



Haines Borough Final Biomass District Energy Design Package

April 23rd, 2019

SUBMITTED BY:

WISEWOOD ENERGY

735 N ALBERTA STREET • PORTLAND, OREGON • 97217

SUBMITTED TO:

BRAD RYAN, DIRECTOR OF PUBLIC FACILITIES
HAINES BOROUGH

FUNDED BY A GRANT FROM THE USDA FOREST SERVICE
AND THE ALASKA ENERGY AUTHORITY



MEMORANDUM

TO: Brad Ryan (Haines Borough)

FROM: Meagan Hartman (Wisewood Energy)

CC: Krista Kielsmeier (Haines Borough), Andrew Haden (Wisewood Energy)

DATE: April 23, 2019

RE: Final biomass district energy design package summary

Wisewood Energy was retained by the Haines Borough to provide the detailed design and engineering of a biomass district energy system that can utilize locally available wood chip fuel from the Haines State Forest. This summary memo and supporting documentation constitutes the final design package, and builds upon the 95% design review memo submitted on February 7, 2019. This final package includes:

1. Final energy model, operating and capital cost opinions for Add Alternate development scenarios, and financial pro forma for Add Alternate development scenarios, included as attachments to this memo;
2. Stamped Mechanical (M0.0 – M11.0), Electrical (E0.1 – E4.0), Structural (S0.01 – S8.02), and Civil (C1.00 – C1.05) design and engineering drawing sets for the biomass district energy system, provided as a separate file;
3. Stamped structural calculations, provided as a separate file;
4. Mechanical specifications, provided as a separate file; and
5. Haines Biomass Site Assessment, submitted previously and included as a separate file.

The proposed biomass district energy system is designed to provide heat to the Haines School and Pool, Administration Building, Library, Vocational Education building (Voc-Ed), Garage, and future Greenhouse; however, these individual connections may be completed at different times with minimal impact to the operations of the system. In consultation with the Borough, the Pool and School have been identified as the Baseline development scenario, the Library and Administration building as Add Alternate One, and the Voc-Ed building and Garage as Add Alternate Two. Costs to connect to the future Greenhouse are not included in capital cost opinions because no site has been identified; however, the future Greenhouse is included in the operating cost opinion for the full system buildout.

Biomass System Design

Based on the Borough's goals to contribute to the local economy and leverage an underutilized, locally available resource, a single 1,700-MBH (500 kW) Fröling TM 500 wood chip boiler has been selected for the system. The biomass boiler is designed to provide approximately 88% of the identified buildings' heating needs at full system buildout, with existing oil boilers at each building providing the remaining load during peak and/or trim use and to serve as system backup (see Attachment 1 for the full buildout energy model). The Fröling boiler is capable of cleanly and efficiently utilizing wood chips with up to 45% moisture content, sufficient to handle material produced from the local Haines State Forest that has been passively dried. A fuel storage bay with a walking floor and hydraulic ram infeed will enable the system to effectively handle coarse wood chips with up to a four-inch particle size.

Financial Analysis

Updated operating costs have been provided for the Baseline development scenario of the School and Pool, Baseline with Add Alternate One, and full system buildout with both Add Alternates and the future Greenhouse included (see Attachments 2-4). Although each development scenario has different capital and operating cost estimates, their projected annual savings against business-as-usual operations are comparable: \$46,000, \$45,000, and \$47,000, respectively. See Table 1 below for a side-by-side comparison of savings and other relevant metrics.

Approximately \$70,000 – 90,000 of the annual estimated biomass operating costs is allocated to wood fuel material and fuel handling and delivery, with another \$10,000 – 15,000 for ash disposal and scheduled maintenance (depending on the development scenario); should these services be provided by local contractors, approximately 73 – 77% of the total operating costs could be retained in the local economy across the proposed development scenarios. Fuel handling costs in all scenarios assume that fuel is transported from a secondary storage site to the district energy facility using small (10-yard) trucks; these costs can be significantly reduced or eliminated if either a larger truck is identified and/or a fuel provider is able to consistently deliver material directly to the district energy facility's fuel storage bay (with capacity for approximately 30 tons assuming 45% moisture content). Finally, it should be noted that estimated annual savings have increased since the 95% design memo due to a previously undetected calculation error used to estimate existing fuel costs.

The capital cost opinion for the district energy facility has also been updated and divided to reflect each Add Alternate scenario. Wisewood Energy estimates capital costs at the line item level and uses a standard method of assigning risk factors based on the certainty level of the source of the estimate (such as a vendor's quote versus an engineering estimate). See Attachments 5-7 for the detailed cost opinions of the Baseline scenario,

Add Alternate One additional costs, and Add Alternate Two additional costs; see Table 1 below for a summary comparison. Notably, estimated project costs have been reduced since the 95% design memo due to updated lower PEX piping prices.

Based on the projected capital and operational costs for each of the project’s buildout scenarios, potential payback period scenarios were calculated. The simple payback is calculated assuming the projected savings in Year One operations are the same in subsequent years, without accounting for potential price escalators over the life of the system. The accelerated payback is derived from cumulative project savings that incorporate projected price escalators of 4% for fossil fuels and 2% for electricity, wood fuel, and labor costs. Finally, Wisewood Energy understands that the Borough has approximately \$1 million available in grant funding to construct the biomass project, which was also included in payback calculations.

Both simple and accelerated payback calculations are summarized in Table 1 below for each development scenario, assuming the \$1 million grant is applied to system construction. See Attachments 8-10 for each development scenario’s pro forma, including payback calculations that do not reflect use of the grant.

TABLE 1 Estimated displaced fuel oil, annual savings, capital costs, and payback periods for each development scenario. The capital cost opinion range reflects a total project cost and a risk-adjusted total project cost.

DEVELOPMENT SCENARIO	BASELINE	BASELINE + ADD ALTERNATE 1	FULL BUILDOUT*
Displaced Oil (gal/yr)	32,800	35,200	40,500
Annual Savings	\$46,000	\$45,000	\$47,000
Capital Cost Opinion	\$1.88 – 2.14 M	\$2.3 – 2.61 M	\$2.56 – 2.91 M
Simple Payback** (yrs)	25	36	40
Accelerated Payback** (yrs)	15	19	20

*Estimated fuel oil displacement and savings for the Full Buildout scenario include the future greenhouse; however, capital costs for connecting the greenhouse are not included in the capital cost opinion.

**Simple and accelerated paybacks assume \$1 million in grant funding is used for construction.

Conclusions

Wisewood Energy is pleased to offer this completed design package to support the Borough’s innovative efforts toward energy independence and economic development. We believe that with the estimated annual savings, potential to retain a large portion of operating costs within the local community, existing grant funding, and high capacity of

Borough staff and community members, the proposed biomass district energy system offers a promising opportunity for the Haines community.

We anticipate scheduling a close-out call to review the final design, respond to any questions the Borough might have, and discuss potential next steps for implementation. In the meantime, Wisewood Energy is available for questions or comments on this final design package.

Attachment 1

**Final Energy Model:
Full Buildout**

Haines Borough Biomass District Energy

Proposed System Analysis - Full Buildout

WISEWOOD ENERGY

Location Haines, AK
Client Contact Brad Ryan
Date 4/19/19

Proposed System Biomass District Energy
Proposed System Output (MBH) 1,706
Proposed System Fuel Type Forestry Residuals

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewoodenergy.com

Fuel Prices		Conversion Factors		Current System Consumption	
Heating oil cost [\$ / gal]	\$3.17	Energy of heating oil [Btu / gal]	139,000	Heating oil use [gal / yr]	46,206
Propane cost [\$ / gal]	\$2.00	Energy of propane [Btu / gal]	92,000	Heating oil cost [\$ / yr]	\$148,344
Electricity demand cost [\$ / kWh]	\$0.00	Energy per kWh [Btu / kWh]	3,412	Propane use [gal / yr]	0
Electricity cost [\$ / kWh]	\$0.21	Moisture of biomass [% MC WB]	45%	Propane cost [\$ / yr]	\$0
Biomass fuel cost [\$ / ton]	\$90.00	Energy of bone dry wood [Btu / ton]	16,400,000	Heating electricity use [kWh / yr]*	164,432
		Energy of actual biomass [Btu / ton]	8,146,640	Heating electricity cost [\$ / yr]	\$34,477
				Total energy input [MMBtu / yr]	6,984

Proposed Biomass Boiler Specifications		Proposed Trim Boiler Specifications		Proposed System Values	
Fuel type	Forestry Residuals	Fuel type	Oil	Total load carried by wood	87.8%
Boiler output, high-fire [MBH]	1,706	Boiler output, high-fire [MBH]	2,500	Operating hours per year	4,302
Boiler output, low-fire* [MBH]	341	Boiler output, low-fire [MBH]	500	Biomass boiler output [% of peak]	57%
Max. electrical demand [kW]	15.4	Max. electrical demand [kW]	0.8		
Average electrical demand [kW]	10.2	Average electrical demand [kW]	0.39		
Boiler efficiency	85%	Boiler efficiency	85%		

Proposed Biomass Boiler Consumption and Cost		Proposed Trim Boiler Consumption and Cost		Proposed Totals	
Wood fuel consumption [tons / yr]	702	Oil consumption [gal / yr]	5,719	Total fuel consumption [MMBtu / yr]	6,243
Wood fuel cost [\$ / yr]	\$63,158	Oil cost [\$ / yr]	\$18,148	Total fuel cost [\$ / yr]	\$81,306
Electrical consumption [kWh / yr]	43,840	Electrical consumption [kWh / yr]	1,680	Total electrical consumption [kWh / yr]	45,519
Electrical energy cost [\$ / yr]	\$9,377	Electrical use charge [\$ / yr]	\$359	Total electrical use charge [\$ / yr]	\$9,736
Electrical demand charge [\$ / yr]	\$0	Electrical demand charge [\$ / yr]	\$0	Total electrical demand charge [\$ / yr]	\$0

Month	Heating Degree Days [HDD]	Current gross fossil energy consumption [MMBtu]	Current net space heat energy input [MMBtu]	Projected biomass boiler gross energy consumption [MMBtu]	Projected trim boiler energy consumption [MMBtu]	Projected wood fuel use [tons]
September	124	285	243	251	35	30.9
October	469	509	437	451	63	55.4
November	594	727	622	643	89	78.9
December	1,017	980	841	869	121	106.7
January	874	913	783	808	112	99.2
February	747	805	690	713	99	87.5
March	939	824	708	731	102	89.8
April	320	485	414	428	60	52.5
May	172	327	279	288	40	35.4
June	68	213	181	187	26	23.0
July	20	188	160	165	23	20.2
August	34	208	177	183	25	22.5
Yearly Total	5,377	6,463	5,535	5,717	795	702

* Low-fire output includes the use of a thermal storage to increase effective boiler turndown

Net fossil energy savings [MMBtu / yr] 5,668

Haines Borough Biomass District Energy

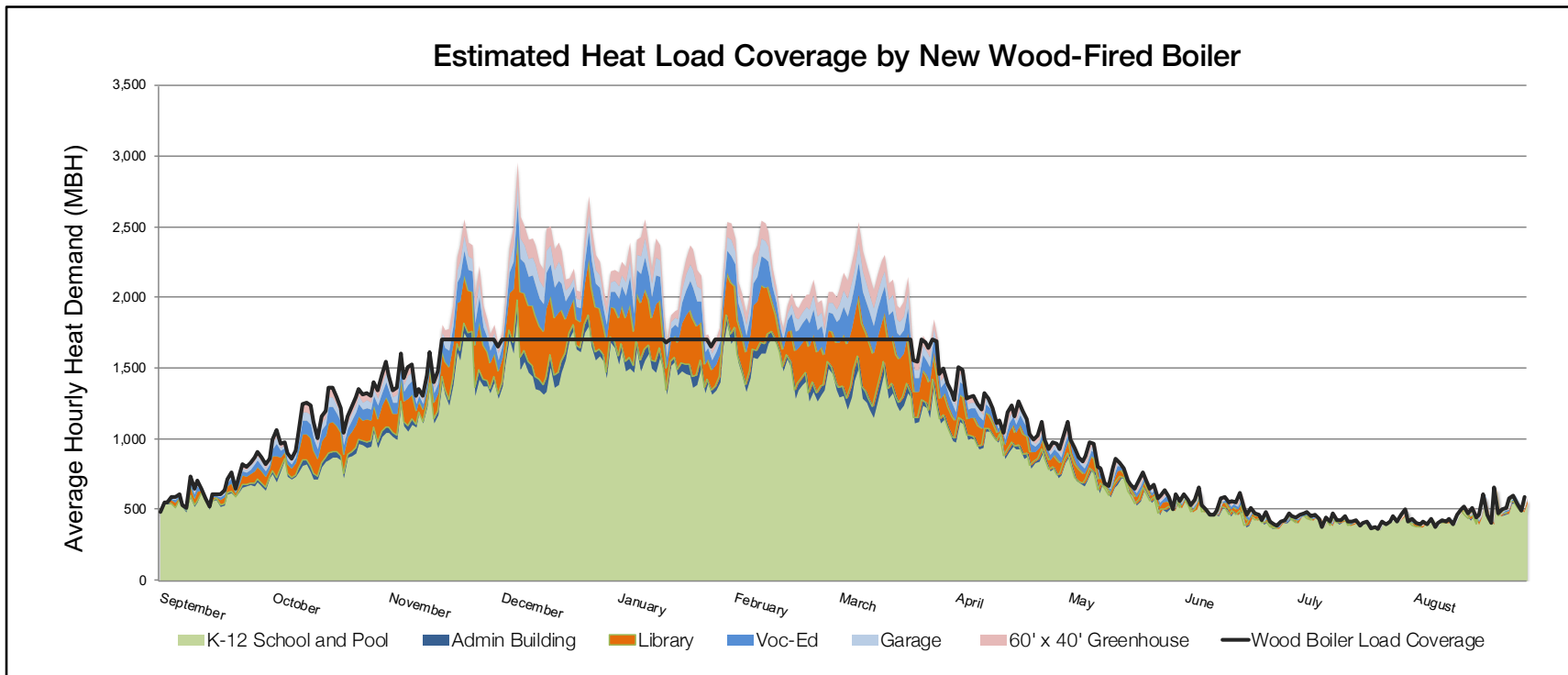
Proposed System Analysis - Full Buildout

WISEWOOD ENERGY

Location Haines, AK
Client Contact Brad Ryan
Date 4/19/19

Proposed System Biomass District Energy
Proposed System Output (MBH) 1,706
Proposed System Fuel Type Forestry Residuals

Contact Andrew Haden
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Haines Borough Biomass District Energy

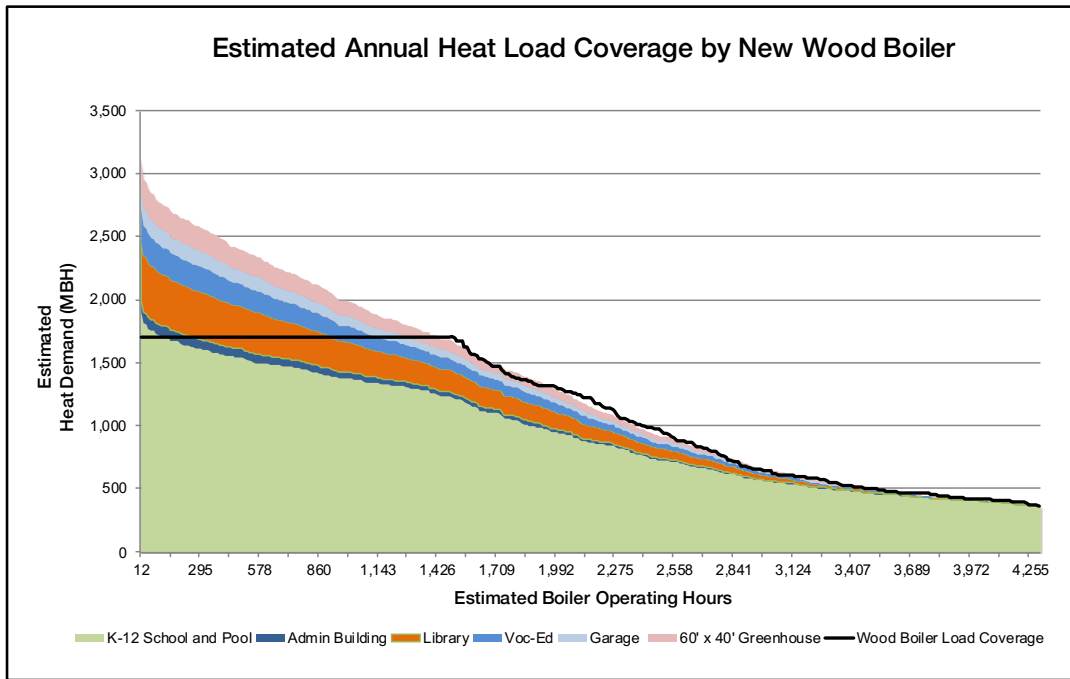
Proposed System Analysis - Full Buildout

Location Haines, AK
Client Contact Brad Ryan
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Proposed System Biomass District Energy
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Boiler Output [MBH]	Fossil Fuel Displaced
250	19.5%
500	38.0%
750	51.9%
1,000	63.7%
1,250	73.8%
1,500	82.0%
1,750	88.9%
2,000	93.6%
2,250	94.6%
2,500	93.7%
2,750	92.0%
3,000	89.9%
3,250	88.0%
3,500	86.9%
3,750	86.0%
4,000	85.0%
4,250	83.8%
4,500	82.5%
4,750	81.3%
5,000	79.2%
5,250	77.6%
5,500	77.4%
5,750	76.0%
6,000	75.0%
6,250	72.6%
6,500	70.4%
6,750	67.3%
7,000	65.6%
7,250	64.4%
7,500	62.8%
7,750	61.2%
8,000	60.5%
8,250	59.5%
8,500	57.7%

Attachment 2

**Operating Cost Opinion:
Baseline (Pool and School)**

Haines Borough Biomass District Energy

Operating Cost Opinion - Baseline (School & Pool)



Location Haines, AK
Client Contact Brad Ryan
Date 4/19/19

Proposed System Biomass District Energy
Proposed System Output (MBH) 1,706
Proposed System Fuel Type Forestry Residuals

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewoodenergy.com

Item	Total
Existing Fossil Fuel System Operating Cost	
Heating Oil	
Current oil consumption	35,042 gallons per year
Current heating oil cost	\$ 3.23 per gallon
Subtotal:	\$ 113,082
Electricity	
Current electricity for heating consumption	152,640 kWh per year
Electricity cost	\$ 0.21 per kWh
Subtotal:	\$ 32,238
Maintenance	
Maintenance labor	\$ 5,000 per year
Maintenance parts	\$ 3,000 per year
Subtotal:	\$ 8,000
Existing Fossil Fuel System Cost, Total	
	\$ 153,320
Proposed Biomass Energy System Operating Cost	
Wood Fuel Delivered to Secondary Storage	
Wood use	560 tons per year
Wood fuel cost	\$ 90 per ton
Subtotal:	\$ 50,361
Wood Fuel Handling & Delivery¹	
Handling and transportation	560 tons per year
Delivery container size	3 tons per load
Fuel deliveries needed	194 loads per year
Fuel handling labor rate	\$ 150 per hour
Labor for delivery	0.75 hours per delivery
Subtotal:	\$ 21,816
Ash Disposal	
Primary boiler ash bin removal	26 intervals
Labor rate	\$ 45 per hour
Labor hours for primary ash bin removal	0.5 per interval
Labor for primary ash bin removal	\$ 23 per interval
Secondary ash dumpster removal	28 intervals
Secondary dumpster disposal fee	\$ 166 per interval
Secondary dumpster rental fee	\$ 21 per month
Subtotal:	\$ 5,440
Electricity to Run Boiler	
Total electrical consumption	38,680 kWh
Total electrical use charge	\$ 8,218 per year
Total electrical demand charge	\$ - per year
Subtotal:	\$ 8,218
Trim Fuel - Heating Oil	
Heating oil use (peak and low load)	2,247 gallons
Heating oil cost	\$ 3.23 per gallon
Subtotal:	\$ 7,250
New Biomass System Operations Cost, Total	
	\$ 93,085

Scheduled Maintenance		
Weekly and monthly boiler checklist		9 months
Labor rate	\$	45 per hour
Monthly labor hours		10 per month
Monthly labor cost	\$	450 per month
Boiler water treatment	\$	50 per month
Annual boiler cleaning	\$	720 per year
		Subtotal: \$ 5,220
Remote Monitoring ²		
Static IP and Internet connection	\$	60 per month
Third party remote monitoring	\$	5,000 per year
		Subtotal: \$ 5,720
Administration		
Insurance ³		0.15% of Project Cost
		Subtotal: \$ 3,213
New Biomass System Maintenance Costs, Total		\$ 14,153
New Biomass System Cost, Total		\$ 107,237

The Operating Cost Opinion budget shown above does not account for potential fuel procurement management costs

Notes

- 1: Fuel handling assumes wood fuel is transported from a secondary storage site to the boiler site for an additional cost, and may be avoided if fuel can be consistently delivered directly to the boiler site
- 2: Remote monitoring services are available from Wisewood Energy as an optional recommended service; costs are estimated
- 3: Insurance is estimated based on other biomass district energy projects and should be confirmed with the Client's insurer

Attachment 3

**Operating Cost Opinion:
Baseline and Add Alternate One
(Pool, School, Admin, and Library)**

Haines Borough Biomass District Energy



Operating Cost Opinion - Baseline & Add Alternate One (Pool, School, Admin, Library)

Location Haines, AK
Client Contact Brad Ryan
Date 4/19/19

Proposed System Biomass District Energy
Proposed System Output (MBH) 1,706
Proposed System Fuel Type Forestry Residuals

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewoodenergy.com

Item	Total
Existing Fossil Fuel System Operating Cost	
Heating Oil	
Current oil consumption	40,067 gallons per year
Current heating oil cost	\$ 3.26 per gallon
Subtotal:	\$ 129,653
Electricity	
Current electricity for heating consumption	164,115 kWh per year
Electricity cost	\$ 0.21 per kWh
Subtotal:	\$ 34,406
Maintenance	
Maintenance labor	\$ 5,000 per year
Maintenance parts	\$ 3,000 per year
Subtotal:	\$ 8,000
Existing Fossil Fuel System Cost, Total	
	\$ 172,059
Proposed Biomass Energy System Operating Cost	
Wood Fuel Delivered to Secondary Storage	
Wood use	604 tons per year
Wood fuel cost	\$ 90 per ton
Subtotal:	\$ 54,403
Wood Fuel Handling & Delivery¹	
Handling and transportation	604 tons per year
Delivery container size	3 tons per load
Fuel deliveries needed	209 loads per year
Fuel handling labor rate	\$ 150 per hour
Labor for delivery	0.75 hours per delivery
Subtotal:	\$ 23,566
Ash Disposal	
Primary boiler ash bin removal	28 intervals
Labor rate	\$ 45 per hour
Labor hours for primary ash bin removal	0.5 per interval
Labor for primary ash bin removal	\$ 23 per interval
Secondary ash dumpster removal	28 intervals
Secondary dumpster disposal fee	\$ 166 per interval
Secondary dumpster rental fee	\$ 21 per month
Subtotal:	\$ 5,486
Electricity to Run Boiler	
Total electrical consumption	39,544 kWh
Total electrical use charge	\$ 9,083 per year
Total electrical demand charge	\$ - per year
Subtotal:	\$ 9,083
Trim Fuel - Heating Oil (Used At Each Building)	
Heating oil use (peak and low load)	4,921 gallons
Heating oil cost	\$ 3.26 per gallon
Subtotal:	\$ 16,042
New Biomass System Operations Cost, Total	
	\$ 108,579

Scheduled Maintenance		
Weekly and monthly boiler checklist		9 months
Labor rate	\$	45 per hour
Monthly labor hours		20 per month
Monthly labor cost	\$	913 per month
Boiler water treatment	\$	50 per month
Annual boiler cleaning	\$	720 per year
		Subtotal: \$ 9,383
Remote Monitoring ²		
Static IP and Internet connection	\$	60 per month
Third party remote monitoring	\$	5,000 per year
		Subtotal: \$ 5,720
Administration		
Insurance ³		0.15% of Project Cost
		Subtotal: \$ 3,912
New Biomass System Maintenance Costs, Total		\$ 19,015
New Biomass System Cost, Total		\$ 127,594

The Operating Cost Opinion budget shown above does not account for potential fuel procurement management costs

Notes

- 1: Fuel handling assumes wood fuel is transported from a secondary storage site to the boiler site for an additional cost, and may be avoided if fuel can be consistently delivered directly to the boiler site
- 2: Remote monitoring services are available from Wisewood Energy as an optional recommended service; costs are estimated
- 3: Insurance is estimated based on other biomass district energy projects and should be confirmed with the Client's insurer

Attachment 4

**Operating Cost Opinion:
Full Buildout**

Haines Borough Biomass District Energy

Operating Cost Opinion - Full Buildout



Location Haines, AK
Client Contact Brad Ryan
Date 4/19/19

Proposed System Biomass District Energy
Proposed System Output (MBH) 1,706
Proposed System Fuel Type Forestry Residuals

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewoodenergy.com

Item	Total
Existing Fossil Fuel System Operating Cost	
Heating Oil	
Current oil consumption	46,206 gallons per year
Current heating oil cost	\$ 3.17 per gallon
Subtotal:	\$ 148,344
Electricity	
Current electricity for heating consumption	164,432 kWh per year
Electricity cost	\$ 0.21 per kWh
Subtotal:	\$ 34,477
Maintenance	
Maintenance labor	\$ 5,000 per year
Maintenance parts	\$ 3,000 per year
Subtotal:	\$ 8,000
Existing Fossil Fuel System Cost, Total	
	\$ 190,821
Proposed Biomass Energy System Operating Cost	
Wood Fuel Delivered to Secondary Storage	
Wood use	702 tons per year
Wood fuel cost	\$ 90 per ton
Subtotal:	\$ 63,158
Wood Fuel Handling & Delivery¹	
Handling and transportation	702 tons per year
Delivery container size	3 tons per load
Fuel deliveries needed	243 loads per year
Fuel handling labor rate	\$ 150 per hour
Labor for delivery	0.75 hours per delivery
Subtotal:	\$ 27,359
Ash Disposal	
Primary boiler ash bin removal	32 intervals
Labor rate	\$ 45 per hour
Labor hours for primary ash bin removal	0.5 per interval
Labor for primary ash bin removal	\$ 23 per interval
Secondary ash dumpster removal	28 intervals
Secondary dumpster disposal fee	\$ 166 per interval
Secondary dumpster rental fee	\$ 21 per month
Subtotal:	\$ 5,587
Electricity to Run Boiler	
Total electrical consumption	45,519 kWh
Total electrical use charge	\$ 9,736 per year
Total electrical demand charge	\$ - per year
Subtotal:	\$ 9,736
Trim Fuel - Heating Oil (Used At Each Building)	
Heating oil use (peak and low load)	5,719 gallons
Heating oil cost	\$ 3.17 per gallon
Subtotal:	\$ 18,148
New Biomass System Operations Cost, Total	
	\$ 123,988

Scheduled Maintenance		
Weekly and monthly boiler checklist		9 months
Labor rate	\$	45 per hour
Monthly labor hours		20 per month
Monthly labor cost	\$	913 per month
Boiler water treatment	\$	50 per month
Annual boiler cleaning	\$	720 per year
		Subtotal: \$ 9,383
Remote Monitoring ²		
Static IP and Internet connection	\$	60 per month
Third party remote monitoring	\$	5,000 per year
		Subtotal: \$ 5,720
Administration		
Insurance ³		0.15% of Project Cost
		Subtotal: \$ 4,368
New Biomass System Maintenance Costs, Total		\$ 19,471
New Biomass System Cost, Total		\$ 143,459

The Operating Cost Opinion budget shown above does not account for potential fuel procurement management costs

Notes

- 1: Fuel handling assumes wood fuel is transported from a secondary storage site to the boiler site for an additional cost, and may be avoided if fuel can be consistently delivered directly to the boiler site
- 2: Remote monitoring services are available from Wisewood Energy as an optional recommended service; costs are estimated
- 3: Insurance is estimated based on other biomass district energy projects and should be confirmed with the Client's insurer

Attachment 5

**Capital Cost Opinion:
Baseline (Pool and School)**

Haines Borough Biomass District Energy
Capital Cost Opinion - Baseline (Pool & School)



Location Haines, AK
Client Contact Brad Ryan
Date 4/19/19

Proposed System Biomass District Energy
Proposed System Output (MBH) 1706
Proposed System Fuel Type Forestry Residuals

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewoodenergy.com

WBS	ITEM	DESCRIPTION	ID	UNIT	UNIT COST	UNIT QTY	LABOR HOURS	LABOR COST	MATLS COST	ITEM COST	% DIRECT	% TOTAL
TOTAL PROJECT COST							2,029	\$ 252,345	\$ 679,815	\$ 1,878,139	-	100.0%
TOTAL - DIRECT CONSTRUCTION							2,029	\$ 252,345	\$ 679,815	\$ 1,310,276	100.0%	69.8%
010	DEVELOPMENT									\$ 4,500	0.3%	0.2%
011	Permits									\$ 4,500	0.3%	0.2%
	1	Fire Marshal review		EA	\$ 4,500	1				\$ 4,500	0.3%	0.2%
020	CIVIL						32	\$ 2,720	\$ 2,400	\$ 36,620	2.8%	1.9%
	2	Site Prep		EA	\$ 600	4	32	\$ 2,720	\$ 2,400	\$ 5,120	0.4%	0.3%
	3	Excavation		CY	\$ 105	300	Included			\$ 31,500	2.4%	1.7%
030	STRUCTURAL						0	\$ -	\$ -	\$ 276,667	21.1%	14.7%
	4	Concrete Foundation		CY	\$ 600	111	Included	\$ -	\$ -	\$ 66,667	5.1%	3.5%
	5	Boiler Building (Pre-engineered Steel)		SF	\$ 105	2,000	Included	\$ -	\$ -	\$ 210,000	16.0%	11.2%
040	MECHANICAL¹						1,697	\$ 212,125	\$ 642,415	\$ 854,540	65.2%	45.5%
041	Fuel Storage and Conveyance						380	\$ 47,500	\$ 65,000	\$ 112,500	8.6%	6.0%
	6	Hydraulics Power Unit (HPU)		EA	\$ 10,000	1	60	\$ 7,500	\$ 10,000	\$ 17,500	1.3%	0.9%
	7	Scraper Floor		EA	\$ 30,000	1	240	\$ 30,000	\$ 30,000	\$ 60,000	4.6%	3.2%
	8	Drag Chain Conveyer		EA	\$ 25,000	1	80	\$ 10,000	\$ 25,000	\$ 35,000	2.7%	1.9%
042	Biomass Boiler						496	\$ 62,000	\$ 249,050	\$ 311,050	23.7%	16.6%
	9	Wood-Fired Boiler		EA	\$ 225,500	1	360	\$ 45,000	\$ 225,500	\$ 270,500	20.6%	14.4%
	10	Breeching and Stack		EA	\$ 250	50	40	\$ 5,000	\$ 12,500	\$ 17,500	1.3%	0.9%
	11	Flue collar adapter		EA	\$ 250	1	8	\$ 1,000	\$ 250	\$ 1,250	0.1%	0.1%
	12	Boiler Trim Package		EA	\$ 1,800	1	40	\$ 5,000	\$ 1,800	\$ 6,800	0.5%	0.4%
	13	Controls		EA	\$ 8,000	1	40	\$ 5,000	\$ 8,000	\$ 13,000	1.0%	0.7%
	14	Computer cabinet Monitor Keyboard		EA	\$ 1,000	1	8	\$ 1,000	\$ 1,000	\$ 2,000	0.2%	0.1%
043	Hydronic Equipment - DE Plant						360	\$ 45,000	\$ 46,310	\$ 91,310	7.0%	4.9%
	15	Pumps P-01-02		EA	\$ 3,449	2	40	\$ 5,000	\$ 6,898	\$ 11,898	0.9%	0.6%
	16	Pumps P-03-04		EA	\$ 403	2	40	\$ 5,000	\$ 806	\$ 5,806	0.4%	0.3%
	17	Pumps P-05-06		EA	\$ 2,497	2	40	\$ 5,000	\$ 4,994	\$ 9,994	0.8%	0.5%
	18	Pumps P-07-08		EA	\$ 5,090	2	40	\$ 5,000	\$ 10,180	\$ 15,180	1.2%	0.8%
	19	Pumps, P-19		EA	\$ 915	1	16	\$ 2,000	\$ 915	\$ 2,915	0.2%	0.2%
	20	Tank, Heating Water Buffer Refurbishment		EA	\$ -	0	32	\$ 4,000	\$ -	\$ 4,000	0.3%	0.2%
	21	Tank, Boiler Loop Expansion		EA	\$ 5,000	1	16	\$ 2,000	\$ 5,000	\$ 7,000	0.5%	0.4%
	22	Air Separator, Boiler Loop		EA	\$ 2,000	1	16	\$ 2,000	\$ 2,000	\$ 4,000	0.3%	0.2%
	23	Chemical Dosing System		EA	\$ 2,597	1	32	\$ 4,000	\$ 2,597	\$ 6,597	0.5%	0.4%
	24	Unit Heater		EA	\$ 1,400	1	16	\$ 2,000	\$ 1,400	\$ 3,400	0.3%	0.2%
	25	Utilities (Water and Drain)		FT	\$ 285	8	40	\$ 5,000	\$ 2,280	\$ 7,280	0.6%	0.4%
	26	Pipe and Duct Insulation		FT	\$ 55	168	32	\$ 4,000	\$ 9,240	\$ 13,240	1.0%	0.7%
044	Hydronic Equipment - School and Pool						461	\$ 57,625	\$ 282,055	\$ 339,680	25.9%	18.1%
	27	Heat Exchanger		EA	\$ 6,800	1	65	\$ 8,125	\$ 6,800	\$ 14,925	1.1%	0.8%
	28	Valves and Trim		EA	\$ 1,000	2	16	\$ 2,000	\$ 2,000	\$ 4,000	0.3%	0.2%
	29	BTU Meter		EA	\$ 2,900	1	24	\$ 3,000	\$ 2,900	\$ 5,900	0.5%	0.3%
	30	DDC Controls		EA	\$ 5,000	1	16	\$ 2,000	\$ 5,000	\$ 7,000	0.5%	0.4%
	31	Pumps P-13-14		EA	\$ 2,697	2	40	\$ 5,000	\$ 5,394	\$ 10,394	0.8%	0.6%
	32	Zone Thermostats		EA	\$ 500	2	12	\$ 1,500	\$ 1,000	\$ 2,500	0.2%	0.1%
	33	Dirt and Air Separator		EA	\$ 3,000	3	12	\$ 1,500	\$ 9,000	\$ 10,500	0.8%	0.6%
	34	Steel Piping, 2.5"		FT	\$ 30	168	80	\$ 10,000	\$ 5,040	\$ 15,040	1.1%	0.8%
	35	Steel Piping, 4"		FT	\$ 38	100	40	\$ 5,000	\$ 3,800	\$ 8,800	0.7%	0.5%
	36	Fittings, 2.5"		EA	\$ 150	16	16	\$ 2,000	\$ 2,400	\$ 4,400	0.3%	0.2%
	37	Fittings, 4"		EA	\$ 315	16	16	\$ 2,000	\$ 5,040	\$ 7,040	0.5%	0.4%
	38	Valves, 4"		FT	\$ 1,479	8	8	\$ 1,000	\$ 11,832	\$ 12,832	1.0%	0.7%
	39	Butterfly Valves, 4"		EA	\$ 300	4	32	\$ 4,000	\$ 1,200	\$ 5,200	0.4%	0.3%
	40	Dual-Line PEX 5" to High School		FT	\$ 44	1,652	40	\$ 5,000	\$ 72,275	\$ 77,275	5.9%	4.1%
	41	Dual-Line PEX Fittings 5" to High School		EA	\$ 539	10	12	\$ 1,500	\$ 5,393	\$ 6,893	0.5%	0.4%
	42	2" PVC Conduit to High School		FT	\$ 3	826	32	\$ 4,000	\$ 2,561	\$ 6,561	0.5%	0.3%
	43	Trenching and Backfilling		LF	\$ 85	1,652	Included	\$ -	\$ 140,420	\$ 140,420	10.7%	7.5%
050	ELECTRICAL						300	\$ 37,500	\$ 35,000	\$ 72,500	5.5%	3.9%
	44	Control wiring				150	\$ 18,750	\$ 10,000	\$ 28,750	2.2%	1.5%	
	45	Power distribution and meter connection ²				150	\$ 18,750	\$ 25,000	\$ 43,750	3.3%	2.3%	
060	PLUMBING						0	\$ -	\$ -	\$ -	0.0%	0.0%
	46	Sewer connections (by Haines Borough)				0			\$ -	\$ -	0.0%	0.0%
070	MISCELLANEOUS									\$ 65,450	5.0%	3.5%
071	Logistics									\$ 55,450	4.2%	3.0%
	47	Freight to project site		EA	\$ 50,000	1				\$ 50,000	3.8%	2.7%
	48	Equipment Rental Boom Lift 40 Ft		MO	\$ 1,950	1				\$ 1,950	0.1%	0.1%
	49	Equipment Rental Forklift 10k		MO	\$ 3,500	1				\$ 3,500	0.3%	0.2%
072	Inspections									\$ 10,000	0.8%	0.5%
	50	Third party inspections		EA	\$ 5,000	2				\$ 10,000	0.8%	0.5%

WBS	ITEM	DESCRIPTION	ID	UNIT	UNIT COST	UNIT QTY	LABOR HOURS	LABOR COST	MATLS COST	ITEM COST	% DIRECT	% TOTAL
TOTAL - INDIRECT CONSTRUCTION										\$ 567,863	43.3%	30.2%
80	DESIGN & ENGINEERING											
1	Civil engineering	0.50%								\$ 19,654	1.5%	1.0%
										\$ 6,551	0.5%	0.3%
2	Structural engineering	0.25%								\$ 3,276	0.3%	0.2%
3	Mechanical engineering	0.50%								\$ 6,551	0.5%	0.3%
4	Electrical engineering	0.25%								\$ 3,276	0.3%	0.2%
90	GENERAL CONTRACTOR											
5	Overhead	5%								\$ 196,541	15.0%	10.5%
										\$ 65,514	5.0%	3.5%
6	Profit	10%								\$ 131,028	10.0%	7.0%
100	CONSTRUCTION ADMINISTRATION											
7	Construction administration	4%								\$ 91,719	7.0%	4.9%
										\$ 52,411	4.0%	2.8%
8	Installation consulting and commissioning	3%								\$ 39,308	3.0%	2.1%
110	CONTRACTOR											
9	Contractor per diem			MD	\$ 150	254				\$ 63,406	4.8%	3.4%
										\$ 38,044	2.9%	2.0%
10	Contractor travel			MW	\$ 500	51				\$ 25,363	1.9%	1.4%
120	CONTINGENCY											
11	Estimating and contracting contingency	10%								\$ 196,541	15.0%	10.5%
										\$ 131,028	10.0%	7.0%
12	Unlisted items allowance	5%								\$ 65,514	5.0%	3.5%
TOTAL PROJECT COST										\$ 1,878,139		
130	RISK ADJUSTMENT ³											
13	Estimated cost variance	20.1%								\$ 263,637		
										\$ 263,637	NA	NA
TOTAL PROJECT COST - RISK ADJUSTED										\$ 2,141,776		

Prices shown reflect market data as of 4/12/2019

Notes

- 1: Connection costs to the planned future Greenhouse are not included because no site for the Greenhouse has been identified
- 2: Electricity distribution may be partially funded by AP&T
- 3: Estimated cost variance is determined at the line item level based on the certainty of the source data and aggregated to provide a risk adjusted total project cost

Attachment 6

**Capital Cost Opinion:
Add Alternate One (Admin and Library)**

Haines Borough Biomass District Energy
Capital Cost Opinion - Add Alternate One (Admin & Library)



Location Haines, AK
Client Contact Brad Ryan
Date 4/19/19

Proposed System Biomass District Energy
Proposed System Output (MBH) 1706
Proposed System Fuel Type Forestry Residuals

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wiswoodenergy.com

WBS	ITEM	DESCRIPTION	ID	UNIT	UNIT COST	UNIT QTY	LABOR HOURS	LABOR COST	MATLS COST	ITEM COST	% DIRECT	% TOTAL
TOTAL PROJECT COST							813	\$ 101,625	\$ 180,414	\$ 417,554	-	100.0%
TOTAL - DIRECT CONSTRUCTION							813	\$ 101,625	\$ 180,414	\$ 283,139	100.0%	67.8%
040	MECHANICAL¹						693	\$ 86,625	\$ 161,414	\$ 249,139	88.0%	59.7%
045	Hydronic Equipment - Administration and Library						693	\$ 86,625	\$ 161,414	\$ 249,139	88.0%	59.7%
1	Pumps P-09-10			EA	\$ 735	2	32	\$ 4,000	\$ 1,470	\$ 5,470	1.9%	1.3%
2	Pumps P-11-12			EA	\$ 1,445	2	32	\$ 4,000	\$ 2,890	\$ 6,890	2.4%	1.7%
3	Skid Mount			EA	\$ 3,000	2	60	\$ 7,500	\$ 6,000	\$ 13,500	4.8%	3.2%
4	Heat Exchanger			EA	\$ 2,540	1	65	\$ 8,125	\$ 2,540	\$ 10,665	3.8%	2.6%
5	Dirty and Air Separator			EA	\$ 3,000	2	8	\$ 1,000	\$ 6,000	\$ 7,000	2.5%	1.7%
6	Valves and Trim			EA	\$ 1,000	2	8	\$ 1,000	\$ 2,000	\$ 3,000	1.1%	0.7%
7	DDC Controls			EA	\$ 5,000	2	40	\$ 5,000	\$ 10,000	\$ 15,000	5.3%	3.6%
8	BTU meter			EA	\$ 2,900	2	24	\$ 3,000	\$ 5,800	\$ 8,800	3.1%	2.1%
9	Steel Piping, 4"			FT	\$ 38	50	260	\$ 32,500	\$ 1,900	\$ 34,400	12.1%	8.2%
10	Valves, 4"			FT	\$ 1,479	8	8	\$ 1,000	\$ 11,832	\$ 12,832	4.5%	3.1%
11	Fittings, 4"			EA	\$ 315	16	16	\$ 2,000	\$ 5,040	\$ 7,040	2.5%	1.7%
12	Butterfly Valves, 4"			EA	\$ 300	4	32	\$ 4,000	\$ 1,200	\$ 5,200	1.8%	1.2%
13	Dual-Line PEX 2.5" to Admin and Library			FT	\$ 15	1,024	40	\$ 5,000	\$ 15,288	\$ 20,288	7.2%	4.9%
14	Dual-Line PEX 2.5" Fittings To Admin and Library			EA	\$ 115	4	16	\$ 2,000	\$ 459	\$ 2,459	0.9%	0.6%
15	2" PVC Conduit to Admin and Library			FT	\$ 3	308	32	\$ 4,000	\$ 955	\$ 4,955	1.7%	1.2%
16	Trenching and Backfilling			LF	\$ 85	1,024	Included	\$ -	\$ 87,040	\$ 87,040	30.7%	20.8%
17	Concrete Foundation			CY	\$ 550	2	Included	\$ -	\$ -	\$ 1,100	0.4%	0.3%
18	Modified Shed for Substation			EA	\$ 1,000	1	20	\$ 2,500	\$ 1,000	\$ 3,500	1.2%	0.8%
050	ELECTRICAL						120	\$ 15,000	\$ 19,000	\$ 34,000	12.0%	8.1%
19	Control wiring					60		\$ 7,500	\$ 7,000	\$ 14,500	5.1%	3.5%
20	Power distribution and meter connection ²					60		\$ 7,500	\$ 12,000	\$ 19,500	6.9%	4.7%
TOTAL - INDIRECT CONSTRUCTION								\$ -	\$ -	\$ 134,415	47.5%	32.2%
80	DESIGN & ENGINEERING									\$ 4,247	1.5%	1.0%
1	Civil engineering		0.50%						\$ 1,416	0.5%	0.3%	
2	Structural engineering		0.25%						\$ 708	0.3%	0.2%	
3	Mechanical engineering		0.50%						\$ 1,416	0.5%	0.3%	
4	Electrical engineering		0.25%						\$ 708	0.3%	0.2%	
90	GENERAL CONTRACTOR									\$ 42,471	15.0%	10.2%
5	Overhead		5%						\$ 14,157	5.0%	3.4%	
6	Profit		10%						\$ 28,314	10.0%	6.8%	
100	CONSTRUCTION ADMINISTRATION									\$ 19,820	7.0%	4.7%
7	Construction administration		4%						\$ 11,326	4.0%	2.7%	
8	Installation consulting and commissioning		3%						\$ 8,494	3.0%	2.0%	
110	CONTRACTOR									\$ 25,406	9.0%	6.1%
9	Contractor per diem			MD	\$ 150	102			\$ 15,244	5.4%	3.7%	
10	Contractor travel			MW	\$ 500	20			\$ 10,163	3.6%	2.4%	
120	CONTINGENCY									\$ 42,471	15.0%	10.2%
11	Estimating and contracting contingency		10%						\$ 28,314	10.0%	6.8%	
12	Unlisted items allowance		5%						\$ 14,157	5.0%	3.4%	
TOTAL PROJECT COST										\$ 417,554		
130	RISK ADJUSTMENT³									\$ 49,003		
7	Estimated cost variance		17.3%						\$ 49,003	NA	NA	
TOTAL PROJECT COST - RISK ADJUSTED										\$ 466,557		

Prices shown reflect market data as of 4/12/2019

Notes

- 1: Connection costs to the planned future Greenhouse are not included because no site for the Greenhouse has been identified
- 2: Electricity distribution may be partially funded by AP&T
- 3: Estimated cost variance is determined at the line item level based on the certainty of the source data and aggregated to provide a risk adjusted total project cost

Attachment 7

**Capital Cost Opinion:
Add Alternate Two (Voc-Ed and Garage)**

Haines Borough Biomass District Energy
Capital Cost Opinion - Add Alternate Two (Voc-Ed & Garage)



Location Haines, AK
Client Contact Brad Ryan
Date 4/19/19

Proposed System Biomass District Energy
Proposed System Output (MBH) 1706
Proposed System Fuel Type Forestry Residuals

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewoodenergy.com

WBS	ITEM	DESCRIPTION	ID	UNIT	UNIT COST	UNIT QTY	LABOR HOURS	LABOR COST	MATLS COST	ITEM COST	% DIRECT	% TOTAL
TOTAL PROJECT COST							368	\$ 46,000	\$ 138,525	\$ 268,591	-	100.0%
TOTAL - DIRECT CONSTRUCTION							368	\$ 46,000	\$ 138,525	\$ 185,625	100.0%	69.1%
040	MECHANICAL¹						308	\$ 38,500	\$ 119,525	\$ 159,125	85.7%	59.2%
046	Hydronic Equipment - Voc-Ed Bldg and Garage						308	\$ 38,500	\$ 119,525	\$ 159,125	85.7%	59.2%
1	Dual-Line PEX 1.5" to Voc-Ed and Garage		FT	\$	9	344	80	\$ 10,000	\$ 3,120	\$ 13,120	7.1%	4.9%
2	Dual-Line PEX 2.5" to Voc-Ed and Garage		FT	\$	15	800	80	\$ 10,000	\$ 11,944	\$ 21,944	11.8%	8.2%
3	Pumps P-15-16		EA	\$	735	2	40	\$ 5,000	\$ 1,470	\$ 6,470	3.5%	2.4%
4	Pumps P-17-18		EA	\$	1,445	2	40	\$ 5,000	\$ 2,890	\$ 7,890	4.3%	2.9%
5	Zone Thermostats		EA	\$	500	2	16	\$ 2,000	\$ 1,000	\$ 3,000	1.6%	1.1%
6	Dual-Line PEX 1.5" Fittings to Voc-Ed and Garage		EA	\$	67	6	16	\$ 2,000	\$ 402	\$ 2,402	1.3%	0.9%
7	Dual-Line PEX 2.5" Fittings to Voc-Ed and Garage		FT	\$	115	4	16	\$ 2,000	\$ 459	\$ 2,459	1.3%	0.9%
8	Trenching and Backfilling to Voc-Ed and Garage		LF	\$	85	1,144	Included	\$ -	\$ 97,240	\$ 97,240	52.4%	36.2%
9	Concrete Foundation		CY	\$	550	2	Included	\$ -	\$ -	\$ 1,100	0.6%	0.4%
10	Modified Shed for Substation		EA	\$	1,000	1	20	\$ 2,500	\$ 1,000	\$ 3,500	1.9%	1.3%
050	ELECTRICAL						60	\$ 7,500	\$ 19,000	\$ 26,500	14.3%	9.9%
11	Control wiring						30	\$ 3,750	\$ 7,000	\$ 10,750	5.8%	4.0%
12	Power distribution and meter connection ²						30	\$ 3,750	\$ 12,000	\$ 15,750	8.5%	5.9%
TOTAL - INDIRECT CONSTRUCTION								\$ -	\$ -	\$ 82,966	44.7%	30.9%
80	DESIGN & ENGINEERING									\$ 2,784	1.5%	1.0%
1	Civil engineering	0.50%							\$ 928	0.5%	0.3%	
2	Structural engineering	0.25%							\$ 464	0.3%	0.2%	
3	Mechanical engineering	0.50%							\$ 928	0.5%	0.3%	
4	Electrical engineering	0.25%							\$ 464	0.3%	0.2%	
90	GENERAL CONTRACTOR									\$ 27,844	15.0%	10.4%
5	Overhead	5%							\$ 9,281	5.0%	3.5%	
6	Profit	10%							\$ 18,563	10.0%	6.9%	
100	CONSTRUCTION ADMINISTRATION									\$ 12,994	7.0%	4.8%
7	Construction administration	4%							\$ 7,425	4.0%	2.8%	
8	Installation consulting and commissioning	3%							\$ 5,569	3.0%	2.1%	
110	CONTRACTOR									\$ 11,500	6.2%	4.3%
9	Contractor per diem		MD	\$	150	46			\$ 6,900	3.7%	2.6%	
10	Contractor travel		MW	\$	500	9			\$ 4,600	2.5%	1.7%	
120	CONTINGENCY									\$ 27,844	15.0%	10.4%
11	Estimating and contracting contingency	10%							\$ 18,563	10.0%	6.9%	
12	Unlisted items allowance	5%							\$ 9,281	5.0%	3.5%	
TOTAL PROJECT COST										\$ 268,591		
130	RISK ADJUSTMENT³									\$ 35,322		
6	Estimated cost variance	19.0%							\$ 35,322	NA	NA	
TOTAL PROJECT COST - RISK ADJUSTED										\$ 303,913		

Prices shown reflect market data as of 4/12/2019

Notes

- 1: Connection costs to the planned future Greenhouse are not included because no site for the Greenhouse has been identified
- 2: Electricity distribution may be partially funded by AP&T
- 3: Estimated cost variance is determined at the line item level based on the certainty of the source data and aggregated to provide a risk adjusted total project cost

Attachment 8

**Pro Forma:
Baseline (Pool and School)**

Haines Borough Biomass District Energy
25-Year Operating Pro Forma - Baseline (Pool & School)



Location Haines, AK
Client Contact Brad Ryan
Date 4/19/19

Proposed System Biomass District Energy
Proposed System Output (MBH) 1,706
Proposed System Fuel Type Forestry Residuals

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewoodenergy.com

	1	2	3	4	5	6	7	8	9	10	15	20	25
Existing Fossil Fuel System Operating Cost													
Existing Fuel Cost													
Fossil Fuel Costs	\$ 113,082	\$ 117,605	\$ 122,309	\$ 127,202	\$ 132,290	\$ 137,582	\$ 143,085	\$ 148,808	\$ 154,760	\$ 160,951	\$ 195,821	\$ 238,247	\$ 289,864
Electricity Costs	\$ 32,238	\$ 32,883	\$ 33,540	\$ 34,211	\$ 34,895	\$ 35,593	\$ 36,305	\$ 37,031	\$ 37,772	\$ 38,527	\$ 42,537	\$ 46,965	\$ 51,853
Operations and Maintenance													
Maintenance, Parts & Labor	\$ 8,000	\$ 8,160	\$ 8,323	\$ 8,490	\$ 8,659	\$ 8,833	\$ 9,009	\$ 9,189	\$ 9,373	\$ 9,561	\$ 10,556	\$ 11,654	\$ 12,867
Existing Boiler Cost, Total	\$ 153,320	\$ 158,648	\$ 164,173	\$ 169,903	\$ 175,845	\$ 182,007	\$ 188,399	\$ 195,029	\$ 201,906	\$ 209,039	\$ 248,914	\$ 296,866	\$ 354,584
Proposed Biomass Energy System Operating Cost													
Proposed Biomass System Operating Cost													
Wood Fuel	\$ 50,361	\$ 51,368	\$ 52,396	\$ 53,444	\$ 54,513	\$ 55,603	\$ 56,715	\$ 57,849	\$ 59,006	\$ 60,186	\$ 66,451	\$ 73,367	\$ 81,003
Wood Fuel Handling & Delivery	\$ 21,816	\$ 22,252	\$ 22,697	\$ 23,151	\$ 23,614	\$ 24,086	\$ 24,568	\$ 25,059	\$ 25,560	\$ 26,072	\$ 28,785	\$ 31,781	\$ 35,089
Ash Disposal	\$ 5,440	\$ 5,549	\$ 5,660	\$ 5,773	\$ 5,888	\$ 6,006	\$ 6,126	\$ 6,249	\$ 6,374	\$ 6,501	\$ 7,178	\$ 7,925	\$ 8,750
Electricity to Run Boiler	\$ 8,218	\$ 8,382	\$ 8,550	\$ 8,721	\$ 8,895	\$ 9,073	\$ 9,255	\$ 9,440	\$ 9,629	\$ 9,821	\$ 10,843	\$ 11,972	\$ 13,218
Remaining Heating Oil	\$ 7,250	\$ 7,395	\$ 7,543	\$ 7,694	\$ 7,847	\$ 8,004	\$ 8,164	\$ 8,328	\$ 8,494	\$ 8,664	\$ 9,566	\$ 10,562	\$ 11,661
New Biomass System Operations Cost, Total	\$ 93,085	\$ 94,946	\$ 96,845	\$ 98,782	\$ 100,758	\$ 102,773	\$ 104,828	\$ 106,925	\$ 109,063	\$ 111,245	\$ 122,823	\$ 135,607	\$ 149,721
Proposed Biomass System Maintenance Cost													
Scheduled Maintenance	\$ 5,220	\$ 5,324	\$ 5,431	\$ 5,540	\$ 5,650	\$ 5,763	\$ 5,879	\$ 5,996	\$ 6,116	\$ 6,238	\$ 6,888	\$ 7,605	\$ 8,396
Remote Monitoring	\$ 5,720	\$ 5,834	\$ 5,951	\$ 6,070	\$ 6,192	\$ 6,315	\$ 6,442	\$ 6,570	\$ 6,702	\$ 6,836	\$ 7,547	\$ 8,333	\$ 9,200
Administration	\$ 3,213	\$ 3,277	\$ 3,342	\$ 3,409	\$ 3,477	\$ 3,547	\$ 3,618	\$ 3,690	\$ 3,764	\$ 3,839	\$ 4,239	\$ 4,680	\$ 5,167
New Biomass System Maintenance Costs, Total	\$ 14,153	\$ 14,436	\$ 14,724	\$ 15,019	\$ 15,319	\$ 15,626	\$ 15,938	\$ 16,257	\$ 16,582	\$ 16,914	\$ 18,674	\$ 20,618	\$ 22,764
New Biomass System Cost, Total	\$ 107,237	\$ 109,382	\$ 111,570	\$ 113,801	\$ 116,077	\$ 118,399	\$ 120,767	\$ 123,182	\$ 125,646	\$ 128,158	\$ 141,497	\$ 156,224	\$ 172,484
Biomass Energy Savings	\$ 46,083	\$ 49,266	\$ 52,603	\$ 56,102	\$ 59,768	\$ 63,609	\$ 67,633	\$ 71,847	\$ 76,260	\$ 80,880	\$ 107,417	\$ 140,641	\$ 182,099
Cumulative Cash Savings	\$ 46,083	\$ 95,348	\$ 147,952	\$ 204,053	\$ 263,821	\$ 327,430	\$ 395,062	\$ 466,909	\$ 543,169	\$ 624,050	\$ 1,105,658	\$ 1,739,455	\$ 2,563,391

Fossil Fuel Price Escalator 4.0%
Wood Fuel, Electricity, and Labor Price Escalator 2.0%

Simple Payback, No Grant (yrs)	46
Accelerated Payback, No Grant (yrs)	23
Simple Payback, \$1M Grant (yrs)	25
Accelerated Payback, \$1M Grant (yrs)	15

Payback is based on risk adjusted total project cost.

Attachment 9

Pro Forma:

**Baseline and Add Alternate One
(Pool, School, Admin, and Library)**

Haines Borough Biomass District Energy

25-Year Operating Pro Forma - Baseline & Add Alternate One (Pool, School, Admin, Library)



Location Haines, AK
 Client Contact Brad Ryan
 Date 4/19/19

Proposed System Biomass District Energy
 Proposed System Output (MBH) 1,706
 Proposed System Fuel Type Forestry Residuals

Contact Andrew Haden
 Phone (503) 706-6187
 Email andrew@wisewoodenergy.com

	1	2	3	4	5	6	7	8	9	10	15	20	25
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Existing Fossil Fuel System Operating Cost

Existing Fuel Cost													
Fossil Fuel Costs	\$ 129,653	\$ 134,840	\$ 140,233	\$ 145,842	\$ 151,676	\$ 157,743	\$ 164,053	\$ 170,615	\$ 177,440	\$ 184,537	\$ 224,518	\$ 273,160	\$ 332,341
Electricity Costs	\$ 34,406	\$ 35,094	\$ 35,796	\$ 36,512	\$ 37,242	\$ 37,987	\$ 38,747	\$ 39,522	\$ 40,312	\$ 41,118	\$ 45,398	\$ 50,123	\$ 55,340
Operations and Maintenance													
Maintenance, Parts & Labor	\$ 8,000	\$ 8,160	\$ 8,323	\$ 8,490	\$ 8,659	\$ 8,833	\$ 9,009	\$ 9,189	\$ 9,373	\$ 9,561	\$ 10,556	\$ 11,654	\$ 12,867
Existing Boiler Cost, Total	\$ 172,059	\$ 178,094	\$ 184,352	\$ 190,844	\$ 197,578	\$ 204,563	\$ 211,809	\$ 219,326	\$ 227,125	\$ 235,216	\$ 280,471	\$ 334,938	\$ 400,548

Proposed Biomass Energy System Operating Cost

Proposed Biomass System Operating Cost													
Wood Fuel	\$ 54,403	\$ 55,491	\$ 56,600	\$ 57,732	\$ 58,887	\$ 60,065	\$ 61,266	\$ 62,491	\$ 63,741	\$ 65,016	\$ 71,783	\$ 79,254	\$ 87,503
Wood Fuel Handling & Delivery	\$ 23,566	\$ 24,038	\$ 24,518	\$ 25,009	\$ 25,509	\$ 26,019	\$ 26,539	\$ 27,070	\$ 27,612	\$ 28,164	\$ 31,095	\$ 34,331	\$ 37,905
Ash Disposal	\$ 5,486	\$ 5,596	\$ 5,708	\$ 5,822	\$ 5,939	\$ 6,057	\$ 6,179	\$ 6,302	\$ 6,428	\$ 6,557	\$ 7,239	\$ 7,993	\$ 8,825
Electricity to Run Boiler	\$ 9,083	\$ 9,264	\$ 9,450	\$ 9,639	\$ 9,831	\$ 10,028	\$ 10,228	\$ 10,433	\$ 10,642	\$ 10,855	\$ 11,984	\$ 13,232	\$ 14,609
Remaining Heating Oil	\$ 16,042	\$ 16,362	\$ 16,690	\$ 17,023	\$ 17,364	\$ 17,711	\$ 18,065	\$ 18,427	\$ 18,795	\$ 19,171	\$ 21,166	\$ 23,369	\$ 25,802
New Biomass System Operations Cost, Total	\$ 108,579	\$ 110,751	\$ 112,966	\$ 115,225	\$ 117,530	\$ 119,880	\$ 122,278	\$ 124,723	\$ 127,218	\$ 129,762	\$ 143,268	\$ 158,179	\$ 174,643
Proposed Biomass System Maintenance Cost													
Scheduled Maintenance	\$ 9,383	\$ 9,570	\$ 9,762	\$ 9,957	\$ 10,156	\$ 10,359	\$ 10,566	\$ 10,778	\$ 10,993	\$ 11,213	\$ 12,380	\$ 13,669	\$ 15,091
Remote Monitoring	\$ 5,720	\$ 5,834	\$ 5,951	\$ 6,070	\$ 6,192	\$ 6,315	\$ 6,442	\$ 6,570	\$ 6,702	\$ 6,836	\$ 7,547	\$ 8,333	\$ 9,200
Administration	\$ 3,912	\$ 3,991	\$ 4,071	\$ 4,152	\$ 4,235	\$ 4,320	\$ 4,406	\$ 4,494	\$ 4,584	\$ 4,676	\$ 5,162	\$ 5,700	\$ 6,293
New Biomass System Maintenance Costs, Total	\$ 19,015	\$ 19,395	\$ 19,783	\$ 20,179	\$ 20,582	\$ 20,994	\$ 21,414	\$ 21,842	\$ 22,279	\$ 22,725	\$ 25,090	\$ 27,701	\$ 30,584
New Biomass System Cost, Total	\$ 127,594	\$ 130,146	\$ 132,749	\$ 135,404	\$ 138,112	\$ 140,874	\$ 143,692	\$ 146,566	\$ 149,497	\$ 152,487	\$ 168,358	\$ 185,881	\$ 205,227
Biomass Energy Savings	\$ 44,465	\$ 47,947	\$ 51,603	\$ 55,440	\$ 59,466	\$ 63,688	\$ 68,117	\$ 72,760	\$ 77,628	\$ 82,729	\$ 112,114	\$ 149,057	\$ 195,321
Cumulative Cash Savings	\$ 44,465	\$ 92,412	\$ 144,016	\$ 199,455	\$ 258,921	\$ 322,609	\$ 390,726	\$ 463,487	\$ 541,115	\$ 623,844	\$ 1,122,928	\$ 1,790,976	\$ 2,670,925

Fossil Fuel Price Escalator 4.0%

Wood Fuel, Electricity, and Labor Price Escalator 2.0%

Simple Payback, No Grant (yrs)	59
Accelerated Payback, No Grant (yrs)	25
Simple Payback, \$1M Grant (yrs)	36
Accelerated Payback, \$1M Grant (yrs)	19

Payback is based on risk adjusted total project cost.

Attachment 10

**Pro Forma:
Full Buildout**

Haines Borough Biomass District Energy

25-Year Operating Pro Forma - Full Buildout

Location Haines, AK
 Client Contact Brad Ryan
 Date 4/19/19

Proposed System Biomass District Energy
 Proposed System Output (MBH) 1,706
 Proposed System Fuel Type Forestry Residuals



Contact Andrew Haden
 Phone (503) 706-6187
 Email andrew@wisewoodenergy.com

	1	2	3	4	5	6	7	8	9	10	15	20	25
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Existing Fossil Fuel System Operating Cost

Existing Fuel Cost													
Fossil Fuel Costs	\$ 148,344	\$ 154,278	\$ 160,449	\$ 166,867	\$ 173,542	\$ 180,483	\$ 187,703	\$ 195,211	\$ 203,019	\$ 211,140	\$ 256,884	\$ 312,539	\$ 380,251
Electricity Costs	\$ 34,477	\$ 35,166	\$ 35,869	\$ 36,587	\$ 37,319	\$ 38,065	\$ 38,826	\$ 39,603	\$ 40,395	\$ 41,203	\$ 45,491	\$ 50,226	\$ 55,453
Operations and Maintenance													
Maintenance, Parts & Labor	\$ 8,000	\$ 8,160	\$ 8,323	\$ 8,490	\$ 8,659	\$ 8,833	\$ 9,009	\$ 9,189	\$ 9,373	\$ 9,561	\$ 10,556	\$ 11,654	\$ 12,867
Existing Boiler Cost, Total	\$ 190,821	\$ 197,604	\$ 204,642	\$ 211,943	\$ 219,520	\$ 227,381	\$ 235,538	\$ 244,003	\$ 252,787	\$ 261,903	\$ 312,931	\$ 374,419	\$ 448,572

Proposed Biomass Energy System Operating Cost

Proposed Biomass System Operating Cost													
Wood Fuel	\$ 63,158	\$ 64,421	\$ 65,710	\$ 67,024	\$ 68,364	\$ 69,732	\$ 71,126	\$ 72,549	\$ 74,000	\$ 75,480	\$ 83,336	\$ 92,010	\$ 101,586
Wood Fuel Handling & Delivery	\$ 27,359	\$ 27,906	\$ 28,464	\$ 29,034	\$ 29,614	\$ 30,207	\$ 30,811	\$ 31,427	\$ 32,055	\$ 32,697	\$ 36,100	\$ 39,857	\$ 44,005
Ash Disposal	\$ 5,587	\$ 5,699	\$ 5,813	\$ 5,929	\$ 6,048	\$ 6,169	\$ 6,292	\$ 6,418	\$ 6,546	\$ 6,677	\$ 7,372	\$ 8,139	\$ 8,987
Electricity to Run Boiler	\$ 9,736	\$ 9,931	\$ 10,130	\$ 10,332	\$ 10,539	\$ 10,750	\$ 10,965	\$ 11,184	\$ 11,407	\$ 11,636	\$ 12,847	\$ 14,184	\$ 15,660
Remaining Heating Oil	\$ 18,148	\$ 18,511	\$ 18,881	\$ 19,259	\$ 19,644	\$ 20,037	\$ 20,437	\$ 20,846	\$ 21,263	\$ 21,688	\$ 23,946	\$ 26,438	\$ 29,189
New Biomass System Operations Cost, Total	\$ 123,988	\$ 126,468	\$ 128,997	\$ 131,577	\$ 134,209	\$ 136,893	\$ 139,631	\$ 142,423	\$ 145,272	\$ 148,177	\$ 163,600	\$ 180,627	\$ 199,427
Proposed Biomass System Maintenance Cost													
Scheduled Maintenance	\$ 9,383	\$ 9,570	\$ 9,762	\$ 9,957	\$ 10,156	\$ 10,359	\$ 10,566	\$ 10,778	\$ 10,993	\$ 11,213	\$ 12,380	\$ 13,669	\$ 15,091
Remote Monitoring	\$ 5,720	\$ 5,834	\$ 5,951	\$ 6,070	\$ 6,192	\$ 6,315	\$ 6,442	\$ 6,570	\$ 6,702	\$ 6,836	\$ 7,547	\$ 8,333	\$ 9,200
Administration	\$ 4,368	\$ 4,456	\$ 4,545	\$ 4,636	\$ 4,728	\$ 4,823	\$ 4,919	\$ 5,018	\$ 5,118	\$ 5,221	\$ 5,764	\$ 6,364	\$ 7,026
New Biomass System Maintenance Costs, Total	\$ 19,471	\$ 19,860	\$ 20,257	\$ 20,663	\$ 21,076	\$ 21,497	\$ 21,927	\$ 22,366	\$ 22,813	\$ 23,269	\$ 25,691	\$ 28,365	\$ 31,318
New Biomass System Cost, Total	\$ 143,459	\$ 146,328	\$ 149,255	\$ 152,240	\$ 155,285	\$ 158,390	\$ 161,558	\$ 164,789	\$ 168,085	\$ 171,447	\$ 189,291	\$ 208,993	\$ 230,745
Biomass Energy Savings	\$ 47,362	\$ 51,276	\$ 55,387	\$ 59,703	\$ 64,235	\$ 68,990	\$ 73,980	\$ 79,213	\$ 84,702	\$ 90,456	\$ 123,640	\$ 165,426	\$ 217,827
Cumulative Cash Savings	\$ 47,362	\$ 98,637	\$ 154,024	\$ 213,727	\$ 277,962	\$ 346,952	\$ 420,932	\$ 500,146	\$ 584,848	\$ 675,304	\$ 1,224,047	\$ 1,963,791	\$ 2,943,422

Fossil Fuel Price Escalator 4.0%

Wood Fuel, Electricity, and Labor Price Escalator 2.0%

Simple Payback, No Grant (yrs)	61
Accelerated Payback, No Grant (yrs)	25
Simple Payback, \$1M Grant (yrs)	40
Accelerated Payback, \$1M Grant (yrs)	20

Payback is based on risk adjusted total project cost.