Feasibility Assessment for Biomass Heating Systems at Mentasta Tribal Office Building and Clinic

FINAL REPORT – 9/17/2018

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Contents

1. Executive Summary 1

2. Introduction 2

3. Preliminary Site Investigation 3

Building Descriptions 3
Existing Heating System 3
Available Space, Street Access, Fuel Storage and Site Constraints 4

4. Biomass System 5

Existing Biomass System 5
Biomass System Options 7
Biomass System Integration 8

5. Energy Consumption and Costs 10

Energy Costs 10
Cord Wood 10
Wood Chips 10
Heating Oil 11
Electricity 11
Existing Fuel Oil Consumption 12
Biomass System Consumption 12

6. Preliminary Cost Estimating 13

7. Economic Analysis 14

O&M Costs 14
Definitions 14
Results 16
Sensitivity Analysis 17

8. Forest Resource and Fuel Availability Assessments 18

Fuel Availability 18
Air Quality Permitting 18

9. General Biomass Technology Information 19

Heating with Wood Fuel 19
Types of Wood Fuel 19
High Efficiency Wood Pellet Boilers 20
High Efficiency Cordwood Boilers 20
Low Efficiency Cordwood Boilers 20
High Efficiency Wood Stoves 21
Bulk Fuel Boilers 21
Grants 21

Appendices

Appendix A – Site Photos
Appendix B – Economic Analysis Spreadsheets
Appendix C – AWEDTG Field Data Sheets

Abbreviations

ACF	Accumulated Cash Flow
AGSD	Alaska Gateway School District
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
AEA	Alaska Energy Authority
AFUE	Annual Fuel Utilization Efficiency
B/C	Benefit / Cost Ratio
BTU	British Thermal Unit
BTU/hr	BTU per hour
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)
kW	Kilowatt(s)
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
TPY	Tons per Year
V	Volts
W	Watts

List of Figures

Figure 1 – Tribal Office Building 2
Figure 2 – Clinic 2
Figure 3 – Site Layout 4
Figure 4 – Existing wood chip storage building (left) and chip boiler building (right). 5
Figure 5 – Existing 7-yd chip bin 6
Figure 6 – Existing Portage & Main chip boiler (left) and thermal storage tank (right). 6
Figure 7 – Portage & Main Enviro-Chip B500 Wood Chip Boiler 7
Figure 8 – Biomass boiler system schematic (11/21/2014 drawings) 8

List of Tables

Table 1 – Executive Summary 1
Table 2 – Energy Comparison Overview 1
Table 3 – Building Characteristics 3
Table 4 – Boiler Equipment 3
Table 5 – Energy Comparison 10
Table 6 – Existing Fuel Oil Consumption 12
Table 7 – Proposed Biomass System Fuel Consumption 12
Table 8 – Estimate of Probable Cost 13
Table 9 – Discount and Escalation rates 14
Table 10 – Economic Definitions 15
Table 11 – Economic Analysis Results 16
Table 12 – Sensitivity Analysis – Heating Oil Price vs Wood Chip Price 17
Table 13 – Sensitivity Analysis – Wood Chip Price vs Project Cost 17

1. Executive Summary

Coffman performed a preliminary biomass feasibility assessment for the Mentasta Tribal Office Building and Clinic to determine the technical and economic viability of biomass heating systems. The proposed biomass heating system is a wood chip boiler system that would be located in a detached building and a buried heating loop would deliver heat to both the Tribal Office and Clinic. Wood chips would be stored at the existing wood chip storage building in Mentasta.

The benefit to cost ratio for the project is 1.02. Any project with a benefit to cost ratio greater than 1.0 is considered economically justified, and therefore the Mentasta project is economically justified. Depending on the relationship with the Alaska Gateway School District (AGSD) the chips may remain a free resource, resulting in an even better benefit to cost ratio of 1.20. When chip prices are $65/ton at the high end, the benefit to cost ratios drop to 0.92 and the project is not economically viable.

A summary of the project's economic analysis is shown in the following table.

Table 1 – Executive Summary

Item	Results at $41/ton Wood Chip Price
Project Capital Cost	($313,000)
Present Value of Project Benefits (20-year life)	$412,661
Present Value of Operating Costs (20-year life)	($92,504)
Benefit / Cost Ratio of Project (20-year life)	1.02
Net Present Value (20-year life)	$7,158
Year Cash Flow is Net Positive	First Year
Payback Period (Year Accumulated Cash Flow > Project Capital Cost)	20 years

The current energy prices in Mentasta are shown in the following table. Wood chips are less expensive than heating oil and electricity on an energy basis.

Table 2 – Energy Comparison Overview

Community	Fuel Type	Units	Gross BTU/unit	System Efficiency	$/unit	Delivered $/MMBTU
Mentasta	Wood Chips	ton	12,000,000	75%	$41	$4.56
	Heating Oil	gal	134,000	75%	$2.55	$25.37
	Electricity	kWh	3,412	99%	$0.37	$109.54

2. Introduction

A preliminary feasibility assessment was completed to determine the technical and economic viability of biomass heating systems for the Tribal Office Building and Clinic located in Mentasta, Alaska. The Mentasta Traditional Council operates and maintains both facilities. The Traditional Council was awarded a biomass pre-feasibility study of these two buildings from the Fairbanks Economic Development Corporation (FEDC).

Figure 1 – Tribal Office Building

Figure 2 – Clinic

3. Preliminary Site Investigation

A site visit of the Mentasta Tribal Office and Clinic was completed by Coffman on July 12, 2018.

Building Descriptions

The two buildings are located adjacent to each other on a large gravel pad on the west edge of the community. The Tribal Office Building was constructed in 2015 and the Clinic was just completed in January 2018. The Clinic is not yet occupied so utility usage for the facility is either for maintaining minimum temp levels for facility preservation or for electrical loads used by the construction contractor. For each facility, the square footage, date of construction, occupant characteristics and type of construction is shown in the following table.

Table 3 – Building Characteristics

Building	Square Footage	Year Built	Occupants	Type of Construction
Tribal Office	2,500	2015	7 employees, M-F 9am-4:30pm	Wood Framed 2x6 stud walls (R-19) and Sloped cold roof (R-30 insulation) with an attic
Clinic	2,500	2018	(Forecasted) 5 employees, M-F 8am-2pm	Wood Framed 2x6 stud walls (R-19) and Sloped cold roof (R-30 insulation) with an attic

Existing Heating System

Both buildings are heated with oil-fired boilers that serve air handlers, cabinet unit heaters, and perimeter base board using 50% propylene glycol. Domestic hot water (DHW) is provided by sidearm hot water heaters. All of the heating zones are controlled by line voltage thermostats, with the thermostat in the space served, and the zone valves all adjacent to the boiler. All of the boilers are recent and appear to be well-maintained and kept in good condition. There were no specific maintenance issues reported during the site visit. The following table shows the heating capacities of the boiler plants.

Table 4 – Boiler Equipment

Building	Boiler Plant	DHW Plant	Fuel Tank
Tribal Office	One Energy Kinetics Frontier Boiler, Model System 2000 EK-1F, 1.0 GPH Input 121 MBH Gross Output	40 Gallon Sidearm, Energy Kinetics	300-gal aboveground fuel tank
Clinic	One Energy Kinetics Frontier Boiler, Model System 2000 EK-1F, 1.0 GPH Input 121 MBH Gross Output	40 Gallon Sidearm, Energy Kinetics	500-gal aboveground fuel tank

The boilers, central pumps and hot water heaters are located in mechanical rooms. The combustion efficiency of the boilers is unknown, as no combustion test reports were available. For this study, the

Annual Fuel Utilization Efficiency of the boiler system is estimated at 75% to account for typical new, well-maintained oil boiler inefficiencies, including short cycling.

Available Space, Street Access, Fuel Storage and Site Constraints

Both buildings are in a large clearing with few site constraints and ample space for access and fuel storage. Both buildings are similar in construction and size. The large clearing does have some site constraints with septic systems and leach fields installed that serve the buildings. In between the two facilities is a wellhead that provides domestic water to both buildings. The well equipment for both facilities is located in the crawl space of the Tribal Council Building.

Neither building has available space inside for the installation of a biomass boiler. A detached biomass boiler module or small outbuilding is required. Space is available for a boiler building and biomass fuel storage system. However, the village already has a wood chip storage facility on the other side of town, so the desire is to save costs by sharing the existing wood chip storage facility. In discussions with the local staff, if a wood chip system is installed for these new facilities, they could store chips for these facilities and transport them from the existing chip shed to the clinic boiler building.

Figure 3 – Site Layout

4. Biomass System

Existing Biomass System

Mentasta already has an existing wood chip biomass heating system that serves the school, old clinic, old post office and rec center on the east end of the community. Wood chips are stored in a large metal building on a concrete pad. Chips are transported by a front-end loader to the chip boiler building, which has a shed roof cover over a Portage & Main 7-yard chip bin. The chip bin automatically feeds chips via an auger to a Portage & Maine Enviro-Chip-B500 chip boiler located inside the boiler building.

Figure 4 – Existing wood chip storage building (left) and chip boiler building (right).

Inside the boiler building, the wood chip boiler sends hot water to a 1,100 gal insulated thermal storage tank. From there the hot water is sent to a brazed plate heat exchanger that delivers heat to an insulated and buried piping loop with 50% propylene glycol to the buildings.

Figure 5 – Existing 7-yd chip bin

Figure 6 – Existing Portage & Main chip boiler (left) and thermal storage tank (right).

The Portage & Main boiler system reportedly works well and is a reliable unit. However, it was reported that there are two design issues that should be implemented on future installations:

1. The 7-yard chip bin is located outside in the elements and therefore the hydraulic fluid and controller will freeze up during winter, causing the unit to stop working. Electric heat blankets were added after the fact to stop this issue, but electric heat is expensive. A preferred option would be to fully enclose the bin with insulated walls, and provide a garage door for bin access. The enclosed bin storage can then be heated using a boiler loop or other means.
2. Reportedly, the thermal storage tank takes over 24 hrs to come up to temperature before there is useable heat for the district system. A smaller tank around 600 gal, may be a better fit because it will take only around 12 hrs to come up to temp. It is recommended that the existing tank temperatures be datalogged and analyzed to verify performance.

Biomass System Options

Due to the success and local knowledge of the operation and maintenance of the Portage & Main chip boiler system at Mentasta, using the same system for the Tribal Office and Clinic makes a lot of sense and would most likely be a very successful installation. The boiler operator is familiar with operating and maintaining this type of system and the Portage & Main boiler is a relatively low-cost chip system compared to other manufacturers. Additionally, the Portage & Main system has proved to be a reliable boiler for the community. Wood chips are also readily available and there is already a wood chip storage building for bulk storage of chips. It is also an advantage that the existing system works well with the locally available wood chips, which might not be the case with a new system.

Due to these factors, the biomass boiler system selected as the basis of design for the Tribal Office and Clinic is the Portage & Main Enviro-Chip B500 boiler with 7-yard chip bin. The B500 boiler has an output of 500,000 BTU/hr at high fire rate and is shown in the figure below.

Figure 7 – Portage & Main Enviro-Chip B500 Wood Chip Boiler

During review of the Clinic engineering drawings it was discovered that a detached wood chip boiler building was already designed to serve the Tribal Office and Clinic. The drawings are titled “Mentasta Clinic” by CTA Architects/Engineers, dated 11/21/2014, and are available by the Mentasta Traditional Council. The design uses a Portage & Main B500 chip boiler, a 650-gal thermal storage tank and district heat exchanger. The biomass boiler schematic is shown on the next page for reference.

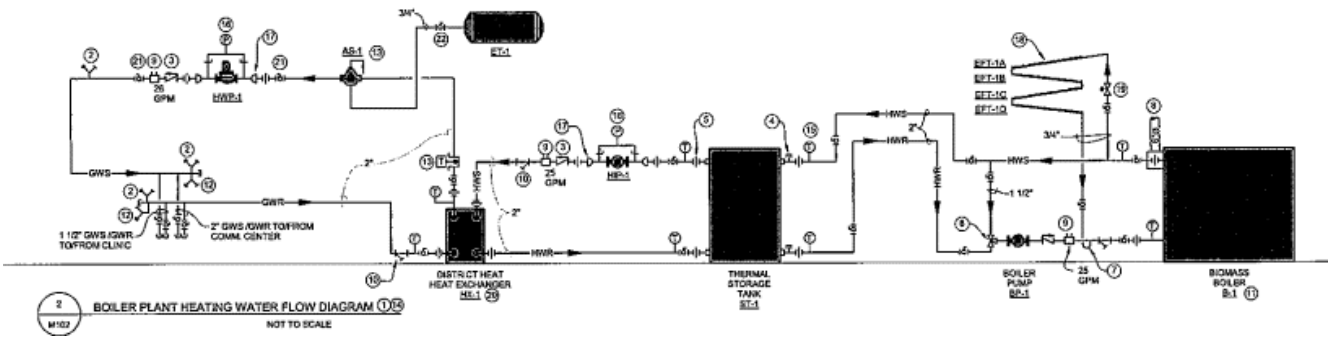


Figure 8 – Biomass boiler system schematic (11/21/2014 drawings)

It is recommended that these engineering drawings be revisited to verify loads and other relevant design parameters, and then the drawings could be updated for the detached biomass boiler building using the lessons learned from the existing Mentasta chip boiler installation. Any engineering firm could take the existing drawings and provide an updated design package.

It is proposed that the Portage & Main chip bin be enclosed in a separate heated space, with an insulated garage door that can open for feeding of the chip bin. The garage door would be elevated so that the bottom of the garage door would be at the same elevation as the chip bin. The Portage & Maine boiler, thermal storage tank, district heat exchanger and pumps would be located inside the detached boiler building as well. The approximate dimensions of the biomass boiler building (including space for the enclosed 7-yard bin) is around 20ft x 16ft.

Wood chips would be stored at the existing wood chip storage building on the east side of town and hauled over using a front-end loader to the proposed biomass boiler building. This was recommended by the Mentasta boiler operator so that additional money would not be needed for more chip storage in the town. In the future, a smaller chip storage facility near the Tribal Office and Clinic could be added if it was needed. For this study, a new wood chip storage building was not included for the clinic boiler facility.

The combustion efficiency of the wood chip boiler can reach 80%. Using thermal storage will also help the unit run at higher efficiencies during normal operation. For this study, an Annual Fuel Utilization Efficiency of 75% was used, to account for normal operations throughout the year.

Biomass System Integration

Integrating the biomass boiler system to the Tribal Office and Clinic can be accomplished by the use of insulated buried piping running 50% propylene glycol between the facilities and the boiler building. A district heat exchanger located in the detached biomass boiler building will take heat from the chip boiler and thermal storage tank and deliver it to the buried piping loop. The buried piping will run across the gravel pad to the Tribal Office and the Clinic, and will connect to the return side of the existing oil-fired boilers. The oil boilers will only run in the event that the biomass boiler cannot meet the full heat demand. The existing hydronic systems in the Tribal Office and Clinic are set to operate at 170°F heating glycol supply / 150°F return, which the wood chip boiler can reach.

An additional heat exchanger could be added before the heating loop connection to the buildings, which allows the building heating systems to still operate in the event that the buried pipe gets damaged or the system is down for maintenance. However, adding an additional heat exchanger adds cost to the project

and reduces the overall thermal performance of the biomass heating system. The 2014 drawings of the biomass system do not use this additional heat exchanger at the buildings. For this study, the additional heat exchangers are not used, but could be added if desired. The final design should take into consideration operational parameters and risk tolerance to determine if the heat exchangers should be included in the system design.

The biomass boiler building will also require an electrical power connection to power the chip boiler, pumps, lights, and associated equipment.

5. Energy Consumption and Costs

Energy Costs

The table below shows the energy comparison of different fuel types in the community. 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, wood chips are cheaper than fuel oil on a $/MMBTU basis in the Mentasta area.

Table 5 – Energy Comparison

Community	Fuel Type	Units	Gross BTU/unit	System Efficiency	$/unit	Delivered $/MMBTU
Mentasta	Wood Chips	ton	12,000,000	75%	$41	$4.56
	Wood Chips	ton	12,000,000	75%	$65	$7.22
	Heating Oil	gal	134,000	75%	$2.55	$25.37
	Electricity	kWh	3,412	99%	$0.37	$109.54

Cord Wood

Cord wood was evaluated as a biomass fuel, but was not considered viable due to the additional handling requirements and manual feeding. In order to burn cord wood, a person is required to stack, move and fire the cord wood boiler daily, if not multiple times per day. Cord wood was not considered viable because the community wishes to have a more automated biomass system that utilizes wood chips.

Wood Chips

Wood chips are currently provided to Mentasta by the Alaska Gateway School District (AGSD), which operates the school in Mentasta. The largest source of chips is from fire remediation in the Tok area. The AGSD processes logs into chips in a variety of places. The main location is in Tok at a 5-acre yard where logs are chipped. Chip processing also occurs right where trees are cut, which minimizes handling and reduces costs of the chips. The wood chip price varies. On the high side the wood chips are $65/ton. Depending on the location of logs for chipping, the AGSD can produce chips even cheaper at $18/ton at low end. For this study the average wood chip price of $41/ton was used. Chips are delivered using a walking floor trailer that can deliver approximately 20 tons of chips in one load. After review of AGSD lab reports, wood chips with 25% to 30% moisture content have around 6,000 BTU/lb, or around 12,000,000 BTU/ton.

Currently, the chips being delivered to the existing Mentasta chip system are delivered for free by the AGSD. The Mentasta Tribal Council then heats the district system, which includes AGSD's school, for free.

According to Scott Macmanus, AGSD Superintendent, they have learned a lot over the years of chipping wood. Now, they cut chips only in October and November, because the sap has dropped down for winter. When they chip green wood at this time of the year there is limited sap in the tree and they can produce chips at 25% moisture content without doing any drying. These chips can be burned right away. If they

chip in the spring, the wood has 55% to 60% moisture content due to the sap content and they have to dry the chips for 1 to 2 years. Wood chip boilers are sensitive to moisture content because as moisture increases there is a reduction in heat output.

Heating Oil

The high price of fuel oil, creating of local jobs, and energy security are the main economic drivers for the use of lower cost biomass heating. Fuel oil is currently purchased at $2.55/gal. The price of fuel oil has fluctuated greatly over time, and currently appears to be at a lower price than in the recent past. The wide variation of fuel oil prices is a disadvantage compared to more stably priced wood pellets. For this study, the energy content of fuel oil is based on 134,000 BTU/gal, according to "Heating Values of Fuels" by the UAF Cooperative Extension, 2009.

Electricity

Electricity for the buildings is provided by Alaska Power and Telephone. According to the utility data provided, the effective electricity rate at the facilities is $0.37/kWh. The effective electricity rate is the cost of all electric costs (demand, energy, customer charges) per kWH for a billing period. On a BTU basis, electricity is the most expensive energy source. There are 3,412 BTU per kWh.

Existing Fuel Oil Consumption

An estimate of the buildings heating oil consumption was made based on annual heating oil data provided, and are shown in the following table. The Clinic is not yet fully occupied, and so the heating oil consumption was estimated based on mechanical equipment, building envelope construction and anticipated usage.

Table 6 – Existing Fuel Oil Consumption

Building	Fuel Type	Annual Consumption	Net MMBTU/yr	Avg. Annual Cost
Multi-Purpose Building	Heating Oil #1	3,400 gal	341.7	$8,670
Clinic	Heating Oil #1	3,500 gal	351.8	$8,925
Total	**Heating Oil #1**	**6,900 gal**	**693.5**	**$17,595**

Biomass System Consumption

It is estimated that the proposed biomass system will offset approximately 98% of the heating energy for the buildings. The chip boiler has a thermal output that is greater than both the oil boiler outputs of the buildings combined, and therefore will carry the entire load. The oil boilers would be used only in the event that the biomass boiler is down for maintenance and during regular boiler operation to keep them in good working order.

Table 7 – Proposed Biomass System Fuel Consumption

Building	Fuel Type	% Heating Source	Net MMBTU/yr	Annual Consumption	Energy Cost	Total Energy Cost	Annual Energy Savings
Tribal Office and Clinic	Wood Chips	98%	679.6	76 tons	$3,096	$3,459	$14,136
	Fuel Oil	2%	7.0	70 gal	$179		
	Additional Electricity	N/A	N/A	500 kWh	$185		

Note – Based on wood chips at $41/ton, heating oil at $2.55/gal and electricity at $0.37/kWh.

6. Preliminary Cost Estimating

An estimate of probable costs was completed for installing the wood chip boiler systems in Mentasta. The estimate is based equipment quotes and from previous projects in Alaska. A remote factor of 10% was used to account for increased shipping and construction costs. Project and Construction Management was estimated at 5%. Engineering design and permitting was estimated at 15% and a 25% contingency was used.

Table 8 – Estimate of Probable Cost

Category	Description		Cost
Site Work	Site Grading		$2,000
	Building Foundation		$5,000
	Buried Utilities		$5,000
		Subtotal	**$12,000**
Electrical Utilities	Service Entrance		$3,000
	Conduit and Wiring		$3,000
		Subtotal	**$6,000**
Biomass Boiler Building	Detached Boiler Building (16'x20') @ $200/SF		$64,000
	Enviro-Chip B500 Chip Boiler and 7-yard Chip Bin		$28,000
	Insulated SS Chimney		$3,000
	Thermal Storage Tank 600 gal		$5,000
	Heat Exchanger		$3,000
	Mechanical, Piping and pump allowance		$30,000
	Electrical allowance		$25,000
	Shipping to Mentasta		$10,000
		Subtotal	**$158,000**
Building Connections	Insulated Pipe to two Buildings		$20,000
	Piping Tie-in to two Boiler Rooms		$10,000
		Subtotal	**$30,000**
Subtotal Material and Installation Cost			**$206,000**
Remote Factor	10%		$20,600
		Subtotal	**$226,600**
Project and Construction Management	5%		$11,330
		Subtotal	**$217,330**
Design Fees and Permitting	15%		$32,600
		Subtotal	**$249,930**
Contingency	25%		$62,483
Total Project Cost			$312,413
Total Budgetary Cost			**$313,000**

7. Economic Analysis

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

Table 9 – Discount and Escalation rates	
Real Discount Rate for Net Present Value Analysis	3%
Wood Fuel Escalation Rate	2%
Fossil Fuel Escalation Rate	5%
Electricity Escalation Rate	3%
O&M Escalation Rate	2%

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, and is used in this report. The escalation rates used for the wood, heating oil, electricity and O&M rates are based on rates used in previous Alaska Energy Authority funded biomass pre-feasibility studies. The wood fuel escalation rate was set at 2%, since there has been limited change in chip costs in the Tok region.

A net present value analysis was completed using real dollars (constant dollars) and the real discount rate, per the Alaska Department of Education and Early Development Life Cycle Cost Analysis Handbook.

O&M Costs

Non-fuel related operations and maintenance costs (O&M) were estimated at $1,500 per year. The estimate is based on annual maintenance time for Portage & Main chip boiler. 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. The cost of operator labor is not included in the analysis. It is assumed that the operator who runs the existing chip system will also run the proposed system.

Definitions

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

Table 10 – Economic Definitions	
Economic Term	**Description**
Project Capital Cost	This is the opinion of probable cost for designing and constructing the project.
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 and the heating oil required by the existing equipment to supply the remaining amount 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.
Payback Period (Year Accumulated Cash Flow > Project Capital Cost)	The Payback Period 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 quantity includes 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.

Results

An economic analysis was completed to determine the simple payback, benefit to cost ratio, and net present value of the proposed wood chip boiler system at the Mentasta Tribal Office and Clinic. A wood chip boiler system would be located in a detached building and heating pipes would deliver heat to the Tribal Office and Clinic. Wood chips would be stored at the existing wood chip storage building in Mentasta.

The benefit to cost ratio for the project is 1.02, based on a wood chip price of $41/ton. Any project with a benefit to cost ratio greater than 1.0 is considered economically justified, and therefore the Mentasta project is economically justified. Depending on the relationship with the Alaska Gateway School District (AGSD) the chips may remain a free resource, resulting in an even better benefit to cost ratio of 1.20. When chip prices are $65/ton at the high end, the benefit to cost ratios drop to 0.92 and the project is not economically viable.

The results are shown in the table below for a variety of wood chip prices. Refer to Appendix B for the economic analysis spreadsheets for greater detail. (Note: values shown in red and parenthesis are negative numbers.)

Table 11 – Economic Analysis Results

Item	Wood Chip Price			
	Results at $65/ton	**Results at $41/ton**	**Results at $18/ton**	**Results at $0/ton**
Project Capital Cost	($313,000)	($313,000)	($313,000)	($313,000)
Present Value of Project Benefits (20-year life)	$412,661	$412,661	$412,661	$412,661
Present Value of Operating Costs (20-year life)	($124,837)	($92,504)	($61,517)	($37,267)
Benefit / Cost Ratio of Project (20-year life)	0.92	1.02	1.12	1.20
Net Present Value (20-year life)	($25,176)	$7,158	$38,144	$62,394
Year Cash Flow is Net Positive	First Year	First Year	First Year	First Year
Payback Period (Year Accumulated Cash Flow > Project Capital Cost)	>20 years	20 years	19 years	18 years

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 project becomes more economically viable. The B/C ratios greater than 1.0 are economically justified and are highlighted in green. B/C ratios less than 1.0 are not economically justified and are highlighted in orange.

Table 12 – Sensitivity Analysis – Heating Oil Price vs Wood Chip Price

B/C Ratios		Wood Chip Price					
		$18/ton	$25/ton	$45/ton	$65/ton	$85/ton	$95/ton
Heating Oil Price	$2.00/gal	0.84	0.81	0.72	0.64	0.55	0.51
	$2.25/gal	0.97	0.94	0.85	0.77	0.68	0.64
	$2.55/gal	1.12	1.09	1.01	0.92	0.83	0.79
	$2.75/gal	1.22	1.19	1.11	1.02	0.94	0.89
	$3.00/gal	1.35	1.32	1.24	1.15	1.06	1.02
	$3.25/gal	1.48	1.45	1.36	1.28	1.19	1.15
	$3.50/gal	1.61	1.58	1.49	1.41	1.32	1.28
	$3.75/gal	1.74	1.71	1.62	1.53	1.45	1.40
	$4.00/gal	1.86	1.83	1.75	1.66	1.58	1.53
	$4.25/gal	1.99	1.96	1.88	1.79	1.70	1.66
	$4.50/gal	2.12	2.09	2.00	1.92	1.83	1.79

Note: Based on a project cost of $313,000.

A sensitivity analysis was also completed to show how the wood chip price and the project cost affects the B/C ratios. Reducing project costs and reducing wood chip prices will further improve the economics of the project.

Table 13 – Sensitivity Analysis – Wood Chip Price vs Project Cost

B/C Ratios		Project Cost				
		($250,000)	($300,000)	($350,000)	($400,000)	($450,000)
Wood Chip Price	$0/ton	1.50	1.25	1.07	0.94	0.83
	$18/ton	1.40	1.17	1.00	0.88	0.78
	$20/ton	1.39	1.16	1.00	0.87	0.77
	$30/ton	1.34	1.12	0.96	0.84	0.74
	$40/ton	1.29	1.07	0.92	0.80	0.71
	$50/ton	1.23	1.03	0.88	0.77	0.68
	$60/ton	1.18	0.98	0.84	0.74	0.65
	$65/ton	1.15	0.96	0.82	0.72	0.64
	$70/ton	1.12	0.94	0.80	0.70	0.62
	$80/ton	1.07	0.89	0.76	0.67	0.59
	$90/ton	1.02	0.85	0.73	0.64	0.56

Note: Based on a heating oil price of $2.55/gal.

8. Forest Resource and Fuel Availability Assessments

Fuel Availability

For this study, the main fuel supplier is the AGSD. According to discussions with the superintendent, there are more than enough available wood chip resources to supply chips to the proposed Mentasta project. No further forest resource assessments were obtained.

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). Recent similarly sized Garn wood fired boiler systems installed in Alaska have not required air quality permits.

9. 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 cordwood 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.

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

The U.S. Department of Agriculture Rural Development has over fifty financial assistance programs for a variety of rural applications. This includes energy efficiency and renewable energy programs.

http://www.rd.usda.gov/programs-services

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:

https://www.fs.fed.us/working-with-us/grants

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/Programs/RenewableEnergyFund

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 washateria system.

http://www.akenergyauthority.org/Programs/AEEE/Biomass

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/Programs/EETF1

The U.S. Forest Service also has grants available, such as the Wood Innovation Program. In 2018, there was $8 million of grant money available to communities to expand and accelerate wood products and wood energy markets.

https://www.fs.usda.gov/naspf/programs/wood-education-and-resource-center/2018-wood-innovations-program-request-proposals

Department of Energy (DOE) funding options can be accessed at these links:

https://www.energy.gov/energy-economy/funding-financing

https://www.energy.gov/eere/wipo/energy-efficiency-and-conservation-block-grant-program

https://www.energy.gov/eere/funding/apply-eere-funding-opportunities

https://archive.epa.gov/greenbuilding/web/html/funding.html#general

Also, the Alaska Housing Finance Corporation (AHFC) and DOE have revolving loan funds that can be used for energy improvements.

https://www.ahfc.us/efficiency/non-residential-buildings/energy-efficiency-revolving-loan-fund-aeerlp/

https://www.energy.gov/savings/energy-efficiency-revolving-loan-fund-program

Finally, clean energy grant programs in Alaska can be found at:
http://programs.dsireusa.org/system/program?fromSir=0&state=AK

Appendix A
Site Photos

Tribal Office Building

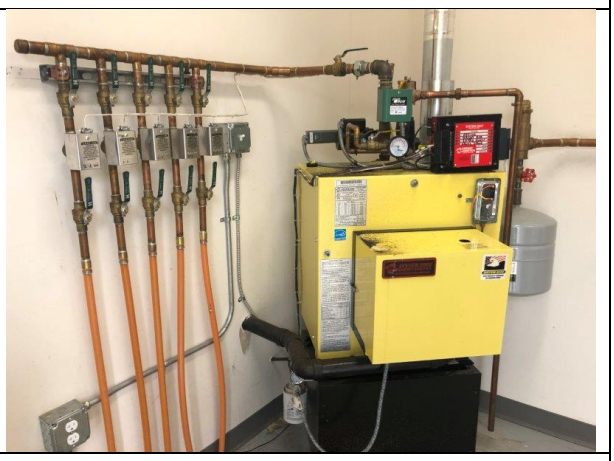
1. West Elevation of Building

2. South Elevation of Building

3. North Elevation of Building

4. East Elevation of Building

5. Fuel Storage

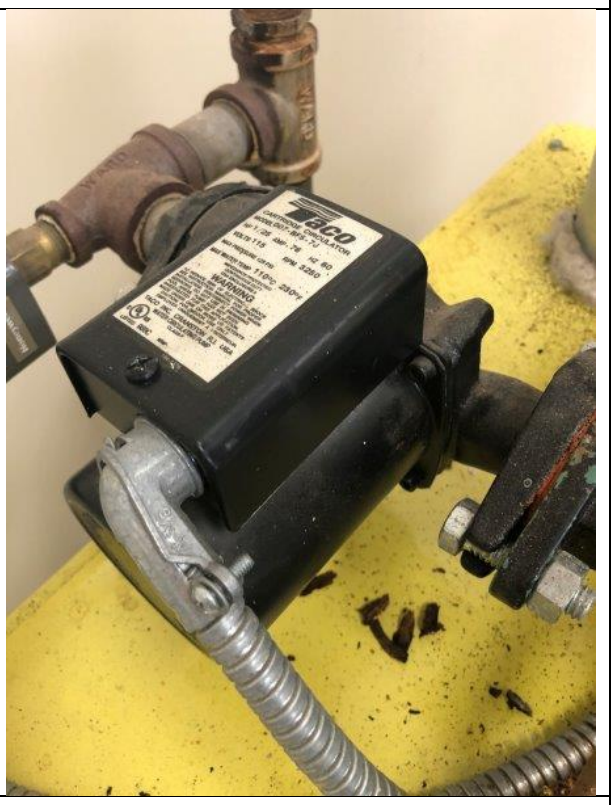


6. Boiler & Baseboard Heating Return

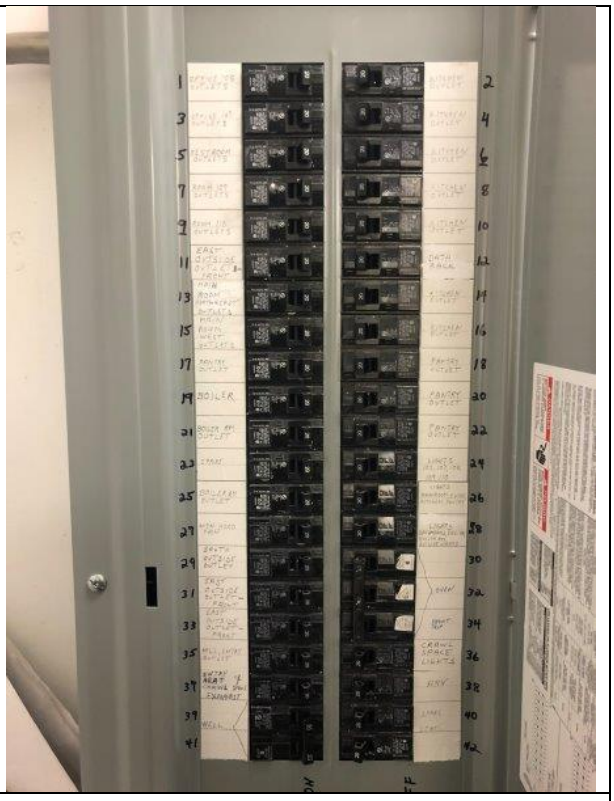
7. Boiler Burner

8. Hot Water Heater

9. Baseboard Heating Supply



10. Hydronic Pumps

	
11. Ventilation System	12. Electrical Panels

Clinic

13. North Elevation of Building

14. West Elevation of Building

15. South Elevation of Building

16. East Elevation of Building

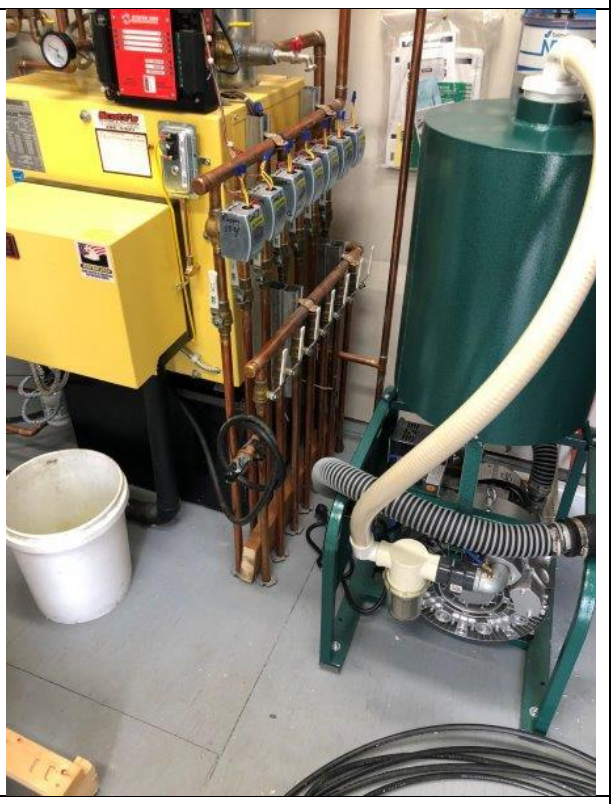
17. Fuel Storage

18. Boiler & Hot Water Heater

19. Heat Exchanger

20. Boiler Burner

21. Medical Central-Vac



22. Radiant Floor

23. HRV Ventilator

24. Electrical Panels

25. Main Electrical Disconnect

Existing Biomass System East End of Town

26. 7-yard chip bin

27. Portage & Main Chip Boiler

28. Thermal Storage Tank

29. Chip bin Controls

30. Chip Storage East end of Town	31. Chip Storage

Appendix B
Economic Analysis Spreadsheets

Mentasta Tribal Office and Clinic
Mentasta, Alaska

Economic Analysis Results	
Project Capital Cost	($313,000)
Present Value of Project Benefits (20-year life)	$412,661
Present Value of Operating Costs (20-year life)	($92,504)
Benefit / Cost Ratio of Project (20-year life)	1.02
Net Present Value (20-year life)	$7,158
Year Accumulated Cash Flow is Net Positive	First Year
Payback Period (Year Accumulated Cash Flow > Project Capital Cost)	20 years

Inflation Rates	
Discount Rate for Net Present Value Analysis	3%
Wood Fuel Escalation Rate	2%
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	$2.55		6,900	gal	**$17,595**	**$18,475**	**$19,398**	**$20,368**	**$21,387**	**$22,456**	**$23,579**	**$24,758**	**$25,996**	**$27,296**	**$28,660**	**$30,093**	**$31,598**	**$33,178**	**$34,837**	**$36,579**	**$38,408**	**$40,328**	**$42,344**	**$44,462**
Biomass System Operating Costs																								
Wood Chip Cost (Delivered)	$41.00	98%	76.0	tons	($3,116)	($3,178)	($3,242)	($3,307)	($3,373)	($3,440)	($3,509)	($3,579)	($3,651)	($3,724)	($3,798)	($3,874)	($3,952)	($4,031)	($4,111)	($4,194)	($4,278)	($4,363)	($4,450)	($4,539)
Fossil Fuel	$2.55	2%	70	gal	($179)	($187)	($197)	($207)	($217)	($228)	($239)	($251)	($264)	($277)	($291)	($305)	($321)	($337)	($353)	($371)	($390)	($409)	($430)	($451)
Additional Electricity	$0.37		500	kWh	($185)	($191)	($196)	($202)	($208)	($214)	($221)	($228)	($234)	($241)	($249)	($256)	($264)	($272)	($280)	($288)	($297)	($306)	($315)	($324)
Operation and Maintenance Costs					($1,500)	($1,530)	($1,561)	($1,592)	($1,624)	($1,656)	($1,689)	($1,723)	($1,757)	($1,793)	($1,828)	($1,865)	($1,902)	($1,940)	($1,979)	($2,019)	($2,059)	($2,100)	($2,142)	($2,185)
Additional Operation and Maintenance Costs for first 2 years					($1,500)	($1,530)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Costs					**($6,480)**	**($6,616)**	**($5,196)**	**($5,307)**	**($5,422)**	**($5,539)**	**($5,658)**	**($5,781)**	**($5,906)**	**($6,035)**	**($6,166)**	**($6,301)**	**($6,439)**	**($6,580)**	**($6,724)**	**($6,872)**	**($7,023)**	**($7,178)**	**($7,337)**	**($7,500)**
Annual Operating Cost Savings					$11,116	$11,858	$14,203	$15,061	$15,965	$16,917	$17,921	$18,977	$20,089	$21,261	$22,494	$23,793	$25,160	$26,598	$28,113	$29,707	$31,384	$33,150	$35,007	$36,962
Accumulated Cash Flow					$11,116	$22,974	$37,177	$52,238	$68,203	$85,121	$103,041	$122,018	$142,107	$163,368	$185,862	$209,655	$234,814	$261,413	$289,526	$319,233	$350,617	$383,767	$418,774	$455,736
Net Present Value					**($302,208)**	**($291,031)**	**($278,033)**	**($264,651)**	**($250,880)**	**($236,711)**	**($222,140)**	**($207,160)**	**($191,763)**	**($175,943)**	**($159,693)**	**($143,005)**	**($125,873)**	**($108,288)**	**($90,243)**	**($71,731)**	**($52,743)**	**($33,271)**	**($13,307)**	**$7,158**

Appendix C
AWEDTG Field Data Sheets

ALASKA WOOD ENERGY DEVELOPMENT TASK GROUP (AWEDTG)

PRE-FEASIBILITY ASSESSMENT FIELD DATA SHEET

APPLICANT:	Mentasta Traditional Council
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:	Anita Andrews
Mailing Address:	PO Box 6079
City:	Mentasta Lake
State: AK	**Zip Code:** 99780
Office phone: (907) 291-2319	**Cell phone:** ( )
Fax: (907)	
Email:	907m2v99780@gmail.com

Facility Identification/Name:	MENTASTA TRIBAL HEALTH CLINIC	
Facility Contact Person:	ANITA	
Facility Contact Telephone:	(907) 302 0735	( )
Facility Contact Email:	907m2v99780@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: Mentasta Tribal Health Clinic **)**

Type:	[X] Health Clinic [ ] Public Safety Bldg. [ ] Community Center	[ ] Water Plant [ ] Washeteria [ ] Public Housing	[ ] Multi-Purpose Bldg [ ] District Energy System [ ] Other (list):

Size of Facility (sq. ft. heated)	2500	Year built/age:	2018
Number of floors:	1	Year(s) renovated:	N/A
Number of bldgs.:	1	Next renovation:	N/A
Frequency of Usage:	UNOPENED	# of Occupants	5
Has an energy audit been conducted?	No	If Yes, when? *	

ANTICIPATED 8-2

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

HEATING SYSTEM INFORMATION

CONFIGURATION (check all that apply)

- ☒ 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)

glycol

- ☒ 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)

							Heating capacity (Btuh / kWh)	Annual Fuel Consumption	Cost
☒ Hot water boiler:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☒ #2 fuel oil		121,000 BTU/h	3,500 gal (Estimated)	$2.50/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)

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

x LINE Voltage thermostats

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

Energy Kinetics EK-1F SN: F1160816557 NB 37622

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

Fintube serves whole building, heated by boiler

Describe age and general condition of existing equipment:

construction finished 2018. Excellent condition

Who performs boiler maintenance? _____ Describe any current maintenance issues:

Bob - Council maintenance man

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

piping - crawlspace, HRV duct - thru attic

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

500 gal aboveground tank

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

N/A

DOMESTIC HOT WATER

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): ADJACENT TO BOILER

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

SAME AS PREVIOUS

BUILDING ENVELOPE

Wall type (stick frame, masonry, SIP, etc.): 6" stick frame and SIP Panel Insulation Value: R-21

Roof type: Shingle Cold roof with fiberglass batt insulation Insulation Value: R-51

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: Alaska Power & Telephone

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

Energy source: ☐ hydropower ☒ diesel generator(s) ☐ Other: _____

Electricity rate per kWh: $0.377 Demand charge: _____

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

Record MDP and electrical panel name plate information:

No MDP. EATON panel

WOOD FUEL INFORMATION

- Wood pellet cost delivered to facility $_____/ton Viable fuel source? Yes (No)
- Wood chip cost delivered to facility $ 65 /ton Viable fuel source? ~~Yes~~ No
- Cord wood cost delivered to facility $ 250 /cord Viable fuel source? ~~Yes~~ No
- Distance to nearest wood pellet and wood chip suppliers? Pellet - Fairbanks. Chip - Delta Junction
- 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: AHTNA, PRIVATE

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.)? No

What are local soil conditions? Permafrost issues? No
Classified fill

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

Can building accommodate a biomass boiler inside, or would an addition for a new boiler be necessary? Where would addition go?
ADDITION, SITE IS CLEAR.

Where would potential boiler plant or addition utilities (water/sewer/power/etc.) come from?
Well on-site. SEPTIC SYSTEM SERVES SITE. GRID POWER

If necessary, can piping be run underground from a central plant to the building? Where would piping enter boiler room?
Yes EXTERNAL WALLS - AMPLE SPACE

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? BRANCHING
For baseboard hydronic heat, what is the diameter of the copper tubing? Size of fins? Number of fins per lineal foot? 3/4", 3.5x3.5, 45
Any other energy using systems (kitchen equipment, lab equipment, pool etc)? Fuel or energy source? No
Any systems that could be added to the boiler system? No
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)

ALASKA WOOD ENERGY DEVELOPMENT TASK GROUP (AWEDTG)

PRE-FEASIBILITY ASSESSMENT FIELD DATA SHEET

APPLICANT:	MENTASTA TRADITIONAL COUNCIL
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:	ANITA ANDREWS
Mailing Address:	POBOX 6079
City:	Mentasta Lake
State: AK	**Zip Code:** 99 780
Office phone: (907) 291-2319	**Cell phone:** ( )
Fax: (907)	
Email:	907m2v99780ta@gmail.com

Facility Identification/Name:	MENTASTA TRADITIONAL COUNCIL	
Facility Contact Person:	ANITA ANDREWS	
Facility Contact Telephone:	(907) 302 0735	( )
Facility Contact Email:	907m2v99780ta@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: Mentasta Traditional Council **)**

Type:	[ ] Health Clinic [ ] Public Safety Bldg. [ ] Community Center	[ ] Water Plant [ ] Washeteria [ ] Public Housing	[ ] Multi-Purpose Bldg [ ] District Energy System [x] Other (list): Tribal Council Office

Size of Facility (sq. ft. heated)	2500	Year built/age:	2015
Number of floors:	1	Year(s) renovated:	N/A
Number of bldgs.:	1	Next renovation:	N/A
Frequency of Usage:	M-F 9-430	# of Occupants	7
Has an energy audit been conducted?	No	If Yes, when? *	

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

HEATING SYSTEM INFORMATION

CONFIGURATION (check all that apply)

- ☒ 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)

- ☒ 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)

							Heating capacity (Btuh / kWh)	Annual Fuel Consumption	Annual Fuel Cost
☒ Hot water boiler:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☒ #2 fuel oil		121,000 BTU/h	3,400 gal	$2.50/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)

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

x Line Voltage thermostats

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

Energy Kinetics EK-1F SN: F1100509417 6 NB#: 14116

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

Fintube serves whole building, heated by boiler

Describe age and general condition of existing equipment:

2015. Excellent Condition

Who performs boiler maintenance? _____ Describe any current maintenance issues:

Bob - Council Maintenance Man

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

piping - crawlspace. HRV Duct - thru attic

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

300 Gal AST

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

N/A

DOMESTIC HOT WATER

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): ADJACENT TO BOILER

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

BUILDING ENVELOPE

Wall type (stick frame, masonry, SIP, etc.): 6" stick frame and SIP panel. Insulation Value: R-21

Roof type: Cold roof with fiberglass batt insulation Insulation Value: R-51

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: Alaska Power & Telephone

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

Energy source: ☐ hydropower ☒ diesel generator(s) ☐ Other: _____

Electricity rate per kWh: $0.377 Demand charge: _____

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

Record MDP and electrical panel name plate information:

SIEMENS. No MDP

WOOD FUEL INFORMATION

- Wood pellet cost delivered to facility $_____/ton Viable fuel source? Yes (No)
- Wood chip cost delivered to facility $ 65 /ton Viable fuel source? (Yes) No
- Cord wood cost delivered to facility $ 250 /cord Viable fuel source? (Yes) No
- Distance to nearest wood pellet and wood chip suppliers? Pellet - Fairbanks. Chip - Delta Junction
- 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:
AHTNA, private allotments

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.)? No

What are local soil conditions? Permafrost issues? NO
Classified fill

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

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

Where would potential boiler plant or addition utilities (water/sewer/power/etc.) come from?
Well on site. SEPTIC SYSTEM SERVES SITE. GRID POWER

If necessary, can piping be run underground from a central plant to the building? Where would piping enter boiler room?
Yes External walls. Ample space.

OTHER INFORMATION

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Any systems that could be added to the boiler system? No
Are heating fuel records available?
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