

***Pre-feasibility Assessment for
Integration of Biomass Energy Systems***

for

***Benewah Community Hospital, Benewah County Courthouse
& Benewah County Federal Building
Saint Maries, Idaho***

April 6, 2007

Presented by

***CTA Architects Engineers
Nick Salmon & Eric Weckenbrock***

For

United States Department of Agriculture
Forest Service
Region One

In partnership with:

Benewah County

USDA Region One Fuels for Schools Program

Idaho Department of Lands: Fuels For Schools Program

Bitter Root Resource and Conservation Development Area, Incorporated

Executive Summary

The following assessment was commissioned to determine the technical and economic feasibility of integrating a wood fired heating system with the existing systems at the Benewah Community Hospital, Benewah County Courthouse & Benewah County Federal Building, located in Saint Maries, Idaho. All three buildings are owned by Benewah County.

The Benewah Community Hospital is heated with three boilers all producing steam. The boilers burn 50,000 gallons of fuel oil each year at a price of \$2.30/gallon or \$115,000 per year. One boiler is original to the 1957 hospital with a capacity of 2,160,000 btu. Two boilers (1,670,000 btu each) were installed in the 1993 and 2004 expansions and are interconnected with the original steam boiler. Hot water is produced via heat exchangers with the exception of a 415,000 btu hot water heater. It is not clear if the combined 5,500,000 capacity of the boilers provide the required redundancy for heating the facility.

The Benewah County Courthouse is an electrically heated facility with no hydronic components. Converting the facility to a hot water heating system would be cost prohibitive (25,000 SF x 20-25\$/SF, or \$500,000-\$625,000), and the feasibility of converting the heating system was not explored.

The Benewah County Federal Building is heated with two hot water boilers 1,992,000 btu in size. The boilers burn 18,000 gallons of fuel oil each year at a price of \$2.30/gallon or \$41,000 per year.

Several options were explored for this assessment. The baseline option (A.1) is designed to provide a central heating plant for the hospital only. The boiler/chip storage building would be located east of the hospital fuel oil tank and south of the alley between the courthouse and hospital. The existing log retaining wall would need to be removed to provide a site for the building. 4 parking spaces would be displaced by the building. Delivery vehicles would pull into the alley and deliver wood fuel with a pneumatic or belt conveyor into the chip storage building.

The chip storage/boiler building would contain a single boiler producing steam for distribution to the 1957 boiler room of the adjacent hospital.

Option A.2 would include all of the components of Option A.1 in addition to a steam to hot water heat exchanger and hot water supply and return lines to the Benewah County Federal Building across the street.

Two wood pellet heating system options were also explored. The baseline option (B.1) would be similar to option A.1, but with a silo for pellet storage rather than a chip storage building. Option B.2 would be similar to option B.1, but with a silo for pellet storage rather than a chip storage building. A limited number of wood heating system vendors produce pellet fired boilers capable of producing steam.

Energy Analysis:

For the purpose of this investigation it is assumed that 95% of the existing annual fuel oil and propane consumption could be offset by the combustion of wood chips in a boiler approximately 1/2 the combined capacity of the existing boilers. Modeling energy consumption would establish a more precise wood boiler size for the facility. The wood heating system would be sized to meet approximately 95% of the typical annual heating load of the building, using the existing boilers for additional capacity in peak load conditions, and for any future expansion.

Building & Site Constraints:

The majority of the adjacent vacant lots in the area of the three buildings are currently used for parking. The vacant lots are also far from the hospital and federal building boiler rooms. Although the proposed site requires modifications to the existing retaining wall and small parking lot, the proximity to the hospital boiler room will minimize the cost of extending steam lines to the boiler room.

Wood fuel delivery trucks would require pneumatic or belt conveyors to convey the wood fuel into the storage bin or silo since it is unlikely that the truck could back into the building from the adjacent streets.

The stack height for the project is likely to be higher than the adjacent courthouse, or more than 50 feet high.

Air Quality Permits:

Air quality permit requirements should be reviewed in greater detail. Modeling of the stack height and emissions should be anticipated.

Estimated Costs:

The total project costs including integration, contingency and escalation are estimated as noted below.

**Option A.1
Hospital Only
2.75 mmbtu boiler**

Chip Storage/ Boiler Building:	\$100,000
Wood Heating & Wood Handling System:	\$250,000
Stack:	\$75,000
Mechanical/Electrical within Boiler Building:	\$50,000
Buried Pipe	\$5,000
Boiler Room Integration:	\$25,000
Heat Exchanger:	-
Subtotal:	\$505,000
Remoteness Factor: 10%	\$50,500
Subtotal:	\$555,500
Fees, Building Permit, Miscellaneous Expenses 15%:	\$83,500
Subtotal:	\$639,000
20% Contingency +/-:	\$128,000
Subtotal:	\$767,000
6% +/- Escalation to bid date (3/2008):	\$46,000
Total	\$813,000

**Option A.2
Hospital and Federal Building
5 mmbtu boiler**

Chip Storage/ Boiler Building:	\$100,000
Wood Heating & Wood Handling System:	\$300,000
Stack:	\$75,000
Mechanical/Electrical within Boiler Building:	\$50,000
Pipe:	\$30,000
Boiler Room Integration:	\$50,000
Heat Exchanger:	\$25,000
Subtotal:	\$630,000
Remoteness Factor: 10%	\$63,000
Subtotal:	\$693,000
Fees, Building Permit, Miscellaneous Expenses 15%:	\$104,000
Subtotal:	\$797,000
20% Contingency +/-:	\$159,000
Subtotal:	\$956,000
6% +/- Escalation to bid date (3/2008):	\$57,000
Total	\$1,013,000

**Option B.1
Hospital Only
2.75 mmbtu boiler**

Pellet Storage/ Boiler Building:	\$75,000
Wood Heating & Wood Handling System:	\$250,000
Stack:	\$75,000
Mechanical/Electrical within Boiler Building:	\$50,000
Buried Pipe	\$5,000
Boiler Room Integration:	\$25,000
Heat Exchanger:	-
Subtotal:	\$480,000
Remoteness Factor: 10%	\$48,000
Subtotal:	\$528,000
Fees, Building Permit, Miscellaneous Expenses 15%:	\$79,000
Subtotal:	\$607,000
20% Contingency +/-:	\$121,000
Subtotal:	\$728,000
6% +/- Escalation to bid date (3/2008):	\$44,000
Total	\$772,000

**Option B.2
Hospital and Federal Building
5 mmbtu boiler**

Pellet Storage/ Boiler Building:	\$75,000
Wood Heating & Wood Handling System:	\$300,000
Stack:	\$75,000
Mechanical/Electrical within Boiler Building:	\$50,000
Pipe:	\$30,000
Boiler Room Integration:	\$50,000
Heat Exchanger:	\$25,000
Subtotal:	\$605,000
Remoteness Factor: 10%	\$60,500
Subtotal:	\$665,500
Fees, Building Permit, Miscellaneous Expenses 15%:	\$100,000
Subtotal:	\$765,500
20% Contingency +/-:	\$153,000
Subtotal:	\$918,500
6% +/- Escalation to bid date (3/2008):	\$55,500
Total	\$974,000

Results of Evaluation

The cash flow analysis assumes delivered fuel oil costs of \$2.30/gal, wood chips at a locally delivered price of \$35 per green ton and wood pellets at a locally delivered price of \$120/ton. The cost and source of wood fuel needs to be verified.

Wood Chip Options:

Option A.1 Baseline: Appears to achieve positive accumulated cash flow (PAC) in 1 year with a subsidy of \$284,550. The project may achieve PAC in 11 years without subsidy. 30 years savings (avoided costs) are approximately \$4,000,000.

Option A.2 Hospital and Federal Building: Appears to achieve positive accumulated cash flow (PAC) in 1 year with a subsidy of \$354,550. The project may achieve PAC in 7 years without subsidy. 30 years savings (avoided costs) are approximately \$6,000,000.

Wood Pellet Options:

Option B.1 Baseline: Appears to achieve positive accumulated cash flow (PAC) in 5 years with a subsidy of \$270,200. The project may achieve PAC in 13 years without subsidy. 30 years savings (avoided costs) are approximately \$3,000,000.

Option B.2 Hospital and Federal Building: Appears to achieve positive accumulated cash flow (PAC) in 2 years with a subsidy of \$340,900. The project may achieve PAC in 12 years without subsidy. 30 years savings (avoided costs) are approximately \$4,000,000.

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. Positive accumulated cash flow in year one indicates a strong project. Positive accumulated cash flow in year 20 or more indicates a challenged project.

Project Funding:

"Fuels For Schools" has identified several sources of financial assistance potentially available for facility owners and managers interested in conversion of fossil fuel heating systems to forest-biomass fueled boilers. Mike Tennery, State Fuels for Schools Coordinator, can provide information and assistance. A few examples include programs through the USDA Rural Development, through carbon trading systems that are being established, municipal leases and others.

Benewah County could enter into a performance contract for the project. Companies such as Siemens, McKinstry, Johnson Controls and Chevron have expressed an interest in participating in funding projects of all sizes throughout the region. This allows the facility owner 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 Benewah Community Hospital appears to be a good candidate for the use of a wood biomass heating system. Modeling the energy use 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 or other project funding.

Benewah County Hospital: Option A.1

St. Maries, ID

Date(Revision Date): April 6, 2007

Analyst: CTA-Architects Engineers- Eric Weckenbrock & Nick Salmon

EXISTING CONDITIONS

	Fuel Oil	Propane	Natural Gas
Existing Fuel Type:	\$2.30	\$1.50	\$11.00
Current Annual Fuel Cost:	50,000	0	28,531
3-year Annual Average Fuel Usage:	\$115,000	\$0	\$313,840
Annual Heating Costs:			

Notes:

Fuel type highlighted
 Current year average \$/gallon or \$/dka
 3-year year average gallon or dka
 Chart will automatically convert

ENERGY CONVERSION (to 1 mmbtu, or 1 dka)

Current Annual Fuel Volume (btu):	6,934,500,000	0	28,530,900,000
Assumed efficiency of existing heating system (%):	70%	80%	80%
Net Annual Fuel Usage (btu):	4,854,150,000	0	22,824,720,000

Chart will automatically convert

Chart will automatically convert

WOOD FUEL COST

	Wood Chips	Wood Pellets
\$/ton:	\$35.00	\$120.00
Assumed efficiency of wood heating system (%):	65%	70%

Modify for local conditions

PROJECTED FUEL USAGE

Assumed btu content of wood fuel
 Tons of wood fuel to create net equivalent of 100% annual heating load

	5400	8200
	691	423

=Net Annual Fuel Usage/10.8 or 16.4 mmbtu/Assumed efficiency of wood heating system

Project Capital Cost	-\$813,000
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Project Financing Information	
Percent Financed	65%
Amount Financed	-\$528,450
Amount of Grants	\$284,550
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-\$68,437
Simple Payback: Total Project Cost/Year One Operating Cost Savings:	10 (years)

35% grant, Maximum \$400,000

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%

Change in this location only

Change in this location only

Change in this location only

Cash flow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 10	Year 11	Year 20	Year 30
Existing Heating System Operating Costs									
Displaced heating costs	\$2.30		50000 gal		\$115,000	\$163,681	\$170,228	\$242,288	\$358,645
Displaced Operation and Maintenance Costs					\$500	\$652	\$672	\$877	\$1,178
Biomass System Operating Costs									
Wood Fuel (\$/ton, delivered to boiler site, btu/lb) (95% of total heat reqmnt)	\$35.00	95%	691 tons		\$22,992	\$27,477	\$28,027	\$33,494	\$40,829
Small load existing fuel (5% of total heat reqmnt)	\$2.30	5%	50000 gal		\$5,750	\$8,184	\$8,511	\$12,114	\$17,932
Operation and Maintenance Costs					\$2,500	\$3,262	\$3,360	\$4,384	\$5,891
Annual Operating Cost Savings					\$84,258	\$125,410	\$131,002	\$193,172	\$295,170
Financed Project Costs - Principal and Interest					(68,437)	(68,437)			
Displaced System Replacement Costs (year one only)									
Net Annual Cash Flow					15,822	56,974	131,002	193,172	295,170
Cumulative Cash Flow					15,822	352,622	483,624	1,956,514	4,415,040

Benewah Hospital & Federal Building: Option A.2

St. Maries, ID

Date(Revision Date): April 6, 2007

Analyst: CTA-Architects Engineers- Eric Weckenbrock & Nick Salmon

EXISTING CONDITIONS

	Fuel Oil	Propane	Natural Gas
Existing Fuel Type:	\$2.30	\$1.50	\$10.75
Current Annual Fuel Cost:	68,000	0	5,000
3-year Annual Average Fuel Usage:	\$156,400	\$0	\$53,750
Annual Heating Costs:			

Notes:

Fuel type highlighted
 Current year average \$/gallon or \$/dka
 Projected gas consumption with future expansion
 Chart will automatically convert

ENERGY CONVERSION (to 1 mmbtu, or 1 dka)

Current Annual Fuel Volume (btu):	9,430,920,000	0	5,000,000,000
Assumed efficiency of existing heating system (%):	70%	80%	80%
Net Annual Fuel Usage (btu):	6,601,644,000	0	4,000,000,000

Chart will automatically convert

Chart will automatically convert

WOOD FUEL COST

\$/ton:
 Assumed efficiency of wood heating system (%):

Wood Chips	Wood Pellets
\$35.00	\$120.00
65%	70%
5400	8200
940	575

Modify for local conditions
 575 =Net Annual Fuel Usage/10.8 or 16.4 mmbtu/Assumed efficiency of wood heating system

PROJECTED FUEL USAGE

Assumed btu content of wood fuel
 Tons of wood fuel to create net equivalent of 100% annual heating load

Project Capital Cost	-\$1,013,000
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Project Financing Information	
Percent Financed	65%
Amount Financed	-\$658,450
Amount of Grants	\$354,550
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-\$85,272
Simple Payback: Total Project Cost/Year One Operating Cost Savings:	9 (years)

35% grant, Maximum \$400,000

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%

Change in this location only

Change in this location only

Change in this location only

Cash flow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 10	Year 11	Year 20	Year 30
Existing Heating System Operating Costs									
Displaced heating costs	\$2.30		68000 gal		\$156,400	\$222,606	\$231,510	\$329,511	\$487,757
Displaced Operation and Maintenance Costs					\$500	\$652	\$672	\$877	\$1,178
Biomass System Operating Costs									
Wood Fuel (\$/ton, delivered to boiler site, btu/lb) (95% of total heat reqmnt)	\$35.00	95%	940 tons		\$31,268	\$37,369	\$38,116	\$45,552	\$55,528
Small load existing fuel (5% of total heat reqmnt)	\$2.30	5%	68000 gal		\$7,820	\$11,130	\$11,576	\$16,476	\$24,388
Operation and Maintenance Costs					\$2,500	\$3,262	\$3,360	\$4,384	\$5,891
Annual Operating Cost Savings					\$115,312	\$171,497	\$179,131	\$263,976	\$403,128
Financed Project Costs - Principal and Interest					(85,272)	(85,272)			
Displaced System Replacement Costs (year one only)									
Net Annual Cash Flow					30,039	86,225	179,131	263,976	403,128
Cumulative Cash Flow					30,039	565,836	744,967	2,758,222	6,116,725

Benewah County Hospital: Option B.1

St. Maries, ID

Date(Revision Date): April 6, 2007

Analyst: CTA-Architects Engineers- Eric Weckenbrock & Nick Salmon

EXISTING CONDITIONS

	Fuel Oil	Propane	Natural Gas
Existing Fuel Type:	\$2.30	\$1.50	\$11.00
Current Annual Fuel Cost:	50,000	0	28,531
3-year Annual Average Fuel Usage:	\$115,000	\$0	\$313,840
Annual Heating Costs:			

Notes:

Fuel type highlighted
Current year average \$/gallon or \$/dka
3-year year average gallon or dka
Chart will automatically convert

ENERGY CONVERSION (to 1 mmbtu, or 1 dka)

Current Annual Fuel Volume (btu):	6,934,500,000	0	28,530,900,000
Assumed efficiency of existing heating system (%):	70%	80%	80%
Net Annual Fuel Usage (btu):	4,854,150,000	0	22,824,720,000

Chart will automatically convert

Chart will automatically convert

WOOD FUEL COST

\$/ton:
Assumed efficiency of wood heating system (%):

Wood Chips Wood Pellets

\$35.00	\$120.00
65%	70%
5400	8200
691	423

Modify for local conditions

=Net Annual Fuel Usage/10.8 or 16.4 mmbtu/Assumed efficiency of wood heating system

PROJECTED FUEL USAGE

Assumed btu content of wood fuel
Tons of wood fuel to create net equivalent of 100% annual heating load

13 (years)

Represents a quick look at project viability

Project Capital Cost	-\$772,000
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Project Financing Information	
Percent Financed	65%
Amount Financed	-\$501,800
Amount of Grants	\$270,200
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-\$64,985
Simple Payback: Total Project Cost/Year One Operating Cost Savings:	

35% grant, Maximum \$400,000

Modify for local conditions

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

Change in this location only

Change in this location only

Change in this location only

Cash flow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 10	Year 11	Year 20	Year 30
Existing Heating System Operating Costs									
Displaced heating costs	\$2.30		50000 gal		\$115,000	\$163,681	\$170,228	\$242,288	\$358,645
Displaced Operation and Maintenance Costs					\$500	\$652	\$672	\$877	\$1,178
Biomass System Operating Costs									
Wood Fuel (\$/ton, delivered to boiler site, btu/lb) (95% of total heat reqmnt)	\$120.00	95%	423 tons		\$48,203	\$57,607	\$58,759	\$70,223	\$85,601
Small load existing fuel (5% of total heat reqmnt)	\$2.30	5%	50000 gal		\$5,750	\$8,184	\$8,511	\$12,114	\$17,932
Operation and Maintenance Costs					\$2,500	\$3,262	\$3,360	\$4,384	\$5,891
Annual Operating Cost Savings					\$59,047	\$95,280	\$100,269	\$156,443	\$250,398
Financed Project Costs - Principal and Interest					(64,985)	(64,985)			
Displaced System Replacement Costs (year one only)									
Net Annual Cash Flow					(5,939)	30,295	100,269	156,443	250,398
Cumulative Cash Flow					(5,939)	111,074	211,343	1,378,449	3,426,762

Benewah Hospital & Federal Building: Option B.2

St. Maries, ID

Date(Revision Date): April 6, 2007

Analyst: CTA-Architects Engineers- Eric Weckenbrock & Nick Salmon

EXISTING CONDITIONS

	Fuel Oil	Propane	Natural Gas
Existing Fuel Type:	\$2.30	\$1.50	\$10.75
Current Annual Fuel Cost:	68,000	0	5,000
3-year Annual Average Fuel Usage:	\$156,400	\$0	\$53,750
Annual Heating Costs:			

Notes:

Fuel type highlighted
 Current year average \$/gallon or \$/dka
 Projected gas consumption with future expansion
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ENERGY CONVERSION (to 1 mmbtu, or 1 dka)

Current Annual Fuel Volume (btu):	9,430,920,000	0	5,000,000,000
Assumed efficiency of existing heating system (%):	70%	80%	80%
Net Annual Fuel Usage (btu):	6,601,644,000	0	4,000,000,000

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WOOD FUEL COST

\$/ton:
 Assumed efficiency of wood heating system (%):

Wood Chips	Wood Pellets	
\$35.00	\$120.00	Modify for local conditions
65%	70%	
5400	8200	
940	575	=Net Annual Fuel Usage/10.8 or 16.4 mmbtu/Assumed efficiency of wood heating system

PROJECTED FUEL USAGE

Assumed btu content of wood fuel
 Tons of wood fuel to create net equivalent of 100% annual heating load

Project Capital Cost	-\$974,000
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Project Financing Information	
Percent Financed	65%
Amount Financed	-\$633,100
Amount of Grants	\$340,900
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-\$81,989
Simple Payback: Total Project Cost/Year One Operating Cost Savings:	12 (years)

35% grant, Maximum \$400,000

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%

Change in this location only

Change in this location only

Change in this location only

Cash flow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 10	Year 11	Year 20	Year 30
Existing Heating System Operating Costs									
Displaced heating costs	\$2.30		68000 gal		\$156,400	\$222,606	\$231,510	\$329,511	\$487,757
Displaced Operation and Maintenance Costs					\$500	\$652	\$672	\$877	\$1,178
Biomass System Operating Costs									
Wood Fuel (\$/ton, delivered to boiler site, btu/lb) (95% of total heat reqmnt)	\$120.00	95%	575 tons		\$65,556	\$78,346	\$79,913	\$95,503	\$116,418
Small load existing fuel (5% of total heat reqmnt)	\$2.30	5%	68000 gal		\$7,820	\$11,130	\$11,576	\$16,476	\$24,388
Operation and Maintenance Costs					\$2,500	\$3,262	\$3,360	\$4,384	\$5,891
Annual Operating Cost Savings					\$81,024	\$130,520	\$137,334	\$214,025	\$342,238
Financed Project Costs - Principal and Interest					(81,989)	(81,989)			
Displaced System Replacement Costs (year one only)									
Net Annual Cash Flow					(966)	48,531	137,334	214,025	342,238
Cumulative Cash Flow					(966)	223,222	360,556	1,957,945	4,758,559