

Feasibility Assessment for Biomass Heating Systems Multi-Use Facility, Kluti-Kaah, Alaska



FINAL REPORT – 9/4/2014



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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

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I. Executive Summary

A preliminary feasibility assessment was completed to determine the technical and economic viability of biomass heating systems at Kluti-Kaah Multi-Use Facility in Kluti-Kaah, Alaska, near Copper Center. 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.

At this time the Multi-Use Facility is an unfinished structure with no mechanical or electrical equipment. It is assumed that the proposed biomass system will be installed at the same time as the initial mechanical system, which will reduce overall installation costs of the proposed biomass system.

The proposed biomass system includes two pellet boilers located in the existing mechanical room. Four exterior pellet silos will transfer pellets via augers to the pellet boiler day hoppers. Wood pellets are delivered by an auger truck.

The results of the economic evaluation are shown below. The proposed pellet system is economically justified at this time, due to the fact that the benefit to cost ratio of the option is greater than 1.0, over a 20 year project life.

Economic Analysis Results	
Project Capital Cost (Additional Cost of Pellet System)	\$130,845
Present Value of Project Benefits (20 year life)	\$897,857
Present Value of Operating Costs (20 year life)	\$586,831
Benefit / Cost Ratio of Project (20 year life)	2.38
Net Present Value (20 year life)	\$180,181
Year Accumulated Cash Flow is Net Positive	First Year
Year Accumulated Cash Flow > Project Capital Cost	12 years
Simple Payback	16.8 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 Multi-Use Facility for the Native Village of Kluti-Kaah in Kluti-Kaah, Alaska, near Copper Center. The location of the building is shown in Figures 1 and 2.



Fig. 1 – Native Village of Kluti-Kaah, Alaska – Google Maps

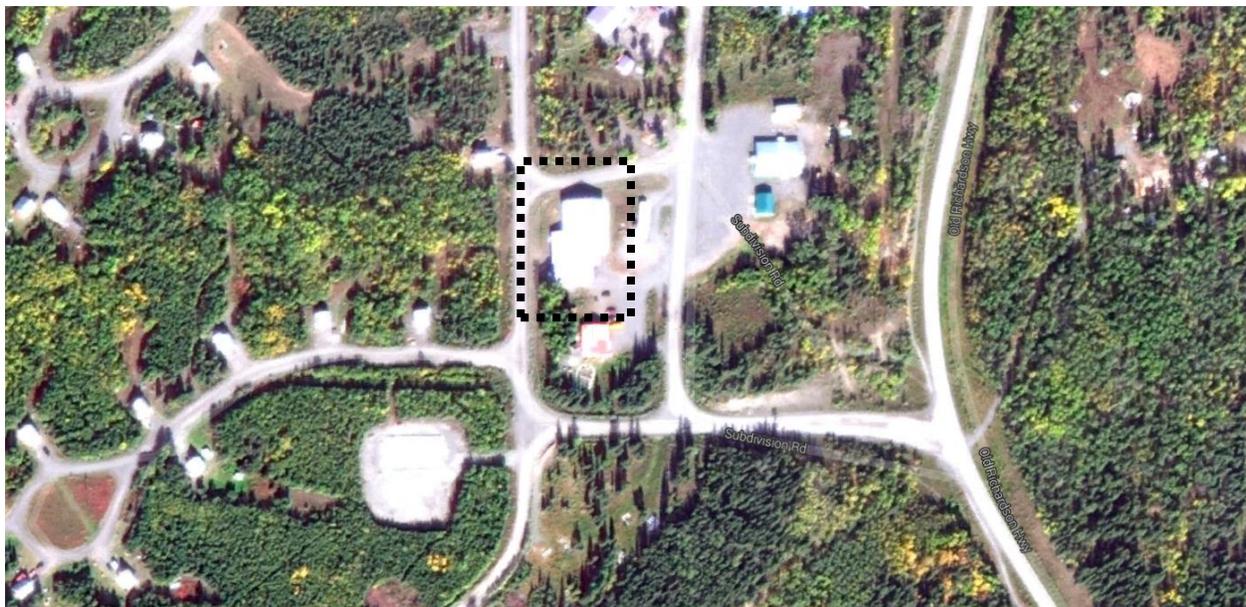


Fig. 2 – Multi-Use Facility – Google Maps

III. Preliminary Site Investigation

Building Description

The Kluti-Kaah Multi-Use Facility is a partially constructed building located in the center of the Kluti-Kaah Village. At the time of the site visit, the facility is an unfinished, un-insulated structure which no electricity, lights, mechanical equipment, or interior finishes. When completed the facility will house a full gymnasium, office space, restrooms, locker rooms with showers, and a commercial kitchen. The facility's structural shell contains 12,675 SF and was completed in two phases. The gymnasium was constructed in 1999 and the office addition was constructed in 2009. The village is currently seeking funding to finish the construction of the facility, independent of the biomass heating system upgrade.

The 2009 design drawings for the facility also show future additions that may be considered. These additions include a future clinic and a future head start area. The building is currently unoccupied because it is un-finished and unusable at this time. It is estimated that the facility would be used 60 hrs per week when completed. There have been no energy audits of the building. Please refer to Appendix D for field data sheet that contains all pertinent information gathered during the site visit.

Existing Heating System

There is no heating system installed in the building at this time. According to design drawings, the facility will be heated by two identical Weil McLain Model 480 heating oil boilers (396 MBH output, 80% combustion efficiency). The gym will be served by four ceiling mounted unit heaters and the office addition will be served by radiant floors. An air handling unit will provide ventilation to the gym and office addition. A future 1000 gallon fuel oil tank is called for on the design drawings.

Domestic Hot Water

There is no domestic hot water system installed in the building at this time. According to the design drawings there will be six shower stalls in the locker rooms. It is anticipated that hot water will be primarily used for hand washing and showering at the facility when it is completed. The design drawings call for a Bock 541E oil fired hot water heater (83 gallons storage with a 623 MBH input burner).

Building Envelope

The building only consists of a structural shell. At, this time the gym appears to be partially insulated with spray foam. The design drawings call for R-38 minimum spray foam insulation on the gym walls. The office addition is 2x6 wood stud construction with no insulation installed at this time. According to design drawings the office walls will have R-21 fiberglass batt insulation. There are no windows installed in the facility at this time. The building does not have arctic entries.

Available Space

There is available space in the large mechanical room. Since there has been no mechanical equipment installed, the room can be redesigned to allow space for new biomass boilers.

Street Access and Fuel Storage

The facility is located on a large gravel site with easy access to all sides of the building. Gravel roads run parallel to the north and west side of the building. A bulk pellet delivery truck can easily access the west

side of the building where the mechanical room is located, and where future wood pellet silos can be located. The wood pellets can be stored in four large 8.5 ton silos, which can be filled with an auger boom from the pellet delivery truck. Please refer to Appendix C for the site plan.

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

Since the facility's mechanical system has not been installed the facility's mechanical system can be partially redesigned to incorporate a biomass boiler system.

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 wish 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.

After considering the multiple options available for biomass, this study focuses on a pellet boiler system with oil fired boiler backup. The pellet boilers will be used as the primary heating source for the facility. The oil fired boiler will be used for peaking during the coldest days of the year and also as a backup source of heat.

The facility's design drawings consist of two Weil McLain 480 oil fired boilers. This study considers replacing one of the oil boilers with two Maine Energy Systems (MES) PES56 pellet boilers (191 MBH output each). In this scenario the two MES pellet boilers and the one Weil McLain oil boiler will be able to provide combined output of 778 MBH, which will meet the estimated building heat load during the coldest day of the year. The facility heat load was estimated at 693 MBH, based on 25 BTU/SF conduction losses and 1.25 CFM/SF outside air loads (with 20% outside air in winter).

Wood pellets will be stored in four 8.5 ton silos located on the west side of the building near the mechanical room. 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" thick concrete slabs approximately 8 ft by 8 ft across. For this study, it is assumed that one large 8 ft x 32 ft slab is made for all four silos to be installed on, to save costs.

Transfer augers will move the pellets from the four silos to a pellet hopper integrated into each pellet boiler. The pellet hopper is connected to the boiler and is used for daily feeding of pellets. For this study, two Maine Energy Systems (MES) PES56 pellet boilers were considered. These boilers are high quality pellet boilers with a good track record for reliability and lifespan. The PES56 has can modulate down to 30% firing rate, has automatic ash removal systems and is easily maintainable.



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

Two MES pellet boilers were chosen instead of one larger pellet boiler to allow for the pellet system to have greater turndown. Having two smaller pellet boilers sequenced together allow them to efficiently match the heat load of the facility, which is more efficient and reduces wood pellet consumption.

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

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 Kluti-Kaah by truck and currently costs \$3.92/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). Superior Pellets manufactures local Alaskan pellets at their North Pole factory and will deliver pellets in bulk to the building. 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 Glennallen is \$350/ton, for a full truck load of pellets, which includes the cost of filling the pellet silos. Since Kluti-Kaah is further away than Glennallen, it is estimated that the pellet price for the Kluti-Kaah Multi-Use facility will be \$360/ton. It is proposed that four 8.5 ton silos are used for the biomass system. This will give the building 34 tons of storage and will allow for a full 15 ton deliveries 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 Kluti-Kaah 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%	\$360	\$26.16
Fuel Oil	gal	134,000	80%	\$3.92	\$36.57
Electricity	kWh	3,413	99%	\$0.28	\$82.87

Table 2 – Energy Comparison

Existing Fuel Oil Consumption

Since the building is unfinished, it does not have any historic energy consumption or energy bills. Heating oil consumption for the facility was estimated based on 103,248 BTU/SF/year. This number is based on the results of the Alaska Housing Finance Corporations “White Paper on Energy Use in Alaska’s Public Facilities”, and is derived from the average heating oil energy utilization index for eight buildings in the Ahtna region near Kluti-Kaah. This estimation was corroborated with a heat load and BIN weather data analysis for the building. It is estimated that on average the Multi-Use Facility will consume approximately 9,766 gallons of heating oil annually. This is shown in the table below.

Building Name	Fuel Type	Estimated Avg. Annual Consumption	Net MMBTU/yr	Annual Fuel Cost
Multi-Use Facility	Fuel Oil	9,766 gal	1,046.9	\$38,283

Table 3 – Existing Fuel Oil Consumption

Biomass System Consumption

It is estimated that the proposed biomass system will offset 91% of the heating energy for the building. The remaining 9% of the heating energy be provided by the oil fired boiler. This result is based on an analysis of outdoor temperature BIN data for the Copper Center region. Based on this analysis, even though two Maine Energy System PES56 pellet boilers will only provide 55% of the building's peak design load, it will provide 91% of the building's heat on an annual basis. The four 8.5 ton silos will hold approximately 50% of the facility's annual pellet demand.

Option	Fuel Type	% Heating Source	Net MMBTU/yr	Annual Consumption	Energy Cost	Total Energy Cost
Proposed Biomass System	Pellets	91%	952.7	69.2 tons	\$24,926	\$28,506
	Fuel Oil	9%	94.2	879 gal	\$3,446	
	Additional Electricity	N/A	N/A	484 kWh	\$135	

Table 4 – Proposed Biomass System Fuel Consumption

V. Preliminary Cost Estimating

At this time the Native Village of Kluti-Kaah has not purchased the mechanical system for the Multi-Use Facility. If the building is to be finished the Village must spend money to buy the currently designed mechanical system that includes two oil boilers, fuel tanks, ductwork, hydronic piping, pumps, air handling unit, exhaust fans, radiant floors, unit heaters and other necessary mechanical items. Regardless of whether or not a new biomass is installed, the village still has to purchase the mechanical system to make the building functional.

In this situation, the additional material cost and additional installation costs of the proposed biomass system was considered. The opinion of probable cost below accounts for the additional cost for installing four pellet storage silos, augers, two pellet boilers and all other necessary components required to make the pellet system work. It is assumed that the pellet system installation will be combined as part of the building's initial mechanical installation. This reduces the cost of the pellet system since the contractor will already be onsite and working on a brand new system, which doesn't require connecting to existing equipment. Since the proposed pellet system design only incorporates one of the two oil fired boilers, the second oil boiler does not need to be purchased and installed. Therefore an estimated \$16,000 credit can be given to account for unneeded boiler equipment and installation costs.

The opinion of probable cost 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 Kluti-Kaah. Project and Construction Management was estimated at 5%. Engineering design and permitting was estimated at 20% and a 15% contingency was used. The engineering design fee assumes that there are design cost savings because the engineering company has already designed the rest of the building's mechanical and electrical systems.

Estimate of Probable Cost – Additional Cost of Pellet Boiler System		
Category	Description	Cost
Site Work and Silos	Site Grading	\$ 4,500
	Concrete Slab	\$ 5,500
	Four 8.5 Ton Silos	\$ 12,000
	Silo Installation	\$ 9,000
	Subtotal	\$ 31,000
Electrical Utilities	Auger Power Connection	\$ 2,500
	Conduit and Wiring	\$ 2,500
	Subtotal	\$ 5,000
Wood Boiler and Augers	Two Maine Energy Systems PES 56 Pellet Boiler	\$ 50,000
	Transfer Augers	\$ 8,000
	Subtotal	\$ 58,000
Interior Mechanical & Electrical	Additional Pellet Boiler Installation, Piping & Materials	\$ 8,000
	Subtotal	\$ 8,000
Oil Boiler Offset	Equipment and Installation cost savings for only installing one oil boiler instead of two.	\$ (16,000)
	Subtotal	\$ (16,000)
Subtotal Material and Installation Cost		\$ 86,000
Remote Factor	5%	\$ 4,300
	Subtotal	\$ 90,300
Project and Construction Management	5%	\$ 4,515
	Subtotal	\$ 94,815
Design Fees and Permitting	20%	\$ 18,963
	Subtotal	\$ 113,778
Contingency	15%	\$ 17,067
Total Project Cost		\$ 130,845

Table 5 – 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 6 – 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 \$1,000 per year. This 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. Once each 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	<p>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.</p> $\text{Simple Payback} = \frac{\text{Installed Cost of ECM}}{\text{First Year Energy Savings of ECM}}$

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)	<p>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:</p> $\text{Benefit / Cost Ratio} = \frac{PV(\text{Project Benefits}) - PV(\text{Operating Costs})}{\text{Project Capital Cost}}$ <p>Where:</p> <p>PV = The present value over the 20 year period</p> <p>Reference Sullivan, Wicks and Koelling, “Engineering Economy”, 14th ed., 2009, pg. 440, Modified B-C Ratio.</p>
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	<p>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:</p> $\text{Installed Cost} \leq \sum_{k=0}^J R_k$ <p>Where:</p> <p>J = Year that the accumulated cash flow is greater than or equal to the Project Capital Cost.</p> <p>R_k = Project Cash flow for the kth year.</p>

Table 7 – Economic Definitions

Results

The economic analysis was completed in order to determine the simple payback, benefit to cost ratio, and net present value of the proposed biomass system. The estimate of probable cost is based on the marginal cost of the pellet system. The results of the proposed wood pellet boiler system are shown below.

Please refer to Appendix B for the economic analysis spreadsheet.

The proposed pellet boiler system consists of two major parts: two new pellet boilers and four new pellet silos. The two pellet boilers will be located inside the existing building's mechanical room. Four new exterior pellet silos will be located outside the building adjacent to the mechanical room on the west side of the building. The benefit to cost ratio for the proposed pellet system is 2.38 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 major advantage of this project is that the cost of the pellet system can be reduced because the pellet system will be installed into the building at the same time as the rest of the building's mechanical equipment is installed. Also, costs are reduced by utilizing interior mechanical space and not building a detached boiler building.

Indoor Pellet Boiler System With Exterior Silos	
Project Capital Cost (Marginal Cost of Pellet System)	\$130,845
Present Value of Project Benefits (20 year life)	\$897,857
Present Value of Operating Costs (20 year life)	\$586,831
Benefit / Cost Ratio of Project (20 year life)	2.38
Net Present Value (20 year life)	\$180,181
Year Accumulated Cash Flow is Net Positive	First Year
Year Accumulated Cash Flow > Project Capital Cost	12 years
Simple Payback	16.8 years

Table 8 – Economic Analysis Results

Sensitivity Analysis

A sensitivity analysis was completed to show how changing heating oil costs and wood costs affect the benefit to cost (B/C) ratios of the project. As heating oil costs increase and wood costs decrease, the projects becomes even more economically viable. All of the B/C ratios shown below are greater than 1.0, which makes them all economically justified.

B/C Ratios		Wood Pellet Cost (\$/ton)			
		\$300/ton	\$325/ton	\$360/ton	\$375/ton
Heating Oil Cost (\$/gal)	\$3.50/gal	2.32	2.07	1.71	1.55
	\$3.75/gal	2.72	2.47	2.11	1.95
	\$3.92/gal	2.99	2.74	2.38	2.22
	\$4.00/gal	3.12	2.86	2.50	2.35
	\$4.25/gal	3.52	3.26	2.90	2.75

Table 9 – 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 (CO₂), 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 CO₂ 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 systems 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 °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 facing climate-change-induced relocation, will receive help with increasing energy sustainability and building capacity as it relocates. 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. Inside Gym



7. Inside Office Addition



8. Spray foam on Gym wall



9. Inside office addition



10. Inside Gym

Appendix B
Economic Analysis Spreadsheet

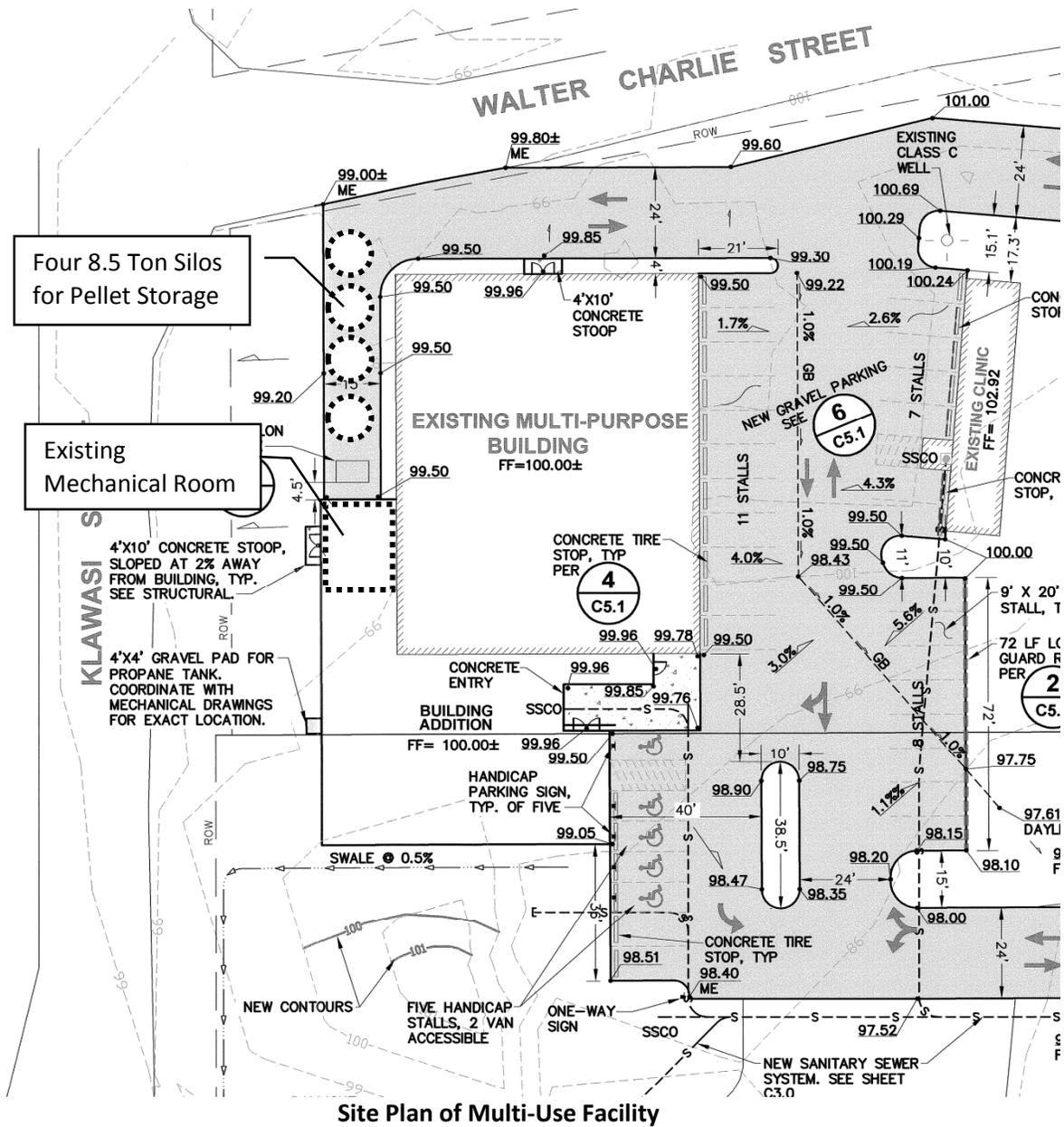
Kluti-Kaah Multi-Use Facility
Kluti-Kaah, Alaska

Economic Analysis Results	
Project Capital Cost	(\$1,30,845)
Present Value of Project Benefits (20 year life)	\$897,857
Present Value of Operating Costs (20 year life)	(\$586,831)
Benefit / Cost Ratio of Project (20 year life)	2.36
Net Present Value (20 year life)	\$180,181
Year Accumulated Cash Flow is Net Positive	First Year
Year Accumulated Cash Flow > Project Capital Cost	12 years
Simple Payback = Total Project Cost / First Year Cost Savings	16.8 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	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year		
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Existing Heating System Operating Costs																								
Existing Heating Oil Consumption	\$3.92		8,766 gal		\$38,283	\$40,197	\$42,207	\$44,317	\$46,533	\$48,860	\$51,303	\$53,868	\$56,561	\$59,389	\$62,359	\$65,476	\$68,750	\$72,188	\$75,797	\$79,587	\$83,566	\$87,745	\$92,132	\$96,739
Biomass System Operating Costs																								
Wood Pellet Fuel (Delivered to site)	\$360.00	91%	69.2 tons		(\$24,912)	(\$25,659)	(\$26,429)	(\$27,222)	(\$28,039)	(\$28,880)	(\$29,746)	(\$30,639)	(\$31,558)	(\$32,505)	(\$33,480)	(\$34,484)	(\$35,519)	(\$36,584)	(\$37,682)	(\$38,812)	(\$39,976)	(\$41,176)	(\$42,411)	(\$43,683)
Fossil Fuel	\$3.92	9%	879 gal		(\$3,446)	(\$3,618)	(\$3,799)	(\$3,989)	(\$4,188)	(\$4,398)	(\$4,618)	(\$4,848)	(\$5,091)	(\$5,345)	(\$5,613)	(\$5,893)	(\$6,188)	(\$6,497)	(\$6,822)	(\$7,163)	(\$7,521)	(\$7,898)	(\$8,292)	(\$8,707)
Additional Electricity	\$0.28		488 kWh		(\$1,36)	(\$140)	(\$144)	(\$148)	(\$153)	(\$157)	(\$162)	(\$167)	(\$172)	(\$177)	(\$182)	(\$188)	(\$193)	(\$199)	(\$205)	(\$211)	(\$217)	(\$224)	(\$231)	(\$238)
Operation and Maintenance Costs					(\$1,000)	(\$1,020)	(\$1,040)	(\$1,061)	(\$1,082)	(\$1,104)	(\$1,126)	(\$1,149)	(\$1,172)	(\$1,195)	(\$1,219)	(\$1,243)	(\$1,268)	(\$1,294)	(\$1,319)	(\$1,346)	(\$1,373)	(\$1,400)	(\$1,428)	(\$1,457)
Additional Operation and Maintenance Costs for first 2 years					(\$1,000)	(\$1,020)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total Operating Costs					(\$30,493)	(\$31,457)	(\$31,412)	(\$32,420)	(\$33,462)	(\$34,539)	(\$35,652)	(\$36,802)	(\$37,992)	(\$39,222)	(\$40,493)	(\$41,808)	(\$43,168)	(\$44,574)	(\$46,028)	(\$47,532)	(\$49,088)	(\$50,698)	(\$52,362)	(\$54,085)
Annual Operating Cost Savings					\$7,790	\$8,740	\$10,795	\$11,897	\$13,071	\$14,321	\$15,651	\$17,065	\$18,569	\$20,167	\$21,865	\$23,668	\$25,582	\$27,614	\$29,769	\$32,055	\$34,478	\$37,047	\$39,770	\$42,654
Accumulated Cash Flow					\$7,790	\$16,529	\$27,324	\$39,221	\$52,292	\$66,613	\$82,264	\$99,329	\$117,898	\$138,065	\$159,930	\$183,598	\$209,181	\$236,794	\$266,563	\$298,618	\$333,096	\$370,143	\$409,913	\$452,566
Net Present Value					(\$123,282)	(\$115,044)	(\$105,166)	(\$94,595)	(\$83,320)	(\$71,327)	(\$58,601)	(\$45,130)	(\$30,898)	(\$15,892)	(\$96)	\$16,504	\$33,925	\$52,181	\$71,288	\$91,264	\$112,123	\$133,885	\$156,565	\$180,181

Appendix C
Site Plan



Site Plan of Multi-Use Facility

Appendix D
AWEDTG Field Data Sheet

ALASKA WOOD ENERGY DEVELOPMENT TASK GROUP (AWEDTG)

PRE-FEASIBILITY ASSESSMENT FIELD DATA SHEET

APPLICANT:	
Eligibility: (check one)	<input type="checkbox"/> Local government <input type="checkbox"/> State agency <input type="checkbox"/> Federal agency <input type="checkbox"/> School/School District
	<input type="checkbox"/> Federally Recognized Tribe <input type="checkbox"/> Regional ANCSA Corp. <input type="checkbox"/> Village ANCSA Corp.
	<input type="checkbox"/> Not-for-profit organization <input type="checkbox"/> Private Entity that can demonstrate a Public Benefit
	<input type="checkbox"/> Other (describe):
Contact Name:	Katherine McConkey (Tribal Administrator)
Mailing Address:	P.O. Box 68
City:	Copper Center
State: AK	Zip Code: 99573
Office phone: (907) 822-5541	Cell phone: ()
Fax: (907)	
Email:	nvkkadmin@cvinternet.net

Facility Identification/Name:	Multi-Use Facility
Facility Contact Person:	Katherine McConkey
Facility Contact Telephone:	(907) 822-5541 ()
Facility Contact Email:	nvkkadmin@cvinternet.net

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

~~SCHOOL FACILITY (Name: _____)~~

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

OTHER FACILITY (Name: Multi-Use Facility)

Type:	<input type="checkbox"/> Health Clinic	<input type="checkbox"/> Water Plant	<input checked="" type="checkbox"/> Multi-Purpose Bldg
	<input type="checkbox"/> Public Safety Bldg.	<input type="checkbox"/> Washeteria	<input type="checkbox"/> District Energy System
	<input type="checkbox"/> Community Center	<input type="checkbox"/> Public Housing	<input type="checkbox"/> Other (list):
Size of Facility (sq. ft. heated)	12,675 SF	Year built/age:	Shell completed 1999.
Number of floors:	1 story	Year(s) renovated:	None
Number of bldgs.:	1 Bldg	Next renovation:	Working on getting funding to finish
Frequency of Usage:	Not Finished	# of Occupants	Not Finished
Has an energy audit been conducted?	No	If Yes, when? *	No

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

HEATING SYSTEM INFORMATION

CONFIGURATION (check all that apply)

— No heating system installed in building.

- Heat plant in one location: on ground level below ground level mezzanine roof 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 No

HEAT DELIVERY (check all that apply)

— NONE.

- Hot water: baseboard 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)

— NONE

- Hot water boiler: natural gas propane electric #1 fuel oil #2 fuel oil
- 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: _____

Heating capacity
(Btuh / kWh)

Annual Fuel
Consumption | Cost

Heating capacity (Btuh / kWh)	Annual Fuel Consumption	Cost
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

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

— NONE

- Thermostats on individual devices/appliances; no central control system
- Pneumatic control system Manufacturer: _____
- Direct digital control system Manufacturer: _____

Approx. Age: _____

Approx. Age: _____

Record Name Plate data for boilers (use separate sheet if necessary):

Describe locations of different parts of the heating system and what building areas are served:

Describe age and general condition of existing equipment:

Who performs boiler maintenance? Dan Novak Describe any current maintenance issues: *He maintains Clinic office & Hall mech. equipment.*

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

NONE

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

NONE

If this fuel is also used for other purposes, please describe:

Fuel for Clinic, Office & Hall is Used on site.

DOMESTIC HOT WATER - NONE

USES OF DOMESTIC HOT WATER

Check all that apply:

- Lavatories
- Kitchen
- Showers
- Laundry
- Water treatment
- Other: _____

TYPE OF SYSTEM

Check all that apply:

- Direct-fired, single tank
- Direct fired, multiple tanks
- 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): _____

Describe on-site fuel storage: number of tanks, size of tanks, location(s) of tanks, condition, spill containment, etc.:

BUILDING ENVELOPE

GYM - Metal Frame w/ SPRAY FOAM.
Addition - wood stud w/ NO INSULATION

Wall type (stick frame, masonry, SIP, etc.): _____ Insulation Value: _____

Roof type: GYM - Hot Roof w/ Spray Foam. Addition - Gable Roof w/ NO INSULATION Insulation Value: _____

Windows: single pane double pane other: NONE INSTALLED

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

Drawings available: architectural mechanical electrical

Outside Air/Air Exchange: HRV CO₂ Sensor NONE INSTALLED

ELECTRICAL

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

Type of grid: building stand-alone village/community power railbelt grid 84% Hydro, 14% CoGen, 2% Diesel

Energy source: hydropower diesel generator(s) Other: Utility

Electricity rate per kWh: _____ Demand charge: NONE

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

Back-up generator on site: Yes No If Yes, provide output capacity: _____

Are there spare circuits in MDP and/or electrical panel?: Yes No NO MDP Installed

Record MDP and electrical panel name plate information: No MDP Installed.

WOOD FUEL INFORMATION

→ Pellets are preferred.

- 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 \$ 200-250/cord Viable fuel source? Yes No
- Distance to nearest wood pellet and wood chip suppliers? Tok & Anchor-ye

Client prefers pellets.

Can logs or wood fuel be stockpiled on site or at a nearby facility? Yes

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

AHTMA and State of Alaska.

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.)? *None.*

What are local soil conditions? Permafrost issues?

No permafrost issue on site. Gravel.

Is the building in proximity to other buildings with biomass potential? If so, Which ones and How close?

Yes. The Clinic, Head Start Bldg, Office and Hall are on site. They are not close.

Can building accommodate a biomass boiler inside, or would an addition for a new boiler be necessary? Where would addition go?

Addition or separate Bldg required.

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

Connection to Multiuse Bldg when completed

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

Yes.

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?~~

~~For baseboard hydronic heat, what is the diameter of the copper tubing? Size of fins? Number of fins per lineal foot?~~

~~Any other energy using systems (kitchen equipment, lab equipment, pool etc)? Fuel or energy source?~~

~~Any systems that could be added to the boiler system?~~

Are heating fuel records available?

NONE Installed.

Partial records were provided for clinic, office, and Hall.

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

NONE

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)

NONE