Preliminary Feasibility Report

Biomass Heating Analysis for Lewis County Complex

Lowville, New York

Prepared by:

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# Table of Contents

**EXECUTIVE SUMMARY** ................................................................................................................................. 1

**INTRODUCTION** ................................................................................................................................................ 3

**ANALYSIS ASSUMPTIONS** ............................................................................................................................. 4
  - Description of the Existing Heating System ................................................................................................. 4
  - Description of the Proposed Biomass System ............................................................................................ 5
  - Semi-Automated Systems ............................................................................................................................ 6
  - Life Cycle Cost Methodology ....................................................................................................................... 8
  - Natural Gas Cost Assumptions .................................................................................................................... 9
  - Woodchip Fuel Cost Assumptions ................................................................................................................ 9
  - Inflation Assumptions .................................................................................................................................. 10
  - Operation and Maintenance Assumptions ................................................................................................... 11
  - Financing Assumptions ............................................................................................................................... 11

**BIOMASS SCENARIO ANALYSIS** .................................................................................................................. 13

**ADDITIONAL ISSUES TO CONSIDER** .......................................................................................................... 16
  - Energy Management .................................................................................................................................... 16
  - Energy Efficiency ......................................................................................................................................... 16

**PROJECT FUNDING POSSIBILITIES** .......................................................................................................... 17
  - USDA Funding Opportunities ..................................................................................................................... 17
  - Municipal Lease / Purchase ......................................................................................................................... 17
  - Carbon Offsets ............................................................................................................................................. 18

**PERMITTING** ................................................................................................................................................... 19

**CONCLUSIONS AND RECOMMENDATIONS** ............................................................................................... 21

**APPENDICES** .................................................................................................................................................. 23
  - Discussion of Biomass Fuels ....................................................................................................................... 23
  - Sensitivity Analysis ....................................................................................................................................... 26
  - Potential Biomass Fuel Suppliers ............................................................................................................... 27
List of Figures

Figure 1: Fuel Usage in Natural Gas Equivalents ........................................................................................................ 4
Figure 2: Proposed Biomass Boiler Location ............................................................................................................... 5
Figure 3: Schematic Section of Semi-Automated Biomass Boiler House ................................................................. 6
Figure 4: Woodchip and Fossil Fuel Inflation ............................................................................................................. 10
Figure 5: Annual Cash Flow Graph for Woodchip Scenario ....................................................................................... 14
Figure 6: Carbon Cycle Illustration ........................................................................................................................ 18
Figure 7: Particulate Emissions ................................................................................................................................. 20

List of Tables

Table 1: Characteristics of Semi-Automated Woodchip Heating Systems ............................................................... 7
Table 2: Fuel Consumption Data and Estimates ......................................................................................................... 9
Table 3: Woodchip Scenario Analysis Assumptions ................................................................................................ 13
Table 4: 30-Year Life Cycle Analysis Spreadsheet for Woodchip Scenario ............................................................ 15
Table 5: Wood and Natural Gas Prices Vary - Interest and Inflation Rates Held Constant .................................. 26
Table 6: Interest and Natural Gas Fuel Inflation Vary - Wood Fuel and General Inflation Rate Constant .......... 26
EXECUTIVE SUMMARY

The Lewis County Complex currently includes the Lewis County Department of Social Services (23,725 SF) and the Lewis County Public Safety Building (21,145 SF); the county plans to build a third, approximately 20,000 SF, building on the site next year. During the summer of 2009, both existing buildings were converted from fuel oil boilers to natural gas boilers and when the new building is built, it too will use natural gas as a heating fuel.

The energy content from heating fuel purchases for 2008 and 2009 was converted to natural gas equivalents and then averaged in order to get an estimate of annual fuel usage. Using this method, it was determined that the Social Services building uses the equivalent of about 7,108 therms annually, the Public Safety building uses about 21,109 therms. It was assumed that the new building would use about the same volume of natural gas per square foot per year as the Social Service building or about 5,992 therms per year. Therefore all three buildings were assumed to use a total of 34,209 therms of natural gas per year on average. At the current cost of $1.10 per therm for natural gas, the county can expect to pay about $37,630 to heat these buildings. This was the amount used in the analysis in this report.

![Lewis County Complex Woodchip vs Natural Gas Heating Comparison](image)

It does not appear that the Lewis County Complex would be a good candidate for a woodchip heating system. For biomass energy projects to be cost effective, particularly when it comes to comparing wood fuel costs against current natural gas prices, bigger is generally better. It does not appear that the county
uses enough natural gas for heating this complex of buildings to seriously consider a woodchip heating system. The analysis in this report indicates that the county would only save about $59,000 in present value operating costs over the 30-year life of a boiler if the costs of fuel, operation, maintenance and debt service are compared against existing fuel costs.

Higher natural gas prices or increased consumption from the new building could improve the economics under this scenario. Woodchip fuel at $50/ton is equivalent to about half the current cost the county is paying for heating fuel per Btu. If natural gas prices begin to approach $1.50 per therm, a biomass project for this site may be worth re-evaluating. Similarly, if the county were able to obtain significant grant funding for the project, then obviously the economics of the project could improve. If all else remained the same, the county would need to obtain grants covering about half of the cost for the project for it to be truly cost effective.

Regardless of whether a biomass project seems appropriate for the county at this time, there are energy related actions Yellow Wood recommends the county take to reduce it energy use.

1. In order to effectively measure progress toward energy efficiency goals, historical energy consumption data should be collected and updated frequently. There are many tools to help the county accomplish this. One such tool is the EPA Energy Star Portfolio Manager software. It is free public domain software that helps facility managers track energy and water use. This software can be downloaded at:

2. The county should consider energy efficiency improvements in all of its buildings. The New York State Energy Research and Development Authority (NYSERDA) and/or the New York Power Authority (NYPA) should be engaged to develop comprehensive energy efficiency recommendations and proposals for incentives for efficiency upgrades before undertaking any major building project. Information on energy efficiency programs is included in the Biomass and Green Building Resources binder accompanying this report.

This preliminary feasibility study was prepared by Yellow Wood Associates in collaboration with Richmond Energy Associates for the Lewis County Complex. Both Yellow Wood and Richmond Energy have extensive community economic development experience and Richmond Energy specializes in biomass energy projects. This study was funded by the Wood Education and Resource Center, Northeastern Area State and Private Forestry, U.S. Department of Agriculture.
INTRODUCTION

There is a significant volume of low-grade biomass in the United States that represents a valuable economic and environmental opportunity if it can be constructively used to produce energy. Commercially available biomass heating systems can provide heat cleanly and efficiently in many commercial applications. Biomass heating technologies are being used quite successfully in over 40 public schools in Vermont alone and the concept of heating institutions with wood is catching on in several other areas of the United States and Canada. Good candidate facilities for biomass energy systems include those that have high heating bills, those that have either steam or hot water heating distribution systems and those that have ready access to reasonably priced biomass fuel.

This report is a pre-feasibility assessment specifically tailored to the Lewis County Complex outlining whether or not woodchip heating makes sense for this facility from a practical perspective. In June 2010, staff from Yellow Wood Associates traveled to Lowville, NY to tour the complex. This assessment includes site specific fuel savings projections based on historic fuel consumption, and provides facility decision-makers suggestions and recommendations on next steps.

The study was funded by the U.S. Department of Agriculture Wood Education and Resource Center.

This preliminary feasibility study was prepared by Yellow Wood Associates and Richmond Energy Associates, LLC.
ANALYSIS ASSUMPTIONS

DESCRIPTION OF THE EXISTING HEATING SYSTEM

The Lewis County Complex currently includes the Lewis County Department of Social Services (23,725 SF) and the Lewis County Public Safety Building (21,145 SF); the county plans to build a third, approximately 20,000 SF, building on the site next year. During the summer of 2009, both existing buildings were converted from fuel oil boilers to natural gas boilers and when the new building is built, it too will use natural gas as a heating fuel. It was assumed the new building would use about the same volume of natural gas per square foot per year as the Social Services building. The energy content from heating fuel purchases for 2008 and 2009 was converted to natural gas equivalents and then averaged in order to get an estimate of annual fuel usage.

Figure 1: Fuel Usage in Natural Gas Equivalents
DESCRIPTION OF THE PROPOSED BIOMASS SYSTEM

The biomass scenario that was analyzed envisions converting a section of the Public Records Building into a boiler room and chip storage facility. Staff said that this building receives little use and it appears that it could be easily converted to a biomass boiler house. The type of woodchip heating system characterized for this site is semi-automated as opposed to a fully automated system. A semi-automated system requires the operator to spend approximately one extra hour per day for fuel handling and basic maintenance, but requires a much lower capital cost investment than a fully automated system, as the building that houses the system and the vendor equipment are both considerably less expensive. Woodchips would be stored at grade and loaded into a day-bin using a skid steer once or twice per day depending on the heating demand and the size of the day-bin. A more complete description of a semi-automated system is presented in the next section.

Figure 2: Proposed Biomass Boiler Location

Hot water from the woodchip boiler house would be tied into the exiting HVAC systems via approximately 1,000 feet of underground-insulated piping that would tie all buildings on the campus into a central boiler plant. Costs for a tall stack were included to ensure good emissions dispersal. A healthy construction contingency, standard general contractor mark-up and professional design fees were also included.
SEMI-AUTOMATED SYSTEMS

This semi-automated system requires the operator to spend approximately one extra hour per day for fuel handling and basic maintenance, but requires a much lower capital cost investment than a fully automated system, as the building that houses the system and the vendor equipment are both considerably less expensive.

Semi-automated biomass systems\(^1\) are a cost efficient alternative to fully automated systems. The semi-automated system is typically installed in an on-grade slab building that includes both a boiler room and chip storage. The system also includes a day-bin fuel hopper to supply the boiler automatically for one-to-two days without reloading. The day-bin of a semi-automated woodchip system is loaded by an operator using a small tractor with a front end bucket or skid steer. Semi-automated systems have automated controls to manage fuel supply and combustion air, although the controls are simpler than those in a fully automated system.

The attraction of a semi-automated system is that both the building that houses the system and the vendor equipment are less expensive than a fully automated system. The system takes the operator up to one hour per day over the typical operation and maintenance time required for a fully automated system; this additional time is for loading the day bin. The semi-automated woodchip system is a good match for a smaller rural school or office building where the additional time in fuel handling is not a significant burden to maintenance staff.

Figure 3: Schematic Section of Semi-Automated Biomass Boiler House
(Drawing Courtesy of the Biomass Energy Resource Center (BERC))

\(^1\)Excerpted from a handout produced by the Biomass Energy Resource Center: [http://www.biomasscenter.org/resources/technology/heating-systems-semiautomated.html](http://www.biomasscenter.org/resources/technology/heating-systems-semiautomated.html).
## Table 1: Characteristics of Semi-Automated Woodchip Heating Systems

<table>
<thead>
<tr>
<th>CHARACTERISTICS OF SEMI-AUTOMATED WOODCHIP HEATING SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Fuel:</strong></td>
</tr>
<tr>
<td><strong>Energy Output:</strong></td>
</tr>
<tr>
<td><strong>Size (Boiler Output):</strong></td>
</tr>
<tr>
<td><strong>Fuel Storage:</strong></td>
</tr>
</tbody>
</table>
| **Fuel Handling:** | Tractor with front-end bucket, from pile to day bin (performed by operator, once or twice daily)  
Automated from day bin to combustion chamber (no operator labor) |
| **Operator Work Load:** | Up to 1 hour daily |
| **Combustion Control:** | Electronic control panel (minimum)  
On-off firing rate (minimum)  
Automated, tuned control of fuel and combustion air  
“Idle” or flame maintenance mode |
| **Stack Emission Control Device:** | None required (unless required by state regulations)  
Must meet applicable state regulations, if any |
| **Ash Removal:** | Manual or automated |
| **Vendor-Supplied Equipment:** | Boiler with standard controls  
Combustion chamber  
Day bin with automated fuel reclaim in bottom  
Automated fuel handling system (day bin to boiler)  
Control panel  
Wood system wiring (from system control panel)  
Breaching (from boiler to stack) |
| **Vendor Responsibilities:** | All installation  
Coordination with General Contractor  
Warranty  
Service capability (limited)  
(Plumbing connection by others)  
(Building construction by others)  
(Tractors by others)  
(Bonding generally not required) |
LIFE CYCLE COST METHODOLOGY

Decision makers need practical methods for evaluating the economic performance of alternative choices for any given purchasing decision. When making a choice between mutually exclusive capital investments, it is prudent to compare all equipment and operating costs spent over the life of the longest lived alternative in order to determine the true least cost choice. The total cost of acquisition, fuel costs, operation and maintenance of an item throughout its useful life is known as its “life cycle cost.” Life cycle costs that should be considered in a life cycle cost analysis include:

- Capital costs for purchasing and installing equipment
- Fuel costs
- Inflation for fuels, operational labor and major repairs
- Annual operation and maintenance costs including scheduled major repairs
- Salvage costs of equipment and buildings at the end of the analysis period.

It is useful for decision makers to consider the impact of debt service if the project is to be financed in order to get a clearer picture of how a project might affect annual budgets. When viewed in this light, equipment with significant capital costs may still be the least-cost alternative. In some cases, a significant capital investment may actually lower annual expenses, if there are sufficient fuel savings to offset debt service and any incremental increases in operation and maintenance costs.

The analysis performed for this facility compares different scenarios over a 30-year horizon and takes into consideration life cycle cost factors. A 30-year time frame is used because it is the expected life of a new boiler.

The alternative biomass scenario envisions installing a new woodchip heating system that would serve the Lewis County Complex. The scenario includes all ancillary equipment and interconnection costs. Under the biomass scenario, the existing heating equipment would still be used to provide supplemental heat during the coldest days of the year if necessary and potentially for the warmer shoulder season months when buildings only require minimal heating during chilly weather.

The analysis projects current and future annual natural gas heating bills and compares that cost against the cost of operating a biomass system. Savings are presented in today’s dollars using a net present value calculation. Net present value (NPV) is defined as the present dollar value of net cash flows over time. This is a standard method for using the time value of money to compare the cost effectiveness of long-term projects.

It is not the intent of this project, nor was it in the scope of work, to develop detailed cost estimates for a biomass boiler facility. It is recommended that for a project of this scale, the Lewis County Complex hire a qualified design team to refine the project concept and to develop firm local cost estimates.
Therefore the capital costs used for the biomass scenario are generic estimates based on our experience with similar scale projects.

**NATURAL GAS COST ASSUMPTIONS**

To estimate annual fuel use for the complex, fuel consumption data for the 2008 and 2009 calendar years was converted to million Btu (mmBtu) and then averaged for the two years. For the purpose of this analysis, the baseline assumes that the new building would be of similar construction as the Social Services building and consume approximately the same Btu/SF annually. Based on average consumption over the past two years, it is assumed that the three-building complex would consume 34,209 of natural gas per year at a price of $1.10 per therm, for a total annual heating bill of $37,630.

**Table 2: Fuel Consumption Data and Estimates**

<table>
<thead>
<tr>
<th>Square Feet</th>
<th>Social Services</th>
<th>Public Safety</th>
<th>New Building</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>23,725</td>
<td>21,145</td>
<td>20,000</td>
<td></td>
</tr>
<tr>
<td>Gallons Fuel Oil 2008</td>
<td>5,400</td>
<td>16,681</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gallons Fuel Oil 2009</td>
<td>3,250</td>
<td>8,737</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Therms Natural Gas 2009</td>
<td>2,106</td>
<td>6,633</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total mmBtu</td>
<td>1,422</td>
<td>4,222</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average mmBtu/yr</td>
<td>710.8</td>
<td>2,110.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projected annual natural gas in therms</td>
<td>7,108</td>
<td>21,109</td>
<td>5,992</td>
<td>34,209</td>
</tr>
</tbody>
</table>

**WOODCHIP FUEL COST ASSUMPTIONS**

Frequently, operators of institutional woodchip systems don’t fire up their biomass boilers until there is constant demand for building heat. During the fall and spring, fossil fuel boilers are often used as they are easier to start up and turn down. Woodchip boilers are then typically used in place of fossil fuel boilers for the bulk of the winter heating season. In Vermont where there are well over 40 schools that heat with wood, the average annual wood utilization is about 85%. However, all of these systems are fully automated and do not require operators to load bins over weekends. Since a semi-automated system was characterized for this site, it was assumed that in some cases natural gas boilers would cover a portion of weekend heating loads during the coldest times of the year. Therefore the woodchip scenario in this study assumes the complex will meet 75% of the winter heating needs with woodchips.

It was calculated that a semi-automated woodchip system would consume 293 tons of chips per year. After consulting with other woodchip users in the region, we are projecting a first year cost of $50 per ton for woodchips, which is equivalent to about $0.57 per therm of natural gas. The remaining 25% of the heating needs were then assumed to be provided by the existing natural gas boilers consuming about
8,500 therms of natural gas. The cost for supplemental natural gas is then adjusted for inflation each year over the 30-year horizon.

INFLATION ASSUMPTIONS

Estimating future fuel costs over time is difficult at best. Over the past few years it has become even more difficult as fuel prices have fluctuated dramatically. Nevertheless, in order to more accurately reflect future costs in a thirty-year analysis, some rate of inflation needs to be applied to future fuel costs.

Figure 4: Woodchip and Fossil Fuel Inflation

We looked retrospectively over the last 20 years (1990 – 2009) using US Energy Information Agency data and found that the average annual increase for natural gas in New York was 5.6% per year. The analysis projects this average inflation rate for natural gas forward over the thirty-year analysis period. Lewis County’s fuel rate of $1.10/therm was used for the first year of the analysis and then inflated each year at 5.6%.

The cost of woodchips used for heating fuel tends to increase more slowly and has historically been much more stable in price over the past two decades than fossil fuels. In Vermont for example, the statewide average woodchip fuel price for institutional biomass heating systems rose from $25/ton to $55/ton in the period between 1989 and 2009. The average annual increase during this period was about 3.6% annually\(^2\) with the greatest increases happening recently. Because woodchip fuel is locally produced from what is generally considered a waste product from some other forest product business, it

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\(^2\) Extrapolated from Vermont Superintendent Association School Energy Management Program data
does not have the same geopolitical pressures that fossil fuels have. Over the past twenty years, woodchip fuel costs have been far less volatile than fossil fuels.

The overall Consumer Price Index for the period between 1990 and 2009, the last year for which full data is available, increased an average of 2.6% annually. This is the annual inflation rate that was used in projecting all future labor costs, operations and maintenance costs and scheduled major repair costs for the biomass scenario.

OPERATION AND MAINTENANCE ASSUMPTIONS

It is typical for operators of semi-automated woodchip heating systems of this size to spend up to one hour per day to load fuel, clean ashes\(^3\) and to check on pumps, motors and controls. For the woodchip scenario, it was assumed that existing on-site staff would spend on average approximately one hour per day in addition to their current boiler maintenance for 150 days per year and 20 hours during the summer months for routine maintenance. At a loaded labor rate of $25/hr, this equals $4,250 annually. An additional $4,250 in annual operational costs is assumed for electricity to run pumps, motors and pollution control equipment.

Another operations and maintenance cost that is included in the analysis is periodic repair or replacement of major items on the boiler such as the furnace refractory. It is reasonable to anticipate these types of costs on a 10-15 year cycle. For this analysis, $15,000 of scheduled maintenance was anticipated in years 10, 20 and 30 and then annualized at $1,500 per year to simulate a sinking fund for major repairs. This $1,500 was then inflated at the general annual inflation rate.

Under any biomass scenario, a case could be made that the existing heating units will require less maintenance and may last longer since they will only be used for a small portion of the heating season. However, all heating equipment should be serviced at least annually no matter how much it is used. Additionally it is very difficult to estimate how long the replacement of the existing units might be delayed. For these reasons, no additional annual maintenance, scheduled repair or planned replacement costs for the existing natural gas boilers were taken into consideration as these are considered costs that the county would have paid anyway. It was assumed that all costs for the operation and maintenance of a biomass boiler are incremental additional costs.

FINANCING ASSUMPTIONS

Financing costs were included in the analysis to give county decision makers a sense of how this project may impact their annual budget. The county likely has access to long-term low interest financing and/or they could explore a lease/purchase arrangement. It was assumed that the Lewis County Complex would be able to obtain a 20-year bond for the capital costs for the biomass project at an interest rate of 3%.

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\(^3\) Wood ash is generally not considered a hazardous material in most states and can be landfilled or land applied as a soil amendment by farmers or by on-site maintenance staff.
The bond payment schedule that was used has fixed principal payments and variable interest payments. Other financing schedules could create even more favorable cash flows depending on how much of the project costs are financed and how the remaining financing is structured. If the county were to forego financing and pay for the project outright, the annual savings would be considerably greater.
**BIOMASS SCENARIO ANALYSIS**

It appears that the Lewis County Complex would not be a very good candidate for a woodchip heating system. The analysis in this report indicates that the county would only have marginal savings in present value operating costs over the 30-year life of a boiler if the costs of fuel, operation, maintenance and debt service are compared against existing fuel costs. Higher natural gas prices or increased consumption from the new building could improve the economics under this scenario. Woodchip fuel at $50/ton is equivalent to about half the current cost the county is paying for heating fuel per Btu. If natural gas prices begin to approach $1.50 per therm, then a biomass project for this site may be worth re-evaluating. Similarly, if the county were able to obtain significant grant funding for the project, then obviously the economics of the project could improve.

Table 3 shows the assumptions used in this analysis, Figure 5 graphs annual costs under the current natural gas heating scenario and the alternate biomass heating scenario, and Table 4 presents the actual spreadsheet analysis tool. Yellow Wood can run the analysis again if the county would like to change any of these assumptions.

**Table 3: Woodchip Scenario Analysis Assumptions**

<table>
<thead>
<tr>
<th>Lewis County Complex</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital Cost Assumptions</strong></td>
</tr>
<tr>
<td>1.0 mmBtu woodchip hot water boiler system including installation</td>
</tr>
<tr>
<td>50 ft stack</td>
</tr>
<tr>
<td>Pollution control equipment</td>
</tr>
<tr>
<td>Renovate existing storage building to use for boiler house and chip storage</td>
</tr>
<tr>
<td>Thermal storage 2,000 gallon</td>
</tr>
<tr>
<td>Interconnect to existing boiler systems</td>
</tr>
<tr>
<td>Cost of Skid Steer</td>
</tr>
<tr>
<td>GC markup at 10%</td>
</tr>
<tr>
<td>Construction contingency at 15%</td>
</tr>
<tr>
<td>Design at 12%</td>
</tr>
<tr>
<td>Total estimated project costs</td>
</tr>
<tr>
<td>Grants</td>
</tr>
<tr>
<td>Total Local Share</td>
</tr>
<tr>
<td><strong>Financing Costs</strong></td>
</tr>
<tr>
<td>Financing, annual interest rate</td>
</tr>
<tr>
<td>Finance term (years)</td>
</tr>
<tr>
<td>1st full year debt service</td>
</tr>
<tr>
<td><strong>Fuel Cost Assumptions</strong></td>
</tr>
<tr>
<td>Current annual natural gas consumption (therm)</td>
</tr>
<tr>
<td>Assumed natural gas price</td>
</tr>
<tr>
<td>Projected annual natural gas bill</td>
</tr>
<tr>
<td>Assumed woodchip price in 1st year (per ton)</td>
</tr>
<tr>
<td>Projected 1st year woodchip fuel bill</td>
</tr>
<tr>
<td>Projected 1st year supplemental natural gas bill</td>
</tr>
<tr>
<td><strong>Inflation Assumptions</strong></td>
</tr>
<tr>
<td>General inflation rate (twenty year average CPI)</td>
</tr>
<tr>
<td>Natural gas inflation rate (average increase for New York Commercial NG users from 1991 - 2009 (US EIA)</td>
</tr>
<tr>
<td>Woodchip inflation rate (average increase in VT from 1990 - 2009 for woodchips in 3.6%)</td>
</tr>
<tr>
<td><strong>O&amp;M Assumptions</strong></td>
</tr>
<tr>
<td>Annual woodchip O&amp;M cost, including electricity for additional pumps and motors and staff time for daily and yearly maintenance</td>
</tr>
<tr>
<td>Major repairs (annualized)</td>
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<tr>
<td><strong>Savings</strong></td>
</tr>
<tr>
<td>Net 1st year fuel savings</td>
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<td>Total 30 year NPV cumulative savings</td>
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Figure 5: Annual Cash Flow Graph for Woodchip Scenario
## Lewis County Complex Biomass Pre-Feasibility Report

### Table 4: 30-Year Life Cycle Analysis Spreadsheet for Woodchip Scenario

<table>
<thead>
<tr>
<th>Yr</th>
<th>Natural Gas Cost</th>
<th>Woodchip Partial Cost</th>
<th>Total Cost</th>
<th>O&amp;M Repair Cost</th>
<th>Total O&amp;M</th>
<th>Cumulative Cashflow</th>
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<tbody>
<tr>
<td>1</td>
<td>$76,630</td>
<td>$32,592</td>
<td>$109,222</td>
<td>$8,560</td>
<td>$117,782</td>
<td>-$25,801</td>
</tr>
<tr>
<td>2</td>
<td>$80,737</td>
<td>$31,381</td>
<td>$112,118</td>
<td>$9,281</td>
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<td>3</td>
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**Total** $2,773,619 $335,730

**30 Yr. NPV at $1,610,154** $467,400 $465,129 $402,530 $234,124 $41,316 $1,390,507

**Total Annual Heating Costs** $23,760

**Woodchip Fuel Cost** $14,661

**Part Natural Gas Cost** $9,407

**Woodchip System O&M /yr** $8,500

**Contingency Allowance /yr** $1,500

**Woodchip + Fuel + O&M + Contingency** $34,688

**Annual Fuel Cost Savings** $13,561

**Simple Payback (hrs)** 30.0

**30 Yr. NPV Savings** $59,647
ADDITIONAL ISSUES TO CONSIDER

ENERGY MANAGEMENT

In order to effectively manage energy use and to identify efficiency opportunities in buildings it is very important to track energy usage. Unless energy consumption is measured over time, it is difficult or impossible to know the impact of efficiency improvements or renewable energy investments. The Environmental Protection Agency developed a public domain software program called Portfolio Manager that can track and assess energy and water consumption across an entire portfolio of buildings. Portfolio Manager can help set efficiency priorities, identify under-performing buildings, verify efficiency improvements, and receive EPA recognition for superior energy performance. Yellow Wood recommends that the county input several years’ worth of energy and water use data into Portfolio Manager as soon as it can. The EPA Portfolio Manager software can be downloaded at the following address: http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.

ENERGY EFFICIENCY

Whether Lewis County converts to biomass or stays with natural gas, the county should use its heating fuel efficiently. The New York State Energy Research and Development Authority (NYSERDA) and/or the New York Power Authority (NYPA) can help identify and prioritize appropriate energy efficiency projects that will improve the county’s infrastructure and save money. Both of these agencies can help with the evaluation of energy efficiency opportunities and provide financial incentives to upgrade and improve equipment efficiencies. If the county decides to move forward with a biomass energy project, it should work with one of these agencies to identify other efficiency projects that could be completed at the same time.

General information on NYSERDA and NYPA programs is included in the Biomass and Green Building Resources binder accompanying this report.
PROJECT FUNDING POSSIBILITIES

USDA FUNDING OPPORTUNITIES

2008 Farm Bill

The 2008 Farm Bill has a number of provisions that may help rural communities consider and implement renewable energy and energy efficiency projects.

- **Section 9009** provides grants for the purpose of enabling rural communities to increase their energy self-sufficiency.
- **Section 9013** provides grants to state and local governments to acquire wood energy systems.

These grants and loan guarantee programs are competitive. The county should check with their local USDA office to express interest and to get program updates.

Rural Community Facilities Grant and Loan Program

The USDA provides grants and loans to assist the development of essential community facilities. Grants can be used to construct, enlarge or improve community facilities for health care, public safety and other community and public services. The amount of grant assistance depends on the median household income and the population of the community where the project is located.

These grants and loans are also competitive. Highest priority projects are those that serve small communities, those that serve low-income communities and those that are highly leveraged with other loan and grant awards.

For more information about USDA programs and services, contact your local USDA office. Information on programs and contact information is provided in the *Biomass and Green Building Resources* binder.

MUNICIPAL LEASE / PURCHASE

As a municipal entity, the county may be eligible for a municipal lease/purchase arrangement to finance the anticipated project costs for a biomass heating system. A municipal lease is a contract that has many of the characteristics of a standard commercial lease, with at least two primary differences:
In a municipal lease, the intent of the lessee is to purchase and take title to the equipment. The financing is a full payout contract with no significant residual or balloon payments at the end of the lease term.

The lease payments include the return of principal and interest, with the interest being exempt from federal income taxation to the recipient. Because the interest is exempt from federal tax, a tax-exempt lease offers the lessee a significant cost savings when compared to conventional leasing.

There are a number of companies that provide municipal leases. Information on municipal leasing is included in the *Biomass and Green Building Resources* binder accompanying this report.

**CARBON OFFSETS**

While fossil fuels introduce carbon that has been sequestered for millions of years into the atmosphere, the carbon dioxide emitted from burning biomass comes from carbon that is already above the ground and in the carbon cycle. Biomass fuels typically come from the waste of some other industrial activity such as a logging operation or from sawmill production. The carbon from this waste would soon wind up in the atmosphere whether it was left to decompose or it was burned as slash. There are few measures the county could undertake that would reduce its carbon footprint more than switching their heating fuel use from natural gas to a biomass fuel.

Figure 6: Carbon Cycle Illustration

![Carbon Cycle Illustration](image)

Carbon offsets help fund projects that reduce greenhouse gases emissions. Carbon offset providers sell the greenhouse gas reductions associated with projects like wind farms or biomass projects to customers who want to offset the emissions they caused by flying, driving, or using electricity. Selling offsets is a way for some renewable energy projects to become more financially viable. Buying offsets is a way for companies and individuals to compensate for the CO₂ pollution they create.

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4 Illustration taken from a handout produced by the Biomass Energy Resource Center
For a biomass heat-only project, a Btu-for-Btu displacement of heating fuel (based on historic purchase records) by biomass is assumed over the project’s predicted operating life. CO₂ avoidance is based on the emissions profile (Lbs. CO₂ /Btu) of the displaced fuel. The US EPA calculates that 11.7 lbs. of CO₂ is produced from each therm of natural gas consumed. It is projected that the Lewis County Complex can offset approximately 25,600 therms of natural gas per year by replacing that heat using biomass. This is equivalent to about 150 tons of CO₂ annually. The market value of this type of offset is between $3/ton and $5/ton. These offsets can be negotiated as either a lump sum offset for up to 10 years or can be paid out as an annual payment. This could mean annual payments of $450 - $750 or a lump sum up front payment of as much as $4,500 to $7,500.

There are a number of companies that are interested in contributing to the construction of new sources of clean and renewable energy through carbon offsets. Information about carbon offsets is included in the Biomass and Green Building Resources binder accompanying this report.

**PERMITTING**

Modern biomass boiler technology is both clean and efficient. Controls moderate both the biomass fuel and air to create either a small hot fire or a large hot fire depending on heat demand from the building. Under full load, modern woodchip boilers routinely operate at steady state efficiencies of 70% – 75%. Operating temperatures in commercial scale biomass boilers can reach up to 2,000 degrees and more, completely eliminating creosote and the need to clean stacks. The amount of ash produced from a 25 ton tractor trailer load of green hardwood chips can fit in a 25 gallon trash can, is not considered a hazardous waste and can be used as a soil amendment on lawns, gardens and playing fields.

However, as with any combustion process, there are emissions from biomass boilers. There is no question that natural gas is the cleanest fuel used for heating. However, biomass compares favorably with fuel oil and modern commercial scale biomass boilers with the appropriate pollution control devices can burn very cleanly and efficiently.

The pollutant of greatest concern with biomass is particulates (PM₁₀). While biomass compares reasonably well with fuel oil, biomass boilers clearly generate more particulates. That is why it is important to install appropriate pollution control equipment. Many modern types of emission control equipment, capable of reducing particulate matter emissions from 50-99 percent, are commercially available in the US. The most common emission control equipment technologies are baghouses, cyclones, multi-cyclones, electrostatic precipitators, and wet scrubbers. Appropriate emission control equipment technologies should be identified in consultation with local air quality regulators. The emissions from a modern woodchip boiler are much less than most people think.

One of the most common misconceptions about institutional/commercial biomass energy systems comes from the experience people have with residential wood stoves and outdoor wood boilers. In general, an institutional/commercial-scale wood energy system emits only one fifteenth (seven percent)
the PM$_{10}$ of the average wood stove on a Btu basis. Over the course of a year, a large, woodchip heated school in a climate like Vermont may have the same particulate emissions as four or five houses heated with wood stoves.

**Figure 7: Particulate Emissions**

![Particulate Matter from Various Wood Combustion Systems](image)

**New EPA Regulations**

On April 29, 2010, the Environmental Protection Agency (EPA) issued a proposed rule that would reduce emissions of toxic air pollutants from existing and new industrial, commercial and institutional boilers located at area source or major source facilities. An area source facility emits or has the potential to emit less than 10 tons per year (tpy) of any single air toxic or less than 25 tpy of any combination of air toxics. The major source facility emits or has the potential to emit 10 or more tpy of any single air toxic or 25 tpy or more of any combination of air toxics.

The proposal would set different requirements for large and small boilers at the area source facility. Large boilers have a heat input capacity equal to or greater than 10 mmBtu/hr and small boilers have a heat input capacity less than 10 mmBtu/hr. The biomass fired new boilers would need to meet limits for PM and CO. For the major source facility, EPA has identified 11 different subcategories of boilers and process heaters based on the design of the various types of units. The proposed rule would include specific requirements for each subcategory.

Details on the status of this proposal will be posted at [www.epa.gov/airquality/combustion/](http://www.epa.gov/airquality/combustion/).

In order to install a new woodchip boiler, it is likely that the county would need to obtain an air quality permit or an amendment to an existing permit. For a woodchip boiler, the permit would likely include requirements for pollution control equipment, such as a bag house or an electrostatic precipitator along with a requirement for a tall stack to help with dispersion. Costs for pollution control equipment and a

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5 Excerpted from a handout produced by the Biomass Energy Resource Center
tall stack are included in the cost estimates for the woodchip scenario analyzed in this report. Other permit conditions might include testing for emissions and efficiency, keeping records of fuel consumption and test results and making periodic submittals to regulatory agencies.

CONCLUSIONS AND RECOMMENDATIONS

It does not appear that the Lewis County Complex would be a very good candidate for a woodchip heating system. For biomass energy projects to be cost effective, particularly when it comes to comparing wood fuel costs against current natural gas prices, bigger is generally better. It does not appear that the county uses enough natural gas for heating this complex of buildings to seriously consider a woodchip heating system. The analysis in this report indicates that the county would obtain only marginal savings in present value operating costs over the 30-year life of a boiler if the costs of fuel, operation, maintenance and debt service are compared against existing fuel costs.

Higher natural gas prices or increased consumption from the new building could improve the economics under this scenario. Woodchip fuel at $50/ton is equivalent to about half the current cost the county is paying for heating fuel per Btu. If natural gas prices begin to approach $1.50 per therm, a biomass project for this site may be worth re-evaluating. Similarly, if the county were able to obtain significant grant funding for the project, then obviously the economics of the project could improve. If all else remained the same, the county would need to obtain grants covering about half of the cost for the project for it to be truly cost effective.

Regardless of whether a biomass project seems appropriate for the county at this time, there are energy related actions Yellow Wood recommends the county take to reduce its energy use.

1. In order to effectively measure progress toward energy efficiency goals, historical energy consumption data should be collected and updated frequently. There are many tools to help the county accomplish this. One such tool is the EPA Energy Star Portfolio Manager software. It is free public domain software that helps facility managers track energy and water use. This software can be downloaded at: [http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager](http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager).

2. The county should consider energy efficiency improvements in all of its buildings. The New York State Energy Research and Development Authority (NYSERDA) and/or the New York Power Authority (NYPA) should be engaged to develop comprehensive energy efficiency recommendations and proposals for incentives for efficiency upgrades before undertaking any major building project. Information on energy efficiency programs is included in the *Biomass and Green Building Resources* binder accompanying this report.
WHO WE ARE

Yellow Wood Associates
Yellow Wood Associates (Yellow Wood) is a woman-owned small business specializing in rural community economic development since 1985. Yellow Wood has experience in green infrastructure, program evaluation, business development, market research, business plans, feasibility studies, and strategic planning for rural communities. Yellow Wood provides a range of services that include measurement training, facilitation, research, and program management.

Richmond Energy Associates
Richmond Energy Associates was created in 1997 to provide consulting services to business and organizations on energy efficiency and renewable energy program design and implementation. Richmond Energy has extensive experience in wood energy systems. Jeff Forward provides analysis and project management on specific biomass projects and works with state, regional and federal agencies to develop initiatives to promote biomass utilization around the country. In addition to his own consulting business, he is also a Senior Associate with Yellow Wood.
APPENDICES

DISCUSSION OF BIOMASS FUELS

Purchasing wood fuel is a different exercise than purchasing natural gas. While natural gas is delivered to the site with little interaction from facility managers, biomass fuel suppliers will need to be cultivated and educated about the type of fuel needed, its characteristics and the frequency of deliveries. Concurrently with designing a wood-energy system, Lewis County should also be cultivating potential biomass fuel suppliers.

Potential wood fuel suppliers include sawmills, loggers, chip brokers and large industrial users such as paper mills or power plants. Many of these forest products producers already make woodchips for pulp and to reduce waste, but may not have much experience dealing with the needs of smaller volume customers. Woodchips produced for institutional/commercial biomass boilers have more stringent specifications than those produced for large industrial customers. And woodchip fuel may need to be delivered in different trailers.

When talking to potential woodchip fuel suppliers, it is important to have the wood fuel specification in mind. A one to three inch square chip is ideal. If possible, woodchips for institutional/commercial biomass systems will come from logs that are debarked prior to chipping because bark produces more ash which translates into a little more daily maintenance. Pieces or small branches that are six inches or longer can jam augers and conveyors which will interrupt the operation of automated fuel handling equipment. Institutional/commercial scale biomass boiler systems in the Northeast are typically designed to operate with wood fuel that is within a 35% to 45% range for moisture content.

Typically institutional/commercial biomass systems of this scale have limited chip storage capacity which means they may need deliveries on relatively short notice. Woodchip fuel suppliers will need to be within a 100 to 150 mile radius or so of the user, the closer the better, as transportation costs will affect price. Chip deliveries are typically made in “live bottom” trailers that will self unload into below-grade chip storage bins. Therefore, potential suppliers must have access to a self-unloading trailer for deliveries.

It is possible to design a wood-energy system that uses any one of a variety of biomass fuels, but green hardwood chips make the best fuel. If it is readily available, it should be the fuel of choice. In addition, users should focus on reliability of supply and consistency of the fuel rather than just lowest cost. The goal should be to minimize maintenance and optimize system performance.

Whichever fuel is used, the fuel type needs to be part of the combustion system design process, and the wood system should be operated using the fuel it is set up to use. Ideally, sample fuel chips should be sent to the manufacturer of the biomass heating equipment so that they can design the fuel handling equipment around the type of fuel and calibrate the system properly when setting the system up. No
A system can be re-calibrated for a different fuel type, but the most practical approach is to stick with one fuel type, at least for a given heating season. If, for some reason, that fuel type becomes unavailable, the manufacturer of the equipment should be consulted to help reconfigure or retune the system for another fuel.

It is best to try to locate several potential suppliers. By doing so, the facility will have the security of knowing there will be back-up in case of an interruption from their primary supplier. This will also generate some competition. Contact the New York State Forest Utilization Program for a list of local suppliers.

The bottom line is that both the facility and fuel suppliers need to clearly understand the characteristics of fuel needed for their particular system. Consistent particle size and moisture content is particularly important for institutional/commercial customers, and Lewis County should insist on the quality of the chip. A sample fuel specification is included in the *Biomass and Green Building Resources* binder to give an idea of the types of characteristics to look for in woodchip fuel. Below is a description of the advantages and disadvantages of different types of biomass fuels in order of preference.

**Green Hardwood Chips**

A consistent green hardwood chip is the easiest fuel for institutional/commercial scale automated biomass heating systems to handle. Rarely will they jam an auger or conveyor. Green chips burn somewhat cooler than most other biomass fuels making it easier to control the combustion. With proper controls, they burn very cleanly with minimal particulate emissions and little ash. They have less dust than other biomass fuels so they are less messy and safer to handle. Ideally moisture content will be between 35% and 45% on a wet basis. Green hardwood chips can come from sawmill residues or timber harvest operations.

**Mill Residues vs. Harvest Residues**

Woodchips can be produced at sawmills or other primary wood products industrial sites as part of their waste wood disposal process. Mill residues are typically the most desirable source of fuel woodchips. Mills can produce a bark-free chip with few long pieces or branches that can jam augers and fuel conveyors. A mill supplier can easily calculate trucking costs and can negotiate dependable delivery at a consistent price.

Another potential type of wood fuel is whole tree chips which are produced as part of tree harvesting. Whole tree chips tend to be a dirtier fuel than sawmill residues and may contain small branches, bark, twigs and leaves. The longer pieces can jam the relatively small augers of an institutional/commercial scale biomass system and can add to the daily maintenance because they produce more ash.
The bole of a tree is the de-limbed trunk or stem. Chips made from boles are in-between the quality of a sawmill chip and a whole tree chip. Bole-tree chips tend to have fewer twigs and long stringers than whole tree chips. Both bole-chips and whole-tree chips can be potentially good sources for biomass fuels, although they have a greater likelihood of including oversized chips and they will produce somewhat more ash, compared to mill residues.

**Softwood Chips**

Green softwood chips will generally have less energy and more water content per truckload, and therefore they will be more expensive to transport than hardwood chips. As long as the combustion and fuel handling equipment is properly calibrated for softwood chips, an automated woodchip heating system can operate satisfactorily with softwood chips. Softwoods tend to have higher moisture contents and can range up to 60% moisture on a wet basis. The best biomass fuel will have less than 50% moisture. One species to avoid altogether is white pine. It has a very high moisture content and therefore relatively low bulk density. The experience in Vermont schools with white pine is that it is a poor biomass fuel for institutional/commercial-scale woodchip systems.

**Dry Chips vs. Green Chips**

Dry chips (less than 20% moisture on a wet basis) burn considerably hotter than green chips and typically have more dust. The increased operating temperature can deteriorate furnace refractory faster increasing maintenance costs slightly. The dust can make for a somewhat dirtier boiler room which will be a problem for some maintenance staff. Dry chips are also easier to accidentally ignite in the fuel storage bin or fuel handling system. If dry chips are used, the combustion equipment needs to be carefully calibrated to handle these higher temperatures. Dry chips are not generally recommended for institutional/commercial settings.

**Bark**

Bark has a high energy value, but it also comes with significant maintenance costs. It produces a considerable amount of ash that needs disposal; it can create more smoke than green chips; and it can cause other routine maintenance problems such as frequent jamming of augers from rocks. Bark can be an inexpensive fuel, but the additional maintenance costs make it unattractive for institutional/commercial biomass systems.

**Sawdust and Shavings**

Sawdust and shavings should ordinarily be ruled out for the institutional/commercial wood heating market. Dry sawdust can be dusty to handle and raises fire safety and explosion issues. Shavings are also dusty and easily ignited and are difficult to handle with typical fuel handling equipment. This fuel type can work fine in an industrial setting, but institutions typically do not have the maintenance staff that can provide the supervision that these fuels need.
SENSITIVITY ANALYSIS

Table 5: Wood and Natural Gas Prices Vary - Interest and Inflation Rates Held Constant

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Annual Fuel Savings Shown

Table 6: Interest and Natural Gas Fuel Inflation Vary - Wood Fuel and General Inflation Rate Constant

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30 Yr. NPV shown
POTENTIAL BIOMASS FUEL SUPPLIERS

Active providers of woodchip fuel change regularly. For the most up-to-date information on potential providers contact the New York State Forest Utilization Program:

Sloane Crawford  
Program Leader  
NYS Forest Utilization Program  
625 Broadway  
Albany, NY 12233-4253  
Phone: (518) 402-9415  
Fax: (518) 402-9028  
sncrawfo@gw.dec.state.ny.us