Pre-Feasibility Assessment for Integration of Biomass Energy Systems

in

Mullan School District
Mullan, Idaho

October 12, 2004

Presented by

CTA Architects Engineers
Dan Stevenson

For

United Stated Department of Agriculture
Forest Service
Region One

In partnership with:

Mullan School District

Bitter Root Resource and Conservation Development Area, Incorporated
Idaho Division of Forestry

CTA Project: BIOMASPFA-MULLN

Executive Summary

The following assessment was commissioned to determine the technical and economic feasibility of integrating a biomass heating system with three existing facilities in Mullan, Idaho. This assessment is funded through the USDA Forest Service, Region One, as part of the Fuels for Schools program. The field investigation took place on October 9, 2004.

Field investigation identified the following information:

The Mullan Athletic Pavilion is located at the east edge of Mullan, with good access to Interstate 90 and the adjacent street network. The existing Mullan High School and John Mullan Elementary School are located on a separate campus south of town about 1,000 lineal feet from the Mullan Athletic Pavilion. A potential pipe route between the MAP building and school facilities would involve removing and replacing pavement and crossing a live stream as well as numerous utilities. It does not appear that building a central plant to serve all three facilities would be feasible.

The MAP building is a two story concrete frame and brick in-fill building. The high school is a two story brick building with limited access to the boiler room. Access to the elementary school boiler room could be accomplished by driving over the paved playground between the buildings. The preferred biomass boiler building location would be on the south side of the MAP building, west of the existing boiler room.

The MAP building is heated with a pair of natural gas fired hot water boilers 3.8 MBTU and 1.6 MBTU in size. The pool is used year-round and maintains a substantial base load of more than 250 decatherms even in the summer months. The building also contains showers used by pool occupants, basketball and football players. Four inches of standing water from an unknown source was identified on the floor of the boiler room. The boiler room has an exceptionally high ceiling and connecting the biomass boiler piping to the existing boiler piping should be readily accomplished.

Option A – Automated Wood Chip Plant
Construct a semi-automated wood chip heating plant on the south side of the MAP building. The heating plant would include a 4.0 MMBTUH hot water boiler and related equipment with adjacent chip storage. This option provides heat for the base load of the pool and assumes that the existing boilers would be used as back up and for peak loads. The biomass system would be a semi-automated system similar to the Chiptec "A" Series, Grovewood Heat or Messersmith Dragon systems that require day bins to be filled with wood chips. A small tractor would be used to transfer the chips from the chip storage building to the day bin. Piping would extend underground from the biomass plant to the existing boiler plant. Underground piping (25 feet of heating supply and return and 25 feet of cold water and waste water lines) would require the removal and replacement of the finished asphalt surface. The $40,000 integration costs for this project would be similar to Victor, Montana. Estimated cost: $350,000.

Option B – Wood Pellet Fuel Plant
Construct a wood pellet heating plant and storage silo adjacent to the existing boiler room. The heating plant would include 4.0 MMBTUH hot water pellet fuel boiler and related equipment. This option provides heat for the base load of the majority of the pool and assumes that the existing boilers would be used for peak loads and as back up. The pellet fuel system would require a separate storage silo. Pellets are produced in Couer d'Alene are available for approximately $100/ton is used in the cash flow analysis. Understanding the extent of the utilization factor (percent of the time the system is operating at full load) is not possible without more detailed energy modeling and is not in the scope of this analysis.
An installed cost for this system would be in the range of $250,000.

Biomass boiler system budget estimates are based upon recent biomass assessments and project costs for completed systems.

Results of Evaluation

The results of this analysis are summarized below. The cost estimate is representative of the scope of this project. A Cash Flow Analysis is provided at the end of the report. The cash flow analysis assumes availability of green chips at a price of $35 per green ton in Option A, and a pellet fuel price of $100 per ton in Option B.

Option A-Semi-Automated Wood Chip Plant achieves a positive accumulated cashflow (PAC) in 10 years with a subsidy of $201,500 and in 18 years without subsidy.

Option B-Wood Pellet Fuel Plant achieves a positive accumulated cashflow (PAC) in 10 years with a subsidy of $250,000, and in 25 years without subsidy.

Accumulated cash flow is the primary evaluation measure that is implemented in this report and is similar to simple payback with the exception that accumulated cash flow takes the cost of financing and fuel escalation into account. For many building owners, a positive accumulated cash flow of about 10 years maximum is considered necessary for implementation. Based on this standard, the amount of project subsidy required to achieve a 10-year PAC was calculated and is indicated above. If the School District choose to further pursue a biomass heating system, it is recommended that each of the options be investigated in further detail.

The approach in analyzing this option has been to remain conservative, yet realistic about the performance of biomass heating plants and the cost of their installation. Due to the preliminary nature of this assessment, it is possible that the construction cost estimates can be reduced as additional information relative to the construction is gathered, favorably affecting the economic analysis.

Other factors should be considered when evaluating the viability of this project. The first is that although the current natural gas fuel cost is approximately $7.21/decatherm, natural gas contracts have been as high as $8.50/decatherm. The cash flow analysis assumes a 6% inflation rate in natural gas costs. Individual years may fluctuate beyond that average. The cost of transporting wood pellet fuel to the site should be considered. Wood pellets typically sell for $100/ton, or $6.00/decatherm. Wood chips sell for $35/ton or $3.00/decatherm.

Air Quality permits for wood burning devices in the State of Idaho are required and may impact the overall cost of the project.

Mullan Athletic Pavilion Biomass Heating Economic Analysis- Wood Chips

Conversion Proforma for MAP - 4.6% APR - 10 Year Term

October 12, 2004
Revision:
Analyst: Salmon-CTA

Project Capital Cost	-$350,000

Project Financing Information	
Percent Financed	42%
Amount Financed	-$148,500
Amount of Grants	$201,500
Interest Rate	4.60%
Term	10
Annual Finance Cost (years)	-$18,860

Escalation factors	
Elec. Escalation factor	1.04
Natural Gas Escalation factor	1.06
Fuel Oil Escalation factor	1.04
Pellet Escalation factor	1.03
Green Chip Escalation factor	1.02
Maint. Escalation factor	1.03

Cashflow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Existing Heating System Operating Costs																			
	$0.000		0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Displaced natural gas heating costs	$7.210		4,494	decatherms	32,402	34,346	36,407	38,591	40,906	43,361	45,962	48,720	51,643	54,742	58,027	61,508	65,199	69,111	73,257
Displaced Operation and Maintenance Costs					570	587	605	623	642	661	681	701	722	744	766	789	813	837	862
Biomass System Operating Costs																			
Green Chip Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$35.00	90%	534	tons	18,704	19,078	19,459	19,849	20,246	20,650	21,063	21,485	21,914	22,353	22,800	23,256	23,721	24,195	24,679
Small load natural gas (10% of total heat rqmnt)	$8.000	10%	449	decatherms	3,595	3,811	4,040	4,282	4,539	4,811	5,100	5,406	5,730	6,074	6,438	6,825	7,234	7,668	8,128
Operation and Maintenance Costs					1,710	1,761	1,814	1,869	1,925	1,982	2,042	2,103	2,166	2,231	2,298	2,367	2,438	2,511	2,587
Annual Operating Cost Savings					***8,963***	***10,283***	***11,698***	***13,215***	***14,839***	***16,578***	***18,438***	***20,428***	***22,555***	***24,828***	***27,256***	***29,850***	***32,618***	***35,573***	***38,725***
Financed Project Costs - Principal and Interest					***(18,860)***	***(18,860)***	***(18,860)***	***(18,860)***	***(18,860)***	***(18,860)***	***(18,860)***	***(18,860)***	***(18,860)***	***(18,860)***					
Displaced System Replacement Costs																			
Special financing																			
	$0.00		481		0	0	0	0	0	0	0	0	0	0					
Net Annual Cash Flow					***(9,897)***	***(8,577)***	***(7,161)***	***(5,645)***	***(4,021)***	***(2,282)***	***(422)***	***1,568***	***3,695***	***5,968***	***27,256***	***29,850***	***32,618***	***35,573***	***38,725***
Cumulative Cash Flow					***(9,897)***	***(18,474)***	***(25,635)***	***(31,280)***	***(35,301)***	***(37,583)***	***(38,004)***	***(36,436)***	***(32,741)***	***(26,773)***	***483***	***30,333***	***62,951***	***98,524***	***137,249***

Cashflow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Existing Heating System Operating Costs																			
	$0.000		0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Displaced natural gas heating costs	$7.210		33495	gallons	77,653	82,312	87,251	92,486	98,035	103,917	110,152	116,761	123,767	131,193	139,064	147,408	156,252	165,628	175,565
Displaced Operation and Maintenance Costs					888	915	942	970	999	1,029	1,060	1,092	1,125	1,159	1,193	1,229	1,266	1,304	1,343
Biomass System Operating Costs																			
Green Chip Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$35.00	90%	534	tons	25,173	25,676	26,190	26,714	27,248	27,793	28,349	28,916	29,494	30,084	30,686	31,299	31,925	32,564	33,215
Small load natural gas (10% of total heat rqmnt)	$8.000	10%	449	gallons	8,616	9,133	9,681	10,262	10,878	11,530	12,222	12,955	13,733	14,557	15,430	16,356	17,337	18,378	19,480
Operation and Maintenance Costs					2,664	2,744	2,826	2,911	2,998	3,088	3,181	3,277	3,375	3,476	3,580	3,688	3,798	3,912	4,030
Annual Operating Cost Savings					***42,088***	***45,673***	***49,495***	***53,569***	***57,910***	***62,535***	***67,460***	***72,705***	***78,290***	***84,235***	***90,562***	***97,294***	***104,458***	***112,078***	***120,184***
Financed Project Costs - Principal and Interest																			
Displaced System Replacement Costs																			
Special financing																			
	$0.00																		
Net Annual Cash Flow					***42,088***	***45,673***	***49,495***	***53,569***	***57,910***	***62,535***	***67,460***	***72,705***	***78,290***	***84,235***	***90,562***	***97,294***	***104,458***	***112,078***	***120,184***

MAP Biomass Heating Economic Analysis- Pellets

Conversion Proforma for MAP - 4.6% APR - 10 Year Term

October 12, 2004
Revision:
Analyst: Salmon-CTA

Project Capital Cost	**-$250,000**

Project Financing Information	
Percent Financed	0%
Amount Financed	$0
Amount of Grants	$250,000
Interest Rate	4.60%
Term	10
Annual Finance Cost (years)	$0

Escalation factors	
Elec. Escalation factor	1.04
Natural Gas Escalation factor	1.06
Fuel Oil Escalation factor	1.04
Green Chip Escalation factor	1.02
Pellet Escalation factor	1.03
Maint. Escalation factor	1.03

Cashflow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Existing Heating System Operating Costs																			
	$0.000		0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Displaced natural gas heating costs	$7.210		4,494	gallons	32,402	34,346	36,407	38,591	40,906	43,361	45,962	48,720	51,643	54,742	58,027	61,508	65,199	69,111	73,257
Displaced Operation and Maintenance Costs					570	587	605	623	642	661	681	701	722	744	766	789	813	837	862
Biomass System Operating Costs																			
Pellet Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$100.00	90%	327	tons	32,678	33,658	34,668	35,708	36,779	37,883	39,019	40,190	41,396	42,637	43,917	45,234	46,591	47,989	49,428
Small load natural gas (10% of total heat rqmnt)	$8.000	10%	449	gallons	3,595	3,811	4,040	4,282	4,539	4,811	5,100	5,406	5,730	6,074	6,438	6,825	7,234	7,668	8,128
Operation and Maintenance Costs					1,710	1,761	1,814	1,869	1,925	1,982	2,042	2,103	2,166	2,231	2,298	2,367	2,438	2,511	2,587
Annual Operating Cost Savings					***-5,012***	***-4,298***	***-3,511***	***-2,645***	***-1,695***	***-655***	***482***	***1,722***	***3,074***	***4,543***	***6,139***	***7,871***	***9,748***	***11,779***	***13,976***
Financed Project Costs - Principal and Interest					***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***					
Displaced System Replacement Costs																			
Special financing																			
	$0.00		0		0	0	0	0	0	0	0	0	0	0					
Net Annual Cash Flow					***(5,012)***	***(4,298)***	***(3,511)***	***(2,645)***	***(1,695)***	***(655)***	***482***	***1,722***	***3,074***	***4,543***	***6,139***	***7,871***	***9,748***	***11,779***	***13,976***
Cumulative Cash Flow					***(5,012)***	***(9,309)***	***(12,820)***	***(15,465)***	***(17,159)***	***(17,814)***	***(17,332)***	***(15,610)***	***(12,536)***	***(7,993)***	***(1,853)***	***6,018***	***15,766***	***27,545***	***41,521***

Cashflow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Existing Heating System Operating Costs																			
	$0.000		0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Displaced natural gas heating costs	$8.000		4,494	gallons	77,653	82,312	87,251	92,486	98,035	103,917	110,152	116,761	123,767	131,193	139,064	147,408	156,252	165,628	175,565
Displaced Operation and Maintenance Costs					888	915	942	970	999	1,029	1,060	1,092	1,125	1,159	1,193	1,229	1,266	1,304	1,343
Biomass System Operating Costs																			
Pellet Fuel ($/ton, delivered to boiler site, btu/lb) (80% of total heat rqmnt)	$100.00	80%	327	tons	50,911	52,439	54,012	55,632	57,301	59,020	60,791	62,615	64,493	66,428	68,421	70,473	72,587	74,765	77,008
Small load natural gas (10% of total heat rqmnt)	$8.000	20%	449	gallons	8,616	9,133	9,681	10,262	10,878	11,530	12,222	12,955	13,733	14,557	15,430	16,356	17,337	18,378	19,480
Operation and Maintenance Costs					2,664	2,744	2,826	2,911	2,998	3,088	3,181	3,277	3,375	3,476	3,580	3,688	3,798	3,912	4,030
Annual Operating Cost Savings					***16,349***	***18,911***	***21,673***	***24,651***	***27,857***	***31,307***	***35,018***	***39,007***	***43,291***	***47,891***	***52,826***	***58,120***	***63,795***	***69,877***	***76,391***
Financed Project Costs - Principal and Interest																			
Displaced System Replacement Costs																			
Special financing																			
	$0.00																		
Net Annual Cash Flow					***16,349***	***18,911***	***21,673***	***24,651***	***27,857***	***31,307***	***35,018***	***39,007***	***43,291***	***47,891***	***52,826***	***58,120***	***63,795***	***69,877***	***76,391***