ridge stores the entire annual fuel supply in open air for many months. Later on, the wood gets transported to a heating plant and cut, stacked, and conveyed to storage sheds where it remains under roof for several months. Workers are then able to access these sheds and fill wheelbarrows of fuel to load the boilers every three to four hours from September through June.

Annual operation and maintenance for the GARN boilers costs roughly $20,000. The cost (all inclusive) to run the GARN boilers is $47,000 per year, far below the cost of using propane.

As an environmental education facility, Wolf Ridge also uses the biomass system as a teaching tool. According to Smerud, "Parents and children who come to Wolf Ridge learn about the boilers. The boilers are incorporated into classes and serve as a model of renewable energy to others. We want to have facilities that model our educational efforts to promote renewable resources." The renewability, local supply, and impact on carbon output were all attractive features of using cordwood versus fossil fuel based heating systems: "Birch is a forty-year renewable resource that is considered carbon neutral, versus propane which takes thousands of years to renew," says Smerud. "Our wood supply comes from local sources, which means that it is transported very short distances compared to petrol products which are transported many miles to end users."

It is easy to become disconnected from the process of how our energy needs are met. Smerud has found that really connecting people to a fuel source and directly relating it to their energy demands has a great impact on their thinking. Unlike the complex process associated with the use of fossil fuels, people can easily envision the process of how biomass is used to meet heating needs.

Since 1987, Wolf Ridge has made improvements to the heating system. Four of their buildings originally had thin-wall fiberglass pipe connected to the heating system. Poor piping (and the fact that they could not bury it deep in the ground because of bedrock) led to heating loss. They would burn around 200 cords of birch per year with the poor quality piping. In the last few years, they replaced old, inefficient piping with super-insulated material, and this has cut their annual fuel demand by twenty percent to 160 cords.

The GARN stoves are a great cordwood system, but despite continuous improvements the GARN boilers have begun to show their age and currently only maintain fifty percent of their original output (480,000 Btu per hour each totaling two million Btu). It also has become very difficult to find a local vendor for firewood processing in the volume and manner needed. Running the system also requires attention to worker compensation issues (e.g. through injuries sustained from lifting the heavy fuel). The boilers also produce a large amount of ash that has to be frequently removed.

Wolf Ridge has been very happy with utilizing biomass for heating over 24 years, and they knew that they wanted to stick with it for their new system. During the initial stages of investigating options for a new system, the view was that they would stay with cordwood as a fuel source. However, issues with processing made them change their mind. Smerud explained that twenty years ago it was easy to find people to process a tremendous amount of wood. In the last three to four years, however, it has been very difficult to find businesses in their rural location that would provide processing, and Wolf Ridge has also on occasion had to source contractors and equipment from more than one hundred miles away. They have struggled with reducing the moisture content of the cordwood fuel so that it will burn well. Given these problems, attention began to shift toward a wood pellet-based system.

To help inform their decision, members of Wolf Ridge's staff talked to numerous manufacturers (including GARN) and toured different facilities in Minnesota, Maine, and New Hampshire that utilize biomass for heating. They discovered that although there are improved techniques and considerably more system choices available now, it was difficult to find a biomass system with a heating output that was appropriate for the size of their facility. Many units on the market were either too large (e.g. meant for municipalities) or too small (e.g. for households). Nevertheless, they kept at it, continued to look around, put out bids, and found a system that best fit their needs in terms of cost, Btu output, system design, and that matched their educational objectives.

In September 2011, Wolf Ridge will begin installation of two new BioMax pellet boilers to replace its four aging GARN boilers. The total cost (labor, boilers, water storage, piping, etc) for the pellet system will be $456,000. To help fund the project, they applied for, and received, a DOE grant for $300,000 that supports the installation of the new pellet boilers as well as educational modeling.

Ultimately, it was decided that wood pellets were the way to go because they are not prone to freezing like woodchips; they have a good Btu output per pound; and they are easy to move, manage, and store. Smerud believes that using pellets as a fuel source is a sound investment: "Pellets may be more expensive, but we believe they are worth it in the long-run."

The new BioMax system offers numerous improvements. For example, the previous system required 24/7 supervision and maintenance. They needed to be checked for loading every three hours and it could take a person about an hour to load the system (six hours per day and 44 hours per week on average including de-ashing). In contrast, the BioMax system will likely only require one person two to four hours a week to complete the necessary operations and maintenance work. Lastly, moisture content will not be a problem with pellets as it was with cordwood. Cordwood was delivered at about fifty percent moisture content and had to sit and dry until it reached thirty percent. Pellets, in contrast, have a five percent moisture content and do not require this processing.

While the pellet system is more automated, it comes with mechanical complexity and electronic controls that should be considered in comparison to the simplicity of loading logs into a stove.

Also, a potential problem is that, unlike cordwood, it will be harder to find a local wood pellet supply. The supplier that Smerud says they are currently considering makes pellets out of waste wood and is located seventy miles away in Superior Wisconsin. If this source does not work out, Wolf Ridge will have to get its pellet supply within a 200-mile radius. Plans to construct pellet mills are being proposed which would be very near Wolf Ridge, and Smerud hopes that five years from now pellets will come from no more than twenty-five miles away.

It is estimated that Wolf Ridge will need about nine truckloads or 180 tons of pellets per year. Pellets cost around $133.00 per ton and delivery is about $13.00 per ton on average. They anticipate having to store eighteen percent of annual needs onsite.

Smerud warned that there are challenges that people should take into consideration when deciding whether to convert to biomass. If using cordwood, it can be difficult to cut and dry quickly enough to have an adequate supply and challenging to get it processed. Staffing can also be an issue when the equipment needs 24/7 attention. Also, a labor supply can be hard to come by in rural areas. Smerud feels the biggest challenge with pellets will probably be simply trying to get the closest source that they can for fuel supply. He commented, “It would be great if our commitment to pellets could create an industry for the fuel and a local pellet mill was developed.” One of the most important considerations Smerud believes biomass adopters should think about is the increased demand it will require from staff and whether you have the resources (labor and fuel supply) to make it successful.

The best qualities of biomass as a fuel source, according to Smerud, are that it is renewable, it helps support the local economy, reduces transportation impact on the environment, and it can have a positive impact on people’s thinking about renewable energy. Overall, Smerud says, “we are extremely happy using biomass, as evidenced by the fact that we’re still committed to it after 24 years.”

Deep Portage Learning Center

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 50,000+ square foot Resources Heritage Center that houses two great halls, a giant climbing wall, a library, classrooms, a theater, a 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 operate from May 1 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 Manfacturers). 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 95 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.

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 per cord to $160.00. 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 2), 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 55-gallon container, which is filled 1.5 times per year. The GARN unit produces 400-500 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 25-30 degrees 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 1,000 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 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 6,000 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.

Birch Grove Community Center

Located in Tofte, Minnesota, Birch Grove began in the 1960s as a school building. It was built to serve 200 kids who primarily came from families working at a nearby taconite pellet plant. When the taconite plant shut down in the 1980s, so did Birch Grove for a period of time.

Nevertheless, there was a community effort to reopen Birch Grove, and after a couple of years the school was once again operational. The town of Tofte now owns the building and has partially converted it to a community center managed by the Birch Grove Foundation. The Birch Grove Community Center has grown over the years and currently houses a charter school, community center, senior center, and a hostel.

This growth combined with high fuel oil prices provided the impetus for utilizing a pellet stove to heat the school. As Allan Olsen, the President of the Birch Grove Foundation, explains, "The primary objective in developing a biomass heating system was to address rising fuel prices." The Foundation wanted to find a heating system that was low maintenance, clean burning, and did not require a lot of staff to operate it.

Considerable research went into choosing the system that best fit Birch Grove's needs. Members of the Foundation Board talked to eight different schools in Minnesota and Wisconsin about their experiences using biomass. One school had used woodchips to heat its campus but had run into major issues. A few other schools said they were very happy using pellet boilers.

Ultimately, Birch Grove decided on a wood pellet boiler based on the positive experiences of schools that had used them. The Pelco boiler was the best option in terms of being low maintenance and clean and because other boilers were too small for their use. In 2009, Birch Grove installed the Pelco 1020 boiler to heat its entire 16,000 square foot facility.

The Pelco 1020 pellet boiler is the smallest Pelco boiler with a heat load between 500,000-550,000 Btu. It only takes 360,000 Btu to heat the school, which means the system has around thirty-five percent excess capacity even when the system is turned down to its lowest settings. The biomass boiler is designed to run best in winter temperatures and burns inefficiently when it is between forty and fifty degrees, so they don't start the boiler until around December when it becomes colder.

The biomass system carries one hundred percent of Birch Grove's heat load in the winter and ninety percent of the work year-round. The facility originally relied on fuel oil for heating. Now the old fuel oil boiler acts as a backup system and carries only ten percent of the heat load during the course of the year (about 800 gallons during the fall months). The Pelco boiler is set at 155 degrees and the fuel oil boiler set at 140 degrees, allowing the Pelco to do most of the work.

The components of the biomass system include a silo that can store twenty tons of pellets, an auger that feeds the system, plumbing, and two small pumps that circulate water (antifreeze solution) through a closed circuit heat exchanger that returns to the pellet boiler. On the other side of the heat exchanger is the furnace, which delivers heat to the school. The system produces a total of approximately fifty gallons of ash per year, which is automatically deposited into a garbage can. Birch Grove uses this ash as garden fertilizer and as a driveway treatment on snow and ice during the winter.

The system's components may give the impression that it would be very labor intensive to operate, but actually the opposite is true. Only one part-time staff person is needed to ensure that the system is running correctly and just one to two hours per week are needed to maintain the system.

To help fund the biomass project, they applied for a Department of Employment and Economic Development (DEED) matching grant of $41,800 that evenly splits the pellet boiler installation costs between the Foundation and DEED. Birch Grove took out an eight year loan from the town of Tofte to pay off its share of the project costs. The total cost of the project was $83,600.

Unfortunately, soon after the boiler was first installed, fuel oil prices dropped, and Birch Grove was breaking even on their heating costs for a while. Olsen explains that they figured on paying about $160 dollars per ton of pellets, but they are actually paying around $200 per ton, which totals out to approximately $7,000 for fuel per year.

Much of the unexpectedly higher fuel cost is the result of not having a local supplier. Currently, Birch Grove hires an auger truck (Widdes Feed and Farm) to pickup and deliver pellets from Great Lakes Renewable Energy in Wisconsin (one-way trip of 168 miles). The total cost is roughly $3,000 for fifteen tons of pellets (which includes the cost of both the pellets and delivery).

In the future, Olsen believes that more local people will be using pellets, which will help Birch Grove reduce its supply costs. The creation of a local pellet plant would be an ideal way to deal with fuel costs. They are also interested in opportunities for cooperative buying schemes that could lower costs. Currently, only small residential houses in the community have pellet boilers to heat their homes and do not have silos or buy in bulk. Potentially, if another facility put in a pellet boiler with a silo, they could team up and split delivery costs.

Nevertheless, now that the price of heating fuels has risen, Birch Grove is once again saving money through reduced heating costs. At $3.50 a gallon for fuel oil, Birch Grove saves about $8,000 dollars per year using pellets and is able to pay off their eight-year loan at $5,000 dollars per year. This is still a savings of $3,000 dollars per year.

The pellets Birch Grove uses for fuel are blended pellet comprised of forty percent softwood (pine species) and sixty percent hardwood tree species (oak, birch, maple). GLRE pellets are first wood chips that are ground in a large hog mill grinder, then go through a rotary drum dryer, and finally into a finish grinder. The fiber is then tempered in a storage vessel and sent to the pellet mill to create the pellets heated to approximately 200 degrees F and 45,000psi pressure. The newly manufactured pellets are then cooled in an air driven cooler and packaged into bulk containers for future unloading into auger trucks and delivery to Birch Grove.

Birch Grove does not want to have too many pellets stored at any point, just enough to provide for their heating needs during cold winter months. They use about 34 tons of pellets per year with two sixteen to seventeen ton loads of delivered pellets (each load lasts them about two months).

As Olsen explains, there are a number of advantages aside from cost in using pellets as a fuel source versus fuel oil. One is that pellets are produced locally, which benefits the local economy and is more environmentally friendly. Birch Grove is also able to use the system as a teaching tool for school kids by explaining how it works. It is also a clean way to generate heating, which is especially important for Birch Grove because a clinic operates nearby and school children are present.

However, there are also a number of disadvantages when using pellets for heating. The pellet boiler is not as flexible as fuel oil in terms of just being able to turn it on and off with a flip of a switch. Also, it is not possible to store a lot of fuel throughout the summer because it collects moisture. Lastly, as mentioned earlier, delivery costs are also an issue because their supply comes from 168 miles away.

Overall, Olsen says that they are very happy with the new pellet boiler. It offers more stable fuel prices, it is low maintenance, and it is easy to operate. The only thing he feels they may have done differently is to step up the size of the storage silo because the cost of getting fuel delivered is high. If they had a forty-ton silo, they could have enough fuel stored so they would only need one delivery per year rather than two.

The most important lesson Birch Grove learned through the development of the project is that "a lot of the fears and concerns that we had could be engineered out. We thought it would smoke a lot, it didn't. We thought the maintenance would be bad, it wasn't. We thought that it would smell, it doesn't."

Olsen mentioned a number of important considerations in deciding whether or not to convert to biomass. One is to understand that you need a backup heating system when it is relatively warm out (i.e. around fifty degrees) because a biomass boiler loses a lot of efficiency when it is not cold outside. Biomass cannot turn on and off easily in temperate climates and can put out too much heat, causing people to open their windows wasting energy.

As far as Birch Grove's future in using biomass is concerned, Olsen said that they are planning to tie future buildings into the system. They can get forty percent more out of the Pelco boiler and increased demand will improve the efficiency of the system. There are plans to add a nine hundred square foot warming house, which will help utilize some of the excess capacity. When they get more experience, the town may also look at heating their second largest building (the town hall) in the future.

Len Busch Roses

Len Busch Roses first opened in 1965 with a few employees, a modest 28,000 square feet of space, and a crop of pom poms. Since then, the company has grown to 530,000 square feet of greenhouses and 160 full-time workers. Len Busch Roses produces a wide variety of flowers including roses, alstroemeria, lilies, tulips, snapdragons, gerberas, and potted flowering plants. Over seven million stems and pots are produced and sold each year through its greenhouses. Len Busch Roses is one of the only rose growers in the country outside of California.
Growing roses has demanding heating requirements, especially in Minnesota's climate, and biomass has played an integral part in heating Len Busch Roses' greenhouses for over thirty years. The company's founder, Len Busch, installed the first biomass boiler in 1977 when oil prices were soaring during the energy crisis. The original boiler (from Hurst Manufacturing) used very clean and already processed fuel from the byproducts of kitchen cabinet manufacturers and handled the heat load for the facility. As the greenhouses were expanded, they added gas boilers to handle the additional load.

In 2000, Patrick Busch bought the company from his father Len. As the company continued to grow, the biomass system was expanded again with the addition of a second biomass boiler installed in 2006. According to Pat Etzel, Len Busch Roses' Senior Maintenance Technician, the project to install the new boiler was simple and straightforward. Part of the project was subcontracted. Overall, the project took around eight months to complete and cost $1.1 million.

In investigating which biomass model would best meet the greenhouses' heating needs, staff visited a number of installations and talked with various operators. Through Len Busch Roses' many years of experience using biomass for heating, they knew that burning wood was the easy part and that issues related to fuel variability and metering were the critical elements. So, they researched systems known for reliable fuel handling and flexibility. In the end, and following a visit to an operator in Wisconsin who had installed a similar system, the company chose a Hurst boiler based on its heavy-duty construction and ability to handle the volume and variability of their fuel supply.

The new boiler is a 400 horsepower firebox unit with an output of thirteen million Btu per hour and 2,600 square feet of heating surface. The older biomass boiler has an output of ten million Btu per hour. The two biomass units handle approximately 95-98% of the heat load with gas boilers acting as backup units.

After the new Hurst boiler was installed, the company was able to largely discontinue reliance on natural gas. However, cabinet manufacturing byproducts were no longer sufficient to meet the company's heating needs, so they went after a more local, renewable source of fuel: tree trimming residue from customers and local residents. According to Etzel, "The key thing about the fuel we burn now is that it comes from a close, local supply. The price kept going up with our original fuel source [natural gas], which provided us the impetus to change to a local supply." The trimming residue comes within a ten-mile radius of the greenhouses and is a mix of chips, logs, and brush. About 10,000-12,000 tons of fuel are burned annually. Because of the solar gain of the greenhouses, the boilers can be shutdown four weeks of the year when a heating source is not required.

The manufacturing byproducts used to fuel the older biomass system was a very clean fuel source that produced little ash (one to two percent of clean wood is ash). Based on experience with this fuel there was little concern with ash in selecting a new boiler system. However, trimming residue is a much dirtier fuel (two to eight percent ash), and they learned that ash is a much bigger issue to deal with than they had anticipated. Ash needs to be manually removed from the boiler once or twice a day and is applied to crop fields as a fertilizer. As Etzel pointed out, if they had known how much work was required to handle the ash, they would have considered installing an automatic ash removal system.

Len Busch Roses also has its own onsite facilities to store and process its fuel. They have a yard open 24/7 to encourage people to drop off their trimming waste. On average, about twenty loads (200 yards) of residue are dropped off per day.

Once the fuel is delivered, its needs to be processed, and a special processing and storage area were built to accomplish this task. Originally, the company attempted to burn chips directly without any processing but found that for ease of operation, the fuel needed to be processed. All of the fuel now goes through a three hundred horsepower (one hundred cubic yards per hour) grinder to achieve the necessary fuel specifications (less than three inches). When grinding logs and brush, they prefer to do an initial course grind (six inches plus) and then leave the fuel to dry out until it is ready to use.

Fuel storage has been an especially important component of the new system. Work to improve storage facilities has been continuous because it is a big challenge to handle the tree-trimming residue that comes in during the summer. The trimming residue is delivered green and put into an open-sided storage building to reduce its moisture content. For the older boiler, fuel is stored in a silo that holds two days worth of fuel and then is automatically delivered to the boiler via an auger. The new boiler has storage via a walking floor system that walks the fuel through a series of conveyors and ultimately to the boiler. Through these improvements, the company significantly lowered its heating costs between 2006 and 2007.

Overall, it takes about four to six hours of labor per day to grind the wood, rake, clean boilers, and lubricate the system. Every week, around twenty to twenty-five hours of labor are needed in the summer and forty plus hours in the winter.

Etzel believes that the main advantage of using biomass as a heating system is cost savings. Assuming 82-83% efficiency for gas and 70% for wood, the fuel cost for gas is between $7.00-$13.00 per deca therm, and with labor costs for wood around $40,000 per year, the cost per million Btu for biomass is about $1.50 per deca therm, representing an eighty to ninety percent heating cost savings. Annually, Len Busch Roses saves between $150,000-$200,000 heating with biomass compared to gas or oil. Through these savings, they expect to have the boiler paid off in four to five years.

However, using biomass for heating is not without its challenges. There is a lot of equipment to maintain and the system cannot be flipped on and off like a conventional gas or oil fired system. There is also considerable fuel variability from size to potential contaminants. Lastly, you need to be able to respond during any hour of the day in case of emergencies.

Overall, Etzel says that they have been very happy with using biomass for heating: “Biomass has been essential for the survival of the company to keep heating costs at a reasonable level. It also fits what we’re trying to do as a company in terms of being more sustainable.”

Etzel thinks some of the most important lessons to take away from Len Busch Roses’ experience in utilizing biomass are to take ash removal seriously, recognize that biomass is a variable fuel source, and there are ways to deal with these issues (e.g. alarm systems, sufficient staffing levels, etc). Also, assessing the availability of a fuel supply that can be relied upon is a critical consideration when deciding whether to adopt a biomass heating system.

Hedstrom Lumber

Hedstrom Lumber is a sawmill located in Grand Marais, Minnesota. The company processes logs into dimensional lumber. It employs around thirty people and delivers over 700 truckloads of lumber annually to retail yards throughout the Midwest.

Hedstrom Lumber has decades of experience utilizing biomass at its site. The first boiler was self-installed in the 1970s, and the company has stuck with biomass as a heat source ever since. Upgrading of the size and technology of the boilers has been continuous and the company is currently on their fourth boiler, which was installed about fifteen years ago. The Johnston steam boiler has custom burners and controls, and it provides one hundred percent of the heat load for Hedstrom Lumber’s 50,000 square foot facility.

Prior to using biomass for heating, the company used fuel oil, the price of which fluctuated and made heating of their facilities expensive. They have found that heating with biomass is the most economical option for their business.

In fact, the primary reason that Hedstrom Lumber switched to biomass and has stayed with it was to save money and lower heating costs. According to Howard Hedstrom, President of Hedstrom Lumber, "With a fuel oil system, all it takes is a flip of a switch to turn the system on and off. Using wood is a much more hands-on and time consuming process for maintenance and operations, so the only real reason to use it is because it is cheaper."

The boiler uses a fuel mixture that is half sawdust and half bark, both of which are "green" wood with high moisture content. Woodchips are also used for fuel once in a while when hog fuel has too much snow content during the winter. Before it is burned, the fuel is processed through a hammer mill and is ground up and resized for better consistency. The dry-basis moisture content of the fuel ranges from 45-55%. This high moisture content is appropriate and can be beneficial to the spreader-stoker type of system.

They store enough fuel to last 3-4 days (50-70 tons) of consumption in their silos. Fuel degradation problems are non-existent because the fuel moves through quickly and they do not store a large amount of long-term fuel.

The system produces about 5 cubic feet of ash per day, which they provide to farmers to use as a soil enhancer.

Aside from the labor needed for ash removal, the system is mostly automated and can be run practically unattended. Generally, about 10-15 hours per week are needed to operate the system.

Hedstrom Lumber uses about 5,000 tons of fuel per year. All of the fuel comes from byproducts of the mill operations, making it a very efficient and inexpensive onsite heating source. Since the fuel comes from onsite sources, they do not have to worry about fuel expenses.

The mill byproducts that are not used for heating, are sold throughout the Midwest region. Sawdust is sold to wood pellet producers and excess woodchips are sold as mulch. In view of the availability of these other markets, the use of wood for fuel results in opportunity costs. From a lost revenue perspective, they lose about $20.00 of revenue per ton for fuel, or about $100,000 in lost revenue per year. This figure must be considered in calculating fuel costs.

Since the 1970s, Hedstrom Lumber has worked hard to continuously improve different aspects of their biomass system. Generally, they have focused on upgrading the controls and fuel handling because those are the most critical operations and the hardest to optimize. One of the most notable improvements Hedstrom Lumber has made is the computerization of the biomass system, which allows for more precise control over inputs. The system utilizes modulating controls that help maintain steadier temperatures as the system is always in the process of burning and drying. Also, the current boiler has a spreader-stoker with a good turn down ability and it can handle a wide range of fuel types with varying moisture contents.

As Hedstrom explains, buying the right biomass system is very site specific, and there is not a one-size-fits-all recommendation for making the right choice. Installers might say that they have the perfect system for you, but people need to realize that the owner/operator is the one who have to live with the system. In choosing the right system, it is important to consider the climate because too much moisture can accumulate with snow and ice, and you have to adjust heating temperatures to first deal with the moisture content/ice and then burn the wood (which takes much more energy).

Hedstrom believes that the most important considerations before installing a biomass heating system are what techniques to use when handling the fuel, matching the fuel with the equipment, and having the right type of bins, conveyors, and controls. He explained, “In every biomass facility I have been in, the storage, handling, and delivery of fuel are the major issues and the ones that are usually not well thought out ahead of time. I have also seen where not enough thought has gone into the ash handling.” However, he pointed out that there are advantages and disadvantages associated with any type of biomass equipment and there is no one “best” way of heating with biomass: “We use chain conveyors. Others use belt conveyors. Spillage and wind throw are hard to contain from belt systems, but chain systems have issues too.”

A key lesson to take away from Hedstrom Lumber’s experience is that “Wood does not burn like gas or oil. You have to plan on the time and cost of the extra attention that biomass systems require, both in manpower, time, and necessary skills.” As Hedstrom Lumber’s experience illustrates, if implemented thoughtfully, biomass can be an economically sound method for heating and can play a significant role in the success of a business.

Conclusions

A great effort was made to select five case studies that represent a broad spectrum of biomass energy and heating applications in Minnesota. The five that were chosen were thought to be the most relevant and adaptable for communities within Cook County. However, because of the time constraints of this project, the case studies that were selected represent a small fraction of the total number of biomass applications within Minnesota, the United States, and globally. Therefore, it would be valuable if further research and case studies could be developed based on the experiences of other biomass sites that were considered but not included in this project.

The following list includes some sites utilizing biomass within Minnesota and whose experiences could be turned into case studies:

Facilities with Large (> 200,000 grn. tons) Supply (Annual Wood Needs) Requirements

Project Name	Location	Contact Person	Contact Phone	Contact Address	Fuel Supply Radius	Annual Wood Needs (approx. green tons)	Wood Product Utilized	Type of Facility
Grand Rapids Cogeneration	Grand Rapids, MN	Mike Polzin	218-628-3627 x5741	30 West Superior St. Duluth, MN 55802	100 mi	>300,000	mill residual (60%), logging slash (37%), other (3%)	CHP plant
Newpage/Hibbard Energy Center*	Duluth, MN	Mike Polzin	218-628-5100	100 North Central Av, Duluth MN 55807	80 mi	> 200,000	mill residual (50%), logging slash (25%), other (25%)	electricity and steam
Laurentian Renewable Energy (LEA)	Virginia-Hibbing, MN	Terry Leoni		Hibbing Public Utilities Hibbing, MN	75 mi	>200,000 for the two plants	logging slash (65%), other (35%)	electricity and steam
St. Paul District Energy II	St. Paul, MN	Jeff Guillemette	651-747-5798	6 West 5th Street St. Paul, MN 55102	100 mi	>200,000	mill residual (5%), logging slash (35%), other (60%)	district heat
SAPPI	Cloquet, MN	Ross Korpela	218-879-2387	221 Avenue B, Cloquet MN55720	60 mi	>300,000	mill residual (10%), roundwood (10%), logging slash (80%)	CHP
Fibrominn	Benson, MN	Greg Langmo	320-843-9013 xt.203	900 Industry Dr. Benson, MN 56215	none designated	>200,000	25% sawdust, shavings, 25% mill residue, 25% roundwood, 25% other	steam and electricity

Facilities with Mid-Range (50,000-200,000 grn. tons) Supply (Annual Wood Needs) Requirements

Project Name	Location	Contact Person	Contact Phone	Contact Address	Fuel Supply Radius	Annual Wood Needs (approx. green tons)	Wood Product Utilized	Type of Facility
Verso Paper	Sartell, MNI	Eric Dyckhuis	320 240 7228	100 East Sartell St, Sartell Mn 56377	75 mi	50,000-200,000	mill residual (63%), logging slash (30%), other (7%)	electricity and steam
Rahr Malting-Koda Energy	Shakopee, MN	Paul Kramer	952-496-7002	801 1st Ave W. Shakopee, MN 55379	70 mi	50,000-200,000	logging slash from forest management (83%), other (17%)	CHP

Facilities with Small (< 50,000 grn. tons) Supply (Annual Wood Needs) Requirements

Project Name	Location	Contact Person	Contact Phone	Contact Address	Fuel Supply Radius	Annual Wood Needs (approx. green tons)	Wood Product Utilized	Type of Facility
Len Busch Roses	Plymouth, MN	Patrick Etzel	763-478-9327	4045 Hwy 101 Plymouth, MN 55446	15 mi	<50,000	20% sawdust, shavings, mill residue, 80% roundwood, split wood, urban residue	steam
Hedstrom Lumber	Grand Marais, MN	Howard Hedstrom	218-387-2995	1504 Gunflint Trl, Grand Marais, MN 55604	150 mi	<50,000	100% sawdust and bark	steam
Andersen Windows	Bayport, MN	Kirk Hogheva	651-264-5150	100 4th Ave. N Bayport, MN 55003	0 mi	<50,000	100% sawdust, shavings, mill residue	steam
Potlatch	Bemidji, MN	Peter Aube	218-759 4301	50516 Sty Rd 45, Bemidji MN 56601	on site	<50,000	100% sawdust, shavings, mill residue	steam
Bergen's Greenhouses	Detroit Lakes, MN	Christopher Bergen	none provided	801 Willow St. W Detroit Lakes, MN 56501	200 mi	<50,000	100% sawdust, shavings, slabs and mill residue	hot water
Creative Sawmilling & Products LLC	Bovey, MN	Jerry Seppala	218-259-3027	313 Lawson Dr. Bovey, MN 55709	10 mi	< 500	75% sawdust, mill residue, 25% roundwood	heat
Ferche Millwork	Rice, MN	Gerald Grider, Charlie Meyer	320-393-5700	400 Division St. N Rice, MN 56367	0 mi	501-5,000	100% sawdust, shavings, mill residue	steam
Foldcraft Company	Kenyon, MN	Doug David	507-789-5111	615 Centennial Dr. Kenyon, MN 55946	0 mi	5,001-50,000	95% sawdust, shavings, 5% chips	heat and steam
Hulls Sawmill	Two Harbors MN	Gregory Hull	218-834-5246	3173 E Alger Rd. Two Harbors, MN 55616	30 mi	<500	75% sawdust, mill residue, 25% roundwood, split	hot water
Isabella Community Center	Isabella, MN	Patricia Thums	none provided	9521 Lankinen Road, PO Box 5 Isabella, MN 55607	20 mi	<500	100% roundwood, split wood	heat
Jarden Home Brands	Cloquet MN	Rick Pomroy, Peter Grams	218-879-6700	1800 Cloquet Ave. Cloquet, MN 55720	50 mi	<50,000	5% sawdust and shavings, 60% forest chips, 35% mill chips	steam
Woodcraft Industries	St. Cloud, MN	Dave Forst	320-252-1503	525 Lincoln Ave SE St. Cloud, MN 56304	internal	<50,000	mill residual (100%)	steam
Boise Inc	International Falls, MN	Dave Austin	218-285-5430	400 3rd Ave E International Falls, MN 56649	150 mi	<50,000	mill residual (50%), logging slash from purchased roundwood (50%)	CHP
Hill Wood Products	Cook, MN	Steve Hill	800-788-9689 xt. 105	9483 Ashawa Road Cook, MN 55722	internal	<50,000	mill residual (100%)	heat and steam
Ponderosa Sawmill	Sandstone, MN	Randy Michel	320-245-0112	48055 Tamarck River Road Sandstone, MN 55072	1 mi and internal	<500	75% slabs, 25% roundwood	heat and hot water
Rasley's Blueberry Bowl	Deer River, MN	Thomas Rasley	218-246-8048	44919 Golf Course Rd. PO Box 37 Deer River, MN 56636	20 mi	<500	100% roundwood, split wood	heat
St. Gabriel's Hospital	Little Falls, MN	Kevin O'Neil	320-632-5441	815 2nd St. SE Little Falls, MN 56345	60 mi	501-5,000	100% chips from mill residue	steam

Wicks's Wood Products	Akeley, MN	Donald Wicks	218-652-2315	85 W Broadway Akeley, MN 56433	internal	no information	80% sawdust and mill residue, 20% chips mill residue	steam
U of M- Morris	Morris, MN	Mike Reese	320-589-1711	46352 State Hwy 329 Morris, MN 56267	20 mi	9,000	Agricultural waste	syngas-power
Goodridge School ISD #561	Goodridge, MN	Ronald Kotrba	none provided	Osmund Ave. PO Box 195 Goodridge, MN 56725	50 mi	170	100% wood pellet	steam
Mahnomen Public Schools ISD#432	Mahnomen, MN	Josh Bendickson	218-935-2211	209 1st St. S PO Box 319 Mahnomen, MN 56557	100 mi	1000	100% chips from forest harvest ops	steam
Northome School ISD #363	Northome, MN	Jerry Struss	218-897-5275	11071 Hwy 1 Northome, MN 56661	local manufacturer	544	100% pellets	heat
Pine River Backus Schools ISD #2174	Pine River, MN	Karl Flin	218-587-8004	PO Box 619810 1st St. N and 401 Merry Ave Pine River, MN 56474	.5 mi	760	100% chips from mill residue	steam and hot water
Swanville Public Schools ISD #486	Swanville, MN	Gene Horthan	none provided	PO Box 98 Swanville, MN 56382	50-100 mi	700	100% pellets	heat
Warroad Schools ISD #690	Warroad, MN	Albert Hasbargen	none provided	510 Cedar Ave. Warroad, MN 56763	100 mi	350	100% chips from mill residue	hot water
Cussom Camp Company	Orr, MN	Tony Vukelich	218-757-3911	10671 Slade Rd. Orr, MN 55771	50 mi	10	100% sawdust, shavings, mill residue	heat
Poly Foam	Lester Prairie, MN	Dave Carl	320-395-2551	116 Pine St. S Lester Prairie, MN 55354	95 mi	<50,000	50% pellets, 50% mill by-product	steam
Marvin Windows	Warroad, MN	Keith Landin	218-386-1430	801 State Ave. Warroad, MN 56763	150 mi	<50,000	mill residual (40%), logging slash (40%), other (20%)	heat and steam
Viking Waterbeds	Saint Joseph, MN	Conrad Legatt	320-259-0909	38169 County Rd. 2 Saint Joseph, MN 56374	internal	20	100% internal mill sawdust, shavings and residue	heat
Tuohy	Chatfield, MN	Gary Ruskell	507-867-7280	42 St. Albans Place Chatfield, MN 55923	30 mi	<50,000	mill residual (100%)	heat

Facilities that Produce a Value-Added Product in Addition to Energy

Project Name	Location	Contact Person	Contact Phone	Contact Address	Fuel Supply Radius	Annual Wood Needs (approx. green tons)	Wood Product Utilized	Type of Facility
Georgia-Pacific (Superwood)	Duluth, MN	Brian Lochner	218-720-8293	100 West Railroad St. Duluth, MN 55802	75 mi	<50,000	mill residual (5%), roundwood (40%), logging slash (55%)	hardboard and steam
Oak Creek Pellets	Hillman, MN	Jeff Thommes	320-468-2795	11783 Patridge Rd. Hillman, MN 56338	75 mi	<50,000	mill residual (100%)	pellets and heat

Source: MNDNR-Division of Forestry. "Active Woody Biomass Energy Facilities in Minnesota." http://files.dnr.state.mn.us/

Ainsworth Engineered (USA)LLC
9358 Hightway 53 south
Cook MN 55723

Contact: Kent Jacobson
Woodlands manager

Type of Energy Facility: *Steam, thermal oil*
Year Installed: *1980/2001*
Season of Use: *Continuous*
Facility Output: *Heat and Steam*
District Heat: *No*

Facility Size; <u>Output per Hour</u>: *104MM BTUs, ,<80,000 lbs steam*
Size of fuel Used: *small uniform*
Percent of Fuel used by TYPE: *21% sawdust, shavings other mill residue 79% chips derived from mill residue.*
Fuel Supply Source: *100% mill residue*
Annual volume used: *none provided*
Fuel Supply Radius: *Residue on site*

Comments: Operations curtailed at this plant as of October 2008.

Ainsworth Engineered (USA) LLC
29647 US Hwy 2 East
Bemidji MN 56601

Contact: Kent Jacobson
Woodlands manager

Type of Energy Facility: *Steam 7Thermal Oil*
Year Installed: 1982
Season of Use: *Contiuous*
Facility Output: *Heat*
District Heat: *No*

Facility Size; <u>Output per Hour</u>: 135 MM BTUs
Size of fuel Used: *Small Uniform size*
Percent of Fuel used by TYPE: *100% Chips from mill residue*
Fuel Supply Source: *100% Mill residue from operations.*
Annual volume used: 50,001-*200,000 Green tons*
Fuel Supply Radius: *All from internal operations*

Comments: Operations curtailed at this plant as of October 2008.

Ainsworth Engineered (USA) LLC
502 County Road 63
Grand Rapids MN 556744

Contact: Kent Jacobson
Woodlands Manager

Type of Energy Facility: *Heat*
Year Installed: *1980*
Season of Use: *operations curtailed*
Facility Output: ***Heat***
District Heat: *No*

Facility Size; <u>Output per Hour</u>: 140MM BTUs
Size of fuel Used: *Small uniform*
Percent of Fuel used by TYPE: *100% sawdust, shavings, mill residue*
Fuel Supply Source: *100% Mill operations*
Annual volume used: *currently 0*
Fuel Supply Radius: *0*

Comments: Mill operations curtailed in September 2006.

Andersen Corporation
100 Fourth Ave N
Bayport MN 55003

Contact: Kirk Hogheva
Manager, Energy and Environmental

Type of Energy Facility: *Steam*

Year Installed: *1913/2007*
Season of Use: *Contiuous*
Facility Output: *Steam*
District Heat: *No*

Facility Size; <u>Output per Hour</u>: ***80,000 MM BTUs***
Size of fuel Used: *Small uniform*
Percent of Fuel used by TYPE: *100 % sawdust, shavings, mill residue*
Fuel Supply Source: *100% Mill waste from operations.*
Comment:
Annual volume used: 5001-5*0,000 green tons*
Fuel Supply Radius: *0*

Bagley Hardwood Products
1004 Central St West
PO Box C
Bagley MN 56621

Type of Energy Facility: *Steam*
Year Installed: *1997*
Season of Use: *Continuous*
Facility Output: *Heat and Steam*
District Heat: *No*

Contact Peggy Fultz
Office Manager
Facility Size; <u>Output per Hour</u>: *9.5MM BTU's ; 840 lbs*
Size of fuel Used*:* *Coarse undefined size*
Percent of Fuel used by TYPE: *100% sawdust, shavings and Mill residue*
Fuel Supply Source: *100% Mill operations*
***Annual volume used:** *5001-50,000 green tons*
Fuel Supply Radius*:* *0 miles*

Comments: Kiln dried wood shavings available in summer months.

Bergen's Greenhouses
801 Willow Street West
Detroit Lakes MN 56501

Contact: Christopher Bergen, Owner

www.Bergensgreenhouses.com

Type of Energy Facility: Hot Water
Year Installed: 1984
Season of Use: Seasonal
Facility Output: Hot water
District Heat: No

Facility Size; <u>Output per Hour</u>: No information
Size of fuel Used: *Coarse undefined size*
Percent of Fuel used by TYPE: *100% sawdust, shavings, slabs and other mill residue.*
Fuel Supply Source: *100% purchased of obtained free.*
Annual volume used: *5,001 -50,000 green tons*
Fuel Supply Radius: *200 miles, mill residue*

Comments: Wood heat has been very beneficial for the company.

Boise Cascade, LLC
400 3rd Av East
International Falls MN 56649

Contact: Steve Earley
Region Woodlands Manager

Type of Energy Facility: *Steam, electricity*
Year Installed: *1985*
Season of Use: *Contiuous*
Facility Output: *Combined heat and power (CHP)*
District Heat: *No*

Mill location; 400 2nd Av
Facility Size; <u>Output per Hour</u>: *185,000 lbs*
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE:*100% sawdust, shavings and other mill residue*
Fuel Supply Source*: 90% mill residue, 10% purchased or obtain free from outside supplier*
Annual volume used: *>201,001 green tons*
Fuel Supply Radius: *60 miles – mill residue*
Comments:

Cass Forest Products
PO Box 1008
Cass Lake MN 56633

Contact: Dave Getz
Owner

Type of Energy Facility***:*** *Steam*
Year Installed: *2005*
Season of Use: *Continuous*
Facility Output: *Steam & Hot water*
District Heat: *No*

Facility Size; <u>Output per Hour</u>: *3.2 MM BTUs*
Size of fuel Used: *Small Uniform*
Percent of Fuel used by TYPE: *100% Sawdust, shavings, other mill residue*
Fuel Supply Source: *100% own operations*
Annual volume used: *501-5,0000 Green tons*
Fuel Supply Radius: *1 Mile*
Comments:

Creative Sawmilling & Products LLC
313 Lawson Dr
Bovey MN 55709

Contact: Jerry Suppala

Type of Energy Facility: *Hot Water*
Year Installed: *1991*
Season of Use: ***Seasonal***
Facility Output: ***Heat***
District Heat: ***No***

Facility Size; <u>Output per Hour</u>: *No information*
Size of fuel Used: ***Coarse undefined***
Percent of Fuel used by TYPE: *75% Sawdust, shavings, mill residue; 25% Roundwood*
Fuel Supply Source: *75% waste from operations; 25% Chips purchased or obtained free of charge*
Annual volume used: *<500 green tons*
Fuel Supply Radius: *10 miles*
Comment:

Environmental Wood Supply LLC
1350 Landmark Tower, #345
St. Peter St
St. Paul MN 55102

Contact: Michael Burns
Jeff Guillmette, Wood procurement
Facility location: 125 Shepard Road W, St. Paul MN 55125

Type of Energy Facility*: Steam*
Year Installed: *2003*
Season of Use: *Continuous*
Facility Output: *CHP*
District Heat: ***Yes***

Facility Size; <u>Output per Hour</u>*: 25 MgWatts, 310,000 lbs*
Size of fuel Used: *Small undefined*
Percent of Fuel used by TYPE: *70% roundwood urban residue, 20% chips forest harvest, 5% clean construction debris*
Fuel Supply Source: *20% forest harvest; 80% purchased or obtained free of charge.*
Annual volume used: *>200,001 green tons*
Fuel Supply Radius: *100 miles*
Comment: supplier for St. Paul District Energy

Ferche Millwork
400 Division Street N
Rice MN 56367

Contact: Gerald Grider

Type of Energy Facility: *Steam*
Year Installed: *1987*
Season of Use: *Continuous*
Facility Output: *Steam*
District Heat: ***No***

Facility Size; <u>Output per Hour</u>: ***1. 509,304 lbs 2. 764,010 lbs***
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *100% Sawdust, shavings, mill residue*
Fuel Supply Source: *100% Mill residue from mill operations*
Annual volume used: *501-5000 green tons*
Fuel Supply Radius: *0*
Comment: *Two facilities, company sells much more than it consumes for animal bedding and residue markets*

Fibrominn
900 Industry Dr
Benson MN 56215

Contact: Greg Langmo

Type of Energy Facility: *Steam*
Year Installed: 2007
Season of Use: *Continuous*
Facility Output: *Electricity*
District Heat: *No*

Facility Size; <u>Output per Hour</u>: *55 Megawatts*
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *25% Sawdust, shavings, mill residue; 25% roundwood; 25%; 25% mill residue; 25% other sources*
Fuel Supply Source: *No information provided*
Annual volume used: **5***0,001-200,000 green tons*
Fuel Supply Radius: *None designated*
Comments:

Foldcraft Company
615 Centennial Dr
Kenyon MN 55946

Contact: Doug David
Facility Manager

Type of Energy Facility: *Steam& radiant heat*
Year Installed: *no information*
Season of Use: *Continuous*
Facility Output: *Heat and steam*
District Heat: *No*

Facility Size; Output per Hour: ***4.46MM ;bs***
Size of fuel Used: *Coarse undefined and small uniforms size*
Percent of Fuel used by TYPE: *95% sawdust, shavings form operations, 5% Chips from mill residue.*
Fuel Supply Source: *100% from process operations*
Comments:
Annual volume used: *5001-50,000 green tons*
Fuel Supply Radius: *0*

Georgia-Pacific Wood Products LLC
1220 W Railroad St
Duluth MN 55802

Contact Brian Lochner
Wood Procurement Manager

Type of Energy Facility*:* *Steam*
Year Installed: *1972*
Season of Use: *Continuous*
Facility Output: *Steam*
District Heat: *No*

Facility Size; Output per Hour: ***25,000 lbs***
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *100% sawdust, shavings, mill residue*
Fuel Supply Source: *100% waste residue from operations*
Comments
Annual volume used: *5001-50,000 green tons*
Fuel Supply Radius: *0*

Hill Wood Products
PO Box 398
Cook MN 55723

Contact: Steve Hill

Facility location: Mtn Iron

Type of Energy Facility: *Suspension burner*
Year Installed: *1986*
Season of Use: *Continuous*
Facility Output: *Heat*
District Heat: *No*

Facility Size; Output per Hour: ***350MM BTUs***
Size of fuel Used: *Small uniform*
Percent of Fuel used by TYPE: *40% dry sawdust; 60% oat hulls*
Fuel Supply Source: *5% waste residue for own process; 95% purchased*
Annual volume used: *>200,001 green tins*
Fuel Supply Radius: *200 miles*

Hill Wood Products 9483 Ashawa Road Cook MN 55722 Contact Steve Hill Facility #2 Ashawa Road	**Type of Energy Facility:** *Suspension burner* **Year Installed**: *1965* **Season of Use:** *Continuous* **Facility Output:** *Heat & Steam* **District Heat:** *No*

Facility Size; <u>Output per Hour</u>: *13,900 BTUs ,600 lbs*
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *100% sawdust, shavings, mill residue*
Fuel Supply Source: *20% waste own operations; 80% purchased*
Annual volume used: *>200,001 green tons*
Fuel Supply Radius: *200 miles*

Hull's Sawmill 3173 E Alger Rd Two Harbors MN 56616 Contact: Gregory Hull	**Type of Energy Facility:** *Hot water* **Year Installed**: *2003* **Season of Use:** *Continuous* **Facility Output:** *Hot water* **District Heat:** *No*

Facility Size; <u>Output per Hour</u>: ***No information provided***
Size of fuel Used: *Coarse undefined*
Percent of Fuel used by TYPE: *75% Sawdust, shavings, mill residue; 25% roundwood, split*
Fuel Supply Source: *100% waste residue for own operations*
Comments:
Annual volume used: **<**500 green tons
Fuel Supply Radius: *30 miles*

Isabella Community Center 9521 Lankinen Road, PO Box 5 Isabella MN 55607 Contact: Patricia Thums	**Type of Energy Facility:** *Hot water* **Year Installed**: *1985* **Season of Use:** *Seasonal* **Facility Output:** *Heat* **District Heat:** *No*

Facility Size; <u>Output per Hour</u>: ***No information provided***
Size of fuel Used: *Small Uniform 8 inch*
Percent of Fuel used by TYPE: *100% Roundwood, split wood*
Fuel Supply Source: *100% Forest Harvest*
Comments:
Annual volume used: *<500 green tons*
Fuel Supply Radius: *20 miles*

Fon du Lac Resource Management Division 1720 Big Lake Road Cloquet MN 55720 Contact: Steve Usu Reservation Forester	**Type of Energy Facility:** *Gasification* **Year Installed**: *2008* **Season of Use:** *Seasonal* **Facility Output:** *Heat & Electricity* **District Heat:** ***No***

Facility Size; <u>Output per Hour</u>: ***200,000 BTUs , 20 Kw***
Size of fuel Used: *Coarse undefined size*
Percent of Fuel used by TYPE: *100% Chips – Harvest operations*
Fuel Supply Source: *100% Forest harvest ops*
Annual volume used: **<** 500 *green tons*
Fuel Supply Radius: *20 miles*

Hedstrom Lumber 1504 Gunflint Trail Grand Marais MN 55604 Contact : Howard Hedstrom	**Type of Energy Facility:** *Steam* **Year Installed** *1970* **Season of Use:** *Continuous* **Facility Output:** *Steam* **District Heat:** *No*

Facility Size; <u>Output per Hour</u>: ***15,000 lbs.***
Size of fuel Used: ***Coarse undefined size***
Percent of Fuel used by TYPE: *100% Sawdust and bark*
Fuel Supply Source: *100% waste residue from mill operations*
Comments:
Annual volume used: *5,001 –50,000 green tons*
Fuel Supply Radius: *150 mile harvest radius*

Itasca Community College 1851 East Hwy 169 Grand Rapids MN 55744 Contact: Mike Kee	**Type of Energy Facility:** *Steam* **Year Installed**: *1989* **Season of Use:** *Seasonal* **Facility Output:** *Steam* **District Heat:** *No*

Facility Size; <u>Output per Hour</u>: ***956,544 BTUs***
Size of fuel Used: *Coarse undefined size*
Percent of Fuel used by TYPE: *100% Chips from mill residue*
Fuel Supply Source: *100% purchased or obtained free of charge*
Comments: Difficulty in obtaining chips for the boiler.
Annual volume used: *None used in 2007*
Fuel Supply Radius: *100 miles*

Itasca County Community YMCA
400 River Road
Grand Rapids MN 55744

Contact: Amy Morrisette

Type of Energy Facility: *Hot water*
Year Installed: *1986-87*
Season of Use: *continuous*
Facility Output: *Heat – Hot water*
District Heat: *No*

Facility Size; Output per Hour: ***No information***
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *100% pellets or Briquettes*
Fuel Supply Source: *100%purchased - outside supply*
Comments:
Annual volume used: 501-5000 green *tons*
Fuel Supply Radius: *No information*

Jarden Home Brands
1800 Cloquet Av
Cloquet MN 55720

Contact: Peter Grames
Plant engineer

Type of Energy Facility: *Steam*
Year Installed: *1932; modified 1940*
Season of Use: *Continuous*
Facility Output: *Steam*
District Heat: *No*

Facility Size; Output per Hour: *8MM BTU per boiler X 4 boilers*
Size of fuel Used: *Coarse undefined size, chips and hogged fuel*
Percent of Fuel used by TYPE: *5% Sawdust, shavings; 60% chips from forest harvest ops; 35% chips from mill residue*
Fuel Supply Source: *40% waste residue from own ops; 60% purchased or obtained free*
Comments
Annual volume used: 5001-*50,000 green tons*
Fuel Supply Radius: *50 mile radius harvest operations*

Len Busch Roses
4045 Hwy 101 North
Plymouth MN 55446

Contact: Pat Etzel
Director of Physical Plant

Type of Energy Facility: *Steam*
Year Installed: *1977 & 2006*
Season of Use: ***Continuous***
Facility Output: ***Steam***
District Heat: ***No***

Facility Size; Output per Hour: ***24,398 lbs***
Size of fuel Used: *Small Uniform size*
Percent of Fuel used by TYPE: *20% sawdust, shavings, mill residue; 80% roundwood, split wood, urban residue*
Fuel Supply Source: *100% purchased or obtained free of charge.*
Comments:
Annual volume used: *5001-50,000 green tons*
Fuel Supply Radius: *15 miles*

Minnesota Power – Hibbard Plant
100 North Central Av
Hibbard Energy Center
Duluth MN 55802

Type of Energy Facility: *Steam*
Year Installed: *1987*
Season of Use: *continuous*
Facility Output: *Electricity & Steam*
District Heat: *No*

Contact : Mike Polzin
30 W Superior St
Duluth MN 55802
Facility Size; Output per Hour: ***450,000 lbs; 2 – 25 MgW turbines***
Size of fuel Used: *Coarse undefined size*
Percent of Fuel used by TYPE: *10% Forest harvest ops, 60% Chips-mill residue, 30% chipped RR ties*
Fuel Supply Source: *10% forest harvest ops, 09% purchased or obtained free of charge*
Annual volume used: *>200,001 green tons*
Fuel Supply Radius: *75 miles forest harvest ops, 120 miles – mill residue*

Comments: Power for New Page mill

Minnesota Power Rapids Energy Center
Grand Rapids MN 56744

Contact : Mike Polzin
30 W Superior St
Duluth MN 55802

Type of Energy Facility: *Steam*
Year Installed: *1980*
Season of Use: *continuous*
Facility Output: *Electricity & Steam*
District Heat: *No*

Facility Size; Output per Hour: ***350,000 lbs***
Size of fuel Used: *Coarse undefined size*
Percent of Fuel used by TYPE: *40% Forest harvest ops, 60% Chips-mill residue*
Fuel Supply Source: *40% forest harvest ops, 09% purchased or obtained free of charge*
Annual volume used: *>200,001 green tons*
Fuel Supply Radius: *100 miles forest harvest ops, 80 miles – mill residue*

Comments: Power and steam for UPM mill

Ponderosa Sawmill
48055 Tamarck River Road
Sandstone MN 55072

Contact: Randy Michel

Type of Energy Facility: *Hot water*
Year Installed: *2002*
Season of Use: *Continuous*
Facility Output: *Heat & Hot water*
District Heat: No

Facility Size; Output per Hour: *100,000 Btus*
Size of fuel Used: *Coarse undefined size*
Percent of Fuel used by TYPE: *75% slabs, 25% roundwood*
Fuel Supply Source: 75% processing waste, 12% Harvest ops, 13% purchased or obtained free
Annual volume used: *<500 green tons*
Fuel Supply Radius: *1 mile harvest and on site*

Comments:

Potlatch Forest Products Corp.
50518 Cty Road 45
Bemidji MN 56607

Contact: Peter Aube

Type of Energy Facility: *Steam*
Year Installed: *1990 / 2007*
Season of Use: *Continuous*
Facility Output: *Steam*
District Heat: *No*

Facility Size; <u>Output per Hour</u>: *60,000 lbs for 2 boilers*
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *100% sawdust, shavings, other mill residue*
Fuel Supply Source: *100% mill operations*
Annual volume used: 5*001 –50,000 green tons*
Fuel Supply Radius: *on site*

Comments:

Rajala Mill Company
Box 231
Bigfork MN 56628

Contact: Jack Rajala

Type of Energy Facility: *Steam*
Year Installed: *1969*
Season of Use: *Continuous*
Facility Output: *Stean*
District Heat: *No*

Facility Size; <u>Output per Hour</u>: *1000 lbs*
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *100% sawdust, shavings, mill residue*
Fuel Supply Source: *100% own operations*
Annual volume used: *501-5000 green tons*
Fuel Supply Radius: *On site*

Comments

Rasley's Blueberry Bowl
44919 Golf Course Road / PO Box 37
Deer River MN 56636

Contact: Thomas Rasley

Type of Energy Facility: *Hot water*
Year Installed: *1986*
Season of Use: *Continuous*
Facility Output: *Heat*
District Heat: *No*

Facility Size; <u>Output per Hour</u>:: *No information*
Size of fuel Used: *Coarse undefined size*
Percent of Fuel used by TYPE: *100% Roundwood or split wood*
Fuel Supply Source: *100% purchased from outside supplier*
Annual volume used: *<500 green tons*
Fuel Supply Radius: *20 miles*

Comments:

SAPPI Fine Paper
20 North 22nd St
Cloquet MN 55720

Contact: Ross Korpela

Type of Energy Facility: *Steam*
Year Installed:
Season of Use: *Continuous*
Facility Output: *Heat* **&**Steam
District Heat: *No*

Facility Size; <u>Output per Hour</u>:: *No information*
Size of fuel Used: *Coarse undefined size*
Percent of Fuel used by TYPE: 3%Roundwood; 90 Chips – forest harvest; 7%Chips mill residue.
Fuel Supply Source: 66% waste process-mill residue; 34 %purchased or obtained free
Annual volume used: *>200,001 green tons*
Fuel Supply Radius: *150 forest harvest; 0 mill residue*
Comments:

St. Gabriel's Hospital
815 2nd St SE
Little Falls MN 56345

Contact: Kevin O'Neil
Facility Services Director

Type of Energy Facility: *Steam*
Year Installed: 1985
Season of Use: *Seasonal*
Facility Output: *Steam*
District Heat: *No*

Facility Size; <u>Output per Hour</u>:: *10,000 lbs*
Size of fuel Used: *Coarse undefined size <2"*
Percent of Fuel used by TYPE: *100% Chips- Mill residue*
Fuel Supply Source: *100% purchased from mill*
Annual volume used: *501-5000 green tons*
Fuel Supply Radius: *60 miles – Mill residue*
Comments:

Valley Forest Wood Products
48985 State Hwy 38
Marcell MN 56657
Contact: Amos Wolf
Logistics Manager

Type of Energy Facility: *Gasification*
Year Installed: *no information*
Season of Use: *Continuous*
Facility Output: *Heat*
District Heat: *No*

Facility Size; <u>Output per Hour</u>:: *1000 lbs*
Size of fuel Used: *Small uniform*
Percent of Fuel used by TYPE: *60% Sawdust, shavings and other mill residue, 40% round or split wood*
Fuel Supply Source: *20% own operations, 10% forest harvest ops, 70% purchased or obtained free*
Annual volume used: 50,001-200,000 green *tons*
Fuel Supply Radius: *90 miles radius forest harvest ops, 70% purchased or free of charged.*
Comments:

Verso Paper
100 East Sartell St
Sartell MN 56377

Contact: Eric Dyckhuis

Type of Energy Facility: *Steam*
Year Installed: *1982*
Season of Use: *Continuous*
Facility Output: *Electricity & Steam*
District Heat: *No*

Facility Size; Output per Hour: 3*00,000 lbs Steam*
Size of fuel Used: *Coarse undefined size*
Percent of Fuel used by TYPE: *10% Chips from forest harvest ops,960% Chips from mill residue*
Fuel Supply Source: *10% Forest Harvest ops, 90% from own mill operations*
Annual volume used: 50 *,001-200,000 green tons*
Fuel Supply Radius: up to *100 miles harvest ops;*

Comments: the mill expects to increase the amount of wood residue utilized in the future to relieve the use of coal.

Wick's Wood Products
85 W Broadway
Akeley MN 56433

Contact Donald Wicks

Type of Energy Facility: *Steam*
Year Installed: *No information*
Season of Use: *Continuous*
Facility Output: *Steam*
District Heat: *No*

Facility Size; Output per Hour: *No information*
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *80% sawdust and other mill residue, 20% Chips – mill residue*
Fuel Supply Source: *90% own process waste, 10% purchased or obtained free of charge*
Annual volume used: *No information*
Fuel Supply Radius: *On site*

Comments:

Woodcraft Industries
525 Lincoln Av SE
St Cloud MN 56304
Contact: Dave Forst
Materials Manager

Type of Energy Facility: *Hot water, Steam, radiant heat*
Year Installed: *1970*
Season of Use: *Continuous*
Facility Output: *Steam*
District Heat: *No*

Facility Size; Output per Hour: *5000lbs*
Size of fuel Used: *Coarse undefined size*
Percent of Fuel used by TYPE: *100%sawdust, shavings form mill residue*
Fuel Supply Source: *100% waste from own operations*
Annual volume used: *>200,001 green tons*
Fuel Supply Radius: *300 miles*

Comments: Company operates three mills in the country.

Schools

Goodridge School ISD # 561
Osmund Av, PO Box 195
Goodridge MN 56725
Contact: Ronald Kotrba
Maintenance Dept.

Type of Energy Facility: *Steam*
Year Installed: *1982/83*
Season of Use: *Seasonal*
Facility Output: *Steam*
District Heat: *No*

Facility Size; Output per Hour: *1.104 MM BTUs*
Size of fuel Used: *3/8 inch wood pellet*
Percent of Fuel used by TYPE: *100% wood pellet*
Fuel Supply Source: *100% forest harvest ops*
Annual volume used: *85 dry tons*
Fuel Supply Radius: *50 miles harvest ops*
Comments:

Mahnomen Public Schools ISD # 432
209 1st St. S.PO Box 319
Mahnomen MN 56557
Contact: Josh Bendickson
Head of Maintenance

Type of Energy Facility: *Steam*
Year Installed: *1985*
Season of Use: *Seasonal*
Facility Output: *Steam*
District Heat: *No*

Facility Size; Output per Hour: *8625 lbs*
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *100% chips from forest harvest ops*
Fuel Supply Source: *100% forest harvest ops*
Annual volume used: *1000 green tons*
Fuel Supply Radius: *100 miles harvest site*
Comments:

Northome School ISD # 363
11071 Hwy 1
Northome MN 56661
Contact: Jerry Struss
Superintendent

Type of Energy Facility: *Hot water*
Year Installed: *1981*
Season of Use: *Continuous*
Facility Output: *Heat*
District Heat: *No*

Facility Size; Output per Hour: *1,351,240 BTUs*
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *100% pelletized wood*
Fuel Supply Source: *100% purchased from outside source.*
Annual volume used: *272 dry tons*
Fuel Supply Radius: *Local manufacturer*
Comments:

Pine River – Backus Schools
PO Box 619810 1st St North and 401 Merry Av
Pine River MN 56474
Contact: Karl Flin Buildings & Grounds Director

Type of Energy Facility: *Hot water, steam and radiant heat*
Year Installed: *1991*
Season of Use: *Seasonal*
Facility Output: *Steam & hot water*
District Heat: *No*

Facility Size; **<u>Output per Hour</u>**: *251,900 lbs #1; 361,000 lbs #2.*
Size of fuel Used: *Coarse undefined size*
Percent of Fuel used by TYPE: *100% Chips from mill residue*
Fuel Supply Source: *100 % forest harvest ops*
Annual volume used: *380 dry tons*
Fuel Supply Radius: *0,5 miles from mill*

Comments

Swanville Public Schools ISD #486
PO Box 98
Swanville MN 56382
Contact: Gene Horthan
Superintendent

Type of Energy Facility: *Steam*
Year Installed: *1981 modified 2005*
Season of Use: Seasonal
Facility Output: *Heat*
District Heat: *No*

Facility Size; **<u>Output per Hour</u>**: *100,000 BTUs*
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *100% pelletized wood*
Fuel Supply Source: *100% purchased or obtained free of charge*
Annual volume used *350 Dry tons*
Fuel Supply Radius: *50-100 miles*

Comments:

Warroad Schools ISD# 690
510 Cedar Av
Warroad MN 56763
Contact: Albert Hasbargen
Facilities Supervisor

Type of Energy Facility: *Hot water*
Year Installed: *1984*
Season of Use: *Seasonal*
Facility Output: *Hot water*
District Heat: *No*

Facility Size; **<u>Output per Hour</u>** *7MM BTUs*
Size of fuel Used: *Small uniform size*
Percent of Fuel used by TYPE: *100% chips from mill residue*
Fuel Supply Source: *100% purchased from outside supplier*
Annual volume used: *700 green tons*
Fuel Supply Radius: *100 miles mill*

Comments:

Source: MNDNR-Division of Forestry. "Minnesota Woody Biomass Facility Directory." http://www.mlep.org/documents/MNBiomassDirectory.pdf

Findings

Despite the fact that this project's case studies are fairly distinct from one another, they do share commonalities that can help illustrate some general lessons endemic to other biomass projects. However, it should be noted that because these lessons are generalizations, they might not hold true in every individual case.

There are a number of recurring of themes across the five case studies. All of the interviewed sites described heating with biomass (regardless of the type of the heating technology, fuel, and capacity used) as being significantly more "hands-on" when compared to conventional gas or oil fired heating systems. Conventional systems can be turned on and off with a flip of a switch. Biomass systems, in contrast, have to be continuously maintained and require specialized knowledge to operate properly. Completing tasks such as fuel loading and ash removal puts higher demands on an organization's staff, so assessing whether the necessary resources are available to maintain a biomass system is a critical factor affecting the success of biomass projects.

In general, no matter what type of biomass fuel a site uses, having a local supply of fuel is a vital part of keeping overall heating costs manageable because delivery costs are significant. Finding a nearby pellet supplier has been a challenge for sites such as Wolf Ridge and Birch Grove Community Center who use wood pellets as fuel. The closest pellet producers are over a hundred miles away, which makes fuel delivery expensive. Interviewees who use pellet systems explained that the primary reason for the lack of local pellet production is the insufficient demand to justify the investment.

Dealing with fuel storage and moisture content were also primary challenge that all of the interviewed sites encountered—especially sites whose fuel is not delivered already processed. Wood storage needs to be large enough to hold a sufficient supply of fuel to meet a facility's heating needs. In many cases, biomass fuel needs to be left to dry for long periods of time to reduce its moisture content before it is burned. Storage is also important for sites lacking a local supply of fuel because they want to pay for as few deliveries as possible to keep costs down. The basic lesson from the interviewed sites is to invest heavily in storage infrastructure because significant issues can arise with insufficient or improper storage practices.

Despite the challenges of heating using biomass, reducing heating costs was one of (if not *the*) primary impetus for all five of the sites choosing to adopt biomass. Most of the sites are located in rural areas in Minnesota where heating fuel availability and system options are much more limited versus urban areas. For example, many of the sites did not have access to natural gas and so propane gas or fuel oil were their options. However, much of the land near the project sites is less developed and consists of large forested areas, and this abundant biomass supply is viewed as a natural fit that allows the sites to economically meet their heating needs.

The developed case studies illustrate that there is no one-size-fits-all method for choosing the right biomass system. It takes extensive research and years of improvements to develop a system that meets the individual needs of an organization. Even after installing their biomass heating systems, all of the interviewed sites have continued to build upon their experience and make improvements to their systems.

Appendix A: Interview Questionnaire

Biomass Feasibility Interview Questionnaire

Survey Objective and Design: Face to face and telephone interviews will be carried out to collect relevant research information to be used in the Community Biomass Feasibility Study. The information gathered through these interviews will help develop approximately five distinct case studies of varying scales, sectors, and fuel types that illustrate energy and heating applications of woody biomass. Ultimately, the developed case studies will help Cook County make an informed decision regarding its own energy future.

As it stands, this is a long survey, but some of the information contained in this questionnaire can be found from alternate sources. Therefore, to reduce the total time required to carry out the interviews, questions will only be used in the interview if the information cannot be found from an alternate source (e.g. from existing project case studies, biomass boiler specs, woody biomass characteristics from reports, company websites, press releases, newsletters, etc). An asterisk is placed next to questions where info can potentially be identified through alternate sources.

Because interviewees may not know the answers to some of the more technical/quantitative questions in the survey off the top of their heads, an email will be sent out prior to the interview detailing the technical questions that will be asked, so that participants will have the necessary information on hand during the interviews. Any technical questions that participants are unable to answer will be included on the post-survey questionnaire. An asterisk is placed next to questions that may be part of the post survey technical questionnaire.

Introductory Email:
Hello _________,

My name is Adam Zoet and I'm the renewable energy policy intern at Dovetail Partners, an environmental non-profit based in Minneapolis. Here's the link to Dovetail's website in case you'd like to check it out: http://www.dovetailinc.org/. As part of my research, I've gathered a diverse set of reports looking at biomass energy and heating applications throughout Minnesota, the US, and abroad. Add What Is Known About The Organization Here.

Dovetail Partners is conducting interviews to explore the feasibility of community-based biomass energy/heating production for communities within Cook County, Minnesota. We will use the information collected through these interviews to develop case studies describing the biomass applications and experiences of different sites. I would be very interested in developing your experience into a case study that others could read and learn from. Your input would be very valuable in conducting our study. Of course, you would not have to provide answers to any questions that you felt uncomfortable with, and we would provide you with a draft of the case study to review before we finalize it.

Basically, the interview would cover questions related to general background, implementation, biomass system specifications, biomass fuel, project funding, costs/savings, environmental, and operations.

Would someone at __________ who is very familiar with the biomass system/operations be available for an hour long interview to discuss your experience utilizing biomass? Please let me know.

Thank you for your consideration,
Adam Zoet

Follow Up Email:
Hi _______,

Thank you very much for being willing to participate in our survey; we really appreciate it. I'll plan to give you a call next ________ at _________.

There is a list below of the more technical questions that I'm planning to cover during the interview. The more detail you can provide will really help me develop __________ case study in a way that others will find useful and can learn from.

General Background Technical Questions:
- Square footage of the buildings that utilize biomass for energy/heating

Biomass System Specifications Technical Questions:
- The biomass system's model number/manufacturer
- Heating capacity
- System components
- Company that installed the biomass system
- Type of backup generator installed (if one is installed)
- Percentage of heat load that comes from biomass

Biomass Fuel Technical Questions:
- Percentage breakdown of biomass fuel type composition
- How many miles away the biomass comes from
- Fuel delivery frequency
- Quantity of fuel delivered
- Cost per green ton per delivery
- Typical moisture content of fuel upon delivery
- Company that delivers the fuel
- Percentage of fuel available on-site versus delivered
- How much fuel is stored
- Estimated annual fuel consumption
- Estimated annual fuel cost

Project Funding Technical Questions:
- Type and amount of external funding for biomass project

Costs/Savings Technical Questions:
- Estimated annual savings using biomass for heating
- Total cost for biomass equipment
- Annual maintenance costs
- Installation cost
- System payback period

Environmental Technical Questions:
- Amount of ash produced

Operations Questions:
- Number of staff and the hours per week needed to operate and maintain the biomass system

Thanks again and I'm looking forward to talking with you!

A. General Background Questions

AA. Could you give me some background about your organization?
***Alternate source: company website**
Notes:

AB. How do you utilize biomass?
***Alternate sources: project case study, company website, press releases, newsletters**
Notes:

AC. Which of your buildings or operations utilize biomass for energy or heating?
***Alternate sources: project case study, company website, press releases, newsletters**
Notes:

AD. How large (preferably in square feet) are the buildings?
***Alternate sources: project case study, company website, press releases, newsletters**
***Post-survey technical questionnaire**
Notes:

AE. What were some of your main objectives in developing a biomass system?
***Alternate sources: project case study, press releases, company website, newsletters**
Notes:

AF. How long did the project take to complete (start and end dates)?
***Alternate sources: project case study, press releases, company website, newsletters**
Notes:

B. Implementation Questions

BA. Could you describe the process of how you implemented a biomass-based system?
***Alternate sources: project case study, press releases, company website, newsletters**
Notes:

BB. Were there any regulatory issues that you ran into developing your project - such as permitting requirements or tax benefits?

***Alternate sources: project case study**

Notes:

BC. Did you switch from a previous heating or energy system to biomass?

***Alternate sources: project case study, press releases, company website, newsletters**

Yes 0
No. . . . . 1 →Skip to CA
Refused. 9
Notes:

BD. What was the previous fuel type you relied on?

***Alternate sources: project case study, press releases, company website, newsletters**

Natural gas. 0
Propane. 1
Electricity 2
Heating oil. 3
Coal. 4
Other. . . . . 5 → Specify in notes
Refused. 9
Notes:

BE. What are the advantages and disadvantages of utilizing biomass over your previous fuel type?

***Alternate source: project case study**

Notes:

<u>C. Biomass System Specifications Questions</u>

CA. What is the model number and manufacturer of your biomass system?

***Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

CB. How did you determine which biomass model to buy (e.g. what were the determining factors)?

***Alternate source: manufacturer's website of biomass unit, project case study**

Notes:

CC. What is the heating capacity or energy output of the biomass unit?

***Alternate source: manufacturer's website of biomass unit, project case study**

***Post-survey technical questionnaire**

Notes:

CD. What are the components of your biomass system?

***Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

CE. What company installed the biomass system?

***Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

CF. Do you have a backup generator installed?

***Alternate source: project case study**

***Post-survey technical questionnaire**

Yes . . . . 0 → Ask: What type of backup unit and what is its fuel source?
No 1
Refused 9
Notes:

CG. Of your total energy consumption/heat load, approximately what percentage comes from biomass?

***Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

D. Biomass Fuel Questions

DA. What type of biomass fuel do you use?

*Alternate source: project case study, press releases, newsletters, company website**

Woodchips. 0
Pellets. 1
Logs. 2
Forest residue 3
Mill residue 4
Logging Residue. 5
Urban Wood Waste. . . 6
Bark 7
Mix . . . . .8 → Ask DA1
Other. . . . . .9 → Specify in notes
Refused 10
Notes:

DA1. What is the percentage breakdown of different fuel types used in the mixture?

*Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

DB. Do you treat or process the biomass fuel in any manner before using it?

*Alternate source: project case study**

Size reduction 0
Compacting 1
Drying 2
Washing 3
Mixing with other fuels. . .4 → Specify in notes
Other. . . . . 5 → Specify in notes
Refused 9
Notes:

DC. What were the main reasons you chose to use this type of biomass fuel?

*Alternate source: project case study, press releases, company website, newsletters**

Cost. 0
Availability. 1
Burning characteristics. 2 → Specify in notes
Notes:

DD. How do you obtain your fuel source?
*Alternate source: project case study**

Delivered. . . . . 0 → Ask DD1-DD10
On site . . . . .1 → Skip to DE
Mix of delivered and on-site . . . . .2 →Ask DD1-DD11
Other . . . . .3 → Specify in notes
Refused. . . . . 9 → Skip to DE
Notes:

DD1. How many miles away does the fuel come from?
*Alternate source: project case study**
***Post-survey technical questionnaire**
Notes:

DD2. How frequently is the fuel delivered?
*Alternate source: project case study**
***Post-survey technical questionnaire**

Weekly 0
Monthly 1
Other. . . . . .2 → Specify in notes
Refused. 9
Notes:

DD3. How much fuel do you have delivered?
*Alternate source: project case study**
***Post-survey technical questionnaire**
Notes:

DD4. What is the total cost per green ton?
*Alternate source: project case study**
***Post-survey technical questionnaire**
Notes:

DD5. What is the typical moisture content of the biomass upon delivery?
*Alternate source: project case study
*Post-survey technical questionnaire
Notes:

DD6. Overall, are you satisfied with the cost per delivery?
*Alternate source: project case study
Notes:

DD7. Do you have any interest in cooperative buying schemes that could lower fuel costs?
*Alternate source: project case study
Notes:

DD8. What is your estimated annual fuel cost?
*Alternate source: project case study
*Post-survey technical questionnaire
Notes:

DD9. What company delivers your fuel?
*Alternate source: project case study
*Post-survey technical questionnaire
Notes:

DD10. Does the fuel come from private or public land?
*Alternate source: project case study
*Post-survey technical questionnaire
Notes:

DD11. What percentage of fuel is available on-site versus what is delivered?
*Alternate source: project case study
*Post-survey technical questionnaire
Notes:

DE. How do you store the biomass fuel and how much do you store?
*Alternate source: project case study**
Post-survey technical questionnaire

Notes:

DF. Do you ever experience fuel degradation problems in storage? If so what?
*Alternate source: project case study**

Notes:

DG. What is your estimated annual biomass fuel consumption?
*Alternate source: project case study**
Post-survey technical questionnaire

Notes:

E. Project Funding Questions

EA. Besides bank loans, did you receive any other public funding for the biomass project?
*Alternate source: project case study**
Post-survey technical questionnaire

Yes 0
No. . . . . 1 → Skip to FA
Refused. 9
Notes:

EB. What type of funding?
*Alternate source: project case study**
Post-survey technical questionnaire

Notes:

EC. How much funding did you receive?
*Alternate source: project case study**
Post-survey technical questionnaire

Notes:

F. Costs/Savings Questions

FA. Approximately, how much money do you save per year using biomass for heating/energy?

*Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

FB. What was the total cost for the biomass equipment?

*Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

FC. What are your annual maintenance costs for the equipment?

*Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

FD. How much did it cost to install the equipment?

*Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

FE. What is the payback period you expect from the system?

*Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

G. Environmental Questions

GA. What are some of the environmental considerations that led you to use biomass?

*Alternate source: project case study**

Notes:

GB. What environmental impacts have resulted from your use of a biomass system?

***Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

GC. How much waste (ash) does the biomass system produce?

***Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

GD. How do you dispose of the ash?

***Alternate source: project case study**

Notes:

<u>H. Operations Questions</u>

HA. How many staff are needed to operate the system?

***Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

HB. Approximate how many hours per week are needed to maintain the system?

***Alternate source: project case study**

***Post-survey technical questionnaire**

Notes:

HC. What other business connections exist through biomass utilization?

***Alternate source: project case study**

Notes:

I. Concluding Questions

IA. Overall, how happy are you with using biomass as an energy or heating source and why?
Notes:

IB. What are the best aspects of utilizing a biomass system for energy or heating?
Notes:

IC. What are the worst or most frustrating aspects of utilizing a biomass system for energy or heating?
Notes:

ID. What were some of the challenges you encountered implementing or running your biomass system?
Notes:

IE. What would you do differently in the development of your biomass system?
Notes:

IF. What was the most important lesson you have learned through developing and utilizing biomass energy/heating?
Notes:

IG. What would you say are the most important considerations when someone is trying to decide whether or not to convert to biomass?
Notes:

IH. What is your future outlook using biomass?
Notes:

Conclusion: Thank you very much for your time answering these questions. As I mentioned, we will be using the information collected through these interviews to develop case studies on biomass applications. If it is ok, we may contact you again just to clarify information and to provide you with a draft of the case study describing your experience to review at your convenience. Dovetail's phone number is 612-333-0430 in case you have any questions or want to stay in touch. As far as a timeframe is concerned, we are planning to have a draft of the case study finished late August and we will be sure to send a copy for you to review. Thanks again!