Feasibility Assessment for Biomass Heating Systems
Buster Gene Memorial Hall, Gakona, Alaska

FINAL REPORT – 9/5/2014

COFFMAN ENGINEERS

800 F Street, Anchorage, AK 99501
p (907) 276-6664 f (907) 276-5042

Tony SlatonBarker, PE, and
Lee Bolling, CEA, CEM

Contents

Appendices

Abbreviations

ACF	Accumulated Cash Flow
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
AEA	Alaska Energy Authority
AFUE	Annual Fuel Utilization Efficiency
B/C	Benefit / Cost Ratio
BTU	British Thermal Unit
BTUH	BTU per hour
CCF	One Hundred Cubic Feet
CEI	Coffman Engineers, Inc.
CFM	Cubic Feet per Minute
Eff	Efficiency
F	Fahrenheit
ft	Feet
GPM	Gallons Per Minute
HP	Horsepower
HVAC	Heating, Ventilating, and Air-Conditioning
in	Inch(es)
kWh	Kilowatt-Hour
lb(s)	Pound(s)
MBH	Thousand BTUs per Hour
O&M	Operations and Maintenance
MMBTU	One Million BTUs
PC	Project Cost
R	R-Value
SF	Square Feet, Supply Fan
TEMP	Temperature
V	Volts
W	Watts

List of Figures

List of Tables

I. Executive Summary

A preliminary feasibility assessment was completed to determine the technical and economic viability of biomass heating systems at the Buster Gene Memorial Hall in Gakona, Alaska. The study evaluated a wood pellet boiler system that would supply the majority of the building's annual heating requirements. The high price of fuel oil is the main economic driver for the use of lower cost biomass heating.

Two options were evaluated:

- Option A: The wood pellet boiler would be located in a large storage room inside the existing Memorial Hall.
- Option B: The wood pellet boiler would be located in a new detached insulated building behind the Memorial Hall.

Both options utilize wood pellets delivered by truck. Two new silos would be loaded by the delivery truck's auger boom for pellet storage.

The results of the economic evaluation are shown below. Option A is economically justified at this time, due to the fact that the benefit to cost ratio of the option is greater than 1.0.

Economic Analysis Results	Option A	Option B
Project Capital Cost	$84,288	$124,759
Present Value of Project Benefits (20 year life)	$246,260	$246,260
Present Value of Operating Costs (20 year life)	$160,306	$161,092
Benefit / Cost Ratio of Project (20 year life)	1.02	0.68
Net Present Value (20 year life)	$1,666	($39,591)
Year Accumulated Cash Flow is Net Positive	First Year	First Year
Year Accumulated Cash Flow > Project Capital Cost	20 years	Over 20 years
Simple Payback	43.6 years	67.3 years

Table 1 – Economic Evaluation Summary

II. Introduction

A preliminary feasibility assessment was completed to determine the technical and economic viability of biomass heating systems for the Buster Gene Memorial Hall for the Native Village of Gakona in Gakona, AK. The location of the building is shown in Figures 1 and 2.

Fig. 1 – Gakona, Alaska – Google Maps

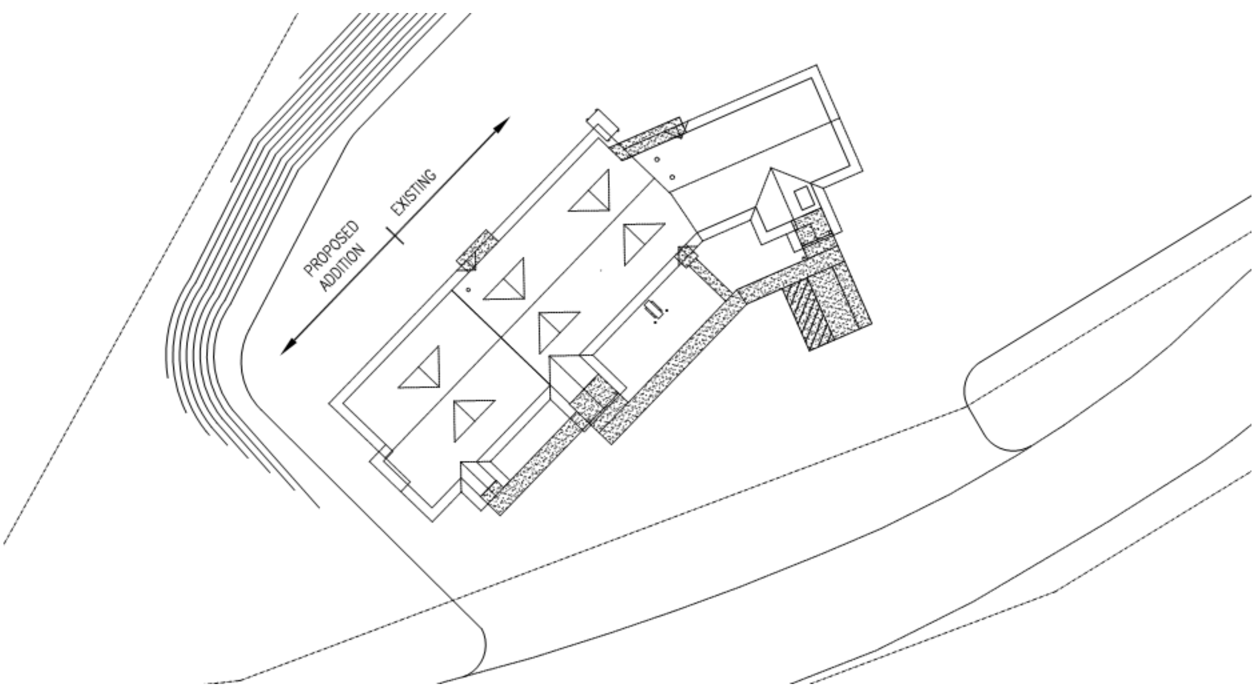


Fig. 2 – Buster Gene Memorial Hall – Design Drawings

III. Preliminary Site Investigation

Building Description

The Buster Gene Memorial Hall is an 8,228 SF single story building that was originally built in 2008 and was added on to with an attached addition in 2013. The building has multiple uses and contains a health clinic, meeting hall, commercial kitchen, and office space. There are no scheduled or planned renovations for the building. It is used by three office staff during the work week from 8am to 5pm. It is also used for church one day per week on Sundays and during the week for pre-school activities and for large gatherings with up to 25 or more people. The building is typically used approximately 60 hours per week. An energy audit was completed on the building in 2010 by Your Clean Energy, LLC. The energy audit is on file at the Native Village of Gakona office. Please refer to Appendix D for field data sheet that contains all pertinent information gathered during the site visit.

Existing Heating System

The building is heated by two identical Energy Kinetics oil boilers (MN: System 2000 EK-2F, 1.40 GPH Firing Rate, 170.5 MBH Output) that were installed in 2008 during original construction. The boilers are located in the boiler room, which has one exterior wall. The boilers serve several heating zones and an indirect hot water heater. The building utilizes both perimeter baseboard registers and radiant floors. The boiler system runs in a primary/secondary system, which utilizes several system pumps to transfer heated glycol to different zones. Each boiler appears to be sized at 60% design heat load, which is typical for this type of building. The combustion efficiency of the existing fuel oil boilers is approximately 87%. For this study, the Annual Fuel Utilization Efficiency of the oil boiler system was estimated at 80% to account for typical oil boiler inefficiencies, including short cycling.

There is routine maintenance of the boilers by a Gakona employee (Darin Gene). The boilers appear to be in good shape and operating correctly. However, it was found that the boilers appear to be piped in a non-traditional way, where the boiler supply line is piped upstream of the boiler return line. This existing installation does not match the building's mechanical design drawings. It is recommended that the boiler supply/return piping is re-piped to match design drawings.

There is also an existing small wood pellet stove in the large community hall that is available for supplemental space heating. According to building staff, the existing pellet stove is rarely used.

One 550 gal heating oil tank serves the boilers and is located to the north side of the building. The tank is dual wall. There is no additional spill containment is present around the tank. Fuel in the tanks is used for building heating and domestic hot water only.

Domestic Hot Water

Domestic hot water is used for hand washing, the kitchen and also for laundry. There are two commercial washing machines in the building. Hot water is provided by a 40 gal Energy Kinetics indirect hot water heater, which uses a loop from the boiler for heat.

Building Envelope

The building is 2x8 wood stud construction with a cold roof. Based on design drawings the walls have two layers of 4" friction fit fiberglass batt insulation (approximately R-30). The cold roof has R-42 blown cellulose insulation. According to the 2010 energy audit, some of the roof insulation was not installed as deep as called for in the design drawings and was estimated at R-33. The windows are double pane and there are two arctic entries for the two main entrances.

Available Space

There are two options for locating a new biomass boiler system. The first option, Option A, would be to locate the biomass boiler in the storage room (RM 108) on the east side of the community hall room. This storage room is approximately 6 ft by 16 ft and part of this room could be converted into a code approved mechanical room to house the biomass boiler.

The second option, Option B, would be to install the biomass boiler system inside a small, detached 8 ft by 10 ft boiler building. The detached boiler building could be located on the north side of the building in the vicinity of the existing shed and would be approximately 30 feet away from the existing mechanical room.

Street Access and Fuel Storage

The building site is situated along a paved road that a bulk pellet delivery truck can easily access. The wood pellets can be stored in two large 8.5 ton silos, which can be filled with an auger boom from the pellet delivery truck. The client preferred location for the pellet silos is the northwest side of the building, near the existing well. Please refer to Appendix C for the site plan. A small amount of site grading would be required to provide delivery truck access to the silos behind the building.

Building or Site constraints

The site is flat with no significant site constraints. There were no wetlands or signs of historical structures observed.

Biomass System Integration

A wood boiler system would easily be able to tie into the return line of the existing hydronic system of the building. There appears to be sufficient room in the mechanical room to tie in to the existing piping without major piping changes. The existing hydronic system, baseboards and radiant floors would be used to distribute heat around the building.

Biomass System Options

The client prefers a biomass fuel that is easy to handle, utilizes automatic fuel loading, and is locally available. Automatic fuel loading is necessary because the village does not have the personnel resources to manually handle and load a batch burning system (such as a cord wood Garn boiler).

Based on these criteria, wood pellets are the preferred biomass fuel. Wood pellets are locally available in Fairbanks and in Delta Junction. Cord wood was not considered as an option because it must be manually batch loaded and fired.

There are two options for pellet boiler systems (see option A and B discussion below). Both options will utilize two 8.5 ton silos to hold wood pellets. The pellet silos will be in the same location for each option. Polydome silos were used as the basis for this study and are available through Superior Pellets in Fairbanks. According to Superior Pellets, each silo can be erected on 6" concrete slabs that are approximately 8 ft by 8 ft. For this study, it is assumed that one large 8 ft x 16 ft slab is made for both silos to save costs.

Transfer augers will move the pellets from the two silos to a pellet hopper integrated into the pellet boiler. The pellet hopper is connected to the boiler and is used for daily feeding of pellets. For this study, one Maine Energy Systems PES56 pellet boiler was used as the basis of design. This boiler is a high quality pellet boiler with a good track record for reliability and lifespan. The PES56 has an output of 191 MBH and can modulate down to 30% firing rate. It also has automatic ash removal systems and is easily maintainable. There are other pellet boilers on the market that have similar characteristics that could be used. Please refer to the Section VIII General Biomass Technology Information for a further discussion on pellet boilers.

Fig. 3 – Maine Energy Systems Pellet Boiler and Polydome Silo
(Not to scale)

Option A: The pellet boiler will be located in the storage room on the east side of the community hall room. Part (or all) of the storage room will be converted to a mechanical room that will contain the pellet boiler and hopper, as well as piping and a circulation pump. The advantage of this option is that it has much lower equipment and installation costs than locating the pellet boiler in a detached boiler building. The disadvantage is that there will be less storage space. Insulated piping will be routed near the ceiling to the existing mechanical room for tie-in.

Option B: For this option, the pellet boiler will be located in a detached 8 ft by 10 ft boiler building, approximately 30 ft from the building's existing mechanical room. The detached building will house the pellet boiler and hopper. It is assumed that concrete slab for the new pellet silos will lengthened for use as the detached boiler foundation for cost savings. This building can either be constructed with new materials or it could be a retrofitted conex that is insulated and modified to meet code requirements for mechanical, electrical, access and egress. Buried insulated piping will deliver heated glycol from the boiler building to the existing mechanical room, where it will be tied into the existing system with a heat exchanger. The advantage of this option is that Memorial Hall will not lose storage space. The disadvantage is significant cost increase due to constructing the detached boiler building and buried insulated lines. Also, the existing shed in the rear of the building will most likely need to be relocated to make space for the detached building.

Please refer to Appendix C for a site plan of the options.

IV. Energy Consumption and Costs

Wood Energy

The gross energy content of wood pellets varies depending on tree species, moisture content and manufacturing. Wood pellets available in Alaska can range in moisture content from 4.5% to 6.5% and in energy value from 8,000 to 8,250 BTU/lb, depending on manufacturer. For this study, wood pellets were estimated to have 8,000 BTU/lb, which is equivalent to 16.0 MMBTU/ton. To determine the delivered $/MMBTU of the biomass system, an 86% efficiency for the Maine Energy System pellet boiler was assumed. This is based on manufacturer documentation.

Wood pellets were used as the biomass fuel for this study. However, the following is additional information on cord wood fuel for future evaluations. The gross energy content of a cord of wood varies depending on tree species and moisture content. Black spruce, white spruce and birch at 20% moisture content have respective gross energy contents of 15.9 MMBTU/Cord, 18.1 MMBTU/cord and 23.6 MMBTU/cord, according to the UAF Cooperative Extension. Wet or greenwood has higher moisture contents and require additional heat to evaporate moisture before the wood can burn. Thus, wood with higher moisture contents will have lower energy contents. Seasoned or dry wood will typically have 20% moisture content. For this study, cord wood was estimated to have 16.0 MMBTU/cord. This is a conservative estimate based on the fact that the community has access to both spruce and birch. To determine the delivered $/MMBTU of the biomass system, a 75% efficiency for batch burning systems was assumed. This is based on manufacturer documentation and typical operational issues which do not allow firing 100% of the time.

Energy Costs

The high price of fuel oil is the main economic driver for the use of lower cost biomass heating. Fuel oil is shipped into Gakona by truck and currently costs $3.75/gal. For this study, the energy content of fuel oil is based on 134,000 BTU/gal, according to the UAF Cooperative Extension.

Superior Pellets out of North Pole, AK is an Alaskan source of wood pellets (contact Chad Schumacher, General Manager at (907) 488-6055 for delivery methods and current costs). Superior Pellets manufactures local Alaskan pellets at their North Pole factory and will deliver pellets in bulk to Gakona. Delivery is made with a 32 ft long pellet truck that can hold 15 tons of pellets. The truck has a 28 ft auger boom for filling a large pellet storage silo (or silos) onsite. The cost for delivering bulk pellets to Gakona is $350/ton, for a full truck load of pellets. This includes the cost of filling the pellet silos. It is proposed that two 8.5 ton silos are used for the biomass system. This will give the building 17 tons of storage and will allow for a full 15 ton delivery from Superior Pellets. The Superior Pellet option is used for the economic analysis in this study because it includes all delivery costs to the pellet storage silo.

Another pellet distributor is End of the Alcan (contact Donna Supernaw at (907) 895-5321), which is located in Delta Junction at milepost 272 on the Richardson Highway. The pellets are manufactured by Premium Pellets in Canada and are transported to Alaska by semi-truck. Trucks carry a load of 30 tons of pellets that can be delivered to Gakona directly. The pellets are packaged in 40 lb bags and are palletized in one ton shipping pallets (2,000 lbs). One shipping pallet contains 50 bags of pellets. A staging area and fork lift will be required to unload the truck and store pellets. The delivered price to the site is $332/ton. Because this price does not include the labor and forklift required to offload the pallets or the labor to rip open each bag of pellets to load a storage silo, this pellet source was not used for the economic analysis in this study.

The table below shows the energy comparison of different fuel types. The system efficiency is used to calculate the delivered MMBTU's of energy to the building. The delivered cost of energy to the building, in $/MMBTU, is the most accurate way to compare costs of different energy types. As shown below, cord wood and wood pellets are cheaper than fuel oil on a $/MMBTU basis.

Fuel Type	Units	Gross BTU/unit	System Efficiency	$/unit	Delivered $/MMBTU
Cord Wood	cords	16,000,000	75%	$200	$16.67
Wood Pellets	tons	16,000,000	86%	$350	$25.44
Fuel Oil	gal	134,000	80%	$3.75	$34.98
Electricity	kWh	3,413	99%	$0.28	$82.87

Table 2 – Energy Comparison

Existing Fuel Oil Consumption

An estimate of the Memorial Hall's heating oil consumption was required because the new addition of the building has only been occupied since October 2013. An estimate was made based on heating oil bills from 2013 and 2014, and from estimating the future consumption of the new addition. Based on this estimate, the Memorial Hall uses approximately 2,800 gal of fuel oil annually for space heating and domestic hot water. The estimated annual fuel cost, based on the current price of heating oil, is $10,500.

Building Name	Fuel Type	Avg. Annual Consumption	Net MMBTU/yr	Annual Fuel Cost
Buster Gene Memorial Hall	Fuel Oil	2,800 gal	300.2	$10,500

Table 3 – Existing Fuel Oil Consumption

Biomass System Consumption

For both options it is estimated that the proposed biomass system will offset 97% of the heating energy for the building. The remaining 3% of the heating energy be provided by the existing oil boilers. This result is based on an analysis of outdoor temperature BIN data for the Gakona region. Based on this analysis, even though one Maine Energy System PES56 pellet boiler will only provide 67% of the building's peak design load, it will provide 97% of the building's heat on an annual basis. Both options utilize the same pellet boiler and are expected to have the same energy costs. The two 8.5 ton silos will hold approximately 80% of the buildings annual pellet demand, or one delivery approximately every 9 months.

Option	Fuel Type	% Heating Source	Net MMBTU/yr	Annual Consumption	Energy Cost	Total Energy Cost
Option A and B	Pellets	97%	291.2	21.2 tons	$7,406	$7,791
	Fuel Oil	3%	9.0	84 gal	$315	
	Additional Electricity	N/A	N/A	252 kWh	$71	

Table 4 – Proposed Biomass System Fuel Consumption

V. Preliminary Cost Estimating

An estimate of probable costs was completed for Option A and Option B. The cost estimate is based on a discussions with pellet boiler manufacture's in-house engineers, mechanical contractors, and silo suppliers. A 5% remote factor was used to account for increased shipping and installation costs to Gakona. Project and Construction Management was estimated at 5%. Engineering design and permitting was estimated at 20% and a 15% contingency was used.

Option A – Indoor Pellet Boiler System With Exterior Silos				
Category	**Description**		**Cost**	
Site Work and Silos	Site Grading		$	4,200
	Concrete Slab		$	4,200
	Two 8.5 Ton Silos		$	5,400
	Silo Installation		$	2,100
		Subtotal	**$**	**15,900**
Electrical Utilities	Auger Power Connection		$	1,500
	Conduit and Wiring		$	1,500
		Subtotal	**$**	**3,000**
Wood Boiler and Augers	Maine Energy Systems PES 56 Pellet Boiler		$	23,000
	Transfer Augers		$	3,000
		Subtotal	**$**	**26,000**
Interior Mechanical & Electrical	Boiler Installation, Piping & Materials		$	7,000
	Fire Allowance		$	1,500
	Electrical Allowance		$	2,000
		Subtotal	**$**	**10,500**
Subtotal Material and Installation Cost			**$**	**55,400**
Remote Factor	5%		$	2,770
		Subtotal	**$**	**58,170**
Project and Construction Management	5%		$	2,909
		Subtotal	**$**	**61,079**
Design Fees and Permitting	20%		$	12,216
		Subtotal	**$**	**73,294**
Contingency	15%		$	10,994
Total Project Cost			**$**	**84,288**

Table 5 – Option A - Estimate of Probable Cost

Option B – Detached Pellet Boiler Building With Exterior Silos			
Category	**Description**		**Cost**
Site Work and Silos	Site Grading		$ 4,500
	Concrete Slab		$ 6,000
	Two 8.5 Ton Silos		$ 5,400
	Silo Installation		$ 2,100
		Subtotal	**$ 18,000**
Electrical Utilities	Service Entrance		$ 2,000
	Conduit and Wiring		$ 2,000
		Subtotal	**$ 4,000**
Wood Boiler and Augers	Maine Energy Systems PES 56 Pellet Boiler		$ 23,000
	Transfer Augers		$ 3,000
		Subtotal	**$ 26,000**
Interior Mechanical & Electrical	Boiler Installation, Piping & Materials		$ 7,000
	Fire Allowance		$ 1,500
	Electrical Allowance		$ 2,000
		Subtotal	**$ 10,500**
Wood Boiler Building	8ft x 10ft Wood Boiler Building		$ 20,000
	Buried Utilities		$ 3,500
		Subtotal	**$ 23,500**
Subtotal Material and Installation Cost			**$ 82,000**
Remote Factor	5%		$ 4,100
		Subtotal	**$ 86,100**
Project and Construction Management	5%		$ 4,305
		Subtotal	**$ 90,405**
Design Fees and Permitting	20%		$ 18,081
		Subtotal	**$ 108,486**
Contingency	15%		$ 16,273
Total Project Cost			**$ 124,759**

Table 6 – Option B - Estimate of Probable Cost

VI. Economic Analysis

The following assumptions were used to complete the economic analysis for this study.

Inflation Rates	
Discount Rate for Net Present Value Analysis	3%
Wood Fuel Escalation Rate	3%
Fossil Fuel Escalation Rate	5%
Electricity Escalation Rate	3%
O&M Escalation Rate	2%

Table 7 – Inflation rates

The real discount rate, or minimum attractive rate of return, is 3.0% and is the current rate used for all Life Cycle Cost Analysis by the Alaska Department of Education and Early Development. This is a typical rate used for completing economic analysis for public entities in Alaska. The escalation rates used for the wood, heating oil, electricity and O&M rates are based on rates used in the Alaska Energy Authority funded 2013 biomass pre-feasibility studies. These are typical rates used for this level of evaluation and were used so that results are consistent and comparable to the 2013 studies.

O&M Costs

Non-fuel related operations and maintenance costs (O&M) were estimated at $380 per year for Option A. Option B was estimated at $420 per year due to additional expenses associated with a detached building. The estimate is based on annual maintenance time for the pellet boiler. Per manufactures recommendations the ash trays should be manually dumped for every two tons of pellets burned. This amounts to dumping ash a little less than once per month. Dumping the ash trays takes less than 10 minutes of non-skilled labor per event. In the winter a 30 minute service is recommended to clean the boilers heat exchanger. In the summer, a 90 minute service is recommended to clean heat exchangers and maintain other components. According to the manufacturer the summer and winter service can be easily completed by the Village's existing maintenance person. For only the first two years of service, the maintenance cost is doubled to account for maintenance staff getting used to operating the new system.

Definitions

There are many different economic terms used in this study. A listing of all of the terms with their definition is provided below for reference.

Economic Term	**Description**
Project Capital Cost	This is the opinion of probable cost for designing and constructing the project.
Simple Payback	The Simple Payback is the Project Capital Cost divided by the first year annual energy savings. The Simple Payback does not take into account escalated energy prices and is therefore not a good measure of project viability. $$Simple\ Payback = \frac{Installed\ Cost\ of\ ECM}{First\ Year\ Energy\ Savings\ of\ ECM}$$

Economic Term	Description
Present Value of Project Benefits (20 year life)	The present value of all of the heating oil that would have been consumed by the existing heating oil-fired heating system, over a 20 year period.
Present Value of Operating Costs (20 year life)	The present value of all of the proposed biomass systems operating costs over a 20 year period. This includes wood fuel, additional electricity, and O&M costs for the proposed biomass system to provide 97% of the building's heat. It also includes the heating oil required for the existing oil-fired boilers to provide the remaining 3% of heat to the building.
Benefit / Cost Ratio of Project (20 year life)	This is the benefit to cost ratio over the 20 year period. A project that has a benefit to cost ratio greater than 1.0 is economically justified. It is defined as follows: $$Benefit\ /\ Cost\ Ratio = \frac{PV(Project\ Benefits) - PV(Operating\ Costs)}{Project\ Capital\ Cost}$$ Where: PV = The present value over the 20 year period. Reference Sullivan, Wicks and Koelling, "Engineering Economy", 14th ed., 2009, pg. 440, Modified B-C Ratio.
Net Present Value (20 year life)	This is the net present value of the project over a 20 year period. If the project has a net present value greater than zero, the project is economically justified. This quantity accounts for the project capital cost, project benefits and operating costs.
Year Accumulated Cash Flow > Project Capital Cost	This is the number of years it takes for the accumulated cash flow of the project to be greater than or equal to the project capital cost. This is similar to the project's simple payback, except that it incorporates the inflation rates. This quantity is the payback of the project including escalating energy prices and O&M rates. This quantity is calculated as follows: $$Installed\ Cost \leq \sum_{k=0}^{J} R_k$$ Where: J = Year that the accumulated cash flow is greater than or equal to the Project Capital Cost. R_k = Project Cash flow for the kth year.

Table 8 – Economic Definitions

Results

The economic analysis for Option A and Option B was completed in order to determine the simple payback, benefit to cost ratio, and net present value of each. The results of the proposed wood pellet boiler system are shown below.

Please refer to Appendix B for the economic analysis spreadsheets for each option.

Option A – In Option A, the pellet boiler is located in the existing building's storage room, east of the community hall room. Option A has a benefit to cost ratio of 1.02 over the 20 year study period, which makes the project economically justified. Any project with a benefit to cost ratio above 1.0 is considered economically justified. The main reason this option is viable is because of its smaller project capital cost due to placing the pellet boiler inside the existing building's storage room. This option does not require building a detached boiler building or burying insulated piping, which significantly increases costs. The disadvantage of this option is that existing storage space will be lost because it will be repurposed for the pellet boiler. However, this may not be an issue since the items in the storage room can easily be stored in the nearby shed behind the building.

Option A - Indoor Pellet Boiler System With Exterior Silos	
Project Capital Cost	$84,288
Present Value of Project Benefits (20 year life)	$246,260
Present Value of Operating Costs (20 year life)	$160,306
Benefit / Cost Ratio of Project (20 year life)	1.02
Net Present Value (20 year life)	$1,666
Year Accumulated Cash Flow is Net Positive	First Year
Year Accumulated Cash Flow > Project Capital Cost	20 years
Simple Payback	43.6 years

Table 9 – Option A - Economic Analysis Results

Option B – In Option B the pellet boiler is installed in a detached boiler building. Option B has a benefit to cost ratio of 0.68, making it not considered economically justified based on the cost estimate and available heating oil offsets. The main reason this option is not viable is due to the additional costs for building the detached building and trenching the insulated piping.

The critical project capital cost to make this option viable (with a benefit to cost ratio of 1.0) is $85,950. If lower cost materials or labor can be found through donations, grants or in-kind support, the project may become economically viable.

Option B - Detached Pellet Boiler Building With Exterior Silos	
Project Capital Cost	$124,759
Present Value of Project Benefits (20 year life)	$246,260
Present Value of Operating Costs (20 year life)	$161,092
Benefit / Cost Ratio of Project (20 year life)	0.68
Net Present Value (20 year life)	($39,591)
Year Accumulated Cash Flow is Net Positive	First Year
Year Accumulated Cash Flow > Project Capital Cost	Over 20 years
Simple Payback	67.3 years

Table 10 – Option B - Economic Analysis Results

Sensitivity Analysis

A sensitivity analysis was completed for both options to show how changing heating oil costs and wood costs affect the benefit to cost (B/C) ratios of the projects. As heating oil costs increase and wood costs decrease, the projects becomes more economically viable. The B/C ratios greater than 1.0 are economically justified and are highlighted in green. B/C rations less than one are not economically justified and are highlighted in red. As the price of heating oil goes up both options become economically more attractive.

Option A – B/C Ratios		Wood Pellet Cost ($/ton)			
		$300/ton	$325/ton	$350/ton	$375/ton
Heating Oil Cost ($/gal)	$3.50/gal	1.08	0.95	0.83	0.71
	$3.75/gal	1.26	1.14	1.02	0.90
	$4.00/gal	1.45	1.33	1.21	1.09
	$4.25/gal	1.64	1.52	1.40	1.28

Table 11 – Option A Sensitivity Analysis

Option B – B/C Ratios		Wood Pellet Cost ($/ton)			
		$300/ton	$325/ton	$350/ton	$375/ton
Heating Oil Cost ($/gal)	$3.50/gal	0.72	0.64	0.56	0.47
	$3.75/gal	0.85	0.77	0.68	0.60
	$4.00/gal	0.98	0.89	0.81	0.73
	$4.25/gal	1.10	1.02	0.94	0.86

Table 12 – Option B Sensitivity Analysis

VII. Forest Resource and Fuel Availability Assessments

Forest Resource Assessments

The Alaska Department of Natural Resources (DNR) has information on the timber and biomass resources of the Valdez Copper River Area. Please refer to the DNR website at http://forestry.alaska.gov/timber/vcra.htm#fiveyear for access to all their information. The DNR has reports on timber sales, five year schedule of timber sales, maps and forest land use plans. The Copper Area Forester is Gary Mullen, who has written the majority of the DNR documents for the Copper Area. Contact with Mr. Mullen was attempted but unsuccessful, as he was out of the office for several weeks during the writing of this report.

Air Quality Permitting

Currently, air quality permitting is regulated according to the Alaska Department of Environmental Conservation Section 18 AAC 50 Air Quality Control regulations. Per these regulations, a minor air quality permit is required if a new wood boiler or wood stove produces one of the following conditions per Section 18 AAC 50.502 (C)(1): 40 tons per year (TPY) of carbon dioxide (CO_2), 15 TPY of particulate matter greater than 10 microns (PM-10), 40 TPY of sulfur dioxide, 0.6 TPY of lead, 100 TPY of carbon monoxide within 10 kilometers of a carbon monoxide nonattainment area, or 10 TPY of direct PM-2.5 emissions. These regulations assume that the device will operate 24 hours per day, 365 days per year and that no fuel burning equipment is used. If a new wood boiler or wood stove is installed in addition to a fuel burning heating device, the increase in air pollutants cannot exceed the following per AAC 50.502 (C)(3): 10 TPY of PM-10, 10 TPY of sulfur dioxide, 10 TPY of nitrogen oxides, 100 TPY of carbon monoxide within 10 kilometers of a carbon monoxide nonattainment area, or 10 TPY of direct PM-2.5 emissions. Per the Wood-fired Heating Device Visible Emission Standards (Section 18 AAC 50.075), a person may not operate a wood-fired heating device in a manner that causes black smoke or visible emissions that exceed 50 percent opacity for more than 15 minutes in any hour in an area where an air quality advisory is in effect.

From Coffman's discussions with Patrick Dunn at the Alaska Department of Environmental Conservation, these regulations are focused on permitting industrial applications of wood burning equipment. In his opinion, it would be unlikely that an individual wood boiler would require an air quality permit unless several boilers were to be installed and operated at the same site. If several boilers were installed and operated together, the emissions produced could be greater than 40 tons of CO_2 per year. This would require permitting per AAC 50.502 (C)(1) or (C)(3). Permitting would not be required on the residential wood fired stoves unless they violated the Wood-fired Heating Device Visible Emission Standards (Section 18 AAC 50.075). The recent Garn boiler system installed in Alaska of similar size and emissions output as the proposed pellet boiler have not needed or obtained air quality permits.

VIII. General Biomass Technology Information

Heating with Wood Fuel

Wood fuels are among the most cost-effective and reliable sources of heating fuel for communities adjacent to forestland when the wood fuels are processed, handled, and combusted appropriately. Compared to other heating energy fuels, such as oil and propane, wood fuels typically have lower energy density and higher associated transportation and handling costs. Due to this low bulk density, wood fuels have a shorter viable haul distance when compared to fossil fuels. This short haul distance also creates an advantage for local communities to utilize locally-sourced wood fuels, while simultaneously retaining local energy dollars.

Most communities in rural Alaska are particularly vulnerable to high energy prices due to the large number of heating degree days and expensive shipping costs. For many communities, wood-fueled heating can lower fuel costs. For example, cordwood sourced at $250 per cord is just 25% of the cost per MMBTU as #1 fuel oil sourced at $7 per gallon. In addition to the financial savings, the local communities also benefit from the multiplier effect of circulating energy dollars within the community longer, more stable energy prices, job creation, and more active forest management.

The local cordwood market is influenced by land ownership, existing forest management and ecological conditions, local demand and supply, and the State of Alaska Energy Assistance program.

Types of Wood Fuel

Wood fuels are specified by energy density, moisture content, ash content, and granulometry. Each of these characteristics affects the wood fuel's handling characteristics, storage requirements, and combustion process. Higher quality fuels have lower moisture, ash, dirt, and rock contents, consistent granulometry, and higher energy density. Different types of fuel quality can be used in wood heating projects as long as the infrastructure specifications match the fuel content characteristics. Typically, lower quality fuel will be the lowest cost fuel, but it will require more expensive storage, handling, and combustion infrastructure, as well as additional maintenance.

Projects in rural Alaska must be designed around the availability of wood fuels. Some fuels can be harvested and manufactured on site, such as cordwood, woodchips, and briquettes. Wood pellets can also be used, but typically require a larger scale pellet manufacturer to make them. The economic feasibility of manufacturing on site is determined by a financial assessment of the project. Typically, larger projects offer more flexibility in terms of owning and operating the wood harvesting and manufacturing equipment, such as a wood chipper, splitter, or equipment to haul wood out of forest, than smaller projects.

High Efficiency Wood Pellet Boilers

High efficiency pellet boilers are designed to burn wood pellets cleanly and efficiently. These boilers utilize pellet storage bins or silos that hold a large percentage of the building's annual pellet supply. Augers or vacuums transfer pellets from the silos to a pellet hopper adjacent to the pellet boiler, where pellets can be fed into the boiler for burning. Pellets are automatically loaded into the pellet boiler and do not require manual loading such as in a Garn cord wood boiler. The pellet boilers typically have a 3 to 1 turn down ratio, which allows the firing rate to modulate from 100% down to 33% fire. This allows the boiler to properly match building heat demand, increasing boiler efficiency. The efficiencies of these boilers can range from 85% to 92% efficiency depending on firing rate.

Two of the best quality pellet boilers in the U.S. market are the Maine Energy Systems PES boilers and the Froling P4 boilers. These boilers have high end controls, automatic ash removal and have a good reputation for quality. The Maxim Pellet Boiler is a less costly option and can be used directly outdoors if needed. According to Chad Shumacher, General Manager of Superior Pellets, his Maxim boiler automation does not operate as well as the Maine Energy Systems units, but they are less than half the price. The working lifespan of the Maxim boilers also may be less than the higher quality units.

High Efficiency Cord Wood Boilers

High Efficiency Low Emission (HELE) cordwood boilers are designed to burn cordwood fuel cleanly and efficiently. The boilers use cordwood that is typically seasoned to 25% moisture content (MC) or less and meet the dimensions required for loading and firing. The amount of cordwood burned by the boiler will depend on the heat load profile of the building and the utilization of the fuel oil system as back up. Two HELE cordwood boiler suppliers include Garn (www.garn.com) and TarmUSA (www.woodboilers.com). Both of these suppliers have units operating in Alaska. TarmUSA has a number of residential units operating in Alaska and has models that range between 100,000 to 300,000 BTU/hr. Garn boilers, manufactured by Dectra Corporation, are used in Tanana, Kasilof, Dot Lake, Thorne Bay, Coffman Cove and other locations to heat homes, washaterias, schools, and community buildings.

The Garn boiler has a unique construction, which is basically a wood boiler housed in a large water tank. Garn boilers come in several sizes and are appropriate for facilities using 100,000 to 1,000,000 BTUs per hour. The jacket of water surrounding the fire box absorbs heat and is piped into buildings via a heat exchanger, and then transferred to an existing building heating system, infloor radiant tubing, unit heaters, or baseboard heaters. In installations where the Garn boiler is in a detached building, there are additional heat exchangers, pumps and a glycol circulation loop that are necessary to transfer heat to the building while allowing for freeze protection. Radiant floor heating is the most efficient heating method when using wood boilers such as Garns, because they can operate using lower supply water temperatures compared to baseboards.

Garn boilers are approximately 87% efficient and store a large quantity of water. For example, the Garn WHS-2000 holds approximately 1,825 gallons of heated water. Garns also produce virtually no smoke when at full burn, because of a primary and secondary gasification (2,000 ^{o}F) burning process. Garns are manually stocked with cordwood and can be loaded multiple times a day during periods of high heating demand. Garns are simple to operate with only three moving parts: a handle, door and blower. Garns produce very little ash and require minimal maintenance. Removing ash and inspecting fans are typical maintenance requirements. Fans are used to produce a draft that increases combustion temperatures and boiler efficiency. In cold climates, Garns can be equipped with exterior insulated storage tanks for extra hot water circulating capacity. Most facilities using cordwood boilers keep existing oil-fired systems operational to provide heating backup during biomass boiler downtimes and to provide additional heat for peak heating demand periods.

Low Efficiency Cord Wood Boilers

Outdoor boilers are categorized as low-efficiency, high emission (LEHE) systems. These boiler systems are not recommended as they produce significant emission issues and do not combust wood fuels efficiently or completely, resulting in significant energy waste and pollution. These systems require significantly more wood to be purchased, handled and combusted to heat a facility as compared to a HELE system. Additionally, several states have placed a moratorium on installing LEHE boilers because of air quality issues (Washington). These LEHE systems can have combustion efficiencies as low as twenty five (25%) percent and produce more than nine times the emission rate of standard industrial boilers. In comparison, HELEs can operate around 87% efficiency.

High Efficiency Wood Stoves

Newer high efficiency wood stoves are available on the market that produce minimal smoke, minimal ash and require less firewood. New EPA-certified wood stoves produce significantly less smoke than older uncertified wood stoves. High efficiency wood stoves are easy to operate with minimal maintenance compared to other biomass systems. The Blaze King Classic high efficiency wood stove (www.blazeking.com) is a recommended model, due to its built-in thermostats that monitor the heat output of the stove. This stove automatically adjusts the air required for combustion. This unique technology, combined with the efficiencies of a catalytic combustor with a built-in thermostat, provides the longest burn times of any wood stove. The Blaze King stove allows for optimal combustion and less frequent loading and firing times.

Bulk Fuel Boilers

Bulk fuel boilers usually burn wood chips, sawdust, bark or pellets and are designed around the wood resources that are available from the local forests or local industry. Several large facilities in Tok, Craig, and Delta Junction (Delta Greely High School) are using bulk fuel biomass systems. Tok uses a commercial grinder to process woodchips. The chips are then dumped into a bin and are carried by a conveyor belt to the boiler. The wood fuel comes from timber scraps, local sawmills and forest thinning projects. The Delta Greely High School has a woodchip bulk fuel boiler that heats the 77,000 square foot facility. The Delta Greely system, designed by Coffman engineers, includes a completely separate boiler building which includes chip storage bunker and space for storage of tractor trailers full of chips (so handling of frozen chips could be avoided). Woodchips are stored in the concrete bunker and augers move the material on a conveyor belt to the boilers.

Grants

There are many grant opportunities for biomass work state, federal, and local for feasibility studies, design and construction. If a project is pursued, a thorough search of websites and discussions with the AEA Biomass group would be recommended to make sure no possible funding opportunities are missed. Below are some funding opportunities and existing past grants that have been awarded.

Currently, there is a funding opportunity for tribal communities that develop clean and renewable energy resources through the U.S. Department of Energy. On April 30, 2013, the Department of Energy announced up to $7 million was available to deploy clean energy projects in tribal communities to reduce reliance on fossil fuel and promote economic development on tribal lands. The Energy Department's Tribal

Energy Program, in cooperation with the Office of Indian Energy, will help Native American communities, tribal energy resource development organizations, and tribal consortia to install community or facility scale clean energy projects.

http://apps1.eere.energy.gov/tribalenergy/

The Department of Energy (DOE), Alaska Native programs, focus on energy efficiency and add ocean energy into the mix. In addition the communities are eligible for up to $250,000 in energy-efficiency aid. The Native village of Kongiganak will get help strengthening its wind-energy infrastructure, increasing energy efficiency and developing “smart grid technology”. Koyukuk will get help upgrading its energy infrastructure, improving energy efficiency and exploring biomass options. The village of Minto will explore all the above options as well as look for solar-energy ideas. Shishmaref, an Alaska Native village faced climate-change-induced relocation, will receive help with increasing energy sustainability and building capacity as it relocates. And the Yakutat T’lingit Tribe will also study efficiency, biomass and ocean energy. This DOE program would be a viable avenue for biomass funding.

http://energy.gov/articles/alaska-native-communities-receive-technical-assistance-local-clean-energy-development

The city of Nulato was awarded a $40,420 grant for engineering services for a wood energy project by the United States Department of Agriculture (USDA) and the United States Forest Service. Links regarding the award of the Woody Biomass Utilization Project recipients are shown below:

http://www.fs.fed.us/news/2012/releases/07/renewablewoods.shtml

http://www.usda.gov/wps/portal/usda/usdahome?contentid=2009/08/0403.xml

Delta Junction was awarded a grant for engineering from the Alaska Energy Authority from the Renewable Energy Fund for $831,203. This fund provides assistance to utilities, independent power producers, local governments, and tribal governments for feasibility studies, reconnaissance studies, energy resource monitoring, and work related to the design and construction of eligible facilities.

http://www.akenergyauthority.org/re-fund-6/4_Program_Update/FinalREFStatusAppendix2013.pdf

http://www.akenergyauthority.org/PDF%20files/PFS-BiomassProgramFactSheet.pdf

http://www.akenergyauthority.org/RenewableEnergyFund/RFA_Project_Locations_20Oct08.pdf

The Alaska Wood Energy Development Task Group (AWEDTG) consists of a coalition of federal and state agencies and not-for-profit organizations that have signed a Memorandum of Understanding (MOU) to explore opportunities to increase the utilization of wood for energy and biofuels production in Alaska. A pre-feasibility study for Aleknagik was conducted in 2012 for the AWEDTG. The preliminary costs for the biomass system(s) are $346,257 for the city hall and health center system and $439,096 for the city hall, health center, and future washeteria system.

http://www.akenergyauthority.org/biomasswoodenergygrants.html

http://www.akenergyauthority.org/BiomassWoodEnergy/Aleknagik%20Final%20Report.pdf

The Emerging Energy Technology Fund grand program provides funds to eligible applicants for demonstrations projects of technologies that have a reasonable expectation to be commercially viable within five years and that are designed to: test emerging energy technologies or methods of conserving energy, improve an existing energy technology, or deploy an existing technology that has not previously been demonstrated in Alaska.

http://www.akenergyauthority.org/EETFundGrantProgram.html

Appendix A
Site Photos

1. South elevation of building.

2. West elevation of building.

3. North elevation of building.

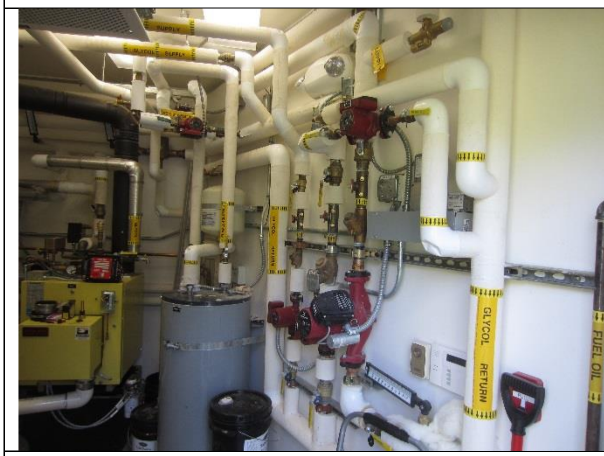
4. East elevation of building.

5. Site entrance.

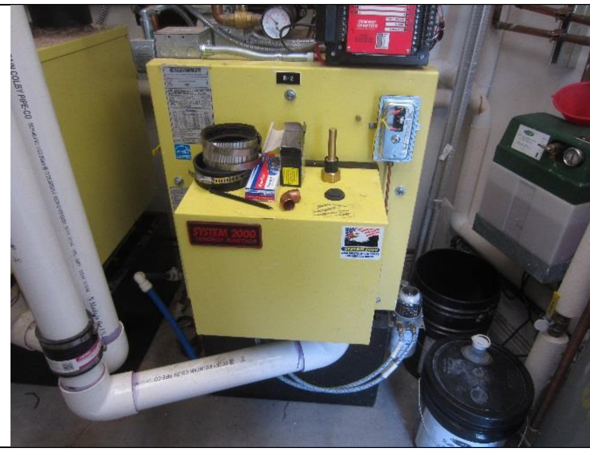
6. Approximate location of new biomass building and pellet storage.

7. Fuel tank and boiler room access door.

8. Boiler room.



9. Boiler room.



10. Boiler Close Up

11. Community Hall Room.

12. Large kitchen.

Appendix B
Economic Analysis Spreadsheet

Buster Gene Memorial Hall - Option A
Gakona, Alaska

Economic Analysis Results	
Project Capital Cost	($84,288)
Present Value of Project Benefits (20 year life)	$246,260
Present Value of Operating Costs (20 year life)	($160,306)
Benefit / Cost Ratio of Project (20 year life)	1.02
Net Present Value (20 year life)	$1,666
Year Accumulated Cash Flow is Net Positive	First Year
Year Accumulated Cash Flow > Project Capital Cost	20 years
Simple Payback = Total Project Cost / First Year Cost Savings	43.6 years

Inflation Rates	
Discount Rate for Net Present Value Analysis	3%
Wood Fuel Escalation Rate	3%
Fossil Fuel Escalation Rate	5%
Electricity Escalation Rate	3%
O&M Escalation Rate	2%

Description	Unit Cost	Heating Source Proportion	Annual Energy Units	Energy Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Existing Heating System Operating Costs														
Existing Heating Oil Consumption	$3.75		2,800	gal	**$10,500**	**$11,025**	**$11,576**	**$12,155**	**$12,763**	**$13,401**	**$14,071**	**$14,775**	**$15,513**	**$16,289**
Biomass System Operating Costs														
Wood Pellet Fuel (Delivered to site)	$350.00	97%	21.2	tons	($7,420)	($7,643)	($7,872)	($8,108)	($8,351)	($8,602)	($8,860)	($9,126)	($9,399)	($9,681)
Fossil Fuel	$3.75	3%	84	gal	($315)	($331)	($347)	($365)	($383)	($402)	($422)	($443)	($465)	($489)
Additional Electricity	$0.28		252	kWh	($71)	($73)	($75)	($77)	($79)	($82)	($84)	($87)	($89)	($92)
Operation and Maintenance Costs					($380)	($388)	($395)	($403)	($411)	($420)	($428)	($437)	($445)	($454)
Additional Operation and Maintenance Costs for first 2 years					($380)	($388)	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Costs					**($8,566)**	**($8,821)**	**($8,689)**	**($8,953)**	**($9,225)**	**($9,505)**	**($9,794)**	**($10,092)**	**($10,399)**	**($10,716)**
Annual Operating Cost Savings					$1,934	$2,204	$2,887	$3,202	$3,538	$3,896	$4,277	$4,682	$5,114	$5,573
Accumulated Cash Flow					$1,934	$4,138	$7,025	$10,227	$13,765	$17,661	$21,938	$26,620	$31,734	$37,306
Net Present Value					**($82,410)**	**($80,333)**	**($77,691)**	**($74,846)**	**($71,794)**	**($68,531)**	**($65,054)**	**($61,358)**	**($57,438)**	**($53,292)**

Description	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Existing Heating System Operating Costs										
Existing Heating Oil Consumption	**$17,103**	**$17,959**	**$18,856**	**$19,799**	**$20,789**	**$21,829**	**$22,920**	**$24,066**	**$25,270**	**$26,533**
Biomass System Operating Costs										
Wood Pellet Fuel (Delivered to site)	($9,972)	($10,271)	($10,579)	($10,897)	($11,223)	($11,560)	($11,907)	($12,264)	($12,632)	($13,011)
Fossil Fuel	($513)	($539)	($566)	($594)	($624)	($655)	($688)	($722)	($758)	($796)
Additional Electricity	($95)	($98)	($101)	($104)	($107)	($110)	($113)	($117)	($120)	($124)
Operation and Maintenance Costs	($463)	($472)	($482)	($492)	($501)	($511)	($522)	($532)	($543)	($554)
Additional Operation and Maintenance Costs for first 2 years	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Costs	**($11,043)**	**($11,380)**	**($11,727)**	**($12,086)**	**($12,455)**	**($12,836)**	**($13,229)**	**($13,635)**	**($14,053)**	**($14,484)**
Annual Operating Cost Savings	$6,060	$6,579	$7,129	$7,714	$8,334	$8,992	$9,691	$10,431	$11,217	$12,049
Accumulated Cash Flow	$43,367	$49,945	$57,075	$64,788	$73,122	$82,115	$91,805	$102,237	$113,453	$125,502
Net Present Value	**($48,913)**	**($44,299)**	**($39,445)**	**($34,345)**	**($28,996)**	**($23,392)**	**($17,529)**	**($11,402)**	**($5,005)**	**$1,666**

Buster Gene Memorial Hall - Option B

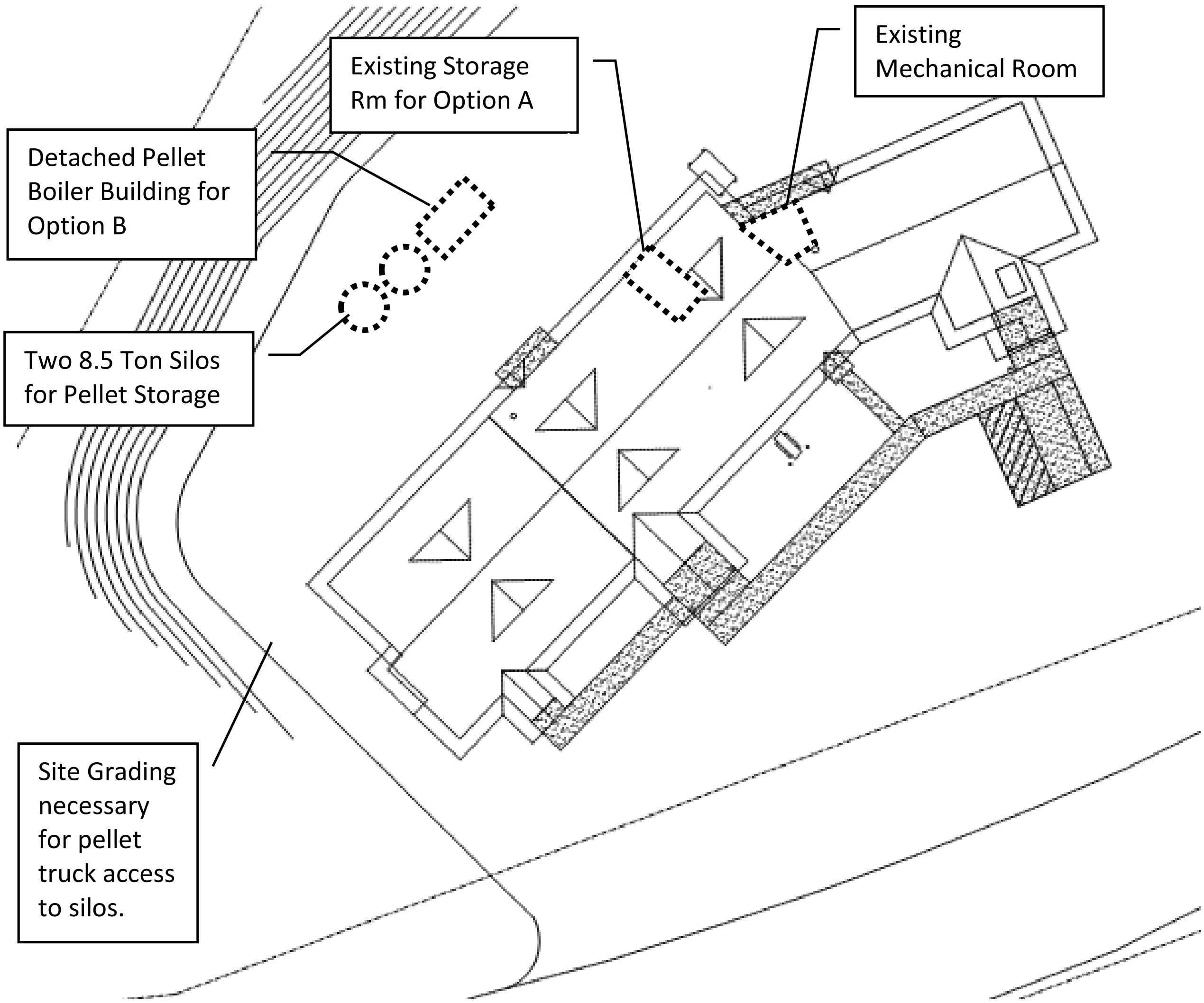
Gakona, Alaska

Economic Analysis Results	
Project Capital Cost	($124,759)
Present Value of Project Benefits (20 year life)	$246,260
Present Value of Operating Costs (20 year life)	($161,092)
Benefit / Cost Ratio of Project (20 year life)	0.68
Net Present Value (20 year life)	($39,591)
Year Accumulated Cash Flow is Net Positive	First Year
Year Accumulated Cash Flow > Project Capital Cost	Over 20 years
Simple Payback = Total Project Cost / First Year Cost Savings	67.3 years

Inflation Rates	
Discount Rate for Net Present Value Analysis	3%
Wood Fuel Escalation Rate	3%
Fossil Fuel Escalation Rate	5%
Electricity Escalation Rate	3%
O&M Escalation Rate	2%

Description	Unit Cost	Heating Source Proportion	Annual Energy Units	Energy Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Existing Heating System Operating Costs																								
Existing Heating Oil Consumption	$3.75		2,800	gal	**$10,500**	**$11,025**	**$11,576**	**$12,155**	**$12,763**	**$13,401**	**$14,071**	**$14,775**	**$15,513**	**$16,289**	**$17,103**	**$17,959**	**$18,856**	**$19,799**	**$20,789**	**$21,829**	**$22,920**	**$24,066**	**$25,270**	**$26,533**
Biomass System Operating Costs																								
Wood Pellet Fuel (Delivered to site)	$350.00	97%	21.2	tons	($7,420)	($7,643)	($7,872)	($8,108)	($8,351)	($8,602)	($8,860)	($9,126)	($9,399)	($9,681)	($9,972)	($10,271)	($10,579)	($10,897)	($11,223)	($11,560)	($11,907)	($12,264)	($12,632)	($13,011)
Fossil Fuel	$3.75	3%	84	gal	($315)	($331)	($347)	($365)	($383)	($402)	($422)	($443)	($465)	($489)	($513)	($539)	($566)	($594)	($624)	($655)	($688)	($722)	($758)	($796)
Additional Electricity	$0.28		252	kWh	($71)	($73)	($75)	($77)	($79)	($82)	($84)	($87)	($89)	($92)	($95)	($98)	($101)	($104)	($107)	($110)	($113)	($117)	($120)	($124)
Operation and Maintenance Costs					($420)	($428)	($437)	($446)	($455)	($464)	($473)	($482)	($492)	($502)	($512)	($522)	($533)	($543)	($554)	($565)	($577)	($588)	($600)	($612)
Additional Operation and Maintenance Costs for first 2 years					($420)	($428)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Costs					**($8,646)**	**($8,903)**	**($8,731)**	**($8,995)**	**($9,268)**	**($9,549)**	**($9,839)**	**($10,138)**	**($10,446)**	**($10,764)**	**($11,092)**	**($11,430)**	**($11,778)**	**($12,137)**	**($12,508)**	**($12,890)**	**($13,284)**	**($13,691)**	**($14,110)**	**($14,543)**
Annual Operating Cost Savings					$1,854	$2,122	$2,845	$3,160	$3,495	$3,852	$4,232	$4,636	$5,067	$5,525	$6,012	$6,529	$7,078	$7,662	$8,281	$8,939	$9,636	$10,375	$11,159	$11,990
Accumulated Cash Flow					$1,854	$3,977	$6,822	$9,981	$13,476	$17,328	$21,559	$26,196	$31,263	$36,788	$42,799	$49,328	$56,407	$64,068	$72,350	$81,288	$90,924	$101,300	$112,459	$124,449
Net Present Value					**($122,959)**	**($120,958)**	**($118,354)**	**($115,547)**	**($112,533)**	**($109,307)**	**($105,866)**	**($102,206)**	**($98,323)**	**($94,212)**	**($89,869)**	**($85,290)**	**($80,470)**	**($75,404)**	**($70,089)**	**($64,518)**	**($58,689)**	**($52,594)**	**($46,230)**	**($39,591)**

Appendix C
Site Plan



Site Plan of Buster Gene Memorial Hall

Appendix D
AWEDTG Field Data Sheet

Lee Bolling 1/22/14

ALASKA WOOD ENERGY DEVELOPMENT TASK GROUP (AWEDTG)

PRE-FEASIBILITY ASSESSMENT FIELD DATA SHEET

APPLICANT:	Native Village of Gakona
Eligibility: (check one)	☐ Local government ☐ State agency ☐ Federal agency ☐ School/School District ☒ Federally Recognized Tribe ☐ Regional ANCSA Corp. ☐ Village ANCSA Corp. ☐ Not-for-profit organization ☐ Private Entity that can demonstrate a Public Benefit ☐ Other (describe):
Contact Name:	Tim Skiba (Environmental Coordinator)
Mailing Address:	P.O. Box 102
City:	Gakona
State:	AK **Zip Code:** 99586
Office phone:	(907) 822-5777 **Cell phone:** ( )
Fax:	(907) 822-5997
Email:	gakonaec@gmail.com

Facility Identification/Name:	Buster Gene Memorial Hall	
Facility Contact Person:	Tim Skiba	
Facility Contact Telephone:	(907) 822-5777	( )
Facility Contact Email:	gakonaec@gmail.com	

SCHOOL/FACILITY INFORMATION (complete separate Field Data Sheet for each building)

SCHOOL FACILITY (Name: ____________________)

School Type: (check all that apply)	[ ] Pre-School [ ] Elementary [ ] Middle School	[ ] Junior High [ ] High School [ ] Campus	[ ] Student Housing [ ] Pool [ ] Gymnasium	[ ] Other (describe):
Size of facility (sq. ft. heated):		Year built/age:		
Number of floors:		Year(s) renovated:		
Number of bldgs.:		Next renovation:		
# of Students:		Has en energy audit been conducted?:		If Yes, when? *

OTHER FACILITY (Name: Buster Gene Memorial Hall)

Type:	[X] Health Clinic [ ] Public Safety Bldg. [X] Community Center	[ ] Water Plant [ ] Washeteria [ ] Public Housing	[X] Multi-Purpose Bldg [ ] District Energy System [X] Other (list): Office
Size of Facility (sq. ft. heated)	8,228 SF	Year built/age:	2008 → 6,232 SF
Number of floors:	1	Year(s) renovated:	2013 → 1,996 SF Addition (Occupied Nov 2013.)
Number of bldgs.:	1	Next renovation:	None
Frequency of Usage:	60 hrs/week	# of Occupants	3 to 25
Has an energy audit been conducted?	Yes	If Yes, when? *	2010

* If an Energy Audit has been conducted, please provide a copy.

HEATING SYSTEM INFORMATION

CONFIGURATION (check all that apply)

- [x] Heat plant in one location: [x] on ground level ☐ below ground level ☐ mezzanine ☐ roof [x] at least 1 exterior wall
- ☐ Different heating plants in different locations: How many? ______ What level(s)? ______
- ☐ Individual room-by-room heating systems (space heaters)
- ☐ Is boiler room accessible to delivery trucks? ☐ Yes [x] No

HEAT DELIVERY (check all that apply)

- [x] Hot water: [x] baseboard [x] radiant heat floor ☐ cabinet heaters ☐ air handlers ☐ radiators ☐ other: ______
- ☐ Steam: ______
- ☐ Forced/ducted air
- ☐ Electric heat: ☐ resistance ☐ boiler ☐ heat pump(s)
- ☐ Space heaters

HEAT GENERATION (check all that apply)

						Heating capacity (Btuh / kWh)	Annual Fuel Consumption	Annual Fuel Cost
[x] Hot water boiler:	☐ natural gas	☐ propane	☐ electric	[x] #1 fuel oil	☐ #2 fuel oil	341,000 BTU/hr	ESTIMATED AT 2,800 gal.	$3.75/gal
☐ Steam boiler:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☐ #2 fuel oil			
☐ Warm air furnace:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☐ #2 fuel oil			
☐ Electric resistance:	☐ baseboard	☐ duct coils						
☐ Heat pumps:	☐ air source	☐ ground source	☐ sea water					
☐ Space heaters:	☐ woodstove	☐ Toyo/Monitor	☐ other: ______					

TEMPERATURE CONTROLS (type of system; check all that apply)

- [x] Thermostats on individual devices/appliances; no central control system
- ☐ Pneumatic control system Manufacturer: ______ Approx. Age: ______
- ☐ Direct digital control system Manufacturer: ______ Approx. Age: ______

Record Name Plate data for boilers (use separate sheet if necessary):
Boiler B-1 & B-2 are identical. SYSTEM 2000 Energy Kinetics. Model EK-2F. 1.40 GPH Input. 170.5 MBH OUTPUT.

Describe locations of different parts of the heating system and what building areas are served:
Majority of building has radiant floor heating. Some perimeter rooms have additional baseboard heating. The clinic is served by an HRV for ventilation.

Describe age and general condition of existing equipment:

Who performs boiler maintenance? Darin Gene Describe any current maintenance issues: None.

Where is piping or ducting routed through the building? (tunnels, utilidors, crawlspace, above false ceiling, attic, etc.):
Piping routed in walls, floor and ceiling.

Describe on-site fuel storage: Number of tanks, size of tanks, location(s) of tanks, condition, spill containment, etc.:
One 550 gal fuel tank.

If this fuel is also used for other purposes, please describe: None.

DOMESTIC HOT WATER

USES OF DOMESTIC HOT WATER
Check all that apply:

- [x] Lavatories
- [x] Kitchen
- [ ] Showers
- [x] Laundry
- [ ] Water treatment
- [ ] Other: ______

TYPE OF SYSTEM
Check all that apply:

- [ ] Direct-fired, single tank
- [ ] Direct fired, multiple tanks
- [x] Indirect , using heating boiler with separate storage tank
- [ ] Hot water generator with separate storage tank
- [ ] Other: ______

What fuels are used to generate hot water? (Check all that apply): ☐ natural gas ☐ propane ☐ electric ☐ #1 fuel oil ☒ #2 fuel oil

Describe location of water heater(s): In mechanical Room

Describe on-site fuel storage: number of tanks, size of tanks, location(s) of tanks, condition, spill containment, etc.:
Indirect hot water heater. No dedicated fuel tank for DHW.

BUILDING ENVELOPE

Wall type (stick frame, masonry, SIP, etc.): 2x8 Wall w/ Fiberglass Batt Insulation Value: R-25

Roof type: Cold roof w/ 10" of blown cellulose Insulation Insulation Value: R-31

Windows: ☐ single pane ☒ double pane ☐ other: ______

Arctic entry(s): ☐ none ☐ at main entrance only ☒ at multiple entrances ☐ at all entrances

Drawings available: ☒ architectural ☒ mechanical ☒ electrical

Outside Air/Air Exchange: ☒ HRV ☐ CO_2 Sensor

ELECTRICAL

Utility company that serves the building or community: Copper Valley Electric

Type of grid: ☐ building stand-alone ☐ village/community power ☒ railbelt grid

Energy source: ☐ hydropower ☐ diesel generator(s) ☒ Other: Copper Valley Electric Utility

Electricity rate per kWh: $0.28/kwh (2014 EFFECTIVE RATE.) Demand charge: None

Electrical energy phase(s) available: ☒ single phase ☐ 3-phase

Back-up generator on site: ☒ Yes ☐ No If Yes, provide output capacity: 12 KW. Located in shed.

Are there spare circuits in MDP and/or electrical panel?: ☒ Yes ☐ No

Record MDP and electrical panel name plate information: See Photos

WOOD FUEL INFORMATION

- Wood pellet cost delivered to facility $ unknown /ton Viable fuel source? (Yes) No
- Wood chip cost delivered to facility $ Unknown /ton Viable fuel source? (Yes) No
- Cord wood cost delivered to facility $ 200 /cord Viable fuel source? (Yes) No

  → Client prefers pellets.

- Distance to nearest wood pellet and wood chip suppliers? Tok and Anchorage
- Can logs or wood fuel be stockpiled on site or at a nearby facility? Yes, lots of space on site.

Who manages local forests? Village Native Corp, Regional Native Corp, State of Alaska, Forest Service, BLM, USF&WS, Other:
BLM, STATE and Ahtna.

FACILITY SITE CONSIDERATIONS

Is there good access to site for delivery vehicles (trucks, chip vans, etc)? Yes

Are there any significant site constraints? (Playgrounds, other buildings, wetlands, underground utilities, etc.)? Lots of available space

What are local soil conditions? Permafrost issues? Yes to permafrost. Local soil is gravel. Ground water table is 4ft below grade.

Is the building in proximity to other buildings with biomass potential? If so, Which ones and How close?
Yes, the new village shop is 100 yds away.

Can building accommodate a biomass boiler inside, or would an addition for a new boiler be necessary? Where would addition go?
New Boiler must be outside in new building.

Where would potential boiler plant or addition utilities (water/sewer/power/etc.) come from?
FROM BUILDING.

If necessary, can piping be run underground from a central plant to the building? Where would piping enter boiler room?

Yes, underground is an option. Piping can come into boiler room in several ways.

OTHER INFORMATION

Provide any other information that will help describe the space heating and domestic hot water systems, such as

Is heat distribution system looping or branching? Looping
For baseboard hydronic heat, what is the diameter of the copper tubing? Size of fins? Number of fins per lineal foot? See Mech Dwgs.
Any other energy using systems (kitchen equipment, lab equipment, pool etc)? Fuel or energy source? → Propane for cooking
Any systems that could be added to the boiler system? None necessary.
Are heating fuel records available? Yes

PICTURE / VIDEO CHECKLIST

Exterior

- ✓ Main entry
- ✓ Building elevations
- ✓ Several near boiler room and where potential addition/wood storage and/or exterior piping may enter the building
- ✓ Access road to building and to boiler room
- ✓ Power poles serving building
- ✓ Electrical service entry
- ✓ Emergency generator

Interior

- ✓ Boilers, pumps, domestic water heaters, heat exchangers – all mechanical equipment in boiler room and in other parts of the building.
- ✓ Boiler room piping at boiler and around boiler room
- ✓ Piping around domestic water heater
- ✓ MDP and/or electrical panels in or around boiler room
- ✓ Pictures of available circuits in MDP or electrical panel (open door).
- ✓ Picture of circuit card of electrical panel
- ✓ Picture of equipment used to heat room in the building (i.e. baseboard fin tube, unit heaters, unit ventilators, air handler, fan coil)
- ✓ Pictures of any other major mechanical equipment
- ✓ Pictures of equipment using fuel not part of heating or domestic hot water system (kitchen equip., lab equip., pool, etc.)
- ✓ Pictures of building plans (site plan, architectural floor plan, mechanical plan, boiler room plan, electrical power plan)