Pre-feasibility Assessment for Integration of Biomass Energy Systems

in

Challis, Idaho

July 28, 2005

Presented by

CTA Architects Engineers
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For

United Stated Department of Agriculture
Forest Service
Region One

In partnership with:

Challis School District

Idaho Department of Lands: Fuels For Schools Program

Bitter Root Resource and Conservation Development Area, Incorporated

CTA Project: BIOMSPFA_CHALS

Executive Summary

The following assessment was commissioned to determine the technical and economic feasibility of integrating a wood chip heating system or wood pellet heating system in the existing Challis Elementary and Challis High School in Challis, Idaho.

The elementary school is approximately 35,000 SF in size and includes a boiler room with ceilings 9-10 feet in height. The facility is heated with a 135,000 kw hot water boiler with heat pumps located in each classroom. The facility uses approximately 515,000 kw for heating, air conditioning, power and lighting during a typical year at a current cost of $.056/kw or $28,000. The heating and air conditioning systems are not in use for June, July and half of the month of August.

The high school is approximately 68,000 SF in size and includes a boiler room with ceilings greater than 12 feet in height. The facility is heated with a 480,000 kw hot water boiler with heat pumps located in each classroom. The facility uses approximately 927,000 kw for heating, air conditioning, power and lighting during a typical year at a current cost of $.054/kw or $50,000. The heating and air conditioning systems are not in use for June, July and half of the month of August.

For the purpose of this investigation it is assumed that 50% of the monthly electric bills could be attributed to the electric boilers. Modeling energy consumption or metering the electric boilers would establish a more precise rate of electric use.

The 22,000 SF middle school is heated with an electric boiler but has been closed for two years due to a loss of enrollment. The middle school gym is heated with three propane furnaces using approximately 10,000 gallons of propane each year. The cost of converting the gym to a hot water heating system is likely to exceed economic benefits of a wood fuel system.

The elementary and high school facilities are more than 3,000 feet apart, and a result it is assumed that the facilities would not be heated by a central plant. The high school boiler room may have adequate space for a wood pellet or wood chip boiler. The elementary school project is likely to require a small expansion to the boiler room. Wood storage would be provided in an adjacent chip bin or pellet silo.

The wood heating system would be sized to meet approximately 90% of the typical annual heating load of the building, using the existing boiler for additional capacity in peak load conditions.

Delivery vehicle access should be accommodated to either site. Deliveries should be scheduled when school is not in session to minimize conflicts with students on campus.

Air quality permit requirements in the State of Idaho should be reviewed in greater detail.

Estimated Costs

The total project costs including contingency are estimated as follows:

Wood Chip Option:
Option A.1 High School: 90% typical annual heating load wood chip heating system ($400,000).
Option A.2 Elementary School: 90% typical annual heating load wood chip heating system ($300,000).

Wood Pellet Option:
Option B.1 High School: 90% typical annual heating load wood pellet heating system ($200,000).
Option B.2 Elementary School: 90% typical annual heating load wood pellet heating system ($200,000).

Results of Evaluation

The cash flow analysis assumes electric costs at $.05/kw, wood chips at a price of $40 per green ton delivered from the Darby, Montana stockpile site and a pellet fuel price of $95 per ton delivered from the Eureka Pellet Mill in Superior, Montana. Challis does not have an active timber industry, although the timber industry in the Salmon area may be able to support a wood heating project in Challis. As noted above, the specific electrical consumption associated with the electric boilers is not known. High and low electrical usage assumptions were used for each option.

Wood Chip Option:
Option A.1 High School: Appears to achieve positive accumulated cash flow (PAC) in 15 years with a subsidy of $200,000. The project may achieve PAC in 30 years without subsidy. 30 years savings are approximately $550,000.

Option A.2 Elementary School: Appears to achieve positive accumulated cash flow (PAC) in 19 years with a subsidy of $150,000. The project may achieve PAC in 30 years without subsidy. 30 years savings are approximately $240,000.

Wood Pellet Option:
Option B.1 High School: Appears to achieve positive accumulated cash flow (PAC) in 10 years with a subsidy of $100,000. The project may achieve PAC in 17 years without subsidy. 30 years savings are approximately $560,000.

Option B.2 Elementary School: Appears to achieve positive accumulated cash flow (PAC) in 16 years with a subsidy of $100,000. The project may achieve PAC in 30 years without subsidy. 30 years savings are approximately $240,000.

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.

Project Funding:

The School District could consider a 50% grant from the US Forest Service/Idaho Department of Lands "Fuels For Schools" Program. The grant supports 50% of the total project costs including required integration costs, but not upgrades to heat distribution. The grant requires that 50% of the wood fuel be derived from forest thinning projects on private, state, tribal or federal lands for the first two years of the project.

The School District may chose to raise the remaining funds for the project using a Maintenance Levy, similar to the current 5-year levy.

The State of Idaho currently provides zero interest bonds for school districts that match at least 10% of the project cost.

The school district could enter into a performance contracts for the project. Companies such as Siemens, McKinstry, Johnson Controls and Chevron have expressed an interest in participating in funding projects of all sizes across the state. This allows the school to pay for the project entirely from the guaranteed energy savings, and to minimize the project funds required to initiate the project.

Next Steps:

The High School appears to be a good candidate for the use of a wood biomass heating system. Modeling the energy use and/or installing a meter on the electric boiler would establish the appropriate size and energy savings associated with the boiler. It is recommended that a detailed energy analysis and cost estimate be developed to refine the project economics before requesting grant support from the Fuels For Schools program.

Challis High School-A.1 90% Wood Chips- 50% Electrical Usage Assumption

Challis, Idaho

Date(Revision Date): July 28, 2005
Analyst: CTA-Architects Engineers- Nick Salmon

EXISTING CONDITIONS

	Electric	Propane	Natural Gas	Notes:
Existing Fuel Type:				Fuel type highlighted
Current Annual Fuel Cost:	$0.05	$0.00	$0.00	Current year average $/gallon or $/dka
3-year Annual Average Fuel Usage:	445,000	0	0	3-year year average gallon or dka
Annual Heating Costs:	$22,250	$0	$0	Chart will automatically convert

ENERGY CONVERSION (to 1 mmbtu, or 1 dka)

Current Annual Fuel Volume (dka):	1,518,785,000	0	0	Chart will automatically convert
Assumed efficiency of existing heating system (%):	80%	80%	80%	
Net Annual Fuel Usage (dka):	1,215,028,000	0	0	Chart will automatically convert

WOOD FUEL COST

	Wood Chips	Wood Pellets	
$/ton:	$40.00	$95.00	Modify for local conditions
Assumed efficiency of wood heating system (%):	65%	70%	

PROJECTED FUEL USAGE

Assumed btu content of wood fuel	5400	8200	
Tons of wood fuel to create net equivalent of 100% annual heating load	173	0	=Net Annual Fuel Usage/10.8 or 16.4 mmbtu/Assumed efficiency of wood heating system

Project Capital Cost	**-$400,000**	nearest $50,000

Project Financing Information		
Percent Financed	**50%**	
Amount Financed	-$200,000	
Amount of Grants	$200,000	
Interest Rate	4.60%	Modify for local conditions
Term	10	
Annual Finance Cost (years)	-$25,400	
Simple Payback: Total Project Cost/Year One Operating Cost Savings:	-32 (years)	Represents a quick look at project viability

Inflation Factors	
O&M Inflation Rate	3%
Current Fuel Inflation Rate	4%
Wood Fuel Inflation Rate	2%

Cash flow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source	Heating Units	Year 1	Year 10	Year 11	Year 20	Year 30
Existing Heating System Operating Costs									
Displaced heating costs	$0.05		445000	kw	$22,250	$31,669	$32,935	$46,877	$69,390
Displaced Operation and Maintenance Costs					$500	$652	$672	$877	$1,178
Biomass System Operating Costs									
Wood Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$40.00	90%	173	tons	$6,231	$7,447	$7,595	$9,077	$11,065
Small load existing fuel (10% of total heat rqmnt)	$0.06	10%	445000	kw	$2,448	$3,484	$3,623	$5,157	$7,633
Operation and Maintenance Costs					$1,500	$1,957	$2,016	$2,630	$3,535
Annual Operating Cost Savings					***$12,572***	***$19,434***	***$20,373***	***$30,890***	***$48,335***
Financed Project Costs - Principal and Interest					*(25,400)*	*(25,400)*			
Displaced System Replacement Costs (year one only)									
Net Annual Cash Flow					*(12,829)*	*(5,966)*	***20,373***	***30,890***	***48,335***
Cumulative Cash Flow					*(12,829)*	*(95,942)*	*(75,568)*	***157,413***	***556,268***

Challis Elementary School-A.2 90% Wood Chips-50% Electrical Usage Assumption

Challis, Idaho

Date(Revision Date): July 28, 2005
Analyst: CTA-Architects Engineers- Nick Salmon

EXISTING CONDITIONS

	Electric	Propane	Natural Gas	Notes:
Existing Fuel Type:				Fuel type highlighted
Current Annual Fuel Cost:	$0.05	$0.00	$0.00	Current year average $/gallon or $/dka
3-year Annual Average Fuel Usage:	250,000	0	0	3-year year average gallon or dka
Annual Heating Costs:	$12,500	$0	$0	Chart will automatically convert

ENERGY CONVERSION (to 1 mmbtu, or 1 dka)

Current Annual Fuel Volume (dka):	853,250,000	0	0	Chart will automatically convert
Assumed efficiency of existing heating system (%):	80%	80%	80%	
Net Annual Fuel Usage (dka):	682,600,000	0	0	Chart will automatically convert

WOOD FUEL COST

	Wood Chips	Wood Pellets	
$/ton:	$40.00	$95.00	Modify for local conditions
Assumed efficiency of wood heating system (%):	65%	70%	

PROJECTED FUEL USAGE

Assumed btu content of wood fuel	5400	8200	
Tons of wood fuel to create net equivalent of 100% annual heating load	97	0	=Net Annual Fuel Usage/10.8 or 16.4 mmbtu/Assumed efficiency of wood heating system

Project Capital Cost	**-$300,000**	nearest $50,000

Project Financing Information		
Percent Financed	**50%**	
Amount Financed	-$150,000	
Amount of Grants	$150,000	
Interest Rate	4.60%	Modify for local conditions
Term	10	
Annual Finance Cost (years)	-$19,050	
Simple Payback: Total Project Cost/Year One Operating Cost Savings:	-45 (years)	Represents a quick look at project viability

Inflation Factors	
O&M Inflation Rate	3%
Current Fuel Inflation Rate	4%
Wood Fuel Inflation Rate	2%

Cash flow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source	Heating Units	Year 1	Year 10	Year 11	Year 20	Year 30
Existing Heating System Operating Costs									
Displaced heating costs	$0.05		250000	kw	$12,500	$17,791	$18,503	$26,336	$38,983
Displaced Operation and Maintenance Costs					$500	$652	$672	$877	$1,178
Biomass System Operating Costs									
Wood Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$40.00	90%	97	tons	$3,501	$4,183	$4,267	$5,100	$6,216
Small load existing fuel (10% of total heat rqmnt)	$0.06	10%	250000	kw	$1,375	$1,957	$2,035	$2,897	$4,288
Operation and Maintenance Costs					$1,500	$1,957	$2,016	$2,630	$3,535
Annual Operating Cost Savings					***$6,624***	***$10,346***	***$10,857***	***$16,586***	***$26,122***
Financed Project Costs - Principal and Interest					*(19,050)*	*(19,050)*			
Displaced System Replacement Costs (year one only)									
Net Annual Cash Flow					*(12,426)*	*(8,704)*	***10,857***	***16,586***	***26,122***
Cumulative Cash Flow					*(12,426)*	*(106,727)*	*(95,870)*	***28,856***	***243,859***

Challis High School-B.1 90% Pellets-50% Electrical Usage Assumption

Challis, Idaho

Date(Revision Date): July 28, 2005
Analyst: CTA-Architects Engineers- Nick Salmon

EXISTING CONDITIONS

	Electric	Propane	Natural Gas	Notes:
Existing Fuel Type:				Fuel type highlighted
Current Annual Fuel Cost:	$0.05	$0.00	$0.00	Current year average $/gallon or $/dka
3-year Annual Average Fuel Usage:	445,000	0	0	3-year year average gallon or dka
Annual Heating Costs:	$22,250	$0	$0	Chart will automatically convert

ENERGY CONVERSION (to 1 mmbtu, or 1 dka)

Current Annual Fuel Volume (dka):	1,518,785,000	0	0	Chart will automatically convert
Assumed efficiency of existing heating system (%):	80%	80%	80%	
Net Annual Fuel Usage (dka):	1,215,028,000	0	0	Chart will automatically convert

WOOD FUEL COST

	Wood Chips	Wood Pellets	
$/ton:	$40.00	$95.00	Modify for local conditions
Assumed efficiency of wood heating system (%):	65%	70%	

PROJECTED FUEL USAGE

Assumed btu content of wood fuel	5400	8200	
Tons of wood fuel to create net equivalent of 100% annual heating load	173	106	=Net Annual Fuel Usage/10.8 or 16.4 mmbtu/Assumed efficiency of wood heating system

Project Capital Cost	**-$200,000**	nearest $50,000

Project Financing Information	
Percent Financed	**50%**
Amount Financed	-$100,000
Amount of Grants	$100,000
Interest Rate	4.60%
Term	10
Annual Finance Cost (years)	-$12,700
Simple Payback: Total Project Cost/Year One Operating Cost Savings:	-21 (years)

Modify for local conditions

Represents a quick look at project viability

Inflation Factors	
O&M Inflation Rate	3%
Current Fuel Inflation Rate	4%
Wood Fuel Inflation Rate	2%

Cash flow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source	Heating Units	Year 1	Year 10	Year 11	Year 20	Year 30
Existing Heating System Operating Costs									
Displaced heating costs	$0.05		445000	kw	$22,250	$31,669	$32,935	$46,877	$69,390
Displaced Operation and Maintenance Costs					$500	$652	$672	$877	$1,178
Biomass System Operating Costs									
Wood Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$95.00	90%	106	tons	$9,049	$10,815	$11,031	$13,183	$16,070
Small load existing fuel (10% of total heat rqmnt)	$0.06	10%	445000	kw	$2,448	$3,484	$3,623	$5,157	$7,633
Operation and Maintenance Costs					$1,500	$1,957	$2,016	$2,630	$3,535
Annual Operating Cost Savings					***$9,753***	***$16,066***	***$16,938***	***$26,784***	***$43,331***
Financed Project Costs - Principal and Interest					*(12,700)*	*(12,700)*			
Displaced System Replacement Costs (year one only)									
Net Annual Cash Flow					*(2,947)*	***3,366***	***16,938***	***26,784***	***43,331***
Cumulative Cash Flow					*(2,947)*	***200***	***17,137***	***215,937***	***568,937***

Challis Elementary School-B.2 90% Pellets-50% Electrical Usage Assumption

Challis, Idaho

Date(Revision Date): July 28, 2005
Analyst: CTA-Architects Engineers- Nick Salmon

EXISTING CONDITIONS

	Electric	Propane	Natural Gas	Notes:
Existing Fuel Type:				Fuel type highlighted
Current Annual Fuel Cost:	$0.05	$0.00	$0.00	Current year average $/gallon or $/dka
3-year Annual Average Fuel Usage:	250,000	0	0	3-year year average gallon or dka
Annual Heating Costs:	$12,500	$0	$0	Chart will automatically convert

ENERGY CONVERSION (to 1 mmbtu, or 1 dka)

Current Annual Fuel Volume (dka):	853,250,000	0	0	Chart will automatically convert
Assumed efficiency of existing heating system (%):	80%	80%	80%	
Net Annual Fuel Usage (dka):	682,600,000	0	0	Chart will automatically convert

WOOD FUEL COST

	Wood Chips	Wood Pellets	
$/ton:	$40.00	$95.00	Modify for local conditions
Assumed efficiency of wood heating system (%):	65%	70%	

PROJECTED FUEL USAGE

Assumed btu content of wood fuel	5400	8200	
Tons of wood fuel to create net equivalent of 100% annual heating load	97	59	=Net Annual Fuel Usage/10.8 or 16.4 mmbtu/Assumed efficiency of wood heating system

Project Capital Cost	**-$200,000**	nearest $50,000

Project Financing Information		
Percent Financed	**50%**	
Amount Financed	-$100,000	
Amount of Grants	$100,000	
Interest Rate	4.60%	Modify for local conditions
Term	10	
Annual Finance Cost (years)	-$12,700	
Simple Payback: Total Project Cost/Year One Operating Cost Savings:	-40 (years)	Represents a quick look at project viability

Inflation Factors	
O&M Inflation Rate	3%
Current Fuel Inflation Rate	4%
Wood Fuel Inflation Rate	2%

Cash flow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source	Heating Units	Year 1	Year 10	Year 11	Year 20	Year 30
Existing Heating System Operating Costs									
Displaced heating costs	$0.05		250000	kw	$12,500	$17,791	$18,503	$26,336	$38,983
Displaced Operation and Maintenance Costs					$500	$652	$672	$877	$1,178
Biomass System Operating Costs									
Wood Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$95.00	90%	59	tons	$5,084	$6,076	$6,197	$7,406	$9,028
Small load existing fuel (10% of total heat rqmnt)	$0.06	10%	250000	kw	$1,375	$1,957	$2,035	$2,897	$4,288
Operation and Maintenance Costs					$1,500	$1,957	$2,016	$2,630	$3,535
Annual Operating Cost Savings					***$5,041***	***$8,454***	***$8,927***	***$14,279***	***$23,310***
Financed Project Costs - Principal and Interest					*(12,700)*	*(12,700)*			
Displaced System Replacement Costs (year one only)									
Net Annual Cash Flow					*(7,659)*	*(4,246)*	***8,927***	***14,279***	***23,310***
Cumulative Cash Flow					*(7,659)*	*(60,563)*	*(51,637)*	***53,886***	***243,128***