BIOMASS HEATING FEASIBILITY ASSESSMENT

Baker High School

Baker City, Oregon

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EXECUTIVE SUMMARY

The following assessment was commissioned by the Oregon Department of Energy (ODOE) and Oregon Department of Justice (DOJ) through the Community Renewable Energy Feasibility (CREF) program. The assessment will determine the viability of biomass energy integration at Baker High School in Baker City, Oregon.

Fuel resource, quality and infrastructure are all critical to the sustainability of biomass energy and must be considered carefully before proceeding with a project. Although this assessment is preliminary in nature and the results must be verified at time of project implementation, it appears that the fuel resource and infrastructure around Baker City are adequate to supply biomass fuel to the project.

Air emissions associated with biomass energy need to be addressed very early in the design process.

The economic metrics of feasibility for this assessment include technical feasibility, the net present value of each project option, and other extenuating factors that were identified during the course of assessment.

The following table summarizes the economic analysis for options considered:

Economic Summary

Option	Project Cost	Wood Fuel Cost $/ton	Year 1 Operating Savings	NPV 30 yr at 3%	ACF YR 30	YR ACF=PC
Option A.1 Gr. Chips - 100% Grant; 0% Financed	$1,479,000	$40	$45,273	$2,810,249	$4,997,917	17
Option A.2 Gr. Chips - 50% Grant; 50% Financed	$1,479,000	$40	$45,273	$1,993,876	$4,040,878	22
Option A.3 Gr. Chips - 0% Grant; 100% Financed	$1,479,000	$40	$45,273	$1,176,398	$3,082,545	26
Option B.1 Pr. Chips - 100% Grant; 0% Financed	$1,479,000	$50	$48,556	$2,891,980	$5,130,261	16
Option B.2 Pr. Chips - 50% Grant; 50% Financed	$1,479,000	$50	$48,556	$2,075,607	$4,173,223	22
Option B.3 Pr. Chips - 0% Grant; 100% Financed	$1,479,000	$50	$48,556	$1,258,129	$3,214,889	25
Option C.1 Pellets - 100% Grant; 0% Financed	$1,025,000	$160	$690	$1,470,070	$2,805,365	25
Option C.2 Pellets - 50% Grant; 50% Financed	$1,025,000	$160	$690	$903,911	$2,141,654	28
Option C.3 Pellets - 0% Grant; 100% Financed	$1,025,000	$160	$690	$337,752	$1,477,943	30
Option D.1 Pucks - 100% Grant; 0% Financed	$1,040,000	$135	$12,225	$1,819,925	$3,377,984	22
Option D.2 Pucks - 50% Grant; 50% Financed	$1,040,000	$135	$12,225	$1,245,481	$2,704,560	26
Option D.3 Pucks - 50% Grant; 50% Financed	$1,040,000	$135	$12,225	$671,037	$2,031,137	29
NPV: Net Present Value; ACF: Accumulated Cash Flow; YR ACF=PC : Year Accumulated Cash Flow equals Project Cost						

Option A is a wood chip boiler utilizing green chips; Option B is a wood chip boiler utilizing processed wood chips; Option C is a densified wood boiler utilizing wood pellets; and Option D is a densified wood boiler utilizing wood pucks. Each option was analyzed at different levels of grant support – 100%, 50%, and 0%.

The summary shows that all the biomass fuel options will have fuel cost savings over natural gas. At the present time, a chip boiler system appears to be the strongest project, especially if at least 50% of the project cost can be offset by a grant. If the project proceeds to implementation, additional capital cost savings measures can be analyzed in more detail, the actual fuel source and cost can be identified, and the economic analysis can be updated to determine the strongest project to proceed with.

CTA would like to acknowledge and thank:

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Randy has been an untiring advocate of bringing a successful biomass project to Baker City. He also provided the background information on the biomass fuel sources for this feasibility report. Randy has also provided many hours of review of this feasibility assessment prior to the final publication of feasibility to the School Board.

AN OVERVIEW OF BIOMASS AND THIS ASSESSMENT

Biomass energy systems hold great potential to reduce energy costs, derive energy from local sources, and reduce the net carbon footprint for certain projects while playing a role in active forest management. That said, implementation of biomass energy has a set of complexities that are important to consider in every project. Failure to satisfy any one or more of these issues may result in a project of marginal success, or outright failure. This assessment attempts to address the feasibility of implementing biomass energy integration at Baker High School in Baker City, Oregon

For every biomass project considered, an objective approach to addressing the following points is required:

1. Fuel resource. Adequate fuel resources must exist in a reasonably local manner.

2. Site technical requirements. Site requirements include:
    a. Logistics of fuel delivery. Trucks, typically 40 ft. chip tractor-trailers need to be able to access the site easily.
    b. Type of existing mechanical system and the complexity of biomass integrating to it.
    c. Space requirements to implement a biomass energy plant. These systems are space intensive and are difficult to implement on some constrained sites.

3. Air Quality and Emissions Permitting. Although modern biomass systems are clean burning and capable of meeting the vast majority of air quality permitting requirements, permitting requirements should always be checked early in the project design process.

4. Economic Criteria:
    a. The economics of biomass are quite dependent on the displacement of a significant amount of fossil fuel energy. The definition of a "significant amount" of fuel varies depends on the cost of that fuel and the counterbalancing cost of project implementation.
    b. The cost of energy is critical as well. Propane and fuel oil offer the best economics, but in many areas of the country, natural gas displacement can offer adequate economic leverage to make projects work. All existing boilers in this assessment are natural gas fired.
    c. The cost of biomass fuel varies on location, available infrastructure, and type of fuel.
    d. Biomass systems do require additional maintenance compared to most systems. This cost must be considered in the course of assessment.

5. Operation and Maintenance Requirements. The type of biomass system must match the existing, or reasonable expansion of, the facilities maintenance staff's capabilities. System maintenance requirements vary greatly in complexity and need to be matched to each situation carefully. The School District has

competent and capable maintenance staff.

6. Project Owner and Staff project support. Biomass implementation is capital intensive and requires physical modification to the facility and its site. The support of the leadership of the affected buildings is critical to a successful project.

Biomass System Types/Primer

Biomass projects take several different forms. For purposes of this assessment, the technologies will be categorized as green chip and pellet. A detailed primer discussing these technologies is available online at: http://www.fleci.org/docs/WhereWoodWorks-Online.pdf.

EXISTING BOILER SYSTEM AND ENERGY USE

The original Baker High School was built in the early 1950's and was heated with two large West Coast steel boilers that were fired with coal. About 35 years ago, one of the West Coast boilers was replaced with a natural gas fired Kewanee steel boiler and power burner rated at 397 HP (13,280 MBH) output. The remaining West Coast boiler is not in use, but the Kewaunee Boiler continues to provide good service. In 1990, the facility experienced a fire which destroyed a portion of the building. During the rebuild, a natural gas-fired, Weil McLain model 988 cast iron steam boiler was installed. That boiler has an output capacity of about 65.1 HP (2176 MBH).

The steam systems for the two operating boilers are connected so either boiler can be used as a backup for the remaining boiler, but the process requires the manual opening and closing of valves on both the steam and condensate piping to accomplish this. During cold weather (below 35 degrees F) the smaller boiler is not able to keep up with the load of the entire building. The system can work satisfactorily when the system is operated using the larger boiler, but the condensate from the old system is wasted and new make-up water must be continuously made up when the system is operated using the small boiler only. For this reason, the old and the new systems are operated independently of each other requiring both boilers to operate simultaneously.

The new system, installed after the 1990 fire, uses the steam produced by the small boiler in a steam to hot water heat exchanger and the hot water is pumped throughout the facility. The existing "Freshman Hall" was remodeled during the fire restoration process to add an overhead, ducted heating and air conditioning system to the project. Because this new HVAC system supplies outside air, the fresh air supplies to the original unit ventilators were blocked, but the units remain and can be used for supplemental heat in the spaces. By adding Freshman Hall to the hot water system, the building square footage is approximately evenly split between the boilers with the new, hot water system providing half of the building requirements and the older, larger Kewanee boiler supplying the other half. It appears that the existing Kewanee boiler is considerably oversized for the present use.

The estimated Median Service Life of a steel fire tube boiler is 25 years (based on the 2007 ASHRAE Handbook - HVAC Applications, chapter 36). Estimated Median Service Life means that 50% of in-service boilers have failed before 25 years, and 50% of in-service boilers are still in operation. The Kewanee boiler is well above the median, due most likely to good annual maintenance and not operating the boiler at 100% capacity constantly over the past 35 years. That being said, the actual estimated remaining service life is difficult to predict. The best case scenario is that the existing boiler remains operational through the next 5 to 10 years and a summer replacement project can be planned. The worst case scenario is to have a major boiler failure during the winter months that would require and emergency boiler replacement project. Either way, one of these scenarios will occur. A boiler replacement should be planned for (if it has not already been done) and its replacement should be budgeted for in the high school maintenance and capital cost budget. The estimated Median Service Life of a cast iron boiler is 35 years, so the existing Weil McLain boiler would be expected to last another 15 years or so with good maintenance.

The peak heating load (boiler size) was estimated by taking an average of three different calculation methods. The first method utilized anecdotal evidence that the Kewanee boiler can heat the entire building, but never comes close to reaching full capacity. The second method uses empirical evidence that the Weil McLain boiler can heat the entire school to about 35 degrees F outside air temperature. The equation for building heat loss is proportional to the temperature difference between the indoor and outdoor temperatures. Extrapolating this data to the design heating load outside air temperature of -20 degrees F, gave the peak heating load for this second method. The third method is based on historical averages. Most buildings of this type an age average between 30 and 50 Btu/hr/SF for the peak heating load. 40 Btu/hr/SF was used for this analysis. The following table summarizes the results and shows that the estimated peak boiler size is 6,271 MBH:

Peak Boiler Size Summary

	Building Area SF	Btu/hr/SF	Boiler HP	Heating Output MBH	Estimated Peak Load Factor	Likely System Peak MBH
Kewanee			397	13280	0.50	6640
Weil McLain			65.1	2176	2.80	6093
Historical Avg.	152,000	40				6080
Average						6271

A more accurate estimate of the maximum heat requirements for this building could be determined by measuring the actual gas consumption of the boilers during an hour of cold weather operation and converting that to a boiler energy use. This winter has been mild and this observation has not been able to be made. If this project proceeds to a full design and implementation, a detailed heating load calculation and basic energy model should be performed to confirm the peak load and the biomass boiler size.

Utility bills were provided by the school district and indicate that the school uses on average approximately 8600 MMBtu (or dekatherm) of natural gas annually with a maximum monthly use of 1800 MMBtu (the maximum occurs in January). The natural gas rate is approximately $12.00 per MMBtu.

BIOMASS BOILER SIZE

Unless the facility has a constant heating load throughout the year, sizing the biomass boiler at the peak heating load is not recommended. Biomass boilers do not modulate down well, and do not operate at peak efficiency at low loads. It is generally recognized that it is also more effective to leave the biomass boiler off during the "shoulder months" (spring and early fall) and use the back-up, natural gas system rather than staring and maintaining the biomass boiler. Often the boiler is only required for a short time during the morning to take the chill off of the building.

CTA recommends sizing the biomass boiler to offset approximately 85% - 90% of the annual heating energy use of a building or facility. The existing heating systems would be used for the other 10% - 15% of the time during peak heating conditions, during the shoulder months, and when the biomass boiler is down for servicing. Recent energy models of similar buildings have found that a boiler sized at 50% of the building peak load will handle approximately 90% of the boiler run hours. Based on this, the recommended biomass boiler size is 3135 MBH (93.7 Boiler HP).

BUILDING AND SITE CONTRAINTS

The location of the biomass boiler plant deserves careful consideration. Locating the boiler in the existing location of the old, abandoned West Coast boiler has advantages. The boiler would be easy to connect to the existing steam and condensate piping and the use of existing indoor space would eliminate some of the requirement to build additional facilities for a new boiler and for wood storage. The problem with this location is that the existing space is smaller than is required for the new boiler. Also, the only area that would be available for storage would be outside, immediately north of the mechanical room. Any storage container or building would be in the way of the existing delivery door and garbage collection location.

Locating a new biomass boiler building just west of the existing gym (see Appendix A) will provide a location that is easily accessed by trucks and will not affect circulation around the existing facility. This location is also adjacent to the underground utility chase that will allow for the steam lines to be readily installed and accessed from the boiler building to the existing mechanical room.

This location will require the relocation of the greenhouses and container and changes to the existing fencing. Parking will need to be revised to maximize the dislocated parking. It is estimated a total of four spaces will be lost.

Truck access will be from E Street with a one-way flow through the parking lot to exit out on G Street. This should be able to be accomplished with little to no disruption to parking or school activities.

Note:
For this feasibility, the wood-fired boiler installed in Enterprise, Oregon is a good physical model for the size of boiler required for Baker High School, estimated at 3,125,000 btuh. The boiler building and boiler system layout and the fuel storage bay required for green or processed chip will be similar to that constructed at Enterprise. The physical size required for the Baker High School boiler and emissions control is about 31' x 6' x 13' high. The steam header must come off the top of the boiler which will add about 4' to the height.

There may be some internal discussion that the wood pellet boiler installed at Harney District Hospital in Burns, Oregon is so much smaller in physical size and why was it necessary that Enterprise have needed such a large boiler building. The difference is the heating system type. The hospital boiler system provides supplemental building hot water heat to a water source heat pump system. The heating output required by the boiler for the hospital is 500,000 btuh in comparison to the larger heating capacity required at Baker High School. The physical size of the hospital boiler is about 8' x 4' x 6' high, installed in a 20' x 8' x 8' steel shipping container with a vertical steel silo and a very simple feed screw from the bottom of the silo to the boiler. The manufacturer of the hospital boiler does not build a steam boiler.

HEATING SYSTEM INTEGRATION

A large portion of this project cost can be attributed to the cost of the integration of a remotely constructed boiler plant to the existing steam and condensate piping inside of the building. It is important when comparing system types, fuel costs and payback, to understand that the cost of system integration remains fairly consistent regardless of fuel. If large construction cost reductions are expected when different system comparisons are made, it is important not to overlook the required capital expense of the integration.

An existing pipe tunnel (that used to serve the pool building) will allow for under grade installation of the steam, condensate, and boiler feedwater piping. The tunnel covers will have to be replaced. The steam piping will enter the existing boiler room and will connect into the existing steam main at the same location the existing West Coast boiler enters the system. A new triplex boiler feed pump system will be installed in the existing boiler room to allow the feedwater to supply the boiler or boilers that are operating. All condensate will return through the existing condensate systems and then to the new boiler feedwater system. Automatic valves will be installed on the two existing boilers and the new biomass boiler to shut down each boiler when it is not in operation. This will eliminate condensate forming in these boilers when they are not in use, but will allow them to be automatically sequenced on as the load demands.

FUEL SOURCE

The success of **all** biomass projects is very dependent upon the quality of fuel that is used in the plant. Many sources of biomass exist in the West and the quality varies widely. Often inexpensive and possibly free fuels are used in plants causing inadequate performance from the plant in terms of energy and emissions output and dramatically increased maintenance and repair expense.

The poor performance of biomass system is often incorrectly placed on the plant equipment. For a successful project, the wood fuel must be identified at the very on-set of the design process so that the correct fuel feed system can be designed and constructed. The failure to miss this critical step in the process can require expensive retrofits.

Two types of biomass are available to this project – wood chips and densified wood product.

Green wood chips can be obtained from many sources such as forest slash or manufactured by-products. The problem with the use of this source of biomass is the consistency of the product that is available. Experience has shown that the biomass systems are quite sensitive to quality of the chips that are available. Inconsistencies in the moisture content of the chips can provide inconsistencies in the output of the boilers. Inconsistent chip size, rocks or other foreign materials in the feedstock causes problems with the intricate auger and conveyor systems that are required. The chip handling, delivery and maintenance provide problems which must be thoroughly understood before these systems are used. The advantage to chips is the low cost, typically $66.67 per bone dry ton ($40.00 per green ton at 40% moisture content wet basis). A bone dry ton is the weight of a ton of product without the moisture. Measuring and selling the fuel on the basis of a bone dry ton allows various fuel sources to be analyzed on an equal basis. In reality, the wood chips will be delivered to the site with moisture content between 30% and 50%. A sample of the product must be tested for moisture content and the price recalculated to a bone dry ton. Wood chips should always be purchased on a bone dry ton basis, but it must be understood that the moisture content is present and must be accounted for in the storage, boiler selection and expected output of the system.

It is imperative that the quality of the fuel be maintained as a standard. This fuel also may be processed by either chipping or grinding. Generally the minimum fuel quality is expected to be derived from chipped or ground whole trees. The following guidance is provided for specifying fuel quality.

Whole Tree Fuel Specification Points:

- Target Moisture Content 40%
- Minimum Btu's/lb (wet weight) 5,400 (HHV)
- Target Chip Size 2" x 2" x ¼" (Local infrastructure specific)
- A maximum of 10% shall be 4 inches or larger in any dimension
- A maximum of 10% shall be smaller than 1/16"
- Minimal wood flour or dust is allowed.
- Total Ash Content Maximum 8% (dry matter basis)
- Alkali Mineral Content of Ash Maximum 0.3 lbs/MMBtu

Material should be aged in the landing for 3-12 months in whole tree piles. Tree felling, skidding, and fuel processing methods should minimize introduction of dirt and rocks. Fuel should be processed directly into the sheltered cover at the time of chipping. If fuel is ground, the fuel should be double ground and sized. It is imperative that the biomass system supplier understand that ground fuel may be used in the plant as material handling for ground fuel can be significantly different than that for chipped-fuel-only plants. Fuel needs to be free of all foreign materials such as rocks, soil, ice, paint, glue, etc.

Another wood chip option would be processed wood chips. This product is currently being developed in a couple of locations in northeast Oregon to meet the needs of the Boise Cascade particleboard plant outside of LaGrande. The processing of these chips produces a clean chip without bark which is dried to 20% moisture content. The advantage of this chip is that would be a consistent chip both in size and moisture content, which would minimize several of the challenges seen in green whole tree chips. The cost of these chips are currently projected to be $62.50 per bone dry ton.

Densified wood products come in two basic configurations. The first is wood pellets which are typically manufactured from the sawdust from manufacturing processes (such as cabinet shops) although forest slash is also used as a feedstock. The wood pellets are small and consistent and are easily delivered, stored and used through a much simpler configuration of augers than the typical chip system. This potentially reduces the first cost for the pellet systems, but the pellets themselves cost $160 per ton delivered. Due to the fact that the pellets are extremely dry (8% moisture content) the actual heat output of a ton of pellets is higher than a typical ton of chips at 30% to 40%. When the two products are compared on a "bone dry ton" basis, the heat output is comparable at about 17.7 million Btu per ton. Since the moisture content of pellets is low and generally quite consistent (8%) the product is often sold on the actual weight of the product delivered. A ton of delivered pellets produces 16.3 million Btu per ton.

Another densified product is being developed at two locations in the region (Baker City and Wallowa). They are developing a "hockey puck" sized product using forest waste. The pucks could be crumbled into a product (prior to delivery) that would handle and burn much like the pellets or supplied in the hockey puck configuration. This product will sell for about $135 per bone dry ton. The hockey puck configuration would result in a very consistent shaped product (similar to, but more uniform than wood chips) with a low moisture content and high heat content (similar to pellets). Crumbling the product prior to delivery could result in a fuel that is similar to pellets and that could have similar advantages of pellets in the way the product is stored and delivered to the boiler. However, since the product is presently being developed, all of the potential and problems that could be present with this new product are not yet apparent. When the product is crumbled, it will not be as uniformly consistent as pellets. Excessive dust could be a problem and irregular pieces would possibly not "flow" from a hopper like pellets. This could result in operational problems requiring additional maintenance or it may mean that the product would need to stored and conveyed to the boilers as hockey pucks, similar to the way chips are handled. However, it is likely modifications can be made to the fuel handling system to address these concerns, so at this time pucks appear to be a viable potential fuel source.

The potential suppliers for various biomass fuels in the Baker City region were compiled by Randy Joseph and his report can be found in Appendix B.

The table on the following page converts the various fuels and their unit costs to a common $ per million Btu (MMBtu) for comparison. A range of prices for each fuel is shown. The price for each fuel type used in this report is underlined.

Estimated Energy Costs For Various Fuels in Dollars Per Million Btu.

Fuel Type			Heating Value		Unit Cost		Energy Cost $/MMBtu
Processed	20%	Moisture	7200	Btu/lb	$45.00	/gr ton	$3.13
Wood Chips		Content			$56.25	/BDT	
					$50.00	/gr ton	$3.47
					$62.50	/BDT	
					$60.00	/gr ton	$4.17
					$75.00	/BDT	
Wood Chips	40%	Moisture	5400	Btu/lb	$30.00	/gr ton	$2.78
(Green)		Content			$50.00	/BDT	
					$40.00	/gr ton	$3.70
					$66.67	/BDT	
					$50.00	/gr ton	$4.63
					$83.33	/BDT	
Wood Pucks			8200	Btu/lb	$135	$/ton	$8.23
					$145	$/ton	$8.84
					$160	$/ton	$9.76
					$175	$/ton	$10.67
Wood Pellets			8200	Btu/lb	$150	$/ton	$9.15
					$160	$/ton	$9.76
					$175	$/ton	$10.67
					$200	$/ton	$12.20
Natural Gas			1000000	Btu/MMBtu	$12.00	$/MMBtu	$12.00

The biggest advantage for wood chips as a fuel is the significantly lower cost per MMBtu. It should also be noted that these prices are based on the biomass fuels report and some of the pricing was estimated because the wood fuel products were not currently being produced. The fuel costs should be updated and the economics revisited when the project proceeds to implementation and the likely fuel source is identified.

AIR QUALITY ISSUES

Air quality permit requirements should be reviewed in greater detail. Emissions control systems and adequate dispersion into the atmosphere are likely to be a concern. If this project proceeds and will be implemented, air dispersion modeling is recommended to determine stack height and select emissions control devices.

BIOMASS SYSTEM OPTIONS

The boilers used for wood chips (higher moisture content) vs. densified wood (lower moisture content) are different. Densified wood burns hotter which requires additional refractory inside the boiler and a different method of ash removal. The ash can actually fuse into a molten, glass-like slag if not properly handled by the boiler. Proper boiler design can eliminate the problem, but the decision to use densified, low moisture, high heat fuels versus a higher moisture product like chips must be made at the time of design and the proper boiler selected to handle only the selected fuel type.

Densified boilers also operate with higher efficiencies. Boiler efficiencies of 70%-75% are typical with pellets and should be consistent with the hockey puck product. Chip type boilers generally operate between 65% and 75%. Presently manufactured gas-fired, steam boilers typically operate in the 78%-82% range. For this study, conservative efficiencies will be used; 65% for wood chip boilers, 70% for pellet and puck boilers, and 80% for gas-fired boilers. The actual efficiency of the existing Kewaunee boiler is likely to be less than this due to age and oversizing, but the study will compare the wood fired solution to a new steam solution since a boiler replacement will be required within the next 10 years.

The biomass boiler should not be considered a direct replacement for the existing Kewanee boiler. The biomass boiler will not be sized large enough to handle the peak conditions, so if the Kewanee boiler were to fail, there would not be enough capacity for a peak heating day. Replacing the Kewanee boiler should be a separate project. Installing a biomass boiler, however, may extend the life of both the Kewanee boiler and the Weil McLain boiler because they will not have to operate as often.

See Appendix A for drawings of the proposed boiler plants. These drawings are schematic and are used to show a potential equipment layout and the corresponding building sizes. If this project proceeds to implementation, the boiler system should be procured first, before the building design is complete, so the building shape can be modified to accommodate the actual biomass boiler system equipment to be installed. Also during this design process, other cost saving measures can be reviewed in more detail as the building and/or storage facilities may be able to be simplified.

A stand alone boiler plant was assumed for all options. For the wood chip options, the concept is a slab on grade building with CMU walls to allow for a solid durable surface to push chips against. Chips would be on one side of the plant and the concept is for a chip van (40 ft trailer) with a live bottom floor to back into the chip storage side and slowly pull out as the chips unload. A travelling auger would run near the floor of the chip storage and pull the chips onto a conveyor which would then elevate and fill a metering bin. Approximately 50 green tons of chips could be stored in this concept with a chip storage footprint area of 48 feet by 16 feet. On average, it is estimated one delivery per week would be needed, however, during peak heating periods two to three deliveries per week may be required.

For the pellet and puck options, the building would be half the size of the chip building, because the chip storage would be replaced with a free standing pellet silo. A 40 ton silo is recommended. This will allow for a typical delivery of 25 – 30 tons without the silo needing to be completely empty. On average, it is estimated one delivery every 2 to 3 weeks would be needed, however, during peak heating periods one delivery per week may be required.

For all options, the boiler plant is positioned where several of the existing greenhouses are located. The greenhouses can be disassembled and moved adjacent to the remaining buildings behind the print shop. Steam and condensate piping will need to be installed in the existing pipe trench that runs to the existing boiler room. A new concrete trench lid will need to be installed the length of the trench.

BIOMASS BOILER OPTIONS
Four biomass system options were analyzed: Option A is a wood chip boiler utilizing green chips; Option B is a wood chip boiler utilizing processed wood chips; Option C is a densified wood boiler utilizing wood pellets; and Option D is a densified wood boiler utilizing wood pucks. Each option was analyzed at different levels of grant support – (1) 100%, (2) 50%, and (3) 0%.

COST ESTIMATE AND ECONOMIC ASSUMPTIONS

COST ESTIMATE
The cost estimates are preliminary and are based on schematic level designs. The estimates utilized data from RS Means and bid data from recent biomass projects. The estimates are shown in Appendix C. The costs for options A and B are identical. The costs for options C & D are nearly identical, although an extra $15,000 was added for option D to account for the potential fuel handling equipment modifications that may be necessary for the crumbled puck product. If this project proceeds into implementation, more detailed estimates should be done as the design is refined and more information is gathered. Cost savings measures can be also be explored in more depth during this design phase.

FUEL DISPLACEMENT
For the purpose of this investigation it is assumed that 85% of the existing annual natural gas consumption would be offset by the use of wood chip fired boiler. However, it would be prudent to not predict 100% of the first year savings, as the first year historically is a time of system optimization and training.

WOOD FUEL COSTS
The cost of green wood chips was assumed to be $40/green ton, the cost of processed wood chips $62.50/bone dry ton, the cost of wood pellets was assumed to be $160/ton, and the cost of wood pucks was assumed to be $135/ton. All figures are delivered prices.

ADDITIONAL ENERGY COSTS
Electrical energy consumption is projected to increase with the installation of the wood fired boiler. Equipment with electric motors include conveyors, augers, an air compressor, and a triplex boiler feedwater unit. The cash flow analysis accounts for the additional electrical energy consumption and reduces the annual savings associated

with using the wood fired boiler plant rather than the natural gas boilers. The power use is based on historical data from a wood fired boiler plant in Darby, Montana

MAINTENANCE COSTS

Maintenance costs for a biomass boiler will be higher than for a natural gas system. Much of the process is automated, but it does take time to schedule and coordinate delivery of the biomass fuel, extra time to assure the system is operating properly and as removal time. The maintenance of a pellet system is less than the maintenance required for a wood chip system. Based on discussions with other biomass system users, system manufacturers, and estimates of operator time required, additional operation and maintenance time on average of 6 hours per week were assumed for the green chip system, 5 hours per week for a processed chip system, 3 hours per week for a pellet system, and 4 hours per week for a puck system. The cost of this over a 40 week operation period at $20/hour was used for the analysis. In addition, experience has shown that the first two heating seasons have extra maintenance time as the system is optimized for the local conditions and fuel types, and the maintenance staff learns the system and how to adjust it to work more efficiently. The analysis includes additional time equal to half the projected maintenance time for the first two years to account for this learning curve.

INFLATION RATE ASSUMPTIONS

The O&M inflation rate was assumed to be 2%. The escalation rate for natural gas and electricity was assumed to be 6%. Recent price volatility has made projections difficult. DOE now predicts a slight drop with long term escalation rates between 3% and 11%. Fuel cost escalation for wood based fuels was estimated at 3% annually. 3.0% was used for the Net Present Value (NPV) discount rate. Any options which included a financing component assumed interest rates of 5.0% for a term of 10 years. The principle and interest payments are based on single annual payments, resulting in slightly higher payments than those associated with a similar loan with monthly payments.

RESULTS OF EVALATION

EVALUATION METRICS

The project was evaluated using a 30-year cash flow analysis. Net Present Value (NPV) at year 30 was calculated as was Accumulated Cash Flow (ACF) in year 30. The net present value is a calculation of the net present value of an investment by using a discount rate and a series of future payments (negative values) and income (positive values). The NPV is based on the net annual cash flow series. The year the ACF equaled the capital cost was also calculated. Accumulated Cash Flow should also be considered an avoided cost rather than a pure savings because the savings are usually not allowed to accumulate.

EVALUATION SUMMARY

The following table summarizes the economic analysis for the options considered:

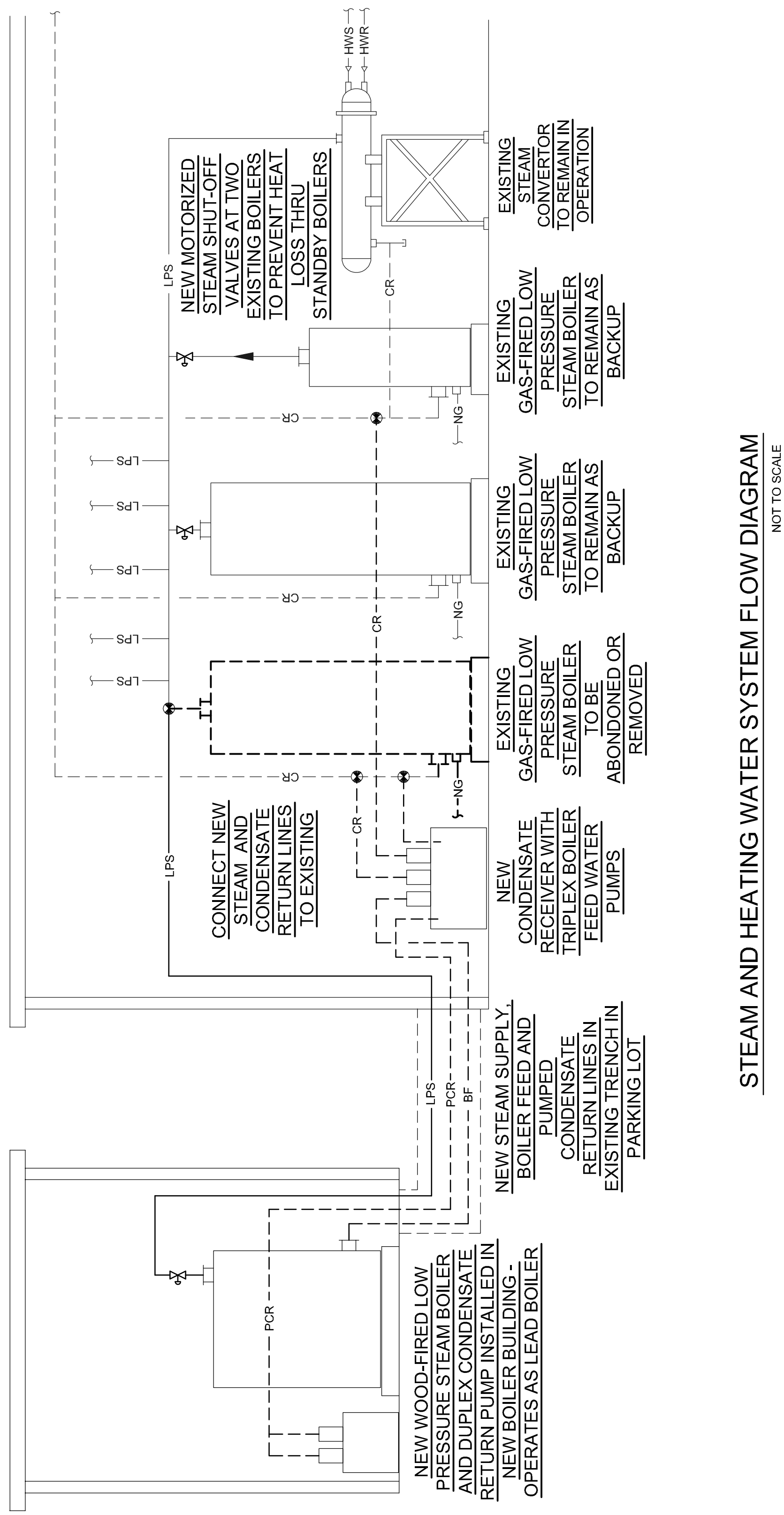
Economic Summary

Option	Project Cost	Wood Fuel Cost $/ton	Year 1 Operating Savings	NPV 30 yr at 3%	ACF YR 30	YR ACF=PC
Option A.1 Gr. Chips - 100% Grant; 0% Financed	$1,479,000	$40	$45,273	$2,810,249	$4,997,917	17
Option A.2 Gr. Chips - 50% Grant; 50% Financed	$1,479,000	$40	$45,273	$1,993,876	$4,040,878	22
Option A.3 Gr. Chips - 0% Grant; 100% Financed	$1,479,000	$40	$45,273	$1,176,398	$3,082,545	26
Option B.1 Pr. Chips - 100% Grant; 0% Financed	$1,479,000	$50	$48,556	$2,891,980	$5,130,261	16
Option B.2 Pr. Chips - 50% Grant; 50% Financed	$1,479,000	$50	$48,556	$2,075,607	$4,173,223	22
Option B.3 Pr. Chips - 0% Grant; 100% Financed	$1,479,000	$50	$48,556	$1,258,129	$3,214,889	25
Option C.1 Pellets - 100% Grant; 0% Financed	$1,025,000	$160	$690	$1,470,070	$2,805,365	25
Option C.2 Pellets - 50% Grant; 50% Financed	$1,025,000	$160	$690	$903,911	$2,141,654	28
Option C.3 Pellets - 0% Grant; 100% Financed	$1,025,000	$160	$690	$337,752	$1,477,943	30
Option D.1 Pucks - 100% Grant; 0% Financed	$1,040,000	$135	$12,225	$1,819,925	$3,377,984	22
Option D.2 Pucks - 50% Grant; 50% Financed	$1,040,000	$135	$12,225	$1,245,481	$2,704,560	26
Option D.3 Pucks - 50% Grant; 50% Financed	$1,040,000	$135	$12,225	$671,037	$2,031,137	29
NPV: Net Present Value; ACF: Accumulated Cash Flow; YR ACF=PC : Year Accumulated Cash Flow equals Project Cost						

CONCLUSION

Detailed economic summary sheets for each of these options can be found in Appendix C. The summary shows that all the biomass fuel options will have fuel cost savings over natural gas. At the present time, a chip boiler system appears to be the strongest project, especially if at least 50% of the project cost can be offset by a grant. If the project proceeds to implementation, additional capital cost savings measures can be analyzed in more detail, the actual fuel source and cost can be identified, and the economic analysis can be updated to determine the strongest project to proceed with.

APPENDIX A SITE AND PLANT DIAGRAMS



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(208)336-4900
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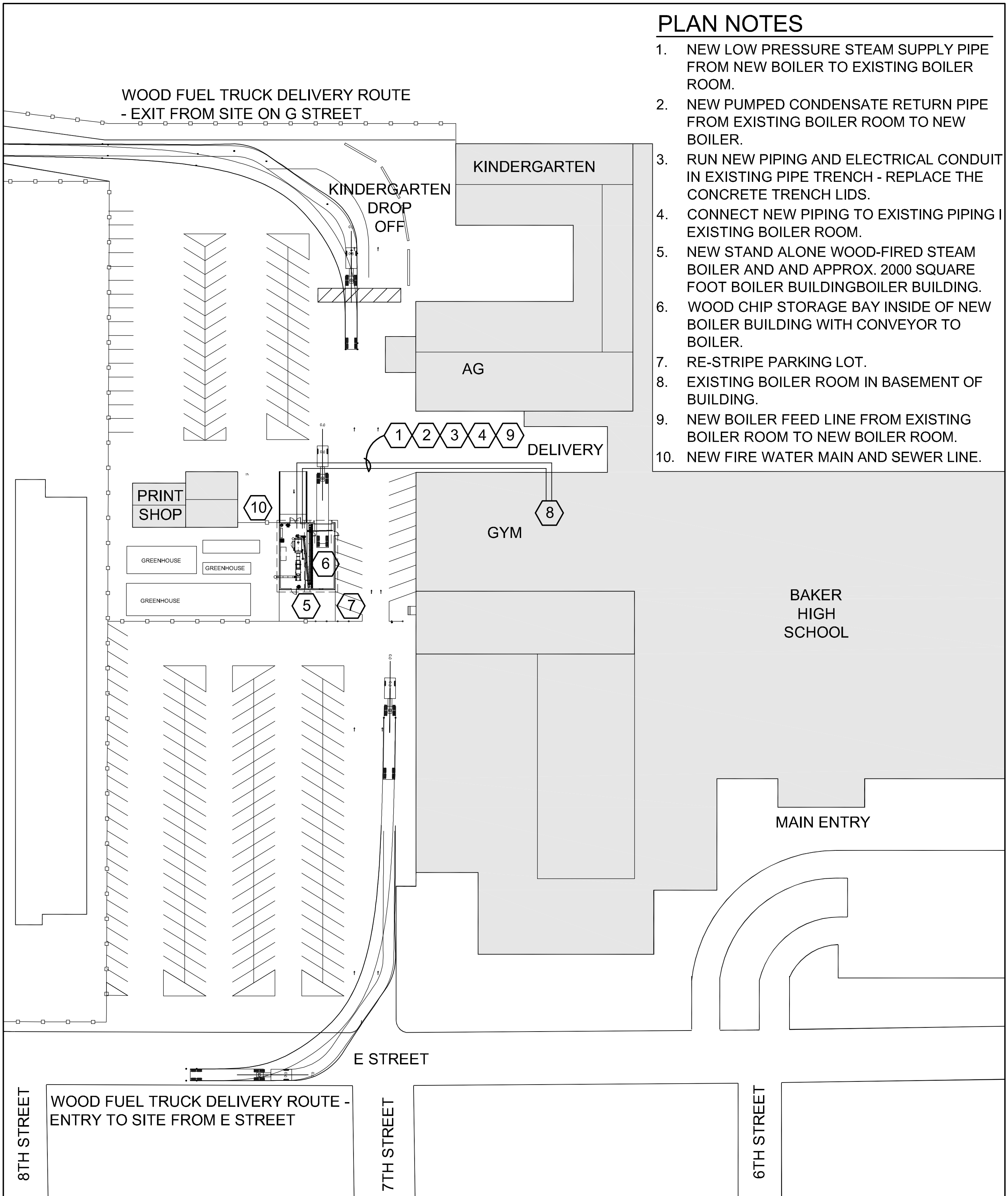
CHIP OR PELLET OPTION A, B, C OR D

PIPING SCHEMATIC

BAKER HIGH SCHOOL

PLAN NOTES

1. NEW LOW PRESSURE STEAM SUPPLY PIPE FROM NEW BOILER TO EXISTING BOILER ROOM.
2. NEW PUMPED CONDENSATE RETURN PIPE FROM EXISTING BOILER ROOM TO NEW BOILER.
3. RUN NEW PIPING AND ELECTRICAL CONDUIT IN EXISTING PIPE TRENCH - REPLACE THE CONCRETE TRENCH LIDS.
4. CONNECT NEW PIPING TO EXISTING PIPING I EXISTING BOILER ROOM.
5. NEW STAND ALONE WOOD-FIRED STEAM BOILER AND AND APPROX. 2000 SQUARE FOOT BOILER BUILDINGBOILER BUILDING.
6. WOOD CHIP STORAGE BAY INSIDE OF NEW BOILER BUILDING WITH CONVEYOR TO BOILER.
7. RE-STRIPE PARKING LOT.
8. EXISTING BOILER ROOM IN BASEMENT OF BUILDING.
9. NEW BOILER FEED LINE FROM EXISTING BOILER ROOM TO NEW BOILER ROOM.
10. NEW FIRE WATER MAIN AND SEWER LINE.



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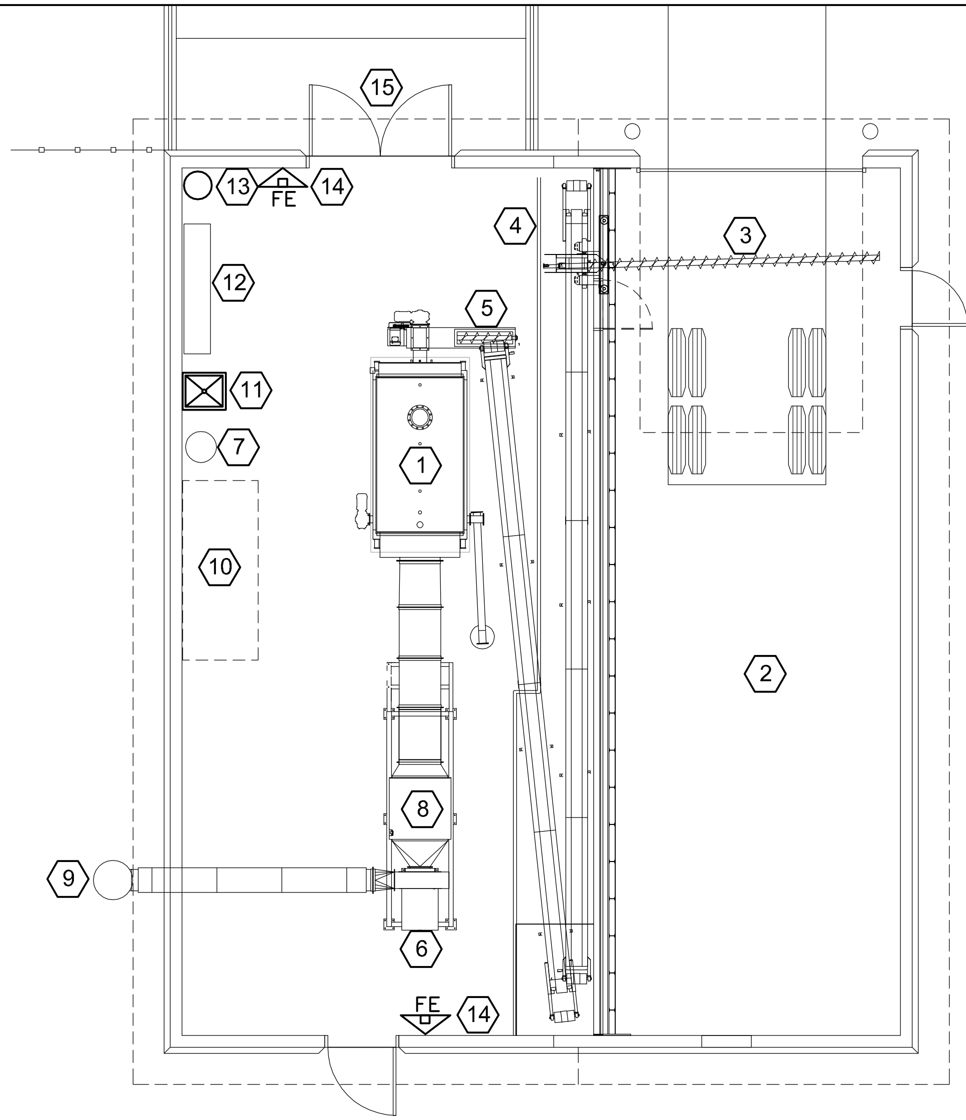
GREEN CHIP OPTION A OR PROCESSED CHIP OPTION B

SITE PLAN

BAKER HIGH SCHOOL



PLAN NOTES

1. WOOD-FIRE LOW PRESSURE STEAM BOILER WITH STEEL REFRACTORY LINED FIRE BOX BASE.
2. WOOD CHIP STORAGE BAY WITH FLAT CONCRETE FLOOR SLAB AND HEAVY DUTY WALLS. STORAGE BIN VOLUME TO BE DETERMINED AFTER WOOD SOURCE HAS BEEN SELECTED TO DETERMINE VOLUME REQUIRED VS DELIVERY INTERVALS.
3. TRAVELING AUGER - RUNS BENEATH WOOD PILE TO TRANSFER WOOD CHIP TO CONVEYOR BELT.
4. CONVEYOR BELT RUNS LENGTH OF CHIP STORAGE - TRANSFERS WOOD CHIP TO BOILER METERING BIN.
5. BOILER METERING BIN AND FEED AUGER.
6. BOILER INDUCED DRAFT FAN.
7. AIR COMPRESSOR FOR BOILER TUBE CLEANING.
8. CYCLONE SOLIDS SEPARATOR - REMOVES ASH PARTICLES FROM BOILER EXHAUST GASES.
9. BOILER FLUE STACK - HEIGHT TO BE DETERMINED BY AIR SHED AIR QUALITY MODEL.
10. BUILDING ELECTRICAL SERVICE.
11. SERVICE SINK.
12. BOILER CONTROL PANELS.
13. DRY-PIPE FIRE SPRINKLER RISER WITH NEW FIRE WATER MAIN TO BUILDING.
14. PORTABLE FIRE EXTINGUISHER.
15. NEW BOILER BUILDING TO BE DESIGNED AFTER SELECTION OF BOILER AND ASSOCIATED EQUIPMENT IS COMPLETED.

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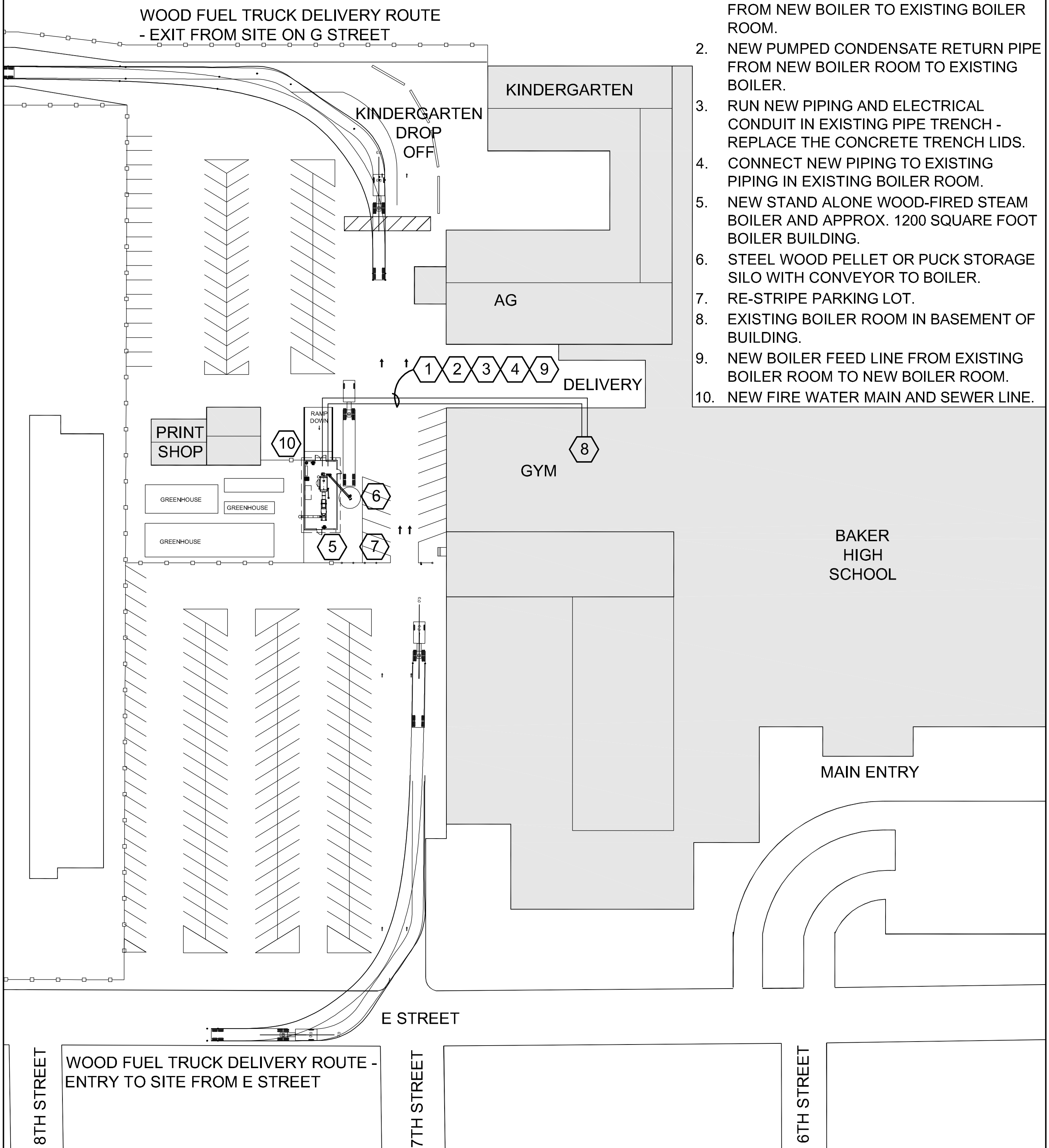
GREEN CHIP OPTION A OR PROCESSED CHIP OPTION B

MECHANICAL FLOOR PLAN

BAKER HIGH SCHOOL

PLAN NOTES

1. NEW LOW PRESSURE STEAM SUPPLY PIPE FROM NEW BOILER TO EXISTING BOILER ROOM.
2. NEW PUMPED CONDENSATE RETURN PIPE FROM NEW BOILER ROOM TO EXISTING BOILER.
3. RUN NEW PIPING AND ELECTRICAL CONDUIT IN EXISTING PIPE TRENCH - REPLACE THE CONCRETE TRENCH LIDS.
4. CONNECT NEW PIPING TO EXISTING PIPING IN EXISTING BOILER ROOM.
5. NEW STAND ALONE WOOD-FIRED STEAM BOILER AND APPROX. 1200 SQUARE FOOT BOILER BUILDING.
6. STEEL WOOD PELLET OR PUCK STORAGE SILO WITH CONVEYOR TO BOILER.
7. RE-STRIPE PARKING LOT.
8. EXISTING BOILER ROOM IN BASEMENT OF BUILDING.
9. NEW BOILER FEED LINE FROM EXISTING BOILER ROOM TO NEW BOILER ROOM.
10. NEW FIRE WATER MAIN AND SEWER LINE.



PELLET OPTION C OR PUCK OPTION D

SITE PLAN

BAKER HIGH SCHOOL

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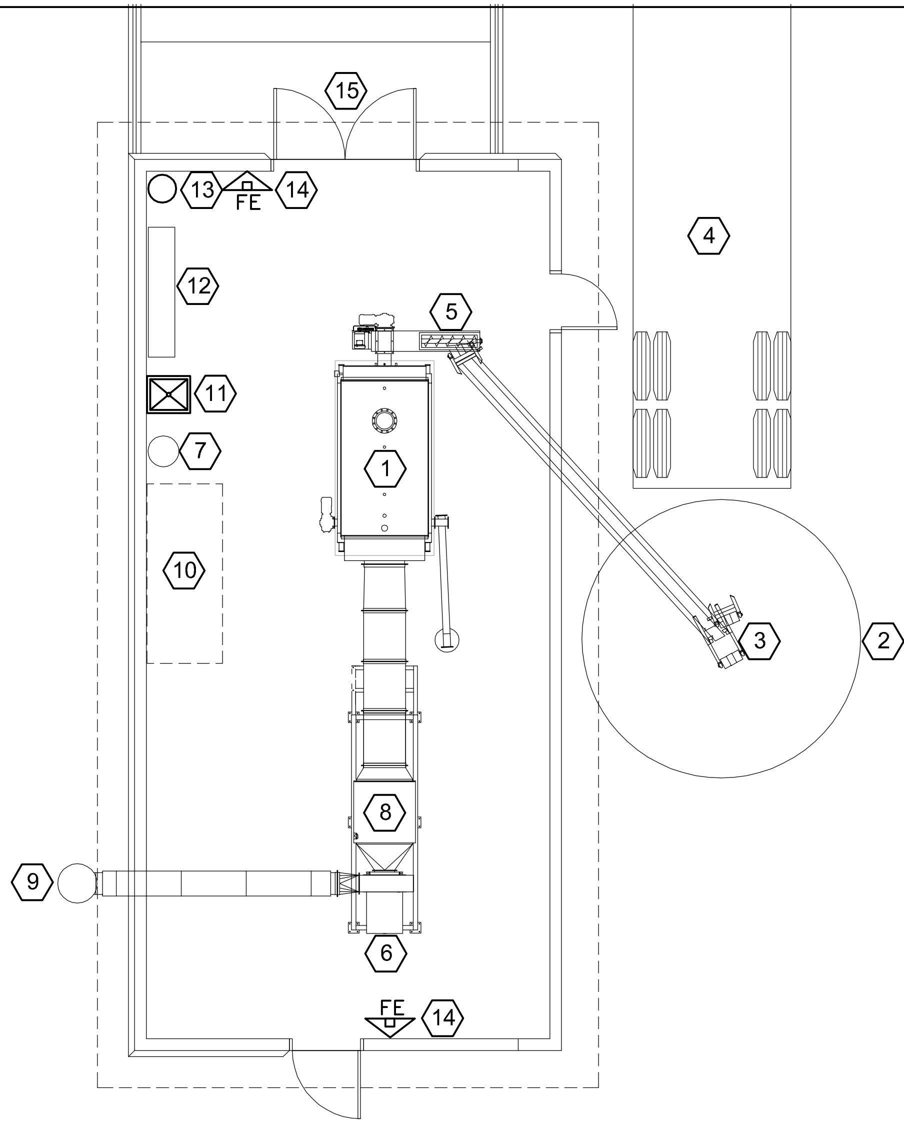

PLAN NOTES

1. WOOD-FIRE LOW PRESSURE STEAM BOILER WITH STEEL REFRACTORY LINED FIRE BOX BASE.
2. ELEVATED STEEL, WOOD PELLET OR PUCK STORAGE SILO WITH CONE SHAPED BASE. STORAGE SILO VOLUME TO BE DETERMINED AFTER WOOD SOURCE HAS BEEN SELECTED TO DETERMINE VOLUME REQUIRED VS DELIVERY INTERVALS.
3. PELLET AUGER - RUNS FROM BENEATH STORAGE SILO THRU BUILDING WALL TO TRANSFER WOOD PELLETS BOILER METERING BIN.
4. CONCRETE TRUCK PARKING AND DELIVERY PAD.
5. BOILER METERING BIN AND FEED AUGER.
6. BOILER INDUCED DRAFT FAN.
7. AIR COMPRESSOR FOR BOILER TUBE CLEANING.
8. CYCLONE SOLIDS SEPARATOR - REMOVES ASH PARTICLES FROM BOILER EXHAUST GASES.
9. BOILER FLUE STACK - HEIGHT TO BE DETERMINED BY AIR SHED AIR QUALITY MODEL.
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PELLET OPTION C OR PUCK OPTION D

MECHANICAL FLOOR PLAN

BAKER HIGH SCHOOL

APPENDIX B BIOMASS SUPPLY REPORT

Biomass Supply
Baker High School

Introduction

A survey of potential suppliers of biomass fuels was conducted mid October – mid November of 2009 by Randy Joseph for Baker High School. The purpose of this survey is to provide fuel costs and availability for a feasibility study of the economics of converting Baker High School to biomass fuel. The feasibility study is being completed by CTA Architects and Engineers. All pricing in the survey of biomass fuels is for November, 2009 delivery. All companies responding indicated they would be able to supply the estimated 600-1000 GT of biomass fuel needed annually.

Responding Companies

Blue Mountain Lumber Products
Pendleton, OR
Contact: Bill Cameron

Blue Mountain Lumber Products is a family-owned, fully-integrated, forest products company located in North Eastern Oregon. Their mission is to efficiently utilize every aspect of our precious forest resources, while improving the health of the forests. They place their emphasis on quality rather than quantity.

Delivered, screened, paper quality chips at $140 BDT and delivered bulk pellets at $160 ton.

West Oregon Wood Products
Columbia City, OR
Contact: Mike Knobel

West Oregon Wood Products' corporate headquarters are located in Columbia City, and a new state of the art Wood Pellet Fuel plant has been built in Banks, Oregon.

Bulk pellets are available from the Columbia City plant at $158 ton plus delivery, estimated at $1,000 per 28 ton truck load.

Borgan Custom Wood LLC.
Baker City, OR
Contact: Kerry Borgan

Borgan Custom Wood LLC is a small custom operator with the capabilities for logging, sawmilling, and chipping. They have a unique system for chipping with a portable

Morbark chipper and 10 ton dump trailer that allows for access to difficult sites and quick setup, which provides for lower operational costs.

Green chips would be available at a delivered cost of $25-$30 GT depending on distance from Baker City. A small percentage of these chips may need additional treatment for consistency in size.

Elkhorn Biomass
Baker City, OR
Contact: Ben Henson – Renewable Energy Solutions

Elkhorn Biomass is producing fire wood in Baker City and is on track to put in a chipping, drying, and densification line in the fall of 2010. In addition to fire wood they are planning on producing processed chips, fire logs, and pucks. A puck is a 1-2 inch chunk sheared off of the same round material that makes fire logs. Pucks are a fuel that is dense, dry, portable, and can be moved with conventional boiler in-feed equipment.

Cost for delivered processed chips would be $62.50 BDT and $135 ton for delivered pucks.

Bear Mountain Forest Product
Cascade Locks, OR
Contact: Rolf Anderson

Bear Mountain Forest Products, founded in 1988 and based in Portland, operates pellet manufacturing plants in Brownsville and Cascade Locks and sells its products to more than 400 retailers in the western United States.

On Tuesday November 10th 2009, Gov. Ted Kulongoski announced a $4.89 million federally funded economic recovery grant from Business Oregon to the Ochoco Lumber Co. of John Day. The funding will construct a wood pellet fuel facility, helping support the retention of 80 full-time jobs and creating 11 new ones in the community. The Recovery Act grant will allow Ochoco Lumber, doing business in John Day as the Malheur Lumber Company, along with its partner Bear Mountain Forest Products, to produce pine fuel pellets for retail sale in the Pacific Northwest as well as Bear Bricks, a compressed fuel product.

Bear Mountain anticipates it will be producing densifide biomass products - pellets, pucks and bricks - at the John Day plant in 2010.

Estimated cost for bulk pellets or pucks would be $150/ton fob John Day.

Integrated Biomass Resources

Wallowa, OR
Contact : David Schmidt

Integrated Biomass Resources (IBR) is presently installing equipment for the production of a fire log/puck and should be in production for the 2010 season. The company will use waste wood and wood byproducts to create fire logs and fire log slices called "pucks." These products serve both commercial and homeowner clients. IBR is also a supplier of processed chips to the Enterprise School District for the school district's chip boiler.

Estimated cost for the delivered puck would be $160/ton and $140/BDT for processed delivered chips.

Others

A3 Energy Partners
Portland OR
Contact: Andrew Haden

A3 Energy Partners was founded by members of the management team of Bear Mountain Forest Products for the purpose of developing decentralized biomass energy processing and utilization solutions, in partnership with their customers and local communities.

A3 Energy Partners is preparing to install a biomass boiler at the John Day airport and is also evaluating the John Day hospital for biomass conversion.

A3 Energy Partners can supply the boiler equipment for schools and arrange fuel supply through Bear Mountain Forest Products.

Chips

There are other known but not contacted logging and chipping operations in Northeast Oregon that could be potential suppliers of green chips. A significant price difference from other suppliers would not be anticipated.

Conclusion

There is an ample supply of biomass fuel products for the Baker High School project within an economical delivery range. The products available now and what is coming online in 2010 will create a sufficient redundancy in manufacturing to insure a stable supply of biomass fuel.

APPENDIX C COST ESTIMATES & ECONOMICS

PRELIMNARY ESTIMATE OF PROBABLE COST OF DESIGN & CONSTRUCTION

DATE PREPARED: 1/31/2010

SHEET 1 OF 1

PROJECT: Baker High School Biomass Boiler

Option: **A & B: Fully Automated 3,100 MBH Wood Chip Boiler with Masonry Building**

CTA Architects Engineers
306 West Railroad Avenue, Suite 104, Missoula, MT 59802
406. 728. 9522 800. 780. 7455 Fax: 406. 728. 8287
1-800-780-7455
http://www.ctagroup.com E-mail: info@ctagroup.com

Costs obtained from RS Means and historical information.

ESTIMATOR: Ratz

	QUANTITY		MATERIAL		LABOR			
	No. Units	Unit Meas.	Per Unit	TOTAL	Per Unit	TOTAL	TOTAL COST	PROJECT COMPONENT COST
BIOMASS BOILER AND STACK SYSTEM								
Wood Fired Boiler System (3.1 MMBtuh Output- Steam)	1	assy	$340,000.00	$340,000	$50,000.00	$50,000	$390,000	
Turn key - includes conveyors, augers, boiler,								
multi cyclone, 50 foot stack								
Subtotal							$390,000	
TOTAL- BIOMASS BOILER SYSTEMS								**$390,000**
BOILER BUILDING COSTS								
Boiler Plant Building - CMU (Slab on Grade)	1600	sf	$80.00	$128,000	$80.00	$128,000	$256,000	
Subtotal							$256,000	
TOTAL- Boiler Building								**$256,000**
BOILER BUILDING MECHANICAL AND ELECTRICAL COSTS								
Site Utilities								
6" PVC Sewer Main	250	lf	$6.75	$1,687.50	$2.75	$687.50	$2,375.00	
Trenching (8' w x 6' d x 250 lf)	500	cy	$6.00	$3,000.00	$6.00	$3,000.00	$6,000.00	
1-1/2" C900 Water Main	250	lf	$6.75	$1,687.50	$2.75	$687.50	$2,375.00	
Trenching (8' w x 6' d x 1000 lf)	500	cy	$6.00	$3,000.00	$6.00	$3,000.00	$6,000.00	
Fire Protection System								
Automatic Fire Protection System	1600	sf	$4.00	$6,400.00	$4.00	$6,400.00	$12,800.00	
Fire Riser w/ Backflow Preventer	1	ls	$5,000.00	$5,000.00	$5,000.00	$5,000.00	$10,000.00	
Domestic Water System								
1-1/2" Insulated Copper CW	75	lf	$22.50	$1,687.50	$14.00	$1,050.00	$2,737.50	
3/4" Insulated Copper (CW & HW)	50	lf	$9.50	$475.00	$10.50	$525.00	$1,000.00	
Emergency Shower and Mixing Valve	1	assy	$1,500.00	$1,500.00	$300.00	$300.00	$1,800.00	
Electric Water Heater	1	ea	$500.00	$500.00	$200.00	$200.00	$700.00	
Service Sink	1	ea	$900.00	$900.00	$700.00	$700.00	$1,600.00	
D-W-V System								
2" PVC D-W-V	120	lf	$3.50	$420.00	$17.50	$2,100.00	$2,520.00	
3" PVC D-W-V	70	lf	$6.00	$420.00	$19.00	$1,330.00	$1,750.00	
Floor Drains	4	ea	$850.00	$3,400.00	$100.00	$400.00	$3,800.00	
Miscellaneous Plumbing	1	ls	$500.00	$500.00	$500.00	$500.00	$1,000.00	
HVAC								
Combustion Ductwork	600	lbs	$1.50	$900.00	$6.50	$3,900.00	$4,800.00	
Louvers	85	sf	$57.00	$4,845.00	$16.50	$1,402.50	$6,247.50	
Control Dampers	4	ea	$650.00	$2,600.00	$130.00	$520.00	$3,120.00	
Unit Heater	2	ea	$600.00	$1,200.00	$120.00	$240.00	$1,440.00	
Steam and Condensate Piping								
3/4" Insulated Black Steel (LPS)	60	lf	$6.50	$390.00	$12.50	$750.00	$1,140.00	
1" Insulated Black Steel (LPS)	50	lf	$7.00	$350.00	$14.50	$725.00	$1,075.00	
6" Insulated Black Steel (LPS)	60	lf	$50.00	$3,000.00	$48.00	$2,880.00	$5,880.00	
12" Insulated Black Steel (LPS Header)	5	lf	$113.00	$565.00	$86.00	$430.00	$995.00	
1-1/2" Insulated Black Steel (sch 80 BF)	85	lf	$16.00	$1,360.00	$18.00	$1,530.00	$2,890.00	
1-1/2" Insulated Black Steel (sch 80 PCR)	85	lf	$16.00	$1,360.00	$18.00	$1,530.00	$2,890.00	
3/4" Insulated Black Steel (sch 80 LPR)	100	lf	$9.50	$950.00	$15.00	$1,500.00	$2,450.00	
1" Insulated Black Steel (sch 80 LPR)	25	lf	$11.50	$287.50	$16.00	$400.00	$687.50	
6" Class 125 Gate Valve	1	ea	$1,650.00	$1,650.00	$450.00	$450.00	$2,100.00	
F&T Steam Traps	4	ea	$125.00	$500.00	$30.00	$120.00	$620.00	
Duplex Condensate Transfer Pump	1	ea	$5,500.00	$5,500.00	$250.00	$250.00	$5,750.00	
Miscellaneous Steam Piping Components	1	ls	$5,000.00	$5,000.00	$5,000.00	$5,000.00	$10,000.00	
Temperature Controls	1	ls	$5,000.00	$5,000.00	$2,500.00	$2,500.00	$7,500.00	
Plant Electrical Work	1	ls	$20,000.00	$20,000	$10,000.00	$10,000	$30,000	
Subtotal							*$146,043*	
TOTAL- BOILER BUILDING MECHANICAL & ELECTRICAL COSTS								**$146,043**
SUBTOTAL BUILDING & BOILER								**$792,043**
MECHANICAL INTEGRATION COSTS								
Existing Boiler Room								
Existing Pipe Trench								
Replace Existing Pipe Trench Covers	230	lf	$15.00	$3,450.00	$50.00	$11,500.00	$14,950.00	
Steam and Condensate Piping								
6" Insulated Black Steel (LPS)	350	lf	$50.00	$17,500.00	$48.00	$16,800.00	$34,300.00	
1-1/2" Insulated Black Steel (sch 80 BF)	350	lf	$16.00	$5,600.00	$18.00	$6,300.00	$11,900.00	
1-1/2" Insulated Black Steel (sch 80 PCR)	350	lf	$16.00	$5,600.00	$18.00	$6,300.00	$11,900.00	
3/4" Insulated Black Steel (sch 80 LPR)	50	lf	$9.50	$475.00	$15.00	$750.00	$1,225.00	
6" Class 125 Gate Valve	1	ea	$1,650.00	$1,650.00	$450.00	$450.00	$2,100.00	
F&T Steam Traps	3	ea	$125.00	$375.00	$30.00	$90.00	$465.00	
Triplex Boiler Feedwater Unit	1	ea	$20,000.00	$20,000.00	$1,500.00	$1,500.00	$21,500.00	
Miscellaneous Steam Piping Components	1	ls	$5,000.00	$5,000.00	$5,000.00	$5,000.00	$10,000.00	
Temperature Controls	1	ls	$2,500.00	$2,500	$2,500.00	$2,500	$5,000	
Electrical Work	1	ls	$2,500.00	$2,500	$2,500.00	$2,500	$5,000	
Subtotal							*$118,340*	
TOTAL- INTEGRATION COSTS								**$118,340**
SUBTOTAL								**$910,383**
General Conditions , OH&P	*15%*						*$136,557*	
SUBTOTAL								**$1,046,940**
Escalation to Bid Date (Feb. 2011)	*5%*						*$52,347*	
SUBTOTAL								**$1,099,287**
REMOTE FACTOR	5.00%							$54,964
SUBTOTAL CONSTRUCTION								**$1,154,251**
SOFT COSTS								
A/E Design Fee, Building Permit, Air Quality, Misc. Exp.	*12%*						$131,914	
SUBTOTAL SOFT COSTS							$131,914	**$131,914**
PRECONTINGENCY PROJECT TOTAL								**$1,286,166**
CONTINGENCY	15.00%							$192,925
RECOMMENDED PROJECT BUDGET - DESIGN AND CONSTRUCTION COSTS								**$1,479,090**

PRELIMNARY ESTIMATE OF PROBABLE COST OF DESIGN & CONSTRUCTION

DATE PREPARED 1/31/2010

SHEET 1 OF 1

PROJECT
Baker High School Biomass Boiler

Option
C & D: Fully Automated 3,100 MBH Wood Pellet Boiler with Masonry Building and Exterior Silo

CTA Architects Engineers
306 West Railroad Avenue, Suite 104, Missoula, MT 59802
406. 728. 9522 800. 780. 7455 Fax: 406. 728. 8287
1-800-780-7455
http://www.ctagroup.com E-mail: info@ctagroup.com

Costs obtained from RS Means and historical information.

ESTIMATOR
Ratz

	QUANTITY		MATERIAL		LABOR			
	No. Units	Unit Meas.	Per Unit	TOTAL	Per Unit	TOTAL	TOTAL COST	PROJECT COMPONENT COST
BIOMASS BOILER AND STACK SYSTEM								
Wood Pellet Fired Boiler System (3.1 MMBtuh Output- Steam)	1	assy	$210,000.00	$210,000	$35,000.00	$35,000	$245,000	
Turn key - includes augers, boiler, multi cyclone,								
50 foot stack, 40 silo								
Subtotal							$245,000	
TOTAL- BIOMASS BOILER SYSTEMS								**$245,000**
BOILER BUILDING COSTS								
Boiler Plant Building - CMU (Slab on Grade)	800	sf	$80.00	$64,000	$80.00	$64,000	$128,000	
Subtotal							$128,000	
TOTAL- Boiler Building								**$128,000**
BOILER BUILDING MECHANICAL AND ELECTRICAL COSTS								
Site Utilities								
6" PVC Sewer Main	250	lf	$6.75	$1,687.50	$2.75	$687.50	$2,375.00	
Trenching (8' w x 6' d x 250 lf)	500	cy	$6.00	$3,000.00	$6.00	$3,000.00	$6,000.00	
1-1/2" C900 Water Main	250	lf	$6.75	$1,687.50	$2.75	$687.50	$2,375.00	
Trenching (8' w x 6' d x 1000 lf)	500	cy	$6.00	$3,000.00	$6.00	$3,000.00	$6,000.00	
Fire Protection System								
Automatic Fire Protection System	800	sf	$4.00	$3,200.00	$4.00	$3,200.00	$6,400.00	
Fire Riser w/ Backflow Preventer	1	ls	$5,000.00	$5,000.00	$5,000.00	$5,000.00	$10,000.00	
Domestic Water System								
1-1/2" Insulated Copper CW	75	lf	$22.50	$1,687.50	$14.00	$1,050.00	$2,737.50	
3/4" Insulated Copper (CW & HW)	50	lf	$9.50	$475.00	$10.50	$525.00	$1,000.00	
Emergency Shower and Mixing Valve	1	assy	$1,500.00	$1,500.00	$300.00	$300.00	$1,800.00	
Electric Water Heater	1	ea	$500.00	$500.00	$200.00	$200.00	$700.00	
Service Sink	1	ea	$900.00	$900.00	$700.00	$700.00	$1,600.00	
D-W-V System								
2" PVC D-W-V	120	lf	$3.50	$420.00	$17.50	$2,100.00	$2,520.00	
3" PVC D-W-V	70	lf	$6.00	$420.00	$19.00	$1,330.00	$1,750.00	
Floor Drains	4	ea	$850.00	$3,400.00	$100.00	$400.00	$3,800.00	
Miscellaneous Plumbing	1	ls	$500.00	$500.00	$500.00	$500.00	$1,000.00	
HVAC								
Combustion Ductwork	600	lbs	$1.50	$900.00	$6.50	$3,900.00	$4,800.00	
Louvers	85	sf	$57.00	$4,845.00	$16.50	$1,402.50	$6,247.50	
Control Dampers	4	ea	$650.00	$2,600.00	$130.00	$520.00	$3,120.00	
Unit Heater	2	ea	$600.00	$1,200.00	$120.00	$240.00	$1,440.00	
Steam and Condensate Piping								
3/4" Insulated Black Steel (LPS)	60	lf	$6.50	$390.00	$12.50	$750.00	$1,140.00	
1" Insulated Black Steel (LPS)	50	lf	$7.00	$350.00	$14.50	$725.00	$1,075.00	
6" Insulated Black Steel (LPS)	60	lf	$50.00	$3,000.00	$48.00	$2,880.00	$5,880.00	
12" Insulated Black Steel (LPS Header)	5	lf	$113.00	$565.00	$86.00	$430.00	$995.00	
1-1/2" Insulated Black Steel (sch 80 BF)	85	lf	$16.00	$1,360.00	$18.00	$1,530.00	$2,890.00	
1-1/2" Insulated Black Steel (sch 80 PCR)	85	lf	$16.00	$1,360.00	$18.00	$1,530.00	$2,890.00	
3/4" Insulated Black Steel (sch 80 LPR)	100	lf	$9.50	$950.00	$15.00	$1,500.00	$2,450.00	
1" Insulated Black Steel (sch 80 LPR)	25	lf	$11.50	$287.50	$16.00	$400.00	$687.50	
6" Class 125 Gate Valve	1	ea	$1,650.00	$1,650.00	$450.00	$450.00	$2,100.00	
F&T Steam Traps	4	ea	$125.00	$500.00	$30.00	$120.00	$620.00	
Duplex Condensate Transfer Pump	1	ea	$5,500.00	$5,500.00	$250.00	$250.00	$5,750.00	
Miscellaneous Steam Piping Components	1	ls	$5,000.00	$5,000.00	$5,000.00	$5,000.00	$10,000.00	
Temperature Controls	1	ls	$5,000.00	$5,000.00	$2,500.00	$2,500.00	$7,500.00	
Plant Electrical Work	1	ls	$20,000.00	$20,000	$10,000.00	$10,000	$30,000	
Subtotal							*$139,643*	
TOTAL- BOILER BUILDING MECHANICAL & ELECTRICAL COSTS								**$139,643**
SUBTOTAL BUILDING & BOILER								**$512,643**
MECHANICAL INTEGRATION COSTS								
Existing Boiler Room								
Existing Pipe Trench								
Replace Existing Pipe Trench Covers	230	lf	$15.00	$3,450.00	$50.00	$11,500.00	$14,950.00	
Steam and Condensate Piping								
6" Insulated Black Steel (LPS)	350	lf	$50.00	$17,500.00	$48.00	$16,800.00	$34,300.00	
1-1/2" Insulated Black Steel (sch 80 BF)	350	lf	$16.00	$5,600.00	$18.00	$6,300.00	$11,900.00	
1-1/2" Insulated Black Steel (sch 80 PCR)	350	lf	$16.00	$5,600.00	$18.00	$6,300.00	$11,900.00	
3/4" Insulated Black Steel (sch 80 LPR)	50	lf	$9.50	$475.00	$15.00	$750.00	$1,225.00	
6" Class 125 Gate Valve	1	ea	$1,650.00	$1,650.00	$450.00	$450.00	$2,100.00	
F&T Steam Traps	3	ea	$125.00	$375.00	$30.00	$90.00	$465.00	
Triplex Boiler Feedwater Unit	1	ea	$20,000.00	$20,000.00	$1,500.00	$1,500.00	$21,500.00	
Miscellaneous Steam Piping Components	1	ls	$5,000.00	$5,000.00	$5,000.00	$5,000.00	$10,000.00	
Temperature Controls	1	ls	$2,500.00	$2,500	$2,500.00	$2,500	$5,000	
Electrical Work	1	ls	$2,500.00	$2,500	$2,500.00	$2,500	$5,000	
Subtotal							*$118,340*	
TOTAL- INTEGRATION COSTS								**$118,340**
SUBTOTAL								**$630,983**
General Conditions , OH&P	*15%*						*$94,647*	
SUBTOTAL								**$725,630**
Escalation to Bid Date (Feb. 2011)	*5%*						*$36,281*	
SUBTOTAL								**$761,911**
REMOTE FACTOR	5.00%							$38,096
SUBTOTAL CONSTRUCTION								**$800,007**
SOFT COSTS								
A/E Design Fee, Building Permit, Air Quality, Misc. Exp.	*12%*						$91,429	
SUBTOTAL SOFT COSTS							$91,429	**$91,429**
PRECONTINGENCY PROJECT TOTAL								**$891,436**
CONTINGENCY	15.00%							$133,715
RECOMMENDED PROJECT BUDGET - DESIGN AND CONSTRUCTION COSTS								**$1,025,152**

Baker High School

Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option A.1

Green Wood Chips
100% Grants
0% Financed

EXISTING CONDITIONS

	Natural Gas	Fuel Oil	Propane	Electricity
Existing Fuel Type:	Natural Gas	Fuel Oil	Propane	Electricity
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

	Wood Chips
WOOD FUEL COST	
$/ton:	$40.00
Assumed efficiency of wood heating system (%):	65%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 40% MC**	5400
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	980
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	833
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	33

Project Capital Cost	**-$1,479,000**

Project Financing Information	
Percent Financed	**0%**
Amount Financed	$0
Amount of Grants	$1,479,000
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	$0

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	6.0	40	240	$20.00	$4,800
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	3.0	40	120	$20.00	$2,400

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	32.7 years
Net Present Value (30 year analysis):	$2,810,249
Net Present Value (20 year analysis):	$1,481,657

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 2	Year 3	Year 4	Year 5
Existing Heating System Operating Costs									
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288
					$0	$0	$0	$0	$0
Biomass System Operating Costs									
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$40.00	85%	833	tons	$33,322	$34,322	$35,351	$36,412	$37,504
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543
Additional Operation and Maintenance Costs					$4,800	$4,896	$4,994	$5,094	$5,196
Additional Operation and Maintenance Costs First 2 years					$2,400	$2,448			
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430
Annual Operating Cost Savings					***$45,273***	***$49,277***	***$56,054***	***$60,678***	***$65,614***
Financed Project Costs - Principal and Interest					***0***	***0***	***0***	***0***	***0***
Displaced System Replacement Costs (year one only)					***0***				
Net Annual Cash Flow					***45,273***	***49,277***	***56,054***	***60,678***	***65,614***
Accumulated Cash Flow					***45,273***	***94,550***	***150,604***	***211,282***	***276,896***

Cash flow Descriptions	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs									
Displaced heating costs	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs									
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$38,629	$39,788	$40,982	$42,211	$43,478	$50,402	$58,430	$67,737	$78,525
Small load existing fuel (15% of total heat rqmnt)	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs	$5,300	$5,406	$5,514	$5,624	$5,736	$6,333	$6,993	$7,720	$8,524
Additional Operation and Maintenance Costs First 2 years									
Additional Electrical Cost	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings	***$70,884***	***$76,508***	***$82,508***	***$88,909***	***$95,735***	***$137,238***	***$194,158***	***$271,921***	***$377,821***
Financed Project Costs - Principal and Interest	***0***	***0***	***0***	***0***	***0***				
Displaced System Replacement Costs (year one only)									
Net Annual Cash Flow	***70,884***	***76,508***	***82,508***	***88,909***	***95,735***	***137,238***	***194,158***	***271,921***	***377,821***
Accumulated Cash Flow	***347,781***	***424,289***	***506,797***	***595,706***	***691,441***	***1,289,354***	***2,139,171***	***3,333,614***	***4,997,917***

Baker High School

Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option A.2

Green Wood Chips
50% Grants
50% Financed

EXISTING CONDITIONS				
Existing Fuel Type:	**Natural Gas**	**Fuel Oil**	**Propane**	**Electricity**
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

WOOD FUEL COST	**Wood Chips**
$/ton:	$40.00
Assumed efficiency of wood heating system (%):	65%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 40% MC**	5400
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	980
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	833
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	33

Project Capital Cost	**-$1,479,000**

Project Financing Information	
Percent Financed	**50%**
Amount Financed	-$739,000
Amount of Grants	$740,000
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-$95,704

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	6.0	40	240	$20.00	$4,800
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	3.0	40	120	$20.00	$2,400

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	32.7 years
Net Present Value (30 year analysis):	$1,993,876
Net Present Value (20 year analysis):	$665,283

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 2	Year 3	Year 4	Year 5
Existing Heating System Operating Costs									
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288
					$0	$0	$0	$0	$0
Biomass System Operating Costs									
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$40.00	85%	833	tons	$33,322	$34,322	$35,351	$36,412	$37,504
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543
Additional Operation and Maintenance Costs					$4,800	$4,896	$4,994	$5,094	$5,196
Additional Operation and Maintenance Costs First 2 years					$2,400	$2,448			
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430
Annual Operating Cost Savings					***$45,273***	***$49,277***	***$56,054***	***$60,678***	***$65,614***
Financed Project Costs - Principal and Interest					***(95,704)***	***(95,704)***	***(95,704)***	***(95,704)***	***(95,704)***
Displaced System Replacement Costs (year one only)					***0***				
Net Annual Cash Flow					***(50,431)***	***(46,427)***	***(39,650)***	***(35,026)***	***(30,089)***
Accumulated Cash Flow					***(50,431)***	***(96,858)***	***(136,507)***	***(171,534)***	***(201,623)***

Cash flow Descriptions	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs									
Displaced heating costs	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs									
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$38,629	$39,788	$40,982	$42,211	$43,478	$50,402	$58,430	$67,737	$78,525
Small load existing fuel (15% of total heat rqmnt)	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs	$5,300	$5,406	$5,514	$5,624	$5,736	$6,333	$6,993	$7,720	$8,524
Additional Operation and Maintenance Costs First 2 years									
Additional Electrical Cost	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings	***$70,884***	***$76,508***	***$82,508***	***$88,909***	***$95,735***	***$137,238***	***$194,158***	***$271,921***	***$377,821***
Financed Project Costs - Principal and Interest	***(95,704)***	***(95,704)***	***(95,704)***	***(95,704)***	***(95,704)***				
Displaced System Replacement Costs (year one only)									
Net Annual Cash Flow	***(24,820)***	***(19,196)***	***(13,195)***	***(6,795)***	***31***	***137,238***	***194,158***	***271,921***	***377,821***
Accumulated Cash Flow	***(226,443)***	***(245,639)***	***(258,834)***	***(265,629)***	***(265,598)***	***332,315***	***1,182,133***	***2,376,575***	***4,040,878***

Baker High School

Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option A.3

Green Wood Chips
0% Grants
100% Financed

EXISTING CONDITIONS

	Natural Gas	Fuel Oil	Propane	Electricity
Existing Fuel Type:	Natural Gas	Fuel Oil	Propane	Electricity
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

	Wood Chips
WOOD FUEL COST	
$/ton:	$40.00
Assumed efficiency of wood heating system (%):	65%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 40% MC**	5400
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	980
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	833
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	33

Project Capital Cost	**-$1,479,000**

Project Financing Information	
Percent Financed	**100%**
Amount Financed	-$1,479,000
Amount of Grants	$0
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-$191,537

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	6.0	40	240	$20.00	$4,800
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	3.0	40	120	$20.00	$2,400

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	32.7 years
Net Present Value (30 year analysis):	$1,176,398
Net Present Value (20 year analysis):	-$152,195

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow 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 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs																		
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
					$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs																		
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$40.00	85%	833	tons	$33,322	$34,322	$35,351	$36,412	$37,504	$38,629	$39,788	$40,982	$42,211	$43,478	$50,402	$58,430	$67,737	$78,525
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs					$4,800	$4,896	$4,994	$5,094	$5,196	$5,300	$5,406	$5,514	$5,624	$5,736	$6,333	$6,993	$7,720	$8,524
Additional Operation and Maintenance Costs First 2 years					$2,400	$2,448												
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings					***$45,273***	***$49,277***	***$56,054***	***$60,678***	***$65,614***	***$70,884***	***$76,508***	***$82,508***	***$88,909***	***$95,735***	***$137,238***	***$194,158***	***$271,921***	***$377,821***
Financed Project Costs - Principal and Interest					***(191,537)***	***(191,537)***	***(191,537)***	***(191,537)***	***(191,537)***	***(191,537)***	***(191,537)***	***(191,537)***	***(191,537)***	***(191,537)***				
Displaced System Replacement Costs (year one only)					***0***													
Net Annual Cash Flow					***(146,264)***	***(142,260)***	***(135,483)***	***(130,860)***	***(125,923)***	***(120,653)***	***(115,029)***	***(109,029)***	***(102,628)***	***(95,802)***	***137,238***	***194,158***	***271,921***	***377,821***
Accumulated Cash Flow					***(146,264)***	***(288,524)***	***(424,008)***	***(554,867)***	***(680,790)***	***(801,443)***	***(916,472)***	***(1,025,501)***	***(1,128,129)***	***(1,223,932)***	***(626,019)***	***223,799***	***1,418,241***	***3,082,545***

Baker High School

Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option B.1

Processed Wood Chips
100% Grants
0% Financed

	Natural Gas	Fuel Oil	Propane	Electricity
EXISTING CONDITIONS				
Existing Fuel Type:	Natural Gas	Fuel Oil	Propane	Electricity
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

	Wood Chips
WOOD FUEL COST	
$/ton:	$50.00
Assumed efficiency of wood heating system (%):	65%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 20% MC**	7200
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	735
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	625
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	25

Project Capital Cost	**-$1,479,000**

Project Financing Information	
Percent Financed	**0%**
Amount Financed	$0
Amount of Grants	$1,479,000
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	$0

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	5.0	40	200	$20.00	$4,000
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	2.5	40	100	$20.00	$2,000

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	30.5 years
Net Present Value (30 year analysis):	$2,891,980
Net Present Value (20 year analysis):	$1,537,050

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow 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 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs																		
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
					$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs																		
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$50.00	85%	625	tons	$31,239	$32,176	$33,142	$34,136	$35,160	$36,215	$37,301	$38,420	$39,573	$40,760	$47,252	$54,778	$63,503	$73,617
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs					$4,000	$4,080	$4,162	$4,245	$4,330	$4,416	$4,505	$4,595	$4,687	$4,780	$5,278	$5,827	$6,434	$7,103
Additional Operation and Maintenance Costs First 2 years					$2,000	$2,040												
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings					***$48,556***	***$52,646***	***$59,096***	***$63,802***	***$68,824***	***$74,182***	***$79,896***	***$85,989***	***$92,485***	***$99,408***	***$141,444***	***$198,976***	***$277,442***	***$384,150***
Financed Project Costs - Principal and Interest					***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***				
Displaced System Replacement Costs (year one only)					***0***													
Net Annual Cash Flow					***48,556***	***52,646***	***59,096***	***63,802***	***68,824***	***74,182***	***79,896***	***85,989***	***92,485***	***99,408***	***141,444***	***198,976***	***277,442***	***384,150***
Accumulated Cash Flow					***48,556***	***101,202***	***160,298***	***224,100***	***292,924***	***367,106***	***447,002***	***532,991***	***625,475***	***724,884***	***1,342,731***	***2,215,378***	***3,435,977***	***5,130,261***

Baker High School

Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option B.2

Processed Wood Chips
50% Grants
50% Financed

EXISTING CONDITIONS

	Natural Gas	Fuel Oil	Propane	Electricity
Existing Fuel Type:	Natural Gas	Fuel Oil	Propane	Electricity
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

WOOD FUEL COST

	Wood Chips
$/ton:	$50.00
Assumed efficiency of wood heating system (%):	65%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 20% MC**	7200
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	735
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	625
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	25

Project Capital Cost	**-$1,479,000**

Project Financing Information	
Percent Financed	**50%**
Amount Financed	-$739,000
Amount of Grants	$740,000
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-$95,704

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	5.0	40	200	$20.00	$4,000
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	2.5	40	100	$20.00	$2,000

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	30.5 years
Net Present Value (30 year analysis):	$2,075,607
Net Present Value (20 year analysis):	$720,677

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow 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 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs																		
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
					$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs																		
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$50.00	85%	625	tons	$31,239	$32,176	$33,142	$34,136	$35,160	$36,215	$37,301	$38,420	$39,573	$40,760	$47,252	$54,778	$63,503	$73,617
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs					$4,000	$4,080	$4,162	$4,245	$4,330	$4,416	$4,505	$4,595	$4,687	$4,780	$5,278	$5,827	$6,434	$7,103
Additional Operation and Maintenance Costs First 2 years					$2,000	$2,040												
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings					***$48,556***	***$52,646***	***$59,096***	***$63,802***	***$68,824***	***$74,182***	***$79,896***	***$85,989***	***$92,485***	***$99,408***	***$141,444***	***$198,976***	***$277,442***	***$384,150***
Financed Project Costs - Principal and Interest					***(95,704)***	***(95,704)***	***(95,704)***	***(95,704)***	***(95,704)***	***(95,704)***	***(95,704)***	***(95,704)***	***(95,704)***	***(95,704)***				
Displaced System Replacement Costs (year one only)					***0***													
Net Annual Cash Flow					***(47,148)***	***(43,058)***	***(36,608)***	***(31,902)***	***(26,880)***	***(21,522)***	***(15,808)***	***(9,715)***	***(3,219)***	***3,704***	***141,444***	***198,976***	***277,442***	***384,150***
Accumulated Cash Flow					***(47,148)***	***(90,206)***	***(126,814)***	***(158,715)***	***(185,595)***	***(207,117)***	***(222,925)***	***(232,640)***	***(235,860)***	***(232,155)***	***385,692***	***1,258,339***	***2,478,938***	***4,173,223***

Baker High School

Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option B.3

Processed Wood Chips
0% Grants
100% Financed

EXISTING CONDITIONS

	Natural Gas	Fuel Oil	Propane	Electricity
Existing Fuel Type:				
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

	Wood Chips
WOOD FUEL COST	
$/ton:	$50.00
Assumed efficiency of wood heating system (%):	65%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 20% MC**	7200
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	735
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	625
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	25

Project Capital Cost	**-$1,479,000**

Project Financing Information	
Percent Financed	**100%**
Amount Financed	-$1,479,000
Amount of Grants	$0
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-$191,537

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	5.0	40	200	$20.00	$4,000
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	2.5	40	100	$20.00	$2,000

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	30.5 years
Net Present Value (30 year analysis):	$1,258,129
Net Present Value (20 year analysis):	-$96,801

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 2	Year 3	Year 4	Year 5
Existing Heating System Operating Costs									
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288
					$0	$0	$0	$0	$0
Biomass System Operating Costs									
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$50.00	85%	625	tons	$31,239	$32,176	$33,142	$34,136	$35,160
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543
Additional Operation and Maintenance Costs					$4,000	$4,080	$4,162	$4,245	$4,330
Additional Operation and Maintenance Costs First 2 years					$2,000	$2,040			
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430
Annual Operating Cost Savings					***$48,556***	***$52,646***	***$59,096***	***$63,802***	***$68,824***
Financed Project Costs - Principal and Interest					***(191,537)***	***(191,537)***	***(191,537)***	***(191,537)***	***(191,537)***
Displaced System Replacement Costs (year one only)					***0***				
Net Annual Cash Flow					***(142,982)***	***(138,891)***	***(132,441)***	***(127,735)***	***(122,713)***
Accumulated Cash Flow					***(142,982)***	***(281,873)***	***(414,314)***	***(542,049)***	***(664,762)***

Cash flow Descriptions	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs									
Displaced heating costs	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs									
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$36,215	$37,301	$38,420	$39,573	$40,760	$47,252	$54,778	$63,503	$73,617
Small load existing fuel (15% of total heat rqmnt)	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs	$4,416	$4,505	$4,595	$4,687	$4,780	$5,278	$5,827	$6,434	$7,103
Additional Operation and Maintenance Costs First 2 years									
Additional Electrical Cost	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings	***$74,182***	***$79,896***	***$85,989***	***$92,485***	***$99,408***	***$141,444***	***$198,976***	***$277,442***	***$384,150***
Financed Project Costs - Principal and Interest	***(191,537)***	***(191,537)***	***(191,537)***	***(191,537)***	***(191,537)***				
Displaced System Replacement Costs (year one only)									
Net Annual Cash Flow	***(117,355)***	***(111,641)***	***(105,548)***	***(99,053)***	***(92,129)***	***141,444***	***198,976***	***277,442***	***384,150***
Accumulated Cash Flow	***(782,117)***	***(893,759)***	***(999,307)***	***(1,098,360)***	***(1,190,489)***	***(572,642)***	***300,006***	***1,520,604***	***3,214,889***

Baker High School
Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option C.1
Wood Pellets
100% Grants
0% Financed

EXISTING CONDITIONS

	Natural Gas	Fuel Oil	Propane	Electricity
Existing Fuel Type:	Natural Gas	Fuel Oil	Propane	Electricity
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

	Wood Pellets
WOOD FUEL COST	
$/ton:	$160.00
Assumed efficiency of wood heating system (%):	70%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 8% MC**	8200
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	599
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	509
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	20

Project Capital Cost	**-$1,025,000**

Project Financing Information	
Percent Financed	**100%**
Amount Financed	-$1,025,000
Amount of Grants	$0
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-$132,742

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	3.0	40	120	$20.00	$2,400
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	1.5	40	60	$20.00	$1,200

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	1,486.0 years
Net Present Value (30 year analysis):	$337,752
Net Present Value (20 year analysis):	-$541,396

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow 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 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs																		
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
					$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs																		
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$160.00	85%	509	tons	$81,505	$83,950	$86,469	$89,063	$91,735	$94,487	$97,322	$100,241	$103,248	$106,346	$123,284	$142,920	$165,683	$192,072
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs					$2,400	$2,448	$2,497	$2,547	$2,598	$2,650	$2,703	$2,757	$2,812	$2,868	$3,167	$3,496	$3,860	$4,262
Additional Operation and Maintenance Costs First 2 years					$1,200	$1,224												
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings					***$690***	***$3,320***	***$7,433***	***$10,573***	***$13,982***	***$17,676***	***$21,678***	***$26,006***	***$30,684***	***$35,735***	***$67,524***	***$113,165***	***$177,835***	***$268,536***
Financed Project Costs - Principal and Interest					***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***				
Displaced System Replacement Costs (year one only)					***0***													
Net Annual Cash Flow					***(132,052)***	***(129,422)***	***(125,309)***	***(122,169)***	***(118,761)***	***(115,066)***	***(111,065)***	***(106,736)***	***(102,058)***	***(97,007)***	***67,524***	***113,165***	***177,835***	***268,536***
Accumulated Cash Flow					***(132,052)***	***(261,474)***	***(386,783)***	***(508,952)***	***(627,713)***	***(742,778)***	***(853,843)***	***(960,579)***	***(1,062,638)***	***(1,159,645)***	***(890,297)***	***(422,216)***	***328,762***	***1,477,943***

Baker High School

Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option C.2

Wood Pellets
50% Grants
50% Financed

EXISTING CONDITIONS

	Natural Gas	Fuel Oil	Propane	Electricity
Existing Fuel Type:	Natural Gas	Fuel Oil	Propane	Electricity
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

	Wood Pellets
WOOD FUEL COST	
$/ton:	$160.00
Assumed efficiency of wood heating system (%):	70%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 8% MC**	8200
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	599
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	509
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	20

Project Capital Cost	-$1,025,000

Project Financing Information	
Percent Financed	**50%**
Amount Financed	-$512,500
Amount of Grants	$512,500
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-$66,371

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	3.0	40	120	$20.00	$2,400
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	1.5	40	60	$20.00	$1,200

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	1,486.0 years
Net Present Value (30 year analysis):	$903,911
Net Present Value (20 year analysis):	$24,763

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow 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 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs																		
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
					$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs																		
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$160.00	85%	509	tons	$81,505	$83,950	$86,469	$89,063	$91,735	$94,487	$97,322	$100,241	$103,248	$106,346	$123,284	$142,920	$165,683	$192,072
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs					$2,400	$2,448	$2,497	$2,547	$2,598	$2,650	$2,703	$2,757	$2,812	$2,868	$3,167	$3,496	$3,860	$4,262
Additional Operation and Maintenance Costs First 2 years					$1,200	$1,224												
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings					***$690***	***$3,320***	***$7,433***	***$10,573***	***$13,982***	***$17,676***	***$21,678***	***$26,006***	***$30,684***	***$35,735***	***$67,524***	***$113,165***	***$177,835***	***$268,536***
Financed Project Costs - Principal and Interest					***(66,371)***	***(66,371)***	***(66,371)***	***(66,371)***	***(66,371)***	***(66,371)***	***(66,371)***	***(66,371)***	***(66,371)***	***(66,371)***				
Displaced System Replacement Costs (year one only)					***0***													
Net Annual Cash Flow					***(65,681)***	***(63,051)***	***(58,938)***	***(55,798)***	***(52,390)***	***(48,695)***	***(44,694)***	***(40,365)***	***(35,687)***	***(30,636)***	***67,524***	***113,165***	***177,835***	***268,536***
Accumulated Cash Flow					***(65,681)***	***(128,732)***	***(187,670)***	***(243,468)***	***(295,857)***	***(344,552)***	***(389,245)***	***(429,610)***	***(465,298)***	***(495,934)***	***(226,586)***	***241,495***	***992,473***	***2,141,654***

Baker High School
Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option C.3
Wood Pellets
0% Grants
100% Financed

EXISTING CONDITIONS

Existing Fuel Type:	**Natural Gas**	**Fuel Oil**	**Propane**	**Electricity**
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

WOOD FUEL COST	**Wood Pellets**
$/ton:	$160.00
Assumed efficiency of wood heating system (%):	70%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 8% MC**	8200
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	599
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	509
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	20

Project Capital Cost	**-$1,025,000**

Project Financing Information	
Percent Financed	**100%**
Amount Financed	-$1,025,000
Amount of Grants	$0
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-$132,742

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	3.0	40	120	$20.00	$2,400
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	1.5	40	60	$20.00	$1,200

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	1,486.0 years
Net Present Value (30 year analysis):	$337,752
Net Present Value (20 year analysis):	-$541,396

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow 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 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs																		
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
					$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs																		
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$160.00	85%	509	tons	$81,505	$83,950	$86,469	$89,063	$91,735	$94,487	$97,322	$100,241	$103,248	$106,346	$123,284	$142,920	$165,683	$192,072
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs					$2,400	$2,448	$2,497	$2,547	$2,598	$2,650	$2,703	$2,757	$2,812	$2,868	$3,167	$3,496	$3,860	$4,262
Additional Operation and Maintenance Costs First 2 years					$1,200	$1,224												
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings					***$690***	***$3,320***	***$7,433***	***$10,573***	***$13,982***	***$17,676***	***$21,678***	***$26,006***	***$30,684***	***$35,735***	***$67,524***	***$113,165***	***$177,835***	***$268,536***
Financed Project Costs - Principal and Interest					***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***	***(132,742)***				
Displaced System Replacement Costs (year one only)					***0***													
Net Annual Cash Flow					***(132,052)***	***(129,422)***	***(125,309)***	***(122,169)***	***(118,761)***	***(115,066)***	***(111,065)***	***(106,736)***	***(102,058)***	***(97,007)***	***67,524***	***113,165***	***177,835***	***268,536***
Accumulated Cash Flow					***(132,052)***	***(261,474)***	***(386,783)***	***(508,952)***	***(627,713)***	***(742,778)***	***(853,843)***	***(960,579)***	***(1,062,638)***	***(1,159,645)***	***(890,297)***	***(422,216)***	***328,762***	***1,477,943***

Baker High School

Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option D.1

Wood Pucks
100% Grants
0% Financed

EXISTING CONDITIONS	Natural Gas	Fuel Oil	Propane	Electricity
Existing Fuel Type:	Natural Gas	Fuel Oil	Propane	Electricity
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

WOOD FUEL COST	Wood Pucks
$/ton:	$135.00
Assumed efficiency of wood heating system (%):	70%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 8% MC**	8200
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	599
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	509
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	20

Project Capital Cost	-$1,040,000

Project Financing Information	
Percent Financed	0%
Amount Financed	$0
Amount of Grants	$1,040,000
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	$0

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	4.0	40	160	$20.00	$3,200
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	2.0	40	80	$20.00	$1,600

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	85.1 years
Net Present Value (30 year analysis):	$1,819,925
Net Present Value (20 year analysis):	$823,253

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow 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 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs																		
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
					$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs																		
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$135.00	85%	509	tons	$68,770	$70,833	$72,958	$75,147	$77,401	$79,723	$82,115	$84,578	$87,116	$89,729	$104,021	$120,589	$139,795	$162,061
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs					$3,200	$3,264	$3,329	$3,396	$3,464	$3,533	$3,604	$3,676	$3,749	$3,824	$4,222	$4,662	$5,147	$5,683
Additional Operation and Maintenance Costs First 2 years					$1,600	$1,632												
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings					***$12,225***	***$15,214***	***$20,112***	***$23,640***	***$27,449***	***$31,557***	***$35,983***	***$40,750***	***$45,879***	***$51,395***	***$85,731***	***$134,331***	***$202,436***	***$297,127***
Financed Project Costs - Principal and Interest					***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***				
Displaced System Replacement Costs (year one only)					***0***													
Net Annual Cash Flow					***12,225***	***15,214***	***20,112***	***23,640***	***27,449***	***31,557***	***35,983***	***40,750***	***45,879***	***51,395***	***85,731***	***134,331***	***202,436***	***297,127***
Accumulated Cash Flow					***12,225***	***27,439***	***47,550***	***71,191***	***98,640***	***130,197***	***166,180***	***206,929***	***252,809***	***304,204***	***659,343***	***1,227,160***	***2,094,067***	***3,377,984***

Baker High School

Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option D.2

Wood Pucks
50% Grants
50% Financed

EXISTING CONDITIONS

	Natural Gas	Fuel Oil	Propane	Electricity
Existing Fuel Type:	Natural Gas	Fuel Oil	Propane	Electricity
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

	Wood Pucks
WOOD FUEL COST	
$/ton:	$135.00
Assumed efficiency of wood heating system (%):	70%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 8% MC**	8200
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	599
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	509
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	20

Project Capital Cost	-$1,040,000

Project Financing Information	
Percent Financed	**50%**
Amount Financed	-$520,000
Amount of Grants	$520,000
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-$67,342

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	4.0	40	160	$20.00	$3,200
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	2.0	40	80	$20.00	$1,600

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	85.1 years
Net Present Value (30 year analysis):	$1,245,481
Net Present Value (20 year analysis):	$248,809

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow 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 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs																		
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
					$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs																		
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$135.00	85%	509	tons	$68,770	$70,833	$72,958	$75,147	$77,401	$79,723	$82,115	$84,578	$87,116	$89,729	$104,021	$120,589	$139,795	$162,061
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs					$3,200	$3,264	$3,329	$3,396	$3,464	$3,533	$3,604	$3,676	$3,749	$3,824	$4,222	$4,662	$5,147	$5,683
Additional Operation and Maintenance Costs First 2 years					$1,600	$1,632												
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings					***$12,225***	***$15,214***	***$20,112***	***$23,640***	***$27,449***	***$31,557***	***$35,983***	***$40,750***	***$45,879***	***$51,395***	***$85,731***	***$134,331***	***$202,436***	***$297,127***
Financed Project Costs - Principal and Interest					*(67,342)*	*(67,342)*	*(67,342)*	*(67,342)*	*(67,342)*	*(67,342)*	*(67,342)*	*(67,342)*	*(67,342)*	*(67,342)*				
Displaced System Replacement Costs (year one only)					***0***													
Net Annual Cash Flow					*(55,117)*	*(52,129)*	*(47,231)*	*(43,702)*	*(39,893)*	*(35,786)*	*(31,359)*	*(26,593)*	*(21,463)*	*(15,947)*	***85,731***	***134,331***	***202,436***	***297,127***
Accumulated Cash Flow					*(55,117)*	*(107,246)*	*(154,477)*	*(198,179)*	*(238,072)*	*(273,858)*	*(305,217)*	*(331,810)*	*(353,273)*	*(369,220)*	*(14,081)*	***553,736***	***1,420,643***	***2,704,560***

Baker High School
Baker City, Oregon

Date: January 29, 2010
Analyst: CTA Architects Engineers - Nathan Ratz

Option D.3
Wood Pucks
0% Grants
100% Financed

EXISTING CONDITIONS

Existing Fuel Type:	**Natural Gas**	**Fuel Oil**	**Propane**	**Electricity**
Fuel Units:	dkt	gallons	galllons	kwh
Current Fuel Unit Cost:	$12.00	$0.00	$0.00	$0.00
Estimated Average Annual Fuel Usage:	8,600	0	0	0
Annual Heating Costs:	$103,200	$0	$0	$0
ENERGY CONVERSION (to 1,000,000 Btu; or 1 dkt)				
Fuel Heating Value (Btu/unit of fuel):	1000000	134000	90500	3413
Current Annual Fuel Volume (Btu):	8,600,000,000	0	0	0
Assumed efficiency of existing heating system (%):	80%	80%	80%	100%
Net Annual Energy Produced (Btu):	6,880,000,000	0	0	0

WOOD FUEL COST	**Wood Pucks**
$/ton:	$135.00
Assumed efficiency of wood heating system (%):	70%
PROJECTED WOOD FUEL USAGE	
Estimated Btu content of wood fuel (Btu/lb) - **Assumed 8% MC**	8200
Tons of wood fuel to supplant net equivalent of 100% annual heating load.	599
Tons of wood fuel to supplant net equivalent of 85% annual heating load.	509
25 ton chip van loads to supplant net equivalent of 85% annual heating load.	20

Project Capital Cost	**-$1,040,000**

Project Financing Information	
Percent Financed	**100%**
Amount Financed	-$1,040,000
Amount of Grants	$0
Interest Rate	5.00%
Term	10
Annual Finance Cost (years)	-$134,685

Additional Power Use	
Est. Pwr Use	35000 kWh
Elec Rate	$0.055 /kWh

Additional Maintenance					
Type	Hr/Wk	Wk/Yr	Total Hr	Wage/Hr	Total
Biomass System	4.0	40	160	$20.00	$3,200
Other	0.0	40	0	$20.00	$0
1st 2 Year Learning	2.0	40	80	$20.00	$1,600

Simple Payback: Total Project Cost/Year One Operating Cost Savings:	85.1 years
Net Present Value (30 year analysis):	$671,037
Net Present Value (20 year analysis):	-$325,636

Inflation Factors	
O&M Inflation Rate	2.0%
Current Fuel Inflation Rate	6.0%
Wood Fuel Inflation Rate	3.0%
Discount Rate for Net Present Value Calculation	3.0%

Cash flow 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 15	Year 20	Year 25	Year 30
Existing Heating System Operating Costs																		
Displaced heating costs	$12.00		8600	dkt	$103,200	$109,392	$115,956	$122,913	$130,288	$138,105	$146,391	$155,175	$164,485	$174,354	$233,325	$312,242	$417,850	$559,178
					$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Biomass System Operating Costs																		
Wood Fuel ($/ton, delivered to boiler site) (85% of total heat rqmnt)	$135.00	85%	509	tons	$68,770	$70,833	$72,958	$75,147	$77,401	$79,723	$82,115	$84,578	$87,116	$89,729	$104,021	$120,589	$139,795	$162,061
Small load existing fuel (15% of total heat rqmnt)	$12.00	15%	1290	dkt	$15,480	$16,409	$17,393	$18,437	$19,543	$20,716	$21,959	$23,276	$24,673	$26,153	$34,999	$46,836	$62,678	$83,877
Additional Operation and Maintenance Costs					$3,200	$3,264	$3,329	$3,396	$3,464	$3,533	$3,604	$3,676	$3,749	$3,824	$4,222	$4,662	$5,147	$5,683
Additional Operation and Maintenance Costs First 2 years					$1,600	$1,632												
Additional Electrical Cost	$0.055				$1,925	$2,041	$2,163	$2,293	$2,430	$2,576	$2,731	$2,894	$3,068	$3,252	$4,352	$5,824	$7,794	$10,430
Annual Operating Cost Savings					***$12,225***	***$15,214***	***$20,112***	***$23,640***	***$27,449***	***$31,557***	***$35,983***	***$40,750***	***$45,879***	***$51,395***	***$85,731***	***$134,331***	***$202,436***	***$297,127***
Financed Project Costs - Principal and Interest					***(134,685)***	***(134,685)***	***(134,685)***	***(134,685)***	***(134,685)***	***(134,685)***	***(134,685)***	***(134,685)***	***(134,685)***	***(134,685)***				
Displaced System Replacement Costs (year one only)					***0***													
Net Annual Cash Flow					***(122,460)***	***(119,471)***	***(114,573)***	***(111,044)***	***(107,236)***	***(103,128)***	***(98,702)***	***(93,935)***	***(88,806)***	***(83,290)***	***85,731***	***134,331***	***202,436***	***297,127***
Accumulated Cash Flow					***(122,460)***	***(241,931)***	***(356,504)***	***(467,548)***	***(574,784)***	***(677,912)***	***(776,614)***	***(870,549)***	***(959,354)***	***(1,042,644)***	***(687,505)***	***(119,688)***	***747,219***	***2,031,137***