Pre-Feasibility Study

Heating with Woody Biomass for the Glennallen, Alaska Cluster

This pre-feasibility assessment considers the potential for heating buildings at AK DOF Forestry, Cross Road Medical Center, BLM/NPS Campus, PWSCC Glennallen Campus, and Copper River School District with woody biomass from regional forests.

Funding for this report was provided by Alaska Energy Authority and USDA Forest Service.

Dalson Energy Inc.

308 G St. Ste 303
Anchorage, Alaska 99501

907-277-7900

8/14/2012

Contents

Executive Summary 4
Regional biomass information 4
Available fuels 6
Economic development 8
Site Specific Analysis: AK Division of Forestry 8
General Description of Opportunity & Challenges 8
Technology or installation options assessed 8
Project chart 11
Preliminary Cost Estimating 12
Economic Analysis 13
General perspective of project viability, and recommended next steps 16
Site Specific Analysis: Cross Road Medical Center 16
General Description of Opportunity & Challenges 16
Technology or installation options assessed 17
Project chart 18
Preliminary Cost Estimating 19
Economic Analysis 20
General perspective of project viability, and recommended next steps 23
Site Specific Analysis: Community Chapel 23
General Description of Opportunity & Challenges 23
Technology or installation options assessed 23
Project chart 24
Preliminary Cost Estimating 25
Economic Analysis 26
General perspective of project viability, and recommended next steps 29
Site Specific Analysis: Prince William Sound Community College 29
General Description of Opportunity & Challenges 29
Technology or installation options assessed 29
Project chart 31
Preliminary Cost Estimating 32

Economic Analysis 33
General perspective of project viability, and recommended next steps 36
Site Specific Analysis: Chistochina School 36
General Description of Opportunity & Challenges 36
Technology or installation options assessed 36
Project chart 37
Preliminary Cost Estimating 38
Economic Analysis 39
Life Cycle Cost Analysis 42
General perspective of project viability, and recommended next steps 43
Site Specific Analysis: BLM NPS Campus 43
General Description of Opportunity & Challenges 43
Technology or installation options assessed 43
Project chart BLM/ NPS 44
Preliminary Cost Estimating: BLM Cluster #1 46
Economic Analysis: BLM Cluster #1 47
Preliminary Cost Estimating: NPS Cluster #1 50
Economic Analysis: NPS Cluster #1 51
Preliminary Cost Estimating: NPS Cluster #2 54
Economic Analysis: NPS Cluster #2 55
General perspective of project viability, and recommended next steps 58
Summary of Benefit/ Cost analyses 58
Recommendations and Next Steps 59
Appendix I: Heating Fuels Assumptions 62

Executive Summary

This assessment suggests small-scale heating with woody biomass is technically, operationally, and financially feasible in a number of community buildings in the Glennallen, AK, area. Of the projects surveyed, two were found to be financially feasible; four were found to be operationally and technically feasible; and two are recommended to proceed to development, with technical, operational, and financial viability. The two projects most highly recommended to proceed to development are the Cross Road Medical Center, and National Park Service (NPS) Cluster #1.

In general, containerized cordwood heating systems are the most financially attractive of the possible project configurations evaluated, with the lowest capital cost and the lowest wood fuel cost. Pellets are also an option for small-scale heating, although the projects described in this report have marginal economic feasibility, based on a B/C ratio of offset fossil fuels. Because of the relatively small-scale of the projects and the existing supply of local production, woodchip systems do not currently appear to be an operationally-viable option for the projects reviewed. Options for improving project's financial profiles are discussed.

Regional biomass information

Over 1 million acres in the Copper Valley are forested. A number of institutional landowners manage these lands, including the State of Alaska Division of Forestry (AK DOF), US Bureau of Land Management (BLM), and Ahtna, Inc. According to a 2010 AK DOF timber resource assessment[1], State lands alone in the Copper Valley hold more than 2 million tons of timber > 5" DBH (diameter at breast height), and over 96,000 acres of pole timber. Non-commercial trees (too small or defective to make sawlogs), including pole timber, is generally suitable as biomass energy feedstock. Concurrent to making timber resources available for biomass energy development, the State of Alaska is undertaking Wildfire Fuels Reduction Projects around Glennallen, McCarthy, Tazlina, Gulkana, and Gakona.

The presence of a forest resource is distinct from a wood energy fuel supply. Every energy project needs a fuel plan. That plan could include a harvest contract and/or wood fuel delivery contract, and an operations plan prior to development. Additionally, every project is strongly recommended to have a primary and secondary fuel supplier identified prior to investing in a project. A reliable long-term woody biomass fuel supply and reliable harvest contract arrangements are essential to project success.

[1] ftp://ftp.aidea.org/BiomassEnergy/GlennallenInventory%282%29.pdf

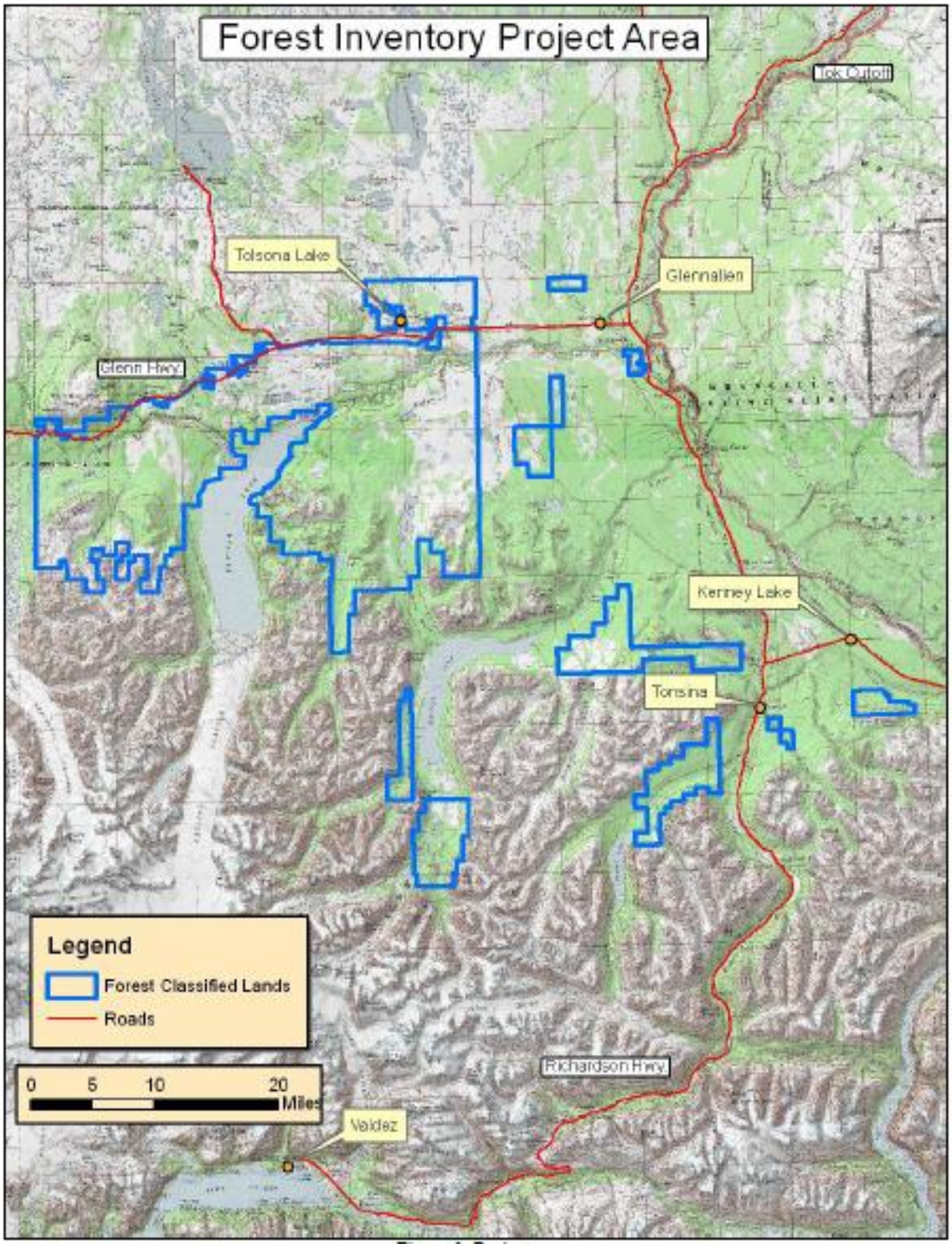

Figure 1: State Land forest inventory map[2].

[2] Hanson, Douglas. "Forest Resources on State Forest Lands in the Copper River Basin: A Preliminary Estimate." Alaska Department of Natural Resources – Forestry. March 2010.

Available fuels

Wood chips

There are currently no local commercial manufacturers of woodchips. One initiative, the Glennallen School biomass boiler project, may develop (or catalyze the development of) a chip manufacturing operation if it proceeds to development.

Regal Enterprises produces woodchips for its own use. It operates a small biomass boiler for heating several buildings. Regal Enterprises does not currently plan to sell chips commercially but may be willing to do so if approached with a proposal for a fuel supply contract. Regal Enterprises historically harvested firewood and sawtimber but their future production plans are unknown at this time.

Regionally, the Alaska Gateway School District (AGSD) in Tok, AK procures wood chips for the Tok School's biomass boiler project from local sources. A few trailers of chips could satisfy the annual demand of any of the projects considered in this report. The woodchip supply is considered reliable, and is priced at $60 - $80/ ton FOB Tok, AK. Regional vendors may be available to deliver woodchips in the amounts necessary, until local sources are identified.

Cordwood

Glennallen is located in the Valdez-Cordova Census area, which contains about 10,000 residents. Of 3,914 occupied housing units in this census area, approximately 630 used wood as a primary heat source, according to U.S. Census data. At an average of 5 cords per house, approximately 3,150 cords are used annually in this Census area. There is no way to differentiate between cordwood and pellet wood among the Census data, but pellets are expected to be a small percentage of the total wood fuel heating demand.

Historically, wood is harvested by individual households for personal use. Additionally local businesses harvest and sell firewood, as log-loads or processed cordwood. Local commercial firewood manufacturers include Regal Enterprises and Bengston Logging.

Cordwood is also available from regional producers, such as Young's Timber Inc. and Kristian Crozier in Tok, AK.

Commodity prices for cordwood, excluding delivery charges, follow:

- Log length -- $180/ cord (for purchase of an approximately 10 cord truckload)
- Split/ delivered -- $200/ cord

Pellets

Pellets are not produced commercially in the Copper Valley. However, a variety of pellet supplies are accessible:

- Superior Pellets, manufactured in North Pole, AK; available in 40 pound bags or bulk. The company plans to acquire a 16 ton auger delivery truck in 2012. Current pellet price is $275/ ton FOB Fairbanks, AK.
- End of the Alcan (Supernaw's), located in Delta Junction, imports pellets from Prince George, Canada. Pellets are palletized in 40 lb. bags, 1 ton per pallet. Pallets are delivered to Delta Junction or Tok. This operator currently distributes about 1,000 tons per year. Each load carries about 25 tons (25 pallets). $330 per ton, FOB Tok.
- Dry Creek produces pellets for local consumption. There are currently no plans to expand, although representatives did express a willingness to explore options. Limited staffing is a challenge.
- There was a pellet manufacturing initiative in Gulkana, but, to the knowledge of the Consultant, that facility is not moving forward.
- Pellets from a variety of suppliers in Anchorage, mostly imported from Lower 48 or Canada.
- Tongass Forest Enterprises, located in Ketchikan, is manufacturing pellets—currently limited to local consumption.

Summary

With regard to woodchips, the viability of any project depends on the ability to reliably obtain chips at a reasonable price. Local woodchip producers are not actively manufacturing chips for sale. Therefore, the viability of any woodchip project depends on new woodchip manufacturing enterprises, or being able to obtain chips from the suppliers of the Alaska Gateway School District in Tok, or another supplier in the area. A primary and secondary source of chips is recommended. Simple chipping equipment and infrastructure could be purchased by a regional organization and made available for lease to entrepreneurs. Generally preferred chip fuel is 20 – 35% moisture content, and less than 2.5" in size. However, some boilers are designed to use "micro-chips," which are less than 1"**.** Microchips can substitute for pellets in some boiler systems.

With regard to cordwood, the projects discussed herein use about 15 – 30 cords annually. The challenge here is sourcing, not supply. Within the regional biomass market, the additional market demand of 15 – 30 cords will likely have little impact on the commodity pricing. With upcoming wildfire-fuels reduction programs, it appears that more than sufficient volumes of wood will be available for sales, if entrepreneurs engage with agencies (AK DOF, BLM, Ahtna). Additionally, bulk purchases are available from commercial operators in Tok, Alaska.

Any project proceeding to development is recommended to have the following in place:

A) Negotiated fuel supply agreement with a local provider of firewood
B) Properly stored (decked) wood in advance of the heating season to ensure its dryness[3]. A moisture content of 20%-25% is the range of well-seasoned wood for most combustion systems.

[3] Research conducted by Cold Climate Housing Research Center indicates that one summer is sufficient to achieve the desired amount of drying, if best drying practices are invoked.

With regard to wood pellets, two existing commercial suppliers are operating in the region: Superior Pellets and End of the Alcan. Currently Superior Pellets has a 16 ton auger truck, but plans to purchase additional delivery vehicles upon negotiation of a fuel supply contract.

Additionally, all pellet projects considered have the potential to charter their own truck from Prince George or other sources, if pellet delivery from current local supliers became unavailable.

Economic development

A number of factors yield a favorable market opportunity for woody biomass energy development in the Copper Valley, including high and escalating fossil fuel costs, planned hazardous fuels reduction, and the local labor force.

Economic localization is the term used to describe local benefits gained by locally producing and consuming commodities, especially energy supply and food. Woody biomass in particular can yield savings in heat energy, improved price stability over fossil fuels, locally-retained energy dollars, and job creation.

With regard to price stability, although fossil fuel costs incrementally affect the costs of biomass fuel harvesting and processing, the biomass fuel costs are generally more stable than fossil fuels.

Site Specific Analysis: AK Division of Forestry

General Description of Opportunity & Challenges

Alaska Division of Forestry (AK DOF) office in Copper River is a division of the State of Alaska Division of Forestry, which manages forests for multiple uses and the sustained yield of renewable resources on 20 million acres of State land.

The representative of the office, Regional Forester Gary Mullen, is very interested in a biomass heating project for the purpose of stabilizing operating costs and utilizing a renewable resource.

The facility is composed of three existing buildings: the Administration building, Shop, and Pump House. The Administration building has recently been weatherized. A new Operations building, estimated at 2,000 sq. ft, will be constructed in the coming year.

Technology or installation options assessed

Because of the time constraints on limited current staff, only a fully automated system was considered. This is based on feedback from AK DOF personnel. The project is too small to justify the costs and complexity of a wood chip boiler. Therefore, a pellet boiler was the only technology considered. The pellets were assumed to be back-hauled[4] using Forestry trucks, at no additional transportation costs to AK DOF.

Another type of "fully-automated" heat could be available: a cordwood biomass system operated by a third-party contractor with an Operations and Maintenance Contract. To the knowledge of the Consultant, this type of arrangement has not yet been demonstrated in Alaska, but is regularly practiced in the Eastern U.S. and Europe. With this type of contract, the operational feasibility of the project is dependent on identifying a capable and reliable maintenance contractor. It may be possible to share a maintenance contractor with other entities operating similar wood heating systems.

Both stand-alone and integrated biomass boiler systems were considered. AK DOF-personnel preferred the stand-alone option. There is no room within existing buildings to accommodate the biomass plant. The new building, currently in the design phase, has a separate budget that is limited. Therefore, a separate source of funding for the biomass plant was preferred.

Because of the very low volume of fuel usage, a small "pellet trough" design was considered, to be built into the container system. The trough would be made of plywood, and could be filled from above by 40 lb bags. A forklift could lift up the pallet of pellets for filling from above.

Alternatively, a metal grain-style silo, or equivalent could be employed. One challenge is that a typical bulk pellet delivery truck carries 16 – 27 tons of pellets (a full year supply for AK DOF), but the storage devices for this volume are not easily filled by hand. Because of the low volume of wood fuel usage, and the prospects for using 40 lb. bags of pellets rather than automatic filling, the economic analysis in this report assumes a wooden trough style storage structure built into the containerized boiler system.

One additional note on this project: the AK DOF site also has a well house that distributes water to the Campus building. This well house is outfitted with a 1.5 kilowatt electric baseboard heater. The well house does not appear to be well insulated. The project design assumes heating this well house with a small heat loop line, offsetting an estimated 4,500 kilowatt-hours per year (20 hours per day of operation, 5 months of winter, at a cost of $1,485 per year).

[4] Back-haul assumed based on feedback from Gary Mullen, Regional Forester. Back haul available from Tok, Delta Junction, or Fairbanks.

Figure 2: Top Left: Location of proposed Operations Building. Top Right: Gravel drive to position boiler unit. Bottom Left: Shop/ Storage building.

Project chart

Building Name	Admin, Fire Cache, Water house, Operations (new)
Building Owner	AK DOF
Contact Information	Gary Mullen
Square footage and number of buildings	7,900 sq. ft total (3 buildings). Operations building in design, estimated 1,400 -- 2,200 sq. ft.
Gallons per year, fuel oil #1	estimated 3,600 gallons

PRELIMINARY SITE INVESTIGATION	
What feedback did staff offer on the current heating system?	Has recently completed weatherization on the Admin building, and is considering weatherization of the Shop. Has some money to build a new Operations facility, which will be highly efficient. That building has not yet been designed but will be located north of the Admin building.
What is the staff or building manager's interest in biomass heating?	Seriously interested in automated wood heating. Very ready to install biomass heating plant. Prefers containerized system.
Description of current heating system	Current heating systems are not connected. Office - hydronic fuel oil boiler, 248,000 btu/hr; Shop - unit heater from ceiling (forced air, 185,000 btu); new heating system will be incorporated into new Operations building. Water plant -- 1,500 watt electric baseboard heater heats the water house (5,118 btu/hr).
Available space (within existing structures or space for newly constructed building)	Stand alone boiler system is preferred.
Street access	Excellent street access, about 1/4 mile up driveway from Richardson Hwy. Forestry trucks regularly access the area.
Delivery access	Excellent delivery access to existing gravel driveway.
Fuel storage space	Excellent fuel storage space for proposed pellet system.
Building or site constraints (topography, permitting, historical preservation, etc.)	None.
Options for biomass boiler system (fuel type, technology type, building type)	Given the personnel available, a highly automated system is preferred. At the scale of system required, only pellets are recommended. Bulk pellets are available by the pallet (40 lb bags) or by the truck. With the proposed biomass boiler configuration, the facility should be able to offset 100% of heat demand using 29.6 tons of pellets. Total annual estimated heat requirement is 486 MMBTU.
Estimated boiler size	two (2) 100,000 btu/hr pellet boilers, with cascading control function among them, for a total capacity of 200,000 btu/hr. Boilers should have turn down of 4:1, enabling the facility to meet almost all of its heating needs with pellets.

Preliminary Cost Estimating

Initial investment: DNR Forestry

Biomass System	
Size	(2) 109,000 btu/hr
System Rating -- Btu/hr	218,000
Buffer tank	475 gal.

	footnote		*notes*
Building and Equipment Costs (B&E) $			
Fuel Storage Building (V-storage installed in fabricated building)	A	$ 10,000	
Pre-Fabricated Boiler System			
Base price	C	$ 180,000	Based on quote from viable suppliers.
Boiler shipping to hub city	B	$ 10,000	
Local delivery	B	$ 2,000	
Plumbing and electrical	C	$ 7,000	
Site Prep	C	$ 3,000	Forestry will construct gravel pad
Installation	C	$ 6,000	
District loop & building integration	D	$ 88,000	Forestry will trench.
Subtotal-B&E Costs		***$ 306,000***	
Contingency -- 20%		***$ 61,200***	
Grand Total		**$ 367,200**	
Soft Costs $			
Project Management	C	$ 29,376	8% B&E
A/E Design Services	C	$ 33,048	9% of B&E, because of district loop
Fire Marshall Plan Review			incl'd in design
Equipment Commissioning and Training	C		incl'd with purchase
Construction Management	C	$ 29,376	8% B&E
Subtotal -- Soft Costs		**$ 91,800**	
Recommended Project Budget -- Design and Construction Costs		**$ 459,000**	

footnote	
A	Square bulk silo or pre-fabricated building with V-shaped storage trough, built of wood into container. Waterproof hatch. Fill from above.
B	Estimated based on quotes from viable suppliers
C	Estimate
D	$15,000 per building integration (4 buildings). $35/ft for duel insulated pex pipe. 800 ft.

Economic Analysis

AEA B/C Model_AK DOF

Project Description	
Community	Glennallen
Nearest Fuel Community	Tok
11 Region	Rural
RE Technology	Woody biomass heat
Project ID	
Applicant Name	AK DOF
Project Title	Glennallen DNR Wood Heat
Category	

Results		
NPV Benefits	$144,519	
NPV Capital Costs	$459,000	Low
B/C Ratio	0.31	Med
NPV Net Benefit	($314,481)	High

Performance	Unit	Value
Displaced Electricity	kWh per year	4,500
Displaced Electricity	total lifetime kWh	4,500
Displaced Petroleum Fuel	gallons per year	3,600
Displaced Petroleum Fuel	total lifetime gallons	90,000
Displaced Natural Gas	mmBtu per year	-
Displaced Natural Gas	total lifetime mmBtu	-
Avoided CO2	tonnes per year	37
Avoided CO2	total lifetime tonnes	914

Proposed System	Unit	Value
1 Capital Costs	$	$ 459,000
2 Project Start	year	2013
3 Project Life	years	25
Displaced Electric	kWh per year	4,500
4 Displaced Heat	gallons displaced per year	3,600
Displaced Transportation	gallons displaced per year	0.00
10 Renewable Generation O&M	$ per BTU	
Electric Capacity	kW	0
Electric Capacity Factor	%	0
Heating Capacity	Btu/hr.	218,000
Heating Capacity Factor	%	86

Base System	Unit	Value
Diesel Generator O&M	$ per kWh	$ 0.033
Diesel Generation Efficienc	kWh per gallon	

Parameters	Unit	Value
Heating Fuel Premium	$ per gallon	$ 2.00
Transportation Fuel Premiu	$ per gallon	$ 1.00
Discount Rate	% per year	3%
Crude Oil	$ per barrel	EIA Mid
Natural Gas	$ per mmBtu	ISER - Mid

Heating		Units	2013	2014	2015	2016	2017	2018	2019	2020
Proposed										
	Renewable Heat	gallons displaced	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 320	$ 323	$ 326	$ 330	$ 333	$ 336	$ 340	$ 343
Entered Value	Renewable Heat O&M	$ per year	$ 8,000	$ 8,080	$ 8,161	$ 8,242	$ 8,325	$ 8,408	$ 8,492	$ 8,577
Entered Value	Renewable Fuel Use Quantity (Biomass)	green tons	30	30	30	30	30	30	30	30
Entered Value	Renewable Fuel Cost	$ per unit	$330.00	$333	$337	$340	$343	$347	$350	$354
	Total Renewable Fuel Cost	$ per year	$ 9,900	$ 9,999	$ 10,099	$ 10,200	$ 10,302	$ 10,405	$ 10,509	$ 10,614
	Remaining Fuel Oil (supplement)	gallons remaining	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Fuel Cost (supplement)	$ per year	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Proposed Heat Cost	**$ per year**	**$ 18,220**	**$ 18,402**	**$ 18,586**	**$ 18,772**	**$ 18,960**	**$ 19,149**	**$ 19,341**	**$ 19,534**
Base										
	Fuel Use	gallons per year	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
	Fuel Cost	$ per gallon	$5.63	$5.95	$5.95	$6.23	$6.23	$6.59	$6.59	$6.93
Entered Value	Fuel Scheduled Repairs	$ per year	$ 200	$ 202	$ 204	$ 206	$ 208	$ 210	$ 212	$ 214
Entered Value	Fuel O&M	$ per year	$ 750	$ 758	$ 765	$ 773	$ 780	$ 788	$ 796	$ 804
	Fuel Cost	$ per year	$ 20,281	$ 21,420	$ 21,420	$ 22,432	$ 22,432	$ 23,740	$ 23,740	$ 24,936
	Base Heating Cost	**$ per year**	**$ 21,231**	**$ 22,380**	**$ 22,389**	**$ 23,411**	**$ 23,421**	**$ 24,739**	**$ 24,749**	**$ 25,955**

Heating		Units	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed												
	Renewable Heat	gallons displaced	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 347	$ 350	$ 353	$ 357	$ 361	$ 364	$ 368	$ 372	$ 375	$ 379
Entered Value	Renewable Heat O&M	$ per year	$ 8,663	$ 8,749	$ 8,837	$ 8,925	$ 9,015	$ 9,105	$ 9,196	$ 9,288	$ 9,381	$ 9,474
Entered Value	Renewable Fuel Use Quantity (Biomass)	green tons	30	30	30	30	30	30	30	30	30	30
Entered Value	Renewable Fuel Cost	$ per unit	$357	$361	$365	$368	$372	$376	$379	$383	$387	$391
	Total Renewable Fuel Cost	$ per year	$ 10,720	$ 10,827	$ 10,936	$ 11,045	$ 11,156	$ 11,267	$ 11,380	$ 11,494	$ 11,609	$ 11,725
	Remaining Fuel Oil (supplement)	gallons remaining	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Fuel Cost (supplement)	$ per year	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Proposed Heat Cost	**$ per year**	**$ 19,730**	**$ 19,927**	**$ 20,126**	**$ 20,327**	**$ 20,531**	**$ 20,736**	**$ 20,943**	**$ 21,153**	**$ 21,364**	**$ 21,578**
Base												
	Fuel Use	gallons per year	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
	Fuel Cost	$ per gallon	$6.93	$7.21	$7.21	$7.46	$7.46	$7.68	$7.68	$7.85	$7.85	$7.97
Entered Value	Fuel Scheduled Repairs	$ per year	$ 217	$ 219	$ 221	$ 223	$ 225	$ 228	$ 230	$ 232	$ 235	$ 237
Entered Value	Fuel O&M	$ per year	$ 812	$ 820	$ 828	$ 837	$ 845	$ 854	$ 862	$ 871	$ 879	$ 888
	Fuel Cost	$ per year	$ 24,936	$ 25,947	$ 25,947	$ 26,850	$ 26,850	$ 27,643	$ 27,643	$ 28,246	$ 28,246	$ 28,686
	Base Heating Cost	**$ per year**	**$ 25,965**	**$ 26,986**	**$ 26,996**	**$ 27,910**	**$ 27,921**	**$ 28,724**	**$ 28,735**	**$ 29,349**	**$ 29,360**	**$ 29,811**

Heating		Units	2031	2032	2033	2034	2035	2036	2037	PV
Proposed										
	Renewable Heat	gallons displaced	3,600	3,600	3,600	3,600	3,600	3,600	3,600	
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 383	$ 387	$ 390	$ 394	$ 398	$ 402	$ 406	**$6,200**
Entered Value	Renewable Heat O&M	$ per year	$ 9,569	$ 9,665	$ 9,762	$ 9,859	$ 9,958	$ 10,057	$ 10,158	**$155,001**
Entered Value	Renewable Fuel Use Quantity (Biomass)	green tons	30	30	30	30	30	30	30	
Entered Value	Renewable Fuel Cost	$ per unit	$395	$399	$403	$407	$411	$415	$419	
	Total Renewable Fuel Cost	$ per year	$ 11,842	$ 11,960	$ 12,080	$ 12,201	$ 12,323	$ 12,446	$ 12,570	
	Remaining Fuel Oil (supplement)	gallons remaining	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total Fuel Cost (supplement)	$ per year	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
	Proposed Heat Cost	**$ per year**	**$ 21,794**	**$ 22,012**	**$ 22,232**	**$ 22,454**	**$ 22,679**	**$ 22,906**	**$ 23,135**	**$353,016**
Base										
	Fuel Use	gallons per year	3,600	3,600	3,600	3,600	3,600	3,600	3,600	
	Fuel Cost	$ per gallon	$7.97	$8.04	$8.04	$8.09	$8.09	$8.21	$8.21	
Entered Value	Fuel Scheduled Repairs	$ per year	$ 239	$ 242	$ 244	$ 246	$ 249	$ 251	$ 254	**$3,875**
Entered Value	Fuel O&M	$ per year	$ 897	$ 906	$ 915	$ 924	$ 934	$ 943	$ 952	**$14,531**
	Fuel Cost	$ per year	$ 28,686	$ 28,932	$ 28,932	$ 29,127	$ 29,127	$ 29,573	$ 29,573	**$446,033**
	Base Heating Cost	**$ per year**	**$ 29,822**	**$ 30,080**	**$ 30,091**	**$ 30,298**	**$ 30,310**	**$ 30,767**	**$ 30,779**	**$464,440**

General perspective of project viability, and recommended next steps

Due to relatively low fuel oil consumption, this project has marginal economic feasibility from a B/C ratio perspective based on fossil fuel offsets at current prices.. However, it has all the attributes of a project that will thrive operationally: motivated and capable staff, appropriate technology for available fuels and operating requirements, and simple building interconnections. This project will demonstrate the viability of small-scale biomass heating to a variety of commercial and municipal buildings.

Because of uncertainty regarding new building loads, and the potential to adjust the Shop heat load as additional weatherization measures are undertaken, the recommended project technology are two highly modulating wood pellet boilers. These boilers could offset up to 100% of the fuel oil demand of the facility.

AEA historically recommends funding for projects with a Benefit/ Cost ratio greater than 1.0. This project is unlikely to move forward if AEA Renewable Energy Grant fund parameters are exclusively based on fossil fuel-offset B/C ratio at current fossil fuel prices.

Creative project development will need to be undertaken for this project to move forward. Such development could include:

- Partner with the neighboring heat consumer, DOT, for a district heating system serving both agencies. This project would likely be able to be financed by grants or private third parties
- Work to establish values of the project in addition to B/C ratio, such as the value of demonstration, the value of purchasing regionally manufactured wood fuels, etc, to obtain grant funds
- Negotiate lower pellet prices for a long term wood fuel contract and/or partnering with another pellet consumer to negotiate lower prices through bulk purchasing

This project is recommended to prove the concept of small-scale wood heating. It is also believed that the facility staff would be very interested in record-keeping for the purpose of building models of biomass heating in interior Alaska.

Site Specific Analysis: Cross Road Medical Center

General Description of Opportunity & Challenges

Cross Road Medical Center (CRMC) is a not-for-profit Community Health Center serving the residents of South Central Alaska. Since 1956, CRMC has been the only MD level provider of health care for an area nearly the size of West Virginia.

CEO Joel R. Medendorp, MBA, and CFO Kevin Dorsey, CPA, have been highly engaged in exploring the possibility of a wood energy project, with the primary goal being reducing costs. Mr. Medendorp also supports local economic development via local wood harvests, and has proposed allowing Clinic patients to offset their healthcare bills by paying with cordwood.

The facility appears to be well maintained and has a dedicated maintenance staff, who participated in all discussions regarding biomass heating.

The facility is comprised of three buildings: the Ambulance Garage and Clinic, which are heated by a single hydronic boiler system located in the Ambulance Garage, and the Admin building, which is heated by a separate hydronic boiler.

Technology or installation options assessed

The heat load of the facility would accommodate a cordwood or pellet boiler. Both containerized and new building construction options were considered for this report. Due to Mr. Medendorp's desire to construct a new ambulance bay, Dalson Energy recommends an addition onto the existing ambulance garage for congruency with the existing structure. One bay would be used for the boiler equipment and fuel trailer; the other would be used for trucks and other equipment. Both bays would be heated.


f

Figure 3: Above Left: Head Maintenance Manager Tim Sloma and CEO Joel Medendorp in front of the Clinic. Above Right: Foreground shows the existing boiler building and area for new biomass boiler installation. Background is Clinic. Below: Foreground Admin building, background shows the Clinic.

Project chart

Building Name **Building Owner** **Contact Information**	Administration building, Clinic, Garage (3) Cross Road Medical Center (non profit) Joel Medendorp, Kevin Dorsey
Square footage	21,640 sq. ft. Total. (Admin is 2,700 square feet; Clinic is 17,640 sq. ft; Garage is 1,300 sq. ft.)
Gallons per year, fuel oil #1	7,675 gallons

PRELIMINARY SITE INVESTIGATION	
What feedback did staff offer on the current heating system?	Goal to reduce cost. Interested in potential trade for cordwood in exchange for medical bills.
What is the staff or building manager's interest in biomass heating?	Very positive interest. Reduce costs. Willing to hire. Keep existing system as back up. Potential to use some hazardous fuels on the property in the biomass system for a few years of operation.
Description of current heating system	Garage and clinic are open 24/7. Admin operates as an office. The Garage and Clinic are heated by a single hydronic heating system, located in the garage, using about 6,000 gallons per year. The Admin building is heated by a single hydronic boiler, located on the Northwest corner of the building.
Available space (within existing structures or space for newly constructed building)	200 acres on site. Only 50 acres are developed.
Street access	Excellent acess to Glenn Hwy.
Delivery access	Excellent.
Fuel storage space	Excellent, with "day bin" space adequate, as well as long term storage on the "back 40."
Building or site constraints (topography, permitting, historical preservation, etc.)	These three buildings are within 130' of each other.
Options for biomass boiler system (fuel type, technology type, building type)	Cordwood option preferred for local fuel utilization, economic development, and potential to trade for medical bills. Total MMBTU is 959 per year. To offset 80% of the load, about 45 cords of firewood would be required (assumes 20% MC White Spruce Cordwood at 18.6 MMBTU/cord). Cordwood system of about 350,000 btu/hr is recommended. A GarnPac would serve this load well. System would be located on East side of Garage. A boiler plus new vehicle bay could be added. Trailer with cordwood could be backed into the Garage, then removed and reloaded when necessary.
Estimated Boiler Size	350,000 btu/hr cordwood

Preliminary Cost Estimating

Initial investment: Clinic, Option #1

Biomass System	
Rating -- Btu/hr	350,000
Btu stored	415,000

	footnote		notes
Building and Equipment Costs (B&E) $			
Fuel storage facility (gated gravel facility + trailer)	A	$ 1,500	
Boilers			
Base price	B	$ 30,000	
Shipping to Tok	C	$ 10,000	
Shipping to Glennallen	C	$ 2,000	
Boiler Building	D	$ 67,200	12' x 40'
Plumbing and electrical	C	$ 40,000	
Installation	C	$ 20,000	
District loop & building integration	E	$ 20,150	
Subtotal-B&E Costs		***$ 190,850***	
Contingency -- 20%		***$ 38,170***	
Grand Total		**$ 229,020**	
Soft Costs $			
Project Management		$ 18,322	8% of B&E
A/E Design Services		$ 27,482	12% of B&E
Fire Marshall Plan Review			included in design
Equipment Commissioning and Training	C	$ 4,000	
Construction Management		$ 18,322	8% of B&E
Subtotal -- Soft Costs		**$ 68,126**	
Recommended Project Budget -- Design and Construction		**$ 297,146**	

footnote

A	Long term storage at Shop/ Storage area
B	Based on quotes from viable suppliers
C	Estimate
D	$140/ sq ft
E	$15,000 per building integration (1 building). $35/ft for duel insulated pex pipe. $600 for trenching 130 feet.

Economic Analysis

Project Description	
Community	Glennallen
Nearest Fuel Community	Tok
Region	Rural
RE Technology	Woody biomass heat
Project ID	
Applicant Name	Cross Road Medical Center
Project Title	Glennallen Crossroads Medical Wood Heat
Category	

Results	
NPV Benefits	$347,927
NPV Capital Costs	$297,146
B/C Ratio	1.17
NPV Net Benefit	$50,781

Performance	Unit	Value
Displaced Electricity	kWh per year	-
Displaced Electricity	total lifetime kWh	-
Displaced Petroleum Fuel	gallons per year	7,675
Displaced Petroleum Fuel	total lifetime gallons	191,875
Displaced Natural Gas	mmBtu per year	-
Displaced Natural Gas	total lifetime mmBtu	-
Avoided CO2	tonnes per year	78
Avoided CO2	total lifetime tonnes	1,948

Proposed System	Unit	Value
Capital Costs	$	$ 297,146
Project Start	year	2013
Project Life	years	25
Displaced Electric	kWh per year	-
Displaced Heat	gallons displaced per year	6,140
Displaced Transportation	gallons displaced per year	0.00
Renewable Generation O&M	$ per BTU	
Electric Capacity	kW	0
Electric Capacity Factor	%	0
Heating Capacity	Btu/hr.	350,000
Heating Capacity Factor	%	86

Parameters	Unit	Value
Heating Fuel Premium	$ per gallon	$ 2.00
Transportation Fuel Premiu	$ per gallon	$ 1.00
Discount Rate	% per year	3%
Crude Oil	$ per barrel	EIA Mid
Natural Gas	$ per mmBtu	ISER - Mid

Heating		Units	2013	2014	2015	2016	2017	2018	2019	2020
Proposed										
	Renewable Heat	gallons displace	6,140	6,140	6,140	6,140	6,140	6,140	6,140	6,140
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 320	$ 323	$ 326	$ 330	$ 333	$ 336	$ 340	$ 343
Entered Value	Renewable Heat O&M	$ per year	$ 12,936	$ 13,065	$ 13,196	$ 13,328	$ 13,461	$ 13,596	$ 13,732	$ 13,869
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	45	45	45	45	45	45	45	45
Entered Value	Renewable Fuel Cost	$ per unit	$200.00	$202.00	$204.02	$206.06	$208.12	$210.20	$212.30	$214.43
	Total Renewable Fuel Cost	$ per year	$ 9,000	$ 9,090	$ 9,181	$ 9,273	$ 9,365	$ 9,459	$ 9,554	$ 9,649
	Remaining Fuel Oil (supplement)	gallons remainin	1535.00	1535.00	1535.00	1535.00	1535.00	1535.00	1535.00	1535.00
	Total Fuel Cost (supplement)	$ per year	$ 8,648	$ 9,133	$ 9,133	$ 9,565	$ 9,565	$ 10,123	$ 10,123	$ 10,632
	Proposed Heat Cost	**$ per year**	**$ 30,904**	**$ 31,612**	**$ 31,837**	**$ 32,495**	**$ 32,724**	**$ 33,514**	**$ 33,748**	**$ 34,494**
Base										
	Fuel Use	gallons per year	7,675	7,675	7,675	7,675	7,675	7,675	7,675	7,675
	Fuel Cost	$ per gallon	$5.63	$5.95	$5.95	$6.23	$6.23	$6.59	$6.59	$6.93
Entered Value	Fuel Scheduled Repairs	$ per year	$ 200	$ 202	$ 204	$ 206	$ 208	$ 210	$ 212	$ 214
Entered Value	Fuel O&M	$ per year	$ 750	$ 758	$ 765	$ 773	$ 780	$ 788	$ 796	$ 804
	Fuel Cost	$ per year	$ 43,238	$ 45,666	$ 45,666	$ 47,824	$ 47,824	$ 50,613	$ 50,613	$ 53,162
	Base Heating Cost	**$ per year**	**$ 44,188**	**$ 46,626**	**$ 46,635**	**$ 48,803**	**$ 48,812**	**$ 51,611**	**$ 51,621**	**$ 54,181**

Heating		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed											
	Renewable Heat	6,140	6,140	6,140	6,140	6,140	6,140	6,140	6,140	6,140	6,140
Entered Value	Renewable Heat Scheduled Repairs	$ 347	$ 350	$ 353	$ 357	$ 361	$ 364	$ 368	$ 372	$ 375	$ 379
Entered Value	Renewable Heat O&M	$14,008	$14,148	$14,289	$14,432	$14,577	$14,722	$14,870	$15,018	$15,168	$15,320
Entered Value	Renewable Fuel Use Quantity (Biomass)	45	45	45	45	45	45	45	45	45	45
Entered Value	Renewable Fuel Cost	$216.57	$218.74	$220.92	$223.13	$225.37	$227.62	$229.89	$232.19	$234.52	$236.86
	Total Renewable Fuel Cost	$ 9,746	$ 9,843	$ 9,942	$10,041	$10,141	$10,243	$10,345	$10,449	$10,553	$10,659
	Remaining Fuel Oil (supplement)	1535.00	1535.00	1535.00	1535.00	1535.00	1535.00	1535.00	1535.00	1535.00	1535.00
	Total Fuel Cost (supplement)	$10,632	$11,063	$11,063	$11,449	$11,449	$11,787	$11,787	$12,044	$12,044	$12,231
	Proposed Heat Cost	**$34,733**	**$35,404**	**$35,648**	**$36,279**	**$36,527**	**$37,116**	**$37,369**	**$37,882**	**$38,141**	**$38,589**
Base											
	Fuel Use	7,675	7,675	7,675	7,675	7,675	7,675	7,675	7,675	7,675	7,675
	Fuel Cost	$6.93	$7.21	$7.21	$7.46	$7.46	$7.68	$7.68	$7.85	$7.85	$7.97
Entered Value	Fuel Scheduled Repairs	$ 217	$ 219	$ 221	$ 223	$ 225	$ 228	$ 230	$ 232	$ 235	$ 237
Entered Value	Fuel O&M	$ 812	$ 820	$ 828	$ 837	$ 845	$ 854	$ 862	$ 871	$ 879	$ 888
	Fuel Cost	$53,162	$55,317	$55,317	$57,244	$57,244	$58,933	$58,933	$60,218	$60,218	$61,157
	Base Heating Cost	**$54,191**	**$56,356**	**$56,366**	**$58,303**	**$58,314**	**$60,014**	**$60,025**	**$61,321**	**$61,332**	**$62,282**

Heating		2031	2032	2033	2034	2035	2036	2037	PV
Proposed									
	Renewable Heat	6,140	6,140	6,140	6,140	6,140	6,140	6,140	
Entered Value	Renewable Heat Scheduled Repairs	$ 383	$ 387	$ 390	$ 394	$ 398	$ 402	$ 406	**$6,200**
Entered Value	Renewable Heat O&M	$15,473	$15,628	$15,784	$15,942	$16,102	$16,263	$16,425	**$250,637**
Entered Value	Renewable Fuel Use Quantity (Biomass)	45	45	45	45	45	45	45	
Entered Value	Renewable Fuel Cost	$239.23	$241.62	$244.04	$246.48	$248.94	$251.43	$253.95	
	Total Renewable Fuel Cost	$10,765	$10,873	$10,982	$11,092	$11,202	$11,314	$11,428	
	Remaining Fuel Oil (supplement)	1535.00	1535.00	1535.00	1535.00	1535.00	1535.00	1535.00	
	Total Fuel Cost (supplement)	$12,231	$12,336	$12,336	$12,419	$12,419	$12,610	$12,610	
	Proposed Heat Cost	**$ 38,853**	**$ 39,224**	**$ 39,493**	**$ 39,848**	**$ 40,122**	**$ 40,589**	**$ 40,869**	**$621,397**
Base									
	Fuel Use	7,675	7,675	7,675	7,675	7,675	7,675	7,675	
	Fuel Cost	$7.97	$8.04	$8.04	$8.09	$8.09	$8.21	$8.21	
Entered Value	Fuel Scheduled Repairs	$ 239	$ 242	$ 244	$ 246	$ 249	$ 251	$ 254	**$3,875**
Entered Value	Fuel O&M	$ 897	$ 906	$ 915	$ 924	$ 934	$ 943	$ 952	**$14,531**
	Fuel Cost	$61,157	$61,682	$61,682	$62,097	$62,097	$63,048	$63,048	**$950,918**
	Base Heating Cost	**$ 62,293**	**$ 62,829**	**$ 62,841**	**$ 63,268**	**$ 63,280**	**$ 64,242**	**$ 64,254**	**$969,325**

General perspective of project viability, and recommended next steps

This project has strong economic and operational feasibility. It has all the attributes of a project that will thrive operationally: motivated and capable staff, appropriate technology for available fuels and operating requirements, and simple building interconnections. This project will demonstrate the viability of small-scale biomass heating to a variety of commercial and municipal buildings using cordwood.

This project also underlines an essential aspect of heating with wood in places like Glennallen: ultimately, heating with wood is about thriving rural communities. This project will result in cost savings and economic development to the region, as well as a few happy patients who are able to offset health care costs with cordwood.

This project is recommended to demonstrate the concept of small-scale wood heating with cordwood. It is also believed that the facility staff would be very interested in record-keeping for the purpose of building models of biomass heating in interior Alaska.

Site Specific Analysis: Community Chapel

General Description of Opportunity & Challenges

The Glennallen Community Chapel is a community building used for Church services and community events, such as weddings.

Pastor Nathan Weimer expressed interest in a cordwood heating system for its potential to reduce utility costs and provide reliable heat. However, he stressed that the Chapel would need to hire someone to stoke the boiler.

Technology or installation options assessed

Because of the relatively low fuel oil consumption, the only options considered were cordwood and pellet heating systems. Because the Chapel staff preferred local resource utilization and manual stoking, one recommended option is cordwood. This facility may be able to contract a third party to perform Operations and Maintenance.

Figure 4: Left -- Pastor Nathan Weimer with his Church. Right: West side of the Church, where the biomass boiler unit would be positioned.

Project chart

Building Name	Glennallen Community Chapel
Building Owner	Glennallen Community Chapel
Contact Information	James Fields 907 320 0334; also Nathan Weimer (pastor) 907 822-3499
Square footage and number of buildings	10,000 sq ft; 1 bldg
Gallons per year, fuel oil #1	2,800 gallons

PRELIMINARY SITE INVESTIGATION	
What feedback did staff offer on the current heating system?	Would need to hire staff. Not afraid of cordwood system. Would like to use local resources.
What is the staff or building manager's interest in biomass heating?	Lowering cost
Description of current heating system	Two (2) hydronic fuel oil boilers, 152,000 btu/hr each. Maintenance is completed by the landlord. The leasee calls when there are problems. Some leaking on boilers and stacks. There may be the possibility to lower cost through improved insulation.
Available space (within existing structures or space for newly constructed building)	There is no space within the structure but there is adequate space for the boiler and fuel storage in the parking lot on the West side of the building (approximately 20' x 60'). The parking lot is used for weddings, so some aesthetic consideration of the boiler building exterior is advised.
Street access	Excellent
Delivery access	Excellent
Fuel storage space	Excellent, with additional space via clearing land on property. Approximately 3 -- 4 acres is owned by the Church.
Building or site constraints (topography, permitting, historical preservation, etc.)	used for weddings; other than that it is a parking lot
Options for biomass boiler system (fuel type, technology type, building type)	Preference for cordwood; concern about price and availability; to offset 80% of current annual load would require approximately 20 cords of seasoned cordwood (assumed 20% moisture content White Spruce at 18.6 MMBTU/cord)
Estimated Boiler Size	120,000 btu/hr cordwood boiler

Preliminary Cost Estimating

Initial investment: Chapel

Biomass System	
Rating -- Btu/hr	120,000
Btu stored	160,000

	footnote		*notes*
Building and Equipment Costs (B&E) $			
Fuel Storage Building (fabricated building, gravel pad, $27/sf)	A	$ 10,800	(20 cds @ 20 sq. ft. / cd.)
Pre-Fabricated Boiler System			
Base price	C	$ 93,000	
Shipping to Tok	C	$ 20,000	
Delivery to Glennallen	C	$ 3,000	
Plumbing and electrical	C	$ 2,500	
Site Prep	C	$ 4,500	
Installation	C	$ 6,000	
Subtotal-B&E Costs		***$ 139,800***	
Contingency -- 20%		***$ 27,960***	
Grand Total		**$ 167,760**	
Soft Costs $			
Project Management	C	$ 13,421	8% of B&E
A/E Design Services	C	$ 10,066	6% of B&E
Fire Marshall Plan Review	C		pre-approved
Equipment Commissioning and Training	C	$ 4,000	
Construction Management	C	$ 13,421	8% B&E
Subtotal -- Soft Costs		**$ 40,907**	
Recommended Project Budget -- Design and Construction Costs		**$ 208,667**	

footnote	
A	Long term storage at back field
B	Based on quotes from viable suppliers
C	Estimate

Economic Analysis

AEA B/C Model_Chapel

Project Description	
Community	Glennallen
Nearest Fuel Community	Tok
Region	Rural
RE Technology	Woody biomass heat
Project ID	
Applicant Name	Community Chapel
Project Title	Glennallen Community Chapel Wood Heat
Category	

Results	
NPV Benefits	$20,521
NPV Capital Costs	$208,667
B/C Ratio	0.10
NPV Net Benefit	($188,146)

Performance	Unit	Value
Displaced Electricity	kWh per year	-
Displaced Electricity	total lifetime kWh	-
Displaced Petroleum Fuel	gallons per year	2,240
Displaced Petroleum Fuel	total lifetime gallons	60,000
Displaced Natural Gas	mmBtu per year	-
Displaced Natural Gas	total lifetime mmBtu	-
Avoided CO2	tonnes per year	23
Avoided CO2	total lifetime tonnes	609

Proposed System	Unit	Value
Capital Costs	$	$ 208,667
Project Start	year	2013
Project Life	years	25
Displaced Electric	kWh per year	-
Displaced Heat	gallons displaced per year	2,240
Displaced Transportation	gallons displaced per year	0.00
Renewable Generation O&I	$ per BTU	0.000029
Electric Capacity	kW	0
Electric Capacity Factor	%	0
Heating Capacity	Btu/hr.	120,000
Heating Capacity Factor	%	86

Base System	Unit	Value
Diesel Generator O&M	$ per kWh	$ 0.033
Diesel Generation Efficienc	kWh per gallon	

Parameters	Unit	Value
Heating Fuel Premium	$ per gallon	$ 2.00
Transportation Fuel Premiu	$ per gallon	$ 1.00
Discount Rate	% per year	3%
Crude Oil	$ per barrel	EIA Mid
Natural Gas	$ per mmBtu	ISER - Mid

Heating		Units	2013	2014	2015	2016	2017	2018	2019	2020
Proposed										
	Renewable Heat	gallons displace	2,240	2,240	2,240	2,240	2,240	2,240	2,240	2,240
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 320	$ 323	$ 326	$ 330	$ 333	$ 336	$ 340	$ 343
Entered Value	Renewable Heat O&M	$ per year	$ 10,300	$ 10,403	$ 10,507	$ 10,612	$ 10,718	$ 10,825	$ 10,934	$ 11,043
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	20	20	20	20	20	20	20	20
Entered Value	Renewable Fuel Cost	$ per unit	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00
	Total Renewable Fuel Cost	$ per year	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000
	Remaining Fuel Oil (supplement)	gallons remainin	160.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00
	Total Fuel Cost (supplement)	$ per year	$ 901	$ 952	$ 952	$ 997	$ 997	$ 1,055	$ 1,055	$ 1,108
	Proposed Heat Cost	**$ per year**	**$ 15,521**	**$ 15,678**	**$ 15,785**	**$ 15,939**	**$ 16,048**	**$ 16,217**	**$ 16,328**	**$ 16,494**
Base										
	Fuel Use	gallons per year	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
	Fuel Cost	$ per gallon	$5.63	$5.95	$5.95	$6.23	$6.23	$6.59	$6.59	$6.93
Entered Value	Fuel Scheduled Repairs	$ per year	$ 200	$ 202	$ 204	$ 206	$ 208	$ 210	$ 212	$ 214
Entered Value	Fuel O&M	$ per year	$ 750	$ 758	$ 765	$ 773	$ 780	$ 788	$ 796	$ 804
	Fuel Cost	$ per year	$ 13,521	$ 14,280	$ 14,280	$ 14,955	$ 14,955	$ 15,827	$ 15,827	$ 16,624
	Base Heating Cost	**$ per year**	**$ 14,471**	**$ 15,240**	**$ 15,249**	**$ 15,933**	**$ 15,943**	**$ 16,825**	**$ 16,835**	**$ 17,643**

Heating		Units	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed												
	Renewable Heat	gallons displace	2,240	2,240	2,240	2,240	2,240	2,240	2,240	2,240	2,240	2,240
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 347	$ 350	$ 353	$ 357	$ 361	$ 364	$ 368	$ 372	$ 375	$ 379
Entered Value	Renewable Heat O&M	$ per year	$ 11,153	$ 11,265	$ 11,378	$ 11,491	$ 11,606	$ 11,722	$ 11,840	$ 11,958	$ 12,078	$ 12,198
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	20	20	20	20	20	20	20	20	20	20
Entered Value	Renewable Fuel Cost	$ per unit	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00
	Total Renewable Fuel Cost	$ per year	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000
	Remaining Fuel Oil (supplement)	gallons remainin	160.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00
	Total Fuel Cost (supplement)	$ per year	$ 1,108	$ 1,153	$ 1,153	$ 1,193	$ 1,193	$ 1,229	$ 1,229	$ 1,255	$ 1,255	$ 1,275
	Proposed Heat Cost	**$ per year**	**$ 16,608**	**$ 16,768**	**$ 16,884**	**$ 17,042**	**$ 17,160**	**$ 17,315**	**$ 17,436**	**$ 17,585**	**$ 17,708**	**$ 17,852**
Base												
	Fuel Use	gallons per year	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
	Fuel Cost	$ per gallon	$6.93	$7.21	$7.21	$7.46	$7.46	$7.68	$7.68	$7.85	$7.85	$7.97
Entered Value	Fuel Scheduled Repairs	$ per year	$ 217	$ 219	$ 221	$ 223	$ 225	$ 228	$ 230	$ 232	$ 235	$ 237
Entered Value	Fuel O&M	$ per year	$ 812	$ 820	$ 828	$ 837	$ 845	$ 854	$ 862	$ 871	$ 879	$ 888
	Fuel Cost	$ per year	$ 16,624	$ 17,298	$ 17,298	$ 17,900	$ 17,900	$ 18,429	$ 18,429	$ 18,830	$ 18,830	$ 19,124
	Base Heating Cost	**$ per year**	**$ 17,653**	**$ 18,337**	**$ 18,347**	**$ 18,960**	**$ 18,971**	**$ 19,510**	**$ 19,521**	**$ 19,933**	**$ 19,944**	**$ 20,249**

Heating			Units	2031	2032	2033	2034	2035	2036	2037	PV
Proposed											
		Renewable Heat	gallons displaced	2,240	2,240	2,240	2,240	2,240	2,240	2,240	
	Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 383	$ 387	$ 390	$ 394	$ 398	$ 402	$ 406	**$6,200**
	Entered Value	Renewable Heat O&M	$ per year	$ 12,320	$ 12,444	$ 12,568	$ 12,694	$ 12,821	$ 12,949	$ 13,078	**$199,564**
	Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	20	20	20	20	20	20	20	
	Entered Value	Renewable Fuel Cost	$ per unit	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00	
		Total Renewable Fuel Cost	$ per year	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	
		Remaining Fuel Oil (supplement)	gallons remaining	160.00	160.00	160.00	160.00	160.00	160.00	160.00	
		Total Fuel Cost (supplement)	$ per year	$ 1,275	$ 1,286	$ 1,286	$ 1,295	$ 1,295	$ 1,314	$ 1,314	
		Proposed Heat Cost	**$ per year**	**$ 17,978**	**$ 18,116**	**$ 18,244**	**$ 18,383**	**$ 18,513**	**$ 18,665**	**$ 18,799**	**$295,241**
Base											
		Fuel Use	gallons per year	2,400	2,400	2,400	2,400	2,400	2,400	2,400	
		Fuel Cost	$ per gallon	$7.97	$8.04	$8.04	$8.09	$8.09	$8.21	$8.21	
	Entered Value	Fuel Scheduled Repairs	$ per year	$ 239	$ 242	$ 244	$ 246	$ 249	$ 251	$ 254	**$3,875**
	Entered Value	Fuel O&M	$ per year	$ 897	$ 906	$ 915	$ 924	$ 934	$ 943	$ 952	**$14,531**
		Fuel Cost	$ per year	$ 19,124	$ 19,288	$ 19,288	$ 19,418	$ 19,418	$ 19,715	$ 19,715	**$297,356**
		Base Heating Cost	**$ per year**	**$ 20,260**	**$ 20,436**	**$ 20,447**	**$ 20,589**	**$ 20,601**	**$ 20,910**	**$ 20,922**	**$315,762**

General perspective of project viability, and recommended next steps

Technically, a new biomass boiler unit has strong viability. It could sit directly adjacent to the existing boiler room and easily tie in. However, there is some concern about the capacity of (volunteer?) maintenance staff. The existing boiler room appeared to have deferred maintenance issues. The building owners are interested, but it is not clear what level of involvement they would have in operating the unit. Third party O&M contracting may be a good option for this facility.

This project has a low financial rating, based on B/C ratio for offsetting fossil fuels at current costs, and given the relatively low overall fuel usage.

Site Specific Analysis: Prince William Sound Community College

General Description of Opportunity & Challenges

Prince William Sound Community College is an extension office of the main campus located in Valdez, Alaska. The College offers a variety of accredited courses and community training courses, such as emergency response.

Technology or installation options assessed

The college has only two full-time staff, and no maintenance personnel. Because of the limited availability of current staff, only a fully automated system was considered, based on feedback from the Community College personnel. The project is too small to justify the cost and complexity of a wood chip boiler. Therefore, a pellet boiler was the only technology considered for this report.

This facility may be able to contract a third-party to perform Operations and Maintenance (O&M), similar to AK DOF and the Glennallen Community Chapel. A community workforce development project could be initiated to recruit and train an O&M contractor, for the benefit of several installations in the Glennallen area.

Because of the low volume of fuel usage, a small pellet trough was assumed to be built into the container system. The trough would be made of wood, and could be filled from above by 40 lb bags. A forklift could lift up the pallet of pellets for filling from above.

Alternatively, a metal grain-style silo or equivalent could be employed. One challenge is that a typical bulk pellet fuel delivery truck carries 16 – 27 tons of pellets (nearly a full year supply for the College), but the storage devices for this volume are not easily filled by hand. Because of the low volume of wood fuel usage, and the prospects for using 40 lb. bags of pellets rather than automatic filling, the economic analysis in this report assumes a wooden trough style storage structure built into the containerized boiler system.

Figure 5: Left: Face of Prince William Sound Community College. Right: East side of the facility, where the biomass boiler facility would be positioned.

Project chart

Glennallen Cluster

Building Name	Glennallen Campus Buildings
Building Owner	Prince William Sound Community College
Contact Information	James Fields, 907 320 0334
Square footage and number of buildings	5,780 square feet total
Gallons per year, fuel oil #1	4,500 gallons

PRELIMINARY SITE INVESTIGATION	
What feedback did staff offer on the current heating system?	This building is leased by University of Alaska Anchorage via Prince William Sound Community College. The building is owned and maintained by Homestead Enterprise. The Community College staff call Homestead Enterprise when there is a problem. There is no on-site maintenance staff. Both owners of Homestead Enterprise are in the construction and supply business, with extensive knowledge of boilers, plumbing, mechanical maintenance.
What is the staff or building manager's interest in biomass heating?	Staff of the Community College hope to avoid lease fuel surcharge clauses as a result of stable fuel costs.
Description of current heating system	Single hydronic boiler, 266 MBH Burnham. Very old and appears to be leaky and potentially dangerous. Stack also shows residues.
Available space (within existing structures or space for newly constructed building)	Very adequate space immediately outside boiler room on the East side of the building in the gravel drive.
Street access	Excellent.
Delivery access	Excellent.
Fuel storage space	Excellent.
Building or site constraints (topography, permitting, historical preservation, etc.)	none
Options for biomass boiler system (fuel type, technology type, building type)	Because there is no existing maintenance staff, a highly automated heat system is preferred. At the scale of of the facility, pellets appear to be the preferred option. Peak load is about 260,000 btu/hr. Recommended biomass size is about 150,000 btu/hr. About 37 tons of pellets needed per year.
Boiler size	164,000 btu/hr pellet boiler

Preliminary Cost Estimating

Initial investment: Price William Sound Community College

Biomass System	
System Rating -- Btu/hr	164,000 btu/hr
Buffer tank	380 gal.

	footnote		notes
Building and Equipment Costs (B&E) $			
Pellet storage structure	A	$ 10,000	
Pre-Fabricated Boiler System			
Base price	B	$ 186,000	
Shipping to Tok	C	$ 10,000	
Local delivery	C	$ 2,000	
Plumbing and electrical	C	$ 2,500	
Site Prep	C	$ 4,500	
Installation	C	$ 6,000	
Subtotal-B&E Costs		***$ 221,000***	
Contingency -- 20%		***$ 44,200***	
Grand Total		**$ 265,200**	
Soft Costs $			
Project Management	C	$ 21,216	8% of B&E
A/E Design Services	C	$ 15,912	6% of B&E
Fire Marshall Plan Review			pre-approved
Equipment Commissioning and Training	C	$ 4,000	
Construction Management	C	$ 21,216	8% B&E
Subtotal -- Soft Costs		**$ 62,344**	
Recommended Project Budget -- Design and Construction Costs		**$ 327,544**	

footnote	
A	Square bulk silo or pre-fabricated building with V-shaped storage trough, built of wood into container. Waterproof hatch. Fill from above.
B	Based on quotes from viable suppliers
C	Estimate

Economic Analysis

Project Description	
Community	Glennallen
Nearest Fuel Community	Tok
Region	Rural
RE Technology	Woody biomass heat
Project ID	
Applicant Name	Prince William Sound Community College
Project Title	PWSCC Wood Heat
Category	

Results		
NPV Benefits	$108,084	
NPV Capital Costs	$327,544	Low
B/C Ratio	0.33	Med
NPV Net Benefit	($219,460)	High

Performance	Unit	Value
Displaced Electricity	kWh per year	-
Displaced Electricity	total lifetime kWh	-
Displaced Petroleum Fuel	gallons per year	4,050
Displaced Petroleum Fuel	total lifetime gallons	112,500
Displaced Natural Gas	mmBtu per year	-
Displaced Natural Gas	total lifetime mmBtu	-
Avoided CO2	tonnes per year	41
Avoided CO2	total lifetime tonnes	1,142

Proposed System	Unit	Value
Capital Costs	$	$ 327,544
Project Start	year	2013
Project Life	years	25
Displaced Electric	kWh per year	-
Displaced Heat	gallons displaced per year	4,050
Displaced Transportation	gallons displaced per year	0.00
Renewable Generation O&M	$ per BTU	
Electric Capacity	kW	0
Electric Capacity Factor	%	0
Heating Capacity	Btu/hr.	150,000
Heating Capacity Factor	%	86

Base System	Unit	Value
Diesel Generator O&M	$ per kWh	$ 0.033
Diesel Generation Efficienc	kWh per gallon	

Parameters	Unit	Value
Heating Fuel Premium	$ per gallon	$ 2.00
Transportation Fuel Premiu	$ per gallon	$ 1.00
Discount Rate	% per year	3%
Crude Oil	$ per barrel	EIA Mid
Natural Gas	$ per mmBtu	ISER - Mid

Heating		Units	2013	2014	2015	2016	2017	2018	2019	2020
Proposed										
	Renewable Heat	gallons displace	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 320	$ 323	$ 326	$ 330	$ 333	$ 336	$ 340	$ 343
Entered Value	Renewable Heat O&M	$ per year	$ 8,000	$ 8,080	$ 8,161	$ 8,242	$ 8,325	$ 8,408	$ 8,492	$ 8,577
Entered Value	Renewable Fuel Use Quantity (Biomass)	green tons	37	37	37	37	37	37	37	37
Entered Value	Renewable Fuel Cost	$ per unit	$350	$354	$357	$361	$364	$368	$372	$375
	Total Renewable Fuel Cost	$ per year	$ 12,950	$ 13,080	$ 13,210	$ 13,342	$ 13,476	$ 13,611	$ 13,747	$ 13,884
	Remaining Fuel Oil (supplement)	gallons remainin	450	450	450	450	450	450	450	450
	Total Fuel Cost (supplement)	$ per year	$ 2,535	$ 2,678	$ 2,678	$ 2,804	$ 2,804	$ 2,968	$ 2,968	$ 3,117
	Proposed Heat Cost	**$ per year**	**$ 23,805**	**$ 24,160**	**$ 24,375**	**$ 24,719**	**$ 24,938**	**$ 25,322**	**$ 25,546**	**$ 25,921**
Base										
	Fuel Use	gallons per year	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
	Fuel Cost	$ per gallon	$5.63	$5.95	$5.95	$6.23	$6.23	$6.59	$6.59	$6.93
Entered Value	Fuel Scheduled Repairs	$ per year	$ 200	$ 202	$ 204	$ 206	$ 208	$ 210	$ 212	$ 214
Entered Value	Fuel O&M	$ per year	$ 750	$ 758	$ 765	$ 773	$ 780	$ 788	$ 796	$ 804
	Fuel Cost	$ per year	$ 25,351	$ 26,775	$ 26,775	$ 28,040	$ 28,040	$ 29,675	$ 29,675	$ 31,170
	Base Heating Cost	**$ per year**	**$ 26,301**	**$ 27,735**	**$ 27,744**	**$ 29,019**	**$ 29,029**	**$ 30,674**	**$ 30,684**	**$ 32,189**

Heating		Units	2021	2022	2023	2024	2025	2026	2027	2028	2029
Proposed											
	Renewable Heat	gallons displace	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 347	$ 350	$ 353	$ 357	$ 361	$ 364	$ 368	$ 372	$ 375
Entered Value	Renewable Heat O&M	$ per year	$ 8,663	$ 8,749	$ 8,837	$ 8,925	$ 9,015	$ 9,105	$ 9,196	$ 9,288	$ 9,381
Entered Value	Renewable Fuel Use Quantity (Biomass)	green tons	37	37	37	37	37	37	37	37	37
Entered Value	Renewable Fuel Cost	$ per unit	$379	$383	$387	$390	$394	$398	$402	$406	$410
	Total Renewable Fuel Cost	$ per year	$ 14,023	$ 14,163	$ 14,305	$ 14,448	$ 14,592	$ 14,738	$ 14,886	$ 15,035	$ 15,185
	Remaining Fuel Oil (supplement)	gallons remainin	450	450	450	450	450	450	450	450	450
	Total Fuel Cost (supplement)	$ per year	$ 3,117	$ 3,243	$ 3,243	$ 3,356	$ 3,356	$ 3,455	$ 3,455	$ 3,531	$ 3,531
	Proposed Heat Cost	**$ per year**	**$ 26,149**	**$ 26,506**	**$ 26,739**	**$ 27,087**	**$ 27,324**	**$ 27,663**	**$ 27,905**	**$ 28,225**	**$ 28,471**
Base											
	Fuel Use	gallons per year	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
	Fuel Cost	$ per gallon	$6.93	$7.21	$7.21	$7.46	$7.46	$7.68	$7.68	$7.85	$7.85
Entered Value	Fuel Scheduled Repairs	$ per year	$ 217	$ 219	$ 221	$ 223	$ 225	$ 228	$ 230	$ 232	$ 235
Entered Value	Fuel O&M	$ per year	$ 812	$ 820	$ 828	$ 837	$ 845	$ 854	$ 862	$ 871	$ 879
	Fuel Cost	$ per year	$ 31,170	$ 32,433	$ 32,433	$ 33,563	$ 33,563	$ 34,554	$ 34,554	$ 35,307	$ 35,307
	Base Heating Cost	**$ per year**	**$ 32,199**	**$ 33,472**	**$ 33,483**	**$ 34,623**	**$ 34,634**	**$ 35,635**	**$ 35,646**	**$ 36,410**	**$ 36,421**

Heating		Units	2030	2031	2032	2033	2034	2035	2036	2037	PV
Proposed											
	Renewable Heat	gallons displace	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050	
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 379	$ 383	$ 387	$ 390	$ 394	$ 398	$ 402	$ 406	**$6,200**
Entered Value	Renewable Heat O&M	$ per year	$ 9,474	$ 9,569	$ 9,665	$ 9,762	$ 9,859	$ 9,958	$ 10,057	$ 10,158	**$155,001**
Entered Value	Renewable Fuel Use Quantity (Biomass)	green tons	37	37	37	37	37	37	37	37	
Entered Value	Renewable Fuel Cost	$ per unit	$415	$419	$423	$427	$431	$436	$440	$444	
	Total Renewable Fuel Cost	$ per year	$ 15,337	$ 15,490	$ 15,645	$ 15,801	$ 15,959	$ 16,119	$ 16,280	$ 16,443	
	Remaining Fuel Oil (supplement)	gallons remainin	450	450	450	450	450	450	450	450	
	Total Fuel Cost (supplement)	$ per year	$ 3,586	$ 3,586	$ 3,617	$ 3,617	$ 3,641	$ 3,641	$ 3,697	$ 3,697	
	Proposed Heat Cost	**$ per year**	**$ 28,776**	**$ 29,028**	**$ 29,313**	**$ 29,570**	**$ 29,854**	**$ 30,116**	**$ 30,436**	**$ 30,704**	**$467,864**
Base											
	Fuel Use	gallons per year	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
	Fuel Cost	$ per gallon	$7.97	$7.97	$8.04	$8.04	$8.09	$8.09	$8.21	$8.21	
Entered Value	Fuel Scheduled Repairs	$ per year	$ 237	$ 239	$ 242	$ 244	$ 246	$ 249	$ 251	$ 254	**$3,875**
Entered Value	Fuel O&M	$ per year	$ 888	$ 897	$ 906	$ 915	$ 924	$ 934	$ 943	$ 952	**$14,531**
	Fuel Cost	$ per year	$ 35,857	$ 35,857	$ 36,165	$ 36,165	$ 36,409	$ 36,409	$ 36,966	$ 36,966	**$557,542**
	Base Heating Cost	**$ per year**	**$ 36,982**	**$ 36,994**	**$ 37,313**	**$ 37,324**	**$ 37,580**	**$ 37,591**	**$ 38,161**	**$ 38,173**	**$575,948**

General perspective of project viability, and recommended next steps

Technically, a new biomass boiler unit has strong viability. It could sit directly adjacent to the existing boiler room and easily tie in. However, there is some concern about the capacity of the tenant for maintenance. The existing boiler room is under-maintained and potentially dangerous, and the building owner was not able to be contacted and did not return phone calls. A pellet boiler could be viable in terms of its low maintenance requirements, and the possibility of a local contractor servicing several local pellet boilers. An O&M contract with a third party is also a viable wood-heating option.

Site Specific Analysis: Chistochina School

General Description of Opportunity & Challenges

The Chistochina School building no longer operates as a School, due to low enrollment. However, the School is still State property. Currently, the School is being leased by George Drinkwater of Cheesh'na Tribal Council. It will be used for a variety of community activities, such as community education and recreational activities. The School has provided a letter explaining the closure. It is currently leased to the contractor that is building a new clinic.

The building was recommended for consideration because the utility costs inhibit the ability of the tribe to use it as a community center, according to the application.

Technology or installation options assessed

There are no maintenance personnel, or full time staff. Because of the lack of availability of current staff, only a fully automated system was considered, based on feedback from the building Leasee, Mr. Drinkwater. The project is too small to accommodate a wood chip boiler. Therefore, a pellet boiler was the only technology considered.

An O&M contract with a third party is also a viable wood-heating option. This option could accommodate a cordwood boiler. Given the School's heat load, the project financial profile of a cordwood boiler project would be similar to that of the Glennallen Community Chapel.

Project chart

Building Name	Chistochina school
Building Owner	Copper River School District
Contact Information	George Drinkwater, Lessee. Michael Johnson, Superintendent
Square footage	5,604 square feet, 1 building

PRELIMINARY SITE INVESTIGATION	
What feedback did staff offer on the current heating system?	School is closed as a result of low enrollment (<10 students). George Drinkwater of Cheesh'na Tribal Council leased the school property for uses to be determined, but it could include community education and recreational activities.
What is the staff or building manager's interest in biomass heating?	Superintendent provided letter explaining school closure. Lessee is interested in automated heating system (woodchip, puck or pellet-fired system) for reduced cost.
Description of current heating system	#1 fuel oil-fired boiler system
Available space (within existing structures or space for newly constructed building)	Limited space inside buildings. Open space around school building is available; 5,640 square feet
Street access	Good access from paved roads
Delivery access	Good access for trucks or delivery vehicles
Fuel storage space	Good space for storage buildings or silo
Building or site constraints (topography, permitting, historical preservation, etc.)	None identified
Options for biomass boiler system (fuel type, technology type, building type)	Pellet boiler with external storage silo, or other automated system most appropriate. Approximately 20 tons of pellets per year.
Estimated boiler size	120,000 btu/hr pellet

Preliminary Cost Estimating

Initial investment: Chistochina School

Biomass System	
System Rating -- Btu/hr	120,000
Buffer tank	350 gal.

	footnote		*notes*
Building and Equipment Costs (B&E) $			
Pellet storage structure	A	$ 10,000	
Pre-Fabricated Boiler System			
Base price	B	$ 186,000	
Shipping to Tok	C	$ 10,000	
Local delivery	C	$ 2,000	
Plumbing and electrical	C	$ 2,500	
Site Prep	C	$ 4,500	
Installation	C	$ 6,000	
Subtotal-B&E Costs		***$ 221,000***	
Contingency -- 20%		***$ 44,200***	
Grand Total		**$ 265,200**	
Soft Costs $			
Project Management	C	$ 21,216	8% of B&E
A/E Design Services	C	$ 15,912	6% of B&E
Fire Marshall Plan Review			pre-approved
Equipment Commissioning and Training	C	$ 4,000	
Construction Management	C	$ 21,216	8% B&E
Subtotal -- Soft Costs		**$ 62,344**	
Recommended Project Budget -- Design and Construction Costs		**$ 327,544**	

footnote	
	Square bulk silo or pre-fabricated building with V-shaped storage trough, built of wood into container.
A	Waterproof hatch. Fill from above.
B	Estimated from quotes from viable suppliers
C	Estimate

Economic Analysis

Project Description	
Community	Glennallen
Nearest Fuel Community	Tok
Region	Rural
RE Technology	Woody biomass heat
Project ID	
Applicant Name	Chistochina School
Project Title	Chistochina School Wood Heat
Category	

Results	
NPV Benefits	($1,786)
NPV Capital Costs	$327,544
B/C Ratio	(0.01)
NPV Net Benefit	($329,330)

Performance	Unit	Value
Displaced Electricity	kWh per year	-
Displaced Electricity	total lifetime kWh	-
Displaced Petroleum Fuel	gallons per year	2,400
Displaced Petroleum Fuel	total lifetime gallons	60,000
Displaced Natural Gas	mmBtu per year	-
Displaced Natural Gas	total lifetime mmBtu	-
Avoided CO2	tonnes per year	24
Avoided CO2	total lifetime tonnes	609

Proposed System	Unit	Value
Capital Costs	$	$ 327,544
Project Start	year	2013
Project Life	years	25
Displaced Electric	kWh per year	-
Displaced Heat	gallons displaced per year	1,920
Displaced Transportation	gallons displaced per year	0.00
Renewable Generation O&I	$ per BTU	
Electric Capacity	kW	0
Electric Capacity Factor	%	0
Heating Capacity	Btu/hr.	120,000
Heating Capacity Factor	%	86

Base System	Unit	Value
Diesel Generator O&M	$ per kWh	$ 0.033
Diesel Generation Efficienc	kWh per gallon	

Parameters	Unit	Value
Heating Fuel Premium	$ per gallon	$ 2.00
Transportation Fuel Premiu	$ per gallon	$ 1.00
Discount Rate	% per year	3%
Crude Oil	$ per barrel	EIA Mid
Natural Gas	$ per mmBtu	ISER - Mid

Heating		Units	2013	2014	2015	2016	2017	2018	2019	2020
Proposed										
	Renewable Heat	gallons displace	1,920	1,920	1,920	1,920	1,920	1,920	1,920	1,920
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 320	$ 323	$ 326	$ 330	$ 333	$ 336	$ 340	$ 343
Entered Value	Renewable Heat O&M	$ per year	$ 6,000	$ 6,060	$ 6,121	$ 6,182	$ 6,244	$ 6,306	$ 6,369	$ 6,433
Entered Value	Renewable Fuel Use Quantity (Biomass)	tons	20	20	20	20	20	20	20	20
Entered Value	Renewable Fuel Cost	$ per unit	$350.00	$353.50	$357.04	$360.61	$364.21	$367.85	$371.53	$375.25
	Total Renewable Fuel Cost	$ per year	$ 7,000	$ 7,070	$ 7,141	$ 7,212	$ 7,284	$ 7,357	$ 7,431	$ 7,505
	Remaining Fuel Oil (supplement)	gallons remainin	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00
	Total Fuel Cost (supplement)	$ per year	$ 2,704	$ 2,856	$ 2,856	$ 2,991	$ 2,991	$ 3,165	$ 3,165	$ 3,325
	Proposed Heat Cost	**$ per year**	**$ 16,024**	**$ 16,309**	**$ 16,444**	**$ 16,715**	**$ 16,852**	**$ 17,165**	**$ 17,305**	**$ 17,606**
Base										
	Fuel Use	gallons per year	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
	Fuel Cost	$ per gallon	$5.63	$5.95	$5.95	$6.23	$6.23	$6.59	$6.59	$6.93
Entered Value	Fuel Scheduled Repairs	$ per year	$ 200	$ 202	$ 204	$ 206	$ 208	$ 210	$ 212	$ 214
Entered Value	Fuel O&M	$ per year	$ 750	$ 758	$ 765	$ 773	$ 780	$ 788	$ 796	$ 804
	Fuel Cost	$ per year	$ 13,521	$ 14,280	$ 14,280	$ 14,955	$ 14,955	$ 15,827	$ 15,827	$ 16,624
	Base Heating Cost	**$ per year**	**$ 14,471**	**$ 15,240**	**$ 15,249**	**$ 15,933**	**$ 15,943**	**$ 16,825**	**$ 16,835**	**$ 17,643**

Heating		Units	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed												
	Renewable Heat	gallons displace	1,920	1,920	1,920	1,920	1,920	1,920	1,920	1,920	1,920	1,920
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 347	$ 350	$ 353	$ 357	$ 361	$ 364	$ 368	$ 372	$ 375	$ 379
Entered Value	Renewable Heat O&M	$ per year	$ 6,497	$ 6,562	$ 6,628	$ 6,694	$ 6,761	$ 6,829	$ 6,897	$ 6,966	$ 7,035	$ 7,106
Entered Value	Renewable Fuel Use Quantity (Biomass)	tons	20	20	20	20	20	20	20	20	20	20
Entered Value	Renewable Fuel Cost	$ per unit	$379.00	$382.79	$386.62	$390.48	$394.39	$398.33	$402.32	$406.34	$410.40	$414.51
	Total Renewable Fuel Cost	$ per year	$ 7,580	$ 7,656	$ 7,732	$ 7,810	$ 7,888	$ 7,967	$ 8,046	$ 8,127	$ 8,208	$ 8,290
	Remaining Fuel Oil (supplement)	gallons remainin	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00
	Total Fuel Cost (supplement)	$ per year	$ 3,325	$ 3,460	$ 3,460	$ 3,580	$ 3,580	$ 3,686	$ 3,686	$ 3,766	$ 3,766	$ 3,825
	Proposed Heat Cost	**$ per year**	**$ 17,748**	**$ 18,027**	**$ 18,173**	**$ 18,441**	**$ 18,589**	**$ 18,845**	**$ 18,997**	**$ 19,230**	**$ 19,385**	**$ 19,600**
Base												
	Fuel Use	gallons per year	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
	Fuel Cost	$ per gallon	$6.93	$7.21	$7.21	$7.46	$7.46	$7.68	$7.68	$7.85	$7.85	$7.97
Entered Value	Fuel Scheduled Repairs	$ per year	$ 217	$ 219	$ 221	$ 223	$ 225	$ 228	$ 230	$ 232	$ 235	$ 237
Entered Value	Fuel O&M	$ per year	$ 812	$ 820	$ 828	$ 837	$ 845	$ 854	$ 862	$ 871	$ 879	$ 888
	Fuel Cost	$ per year	$ 16,624	$ 17,298	$ 17,298	$ 17,900	$ 17,900	$ 18,429	$ 18,429	$ 18,830	$ 18,830	$ 19,124
	Base Heating Cost	**$ per year**	**$ 17,653**	**$ 18,337**	**$ 18,347**	**$ 18,960**	**$ 18,971**	**$ 19,510**	**$ 19,521**	**$ 19,933**	**$ 19,944**	**$ 20,249**

Heating			Units	2031	2032	2033	2034	2035	2036	2037	PV
Proposed											
		Renewable Heat	gallons displaced	1,920	1,920	1,920	1,920	1,920	1,920	1,920	
	Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 383	$ 387	$ 390	$ 394	$ 398	$ 402	$ 406	**$6,200**
	Entered Value	Renewable Heat O&M	$ per year	$ 7,177	$ 7,249	$ 7,321	$ 7,394	$ 7,468	$ 7,543	$ 7,618	**$116,251**
	Entered Value	Renewable Fuel Use Quantity (Biomass)	tons	20	20	20	20	20	20	20	
	Entered Value	Renewable Fuel Cost	$ per unit	$418.65	$422.84	$427.07	$431.34	$435.65	$440.01	$444.41	
		Total Renewable Fuel Cost	$ per year	$ 8,373	$ 8,457	$ 8,541	$ 8,627	$ 8,713	$ 8,800	$ 8,888	
		Remaining Fuel Oil (supplement)	gallons remaining	480.00	480.00	480.00	480.00	480.00	480.00	480.00	
		Total Fuel Cost (supplement)	$ per year	$ 3,825	$ 3,858	$ 3,858	$ 3,884	$ 3,884	$ 3,943	$ 3,943	
		Proposed Heat Cost	**$ per year**	**$ 19,757**	**$ 19,950**	**$ 20,111**	**$ 20,299**	**$ 20,463**	**$ 20,688**	**$ 20,856**	**$317,548**
Base											
		Fuel Use	gallons per year	2,400	2,400	2,400	2,400	2,400	2,400	2,400	
		Fuel Cost	$ per gallon	$7.97	$8.04	$8.04	$8.09	$8.09	$8.21	$8.21	
	Entered Value	Fuel Scheduled Repairs	$ per year	$ 239	$ 242	$ 244	$ 246	$ 249	$ 251	$ 254	**$3,875**
	Entered Value	Fuel O&M	$ per year	$ 897	$ 906	$ 915	$ 924	$ 934	$ 943	$ 952	**$14,531**
		Fuel Cost	$ per year	$ 19,124	$ 19,288	$ 19,288	$ 19,418	$ 19,418	$ 19,715	$ 19,715	**$297,356**
		Base Heating Cost	**$ per year**	**$ 20,260**	**$ 20,436**	**$ 20,447**	**$ 20,589**	**$ 20,601**	**$ 20,910**	**$ 20,922**	**$315,762**

Life Cycle Cost Analysis

Life Cycle Costs of Project Alternatives	
District:	Copper Valley
School:	Chistochina School Wood Pellet Boiler
Project:	Chistochina School Wood Pellet Boiler
Project No.	NA
Study Period:	20
Discount Rate:	3.50%

	Alternative #1 (low)	Alternative #2 (high)
Initial Investment Cost	$ 327,544	$ 400,000
O&M and Repair Cost	$ 7,500	$ 9,320
Replacement Cost	$ 74,247	$ 150,000
Residual Value	$ 50,000	$ 90,000
Total Life Cycle Cost	$ 459,291	$ 649,320
GSF of Project	5,604	5,604
Initial Cost/ GSF	$ 58.45	$ 71.38
LCC/ GSF	$ 81.96	$ 115.87

General perspective of project viability, and recommended next steps

The uncertain future usage of the Chistochina school building makes it an unlikely candidate for a grant-funded biomass project, at least until the community usage is determined.

Site Specific Analysis: BLM NPS Campus

General Description of Opportunity & Challenges

This site is shared between the Bureau of Land Management (BLM) and National Park Service (NPS). The agencies have an interagency agreement that allows them to share space and some resources at this Campus. Decisions affecting both entities would be subject to dual approval from both the Glennallen Field Office Manager (BLM) and the Wrangell St. Elias National Park Superintendent (NPS).

There are multiple challenges to a successful project here, including interagency coordination, high turnover of personnel, and coordination of boiler O&M. However, one of the maintenance staffers at BLM has operated a cordwood pellet boiler in the past, and the existing facilities appear well-maintained.

Technology or installation options assessed

Three Clusters were identified. BLM Cluster #1 contains the Old Admin, Rec, and New Admin buildings, all of which are managed by BLM. NPS Cluster #1 contains the NPS garages, and NPS Cluster #2 contains NPS housing A & B.

Due to the heat load and interest of BLM Forester Ben Seifert, and the familiarity of existing maintenance staff with cordwood heating systems, a cordwood option was considered for Cluster 1. This Cluster could also be heated by pellets.

Figure 6: Cluster 1: from Left to Right: New Admin, Rec, and Old Admin Building. Truck access to proposed boiler facility is pictured on the right.

NPS Cluster #1, comprised of NPS shop buildings, has a load that could be accommodated by either a cordwood or a biomass pellet system. However, the Maintenance Supervisor, who has operated an outdoor cordwood boiler, preferred local resource utilization through a cordwood system. Therefore, a cordwood system was considered for NPS Cluster #2.

Project chart BLM/ NPS

Building Name **Building Owner** **Contact Information**	BLM Cluster Glennallen US Bureau of Land Management, US National Park Service Ben Seifert
Square Footage	20,000 total (8 buildings). Three Clusters evaluated: Cluster 1: Old Admin, Rec, and New Admin buildings (BLM) Cluster 2: Park service garages (NPS) Cluster 3: Park service housing (NPS)
Gallons per year	Cluster 1: 4,400 Cluster 2: 6,038 Cluster 3: 5,488

PRELIMINARY SITE INVESTIGATION	
What feedback did staff offer on the current heating system?	BLM local staff is unsure of the support for biomass conversion project support, especially if the local staff would need to be pulled off their existing workloads to be involved in the development of the project. Suggestion was that a performance contract or ESCO model development might be a more welcome option for them. There is also some difficulty in coordinating multiple agencies. All existing systems operate reliably and appear to be well-maintained.
What is the staff or building manager's interest in biomass heating?	NPS and BLM staff support local resource utilization, lower carbon footprint fuel (less transportation) and economic development through using cordwood.
Description of current heating system	Cluster 1: The buildings in this Cluster have hydronic boiler systems, amounting to a total of 321 MBH boiler capacity. These buildings use about 4,400 gallons of fuel oil per year. Cluster 2: The buildings in this Cluster have a hydronic and a forced air furnace heating system, both heated by fuel oil. A water house here is heated by propane. Cluster 3: The 2vhousing units in this Cluster have 2 hydronic boilers each.
Available space (within existing structures or space for newly constructed building)	Cluster 1: Good access on the North corner of the Old Admin Building. The lot would have to be developed but is already clear and has road access. Cluster 2: No space within the existing building. Cluster 3: No space within existing building.
Street access	Cluster 1: Good. Cluster 2: Good Cluster 3: Good
Delivery access	Cluster 1: Good. Cluster 2: Good Cluster 3: Good
Fuel storage space	Cluster 1: Adequate space on site or available in the "back 40". Cluster 2: Adequate space on site. Cluster 3: Space would need to be created, but there appears to be plenty of room.
Building or site constraints (topography, permitting, historical preservation, etc.)	No building or site constraints, except interagency agreement where necessary.
Options for biomass boiler system (fuel type, technology type, building type)	Loads would justify a cordwood or pellet heating system. Cluster 1: approximately 25 cords to offet 80% of load (assuming 20% MC per cord, 18.6 MMBTU / cord of White Spruce) Cluster 2: approximately 35 cords to offet 80% of load (assuming 20% MC per cord, 18.6 MMBTU / cord of White Spruce) Cluster 3: approximately 32 cords to offet 80% of load (assuming 20% MC per cord, 18.6 MMBTU / cord of White Spruce)
Estimated boiler size:	Cluster 1: 200,000 btu/hr Cluster 2: 300,000 btu/hr Cluster 3: 250,000 btu/hr

Preliminary Cost Estimating: BLM Cluster #1

Biomass System	
Brand and Model #	WHS 1500
Rating -- Btu/hr	200,000
Btu stored	350,000

	footnote		notes
Building and Equipment Costs (B&E) $			
Fuel Storage Building (conex or equivalent, gravel pad, chute $30/sf)	A	$ 15,120	(28 cds) @ $27 / sq. ft.
Boilers			
Base price	B	$ 100,000	
Shipping to hub city	C	$ 20,000	
Local delivery	C	$ 3,000	
Plumbing and electrical	C	$ 2,500	
Installation	C	$ 4,500	
Site prep		$ 6,000	
District loop & building integration	C	$ 53,750	
Subtotal-B&E Costs		***$ 204,870***	
Contingency -- 20%		***$ 40,974***	
Grand Total		**$ 245,844**	
Soft Costs $			
Project Management		$ 19,668	8% of B&E
A/E Design Services		$ 22,126	9% of B&E, because of district loop
Fire Marshall Plan Review			included in design
Equipment Commissioning and Training	C		included with boiler price
Construction Management		$ 19,668	8% of B&E
Subtotal -- Soft Costs		**$ 61,461**	
Recommended Project Budget -- Design and Construction		**$ 307,305**	

footnote	
A	A cord occupies 128 cu. ft. If the wood is stacked 6 1/2 feet high, the area required to store the wood is 20 sq. ft per cord.
B	Quote
C	Shipping quoted 7/3/12
D	Estimate

Economic Analysis: BLM Cluster #1

Project Description	
Community	Glennallen
Nearest Fuel Community	Tok
Region	Rural
RE Technology	Woody biomass heat
Project ID	
Applicant Name	Bureau of Land Management
Project Title	BLM Cluster #1 Wood Heat
Category	

Results	
NPV Benefits	$150,566
NPV Capital Costs	$307,305
B/C Ratio	0.49
NPV Net Benefit	($156,739)

Performance	Unit	Value
Displaced Electricity	kWh per year	-
Displaced Electricity	total lifetime kWh	-
Displaced Petroleum Fuel	gallons per year	4,400
Displaced Petroleum Fuel	total lifetime gallons	110,000
Displaced Natural Gas	mmBtu per year	-
Displaced Natural Gas	total lifetime mmBtu	-
Avoided CO2	tonnes per year	45
Avoided CO2	total lifetime tonnes	1,117

Proposed System	Unit	Value
Capital Costs	$	$ 307,305
Project Start	year	2013
Project Life	years	25
Displaced Electric	kWh per year	-
Displaced Heat	gallons displaced per year	3,520
Displaced Transportation	gallons displaced per year	0.00
Renewable Generation O&M	$ per BTU	
Electric Capacity	kW	0
Electric Capacity Factor	%	0
Heating Capacity	Btu/hr.	200,000
Heating Capacity Factor	%	86

Base System	Unit	Value
Diesel Generator O&M	$ per kWh	$ 0.033
Diesel Generation Efficienc	kWh per gallon	

Parameters	Unit	Value
Heating Fuel Premium	$ per gallon	$ 2.00
Transportation Fuel Premiu	$ per gallon	$ 1.00
Discount Rate	% per year	3%
Crude Oil	$ per barrel	EIA Mid
Natural Gas	$ per mmBtu	ISER - Mid

Heating		Units	2013	2014	2015	2016	2017	2018	2019	2020	2021
Proposed											
	Renewable Heat	gallons displaced	3,520	3,520	3,520	3,520	3,520	3,520	3,520	3,520	3,520
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 320	$ 323	$ 326	$ 330	$ 333	$ 336	$ 340	$ 343	$ 347
Entered Value	Renewable Heat O&M	$ per year	$ 10,300	$ 10,403	$ 10,507	$ 10,612	$ 10,718	$ 10,825	$ 10,934	$ 11,043	$ 11,153
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	25	25	25	25	25	25	25	25	25
Entered Value	Renewable Fuel Cost	$ per unit	$200.00	$202.00	$204.02	$206.06	$208.12	$210.20	$212.30	$214.43	$216.57
	Total Renewable Fuel Cost	$ per year	$ 5,000	$ 5,050	$ 5,101	$ 5,152	$ 5,203	$ 5,255	$ 5,308	$ 5,361	$ 5,414
	Remaining Fuel Oil (supplement)	gallons remaining	880.00	880.00	880.00	880.00	880.00	880.00	880.00	880.00	880.00
	Total Fuel Cost (supplement)	$ per year	$ 4,958	$ 5,236	$ 5,236	$ 5,483	$ 5,483	$ 5,803	$ 5,803	$ 6,096	$ 6,096
	Proposed Heat Cost	**$ per year**	**$ 20,578**	**$ 21,012**	**$ 21,170**	**$ 21,577**	**$ 21,738**	**$ 22,220**	**$ 22,384**	**$ 22,842**	**$ 23,010**
Base											
	Fuel Use	gallons per year	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400
	Fuel Cost	$ per gallon	$5.63	$5.95	$5.95	$6.23	$6.23	$6.59	$6.59	$6.93	$6.93
Entered Value	Fuel Scheduled Repairs	$ per year	$ 200	$ 202	$ 204	$ 206	$ 208	$ 210	$ 212	$ 214	$ 217
Entered Value	Fuel O&M	$ per year	$ 750	$ 758	$ 751	$ 759	$ 752	$ 760	$ 753	$ 761	$ 754
	Fuel Cost	$ per year	$ 24,788	$ 26,180	$ 26,180	$ 27,417	$ 27,417	$ 29,016	$ 29,016	$ 30,478	$ 30,478
	Base Heating Cost	**$ per year**	**$ 25,738**	**$ 27,140**	**$ 27,135**	**$ 28,382**	**$ 28,377**	**$ 29,985**	**$ 29,981**	**$ 31,452**	**$ 31,448**

Heating		Units	2022	2023	2024	2025	2026	2027	2028	2029
Proposed										
	Renewable Heat	gallons displaced	3,520	3,520	3,520	3,520	3,520	3,520	3,520	3,520
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 350	$ 353	$ 357	$ 361	$ 364	$ 368	$ 372	$ 375
Entered Value	Renewable Heat O&M	$ per year	$ 11,265	$ 11,378	$ 11,491	$ 11,606	$ 11,722	$ 11,840	$ 11,958	$ 12,078
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	25	25	25	25	25	25	25	25
Entered Value	Renewable Fuel Cost	$ per unit	$218.74	$220.92	$223.13	$225.37	$227.62	$229.89	$232.19	$234.52
	Total Renewable Fuel Cost	$ per year	$ 5,468	$ 5,523	$ 5,578	$ 5,634	$ 5,690	$ 5,747	$ 5,805	$ 5,863
	Remaining Fuel Oil (supplement)	gallons remaining	880.00	880.00	880.00	880.00	880.00	880.00	880.00	880.00
	Total Fuel Cost (supplement)	$ per year	$ 6,343	$ 6,343	$ 6,563	$ 6,563	$ 6,757	$ 6,757	$ 6,904	$ 6,904
	Proposed Heat Cost	**$ per year**	**$ 23,426**	**$ 23,597**	**$ 23,990**	**$ 24,164**	**$ 24,534**	**$ 24,712**	**$ 25,039**	**$ 25,220**
Base										
	Fuel Use	gallons per year	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400
	Fuel Cost	$ per gallon	$7.21	$7.21	$7.46	$7.46	$7.68	$7.68	$7.85	$7.85
Entered Value	Fuel Scheduled Repairs	$ per year	$ 219	$ 221	$ 223	$ 225	$ 228	$ 230	$ 232	$ 235
Entered Value	Fuel O&M	$ per year	$ 762	$ 755	$ 763	$ 756	$ 764	$ 757	$ 765	$ 758
	Fuel Cost	$ per year	$ 31,713	$ 31,713	$ 32,817	$ 32,817	$ 33,786	$ 33,786	$ 34,522	$ 34,522
	Base Heating Cost	**$ per year**	**$ 32,693**	**$ 32,688**	**$ 33,803**	**$ 33,799**	**$ 34,777**	**$ 34,773**	**$ 35,519**	**$ 35,515**

Heating		Units	2030	2031	2032	2033	2034	2035	2036	2037	PV
Proposed											
	Renewable Heat	gallons displaced	3,520	3,520	3,520	3,520	3,520	3,520	3,520	3,520	
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 379	$ 383	$ 387	$ 390	$ 394	$ 398	$ 402	$ 406	$6,200
Entered Value	Renewable Heat O&M	$ per year	$ 12,198	$ 12,320	$ 12,444	$ 12,568	$ 12,694	$ 12,821	$ 12,949	$ 13,078	$199,564
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	25	25	25	25	25	25	25	25	
Entered Value	Renewable Fuel Cost	$ per unit	$236.86	$239.23	$241.62	$244.04	$246.48	$248.94	$251.43	$253.95	
	Total Renewable Fuel Cost	$ per year	$ 5,922	$ 5,981	$ 6,041	$ 6,101	$ 6,162	$ 6,224	$ 6,286	$ 6,349	
	Remaining Fuel Oil (supplement)	gallons remaining	880.00	880.00	880.00	880.00	880.00	880.00	880.00	880.00	
	Total Fuel Cost (supplement)	$ per year	$ 7,012	$ 7,012	$ 7,072	$ 7,072	$ 7,120	$ 7,120	$ 7,229	$ 7,229	
	Proposed Heat Cost	**$ per year**	**$ 25,511**	**$ 25,696**	**$ 25,943**	**$ 26,132**	**$ 26,370**	**$ 26,562**	**$ 26,866**	**$ 27,062**	**$411,670**
Base											
	Fuel Use	gallons per year	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	
	Fuel Cost	$ per gallon	$7.97	$7.97	$8.04	$8.04	$8.09	$8.09	$8.21	$8.21	
Entered Value	Fuel Scheduled Repairs	$ per year	$ 237	$ 239	$ 242	$ 244	$ 246	$ 249	$ 251	$ 254	$3,875
Entered Value	Fuel O&M	$ per year	$ 766	$ 759	$ 767	$ 760	$ 768	$ 761	$ 769	$ 762	$13,210
	Fuel Cost	$ per year	$ 35,061	$ 35,061	$ 35,361	$ 35,361	$ 35,600	$ 35,600	$ 36,145	$ 36,145	$545,152
	Base Heating Cost	**$ per year**	**$ 36,063**	**$ 36,059**	**$ 36,370**	**$ 36,365**	**$ 36,614**	**$ 36,610**	**$ 37,165**	**$ 37,161**	**$562,237**

Preliminary Cost Estimating: NPS Cluster #1

Initial investment: NPS Cluster #1

Biomass System	
Rating -- Btu/hr	300,000
Btu stored	375,000

	footnote		*notes*
Building and Equipment Costs (B&E) $			
Fuel Storage Building	A	$ 18,900	(35 cds) @ $27 / sq. ft.
Boilers			
Base price	B	$ 100,000	
Shipping to hub city	C	$ 20,000	
Local delivery	C	$ 3,000	
Plumbing and electrical	C	$ 2,500	
Installation	C	$ 4,500	
Site prep		$ 6,000	
District loop & building integration	C	$ 33,500	
Subtotal-B&E Costs		***$ 188,400***	
Contingency -- 20%		***$ 37,680***	
Grand Total		**$ 226,080**	

Soft Costs $			
Project Management		$ 18,086	8% of B&E
A/E Design Services		$ 20,347	9% of B&E, because of district loop
Fire Marshall Plan Review			included in design
Equipment Commissioning and Training	C		included with boiler price
Construction Management		$ 18,086	8% of B&E
Subtotal -- Soft Costs		**$ 56,520**	

Recommended Project Budget -- Design and Construction $ 282,600

footnote	
A	A cord occupies 128 cu. ft. If the wood is stacked 6 1/2 feet high, the area required to store the wood is 20 sq. ft per cord.
B	Quote
C	Shipping quoted 7/3/12
D	Estimate

Economic Analysis: NPS Cluster #1

Project Description	
Community	Glennallen
Nearest Fuel Community	Tok
Region	Rural
RE Technology	Woody biomass heat
Project ID	
Applicant Name	Bureau of Land Management
Project Title	NPS Cluster #1 Wood Heat
Category	

Results	
NPV Benefits	$281,639
NPV Capital Costs	$282,600
B/C Ratio	1.00
NPV Net Benefit	($961)

Performance	Unit	Value
Displaced Electricity	kWh per year	-
Displaced Electricity	total lifetime kWh	-
Displaced Petroleum Fuel	gallons per year	6,003
Displaced Petroleum Fuel	total lifetime gallons	150,075
Displaced Natural Gas	mmBtu per year	-
Displaced Natural Gas	total lifetime mmBtu	-
Avoided CO2	tonnes per year	61
Avoided CO2	total lifetime tonnes	1,523

Proposed System	Unit	Value
Capital Costs	$	$ 282,600
Project Start	year	2013
Project Life	years	25
Displaced Electric	kWh per year	-
Displaced Heat	gallons displaced per year	4,880
Displaced Transportation	gallons displaced per year	0.00
Renewable Generation O&I	$ per BTU	
Electric Capacity	kW	0
Electric Capacity Factor	%	0
Heating Capacity	Btu/hr.	300,000
Heating Capacity Factor	%	86

Base System	Unit	Value
Diesel Generator O&M	$ per kWh	$ 0.033
Diesel Generation Efficienc	kWh per gallon	

Parameters	Unit	Value
Heating Fuel Premium	$ per gallon	$ 2.00
Transportation Fuel Premiu	$ per gallon	$ 1.00
Discount Rate	% per year	3%
Crude Oil	$ per barrel	EIA Mid
Natural Gas	$ per mmBtu	ISER - Mid

Heating		Units	2013	2014	2015	2016	2017	2018	2019	2020	2021
Proposed											
	Renewable Heat	gallons displace	4,880	4,880	4,880	4,880	4,880	4,880	4,880	4,880	4,880
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 320	$ 323	$ 326	$ 330	$ 333	$ 336	$ 340	$ 343	$ 347
Entered Value	Renewable Heat O&M	$ per year	$ 10,300	$ 10,403	$ 10,507	$ 10,612	$ 10,718	$ 10,825	$ 10,934	$ 11,043	$ 11,153
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	35	35	35	35	35	35	35	35	35
Entered Value	Renewable Fuel Cost	$ per unit	$200.00	$202	$204	$206	$208	$210	$212	$214	$217
	Total Renewable Fuel Cost	$ per year	$ 7,000	$ 7,070	$ 7,141	$ 7,212	$ 7,284	$ 7,357	$ 7,431	$ 7,505	$ 7,580
	Remaining Fuel Oil (supplement)	gallons remainin	1123	1123	1123	1123	1123	1123	1123	1123	1123
	Total Fuel Cost (supplement)	$ per year	$ 6,326	$ 6,682	$ 6,682	$ 6,998	$ 6,998	$ 7,406	$ 7,406	$ 7,779	$ 7,779
	Proposed Heat Cost	**$ per year**	**$ 23,946**	**$ 24,478**	**$ 24,656**	**$ 25,151**	**$ 25,333**	**$ 25,924**	**$ 26,110**	**$ 26,670**	**$ 26,859**
Base											
	Fuel Use	gallons per year	6,003	6,003	6,003	6,003	6,003	6,003	6,003	6,003	6,003
	Fuel Cost	$ per gallon	$5.63	$5.95	$5.95	$6.23	$6.23	$6.59	$6.59	$6.93	$6.93
Entered Value	Fuel Scheduled Repairs	$ per year	$ 200	$ 202	$ 204	$ 206	$ 208	$ 210	$ 212	$ 214	$ 217
Entered Value	Fuel O&M	$ per year	$ 750	$ 758	$ 765	$ 773	$ 780	$ 788	$ 796	$ 804	$ 812
	Fuel Cost	$ per year	$ 33,818	$ 35,718	$ 35,718	$ 37,405	$ 37,405	$ 39,587	$ 39,587	$ 41,581	$ 41,581
	Base Heating Cost	**$ per year**	**$ 34,768**	**$ 36,677**	**$ 36,687**	**$ 38,384**	**$ 38,394**	**$ 40,585**	**$ 40,595**	**$ 42,600**	**$ 42,610**

Heating		Units	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed											
	Renewable Heat	gallons displace	4,880	4,880	4,880	4,880	4,880	4,880	4,880	4,880	4,880
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 350	$ 353	$ 357	$ 361	$ 364	$ 368	$ 372	$ 375	$ 379
Entered Value	Renewable Heat O&M	$ per year	$ 11,265	$ 11,378	$ 11,491	$ 11,606	$ 11,722	$ 11,840	$ 11,958	$ 12,078	$ 12,198
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	35	35	35	35	35	35	35	35	35
Entered Value	Renewable Fuel Cost	$ per unit	$219	$221	$223	$225	$228	$230	$232	$235	$237
	Total Renewable Fuel Cost	$ per year	$ 7,656	$ 7,732	$ 7,810	$ 7,888	$ 7,967	$ 8,046	$ 8,127	$ 8,208	$ 8,290
	Remaining Fuel Oil (supplement)	gallons remainin	1123	1123	1123	1123	1123	1123	1123	1123	1123
	Total Fuel Cost (supplement)	$ per year	$ 8,094	$ 8,094	$ 8,376	$ 8,376	$ 8,623	$ 8,623	$ 8,811	$ 8,811	$ 8,948
	Proposed Heat Cost	**$ per year**	**$ 27,365**	**$ 27,557**	**$ 28,034**	**$ 28,230**	**$ 28,676**	**$ 28,877**	**$ 29,267**	**$ 29,472**	**$ 29,816**
Base											
	Fuel Use	gallons per year	6,003	6,003	6,003	6,003	6,003	6,003	6,003	6,003	6,003
	Fuel Cost	$ per gallon	$7.21	$7.21	$7.46	$7.46	$7.68	$7.68	$7.85	$7.85	$7.97
Entered Value	Fuel Scheduled Repairs	$ per year	$ 219	$ 221	$ 223	$ 225	$ 228	$ 230	$ 232	$ 235	$ 237
Entered Value	Fuel O&M	$ per year	$ 820	$ 828	$ 837	$ 845	$ 854	$ 862	$ 871	$ 879	$ 888
	Fuel Cost	$ per year	$ 43,266	$ 43,266	$ 44,773	$ 44,773	$ 46,095	$ 46,095	$ 47,100	$ 47,100	$ 47,834
	Base Heating Cost	**$ per year**	**$ 44,305**	**$ 44,315**	**$ 45,833**	**$ 45,844**	**$ 47,176**	**$ 47,187**	**$ 48,202**	**$ 48,214**	**$ 48,959**

Heating		Units	2031	2032	2033	2034	2035	2036	2037	PV
Proposed										
	Renewable Heat	gallons displaced	4,880	4,880	4,880	4,880	4,880	4,880	4,880	
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 383	$ 387	$ 390	$ 394	$ 398	$ 402	$ 406	**$6,200**
Entered Value	Renewable Heat O&M	$ per year	$ 12,320	$ 12,444	$ 12,568	$ 12,694	$ 12,821	$ 12,949	$ 13,078	**$199,564**
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	35	35	35	35	35	35	35	
Entered Value	Renewable Fuel Cost	$ per unit	$239	$242	$244	$246	$249	$251	$254	
	Total Renewable Fuel Cost	$ per year	$ 8,373	$ 8,457	$ 8,541	$ 8,627	$ 8,713	$ 8,800	$ 8,888	
	Remaining Fuel Oil (supplement)	gallons remaining	1123	1123	1123	1123	1123	1123	1123	
	Total Fuel Cost (supplement)	$ per year	$ 8,948	$ 9,025	$ 9,025	$ 9,086	$ 9,086	$ 9,225	$ 9,225	
	Proposed Heat Cost	**$ per year**	**$ 30,025**	**$ 30,312**	**$ 30,525**	**$ 30,801**	**$ 31,018**	**$ 31,376**	**$ 31,598**	**$480,528**
Base										
	Fuel Use	gallons per year	6,003	6,003	6,003	6,003	6,003	6,003	6,003	
	Fuel Cost	$ per gallon	$7.97	$8.04	$8.04	$8.09	$8.09	$8.21	$8.21	
Entered Value	Fuel Scheduled Repairs	$ per year	$ 239	$ 242	$ 244	$ 246	$ 249	$ 251	$ 254	**$3,875**
Entered Value	Fuel O&M	$ per year	$ 897	$ 906	$ 915	$ 924	$ 934	$ 943	$ 952	**$14,531**
	Fuel Cost	$ per year	$ 47,834	$ 48,244	$ 48,244	$ 48,569	$ 48,569	$ 49,313	$ 49,313	**$743,761**
	Base Heating Cost	**$ per year**	**$ 48,970**	**$ 49,392**	**$ 49,403**	**$ 49,740**	**$ 49,752**	**$ 50,507**	**$ 50,519**	**$762,167**

Preliminary Cost Estimating: NPS Cluster #2

Biomass System	
Rating -- Btu/hr	250,000
Btu stored	300,000

	footnote		notes
Building and Equipment Costs (B&E) $			
Fuel Storage Building	A	$ 17,280	(32 cds) @ $27 / sq. ft.
Boilers			
Base price	B	$ 100,000	
Shipping to hub city	C	$ 20,000	
Local delivery	C	$ 3,000	
Plumbing and electrical	C	$ 2,500	
Installation	C	$ 4,500	
Site prep		$ 6,000	
District loop & building integration	C	$ 33,500	
Subtotal-B&E Costs		***$ 186,780***	
Contingency -- 20%		***$ 37,356***	
Grand Total		**$ 224,136**	

Soft Costs $			
Project Management		$ 17,931	8% of B&E
A/E Design Services		$ 20,172	9% of B&E, because of district loop
Fire Marshall Plan Review			included in design
Equipment Commissioning and Training	C		included with boiler price
Construction Management		$ 17,931	8% of B&E
Subtotal -- Soft Costs		**$ 56,034**	

Recommended Project Budget -- Design and Construction	**$ 280,170**

footnote	
A	A cord occupies 128 cu. ft. If the wood is stacked 6 1/2 feet high, the area required to store the wood is 20 sq. ft per cord.
B	Quote
C	Shipping quoted 7/3/12
D	Estimate

Economic Analysis: NPS Cluster #2

Project Description	
Community	Glennallen
Nearest Fuel Community	Tok
Region	Rural
RE Technology	Woody biomass heat
Project ID	
Applicant Name	Bureau of Land Management
Project Title	NPS Cluster #2 Wood Heat
Category	

Results	
NPV Benefits	$232,554
NPV Capital Costs	$280,170
B/C Ratio	0.83
NPV Net Benefit	($47,616)

Performance	Unit	Value
Displaced Electricity	kWh per year	-
Displaced Electricity	total lifetime kWh	-
Displaced Petroleum Fuel	gallons per year	5,488
Displaced Petroleum Fuel	total lifetime gallons	137,200
Displaced Natural Gas	mmBtu per year	-
Displaced Natural Gas	total lifetime mmBtu	-
Avoided CO2	tonnes per year	56
Avoided CO2	total lifetime tonnes	1,393

Proposed System	Unit	Value
Capital Costs	$	$ 280,170
Project Start	year	2013
Project Life	years	25
Displaced Electric	kWh per year	-
Displaced Heat	gallons displaced per year	4,390
Displaced Transportation	gallons displaced per year	0.00
Renewable Generation O&M	$ per BTU	
Electric Capacity	kW	0
Electric Capacity Factor	%	0
Heating Capacity	Btu/hr.	250,000
Heating Capacity Factor	%	86

Base System	Unit	Value
Diesel Generator O&M	$ per kWh	$ 0.033
Diesel Generation Efficienc	kWh per gallon	

Parameters	Unit	Value
Heating Fuel Premium	$ per gallon	$ 2.00
Transportation Fuel Premiu	$ per gallon	$ 1.00
Discount Rate	% per year	3%
Crude Oil	$ per barrel	EIA Mid
Natural Gas	$ per mmBtu	ISER - Mid

Heating		Units	2013	2014	2015	2016	2017	2018	2019	2020	2021
Proposed											
	Renewable Heat	gallons displace	4,390	4,390	4,390	4,390	4,390	4,390	4,390	4,390	4,390
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 320	$ 323	$ 326	$ 330	$ 333	$ 336	$ 340	$ 343	$ 347
Entered Value	Renewable Heat O&M	$ per year	$ 10,300	$ 10,403	$ 10,507	$ 10,612	$ 10,718	$ 10,825	$ 10,934	$ 11,043	$ 11,153
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	32	32	32	32	32	32	32	32	32
Entered Value	Renewable Fuel Cost	$ per unit	$200	$202	$204	$206	$208	$210	$212	$214	$217
	Total Renewable Fuel Cost	$ per year	$ 6,400	$ 6,464	$ 6,529	$ 6,594	$ 6,660	$ 6,726	$ 6,794	$ 6,862	$ 6,930
	Remaining Fuel Oil (supplement)	gallons remainin	1098	1098	1098	1098	1098	1098	1098	1098	1098
	Total Fuel Cost (supplement)	$ per year	$ 6,186	$ 6,533	$ 6,533	$ 6,842	$ 6,842	$ 7,241	$ 7,241	$ 7,606	$ 7,606
	Proposed Heat Cost	**$ per year**	**$ 23,206**	**$ 23,723**	**$ 23,895**	**$ 24,377**	**$ 24,553**	**$ 25,129**	**$ 25,308**	**$ 25,853**	**$ 26,036**
Base											
	Fuel Use	gallons per year	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488
	Fuel Cost	$ per gallon	$5.63	$5.95	$5.95	$6.23	$6.23	$6.59	$6.59	$6.93	$6.93
Entered Value	Fuel Scheduled Repairs	$ per year	$ 200	$ 202	$ 204	$ 206	$ 208	$ 210	$ 212	$ 214	$ 217
Entered Value	Fuel O&M	$ per year	$ 750	$ 758	$ 765	$ 773	$ 780	$ 788	$ 796	$ 804	$ 812
	Fuel Cost	$ per year	$ 30,917	$ 32,654	$ 32,654	$ 34,196	$ 34,196	$ 36,190	$ 36,190	$ 38,014	$ 38,014
	Base Heating Cost	**$ per year**	**$ 31,867**	**$ 33,613**	**$ 33,623**	**$ 35,175**	**$ 35,185**	**$ 37,189**	**$ 37,199**	**$ 39,032**	**$ 39,042**

Heating		Units	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed											
	Renewable Heat	gallons displace	4,390	4,390	4,390	4,390	4,390	4,390	4,390	4,390	4,390
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 350	$ 353	$ 357	$ 361	$ 364	$ 368	$ 372	$ 375	$ 379
Entered Value	Renewable Heat O&M	$ per year	$ 11,265	$ 11,378	$ 11,491	$ 11,606	$ 11,722	$ 11,840	$ 11,958	$ 12,078	$ 12,198
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	32	32	32	32	32	32	32	32	32
Entered Value	Renewable Fuel Cost	$ per unit	$219	$221	$223	$225	$228	$230	$232	$235	$237
	Total Renewable Fuel Cost	$ per year	$ 7,000	$ 7,070	$ 7,140	$ 7,212	$ 7,284	$ 7,357	$ 7,430	$ 7,505	$ 7,580
	Remaining Fuel Oil (supplement)	gallons remainin	1098	1098	1098	1098	1098	1098	1098	1098	1098
	Total Fuel Cost (supplement)	$ per year	$ 7,914	$ 7,914	$ 8,189	$ 8,189	$ 8,431	$ 8,431	$ 8,615	$ 8,615	$ 8,749
	Proposed Heat Cost	**$ per year**	**$ 26,528**	**$ 26,714**	**$ 27,178**	**$ 27,368**	**$ 27,801**	**$ 27,995**	**$ 28,375**	**$ 28,572**	**$ 28,906**
Base											
	Fuel Use	gallons per year	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488
	Fuel Cost	$ per gallon	$7.21	$7.21	$7.46	$7.46	$7.68	$7.68	$7.85	$7.85	$7.97
Entered Value	Fuel Scheduled Repairs	$ per year	$ 219	$ 221	$ 223	$ 225	$ 228	$ 230	$ 232	$ 235	$ 237
Entered Value	Fuel O&M	$ per year	$ 820	$ 828	$ 837	$ 845	$ 854	$ 862	$ 871	$ 879	$ 888
	Fuel Cost	$ per year	$ 39,554	$ 39,554	$ 40,932	$ 40,932	$ 42,140	$ 42,140	$ 43,059	$ 43,059	$ 43,730
	Base Heating Cost	**$ per year**	**$ 40,593**	**$ 40,604**	**$ 41,992**	**$ 42,002**	**$ 43,221**	**$ 43,232**	**$ 44,162**	**$ 44,173**	**$ 44,855**

Heating		Units	2031	2032	2033	2034	2035	2036	2037	PV
Proposed										
	Renewable Heat	gallons displaced	4,390	4,390	4,390	4,390	4,390	4,390	4,390	
Entered Value	Renewable Heat Scheduled Repairs	$ per year	$ 383	$ 387	$ 390	$ 394	$ 398	$ 402	$ 406	**$6,200**
Entered Value	Renewable Heat O&M	$ per year	$ 12,320	$ 12,444	$ 12,568	$ 12,694	$ 12,821	$ 12,949	$ 13,078	**$199,564**
Entered Value	Renewable Fuel Use Quantity (Biomass)	cords	32	32	32	32	32	32	32	
Entered Value	Renewable Fuel Cost	$ per unit	$239	$242	$244	$246	$249	$251	$254	
	Total Renewable Fuel Cost	$ per year	$ 7,655	$ 7,732	$ 7,809	$ 7,887	$ 7,966	$ 8,046	$ 8,126	
	Remaining Fuel Oil (supplement)	gallons remaining	1098	1098	1098	1098	1098	1098	1098	
	Total Fuel Cost (supplement)	$ per year	$ 8,749	$ 8,824	$ 8,824	$ 8,884	$ 8,884	$ 9,020	$ 9,020	
	Proposed Heat Cost	**$ per year**	**$ 29,108**	**$ 29,386**	**$ 29,592**	**$ 29,859**	**$ 30,069**	**$ 30,417**	**$ 30,631**	**$465,805**
Base										
	Fuel Use	gallons per year	5,488	5,488	5,488	5,488	5,488	5,488	5,488	
	Fuel Cost	$ per gallon	$7.97	$8.04	$8.04	$8.09	$8.09	$8.21	$8.21	
Entered Value	Fuel Scheduled Repairs	$ per year	$ 239	$ 242	$ 244	$ 246	$ 249	$ 251	$ 254	**$3,875**
Entered Value	Fuel O&M	$ per year	$ 897	$ 906	$ 915	$ 924	$ 934	$ 943	$ 952	**$14,531**
	Fuel Cost	$ per year	$ 43,730	$ 44,105	$ 44,105	$ 44,403	$ 44,403	$ 45,082	$ 45,082	**$679,953**
	Base Heating Cost	**$ per year**	**$ 44,866**	**$ 45,253**	**$ 45,265**	**$ 45,573**	**$ 45,585**	**$ 46,277**	**$ 46,289**	**$698,359**

General perspective of project viability, and recommended next steps

BLM Cluster #1, which would be owned and operated by BLM, has a reasonable heat load to accommodate a cordwood or pellet-fired biomass boiler, a motivated project champion, and experienced maintenance personnel to operate the project. However, this project has marginal economic feasibility, and key decision makers at the BLM were not available to discuss the project and did not respond to emails or phone calls.

NPS Cluster #1 and #2, which would be owned and operated by NPS, have reasonable heat loads to accommodate a cordwood biomass boiler and experienced personnel to operate the project. Like BLM Cluster #1, these projects could source firewood from BLM lands. Both projects have reasonable economic feasibility.

Summary of Benefit/ Cost analyses

Dalson Energy would like to note that B/C analyses and the other financial metrics listed in this report are only one way of calculating the value of projects. A project's likelihood of operational success is another crucial factor. In many cases, a project with lower operational risk and less attractive financials may be preferable over a project with higher risk and more attractive financials.

Additionally, the nascent biomass energy industry in Alaska is still building experience of demonstrated operational success; projects with marginal economic feasibility may be considered an investment in the industry.

Consideration is also suggested for the local economic development, job creation and workforce development aspects of biomass energy projects. A cluster of biomass projects in an area like Copper Valley can catalyze the development of local harvest and processing businesses, which in turn stimulate other economic activity through the proven multiplier effects of economic localization.

	Estimated System Description (abbreviated)	NPV Benefits	NPV Capital Costs	B/C Ratio
AK DOF	Two (2) 100,000 btu pellet boilers, containerized; hand loaded pellets if necessary into fuel hopper	$144,500	$459,000	0.31
Cross Road Medical Center	350,000 btu cordwood boiler, integrated into new garage bay on existing ambulance garage; trailer for moving cordwood from long term storage to garage bay	$348,000	$297,000	1.17
Community Chapel	120,000 btu cordwood boiler, containerized. Fuel storage in a separate building on site.	$20,500	$208,600	0.10
Prince William Sound Community College	160,000 btu pellet boiler, containerized. Fuel storage via hopper.	$108,000	$327,500	0.33
Chistochina School	120,000 btu pellet boiler, containerized. Fuel storage in a separate building on site.	($1,786)	$327,500	0.01
BLM Cluster #1	200,000 btu cordwood boiler, containerized. Fuel storage building in a separate building on site.	$150,500	$307,300	0.49
NPS Cluster #1	300,000 btu cordwood boiler, containerized. Fuel storage building in a separate building on site.	$281,600	$282,600	1.00
NPS Cluster #2	250,000 btu cordwood boiler, containerized. Fuel storage building in a separate building on site.	$232,500	$280,170	0.83

Recommendations and Next Steps

Each candidate facility is invited to examine the proposed capital costs and operational profiles of the projects presented in this report, and approach the Consultant with any concerns or questions.

Facilities with a Benefit/ Cost ratio greater than 1.0 are likely candidates for Alaska Energy Authority's Renewable Energy Fund grant program, Round 6 has a September 24, 2012 deadline. Any of these projects could apply for design and construction grants.

Projects with a Benefit/ Cost ratio less than 1.0 are encouraged to look at creative strategies for improving the financial profile of their project. In particular, AK DOF, which has a high probability for operational success, is encouraged to adapt their project profile by exploring a heat loop partnership with DOT.

The most likely candidates for successful projects appear to be the Cross Road Medical Center and the AK DOF Campus. Both of these projects have motivated and capable staff, appropriate technology for available fuels and operating requirements, and simple building interconnections. These facilities are owned and controlled by the organization, rather than being leased from a separate owner. The NPS Clusters may also be successful, but the management team was not available to discuss the opportunity for biomass heating.

Additionally, this pre-feasibility study has identified a business opportunity for third-party O&M services for small wood boiler projects, particularly cordwood boiler projects. Several of the projects considered may be viable from both a financial and operational perspective if third-party O&M services are used..

About the Consultant

Dalson Energy is a Renewable Energy Consulting and Technology Research firm based in Anchorage, Alaska. Dalson Energy staff and partners have decades of experience in construction project management, project development consulting and renewable energy technology research. Dalson Energy teams with licensed engineers, architects and designers in Alaska, Canada and Lower 48.

Dalson Energy has worked with Alaska Energy Authority, Alaska Center for Energy & Power, University of Alaska Fairbanks, Washington State CTED (Community Trade & Economic Development) and California Energy Commission on biomass energy technology research.

Thomas Deerfield, Dalson Energy's President has been involved in biomass energy RD&D since 2001, winning grants and managing projects with NREL (National Renewable Energy Labs), USFS (US Forest Service), and CEC (California Energy Commission).

Thomas managed the field-testing of biomass CHP systems, including the first grid-connected biomass gasification CHP system in the U.S. (2007). Thomas coordinated the design and creation of the first prototype Biomass "Boiler in a Box" in Alaska, in 2010. That Garn-based system is now installed in Elim, in the Bering Sea region.

Thomas founded Shasta Energy Group (SEG), a 501c3 nonprofit, and managed wind energy research, biomass energy feasibility studies, energy efficiency for buildings, and hydronic heating system research design and development (RD&D). He also initiated a rural economic development think tank and has engaged his writing skills to assist many other renewable energy project initiatives.

Wynne Auld is a Biomass Energy Specialist with Dalson Energy. She focuses on assessing opportunities for woody biomass heating, and assisting communities in developing wood energy projects. Over the past few years she has supported the business development of integrated biomass energy campuses in Oregon and Idaho, especially related to their energy initiatives. Her efforts have included marketing Campus biomass heating products to major wholesalers and retail buyers, and planning and developing Campus sort yards.

Appendix I: Heating Fuels Assumptions

- Cordwood
    - White Spruce Species
    - 20% Moisture Content
    - 18.6 MMBTU per cord
- Wood pellets
    - 16.4 MMBTU per ton
- Fuel Oil #1
    - 0.135 MMBTU per gallon