CASE STUDY

Green Energy
as a Rural Economic Development Tool Project

COMMUNITY: Village of Granisle

PROJECT: Granisle Fire Hall Biomass Furnace Project

NOTES:

FUNDED BY:

British Columbia
Ministry of Jobs, Tourism and Innovation
Pine Beetle Epidemic Response Branch

Southern Interior Beetle Action Coalition
SIBAC

Canada's Rural Partnership
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Columbia Basin Trust
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Executive Summary

In November of 2011 the Village of Granisle (VG) undertook the Biomass Furnace Project (BFP) to install a containerized wood chip boiler to heat their 200 m^2 fire hall. The BFP was undertaken with a number of goals. The first was to lower energy costs. The second was to reduce their GHG emissions. The third was to act as a catalyst to help the community understand a more local energy source (i.e. wood chips from their community forest or through wildfire mitigation work). The Village was successful in meeting these goals. Wood chips are still being sourced from a nearby community but with the knowledge learned from operating the BFP, the Village of Granisle is contemplating producing their own wood chips.

A 40 foot shipping container was installed behind the fire hall. The container has a 30 kW (100,000 BTU/hr) automated wood chip boiler (with integrated propane ignition and backup); as well as a small wood chip storage bin (day-bin). Village of Granisle Public Works staff did the site prep work for the container as well as installed a roof to protect it and the main chip storage area. Wood chips are transferred from the main storage to the day-bin and then automatically fed into the computer controlled boiler. The boiler heats up a water/glycol mix which is piped into the fire hall where it passes through a heat exchanger to heat the hot water loop in the building. This hot water is stored in two 80 USG insulated tanks. As heat is needed, it is piped out to either a unit heater in the two truck bays or the baseboards of the office/meeting space. Each space is controlled individually via a thermostat typically set at 23°C (74°F).

When the system is operating normally it requires about 5-10 hours a month of operator time. This work is primarily for fuel handling, system operation and maintenance (ash cleaning/removal, heat exchanger tube cleaning, etc.). The system consumes about a half of a 53 ft truck load a year of chips (55m^3), sourced from a sawmill in Burns Lake. The system is being operated by a volunteer member of the fire department at no cost.

Prior to the BFP the Village was spending approximately $7,000 per year on propane. This has already been reduced by 50% and is expected to drop to 20% once the system becomes completely optimized. Currently the Village is spending about $1,000/year for wood chips. This is also expected to rise to about $1,500/year as optimization occurs.

Granisle Fire Hall

Yearly Operating Costs

BEP YEARLY OPERATING COSTS	YEARLY COST
Wood Chips (estimated)	$1,500
Propane (estimated)	$1,500
Staffing	$0
Maintenance (over the life of the project)	$500
Total BFP Yearly Costs	$3,500/year
Yearly Costs prior to BFP	$7,000/year
Saving Due to BFP	**$3,500/year**

In addition, the BFP will result in reduced GHG of approximately 15 tonnes. Based on current Pacific Carbon Trust pricing, this would amount to an additional $400 in savings due to reduced need to purchase offsets.

The cost of the project was $60,800. $34,500 was received as a grant from the Gas Tax Innovation Fund program funded by the Government of Canada in partnership with the Province of BC and administered by the Union of BC Municipalities. The Village received a $20,000 grant from the Omenica Beetle Action Coalition (OBAC). The remaining $6,300 was in kind support (staff time in managing the project and administration) from the Village. The payback are summarised in the table below.

Capital Costs and Payback

	BFP – with all grants	BFP – without OBAC	BFP – Without Gas Tax and OBAC
Total Project Cost	$60,800	$60,800	$60,800
OBAC Grant	$20,000	$0	$0
Gas Tax	$34,500	$34,500	$0
VG Contribution	$6,300	$26,300	$60,800
Fuel Savings	$3,900	$3,900	$3,900
Simple Payback	< 2 Years	8 Years	16 Years
Net Present Value (20 years and 5%)	$42,300	$22,300	-$12,200
Internal Rate of Return	62%	14%	2%

The key lessons for the project:

- Operations staff 'buy-in' is crucial to the success of any project that uses a new technology.
- Installing new technology involves education on the part of the operator as well as for the supplier and it is important that both are committed to seeing the project succeed.
- Using local suppliers and resources is important because it increases the ability for system operators to get support in a timely and cost effective manner.
- Just as understanding how to operate the boiler is a learned skill, so is ensuring the wood chip quality is maintained by addressing such issues as moisture and contamination
- Keeping the project simple and within the capacity of local staff is critical to ensuring the economics of the project remain viable.

Acknowledgements

The Green Energy as a Rural Economic Development Tool would like to acknowledge and thank The Village of Granisle for agreeing to participate in this case study. In particular, we would like to thank Jim O'Farrell, Village Counselor, Firefighter and Biomass Boiler operator for taking the time to answer questions and be a part of this case study. We would also like to thank Sharon Smith for providing the documentation and data that were used in this case study. We would also like to acknowledge Hans Duerichen of Ardent Energy who provided additional technical data on the boiler. Finally, the author would like to thank the Wood Waste 2 Rural Heat project for providing additional background.

Introduction and Overview

Figure 1 - Map of BC

The Village of Granisle (VG) is a small community of about 350 people with a trading centre of 700. Granisle is located 4 hours west of Prince George and aproximately 45 minutes north of Highway 16 between Burns Lake and Houston. It is a destination community on the shores of Babine Lake surrounded by large forested lands.

During the 1970's to 1990's the major employer in the area was a large mine and the population was over two thousand people. During this time the Village built a number of community facilities including a school suitable for over 600 children, an ice rink and curling rink. In the mid-nineties the mines closed and a large portion of the population left. With the exodus of people the village has struggled to continue to maintain and operate these facilities.

Like many communities, Granisle has signed the Province of BC Climate Action Charter. As a signatory to the Charter, Granisle has agreed "to measuring and reporting on their community's greenhouse gas emissions profile. They will also work to create compact, more energy efficient communities." (Province of BC). This was the catalyst for the community to look at ways of reducing emissions and energy consumption. In 2011, the VG completed a Community Energy and Emissions plan (CEEP). As part of the process the mayor and council recognised that there was an opportunity to explore alternative forms of energy and in particular, bioenergy. Granisle is somewhat unique in that they are one of a small number of communities that have a stand-alone propane distribution network for the entire community (such as Whistler, Revelstoke, etc.). The network is owned and operated by Pacific Northern Gas (PNG). The community also entered into the process for obtaining a community forest license. The end result is the community was paying for premium fossil fuel and had the potential to develop biomass fuel.

After looking informally at a number of different scenarios to utilise this biomass fuel, it was decided to install a biomass heating system for the VG Fire Hall also called the Biomass Furnace Project (BFP). The fire hall is an older metal building. It has two bays for fire trucks as well as office/meeting space. It is approximately 200 m^2 (2200 ft^2) and is very typical of buildings in rural and remote communities. Initially, the hall was heated using a combination of propane forced air furnaces in the truck bays and electric baseboards in the office space.

Biomass Furnace Project – An Overview of the System

A 100,000 BTU/hr (30 kW) woodchip boiler (*Figure 3*) provides 80°C hot water to heat the two truck bays and office space of the Granisle Fire Hall. The boiler is primarily fueled by wood chips but uses propane for initial start-up (5-10 min) and backup. The boiler is located in a 40 foot shipping container installed behind the fire hall. The boiler takes up the first 8-10 feet of the container (red container on right hand side of *Figure 4*). The next 10 feet is used for wood chip storage and the remaining space up to the main doors on the back is empty (*Figure 5*). This short term storage or day-bin is approximately 7 m^3 (9 cubic yards) and contains enough fuel for about 2 weeks. A feeder system located at the bottom of the bin (*Figure 6*) moves the chip into the boiler supply auger.

Figure 3 - Wood chip boiler

Figure 5 - Day-bin in container

Figure 4 - Boiler container

Figure 6 - Boiler feed system in bottom of the day-bin

The space between the two containers in *Figure 4* is used for the main chip storage area. The storage space is large enough to receive an entire 53 foot walking floor trailer load of approximately 20 tonnes or 113 m^3. However, the VG is only taking half trailer loads or 50 m^3 per delivery. One delivery is estimated to last just over one year (*Figure 7*).

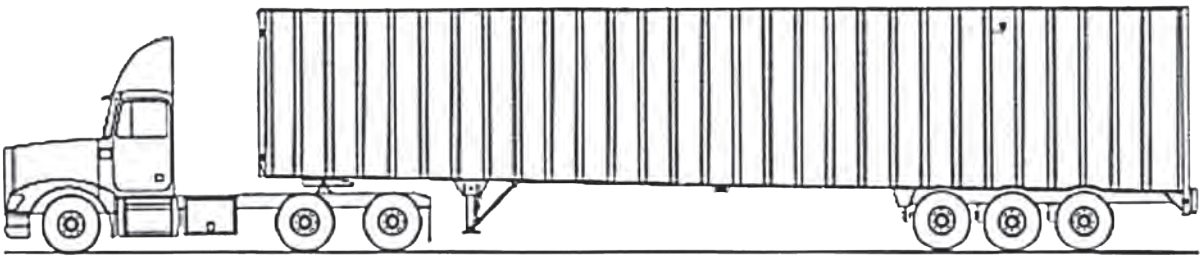

Figure 7 - 53 foot Walking floor truck and trailer (transportation)

The chips are sourced from a sawmill/pellet plant in Burns Lake approximately one hour away.

A hot water/glycol solution from the boiler is piped into the fire hall (*Figure 8*), and through a 200,000 BTU heat exchanger connected to the buildings heating system. The water/glycol solution then returns back to the boiler. The water in the building's heating system passes through the heat exchanger and into two 80 US gallon hot water storage tanks. The hot water storage tanks are conventional electric water heaters that have not had the heating elements connected. Water from these tanks is sent throughout the building. In the truck bays, a fan coil unit is used to blow air over a heat exchanger and the resulting hot air heats the space directly with no duct work. In the office space a series of hot water baseboard radiators is used to distribute the heat. A complete piping layout diagram is available in Appendix 1.

Figure 8 - Pipe from boiler to fire hall

Project Development Timeline

In 2010, VG, like many BC communities, had signed on to the Province of BC Climate Action Charter. In late 2010, David Dubois of the Green Heat Initiative (now the Wood Waste 2 Rural Heat Project) was asked to investigate the potential of installing a heating system and provide feedback and direction. In addition, the Village had partnered with the Lake Babine First Nation to develop the Babine Lake Community Forest (BLCF). In January 2011, VG completed a detailed Community Energy and Emissions Plan (CEEP) to identify possible courses of action to reduce energy usage and GHG emissions. In early 2011, the BLCF was granted a harvest license. The feedback from Mr. Dubois, combined with the CEEP and the new community forest were the catalyst for mayor and council to decide to pursue a biomass heating project.

After considering a number of potential options it was finally decided that converting the fire hall to a biomass heating system would be an appropriate first step in developing a variety of potential projects. It was also decided that the VG Chief Administration Officer and Financial Officer would manage the project. In mid-2011, Ardent Energy (a local company from Smithers approximately 1.5 hours away) was selected to design, supply, and install the 30 kW (100,000 BTU/hr) BB100 boiler system built by LEI products in Kentucky.

The initial site preparation (installing the container and roof over the fuel storage area) was completed by VG Public Works staff. The boiler installation took place in November of 2011. System start-up, commissioning and trouble-shooting took place from December 2011 to April 2012. There were a number of problems during start-up that were eventually traced back to faulty electrical components. During the summer Ardent Energy replaced the boiler and, based on suggestions from Mr. O'Farrell (boiler operator and electrician), added some additional heat shielding. The boiler was brought back online for the winter 2012/13 heating system and has been operating quite efficiently since then with only minor problems (see "Lessons Learned").

Operations – From Wood Chip to Warm Building

VG purchases their wood chip fuels from a local sawmill/pellet plant in Burns Lake, BC (approximately 1.5 hours away by transport truck). The fuel is a by-product of existing operations. Ideally it should be very clean with no foreign material (stones, metal, plastic, etc.). *Figure 9* shows the current fuel. The fuel is primarily from post production residuals. Since the boiler started in 2011, VG has had two fuel deliveries. The first was about half a truck load. The second was a full truck load.

Figure 9 - Chip fuel

The VG changed their storage between the first and second delivery. The space between the two containers was being used for the old fire truck in the event it was needed. It was determined that the truck no longer needed to be stored in the covered space so it was removed and now the space is used to store chips.

The delivery truck is able to back up to the main chip storage and unload the chips directly into the space. Village staff then use garbage bins to transport the wood chips from the main storage to fill the day-bin. This process takes about an hour. Operations staff is looking at an option to relocate the feed auger from the day-bin directly into the main storage in order to eliminate the need to manually handle the fuel.

The fuel is augured from the day-bin to the boiler feed chute where it drops into the boiler. This is a safety feature that prevents the possibility of ignition of the fuel in the auger and day-bin. The boiler uses a propane burner to ignite the woodchips and heat the boiler to temperature. In the event of fuel supply problem the propane burner can be used as a back-up. The other benefit is that the system has fewer emissions during start-up. Once the fuel is consumed the ash is collected and removed from the boiler automatically. *Figure 11* shows the removal auger and storage bin. The ash bin is emptied about once a week. The system generates about 20 gallons of ash per year.

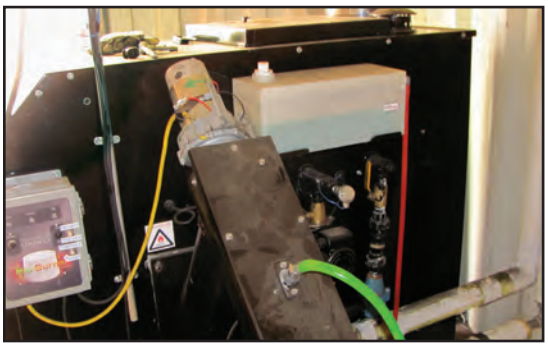

Figure 10 - Boiler feed auger and chute with emergency water dousing system

Figure 11 - Ash removal auger

The hot combustion gases pass through a heat exchanger where a water/glycol solution is heated to approximately 85°C. From the heat exchanger the exhaust passes through an integral cyclone filter to remove the majority of large particulate matter before venting to atmosphere. Periodically the tubes of the heat exchanger are cleaned by using a power drill to spin brushes permanently mounted inside the heat exchanger tubes.

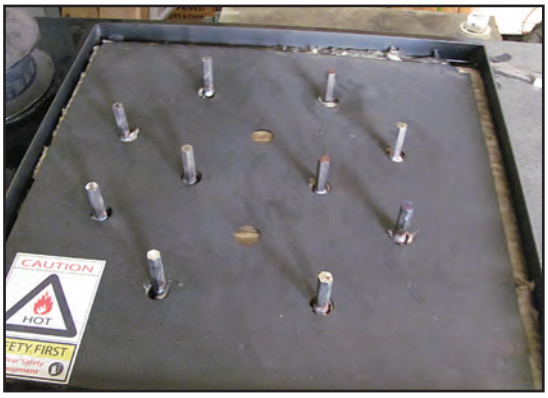

Figure 12 - Heat exchanger tube brush ends

The entire combustion process is controlled by electronics that meter the fuel and air flow to optimise heat output and minimise emissions. The system is visually inspected every two/three days by the operator and minor adjustments made depending on things such as fuel quality/moisture, ambient conditions, etc. The water/glycol mixture from the boiler is pumped into the fire hall and through a 200,000 BTU heat exchanger before returning to the boiler. Water from the secondary heating loop, inside the fire-hall, passes through this heat exchanger and into two 80 gallon hot water tanks. These are conventional electric hot water heating tanks that have not been connected to electricity but could if future need arose. The hot water is pumped out of the tanks and either to a 140,000 BTU unit heater to heat the bays or approximately 40 feet of baseboards to heat the office space. Each system has a separate thermostat to control temperature. Typically these are set to 23°C (74°F).

After the installation of the boiler additional retrofits were done to further enhance energy efficiency. These retrofits were completed under a different project.

Capital Costs and Funding

The total cost for the BFP was $60,794.25. A breakdown of the specific costs is noted in *Table 1 - Biomass Furnace Project Capital Expenses.* $34,500 was received as a grant from the Gas Tax Innovation Fund program funded by the Government of Canada in partnership with the Province of BC and administered by the Union of BC Municipalities. VG received $20,000 in funding from the Omenica Beetle Action Coalition (OBAC) as part of their Alternative Energy Strategy (www.ominecacoalition.ca). The remaining $6,300 was in kind support (staff time in managing the project and administration) from the Village.

Table 1 - Biomass Furnace Project Capital Expenses

Expense Item	Source	Budget	Actual
Boiler and Fuel Storage System	Ardent Energy	$22,000	$22,000
Modifications and Installation	Ardent Energy	$9,875	$10,469
Storage Container	D&E Vending	$6,580	$6,580
Roofing Material and Trusses	Starland Supply/Tricon	$8,884	$8,561
Container Man Door Installation	Kaleig Holdings	$1,131	$1,131
Site Prep and Roof Install	VG Public Works	$5,500	$5,782
Administration	VG Staff	$5,000	$6,272
TOTAL		**$59,000**	**$60,800**

Operating Costs

Prior to the installation of the BFP the VG was spending approximately $7,000/year on propane. The current cost of propane on the Pacific Northern Gas grid system is $21.86/GJ (Pacific Northern Gas Ltd.). This includes a $10.75 basic monthly connection fee. It does not include the BC carbon tax of $0.0462/l or $1.83/GJ. Therefore the net cost of propane for VG is $23.69/GJ or $0.085/kWh. Wood chips are purchased at a cost of $1000/load delivered. Approximately half of this cost is trucking.

Table 2 - Fuel Cost Summary[1]

Fuel Type		2010	2011[1]	2012
Propane	Volume	*12,635 L*	*10,252 L*	*5,087 L*
	Energy	*320 GJ*	*260 GJ*	*129 GJ*
	Total Cost	$7,581	$6,151	$3,052
	Price $/L	$0.60/L	$0.60/L	$0.60/L
	Price $/GJ	*$23.69/GJ*	*$23.69/GJ*	*$23.69/GJ*
Wood Chips[3]	Amount	-	-	*10 tonne*
	Energy	-	-	*145 GJ*
	Total Cost	-	-	$1,000
	Price $/tonne	-	-	$100/tonne
	Price $/GJ	-	-	*$6.90/GJ*
TOTAL ENERGY COST		**$7,600**	**$6,200**	**$4,100**
TOTAL ENERGY USAGE		**320 GJ**	**260 GJ**	**274 GJ**

1. Values in italics were calculated based on data provided by VG staff
2. It was assumed that no biomass was consumed in 2011
3. The VG was billed for ½ a truck load of approximately 50 m3 at $20/m3. It is estimated that moisture of the chips was approximately 20% on a wet basis. At that moisture the density is 203 kg/m3 and the energy density is 14.4 GJ/tonne.

To date the BFP has only been supplying about 50% of the total energy needed. As the operation of the system improves propane consumption can be expected to decrease to about 20% of the total energy demand (60 GJ). Based on the values in *Table 2*, the yearly propane cost would be $1500. The remaining 80% (230 GJ) would be supplied by wood chips at a cost of about $1500/year.

The system is currently being operated primarily by Mr. O'Farrell because he is a member of the Granisle Fire Department. It is worth noting that during start-up, commissioning, and troubleshooting Mr. O'Farrell spent approximately 400 hours working on the system. The primary issues related to the failure of electrical components used in the computer controlling the boiler. The problem was cured with additional heat shielding. Further testing by the manufacturer showed that carbon dust also contributed to the failure. This was also cured by the additional shielding. There was a secondary issue related to the size of motors on the chip auger feed system. These motors were also upgraded. Both issues were warranty issues and did not result in costs to the Village. In December and January, the system was up and running quite consistently but was having problems with fuel. Mr. O'Farrell worked on it 13 hours each month. Please see the "Lessons Learned" section for more information. He anticipates normally the system would only require 5-10 hours/month to operate. However, if Mr. O'Farrell had not been able to donate his time — as a volunteer — this would have SIGNIFICANTLY impacted the viability of the project.

Table 3 - BFP Estimated Yearly Operating Costs

BEP Yearly Operating Costs	Yearly Cost
Wood Chips (estimated)	$1,500
Propane (estimated)	$15,00
Staffing	$0
Maintenance (over the life of the project)	$500
Total BEP Yearly Costs	**$3,500/year**
Yearly Costs prior to BFP	**$7,000/year**
Saving Due to BFP	**$3,500/year**

The BFP will also result in a reduction in GHG's. Based on the Province of BC's current method of calculating GHG emissions (Province of BC - Ministry of Environment), the BFP will result in approximately 15 tonnes of CO2e reduction. Currently if the VG was to purchase offsets from Pacific Carbon Trust at $25/tonne, as required to meet the goals of the Climate Action Charter this would be an additional $400/year in expenses.

Project Capital Payback

There are number of different ways to calculate return on investment or project capital payback period. The BFP has not yet been fully operational for a full year so capital payback projection is based on the assumptions noted on the previous page.

The total cost of the BFP was $60,800, of which $6,300 was for staff time to administer the project. If this cost is removed from the project the actual capital cost is $54,500.

In order to determine the Rate of Return it is useful to determine the Business as Usual scenario (BAU). In the BAU scenario, propane would still be used as the main fuel at a cost of $7,000/year plus approximately $400 in carbon offsets would have to be purchased. Because the system is being operated by the fire department there is no cost of staffing. The operating cost for the BFP is estimated at $3,500/year, with savings of $3,900/year over the BAU (including offsets). The simple payback for the VG investment in the BFP is under 2 years. If the VG did not receive any grants the simple payback would have been 16 years.

The Net Present Value (NPV) (based on 20 year term which is the estimate of the useable life of a biomass boiler and 5% discount rate) is $42,300. If the VG had undertaken the project without grants the NPV would have been -$12,200. The Internal Rate of Return (IRR) is 62% and 2% with and without grants.

Table 4 - Rates of Return

	BFP – with all grants	BFP – without OBAC	BFP – Without Gas Tax and OBAC
Total Project Cost	$60,800	$60,800	$60,800
OBAC Grant	$20,000	$0	$0
Gas Tax	$34,500	$34,500	$0
VG Contribution (including In-kind)	$6,300	$26,300	$60,800
Fuel Savings	$3,900	$3,900	$3,900
Simple Payback	< 2 Years	8 Years	16 Years
Net Present Value (20 years and 5%)	$42,300	$22,300	-$12,200
Internal Rate of Return	**7%**	**14%**	**2%**

Other Benefits of the BFP

The Village of Granisle is now in a position to leverage the knowledge gained from the BFP to further reduce energy costs in the community. A specific example is that the community now has the experience to install additional boiler capacity. This additional heat could be piped to the school, village office, and arena. It could be used to attract new development that has a high heat demand. Currently wood chips are being sourced from Burns Lake but as VG gains operational experience they may be able to tap into more local sources such as the community forest or biomass from wildfire abatement. In addition, VG can be an example to the local community of how biomass can be used for heat thus encouraging others to adopt similar system. The result is that energy dollars are remaining in the community.

> "Through growing pains and challenges, we are proud of the end results and we welcome interested parties to visit Village to see firsthand the operation of this Biomass Furnace Project."
>
> — Granisle Mayor Linda McGuire

The Benefit of Hindsight – Lessons Learned

The BFP has been a very successful project however there have been some interesting lessons learned.

Knowledge Base

The VG took on a new type of project when it decided to install the BFP. There was a steep learning curve required to understand the nature of how a biomass heating system works and the interconnectivity of the various components. It was critical that VG was able to get 'buy-in' from those operating the system. Even though this was not a first of its kind installation with brand new technology it was still a relatively new design. Those working with the system had to be willing to learn how to operate the equipment and troubleshoot problems.

Strong Supplier Support

Anytime you are installing a new type of equipment that you have little experience with is important that you have support from the supplier. The supplier must be willing to stand by their equipment and have the ability to provide on the ground help. In this case the supplier has worked closely with VG on resolving problems. The BB100 used in the BFP is one of fifty that have been built by the manufacturer to date and so there have still be some problems with the physical design of the system. For the VG it resulted in significant problems initially with the electronics. The supplier was able to work closely with the operator to identify the fault which led to the replacement of the boiler and the installation of a new boiler along with modifications to better isolate the control panel from the heat of the boiler and protect from carbon dust. Also there were issues with the size of motors on the fuel feed auger. These needed to be upgraded to address chip delivery issues.

Local is Better

It is one thing to be doing this development in a large centre with access to a great deal of resources but in rural or remote communities it is even more difficult. The VG decided to use relatively local business whenever possible. The result has been more spending of project dollars to the local economy. In addition when support was needed the supplier was better able to respond in a timely manner without excessive costs.

Fuel Supply

The initial plan was to store all the wood chips inside the container but the VG loader for moving the wood chips, did not fit inside the container. The result is that Village staff has to manually transport chips from the main storage to the day-bin. This is a labour intensive process and quite costly. In order to overcome this problem, the feed system from the day-bin is being relocated to the main chip storage. This allows for better usage of the container space and will allow for the installation of additional boilers as needed. Any additional boiler would still be able to use the existing feed system.

Fuel Quality

Not all wood chips are the same. As seasons change so does the moisture content of the wood used in sawmills and as a result so does the moisture content of their wood chips. The initial load of chips that were received were relatively wet and thus produced less energy, however with time they have dried out resulting in better performance. In addition contamination was a problem in the second load that was received but by inspecting the chips as they are being loaded into the day-bin this problem has been reduced. The end result of both of these problems has been increased operations and maintenance costs. Careful monitoring of fuel as it delivered as well as communicating with the fuel supplier in regards to quality is critical.

Keep it Simple

The VG of purposely kept the project small and manageable by Village staff. In some cases communities have tried to develop very complex systems that have required significant design, engineering and project management. In some cases the projects were not completed because these additional costs made the projects to expensive. By working with suppliers and using Village staff expertise the VG has been able to risk manage many aspects of this project resulting in a viable deployment.

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NOTES: Appendix 1 Firehall Flowsheet

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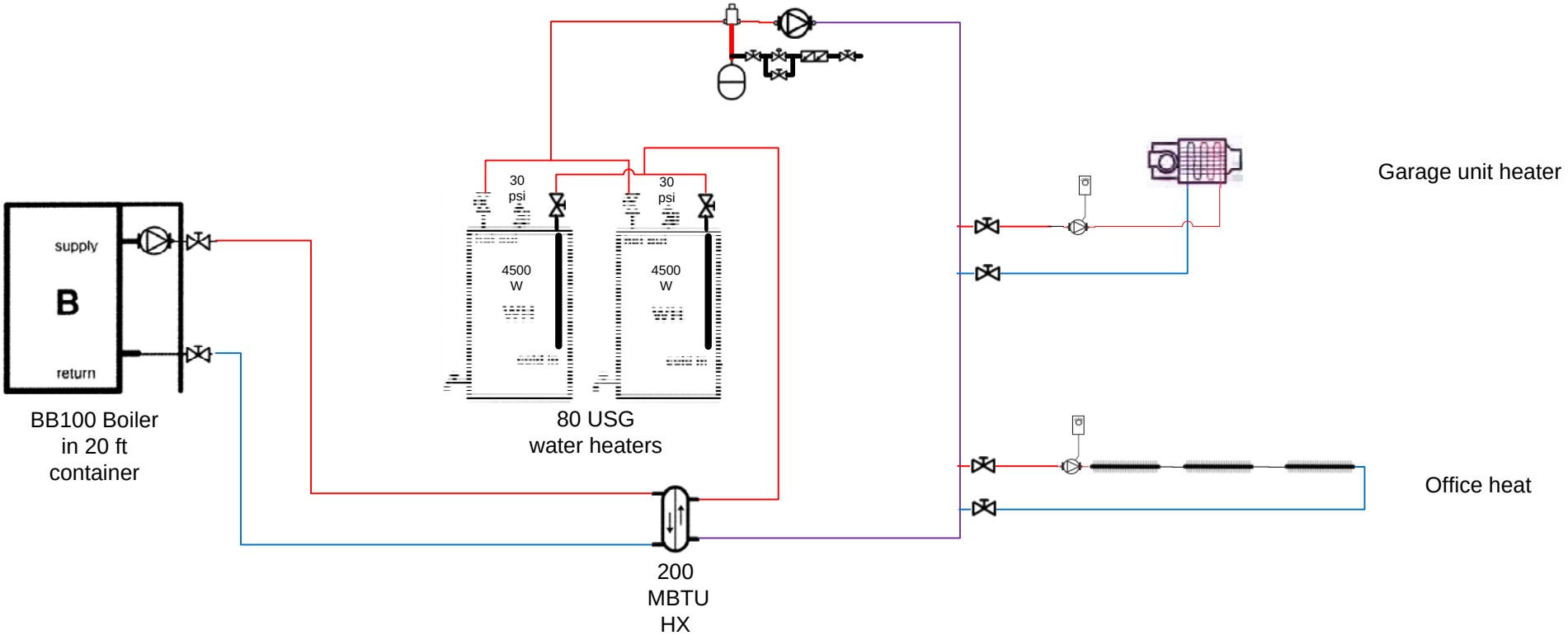

BB100 Boiler
in 20 ft
container

80 USG
water heaters

200
MBTU
HX

Garage unit heater

Office heat

Proposed Biomass Heating
For
Granisle Firehall

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NOTES: Appendix 2 Boiler Spec Sheet

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LEI-PRODUCTS

BB-100 Product Information

The Bio-Burner is a multi-fuel, multi-day biomass heating system. It is a hydronic, non-pressurized boiler that can be attached to any existing heating system. The Bio-Burner is also non-catalytic – the burn takes place in a single burn chamber. The Bio-Burner has a unique computer controlled combustion process which results in a highly efficient and clean burn. The Bio-Burner has also passed all UL & CSA safety standards required for indoor & outdoor use.

Typical biomass fuels used in this system include:

- Wood chips - Sawdust - Pellets - Animal bedding - Grains - Grasses - Other crops & more.

FUNCTIONALITY

1 - Biomass Fuel Input

The process begins by filling the fuel bin for The Bio-Burner with approved biomass fuel. The computer controls on The Bio-Burner automatically meter fuel into the combustion chamber when there is a call for heat.

2 - Combustion Process

Once biomass fuel is metered into the combustion chamber, the ignition cycle begins with either natural gas or propane. The typical 'cold' ignition cycle is between 5 and 10 minutes. Once the combustion chamber reaches a stable temperature, the gas shuts off and the unit maintains heat output on biomass. The combustion process for The Bio-Burner is closely managed by its sophisticated yet simple computer controls. With constant control over the precise fuel & air ratios & fuel agitation, The Bio-Burner is capable of achieving a complete burn in a single burn chamber with little to no smoke & emissions from start up to shut down. Because of the low levels of smoke & emissions, The Bio-Burner will never accumulate creosote.

3 - Heat Output

Hot air exits the combustion chamber making its way to the decoupled water heat exchanger. The hot water heat exchanger has 10 heat exchange tubes which allow air to flow through the exhanger an out through the exhaust. Inside of each of the heat exchanger tubes are turbulators which assist in extremely efficient heat transfer. The turbulators also act as cleaners for the heat exchanger tubes. The Bio-Burner allows for tooless entry to the top of each of the turbulators for easy access & cleaning of the heat exchanger. Once heat has been transfered to create water, the hot water is then delivered to provide heat to any number of heating applications. Hot water can be used in radiant and forced air heating applications as well as to heat domestic hot water.

4 - Clean & Green

The emissions from The Bio-Burner are extremely clean. Due to the precise fuel and air ratio controls, highly efficient combustion process, highly efficient heat exchange & the fly ash collection system, The Bio-Burner is as green as it gets. You will never see creosote build up & will never see a single spark escape through the exhaust of The Bio-Burner.

5 - Easy Maintenance

ASH REMOVAL

Every model of The Bio-Burner comes equipped with automatic combustion chamber ash removal. Ash removal for The Bio-Burner is as simple as checking to see if your bucket is full.

GREASE POINTS

All grease points are easily accessable and accept standard inexpensive low temp grease.

HX TUBE CLEANING

Each heat exchanger tubes is equipped with a turbulator/cleaner. The Bio-Burner is designed to allow toolless entry for cleaning each tube by simply spinning all 10 turbulators with a cordless drill or wrench. Any ash build up then falls into the ash removal pan at the base of the unit for easy removal.

FLEXIBILITY

1 - Multiple Biomass Fuel Capabilities

The Bio-Burner is capable of burning multiple biomass fuel types such as:

- Wood chips - Sawdust - Pellets - Animal bedding - Grains & more.

The Bio-Burner is designed to utilize inexpensive & locally available fuels. Cheap heat is the key ingredient for the sucess of The Bio-Burner. To effectively lower heating costs, unprocessed & readily available biomass fuels should be used.

2 - Multiple Heating Applications

The Bio-Burner can be used in a variety of heating applications such as:

- Structural heating
- Domestic hot water
- Drying applications
- Green houses
- Poultry farms
- Equine applications

AUTOMATION

1 - Fuel Handeling

Each of the fuel bin options for The Bio-Burner are completely automated. Once fuel has been loaded into the fuel storage bin, it is then automatically metered into The Bio-Burners combustion chamber as the unit calls for heat. The fuel is auger fed from the floor of the fuel storage bin to the fuel input tube at the upper portion of the combustion chamber. The fuel is then gravity fed and falls to the combustion chamber floor to begin the combustion process assisted by injected air & agitation.

No physical adjustments are required when changing fuel types. The Bio-Burner is able to achieve multiple days or even weeks of run time between bin refills.

2 - Computer Controls

Simple yet sophisticated computer controls are the brains behind The Bio-Burner. The computer controls monitor temperatures at 3 different points thru-out the unit:

Combustion Chamber - Water Heat Exchanger - Flu Exhaust

Other automated features include:

- Fuel Input Speed
- Air Injection Speed
- Fuel Ignition & Re-Lite
- Gas Backup Heat

Combined, these automated features result in clean, efficient & consistant heat output. For more information on features such as remote control access, see the product owners manual.

3 - Ash Removal

Every one of The Bio-Burner models are equipped with automatic combustion chamber ash removal. Removing combustion chamber ash from The Bio-Burner is as simple as periodically emptying the ash container. All other ash removal ports & cleanouts enable the user to completely clean out the unit through easy access points with minimal effort.

SAFETY

The Bio-Burner has been approved with CSA & UL safety standards for indoor & outdoor use. There are a combination of computer controlled & mechanical safety features included with all of The Bio-Burner models. For a detailed list of saftey features, see The Bio-Burner owners manual.

PRODUCT OPTIONS

OPTION 1 - Fuel Bin Size and Configuration

The Bio-Burner has 2 fuel bin options. The Standard 2 Yard Bin or the Bulk Bin Kit for up to 22 yards of storage capacity.

2YD STANDARD BIN

The 2 Cubic Yard Standard Bin is the smallest fuel bin option for The Bio-Burner. It is weatherproof and safe for use indoors & outdoors. The Bio-Burner's computer controls automatically meter fuel from the bin into the boilers combustion chamber as needed. No physical adjustments are needed when switching between approved fuel types. This fuel bin option is available for any of The Bio-Burner models.

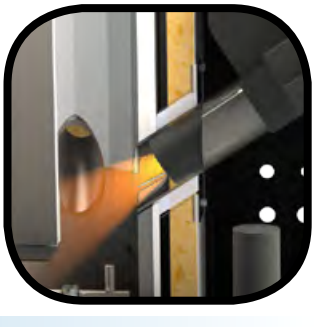
BULK BIN KIT

The Bulk Bin Kit for The Bio-Burner is configurable up to 22 cubic yards of fuel. The storage bin is available in 2 different configurations: 7ft diameter or 9ft diameter and up to 8ft in height. The Bio-Burner's computer controls automatically meter fuel from the bin into the boilers combustion chamber as needed. No physical adjustments are needed when switching between approved fuel types. This fuel bin option is available for any of The Bio-Burner models.

*__NOTE:__ *The floor & side walls are priced separately*

OPTION 2 - Gas Backup :: Natural Gas or Propane (LP)

The Bio-Burner uses gas for ignition with the added bonus of gas backup heat.



NATURAL GAS

If natural gas is available, it is typicaly the leist expensive gas backup option.

PROPANE (LP)

Propane, in most cases, is more expensive than natural gas. However, it does have it's benefits. Portable tanks can be used with no need for trenching or running hard lines.

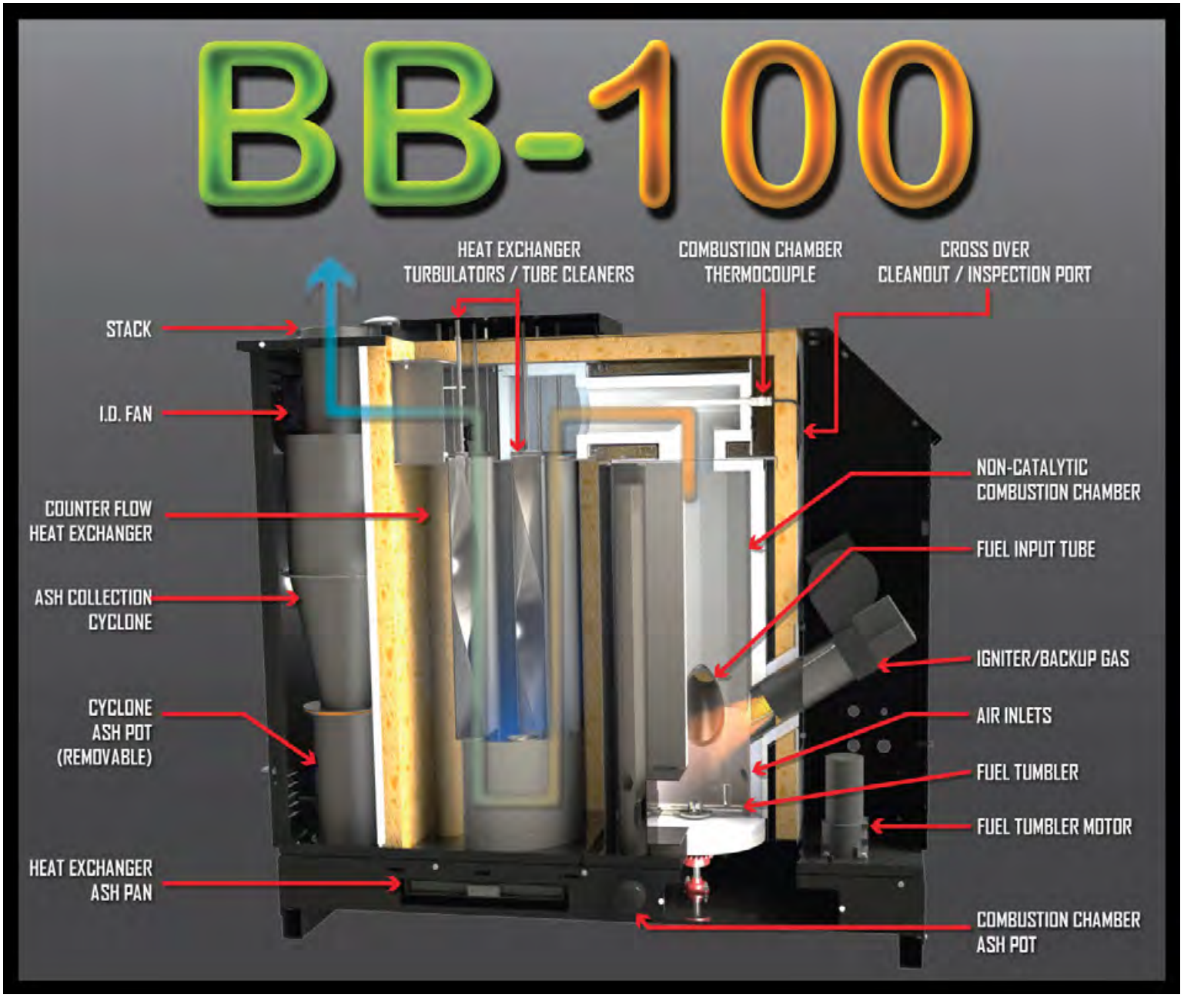
OPTION 3 - EPA Phase II Hang Tag

MODEL "BB-100"

The Bio-Burner model BB-100 is capable of burning multiple types of biomass. Due to this ability it is not EPA Phase II approved. The BB-100's design is the same as that of the EPA Phase II model (MBB-100) with the exception of the EPA Phase II Hang Tag.

MODEL "MBB-100"

The Bio-Burner model MBB-100 is EPA Phase II approved for burning wood pellets only. To maintain the EPA Phase II rating, no other biomass fuels should be used in this model.



TECHNICAL SPECIFIATIONS

Heat output: 100,000 BTU (39+kw)
Weight: 900 LBS
Burner footprint: 60"W x 22"D x 55"H
Power requirement: 120 VAC, 4 amps nominal
Flue pipe: 6"
Water storage: 16 Gallons
Water hookup: 1" NPT
Gas Ignition & Backup: Propane or Natural Gas 120K BTU input (1" NPT)
Fuel bin capacity: 2 - 22 cubic yards
ID fan: Computer controlled VFD

Fuel stir motor: 115 VAC constant speed
HX turbulators: Easy access for easy cleaning
Water pump: 10 GPM (included)
Boiler protection valve: 135 degree included
Flow rate required: 10 GPM minimum
Ash removal: Automatic
User interface: Touch screen controls with remote access
Maximum fuel size: B10
Acceptable fuel moisture: Up to 40% (wet basis)
Temperature ranges: Water - 135 - 185°F
Flue - 250 - 450°F
Combustion - 1100 - 1800°F

CASE STUDY

Green Energy
as a Rural Economic Development Tool Project

COMMUNITY: Village of Granisle

PROJECT: Granisle Fire Hall Biomass Furnace Project

NOTES: Appendix 3 OBAC Final Report

FUNDED BY:

British Columbia
Ministry of Jobs, Tourism and Innovation
Pine Beetle Epidemic Response Branch

Southern Interior Beetle Action Coalition SIBAC

Canada's Rural Partnership
Government of Canada / Gouvernement du Canada

Columbia Basin Trust
a legacy for the people

Cariboo Chilcotin Beetle Action Coalition

Omineca Beetle Action Coalition

GRANISLE FIRE DEPARTMENT BIOMASS FURNACE PROJECT

January 2013

The Biomass Furnace Project (BFP) has been a very interesting project with ongoing lessons being learned. We believe it will be a very successful project when all the "kinks" are worked out.

In follow up to the Energy Plan, the Village of Granisle chose to focus on the Fire Hall for energy efficiencies. The Village Council decided to separate the efficiencies into two separate components; a Biomass Burner and building retrofits. The focus of this report is for the Bio Mass heating system.

The Village of Granisle had the vision to install a Bio energy heating system with the goal of reducing carbon emissions while reducing fuel (propane) costs to the municipality. This system is located in a stand-alone building (container) adjacent to the Fire Hall. This Bio Burner is currently using wood chips for fuel and is a multi-day burner/boiler with a universal feed system. The wood chips are regularly loaded to a bulk storage system in order to feed the furnace automatically.

The installation took place in November 2011 with start-up and trouble-shooting ongoing from December 2011 to April 2012. There was quite a bit of down time including complete shut down due to the need for a bio furnace replacement (as mentioned in Breaking New Ground). These temporary difficulties made it difficult to accurately determine the overall savings in fuel costs and efficiencies. The furnace was started again in November and December 2012. From December until present, the furnace has run very efficiently, keeping the fire hall at a comfortable 74 degrees F. When the furnace is working properly we are finding that there isn't any propane usage for the heating of the fire hall.

Lessons Learned

Knowledge Base

The Village of Granisle contracted Ardent Energy for the actual purchase and installation of the unit. The initial site prep and container & roof installation was completed by the Village Public Work Staff. The project management was conducted by the CAO & Financial Officer. Luckily, one of the Village Councillors has an electrical background and "took the project on". The Councillor has been a great asset for this project, working with the contractor as well as assisting with the ongoing operation of the furnace. His knowledge and availability of time has been invaluable. The time estimated that our councillor has spent for the past year is about 400 hours. This is time that our Public Works employees would have had to take away from their existing workload which we had not accounted for. The system is running much more smoothly now and will not need the attention that it initially did so we are planning on having Public Works take on this added responsibility.

GRANISLE FIRE DEPARTMENT BIOMASS FURNACE PROJECT

January 2013

Breaking New Ground

On initial installation there were difficulties with malfunctions causing the furnace to shut down. Initially it was thought that it was due to power surges affecting the computer. But after further testing and computer malfunctions and furnace replacement, it was found to be due to the computerized electronics being affected by the heat produced from the furnace. This has been addressed by improved sealing of the electronics compartment as well as providing more insulation around the unit and chimney.

Next, issues have been due to mechanical problems with the auger (fuel feeder). These have all been worked out by increasing the size of motors, solving chip delivery issues.

Although there have been difficulties the supplier has been excellent to work with and as we find issues and problems, they quickly act to provide assistance and work to correct the problem –at no cost to the Village.

Fuel Quality/Handling

The Village has purchased bulk wood chips from a company in a neighboring community. The wood chips are hauled in by the truck load once a year and stored in a container in close proximity to the bio furnace container. The bulk chips must be transferred manually into the bio furnace storage area. This can be quite time consuming and labour intensive. More efficient methods of transfer of the chips are being investigated. We are considering relocating the furnace to reposition the auger system, eliminating the need to move the chips twice.

Maintenance of the furnace also includes the cleaning and emptying of the ash by-product. There is a recommendation for a self-cleaning ash system. The supplier is installing an automatic ash disposal system as well as upgrading the blower (air) system and software upgrades, all at no additional costs to the Village.

Benefits As We See It

Although we have not seen a consistent functioning bio mass furnace to date, we have observed a decrease in the use of propane for the Fire Hall resulting in a decrease in costs for propane. We have seen how biomass can be used for efficient heat. When we reviewed the overall cost comparison for propane usage plus the additional cost of the purchase of wood chips we have reduced the overall cost of heating for the fire hall by about 41%. (2011 Propane Costs for winter months --$4994.27 compared to 2012 Propane Costs plus wood chip costs --$2963.92) The Village is already investigating a more locally produced source for wood chips. We will see a decrease in our Carbon Footprint resulting in a reduced use of fossil fuels and much more efficient method of heating. This project will contribute to the global effort to reduce greenhouse gas emissions thus meeting our goal.

This project has been a great opportunity for the Village and the supplier to expand their knowledge and to develop a more efficient "product" (the bio burner). This will provide the supplier the information to continue to develop a much more effective and efficient final product in the future.

GRANISLE FIRE DEPARTMENT BIOMASS FURNACE PROJECT

January 2013

The Village of Granisle looks forward to sharing any knowledge regarding this project to foster regional learning opportunities and invites OBAC, RDBN and communities to come for a tour of the facility. Although there has only been one official tour (John Rustad, MLA) of the facility, Village staff will be scheduling tours with the local school, new councillors and members of the community over the next month.

The Village of Granisle would like to thank the Omineca Beetle Action Coalition for its foresight in supporting and providing a grant towards this very worthwhile project.

PROJECT EXPENSES

EXPENSE ITEM	SOURCE	BUDGET	ACTUAL
Boiler & Fuel Storage System	Ardent Energy	$ 22,000.00	$ 22,000.00
Modification & Install system	Ardent Energy	$ 9,875.00	$ 10,468.61
Storage Container	D&E Vending Ltd.	$ 6,580.00	$ 6,580.00
Roofing Material & Trusses	Starland Supply & Tricon	$ 8,884.39	$ 8,560.82
Man door Installation	Kaleig Holdings	$ 1,131.02	$ 1,131.02
Site Prep, Roof Install	Staff (Public Works)	$ 5,500.00	$ 5,781.80
Administration/Management	Staff	$ 5,000.00	$ 6,272.00
TOTAL		**$ 58,970.00**	**$ 60,794.25**

Volunteer hours spent for installation, troubleshooting, servicing and follow-up maintenance provided by Village of Granisle Councillor

400 hrs. @ $25.00/hr. = $1000.00 (not billed) Volunteer