



# Boise County Woody Biomass Feasibility

USDA RURAL DEVELOPMENT  
RENEWABLE ENERGY SYSTEM FEASIBILITY STUDY  
01 MARCH 2011





February 25, 2011

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RE: BOISE COUNTY RENEWABLE ENERGY SYSTEM FEASIBILITY STUDY (CONTRACT #CON0030)

Dear Mr. Chatburn and Mr. Crockett,

We are pleased to enclose the biomass feasibility report for Boise County, Idaho. In this report we detail the information which outlines the issues, challenges, and opportunities for implementing a small-scale biomass combined heat and power (CHP) project utilizing forest slash in Southern Idaho. Our findings are summarized in the Executive Summary portion of this report. Although at this time a project of this type and scale is not financially feasible, this report provides valuable information on what is necessary to make such project viable. At such time when Federal or public forestland policy changes, allowing sustainable forest waste recovery, then said projects of optimum size will become financially and operationally viable.

This project study was based on the concept of examining the feasibility of developing a project that would produce only 2-3 megawatts (MW) of power. Depending on the operational and thermal efficiency of the plant design and technology, 8-10,000 bone dry tons (bdt) of biomass fuel is required for each MW produced on an annual basis. Based on current PURPA power purchase rates of \$85 per MW h, 10-20 megawatts is the optimal size for a biomass plant in Idaho. Unfortunately, the amount of fuel required to run a plant of this size is all but impossible to obtain on a long-term investment-grade basis. This is because most of the biomass fuel resource resides on Federal land, making it all but impossible to procure. By significantly downsizing the plant, it was hoped that the reduced volume of fuel needed to power a small plant would be obtainable from sources other than Federal or State lands.

By reducing the size of the plant, it was assumed that some Federal support would have to be obtained to offset the capital cost of construction – since neither the cost of fuel nor cost of purchased power is flexible. It should be noted that in our report we demonstrate in a sample Pro Forma what the power purchase rate would have to be in order to make small (<5 MW) biomass plant financially feasible without subsidies or grant support.

We have greatly appreciated the opportunity to collaborate with the Idaho Office of Energy Resource, Boise County Commissioner, and community stakeholders. If you have any questions or require any additional information, please do not hesitate to call.

Sincerely,

David C. Naccarato, MA  
Business Development Manager

CC: Trevor L. Howard, Boise County Engineer

# Preface

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## **INTENT**

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To determine the technical, contractual, economic/financial, and political/environmental issues that may or may not render this project financially or operationally impossible.

In conjunction with Boise County, Idaho's Office of Energy Resources, and the Federal Government, McKinstry has completed a feasibility study for a small-scale woody biomass renewable energy generation facility, proposed to be located in Horseshoe Bend, Boise County, Idaho.

It should be noted that this study has benefitted from considerable knowledge capital accumulated from previous studies and project development for woody biomass systems in other locations around the Western United States.

## **ACKNOWLEDGMENT**

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This material is based upon work supported by the Department of Energy under Award Number DE-EE000141.

## **DISCLAIMER**

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# 1

## Executive Summary

# 1. Executive Summary



## Introduction

The purpose of this report is to explore the feasibility of a woody biomass energy facility in Boise County, Idaho. This study is funded by a USDA Rural Development grant and requires both a technical report and an economic analysis of the project. This effort was led by McKinstry, a 50-year-old design, build, operate, and maintain firm with a focus in energy efficiency. McKinstry contracted with LD Jellison, Inc., a Washington forest products and renewable energy consulting firm, to provide a third-party independent analysis of the available woody biomass within the resource areas for the proposed facility.

Depending on the efficiency of the technology, equipment, and design, between 7,500 and 9,000 bone dry tons (bdt) of fuel is required to produce 1 MW on an annual basis. A 10-20 MW plant strikes a good balance between a reasonably compact and affordable facility (on a dollar per MW basis), while providing sufficient capacity so as to provide attractive financial performance based on Idaho Power's power purchased rates. Since the Power Purchase Agreement (PPA) requires guaranteed power production, an investment-grade source of fuel is required in order to engineer, procure, construct, and operate a biomass facility. This is based on the average power purchase rate of \$88 per megawatt hour (MW h) as stipulated by the Idaho Public Utilities Commission PURPA contract rates. This includes \$5/MW h for "green tags" which can be sold to other utilities that have portfolio requirements for green energy. The cost of power determines the optimal size of a power plant, irrespective of whether or not sufficient fuel is available.

In preliminary reviews, it was determined that there was an insufficient supply of fuel to sustain a 10-20MW facility in Boise County. Therefore it was decided to investigate the potential for a small-scale facility, 3MW in size. An additional obstacle for a 10-20 MW facility is that the current transmission network in the Boise County region is insufficient for a generation project of this size. Despite Idaho Power's interest in renewable base-load power, they are not interested in increasing the line capacity for this project. The cost for this transmission line upgrade would be cost-prohibitive to virtually any project's financial performance. Therefore the transmission capacity of 3 MW was accepted as the maximum size for this project.

After review of three potential locations (Horseshoe Bend, Idaho City, and Garden Valley), it was determined that Horseshoe Bend was the best location for a potential facility. A 3MW facility will require approximately 24,000 bdt of fuel on an annual basis. However, regardless of the plant size the fuel supply would have to meet investment-grade criteria, sufficient to obtain project funding. This required that the resource be such so as to secure a long-term (15-20 year) supply with reasonable fuel cost controls.

This Fuel Resource Study determines that from the standpoint of the annual fuel requirement of 24,000 bdt, there is insufficient fuel available to justify the proposed biomass facility in Horseshoe Bend, Idaho.

### A NOTE ON READING THIS REPORT

The organization of this study is based upon the USDA Rural Development Guidelines for a Renewable Energy System Feasibility Study; however, to provide the necessary information, it was occasionally necessary to stray from the Guideline's formatting.

The Guideline's required sections have been formatted consistently throughout this report, and will resemble the example provided:

### SECTION TITLE

*Question to be answered.*

# 1. Executive Summary

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## Technical Summary

### FUEL

A central goal of this effort is to determine if, from the standpoint of the annual fuel requirement of approximately 24,000 bdt, the proposed 30,000 PPH biomass boiler system is economically viable and feasible, and whether the fuel can be procured in such a way as to positively promote the sustainability of the forests and environment. This report contains a comprehensive fuel analysis that identifies the biomass resources within a 60-120 minute transport time.

In the course of this study, LD Jellison conducted four analyses of woody biomass in the study resource area in order to determine whether there is sufficient woody biomass to justify the proposed biomass facility in Horseshoe Bend, Idaho.

The qualitative analysis determined that the composition of potentially available woody biomass in the study resource area is composed of less than 30% of secondary mill residues and urban wood residues.

The quantitative analysis estimated 23,538 bdt of unutilized woody biomass potentially available annually from public and private commercial timberlands in the study resource counties.

The economic analysis estimated the current average delivered price for forest residual biomass hog fuel in the study resource areas at \$23 per bdt, and the ten-year forecast average price for delivered forest residual biomass hog fuel not to exceed \$35 per bdt.

Finally, the competition analysis identified no current or proposed competition for potentially available woody biomass in the study resource area.

In conclusion, this Fuel Resource Study determines that from the standpoint of the annual fuel requirement of 24,000 bdt, there is insufficient fuel available to justify the proposed 30,000 PPH biomass facility in Horseshoe Bend, Idaho.

### NOTES

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- The project is designed to utilize the lowest market value material being sources from forest slash, limbs, tops, and stumpage.
- Ideally the fuel will originate from sustainable recovery management techniques (including lands or projects defined by the Sustainable Forestry Council).
- These specifications are intentionally designed to not compete with pulp fiber and higher value fiber supply chains.

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## TECHNOLOGY

For the technology portion of the report, McKinstry solicited Nexterra's expertise. Nexterra Systems Corp., based in Vancouver BC, develops, manufactures, and delivers advanced gasification systems that enable customers to self-generate clean, low cost heat and power at industrial and institutional facilities using waste fuels.

In general, traditional biomass power-generation projects fall into three categories:

1. Mid to large scale (15–50MWe) simple cycle steam power generation
2. Mid to large scale (15–50MWe) combined steam heat and power
3. Small scale (1–10MWe) simple cycle steam power generation

### *Mid to Large (15–50MWe) Simple Cycle Steam*

Currently several obstacles exist to implementing projects of this scale. For financing/power purchase agreements, the Power Purchase Agreements require lengthy terms and the utility wants the operator to provide liquidated damages for the entire value of the contract. To achieve adequate fuel supply, large, long-term contracts are required with multiple suppliers. This uncertainty can undermine the project's financing. Finally, there are often public acceptance issues. Multiple large-scale biomass projects have been delayed or abandoned due to public concern surrounding emissions, truck traffic, long-term health effects, etc.

### *Mid to Large scale (15–50MWe) Combined Steam Heat & Power*

These projects are typically co-located at an existing industrial site. This can be an excellent model if the industrial entity planning to own the power generation assets and use the thermal energy as process heat. However, several obstacles exist to the county. If a private third party entity or the county is to own the power generation assets, it can be difficult to negotiate a contract and/or value the thermal energy being sold back to the industrial client. To achieve adequate fuel supply, large, long-term contracts are required with multiple suppliers. This uncertainty can undermine project financing.

### *Small Scale (1–10MWe) Simple Cycle Steam Power Generation*

There appears to be an almost complete lack of small scale, steam based power generation or steam combined heat and power (CHP) systems commissioned in North America for over a decade. A major obstacle includes the capital costs and operational costs relative to the project-generated revenue. In addition, high-pressure steam boilers that drive the power generation turbine require first class boiler chiefs to be available 24x7x365. This staffing cost usually undermines the overall project Pro Forma.

### *Recommendation*

Nexterra concludes the best model for a biomass power generation project is a small-scale biomass Organic Rankine Cycle (or future IC Engine) CHP (500 KW–2.5MWe) system.

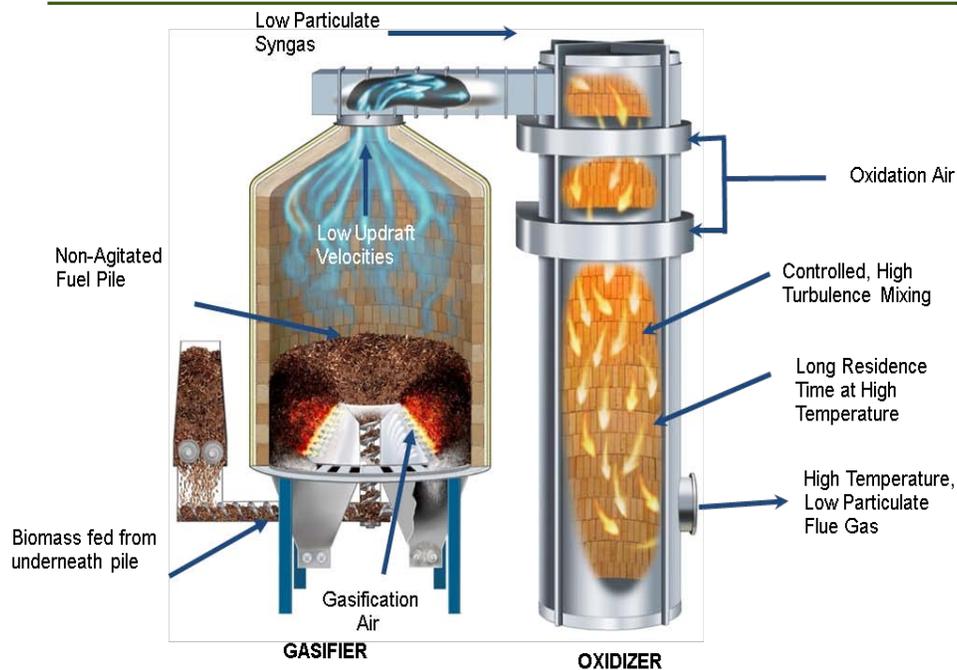
However, this project still requires a use for the thermal energy (district energy, institutional heating, small-scale industrial, etc.), manageable Capex costs, significantly lower operation and maintenance costs relative to steam power generation, manageable fuel requirements, and a manageable public consultation process.

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## NEXTERRA GASIFICATION TECHNOLOGY

The proposed project will utilize Nexterra's woody biomass gasification technology. This proprietary system converts woody biomass into a synthetic gas under an oxygen deprived, controlled atmospheric environment.

## Core Technology



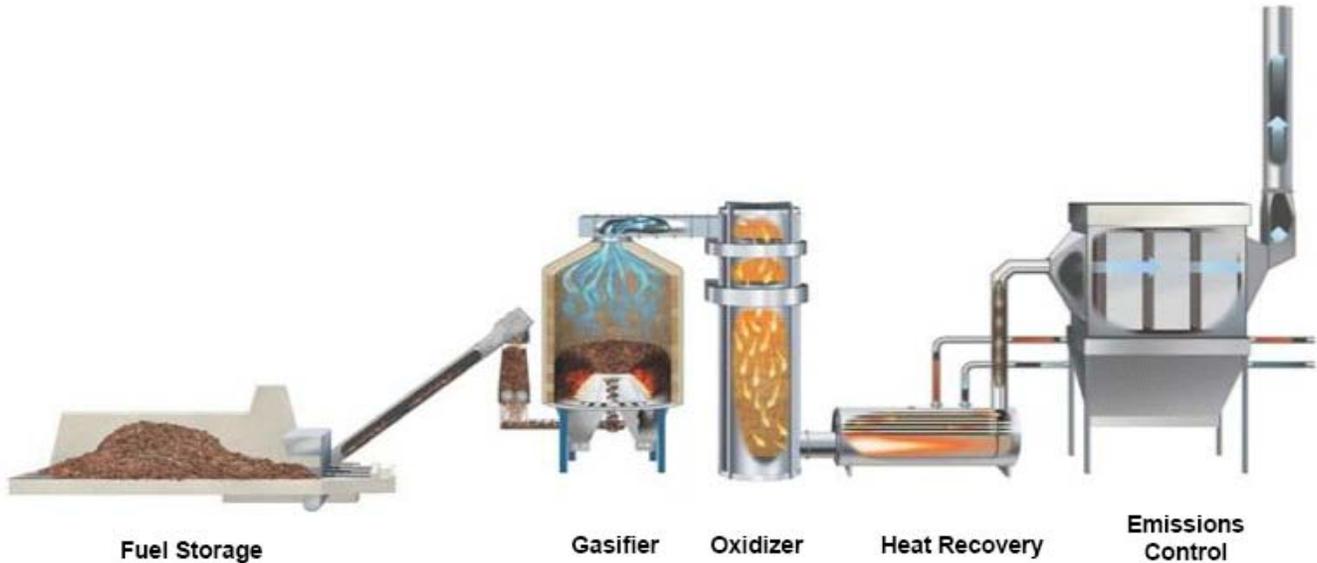
## PARAMATERS CONSIDERED

<i>Siting</i>	Adjacent to existing physical plant or convenient transportation routes
<i>Odors</i>	Imperceptible
<i>Noise</i>	Meets residential noise standards
<i>Truck Traffic</i>	1-2 trucks/day
<i>Ash</i>	Granular sand-like ash can be returned to the forest floor or land-filled

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The syngas/biogas is then transported for use in the following ways:

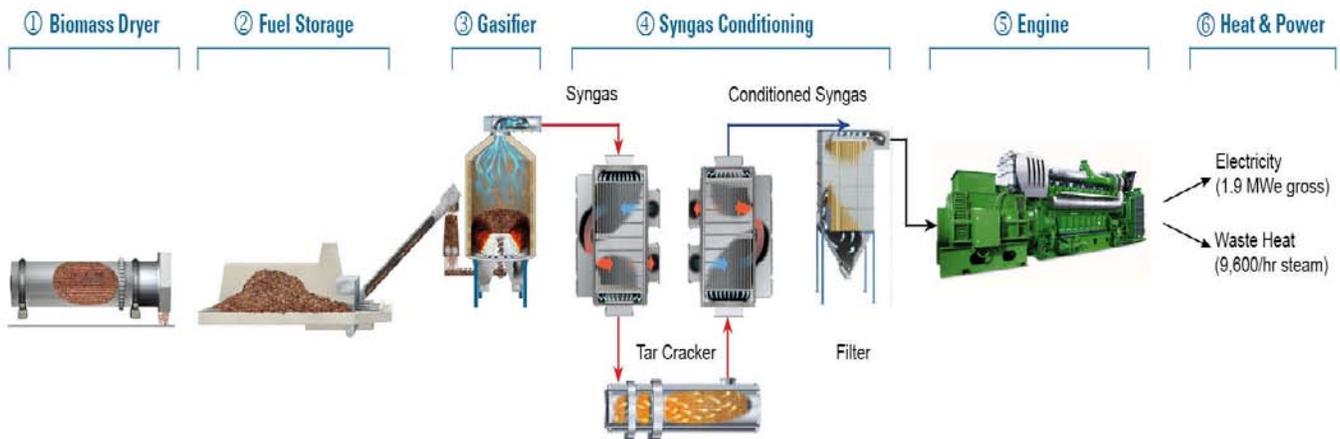
1. Syngas can be transported to a combustion chamber for generating high-pressure steam to be used to generate power through steam turbines. The following diagram shows a standard process whereby the thermal energy can be direct or converted through either a steam turbine or ORC hot water system.



2. Syngas can be transported to a combustion chamber to generate hot water, which can be used in conjunction with a refrigerant gas/fluid for use in an Organic Rankine Cycle (ORC) engine. This method reduces operational costs associated with high-pressure steam systems.

Please see the following page for more information about this method.

3. Syngas can be transported to be burned in an internal combustion (IC) GE Jenbacher biogas engine/generator. The following is a process diagram that utilizes an IC Jenbacher engine for power production:

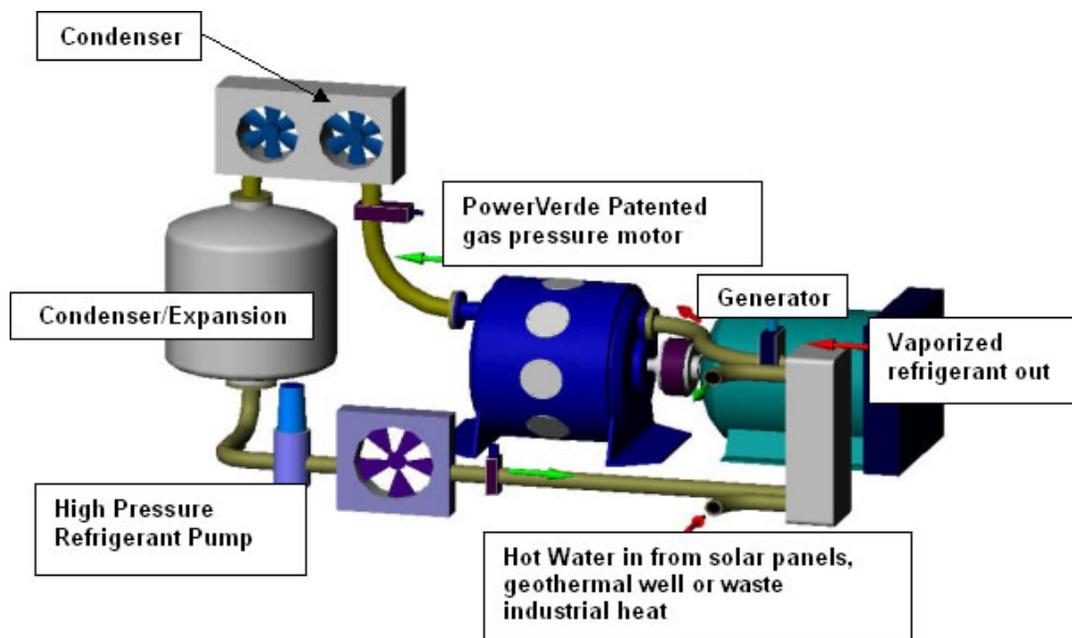


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## ORGANIC RANKINE CYCLE (ORC) TECHNOLOGY

The Rankine Cycle is the same heat-engine operating cycle used by all steam engines since the start of the industrial age. As with most engine cycles, the Rankine Cycle is a four-stage process. Simply put, the working fluid (usually water) is pumped into a boiler. While the fluid is in the boiler, an external heat source superheats the fluid. The hot water vapor then expands to drive a turbine. Once past the turbine, the steam is condensed back into liquid and recycled back to the pump to start the cycle all over again. Pump, boiler, turbine, and condenser are the four parts of a standard steam engine and represent each phase of the Rankine Cycle.

An Organic Rankine Cycle (ORC) Plant is a facility that generates electricity using a heated organic fluid as the heat transfer medium. This is common in the geothermal industry where ORC engines recover heat from relatively low temperature water pumped from the ground. The low boiling point of the organic fluid allows for lower working pressures than in a steam-powered system.



Though the amount of work performed by a typical ORC cannot compare with a steam engine, there are several compelling reasons to choose an ORC system for the Boise County project.

### *System Size*

First, the relatively small size of the system, constrained by fuel availability and transmission capacity, lends itself well to an ORC application.

### *Minimal Operational Requirements*

More importantly, the low working pressure of an ORC plant allows for the facility to be remotely monitored and operated at times. A traditional steam boiler would require 24x7 staffing. The low peripheral speed results in less mechanical stress on the turbine and no erosion of the turbine blades. Low speeds allow for direct drive of the turbine, as there is no need for a reduction gear. All of the above result in a long operating life, less maintenance, and fewer repairs. As the amount of revenue generated is limited by the size of the facility, it was necessary to choose a system that did not require operators to be on site 24x7.

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## *Efficiency*

For a relatively small amount of waste heat used to drive the engine a comparatively high amount of work can be performed. The amount of electricity generated by the turbine can be equal to 85% of the equivalent energy generated by the steam engine. This is the result of the relatively low peripheral speed of the turbine.

A more detailed examination of the pressure, volume, and temperature relationships of each stage of the Rankine Cycle is needed to understand the necessity for using organic chemicals instead of water for extracting energy from waste heat.

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	<i>Location:</i> Pump
<b>Phase 1</b>	<i>Process:</i> Isentropic
<b>to</b>	The pump causes an isentropic increase in pressure of the working fluid. This happens as a result of being adiabatic – no heat is lost or gained to or from the surrounding environment nor self-generated. In an isentropic process, the entropy of the working fluid remains constant. In other words, the working fluid is pumped to a higher pressure without heat transfer into or out of the working fluid, and the temperature of the working fluid remains constant. Since water in its liquid form is essentially incompressible, there is no significant reduction in the working fluid’s volume. Pumps are usually powered by energy taken from the electrical power generated by the engine itself.
<b>Phase 2</b>	
<b>to</b>	
<b>Phase 3</b>	
<b>to</b>	
<b>Phase 4</b>	
<b>to</b>	
<b>Phase 1</b>	

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	<i>Location:</i> Boiler
<b>Phase 2</b>	<i>Process:</i> Isobaric heating of the working fluid.
<b>to</b>	A fluid experiencing an isobaric process has no increase or decrease in its pressure. Per the ideal gas law, as pressure remains constant the volume expands and the temperature increases. The heat is applied from an external source such as the burning of fossil fuels.
<b>Phase 3</b>	
<b>to</b>	
<b>Phase 4</b>	
<b>to</b>	
<b>Phase 1</b>	

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	<i>Location:</i> Turbines
<b>Phase 3</b>	<i>Process:</i> Isentropic expansion of the working fluid.
<b>to</b>	As the working fluid expands it causes the steam to expand, which drives the blades of the turbine, spinning the turbine and generating electrical power. This expansion occurs without the entropy of the working fluid since no heat is lost or gained. As a result, the temperature of the working fluid remains the same. However, in accordance with the Ideal Gas Law, a fluid at constant temperature experiencing an increase in volume also experiences a decrease in pressure.
<b>Phase 4</b>	
<b>to</b>	
<b>Phase 1</b>	

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	<i>Location:</i> Condenser
<b>Phase 4</b>	<i>Process:</i> Isobaric cooling.
<b>to</b>	As in the boiler, a working fluid experiencing an isobaric process has no change in its pressure. Condensers convert the working fluid from a gas back to its initial liquid state by acting as a heat exchanger. The fluid’s heat gained from the boiler is radiated off and, as the temperature drops, the volume of the working fluid decreases in accordance with the Ideal Gas Law.
<b>Phase 1</b>	

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## *\*Exceptions to the Rule*

The above describes an ideal Rankine Cycle; in reality the compression by the pump and expansion in the turbine are not isentropic. Heat is gained during pumping and lost in the turbine. The exchange of heat

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during both processes increases the power required by the pump and decreases the power generated by the turbine.

## METHODS TO INCREASE EFFICIENCY

The Rankine Cycle can be further modified by reheating and regeneration. In reheating, two turbines work in series. The first turbine receives steam directly from its initial heating in the boiler. Then, instead of proceeding to the condenser, the steam is redirected back to the boiler for a second heating. It then proceeds to a second turbine, which operates at a lower pressure.

Regenerators are typically constructed of a wire metal mesh or a series of closely spaced thin metal plates. The void spaces between the metal wires and plates allow for easy flow of the working fluid through the regenerator. The relatively large surface area of the metal permits conduction of heat. A regenerative Rankine Cycle utilizes steam from the hot portion of the cycle (Phase 2 to 3 and Phase 3 to 4) to reheat the liquid cooled by the condenser, to greatly increase the efficiency of the work performed by the system. Both the reheating and regeneration modifications to the Rankine Cycle are examples of utilizing internally generated waste heat. The organic versions of the Rankine Cycle do something similar with external sources of waste heat.

Another option is to use organic working fluids. The amount of work ( $W$ ) produced by the steam engine per cycle is equal to the area enclosed by the four pressure-volume lines (pounds  $\times$  feet), or roughly the difference in pressure (pounds per square foot) multiplied by the difference in volume (cubic feet):

$$W = \text{Area (pounds} \times \text{feet)} \times \text{volume (cubic feet)}$$

The efficiency ( $e$ ) of the engine is equivalent to the work divided by heat ( $Q_{in}$ ) that enters the engine during the "2 to 3" phase of the cycle:

$$e = W/Q_{in}$$

To increase the work performed by a Rankine Cycle heat engine and its efficiency, the engines resulting cycle must either produce much higher pressures or increase the volume occupied by the working fluid as it goes from expansion to condensation. Since a potential waste-heat source of a Rankine Cycle heat engine is less intense and more diffuse than the direct heat of a fuel-burning boiler, working fluid other than water is needed to efficiently capture and use this energy, which brings us to organic working fluids.

## ORGANIC WORKING FLUIDS

The ORC utilized heated gas to drive a turbine — similar to a standard steam engine; however, this gas is a heated organic chemical instead of superheated water steam. The organic chemicals used by the ORC typically include Freon, iso-pentane, CFCs, HFCs, butane, propane, and ammonia. These refrigerants boil at extremely low temperatures (typically 150°F), which generates significant pressure in the cycle.

Heating and expansion occurs with the application of heat to an evaporator, which is different from a steam processes. The condenser can utilize ambient air temperatures to cool the fluid back into a liquid. There is no need for direct contact between the heating source at the evaporator or the cooling source at the condenser.

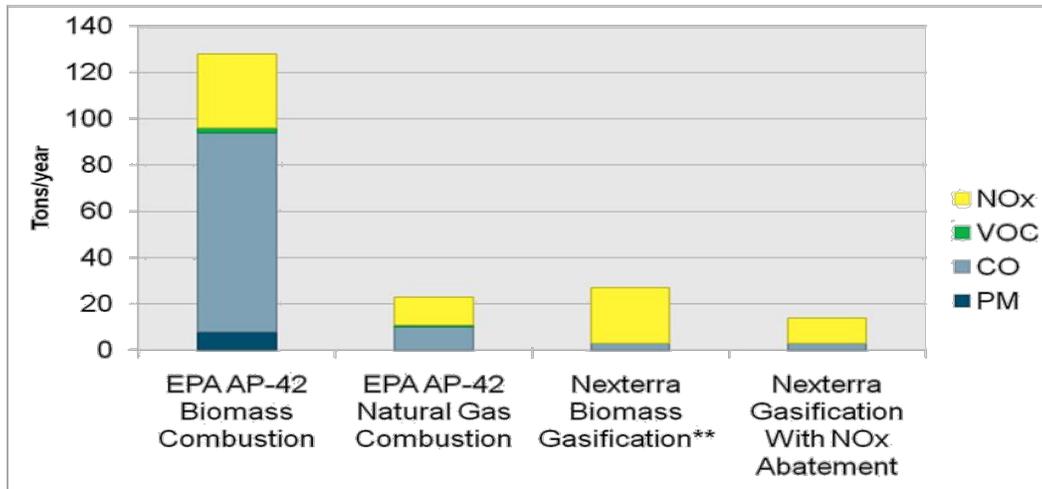
For those applications where higher temperatures are available to heat the organic working fluid, a regenerator is often added to increase the efficiency of the system. As discussed above, as the heated organic fluid leaves the boiler it passes through the regenerator some of its heat remains. When the cooled organic fluid leaves the condenser it passes through the regenerator in the opposite direction, acquiring some of the previously deposited heat, and preheating the fluid before it enters the boiler. Less heat is needed to boil the liquid, which increase the efficiency of the engine, since it is doing the same amount of work.

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## EMISSIONS

The proposed Nexterra gasification process will exceed current code requirements for airborne emissions. The system may include Electro-Static Precipitators (ESP) and additional urea-based NOx reduction technologies such as a Selective Non-Catalytic Reduction (SNCR) resulting in emissions meeting or exceeding most natural gas-fired systems (please see the following graph).

### Nexterra Emissions vs. Natural Gas Combustion

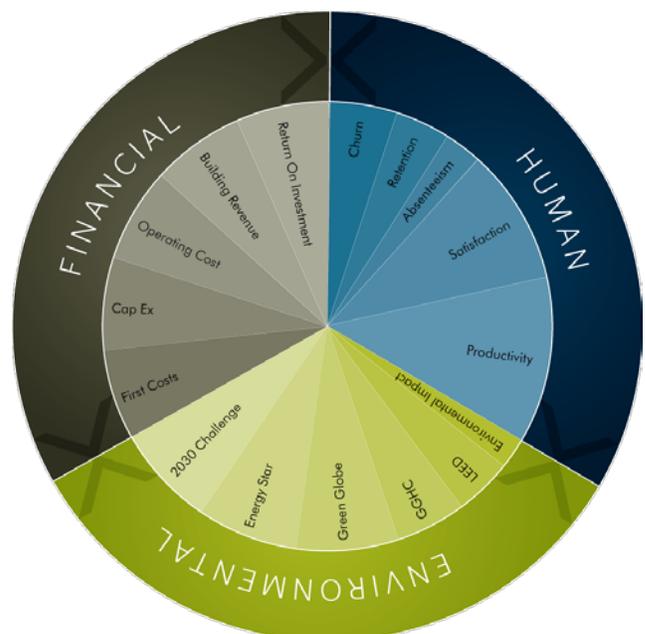


\* Data is for 24 MMBtu/hr system, 45% mc fuel  
 \*\* Third party test results from plant at the University of South Carolina (USC)

## TOTAL COST OF OWNERSHIP (TCO)

Any institution that is serious about implementing performance-based projects must employ a design and delivery process that incorporates a true life cycle performance analysis and methodology. Better designs, equipment, and systems may have slightly higher first cost, but will return real savings at a rate of many times the original investment. McKinstry's Total Cost of Ownership (TCO) service is a proprietary decision-making platform that evaluates the direct and indirect financial, environmental, and human impacts made by specific engineering, design, and equipment decisions. This tool was developed from our extensive design and construction experience, as well as our experience managing more than 100 million square feet of facilities for clients across the country.

TCO delivers a comprehensive look at value-creating options that return net-present value (NPV) over the long-term ownership of the facility. This includes all building systems and operating costs of the entire array of requirements—extending from systems maintenance to staffing levels, and from janitorial expenses to security costs. We have developed industry baselines,



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benchmarks, and project targets that allow our clients to quickly see the impact of costs of both large-scale systems options, as well as individual component analysis. We are using this tool with much success on many major projects and would implement this process as part of the engineering phase for Boise County's biomass renewable energy generation plant.

## *Optimizing all Costs of Ownership over the Life Cycle of the Facility/System*

The goal of TCO is to make design and construction choices that optimize the present value of all the costs incurred and all of the value delivered over the life of facility assets. TCO is not a one-size-fits-all tool. McKinstry will implement the business analysis processes that enable us to accurately customize TCO to Boise County's specific needs.

By estimating design effects on first costs, building operational budgets, long-term capital expenditure forecasts, and other human factors, McKinstry offers its clients and design partners a whole new approach to cost assessment, design decisions, and financing strategies. Multiple scenarios can be compared to see how they score. We can provide both global analysis and granular subcomponent design evaluations.

## SUMMARY OF OUR APPROACH

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- TCO Provides A Comprehensive Life-Cycle Cost Analysis that includes:
  - ❑ Annual Preventive Maintenance
  - ❑ Major Repair & Replacement Costs
  - ❑ Utility & Energy Costs
  - ❑ First Costs
  - ❑ Capital Renewal Costs
  - ❑ Facility Flexibility
  - ❑ Risk Management
  - ❑ Performance Benchmarks
  - ❑ Sustainability and Carbon Footprint Benchmarks
- Balances between real-world and theoretical facility operational processes
- Provides a bridge from construction to long-term operation
- Replaces "value engineering"
- Financial and operational modeling for sound design and construction decisions

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## Contractual

### PERFORMANCE-BASED CONTRACTING

“Performance-Based” Design-Build is a term used to describe a Design-Build project that has clear project and facility performance benchmarks, including a way to quantify, measure, verify, and guarantee project performance. Projects must include comprehensive life-cycle performance or Total Cost of Ownership analysis that substantiates the value of a specific equipment, design, system, etc. for lower total operational costs over time. TCO insures the best life-cycle performance. Performance-Based Design-Build mandates a vendor, equipment, design, and/or fuel-neutral process. Final designs and equipment selection should be determined solely on their own merit and life cycle performance.

### INTEGRATED DESIGN-BUILD

Integrated Design-Build is a method whereby a project’s design and construction are included within one contract and implemented by a turnkey prime contractor. This allows cost savings on a number of fronts. First, administration costs are lowered as there is only one contract to monitor. This is contrary to more traditional approaches where design, construction, and other needs are covered by several contracts.

Decisions are made in an integrated design and delivery process with the design-build contractor, integrated design team, and the owner examining the modeling analysis to determine the best “design-build” solution. The possibility of costly design changes may be eliminated, as construction and designs are done simultaneously. When unexpected design changes are needed, it is easier and less costly to alter the design during the design phase rather than ordering a change once the design phase is completed.



Projects include a comprehensive commissioning whereby each component of the project from engineering to construction to maintenance staffs, teams are part of the design process to ensure that what is designed is constructed, installed, and operated correctly – as well as being maintenance-friendly.

In addition, by using a single contract for both design and construction, the owner does not have to coordinate the activities of the designer and builder, since one party is responsible for both functions. Design-build also enhances the quality of the work performed. In Design-Build, qualifications of the firm, not price, should be the determining factor in choosing a firm for a public project.

Idaho statute allows for public institutions to employ an Integrated Design-Build process based on the design-build authority granted to public municipalities pursuant to I.C. §67-2309 and through the Energy Savings Performance Contracting statute I.C. §67-5711D through the Energy Services Provider. This provides public institutions a construction methodology that relies on qualifications and performance, rather than on the more frequently used Design-Bid-Build (“bid-spec” or “low-bid”). This is particularly important when implementing a project that requires a long-term “Total Cost of Ownership” (TCO) approach so as to insure its financial and operational success.

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## ESPC & DBOM/DBOOM

Assuming some degree of public ownership, the project must comply with Idaho State statutes on Design-Build (I.C. §67-2309) and renewable energy generation plants (I.C. §31-869). As a public/private partnership, Design-Build-Operate & Maintain (DBOM) and Design-Build-Own-Operate & Maintain (DBOOM) are contractual options whereby McKinstry has a direct, equity stake in the project, with the optimum percentage of public/private ownership being determined as the project is developed and implemented. However, Boise County is free to own 100% of the project as well.

### ADVANTAGES TO PUBLIC ENTITIES

- Better alternative to “low-bid” process – better designs, systems & equipment
- Emphasizes lowest Total Cost of Ownership (TCO)
- Single-point of accountability – Turn-key Provider/Prime Contractor/ESCO
- Operational & financial risks are burdened by ESCO (Energy Services Company)
- Open-book cost-plus pricing that demonstrates full disclosure and transparency
- Eliminates any incentive to “cut corners”
- Projects are properly commissioned
- GMAX project cost
- Quantifiable Life-Cycle and financial performance

The contractual arrangement for the funding, design, and implementation will largely be determined as to the ownership structure and whether financing will be based on taxable or tax-exempt debt. For the purposes of this report, it was assumed that this project would be implemented under the Idaho Code (I.C. §67-5711D) Energy Savings Performance Contract or similar integrated design-build processes (I.C. §67-2309). The project will be owned and operated by the county with all revenue directed on their behalf. Although the contractor may provide the operational staff, this will be on a contracted basis. This process is known as Design-Build-Operate-Maintain (DBOM).

Another option is that the contractor/investor owns the plant facility for a contractual term. This is known as Design-Build-Own-Operate-Maintain (DBOOM). This is less likely as the Pro Forma is more advantageous to utilize tax-exempt funding such as tax-exempt revenue bonds. In any event, there is prescribed statutory process for multiple ownership options and this project would strictly adhere to said laws, statutes, constitutional authority, and processes.

From the beginning of this process it was determined that a 15-20 year investment-grade source of fuel was the most important component for the successful implementation of this project – regardless of the plant size or capacity. The contracting methodology would require a full credit wrap and investment-grade resource allocation with predictable algorithms for fuel cost escalation and de-escalation, e.g., cost of diesel, etc.

# 1. Executive Summary

## Economic/Financial

### TAX-EXEMPT REVENUE BONDS

This report assumes tax-exempt funding for the project in the form of revenue bonds initiated by the county. As required by the Idaho State Constitution, this would require a 66% or 2/3 majority vote of the eligible voting public to provide approval to the county to enter into long-term debt. It should be noted that this project has never assumed any tax obligation on the part of the constituents. The debt obligation would be met entirely from the guaranteed revenue associated with a 20 or 25-year power purchase agreement (PPA). The term of the revenue bond would be either 15 years in the event of a 20-year PPA, or 20 years in the event of a 25-year PPA.

Although there are potentially other funding mechanisms, particularly taxable debt, these are not explored at this time – nor would they make a significant difference in the financial feasibility of the project.

In all cases the single most important component to successfully implement this project is securing a long-term investment-grade fuel contract to secure the guaranteed PPA. Credit-worthy resource allocation or a credit wrap provided by substantial landowners must be secured. Current lending standards will not tolerate any amount of risk associated with potential disruption of fuel supplies. Neither Federal nor State lands have the ability to provide long-term guarantees; therefore the biomass resources residing on public lands have no value in securing this project.

### GENERAL FINANCIAL ASSUMPTIONS

This report includes three Pro Forma that demonstrate several key points associated with a small-scale biomass generation plant. To start, the single most critical financial component of any power plant is the volume and cost of fuel balanced with the purchase price of electricity. The second most important financial component is the cost of money (interest). The third is the cost of the project itself.

The report is based on three known financial components:

Cost of Fuel	\$30 per bone dry ton (bdt)
Cost of Power (Purchased)	\$88 per MW h (includes green tags)*
Cost of Money	5% tax-exempt
Cost of Construction	\$15.4 million

*\*This does not reflect the pending motion by Idaho's Utilities to reduce the requirement to adhere to PURPA cost-avoided rates.*

The Pro Forma explore three scenarios meant to demonstrate the cost requirements in order to make a small-scale biomass project feasible – none of which exist today:

1. Scenario #1 assumes the current market cost of fuel (\$30/bdt); cost of power purchased (\$88/MW h); and a 5% interest rate. Based on a construction cost of \$15.M this project would require a grant of \$10-12M in order to make a 3MW project viable.
2. Scenario #2 demonstrates that without a grant to offset capital costs, and assuming current power purchase rates, fuel cost would have to be as low as \$3.32/bdt in order to make the project financially viable.
3. Scenario #3 demonstrates that without a grant to offset capital costs, and assuming current fuel purchase rates of \$30/bdt, power purchase rates would have to be increased to \$127.8/MW h in order to make the project financially viable.

# 1. Executive Summary

## Political/Environmental

Although public ownership of energy plants is allowed for under Idaho's renewable energy generation plants statute (I.C. §31-869), there is little interest in the current political climate to consider this option, despite the severe economic recession. The primary benefit for such an arrangement is for a municipality to provide a publically owned facility that is funded by tax-exempt debt that provides well-compensated jobs for a term not less than the debt service or operational life of the facility. In this case, this would be 15-25 years. Such a project would have a profoundly positive impact on the economy of Boise County. However, this innovative approach to a sustainable economic development solution is not readily accepted as politically palatable in today's climate.

Additionally, although a project would be self-funded with no risk to taxpayers (revenue vs. general obligation bonds), it is unlikely that a super-majority of the voters could be persuaded to support a project – either because they were against a publically owned facility or because they were skeptical about the lack of tax obligation. In sum, while the proposed project is currently not financially viable – based on both size and insufficient supply of credit-worthy fuel – this option may become more attractive should the current economic downturn continue for a protracted period. In this event, municipalities may be forced to become more innovative in solving their own economic challenges.

### ECONOMIC DEVELOPMENT & JOB CREATION

The following is an estimate of the job that would be created to design, build, and operate a small-scale biomass facility in Boise County.

#### Construction Jobs Created/Retained

Direct Consulting (Architecture/Engineering)	6-8
Direct Construction (Mechanical, Electrical, General Contracting, etc.)	50-75
Indirect (Parts Houses, Distribution, Supply Vendors, etc.)	30

#### Long-Term

Maintenance /Operations Staff Jobs Created (staff needed)	8-12
Direct Wood Products Industry Jobs Created/Retained (Logging, Transportation, Parts, etc.)	10+
Annual Temporary Service & Maintenance (2-3 weeks)	2-3

# 1. Executive Summary

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## Final Recommendations

The capacity of existing infrastructure provides for a plant no larger than 3MW. At current power purchase rates this becomes financially unfeasible without substantial capital assistance in the form of Federal grants. In lieu of this, power purchase rates must increase from \$88/MW h to \$130/MW h, which is not likely for several years (if ever). Additionally, there is no credit-worthy source for a 20-year investment-grade supply of fuel. Although there is an abundance of biomass resources – particularly on Federal lands, there is no policy allowing for the sustainable recovery of waste biomass from overgrown forests. Unfortunately, the present state of our forests may likely result in future catastrophic fires, with commensurate loss of property and even lives. Although the proposed Boise County biomass project would not solve this larger challenge, it could have a positive impact on the local economy and forest.

As our energy demand increases and the economy continues to evolve around projects that are sustainable and renewable, this project may become financially and politically viable at some point in the future.

# 2

## Economic Feasibility

# 2. Economic

## Project Site

*Provide information regarding the project site.*

For this portion of the study, McKinstry contracted with LD Jellison, a consulting and design company providing consulting services in forest products, biomass power generation, alternative energy, and electric utilities. LD Jellison is comprised of engineers, drafters, technicians, and analysts that provide the following services:

- Raw material analysis (timber to biomass feedstock)
- Feasibility studies
- Design
- Due diligence
- Capital improvements and cost estimates
- Equipment recommendations and acquisition
- Installation
- Project management
- Strategic Planning

<http://www.ldjellison.com/>

For this analysis, three potential site areas were selected by the county: Horseshoe Bend, Garden Valley, and Idaho City. These sites were selected by the county because all three sites are within Boise County, possess the potential for steam hosting and industrial development, and have potential access to required infrastructure for the facility.

Before providing details of these three sites, we have provided an overview of the sites that were not selected for this project.



### *Federal Lands*

Based on multiple biomass projects in which Federal fuel was investigated as a viable investment-grade (read “bankable”) source for woody biomass facilities, we concluded early in this study that there was no viable alternate for dependable long-term supply from Federal Forest – Boise National or otherwise. Although it was assumed the Forest Service could provide fuel on a non-guaranteed year-to-year basis, this was irrelevant to the financing requirements necessary to fund a project – either with tax-exempt or taxable debt.

In addition, until the new stewardship rules are in place (approximately 2014) there is no way to plan a project around Federal supply. If the past is any indication of future trends, it is unlikely that the new rules will provide a way to expedite the time required of the NEPA process. It is unknown if there is any chance for 15-20 year stewardship contracts, or if they would ensure sufficient acreage allocation.

In conclusion, for the practical purpose of successfully developing, funding and implementing a woody biomass project in Boise County, this project cannot rely or depend on any fuel originating from Federal lands.



### *State & Municipal Lands*

On August 30, 2010, McKinstry convened a panel of State and Federal officials to discuss the possibility of the State of Idaho, Bureau of Land Management (BLM), or other public agency underwriting fuel supply for small-scale woody biomass projects. This was based on similar programs in other states where state land holdings were reserved to provide a sustainable resource base for woody biomass renewable energy projects (supply and demand-side).

## 2. Economic

After thorough discussions, it was determined that Idaho has no political, administrative, constitutional, or statutory means to implement such a program. In addition, state lands holding are quite limited and are well managed as compared to Federal lands. Although the current housing slump has reduced the need for state forestry resources, this does not provide a long-term solution to Boise County or any other woody biomass generation plant in Southern Idaho. As a result, it is not practical to look for fuel from state lands as a practical means to secure funding for this project.

### *Private Land Holdings*

At several other locations in Oregon, Washington, and Montana, McKinstry is working with large private landholders of sufficient size and financial depth to underwrite fuel supply guarantees sufficient to secure project funding (balanced with the appropriately prices Power Purchase Agreement). Each of these projects is site specific, tuned to a particular location and landholder who has a defined supply of fuel from which a prescribed project is based. Unfortunately, private land holdings are relatively few in the state and extremely limited in the Boise County region. In addition, private lands are very well managed have far less waste material available for biomass energy purposes. In virtually all cases, timber companies do an excellent job vertically integrating their fiber streams, and have little, if any, biomass waste supplies sufficient to fuel a power plant.

After careful examination for the Boise County project, there appears to be no private company that has either the financial resources or fiber volume availability to meet the needs of the proposed Boise County project.

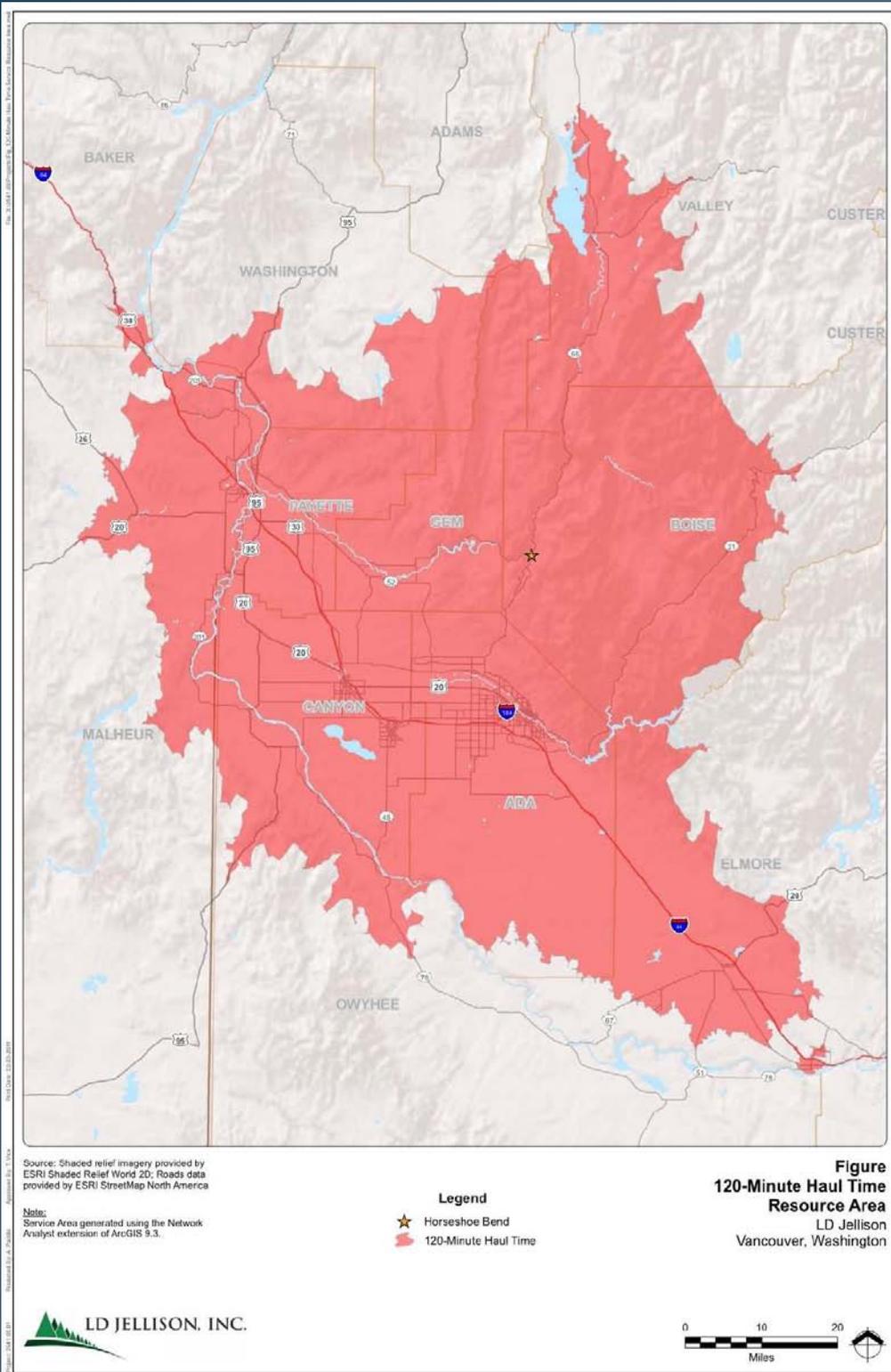
### *Selected Sites Overview*

This study analyzed each of the three potential areas by establishing a set of selection criteria developed to ultimately analyze each location's feasibility. The key selection criteria are outlined in the table below:

Selection Criteria	Horseshoe Bend	Garden Valley	Idaho City
Proximity to Fuel	Yes	Yes	Yes
Fuel Storage	Yes	Yes	Yes
Water	Yes	Yes	Yes
Wastewater Discharge	Yes	Yes	Yes
General Transportation Access	Yes	Yes	Yes
Electrical Transmission	Yes	No	No
Land Use	Yes*	Yes*	Yes*
Potential for Steam Hosting	Yes	No	Yes
Proximity to Residential Sensitive Areas	None	None	None
Proximity to Environmentally Sensitive Areas	None	None	None

\*County or city conditional use permit required

# Study Resource Area



## 2. Economic

### 1. HORSESHOE BEND

The first potential site is located in Horseshoe Bend. Horseshoe Bend is an incorporated city in Boise County and has a population of 770 people according to the 2010 U.S. Census. The most feasible location at this site was determined to be the former Boise Cascade industrial site. The Boise Cascade site is approximately 35 acres, privately owned, relatively flat, and outside of any floodplains. The Horseshoe Bend area is very close to Boise City and the forested areas in Squaw Creek, Harris Creek, and South Fork Payette. The site is close to the Harris Creek/Placerville forests and their fuel supply resources. Overall, Horseshoe Bend is centrally located within Boise County and has the potential to make use of fuel supplies from the study resource area for the proposed facility.

### 2. GARDEN VALLEY

The second identified site is Garden Valley. Garden Valley is an unincorporated town in Boise County, with a collection of small towns and subdivisions throughout the area. In regards to a potential biomass site, there is a sizeable amount of private and United States Bureau of Land Management (BLM) land with potential for siting. The area is in a long and broad valley and much of the ground is flat and outside of any floodplains. While Garden Valley has the potential to make use of fuel supplies from the study resource area, there are no specific sites within the Garden Valley area that would sufficiently meet the criteria for the proposed biomass facility, principally due to the fact that there are no transmission lines with capacity for transmitting the power produced by the proposed biomass facility. In Garden Valley, only feeder lines, which are sized for the loads of the area, are going through the city. These lines are most likely not large enough for the proposed facility.

### 3. IDAHO CITY

The third site is located in Idaho City. Idaho City has a population of 458 people according to the 2010 U.S. Census and is an incorporated city. Specifically, the area identified for this analysis is a portion of land off Bueno Vista Road, adjacent to the town. This site is approximately 240 acres, has relatively flat ground, and is outside of any significant floodplains. The site also contains the old county/city landfill. The land is currently owned by the BLM; however Idaho City and Boise County are considering purchasing the property from the BLM in order to develop it into an industrial park. Overall, while this site may appear to be a potential area for the proposed biomass facility, the fact that there are no power lines with the capacity to transmit the power produced by the proposed facility make this an impractical location to for the facility.

In Idaho City, the capacity of the power lines is relatively small, with a voltage of 12.5kV. According to Idaho Power, it would be costly to upgrade the existing lines that serve Idaho City. If the proposed biomass facility were to be built, the entire line serving Idaho City would likely need to be upgraded, according to Idaho Power. Installing any additional power source onto the feeder line that serves Idaho City would require an upgrade that starts at the proposed biomass facility and goes all the way back to the Amity substation. The cost of this major infrastructure upgrade will be significant, and a connectivity study would have to be done with Idaho Power.

In analyzing the three site areas under the established site selection criteria above, this study concludes that the Horseshoe Bend site area is the most feasible site for the proposed facility. The primary reason Idaho City and Garden Valley are not the most feasible site is because of the lack of sufficient transmission capacity to support the proposed biomass facility.

## 2. Economic

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### AVAILABILITY OF TRAINED OR TRAINABLE LABOR

*Provide information regarding the availability of trained or trainable labor.*

Trained, trainable, or talented labor is readily available regionally. Idaho ranks fourth nationally in percentage of population growth from April 2000 to April 2010 according to initial 2010 Census data.

It is assumed that hiring responsibility lies with the Design/Build contractor as they will be the organization maintaining the facility. McKinstry enjoys a high employee retention rate (historically ~95%) and is a preferred place to work, which will help build a staff of some of the top professionals in the industry. The project will include a plan to hire, train, and provide skilled plant professionals to ensure smooth and effective operations. In addition, the technology providers will have thorough O&M procedures including sub-consultants to provide annual system maintenance and service.

### AVAILABILITY OF INFRASTRUCTURE

*Provide information regarding the availability of infrastructure, including utilities, and rail, air and road service to the site.*

#### *Proximity to Fuel*

The forests within the study resource area include the Boise National Forest and Payette National Forest. Two main access roads from Horseshoe Bend lead into the Boise National Forest; Banks Lowman Road and Harris Creek Road. Both of these roads eventually merge onto Highway 21, which is the main highway running throughout the Boise National Forest. From the Harris Creek Road, the Boise National Forest is approximately 10 miles east of Horseshoe Bend, whereas from the Banks Lowman Road, the forest is approximately 30 miles from Horseshoe Bend. The forest to the north of Horseshoe Bend, approximately 85 miles away, is the Payette National Forest, located off Highway 55.

#### *Fuel Storage*

As a forest products mill processing facility, the Horseshoe Bend site is ideally located for fuel staging and storage. A two to four week on-site fuel supply is generally considered necessary for a biomass power facility that is contracted to provide power under a power purchase agreement in order to allow for fluctuations in fuel supplies due to transportation, inclement weather, natural disasters, or other unanticipated events that could affect the supply of fuel to the facility. This translates into roughly 900 to 1,800 bone dry ton (bdt) of on-site fuel storage for the facility.

Due to the relatively dryer climate of southern Idaho, a covered fuel storage area that would limit additional moisture from adding to the fuel is generally not efficient from a cost-benefit analysis when analyzing the additional capital cost of such a covered structure in light of the increased savings due to minimizing of the moisture content of the fuel. In addition, it is not anticipated at this time that the lead local/regional air-permitting agency would require that the fuel storage be enclosed in order to minimize fugitive dust from the exposed fuel.

The site contains sufficient industrial acreage that would allow for either covered or non-covered storage for the required on-site fuel storage of approximately 900 to 1,800 bdt for the facility.

#### *Water*

Our initial analysis of the former Boise Cascade mill site indicates that the site has more than adequate water infrastructure to support the proposed facility. Currently, water at the site is obtained from the city with sufficient capacity to support the estimated 40 to 50 gallons per minute (gpm) of water required to operate the facility.

When Boise Cascade owned the site, they privately owned all of the water and sewer lines, but were serviced by the city. As the city does not necessarily own the lines at the site, this would likely be a development cost if the facility was built. In addition, several parts of the water lines are old and damaged. While the previous

## 2. Economic

owners of the site initially started development on new lines, the infrastructure was never completed due to lack of funds and issues with the canal and lift station for both the new water and sewer lines.

While water is generally not an issue at the site, additional discussions with the city would be needed to determine specific costs and impact fees. Specific water testing and sourcing analysis will need to be conducted once a specific site, boiler technology, and boiler size are determined as part of the final Level 2 feasibility analysis.

### *Wastewater Discharge*

In addition, our initial analysis of the Boise Cascade site indicates that the site has adequate water discharge infrastructure to support the proposed facility. It is anticipated that the site would discharge approximately 5 to 15 gallons of wastewater discharge (blow down water discharged at approximately 90 to 110 degrees Fahrenheit) into the city sewer system. It is anticipated at this time that this relatively minimal wastewater discharge volume would not be a significant load upon the city sewer system. Overall, the current city sewer infrastructure appears sufficient to sustain the proposed biomass facility.

### *Transportation Access*

Transportation access is another essential criterion that the Horseshoe Bend site meets. Since Horseshoe Bend sits directly on State Highway 55, the impact of the increased volume of truck traffic, three to four trucks per day to supply the facility, will be minimal as this is a well-travelled and well-maintained state highway. While some local roads near the exact site may have to be improved, the state highway would provide sufficient road access to a biomass facility.

Other main access roads in the area include Highway 22, Banks Lowman Road, and Harris Creek Road. The Harris Creek Road is east of the Horseshoe Bend site and leads straight to the Boise National Forest, turning into Centerville Road and then Highway 21. Banks Lowman Road is north of the site and directly leads to Highway 21 and the Boise National Forest. The other forest in the study resource area is the Payette National Forest, which is located near Highway 55. Overall, the Horseshoe Bend site has the advantage of sufficient transportation access from multiple sources.

### *Electrical Transmission*

All of Boise County is contained within the service area of Idaho Power Company (Idaho Power). Accordingly, interconnection of power to be sold by the facility would need to be conducted through Idaho Power. In conducting this feasibility analysis, McKinstry had several conversations with Idaho Power Company (Idaho Power) regarding Idaho Power's line capacity for a power plant in each of the three proposed site areas. According to Idaho Power, they have capacity for a power facility in the Horseshoe Bend area for a power plant that would generate up to three MW (nominal) of electricity. This 3 MW capacity for Horseshoe Bend would not require any line upgrades to accommodate the capacity for transmitting the facility's power.

In addition, the Boise Cascade site has several electrical distribution lines serving the former mill site, and is therefore ideally situated in terms of being able to provide transmission capacity to the biomass power facility. More conversations with Idaho Power will be needed in order to ultimately determine the feasibility for interconnection at this site, but for the purposes of this feasibility study the Horseshoe Bend site would appear adequate for siting of a biomass power plant of up to 3 MW.

### *Land Use*

According to Horseshoe Bend city zoning codes, there is no specific zoning for energy production facilities. Instead, the proposed location for the biomass facility, the former Boise Cascade mill site, is zoned mixed use (MU). Mixed use zoning will require a conditional use permit, which means the facility will require review and approval of a conditional use permit (CUP) from the City of Horseshoe Bend planning and zoning commission. Therefore, in order to establish a biomass facility at this site, a conditional use permit from the City of Horseshoe Bend will be required.

# 2. Economic

## Thermal Hosting

The Horseshoe Bend site carries with it the potential for the biomass facility to serve as a steam and/or hot water host for existing and potential future facilities on or near the former Boise Cascade site, including the Horseshoe Bend School District located approximately 1,000 feet to the southwest. The most viable options for this in purposes of analyzing the feasibility of the site would be the potential to serve as a thermal host that would serve to attract future business to the former Boise Cascade site and/or surrounding areas for industrial or commercial uses. The biomass boiler could be appropriately sized in order to provide heating and potential thermal needs for industrial and/or commercial use at costs that are less than market rates for natural gas.

Further conversations will need to be had with current occupiers at or near the former Boise Cascade site area in order to determine potential thermal loads, delivery distances and associated capital costs, and the potential for secure long-term thermal contracts with the proposed facility and whether such current occupiers could affect the economic feasibility of sizing the boiler to take advantage of these thermal loads.

## Qualitative Analysis: Fuel Composition & Quality

### FEEDSTOCK SOURCE MANAGEMENT

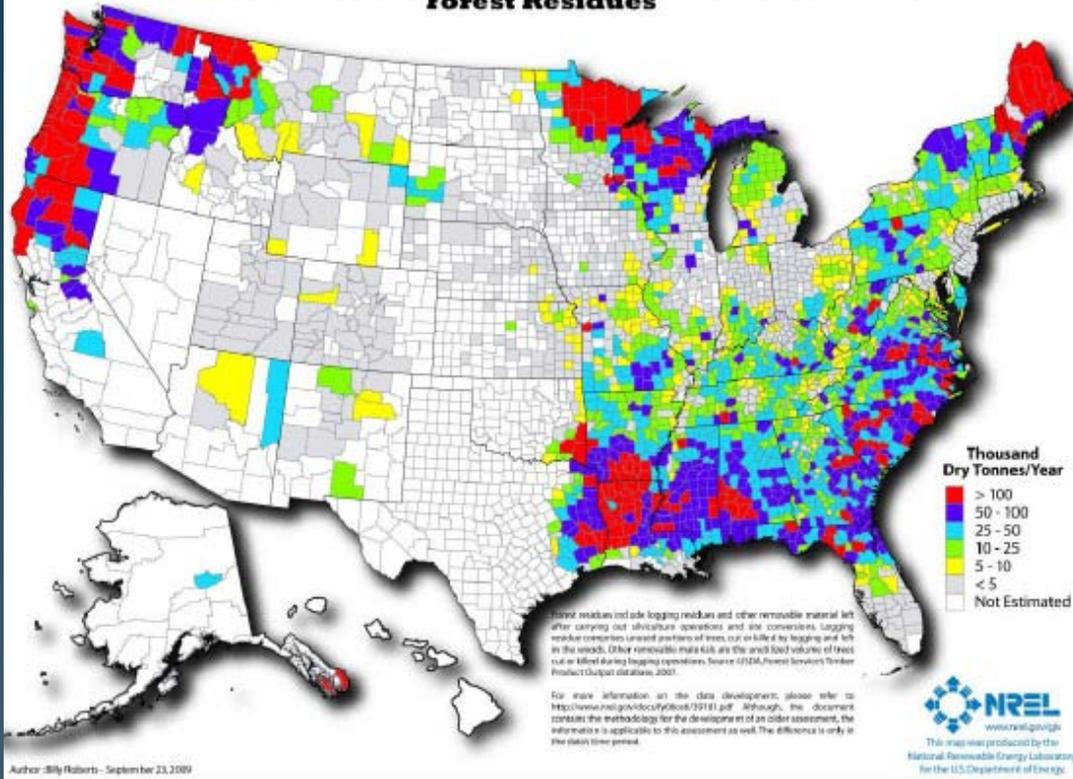
*Discuss feedstock source management, including feedstock collection, pre-treatment, transportation, and storage, and provide estimates of feedstock volumes and costs.*

Fuel specifications are based on forest slash or “hog” fuel, as represented in the images below (for more information on fuel, please see **Appendix A – Fuel Specifications** for more information).

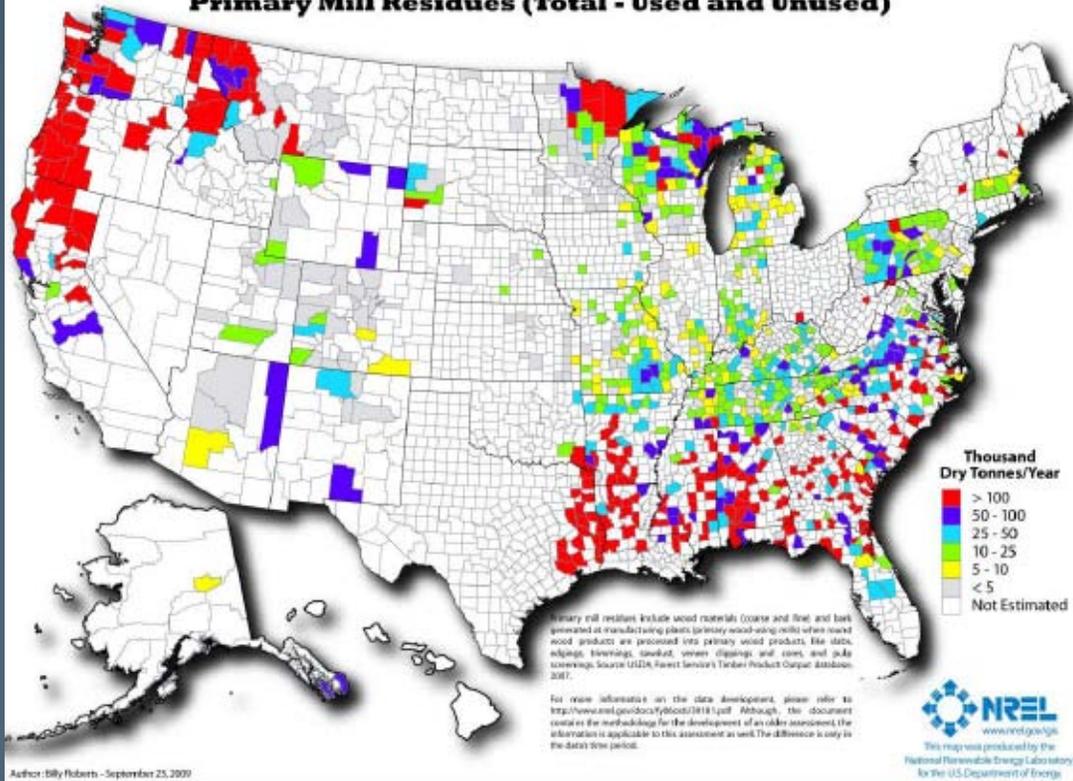


The forest products industry recognizes four general types of woody biomass: forest residues, primary mill residues, secondary mill residues, and urban wood waste. LD Jellison recommends that a maximum of 30% of secondary mill residues and urban wood residues are used to fuel the proposed biomass facility. The table on the following page describes each of the four types of woody biomass and analyzes the availability of each general type of woody biomass in the study resource area.

## Biomass Resources of the United States Forest Residues



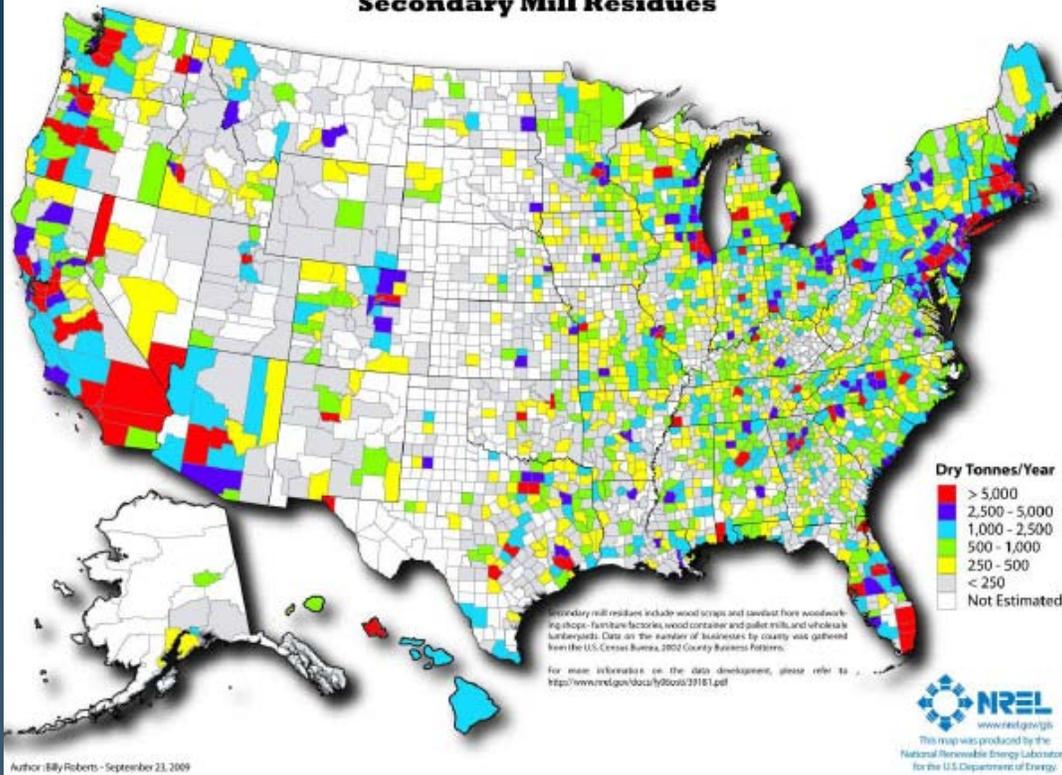
## Biomass Resources of the United States Primary Mill Residues (Total - Used and Unused)



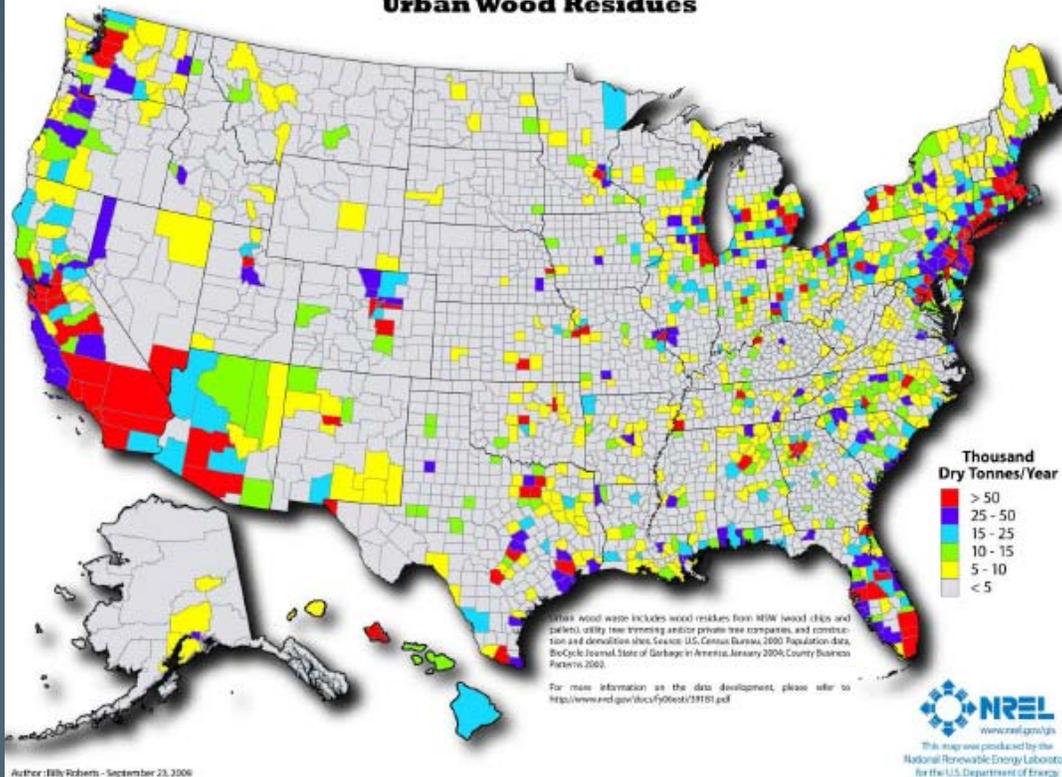
## 2. Economic

<p><i>Forest Residues</i></p>	<p>Forest residues include logging residues and other removable material left after carrying out silviculture operations and site conversions. Logging residue comprises unused portions of trees cut or killed by logging and left in the woods. The Forest Residues figure on the opposite page (top) illustrates the National Renewable Energy Laboratory's (NREL) 2009 estimate of the national distribution of forest residues, county-by-county across the entire United States. As shown, moderate concentrations of forest residues exist in the study resource counties.</p>
<p><i>Primary Mill Residues</i></p>	<p>Primary mill residues include wood materials (coarse and fine) and bark generated at manufacturing plants (primary wood-using mills) when round wood products are processed into primary wood products such as slabs, edgings, trimmings, sawdust, veneer clippings and cores, and pulp screenings. The Primary Mill Residues figure on the opposite page (bottom) illustrates the national distribution of primary mill residues, county-by-county across the United States, as estimated by NREL in 2009. As shown, minimal concentrations of primary mill residues exist in the study resource counties.</p>
<p><i>Secondary Mill Residues</i></p>	<p>Secondary mill residues include wood scraps and sawdust from woodworking shops, furniture factories, wood container and pallet mills, and wholesale lumberyards. The Secondary Mill Residues figure on the following page (top) illustrates the national distribution of secondary mill residues county-by-county across the United States, as estimated by NREL in 2009. As shown, minimal concentrations of secondary mill residues exist in the study resource counties.</p>
<p><i>Urban Wood Residues</i></p>	<p>Urban wood residues include wood residues from municipal solid waste (wood chips and pallets), tree trimming from utilities or from private tree companies, and construction and demolition sites. The Urban Wood Residues figure on the following page (bottom) illustrates the national dispersal of urban wood residues county-by-county across the United States, as estimated by NREL in 2009. As shown, minimal concentrations of urban wood residues exist in the study resource counties.</p>

## Biomass Resources of the United States Secondary Mill Residues



## Biomass Resources of the United States Urban Wood Residues

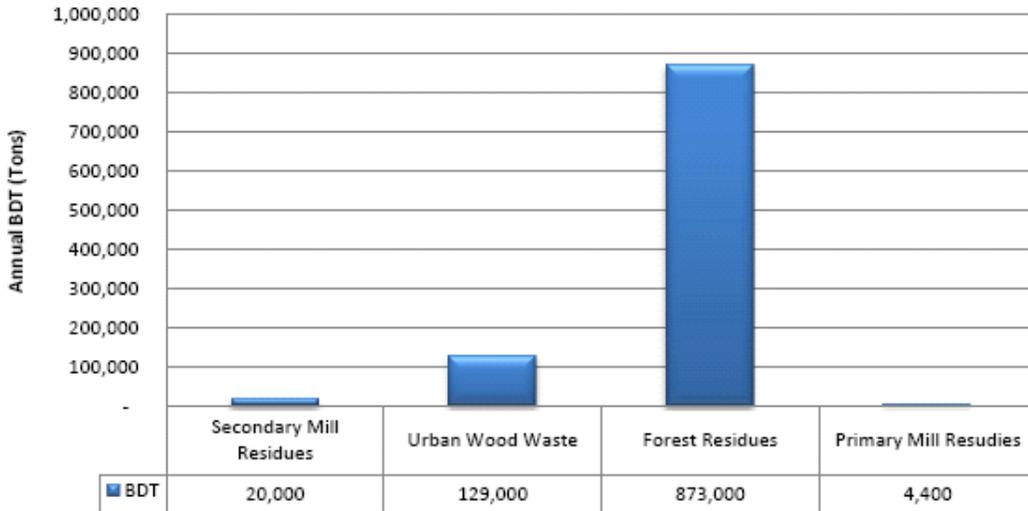


# 2. Economic

## Woody Biomass Composition

According to 2005 NREL estimates, the composition of all woody biomass (forest residues, primary mill residues, secondary mill residues, and urban wood waste) available annually in Idaho is shown in the bar and pie charts below.

**Estimated Idaho Woody Biomass Composition (NREL)  
Annual BDT (Tons)**

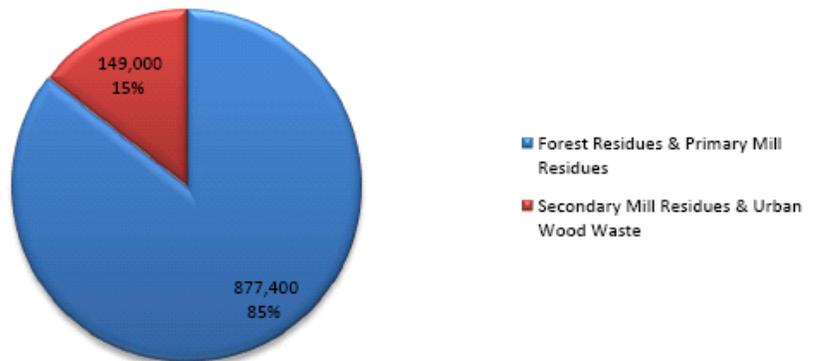


Source: National Renewable Energy Laboratories, 2005.

**Estimated Idaho Woody Biomass Composition (NREL) (BDT)  
Annual Proportions**

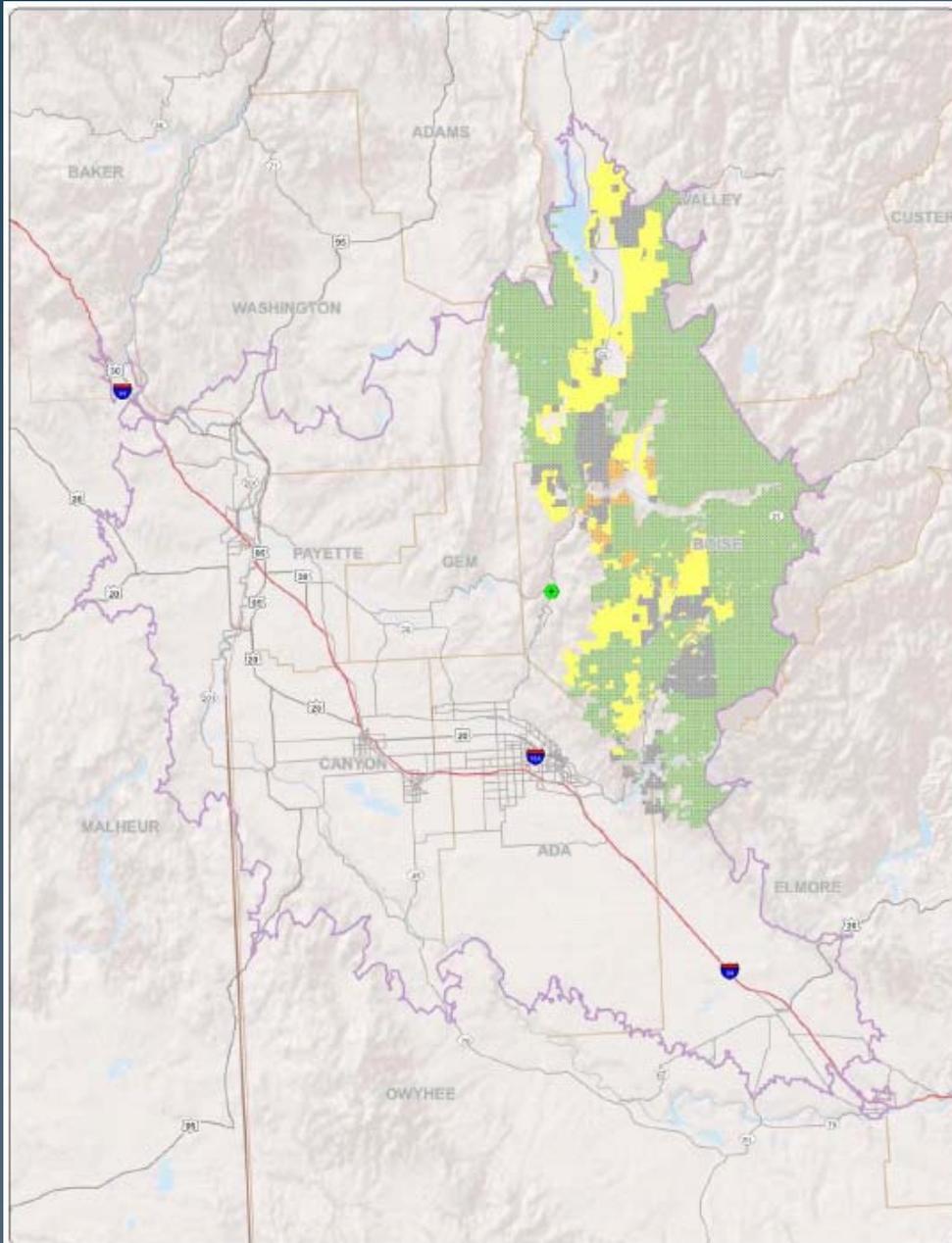
Assuming:

- 1) Logging residues, forest thinning, land clearing, and debris are substantively equal to forest residues;
- 2) Mill residues are substantively equal to primary mill residues; and
- 3) Yard burn and wood residues are substantively equal to secondary mill residues and urban wood waste;



Then as a proportion this equates to approximately 90% forest residues and primary mill residues and 10% secondary mill residues and urban wood waste, which is less than 30% combined aggregate threshold for secondary mill residuals and urban wood residues.

# Timberland Distribution



Source: Shaded relief imagery provided by ESRI Shaded Relief World 2D; Roads data provided by ESRI StreetMap North America; land ownership data acquired from corresponding county.

- Legend**
- Site Location
  - Private Timberlands
  - State & Federal Lands
  - State Lands
  - U.S. Forest Service
  - U.S. Bureau of Land Management

**Figure**  
**Land Ownership**  
**120-Minute Haul Time**  
**Service Resource Area**

LD Jellison, Inc.  
Horseshoe Bend, Idaho



# 2. Economic

## SUMMARY OF QUALITATIVE ANALYSIS

It is recommended that a maximum composition of 30% combined aggregate of secondary mill residues and urban wood residues are used for fuel for the proposed biomass facility. Based on the analysis of available data from the 2005 NREL and our interviews with biomass fuel processors and suppliers, this study concluded that the makeup of the potentially available woody biomass within the study resource area is likely comprised of an estimated aggregate of 15% of secondary mill residues and urban wood residues. This means that the composition of woody biomass residues within the study resource area is not overly weighted by secondary mill residues and urban wood residues.

## Quantitative Analysis: Fuel Supply

This analysis considers ownership classes, timberland locations, timberland composition statistics, existing biomass assessments, and historical harvesting trends. In this study, we contacted both public and private landowners, biomass suppliers and processors, biomass consumers, fuel processors, and in-woods grinders within the study resource areas in order to determine the current and anticipated supply and demand for woody biomass. This information, in addition data analyzed from various governmental agencies and industry sources, allowed us to estimate the current amount of forest residues, primary mill residues, secondary mill residues, and urban wood residues within the study resource areas on an ongoing basis. By analyzing the current supply and demand for woody biomass, we were able to assess whether there is sufficient biomass within the study resource areas, given the current demand, in order to adequately support the proposed biomass facility.

### FOREST RESIDUES

#### Land Ownership Analysis

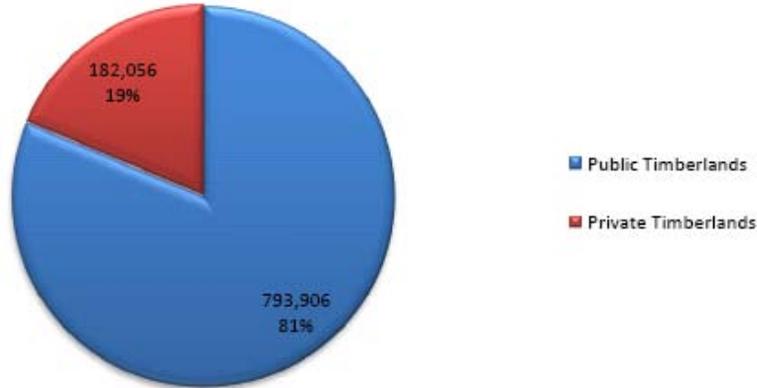
Using geographic information system (GIS) software and data obtained from the USDA Forest Service, this study estimates that the study resource area is composed of approximately 975,962 acres of public and private timberland. The map on the opposite page shows the distribution of timberland within the study resource area, while the tables below depict the public and private commercial timberland ownership in terms of acreage and percentage distribution.

Public Timberland Owners		
Landowner	Acreage	Percentage
State	113,204	14.2%
Federal	661,808	83.4%
BLM	18,894	2.4%
Total Public Timberland	793,906	100.0%

Private Timberland Owners		
Landowner	Acreage	Percentage
Private Land Owner	182,056	100.0%
Total Private Timberland	182,056	100.0%

# 2. Economic

The pie chart below shows the proportional acreage distribution of public and private timberland within the study resource area in relationship to the total amount of timberland.

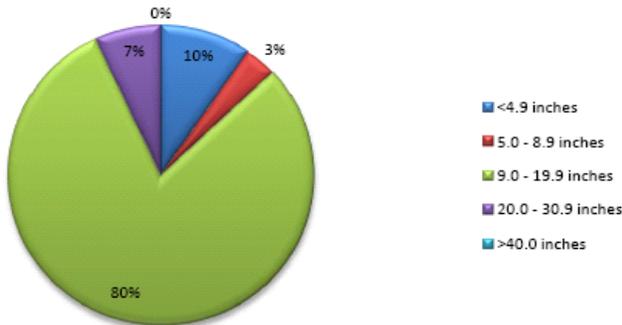


Source: USDA Forest Service.

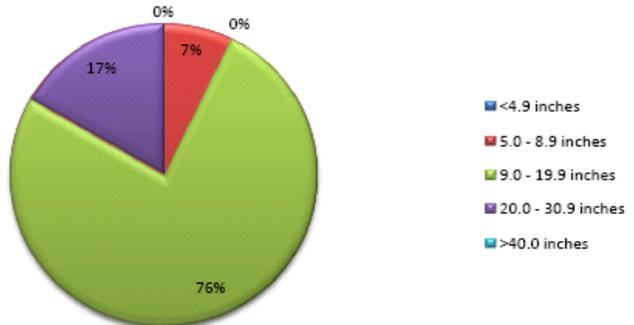
### Timberland Analysis

A factor to be considered in estimating the amount of potential woody biomass from private timberland is the diameter of the trees. The diameter at breast height (DBH) is used in conjunction with species type to calculate the volume of potential biomass that could be collected from a stand of trees. DBH is a determining factor in defining merchantable timber. When more merchantable timber exists in a stand of trees, the potential for logging slash increases. The figures below illustrate the distribution of trees on public and private timberland according to diameter class in accordance with USDA Forest Service acreage estimates.

Growing Stock Distribution on Public Timberland Study Resource Area



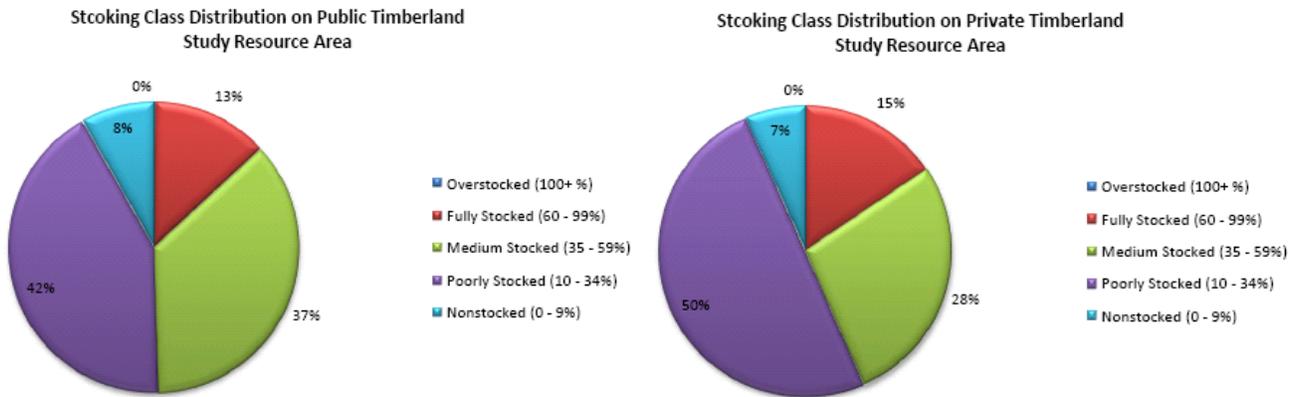
Growing Stock Distribution on Private Timberland Study Resource Area



Source: USDA Forest Service.

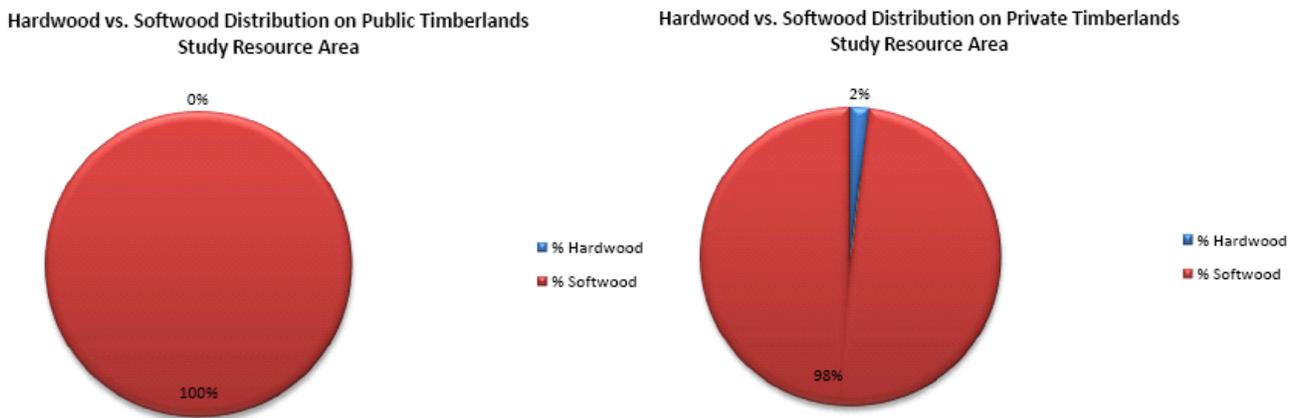
# 2. Economic

The public and private timberlands within the study resource area can further be divided into separate stocking classes of growing-stock trees. Growing-stock trees, as defined by the USDA Forest Service, are live trees at least 5.0 inches DBH that meet merchantability requirements. The five stocking classes identified by the USDA Forest Service are overstocked, fully stocked, medium stocked, poorly stocked, and nonstocked. The figures below illustrate the dispersal of the stocking classes among the public and private timberland in the study resource area.



Source: USDA Forest Service.

The composition of species types assists in determining the density and volume of the retrievable woody biomass from logging and thinning operations. The figures below present the ratio of hardwoods to softwoods (based on the total number of live trees) in accordance with USDA Forest Service estimates.

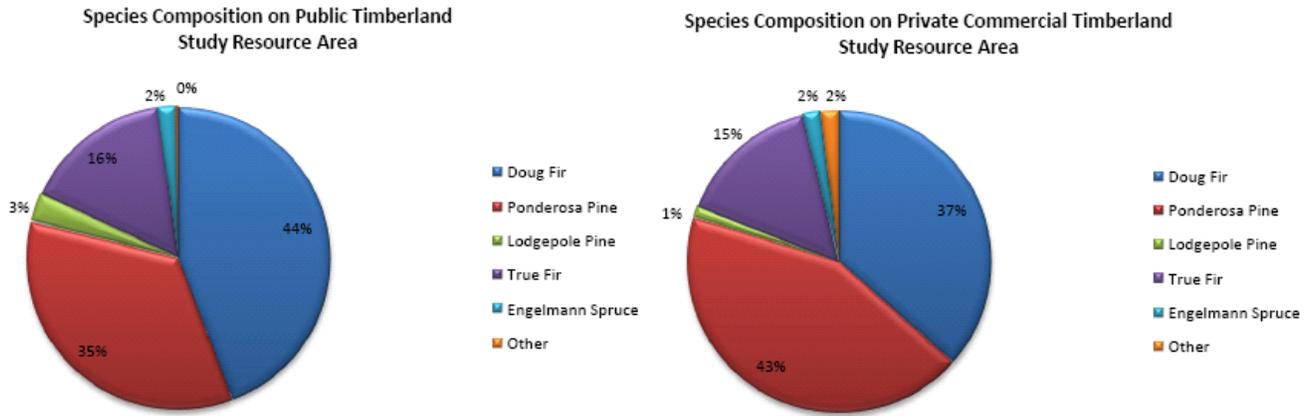


Source: USDA Forest Service.

The majority of live trees (36% of public timberlands and 8% of private commercial timberlands) are classified as softwoods, which the USDA Forest Service defines as coniferous trees, usually evergreen, and having needles or scale-like leaves.

# 2. Economic

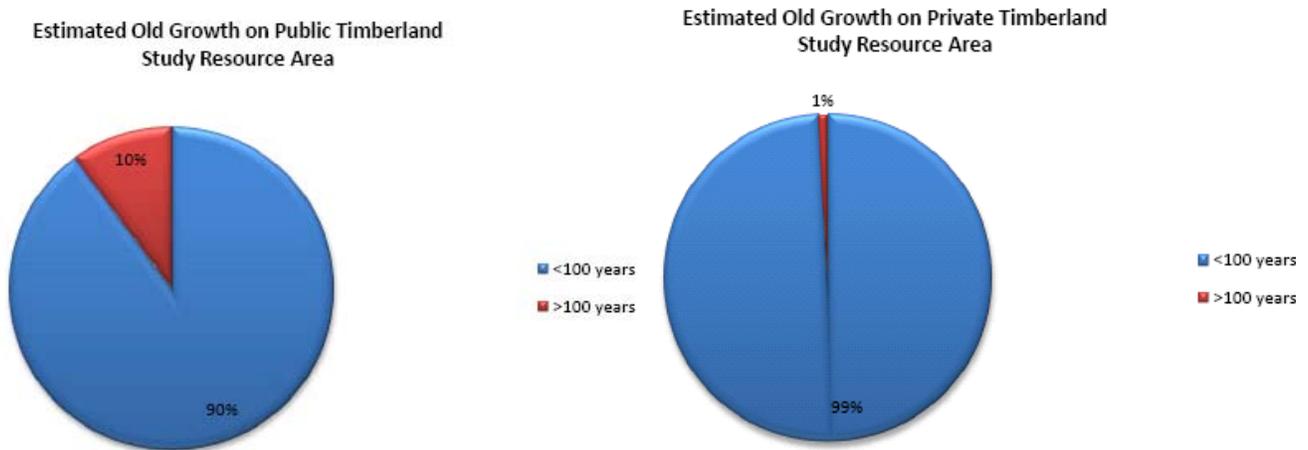
The figures below display the proportional distributions of the various tree species composing the private commercial timberland located in the study resource area (also based on the total number of live trees) in accordance with USDA Forest Service estimates.



Source: USDA Forest Service.

Of the softwoods growing in the study resource area, approximately 44% of public timberland and 37% of private commercial timberland belong to the Douglas Fir species. According to the California Department of Forestry, the typical heating value for Douglas Fir is approximately 9,000 British thermal units (BTU) per pound, which is slightly higher than the approximately 8,000 BTU/pound heating value for a hardwood such as maple.

This study further analyzed the stand age for the study resource area in order to assess the possibility for classification of private commercial timberland old-growth timber. As seen in the figures below, an estimated 10% of public timberland stands are 100 years or older, whereas an estimated 1% of private commercial timberland is in excess of 100 years old using the information analyzed from the USDA Forest Service.



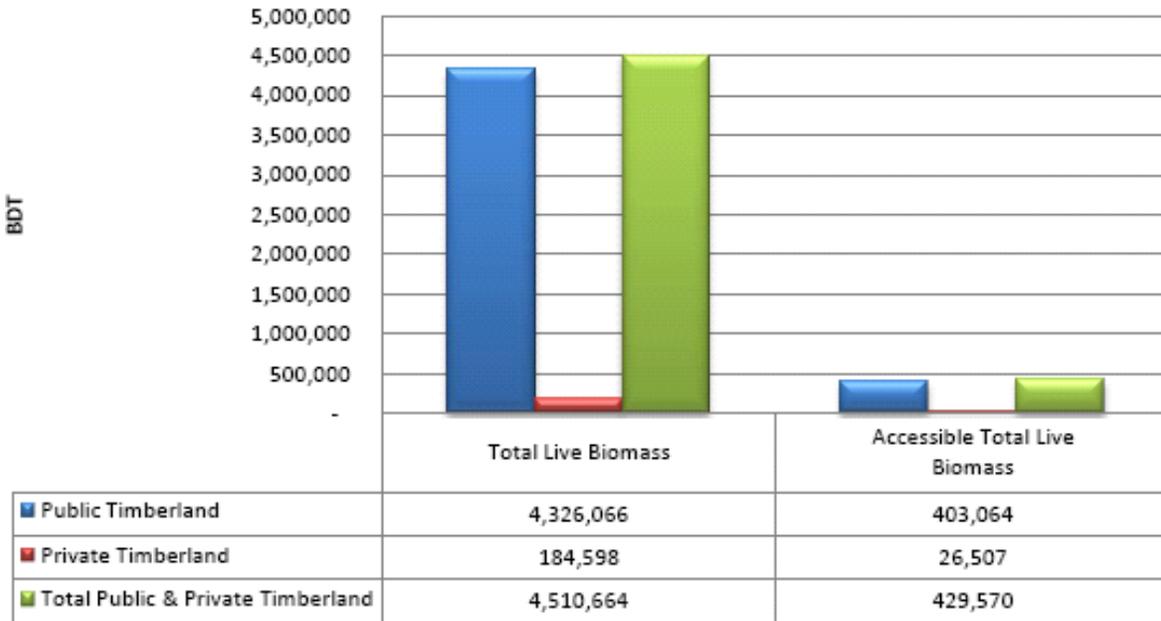
Source: USDA Forest Service.

# 2. Economic

According to our analysis of the data obtained by the USDA Forest Service, we estimate that there are 4,510,644 bdt of live forest biomass located on public and private commercial timberland within the study resource area. According to the definition provided by the USDA, this number includes the complete aboveground weight of wood and bark in live trees at least 1.0 inch DBH, not including all foliage. It also includes the weight of wood and bark in lateral limbs and secondary limbs and twigs from sapling-size trees but not from pole timber and saw timber-size trees.

In order to more accurately assess the amount of woody biomass material economically available for recovery, this study first narrowed the amount of woody biomass to that located less than 200 feet from an existing road and on land with less than a 40% slope. Industry standards indicate that this material is too costly to recover at this time. Applying these filters, the amount of total live woody biomass within these economically retrievable areas within the study resource area is estimated to be 429,570 bdt in accordance with USDA Forest Service data. The figure below provides a summary of the estimated total live forest biomass and estimated accessible total live forest biomass across the various public and private commercial timberlands.

**Live Biomass on Public and Private Commercial Timberlands (BDT)  
Study Resource Area**

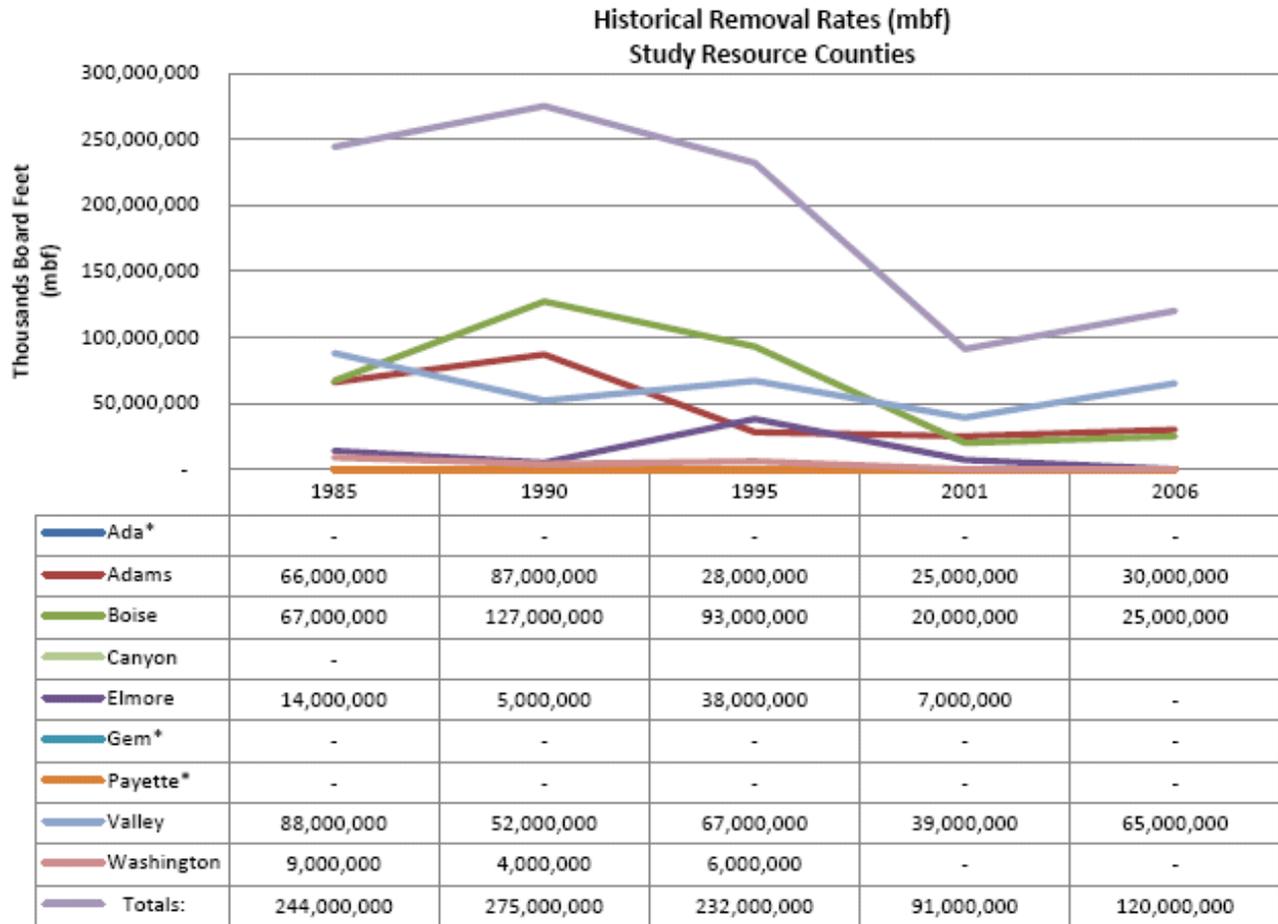


Source: USDA Forest Service.

# 2. Economic

## Historical Harvest Analysis

Historical timber production is an important part of the statistical analysis of the study resource area because it provides insight into the future potential for biomass retrieval. As some counties have only a small portion of timberland falling within the study resource area, harvest data was narrowed to eight study resource counties. The figure below shows the historical volume of timberland harvesting data for each of the study resource counties in accordance with data for these Idaho counties obtained from the Forest Industry Research department at the University of Montana.



\*Total amount assumed to be insignificant per University of Montana study for non-reported years.

Source: University of Montana

## 2. Economic

### Potential Forest Residues

By analyzing the historical harvest data for the study resource counties in conjunction with data from the USDA Forest Service from 2009, this study estimated the total potential amount of forest residues produced from logging operations by dividing the gross weight of merchantable biomass located in the study resource counties by the gross volume of saw timber located in the study resource area, and multiplying the harvest data from 2006. This number provides an estimated approximation of the resulting total potentially available biomass from forest residues created by logging slash based upon the 2006 historical removal data and for the study resource counties, assuming that all biomass from timber harvesting operations is perfectly utilized. The table below provides a summary of these calculations. It is important to note, however, that the creation of this biomass does not necessarily translate to the recoverable amount of biomass, which depends on a variety of factors such as the accessibility of the biomass, harvesting methods used, and efficiency of the biomass recovery operations.

	Weight of Merchantable Biomass (bdt)	÷	Volume of Merchantable Saw Timber (board feet)	x	2006 Timber Harvest Data (board feet)	=	Estimated Total Annual Slash (bdt)	x	Recovery Rate (20)%
Ada	55,364		20,225,295		0		0		
Adams	17,316,085		7,046,516,944		30,000,000		73,722		
Boise	19,887,095		8,104,565,590		25,000,000		61,345		
Canyon	—		—		0		0		
Elmore	8,166,069		2,985,561,744		0		0		
Gem	2,601,055		1,253,152,041		0		0		
Payette	—		—		0		0		
Valley	37,691,667		14,615,767,833		65,000,000		167,624		
Washington	3,634,049		1,516,680,249		0		0		
<b>Totals</b>	<b>89,351,384</b>		<b>35,542,469,696</b>		<b>120,000,000</b>		<b>302,692</b>		<b>60,538</b>

Source: USDA Forest Service

The estimated 302,692 bdt per year includes only forest residues (slash) created from logging operations on public and private commercial timberlands within the nine counties comprising the study resource counties. It does not include forest residuals resulting from thinning operations, land-clearing operations, or fire-reduction treatments. For the purposes of maintaining more conservative estimates, these additional forestry activities were not taken into account in assessing the potentially available forest residues.

The total amount of recoverable forest residues in reality is going to be significantly less than the total potential due to various efficiencies. Based upon LD Jellison's experience in the forest products industry, with fuel resource studies within the Western United States, analyses of the public and private commercial timberlands within the study resource counties, and industry standards, this study assumed a recovery rate of 20% of the total estimated annual slash. This places the total estimated economically recoverable forest residues, based on 2006 historical harvest rates, at approximately 60,538 bdt annually.

# 2. Economic

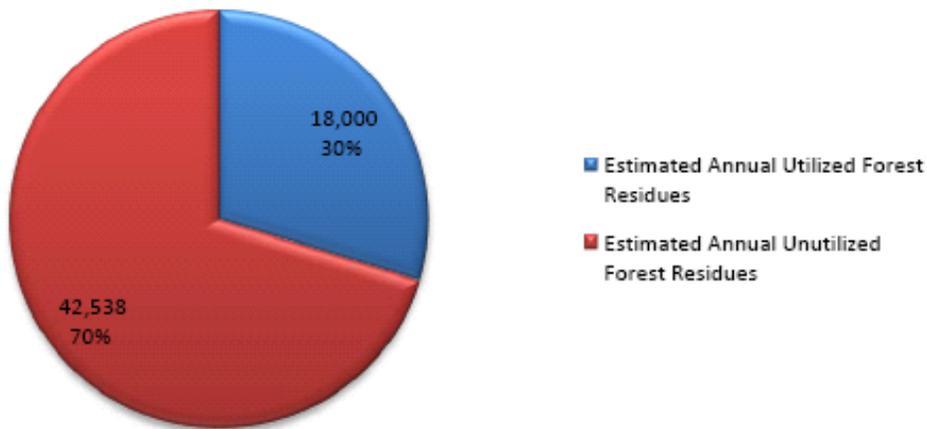
## Current Utilization of Forest Residues

From our interviews with private commercial timberland owners, fuel processors and sawmills, this study identified the equivalent of 0.25 full-time grinders engaging in in-woods grinding operations within the study resource counties. Industry standards indicate that one full-time grinder can produce approximately 300 bdt of biomass fuel per day, or 77,000 bdt per year. This equates to an estimated 18,000 bdt annual current utilization of forest residues from the logging slash created by timber harvesting within the study resource counties, resulting in a remaining estimated 42,538 bdt of unutilized forest residues available annually from logging slash created from timber harvesting within the study resource counties.

### SUMMARY OF AVAILABLE FOREST RESIDUES

This study determined from interviews and industry sources that based upon historical and forecasted harvesting of public and private commercial timberlands there is an estimated 60,538 bdt of forest residues from logging slash available annually within the study resource counties, as shown on below.

**Estimated Utilization of Forest Residues (BDT)  
Study Resource Counties**



Source: LD Jellison

# 2. Economic

## PRIMARY MILL RESIDUES

### Available Primary Mill Residues

Reliable assessment of the potential woody biomass in the study resource area that can be used for fuel for the proposed biomass facility must include the sawmill residuals that are part of the current biomass market. This information is summarized in the table below.

Sawmill	Location	County	Miles from Horseshoe Bend	8 Hour Capacity (mbf)	Est. Annual Production (mbf)	Est. Annual Production (bdt)
Idaho Timber of Boise	Boise, ID	Boise	35	—	16,800**	14,784***
Idaho Timber of Idaho	Weiser, ID	Washington	65	—	31,200**	27,456***
Emerald Forest Products	Emmett, ID	Gem	23	1,000*	480,000	422,400***
Totals						464,640

\* Source: <http://www.wildfireprograms.com/search.html?displayId=397> (accessed 2/18/2011).

\*\* Annual production per [www.idahotimber.com/idaho.htm](http://www.idahotimber.com/idaho.htm) (accessed 2/18/2011).

\*\*\* Assumed 1mbf = .88 bdt of residual material. Source: Alaska Wood Energy Conference, 2005

### Current Utilization of Primary Mill Residues

This study assumed that all primary mill residues currently being produced are being consumed by the market within the study resource area. The reasoning for this assumption is that primary mill residues are more accessible and comparatively more economically retrievable than forest residues.

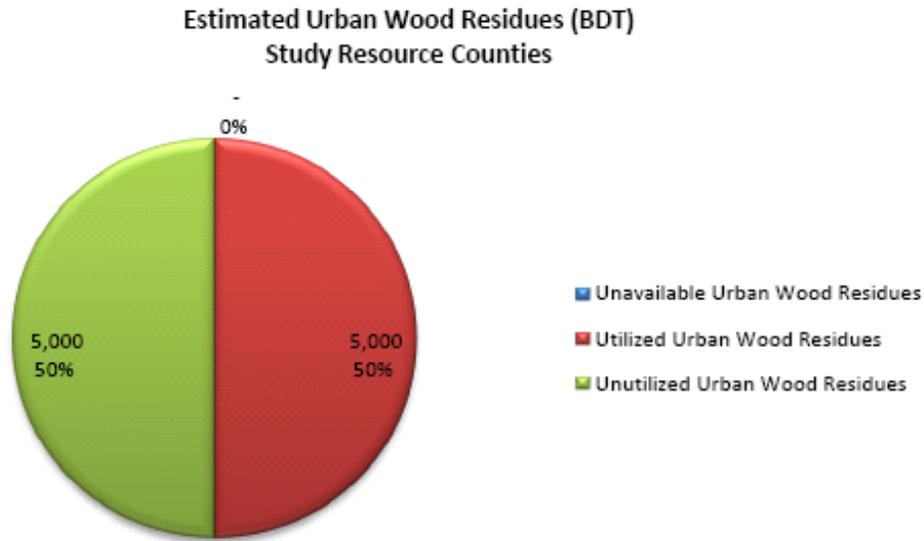
### Secondary Mill Residues

In accordance with the interviews conducted in this study, and taking into account the population density of the study resource counties, this study estimates that the current and historical annual volume of secondary mill residuals within the study resource counties is insignificant and is currently unreliable for purposes of long-term fuel supply contracting for the proposed facility. For example, Payette River Lumber and Nelson Custom Milling are two companies located in Boise County that would produce secondary mill residues; however they are small enough that any contributions would prove to be insignificant. Furthermore, this study assumed that like primary mill residues, all secondary mill residues are being consumed by the market because these residues are comparatively more economically retrievable than forest residues.

# 2. Economic

## Urban Wood Residues

In accordance with the interviews conducted in this study, and taking into account the population density of the study resource counties; this study estimates that the average annual volume of urban wood residues within the study resource counties is 10,000 bdt annually. When taking the population density into account, it is further estimated that 50% of this total, 5,000 bdt, within the study resource counties is unutilized and therefore potentially available for annual use for woody biomass facilities. These findings are summarized in the figure below.



Source: LD Jellison

The table below lists the urban wood residue producers in the Study Resource area.

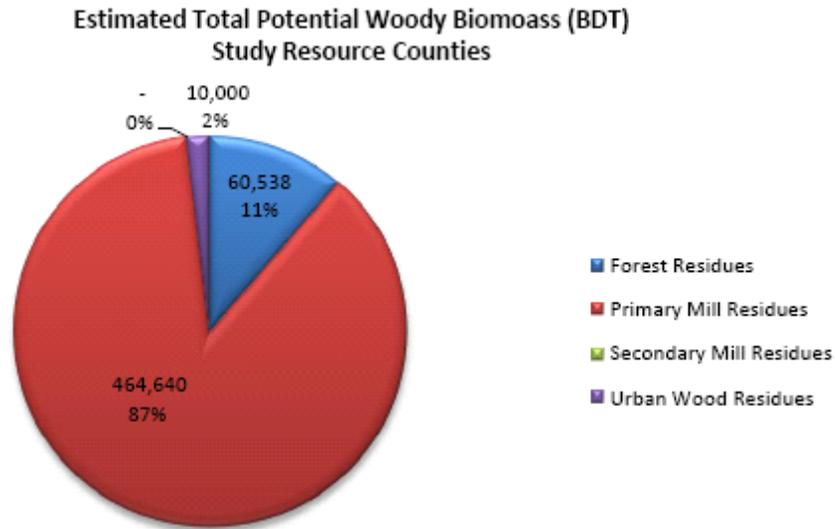
Loggers/Grinders	Location	County	Est. Annual Production (bdt)
Qualitree	Nampa, ID	Canyon	7,000*
Tree Top Recycling	Boise, ID	Boise	15,000*
Diamond Street Recycling	Boise, ID	Boise	20,000*
Total			42,000*

\*Amount inclusive of forest residues and urban wood residues.

# 2. Economic

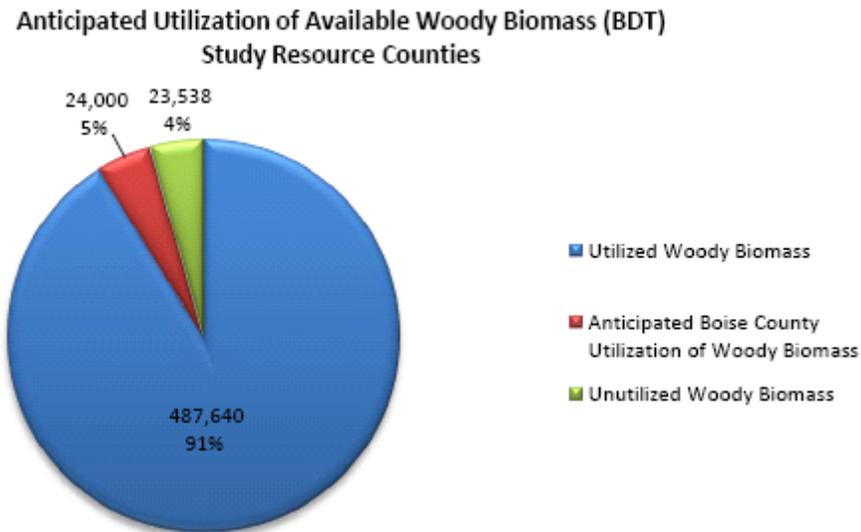
## SUMMARY OF QUANTITATIVE ANALYSIS

This study concludes that there is an estimated total potential of 535,178 bdt of woody biomass available annually within the study resource counties, comprised of the various residues as shown in the figure below.



Source: LD Jellison

Of this total potential 535,178 bdt of woody biomass available annually within the study resource counties, it is further estimated that 487,640 bdt is being utilized by various consumers, and with the 24,000 bdt annual consumption anticipated by Boise County for the biomass facility, this would leave an estimated remaining 23,538 bdt of potentially unutilized woody biomass available annually within the study resource counties as shown in the figure below.



Source: LD Jellison

# 2. Economic

## Fuel Economic Analysis

The economic analysis of this study involved reviewing regional woody biomass recovery operations and examining past, current, and future regional prices for woody biomass materials. For this analysis, we gathered information from leaders in the regional forest products industry. We further obtained and analyzed information from RISI, Inc. (RISI), generally considered the leader in both the forest products and financial industries in providing economic forecasting for wood products on both national and regional levels.

## Biomass Recovery Operations

Logging methods have a significant impact on the availability of forest-sourced woody biomass. Regional logging methods used for harvesting timber can be divided into two general categories: conventional harvesting and whole-tree harvesting.

<p><i>Conventional Harvesting</i></p>	<p>After a tree is felled, the tree limbs and top are then removed in-place where the tree is felled. As a result, the tree limbs and tops are scattered across the entire logging area making it difficult to economically retrieve the logging slash created from conventional harvesting methods. The wood waste requires extra handling of the slash to extract it to a landing area or to pile the slash for open burning.</p>
<p><i>Whole-Tree Harvesting</i></p>	<p>Involves the felling of the tree, which is then transported to a central processing area (landing) where the tree limbs and top are removed. This type of harvesting method concentrates the logging slash in a central landing area where they can be more economically retrieved from a central location.</p>

Historically, the majority of timber was harvested using conventional harvesting methods, which made the collection and utilization of slash created by forest residues difficult. Changing timber harvesting practices, however, have encouraged whole-tree harvesting, which significantly increases the potential availability for forest residues from logging slash created by timber harvesting.

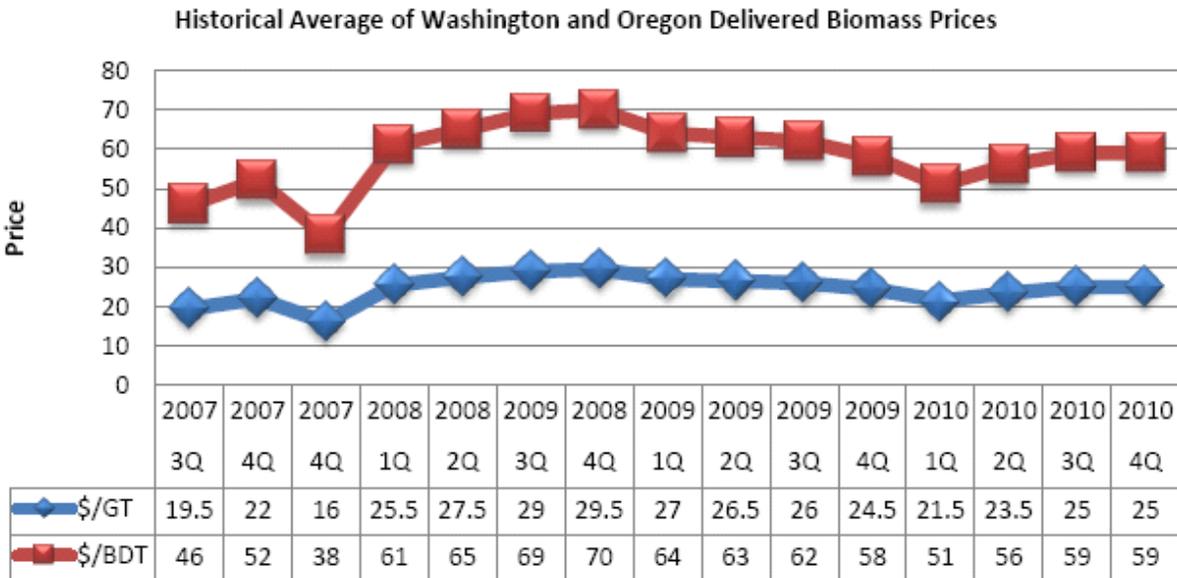
Public and private commercial timberland owners have begun to favor whole-tree harvesting as a more efficient means of harvesting timber. Especially since the removal of slash promotes the growth of seedlings and reduces open burning of forest residues. In addition, government incentive programs such as the U.S. Department of Agriculture’s Biomass Crop Assistance Program (BCAP), have sought to further increase the incentive for the removal of biomass from timberlands.

It is expected that federal, state, and local regulations will become more restrictive in the future with respect to open burning of forest residues, which would have the likely positive effect of increasing the supply of woody biomass for forest residues from logging operations.

# 2. Economic

## Historical Price

According to RISI, the average delivered price for woody biomass in Oregon and Washington for the past three years has averaged from a range of \$16 per green ton to a high of \$29 per green ton, with a current average delivered price of \$26 per green ton. This study assumed a moisture content of 42% for a green ton, which translates into a low of \$38 per bdt, a high of \$70 per bdt, and an average of \$58 per bdt. These historical prices are shown in the figure below.



Source: RISI, 2011

It is important to note and take into account that the prices provided by RISI include the cost of higher-value sawmill residuals, such as shavings, sawdust, bark, and chips, and are therefore higher than the cost of lower-grade forest residual biomass hog fuel that is expected as the primary source of fuel for the proposed biomass facility. Based on interviews with fuel processors, sawmills, and woody biomass fuel consumers in the study resource areas, this study estimates that the average historical delivered prices for this lower-grade fuel for the last two years have ranged from approximately \$20 to \$28 per bdt with a current average delivered price of approximately \$23 per bdt. The historical prices from RISI as shown in the figure above, however, provide a general index for market fluctuation over the past four years.

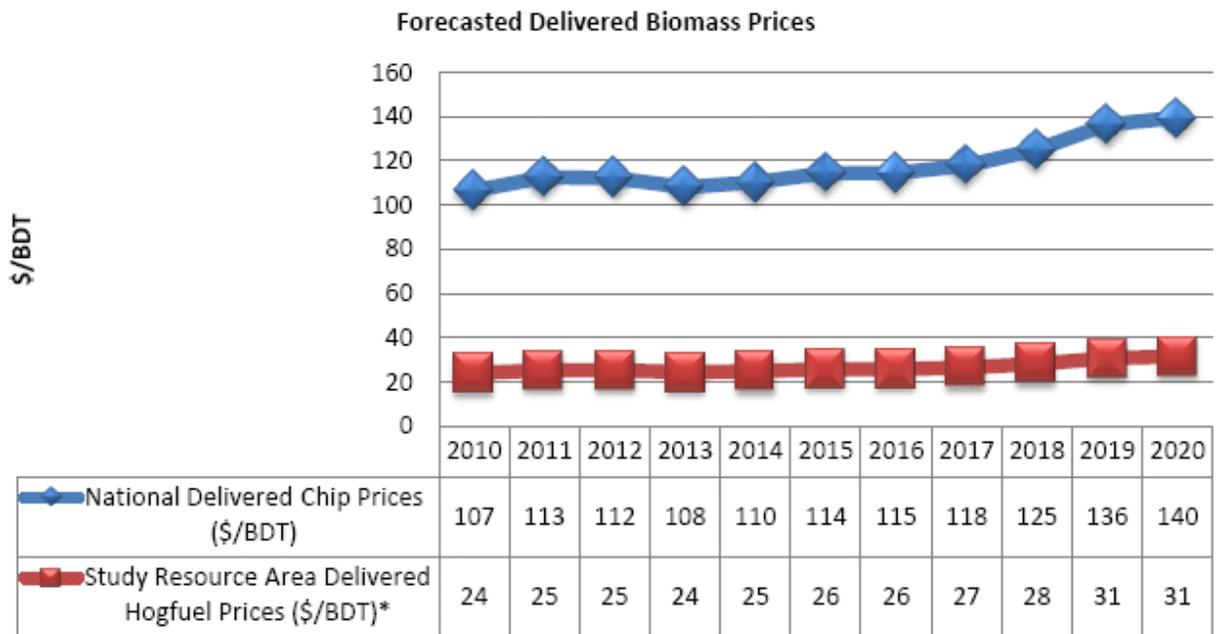
## Current Price

According to RISI, the most recent delivered price index for woody biomass in Washington and Oregon for 4Q 2010 is an average of \$25 per green ton (\$59 per bdt assuming a moisture content of 42% per green ton). This price includes the higher-value sawmill residuals discussed above and is therefore not an accurate indication of current local forest residual biomass hog fuel market conditions. Furthermore, interviews with regional landowners and biomass suppliers and consumers within the study resource area separately concluded that the current average delivered price for forest residual biomass hog fuel is \$23 per bdt.

# 2. Economic

## Forecast Price

In accordance with conversations and discussions with some of the senior economists at RISI, this study assumes a 1:1 correlation between RISI’s forecast delivered chip prices index and woody biomass prices in order to forecast the delivered forest residual biomass hog fuel prices within the study resource areas for the Boise County facility. The figure below illustrates RISI’s price forecast for residual chips and the forecast woody biomass price using the foregoing assumptions. As can be seen, using the forecast price for woody biomass in Washington based upon RISI’s forecast delivered chip price index and assuming a current woody biomass price of \$23 per bdt, the delivered price for woody biomass with the study resource area is not forecasted to exceed \$35 per bdt. This study estimates that ten-year long-term fuel supply contracts within the study resource areas with negotiated escalation and hedging indices would currently average between \$28 and \$35 per bdt.



\*Initial price estimates provided by LD Jellison  
Source: RISI, 2011

### SUMMARY OF ECONOMIC ANALYSIS

This study estimates that the current average price for forest residual biomass hog fuel within the study resource area suitable for the Boise County facility is currently \$23 per bdt. Both the current and ten-year forecasted prices for forest residual biomass hog fuel within the study resource area are forecasted not to exceed \$35 per bdt.

## 2. Economic

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### SUMMARY & CONCLUSIONS OF FUEL STUDY

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In the course of this study, LD Jellison conducted four analyses of woody biomass in the study resource area in order to determine whether there is sufficient woody biomass to justify the proposed biomass facility in Horseshoe Bend, Idaho.

The qualitative analysis determined that the composition of potentially available woody biomass in the study resource area is composed of less than 30% of secondary mill residues and urban wood residues.

The quantitative analysis estimated 23,538 bdt of unutilized woody biomass potentially available annually from public and private commercial timberlands in the study resource counties.

The economic analysis estimated the current average delivered price for forest residual biomass hog fuel in the study resource areas at \$23 per bdt, and the ten-year forecast average price for delivered forest residual biomass hog fuel not to exceed \$35 per bdt.

Finally, the competition analysis identified no current or proposed competition for potentially available woody biomass in the study resource area.

In conclusion, this Fuel Resource Study determines that from the standpoint of the annual fuel requirement of 24,000 bdt, there is insufficient fuel available to justify the proposed 30,000 PPH biomass facility in Horseshoe Bend, Idaho.

# 2. Economic

## EXISTING MANUFACTURING PLANT/FACILITY IMPACTS

*Discuss the proposed project's potential impacts on existing manufacturing plants or other facilities that use similar feedstock if the proposed technology is adopted.*

We do not anticipate any impact(s) to existing manufacturing plants or other facilities that use similar feedstock. This project intends to use new origin fiber supply from the state and will not compete with any other fiber delivery channel. On the contrary, this plant could provide stable source of thermal processing heat to companies with an interest in long-term process heat.

## RESOURCE CONSERVATION, PUBLIC HEALTH & ENVIRONMENT IMPACTS

*Provide projected impacts of the proposed project on resource conservation, public health, and the environment.*

### *Proximity to Residential & Environmentally Sensitive Areas*

In order to identify the residential and environmentally sensitive areas, a criterion of 500 feet for residential areas and 30 miles for environmentally sensitive areas was used. Environmentally sensitive areas were defined as Class 1 areas, which, according to the EPA, are locations that have severe restriction against air quality degradation. Examples of Class 1 areas include National Parks, National Recreation Areas, and Wilderness Areas. While there are a number of Class 1 areas in/near Boise County, there are no environmentally sensitive areas within 30 miles of the Horseshoe Bend site. In regards to residential sensitive areas, no residences were found within 500 feet of the site.

### *CO<sub>2</sub>*

Combustion of biomass for energy, instead of fossil fuels, can have a positive impact in moderating global climate change. Carbon dioxide (CO<sub>2</sub>) buildup in the atmosphere is a significant contributor to global climate change. Fossil fuels release carbon sequestered from geologic carbon sources thus increasing the net atmospheric carbon load. Conversely, when biomass is burned, the CO<sub>2</sub> released is considered to be within the short-term biogenic carbon cycle which avoids the addition of new carbon to the atmosphere. However, biomass energy only supports a net reduction in carbon emissions if the carbon released during biomass harvesting and combustion is re-sequestered by new forest growth in approximately the same timeframe it took to grow the original stock. Forests can support climate mitigation as "carbon-negative" sources if sustainable harvesting and land management practices allow them to sequester the carbon that is emitted through combustion, the fossil fuels needed to harvest and transport the biomass fuel, and a margin for uncertainty.

### *Sustainable Recovery*

All sites will be harvested using Sustainable Management Recovery Techniques (SMRT) that includes best management practices that will focus on optimizing the waste recovery while maximizing the nutritional rejuvenation, health, and vitality of the forest ecosystem. Harvesting the low-grade trees can help improve the forest quality over time through sustainable forestry practices. Removing slash piles, dead and dying trees, diseased and infested trees, and pulpwood from the forest has the benefit of increasing forest health, increased carbon sequestration of the forest, and reduced forest fire potential by removing unnatural levels of fuel.

# 2. Economic

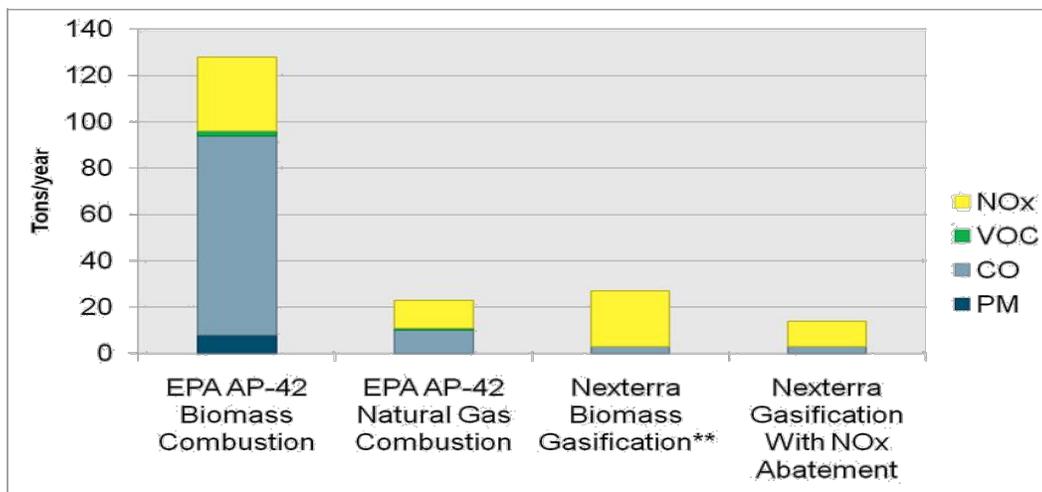
## Air Quality

This facility would positively impact air quality in the county because slash piles from logging activities would be burnt efficiently and with emissions control. Efficient burning at a central location allows for emissions abatement, complete combustion, and ongoing monitoring, which would dramatically decrease the amount of emissions released into the atmosphere.

Reflecting state and federal requirements for the most advanced emissions control technology, waste to energy (WTE) emissions have plummeted since the late 1980s (e.g., annual WTE emissions of dioxin have decreased by a factor of 1,000 to less than 12 grams), and WTE emissions are lower than landfill emissions for 9 of 10 major air pollutants. As a result, the U.S. EPA recognizes WTE as a renewable energy source that “produce[s] 2,800 megawatts of electricity with less environmental impact than almost any other source of electricity.”

The proposed Nexterra gasification process will exceed current code requirements for airborne emissions. The system may include Electro-Static Precipitators (ESP) and additional urea-based NOx reduction technologies such as a Selective Non-Catalytic Reduction (SNCR) resulting in emissions meeting or exceeding most natural gas-fired systems (please see the following graph).

**Nexterra Emissions vs. Natural Gas Combustion**



\* Data is for 24 MMBtu/hr system, 45% mc fuel.  
 \*\* Third party test results from plant at the University of South Carolina (USC)

# 2. Economic

## OVERALL ECONOMIC IMPACT OF THE PROJECT

*Provide an overall economic impact of the project including any additional markets created for agricultural and forestry products and agricultural waste material and potential for rural economic development.*

The most compelling reason for a facility or any consumer to decide on switching to biomass energy is that the cost of biomass fuel is generally much less than the cost of fossil fuels on a Btu basis. These hard-dollar savings often make the investment in biomass heating technology a win-win for facilities and customers looking to reduce operating costs and energy expenditures, combining environmental stewardship and good economics. At the heart of this new application of wood energy is the attraction of using a renewable, locally produced energy source that can save money.

Economically, this facility would create sustainable jobs based on local renewable resources at the facility itself and through the fuel supply chain. The facility would also generate long-term revenue sources for the county and state via income taxes, land leases, business taxes, and would serve as a springboard for a variety of economic development opportunities for Boise County. The economic stimulus of the facility can be used as a platform to implement long-term forest management practices.

Although public ownership of energy plants is allowed for under Idaho's renewable energy generation plants statute (I.C. §31-869), there is little interest in the current political climate to consider this option, despite the severe economic recession. The primary benefit for such an arrangement is for a municipality to provide a publically owned facility that is funded by tax-exempt debt that provides well-compensated jobs for a term not less than the debt service or operational life of the facility. In this case, this would be 15-25 years. Such a project would have a profoundly positive impact on the economy of Boise County. However, this innovative approach to a sustainable economic development solution is not readily accepted as politically palatable in today's climate.

Additionally, although a project would be self-funded with no risk to taxpayers (revenue vs. general obligation bonds), it is unlikely that a super-majority of the voters could be persuaded to support a project – either because they were against a publically owned facility or because they were skeptical about the lack of tax obligation. In sum, while the proposed project is currently not financially viable – based on both size and insufficient supply of credit-worthy fuel – this option may become more attractive should the current economic downturn continue for a protracted period. In this event, municipalities may be forced to become more innovative in solving their own economic challenges.

The following is an estimate of the job that would be created to design, build, and operate a small-scale biomass facility in Boise County.

### Construction Jobs Created/Retained

Direct Consulting (Architecture/Engineering)	6-8
Direct Construction (Mechanical, Electrical, General Contracting, etc.)	50-75
Indirect (Parts Houses, Distribution, Supply Vendors, etc.)	30

### Long-Term

Maintenance /Operations Staff Jobs Created (staff needed)	8-12
Direct Wood Products Industry Jobs Created/Retained (Logging, Transportation, Parts, etc.)	10+
Annual Temporary Service & Maintenance (2-3 weeks)	2-3

## 2. Economic

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### FEASIBILITY/PLANS OF PROJECT TO WORK WITH PRODUCER ASSOCIATIONS OR COOPERATIVES

*Provide feasibility/plans of project to work with producer associations or cooperatives including estimated amount of annual feedstock and biofuel and byproduct dollars from producer associations and cooperatives.*

The primary requirement of this project is that there is a 20-year investment grade supply of fuel. Source of the fuel or whether it originates through cooperatives is secondary. Although biomass utilization cooperatives would be attractive, ultimately the source must be investment-grade with long-term supply and cost guarantees. At this point, final fuel sources, cost, and contracting methodologies have not been determined.

# 2. Economic

## Economic Analysis – Additional Details

### DETAILED ANALYSIS & DESCRIPTION OF PROJECT COSTS

*Provide a detailed analysis and description of project costs including project management, resource assessment, project design, project permitting, land agreements, equipment, site preparation, systems installation, startup and shakedown, warranties, insurance, financing, professional services, and operations and maintenance costs.*

As mentioned previously, this report assumes tax-exempt funding for the project in the form of revenue bonds initiated by the county. As required by the Idaho State Constitution, this would require a 66 or 2/3% majority vote of the eligible voting public to provide approval to the county to enter into long-term debt. It should be noted that this project has never assumed any tax obligation on the part of the constituents. The debt obligation would be met entirely from the guaranteed revenue associated with a 20 or 25-year PPA. The term of the revenue bond would be either 15 years for a 20-year PPA, or 20 years for a 25-year PPA.

Although there are potentially other funding mechanisms, particularly taxable debt, these are not explored at this time – nor would they make a significant difference in the financial feasibility of the project.

In all cases the single most important component to successfully implement this project is securing a long-term investment-grade fuel contract to secure the guaranteed PPA. Credit-worthy resource allocation or a credit wrap provided by substantial landowners must be secured. Current lending standards will not tolerate any amount of risk associated with potential disruption of fuel supplies. As neither Federal nor State lands have the ability to provide long-term guarantees, all biomass resources residing on public lands has no value in securing this project.

#### *General Financial Assumptions*

This report includes three Pro Forma that demonstrate several key points associated with a small-scale biomass generation plant. To start, the single most critical financial component of any power plant is the volume and cost of fuel balanced with the purchase price of electricity. The second most important financial component is the cost of money (interest). The third is the cost of the project itself.

The report is based on three known financial components:

Cost of Fuel	\$30 per bone dry ton (bdt)
Cost of Power (Purchased)	\$88 per MW h (includes green tags)*
Cost of Money	5% tax-exempt
Cost of Construction	\$15.4 million

*\*This does not reflect the pending motion by Idaho's Utilities to reduce the requirement to adhere to PURPA cost-avoided rates. Please see **Appendix B – Adjustment of Avoided Cost Rates** for more information.*

The following are three scenarios meant to demonstrate the cost requirements in order to make a small-scale biomass project feasible – none of which exist today:

# 2. Economic

4. Scenario #1 assumes the current market cost of fuel (\$30/bdt); cost of power purchased (\$88/MW h); and a 5% interest rate. Based on a construction cost of \$15.M this project would require a grant of \$10-12M in order to make a 3MW project viable.

(a) NOTE: A grant may be viable, but only after long-term fuel contracts could be validated.

Boise County Biomass			2.4 MW ORC Biomass Power System		
Parameter	Input Value	Comments	Summary of Results		
<u>General Plant Design Information</u>			<b>Net Cash Flow</b> <b>\$6,234,060</b>		
Biomass Plant Capacity (Lb/Hr, wet)	11,540	Design Criteria			
(Ton/Day, wet)	138	Calculated			
Biomass Ash Production (Lb/Hr)	692	Design Criteria			
(Ton/Day)	8	Calculated			
			<b>Capital Cost (\$2009)</b>	<b>Input Value</b>	<b>Comments</b>
			<b>Total EPC Contract (\$)</b>	<b>\$14,000,000</b>	Cost Estimate
			<b>(\$/kW)</b>	<b>\$5,809</b>	Calculated
			<b>(\$/Ton/Day)</b>	<b>\$101,098</b>	Calculated
Gross Power Output (kW)	2,410	LK-3 Heat Balance			
Gross Plant Heat Rate, HHV (Btu/kW-Hr)	24,421	Calculated			
Net Power Output(kW)	2,160	LK-3 Heat Balance			
Net Plant Heat Rate, HHV (Btu/kW-Hr)	27,247	Calculated			
Process Steam Output (Lb/Hr)	0	Design Criteria			
Biomass Fuel HHV (Btu/Lb, wet)	5,100.0	Design Criteria			
Biomass Moisture Content (wt.%)	40%	Design Criteria			
Biomass Ash Content (wt.%, wet)	6.00%	Calculated			
Annual Plant Capacity Factor (%)	95%	Assumed			
Annual Operating Hours	8,322	Calculated			
<u>Economic Factors</u>					
Equity Financed (%)	100.0%	Assumed			
Interest Rate on Debt (%)	5.0%	Assume Tax Exempt Financing			
<u>Operating Costs</u>					
<u>O&amp;M Cost</u>					
O&M Cost (\$/kW-Hr)	\$0.020	Assumed			
Annual O&M Cost Escalation Rate (%)	3.0%	Assumed			
<u>Biomass Fuel Cost</u>					
Dry Field Biomass Fuel Cost, delivered (\$/Ton, dry)	\$30.00	Design Criteria			
Wet Field Biomass Fuel Cost, delivered (\$/Ton, wet)	\$18.00	Calculated			
(\$/MMBtu, HHV)	\$1.76	Calculated			
Dry Sawmill Hog fuel & Shavings (Tons/Yr)	0	Assumed			
Dry Sawmill Fuel Cost, delivered (\$/Ton, dry)	\$0.00	Assumed			
Wet Sawmill Fuel Cost, delivered (\$/Ton, wet)	\$0.00	Calculated			
(\$/MMBtu, HHV)	\$0.00	Calculated			
Annual Biomass Fuel Cost Escalation Rate (%)	3.0%	Assumed			
Federal/State Forest Thinning Subsidy (\$/Ton, wet)	\$0.00	Assumed			
U.S. Forest Service Lands - Thinning (Acres/Yr)	0	Assumed for forest thinning			
U.S. Forest Service Lands - Thinning (\$/Acre)	\$0	Assumed			
U.S. Bureau of Land Mgmt. - Thinning (Acres/Yr)	0	Assumed for juniper removal			
U.S. Bureau of Land Mgmt. - Thinning (\$/Acre)	\$0	Assumed			
<u>Ash Disposal Cost</u>					
Ash Disposal Cost (\$/Ton)	\$24.00	Design Criteria			
Annual Ash Disposal Cost Escalation Rate (%)	3.0%	Assumed			
<u>Wastewater (WW) Disposal Cost</u>					
WW Disposal Cost (\$/1000 Gallons)	\$3.25	Cost to discharge to a POTW			
WW Disposal Rate (Gpm)	30	Design Criteria			
Annual WW Disposal Cost Escalation Rate (%)	3.0%	Assumed			
<u>Revenue</u>					
<u>Export Process Steam Revenue</u>					
Process Steam Price (\$/1000 Lb)	\$0.00	Assumed			
Annual Process Steam Price Escalation Rate (%)	3.0%	Assumed			
<u>Export Power Sales Revenue</u>					
Electric Power Price (\$/kW-Hr)	\$0.0850	PURPA			
Annual Power Price Escalation Rate (%)	3.0%	Assumed			
<u>Renewable Energy Production Incentive</u>					
Renewable Energy Production Incentive (\$/kW-Hr)	\$0.000	Assumed			
<u>Carbon Emission Reduction Credit</u>					
Carbon Emission Reduction Credit (\$)	\$0				
Annual Carbon Credit Escalation Rate (%)	3.0%	Assumed			

## 2. Economic

5. Scenario #2 demonstrates that without a grant to offset capital costs, and assuming current power purchase rates, fuel cost would have to be as low as \$3.32/bdt in order to make the project financially viable.

(a) NOTE: Although this scenario is not viable, some form of State or Federal biomass fuel subsidy would have to be implemented in order to achieve these low rates.

Boise County Biomass			2.4 MW ORC Biomass Power System		
Parameter	Input Value	Comments	Summary of Results		
<u>General Plant Design Information</u>			<b>Net Cash Flow</b> <b>\$0</b>		
Biomass Plant Capacity (Lb/Hr, wet)	11,540	Design Criteria	-		
(Ton/Day, wet)	138	Calculated			
Biomass Ash Production (Lb/Hr)	692	Design Criteria	-		
(Ton/Day)	8	Calculated			
			<b>Capital Cost (\$2009)</b>	<b>Input Value</b>	<b>Comments</b>
			<b>Total EPC Contract (\$)</b>	<b>\$14,000,000</b>	Cost Estimate
			<b>(\$/kW)</b>	<b>\$5,809</b>	Calculated
			<b>(\$/Ton/Day)</b>	<b>\$101,098</b>	Calculated
Gross Power Output (kW)	2,410	LK-3 Heat Balance	Interest During Construction	<b>\$630,000</b>	Allowance
Gross Plant Heat Rate, HHV (Btu/kW-Hr)	24,421	Calculated	Plant Licenses/Environmental Permits	<b>\$280,000</b>	Allowance
Net Power Output(kW)	2,160	LK-3 Heat Balance	Preliminary Phase Costs	<b>\$150,000</b>	Allowance
Net Plant Heat Rate, HHV (Btu/kW-Hr)	27,247	Calculated	Sunk Cost	<b>\$0</b>	Allowance
Process Steam Output (Lb/Hr)	0	Design Criteria	Electrical Interconnection Studies	<b>\$25,000</b>	Allowance
Biomass Fuel HHV (Btu/Lb, wet)	5,100.0	Design Criteria	69kV Transmission Line Interconnect	<b>\$0</b>	Allowance
Biomass Moisture Content (wt.%)	40%	Design Criteria	Bond Fees	<b>\$0</b>	Allowance
Biomass Ash Content (wt.%, wet)	6.00%	Calculated	Developer Fees	<b>\$0</b>	Allowance
Annual Plant Capacity Factor (%)	95%	Assumed	Working Capital	<b>\$0</b>	Allowance
Annual Operating Hours	8,322	Calculated	<b>Total Installed Cost (\$)</b>	<b>\$15,085,000</b>	Calculated
			Federal/State Capital Cost Support (\$)	<b>\$0</b>	Assumed
			Project Financing	<b>\$301,700</b>	Allowance
			<b>Total Capital Cost Requirement (\$)</b>	<b>\$15,386,700</b>	Calculated
<u>Economic Factors</u>					
Equity Financed (%)	100.0%	Assumed			
Interest Rate on Debt (%)	5.0%	Assume Tax Exempt Financing			
<u>Operating Costs</u>					
<b>O&amp;M Cost</b>					
O&M Cost (\$/kW-Hr)	\$0.020	Assumed			
Annual O&M Cost Escalation Rate (%)	3.0%	Assumed			
<b>Biomass Fuel Cost</b>					
Dry Field Biomass Fuel Cost, delivered (\$/Ton, dry)	\$3.32	Design Criteria			
Wet Field Biomass Fuel Cost, delivered (\$/Ton, wet)	\$1.99	Calculated			
(\$/MMBtu, HHV)	\$0.20	Calculated			
Dry Sawmill Hog fuel & Shavings (Tons/Yr)	0	Assumed			
Dry Sawmill Fuel Cost, delivered (\$/Ton, dry)	\$0.00	Assumed			
Wet Sawmill Fuel Cost, delivered (\$/Ton, wet)	\$0.00	Calculated			
(\$/MMBtu, HHV)	\$0.00	Calculated			
Annual Biomass Fuel Cost Escalation Rate (%)	3.0%	Assumed			
Federal/State Forest Thinning Subsidy (\$/Ton, wet)	\$0.00	Assumed			
U.S. Forest Service Lands - Thinning (Acres/Yr)	0	Assumed for forest thinning			
U.S. Forest Service Lands - Thinning (\$/Acre)	\$0	Assumed			
U.S. Bureau of Land Mgmt. - Thinning (Acres/Yr)	0	Assumed for juniper removal			
U.S. Bureau of Land Mgmt. - Thinning (\$/Acre)	\$0	Assumed			
<b>Ash Disposal Cost</b>					
Ash Disposal Cost (\$/Ton)	\$24.00	Design Criteria			
Annual Ash Disposal Cost Escalation Rate (%)	3.0%	Assumed			
<b>Wastewater (WW) Disposal Cost</b>					
WW Disposal Cost (\$/1000 Gallons)	\$3.25	Cost to discharge to a POTW			
WW Disposal Rate (Gpm)	30	Design Criteria			
Annual WW Disposal Cost Escalation Rate (%)	3.0%	Assumed			
<u>Revenue</u>					
<b>Export Process Steam Revenue</b>					
Process Steam Price (\$/1000 Lb)	\$0.00	Assumed			
Annual Process Steam Price Escalation Rate (%)	3.0%	Assumed			
<b>Export Power Sales Revenue</b>					
Electric Power Price (\$/kW-Hr)	\$0.0850	PURPA			
Annual Power Price Escalation Rate (%)	3.0%	Assumed			
<b>Renewable Energy Production Incentive</b>					
Renewable Energy Production Incentive (\$/kW-Hr)	\$0.000	Assumed			
<b>Carbon Emission Reduction Credit</b>					
Carbon Emission Reduction Credit (\$)	\$0				
Annual Carbon Credit Escalation Rate (%)	3.0%	Assumed			

## 2. Economic

6. Scenario #3 demonstrates that without a grant to offset capital costs, and assuming current fuel purchase rates of \$30/bdt, power purchase rates would have to be increased to \$127.8/MW h in order to make the project financially viable.

(a) NOTE: Of all three scenarios, this option is the most likely as energy costs escalate over time and the value of renewable base-load power becomes more attractive. Many states already have power purchase rates significantly higher than this. At such time that power purchase rates increase to this level, then small-scale biomass projects will become more viable, particularly if the Federal lands policy evolves to provide for sustainable forest practices supporting biomass waste recovery.

Boise County Biomass			2.4 MW ORC Biomass Power System		
Parameter	Input Value	Comments	Summary of Results		
<u>General Plant Design Information</u>			<b>Net Cash Flow</b>		<b>\$0</b>
Biomass Plant Capacity (Lb/Hr, wet)	<b>11,540</b>	Design Criteria			
(Ton/Day, wet)	<b>138</b>	Calculated			
Biomass Ash Production (Lb/Hr)	<b>692</b>	Design Criteria			
(Ton/Day)	<b>8</b>	Calculated			
			<b>Capital Cost (\$2009)</b>	<b>Input Value</b>	<b>Comments</b>
			<b>Total EPC Contract (\$)</b>	<b>\$14,000,000</b>	Cost Estimate
			<b>(\$/kW)</b>	<b>\$5,809</b>	Calculated
			<b>(\$/Ton/Day)</b>	<b>\$101,098</b>	Calculated
Gross Power Output (kW)	<b>2,410</b>	LK-3 Heat Balance	Interest During Construction	<b>\$630,000</b>	Allowance
Gross Plant Heat Rate, HHV (Btu/kW-Hr)	<b>24,421</b>	Calculated	Plant Licenses/Environmental Permits	<b>\$280,000</b>	Allowance
Net Power Output(kW)	<b>2,160</b>	LK-3 Heat Balance	Preliminary Phase Costs	<b>\$150,000</b>	Allowance
Net Plant Heat Rate, HHV (Btu/kW-Hr)	<b>27,247</b>	Calculated	Sunk Cost	<b>\$0</b>	Allowance
Process Steam Output (Lb/Hr)	<b>0</b>	Design Criteria	Electrical Interconnection Studies	<b>\$25,000</b>	Allowance
Biomass Fuel HHV (Btu/Lb, wet)	<b>5,100.0</b>	Design Criteria	69kV Transmission Line Interconnect	<b>\$0</b>	Allowance
Biomass Moisture Content (wt.%)	<b>40%</b>	Design Criteria	Bond Fees	<b>\$0</b>	Allowance
Biomass Ash Content (wt.%, wet)	<b>6.00%</b>	Calculated	Developer Fees	<b>\$0</b>	Allowance
Annual Plant Capacity Factor (%)	<b>95%</b>	Assumed	Working Capital	<b>\$0</b>	Allowance
Annual Operating Hours	8,322	Calculated	<b>Total Installed Cost (\$)</b>	<b>\$15,085,000</b>	Calculated
<u>Economic Factors</u>			Federal/State Capital Cost Support (\$)	<b>\$0</b>	Assumed
Equity Financed (%)	<b>100.0%</b>	Assumed	Project Financing	<b>\$301,700</b>	Allowance
Interest Rate on Debt (%)	<b>5.0%</b>	Assume Tax Exempt Financing	<b>Total Capital Cost Requirement (\$)</b>	<b>\$15,386,700</b>	Calculated
<u>Operating Costs</u>					
<b>O&amp;M Cost</b>					
O&M Cost (\$/kW-Hr)	<b>\$0.020</b>	Assumed			
Annual O&M Cost Escalation Rate (%)	<b>3.0%</b>	Assumed			
<b>Biomass Fuel Cost</b>					
Dry Field Biomass Fuel Cost, delivered (\$/Ton, dry)	<b>\$30.00</b>	Design Criteria			
Wet Field Biomass Fuel Cost, delivered (\$/Ton, wet)	<b>\$18.00</b>	Calculated			
(\$/MMBtu, HHV)	<b>\$1.76</b>	Calculated			
Dry Sawmill Hog fuel & Shavings (Tons/Yr)	<b>0</b>	Assumed			
Dry Sawmill Fuel Cost, delivered (\$/Ton, dry)	<b>\$0.00</b>	Assumed			
Wet Sawmill Fuel Cost, delivered (\$/Ton, wet)	<b>\$0.00</b>	Calculated			
(\$/MMBtu, HHV)	<b>\$0.00</b>	Calculated			
Annual Biomass Fuel Cost Escalation Rate (%)	<b>3.0%</b>	Assumed			
Federal/State Forest Thinning Subsidy (\$/Ton, wet)	<b>\$0.00</b>	Assumed			
U.S. Forest Service Lands - Thinning (Acres/Yr)	<b>0</b>	Assumed for forest thinning			
U.S. Forest Service Lands - Thinning (\$/Acre)	<b>\$0</b>	Assumed			
U.S. Bureau of Land Mgmt. - Thinning (Acres/Yr)	<b>0</b>	Assumed for juniper removal			
U.S. Bureau of Land Mgmt. - Thinning (\$/Acre)	<b>\$0</b>	Assumed			
<b>Ash Disposal Cost</b>					
Ash Disposal Cost (\$/Ton)	<b>\$24.00</b>	Design Criteria			
Annual Ash Disposal Cost Escalation Rate (%)	<b>3.0%</b>	Assumed			
<b>Wastewater (WW) Disposal Cost</b>					
WW Disposal Cost (\$/1000 Gallons)	<b>\$3.25</b>	Cost to discharge to a POTW			
WW Disposal Rate (Gpm)	<b>30</b>	Design Criteria			
Annual WW Disposal Cost Escalation Rate (%)	<b>3.0%</b>	Assumed			
<u>Revenue</u>					
<b>Export Process Steam Revenue</b>					
Process Steam Price (\$/1000 Lb)	<b>\$0.00</b>	Assumed			
Annual Process Steam Price Escalation Rate (%)	<b>3.0%</b>	Assumed			
<b>Export Power Sales Revenue</b>					
Electric Power Price (\$/kW-Hr)	<b>\$0.1278</b>	PURPA			
Annual Power Price Escalation Rate (%)	<b>3.0%</b>	Assumed			
<b>Renewable Energy Production Incentive</b>					
Renewable Energy Production Incentive (\$/kW-Hr)	<b>\$0.000</b>	Assumed			
<b>Carbon Emission Reduction Credit</b>					
Carbon Emission Reduction Credit (\$)	<b>\$0</b>				
Annual Carbon Credit Escalation Rate (%)	<b>3.0%</b>	Assumed			

# 2. Economic

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## DETAILED ANALYSIS & DESCRIPTION OF ANNUAL PROJECT REVENUES & EXPENSES

*Provide a detailed analysis and description of annual project revenues and expenses over the useful life of the project.*

Please reference the three Pro Forma on the previous pages for this information.

## DETAILED DESCRIPTION OF APPLICABLE INVESTMENT INCENTIVES, PRODUCTIVITY INCENTIVES, LOANS & GRANTS

*Provide a detailed description of applicable investment incentives, productivity incentives, loans, and grants.*

As noted above, if fuel becomes available on a long-term basis with sufficient credit-worthiness, then it may be advisable to seek a large Federal grant to offset the capital cost shortfalls due to cost of fuel and low cost of power purchase rates. Biomass Crop Assistance Programs could reduce the cost of fuel for the short term but not for the entire term of the project. Rural development loan guarantees may be of some value as well.

## OTHER PROJECT AUTHORITIES & SUBSIDIES

Identify any other project authorities and subsidies that affect the project.

Recognizing that without a significant increase in purchased power for performance or unreasonably cheap fuel, this project requires approximately \$12M in capital assistance, most likely come from a Federal grant. However, such grants would not be available until sufficient, long-term fuel supplies could be validated and guaranteed. Without this extra funding the project is not feasible. Should the cost-avoided rates for purchased power be increased in the future, then a small-scale biomass project would become financially feasible (assuming adequate fuel supply).

# 3

## Market Feasibility

# 3. Market Feasibility

## SALES ORGANIZATION & MANAGEMENT

*Provide information on the sales organization and management.*

As this plant is solely a CHP plant with no residual products, there is little need for sales or management organizations; however, the potential for thermal process heat would provide the opportunity for the city and county economic development organizations to publicize this as a means to attract companies looking for a stable, long-term process heat. The plant operations and management will be part of the operations team provided by the contractor. This project assumes an integrated DBOM company to provide a turnkey solution, inclusive of all organizational, operational, and management requirements. This plant is not integrated with any other manufacturing process or forest goods industry such as pellet production, etc.

The county has several options for this project:

- The public entity owns the plants (revenue bond);
- Shared ownership between public and private; or
- Strictly private ownership.

However, as discussed previously, the determining factor is driven almost entirely by the cost and financing structure relative to tax exempt or taxable entity. The Pro Forma are based on public entity bonding and running the project even if contractor provides some operational staff.

Idaho statute allows for public institutions to employ an integrated design-build process based on the design-build authority granted to public municipalities pursuant to I.C. §67-2309 and through the Energy Savings Performance Contracting statute I.C. §67-5711D. This provides public institutions a construction methodology that relies on qualifications and performance, rather than on the more frequently used Design-Bid-Build (“bid-spec” or “low-bid”). This is particularly important when implementing a project that requires an approach that ensures financial and operational success.

Integrated design-build is a method whereby a project’s design and construction are included within one contract and implemented by a turnkey prime contractor. This allows cost savings on a number of fronts. First, administration costs are lowered as there is only one contract to monitor. This is contrary to more traditional approaches where design, construction, and other needs are covered by several contracts. Second, the possibility of costly design changes may be eliminated, as construction and designs are done simultaneously. When unexpected design changes are needed, it is easier and less costly to alter the specifications during the design phase rather than ordering a change once the design phase is completed. In addition, by using a single contract for both design and construction, the owner does not have to coordinate the activities of the designer and builder, since one party is responsible for both functions. Design-build also enhances the quality of the work performed. In design-build, qualifications of the firm, not price, should be the determining factor for a public project.

## NATURE & EXTENT OF MARKET & MARKET AREA

*Discuss the nature and extent of market and market area...*

The outputs of this project are 20 or 25-year power purchase from Idaho Energy. Thermal heat may or may not be sold, depending on viable clients. The Power Purchase Agreement (PPA) will be negotiated and finalized with Idaho Power prior to project funding. In the case where there is an absence of anyone purchasing thermal heat, it will be reprocessed in the system, which will provide more power for purchase by Idaho Power.

Products are thermal heat and power which are secured in long-term purchase agreements. Any thermal heat purchases will be secured with investment-grade contracts. At this time, it is assumed that there will not be a market for thermal heat.

# 3. Market Feasibility

## MARKETING PLANS FOR SALE OF PROJECTED OUTPUT

*...and provide marketing plans for sale of projected output, including both the principle products and the by-products.*

As the only product to be sold is power, which would be secured in a PPA with Idaho Power, there is no need for any other marketing or sales plans, as there are not other marketable products. Nor is this plant associated with any other processed, manufactured or forest-product goods. However, it is envisioned that should the plant be implemented in the future, it would likely attract additional businesses that would benefit from the stable supply of waste process heat.

## EXTENT OF COMPETITION INCLUDING OTHER SIMILAR FACILITIES IN THE MARKET AREA

*Discuss the extent of competition including other similar facilities in the market area.*

To our knowledge there are no other projects that would compete with this facility. The single biggest impediment to this or any other plant in Idaho is that the vast majority of available fiber resides on public lands and policy restrictions make it impossible to secure on long-term basis. The fiber supply would not be in conflict or competition with other fiber supply chains.

## COMMITMENTS FROM CUSTOMERS OR BROKERS

*Identify commitments from customers or brokers for both the principle products and the by-products.*

Power Purchase Agreement will be secured with Idaho Power on a 20 or 25-year basis. This will be negotiated under the standard PURPA guidelines with approval coming from the Idaho PUC. There are no other ancillary products or services at this time. Thermal process may or may not be sold depending on viable clients capable of entering in to long-term contracts.

## RISKS RELATED TO THE ADVANCED BIOFUEL INDUSTRY, INCLUDING INDUSTRY STATUS

*Discuss all risks related to the advanced biofuel industry, including industry status.*

This project will not include any biofuel technology except the syngas that is produced as part of the pyrolysis process to be combusted for power generation either through turbines, ORC engines for IC Jenbacher engines. The highest risk associated with the long-term investment-grade supply of woody biomass.

# 4 Technical Feasibility

# 4. Technical

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## CONSTRAINTS OR LIMITATIONS IN FINANCIAL PROJECTIONS

*Identify any constraints or limitations in the financial projections...*

There are no known constraints or limitations of the financial projections. Please see the Pro Forma in Section 2. Economic Feasibility for more details.

This report includes three Pro Forma that demonstrate several key points associated with a small-scale biomass generation plant. Please see the Pro Forma in Section 2. Economic Feasibility for a detailed description on the financial assumptions.

## OTHER FACILITY OR DESIGN-RELATED FACTORS

*... and any other facility or design-related factors that might affect the success of the enterprise.*

On February 3, 2009, McKinstry applied to Idaho Power Company (IPC) for a Generator Interconnection Feasibility Study. The application was made for a total of 13MWs — one 10MW unit and one 3MW unit — in the Horseshoe bend territory. The study results were provided to McKinstry on May 29, 2009, and the results were that IPC did not have adequate transmission capacity to serve this project.

Although the constraints for a 13MW plant were centered on the N-1 contingencies and the potential of a voltage issue that could result from this generation, these constraints could be mitigated if the IPC facilities were upgraded considerably. The study cited two solutions for the constraints:

- the transfer of generation at estimated costs of \$4M
- to upgrade the tripping of the generation at a cost of \$1.3M

Regardless of the capacity constraint, another added cost to the project would be for a line extension that will cost approximately \$250K. All of these costs would be a direct charge to the generating facility.

It is fair to assume that the capacity of existing infrastructure is no more than 3MW. However, actual capacity (3MW or less) has not been determined, nor has the applications to reserve or upgrade infrastructure been pursued.

# 4. Technical

Once a plant has been determined to be financially feasible, determining capacity constraints requires a substantial amount of time and resources, inclusive of long-term investment-grade source of fuel over a 20-year period. Since a 20-year investment-grade source of fuel does not exist, the application process is not reasonable to pursue at this time. Therefore, for the purpose of this study, it is determined that no further capacity analysis is required beyond the preliminary investigation that determined the Horseshoe Bend site as best logistical location.

Since the project was intentionally sized to be approximately 3MW (in order to reduce the volume demand for long-term fuel contracts), the apparent line capacity of 3MW is not in conflict to the proposed intent of the project. In the event that a long-term fuel supply can be established and verified, and should the county wish to proceed with the development of said project, a detailed transmission study can be implemented at that time.

## PROJECT OPERATION & DEVELOPMENT COSTS

*Identify and estimate project operation and development costs...*

For the technology portion of the report, McKinstry solicited Nexterra’s expertise. Nexterra Systems Corp., based in Vancouver BC, develops, manufactures, and delivers advanced gasification systems that enable customers to self-generate clean, low cost heat and power at industrial and institutional facilities using waste fuels.

Nexterra concludes the best model for a biomass power generation project is a small-scale biomass Organic Rankine Cycle (or future IC Engine) CHP (500 KW–2.5MWe) system.

Live bottom trucks will deposit wood fuel or dump trucks into a live bottom fuel storage and reclaim. Fuel is conveyed from the fuel storage bin to the gasifier, where it is converted into syngas. The syngas is drawn into a thermal oxidizer where it is completely combusted. The hot products of combustion are directed into a thermal oil system to produce 48 MMBtu/h of thermal oil to drive an Organic Rankin Cycle (CHP mode).

### *Advantages of Proposed System*

Gasification offers the following advantages:

<p><i>Ultra Low Emissions</i></p>	<p>Gasification is a much cleaner method of deriving heat from biomass compared to conventional mass burning/incineration systems. The system will be designed as a minimum to meet local emission permit levels and the proposed EPA MACT guidelines.</p> <p>To minimize particulate emissions, the flue gas exhausted from the boiler will be cleaned with an electrostatic precipitator. Nexterra systems can produce the lowest emissions feasible from any biomass energy system of similar scale, including PM, CO, VOCs and NOx. Nexterra gasification systems produce VOC and CO emissions that are lower than expected from natural gas fired boilers. Nexterra’s ability to stage the combustion of its syngas results in lower NOx production than can be achieved with conventional combustion systems. Finally, because of its inherently low emissions, gasification is preferred by community and environmental groups.</p>
<p><i>Fuel Flexibility</i></p>	<p>Nexterra’s gasification technology offers several advantages for converting wood biomass into energy when compared to conventional combustion technologies. Nexterra’s technology has demonstrated that it can operate on fuel with moisture content ranging from 6 - 60%. Conventional biomass combustion systems cannot handle such a broad range of moisture content with the same system. This broad range of fuel moisture content means that the lowest cost fuel available can be utilized. For example, expensive wood pellets or chips are not required, but low cost clean construction debris, land clearing debris, and other waste streams may be utilized.</p>

# 4. Technical

A Turboden ORC system driven by a Nexterra's biomass gasification systems offers additional power generation advantages:

<i>Technical Benefits</i>	Very high turbine efficiency (up to 85 %) in CHP mode
	Low mechanical stress of the turbine, no erosion of blades equating to long system life
<i>Operational Benefits</i>	Simple start-stop procedures
	Minimum maintenance requirements
	No extra technical competences needed for ORC operations (different from high pressure steam boilers & turbines)
	Labour cost advantage - No steam engineers required
	System turndown performance at partial load (system can operate down to 20% of the nominal load)
	Very high availability and reliability

### *Order of Magnitude System Costing*

The approximate price range for a biomass gasification CHP system with a capacity to produce 2.4 MWe (gross) and 12.5MWth is as follows:

Fuel Storage & Reclaim	\$400,000 - \$700,000
Gasification System & Emission Control	\$3.5 MM - \$5 MM
ORC Power Generation	\$2.5 MM - \$3.5 MM
Installation	\$2 MM - \$3 MM
<b>Total Installed Cost</b>	<b>\$8.4 MM - \$12.2 MM</b>
Plus Building & Foundations	\$1.5 MM - \$2.5MM
<b>Potential Project Cost</b>	<b>\$9,900,000 - \$14,700,000</b>

Nexterra's pricing is order of magnitude. Pricing ranges are based on an assumed scope of supply outlined in Section 5 of Nexterra's standard Terms and Conditions.

# 4. Technical

## CHP System Performance Specifications

Nexterra has developed a preliminary energy balance assuming the system conditions shown below. Nexterra has taken into account the expected parasitic load losses of the entire gasification system including the quoted fuel storage and handling system.

Variable	Value	Units
Gross Power Output	2.41	MWe
Parasitic Load	410	KWe
Gross Power Output	2.0	MWe
Supply Temperature	110	deg C
Return Temperature	85	deg C
Stack Temperature	177	deg C
Net Usable Heat	12.5	MWth
Fuel Higher Heating Value (bone dry)*	8,225	Btu/lb
Fuel Moisture Content (wet basis)	40	%
Fuel Ash Content (assumed, bone dry)	4	%
Fuel Consumption Per Hour (green – as fired)	6.28	tonnes/hr
Annual Operating Hours**	8,400	hrs
Hourly Ash Production	0.15	tonnes/hr

## Nexterra Typical Scope of Supply

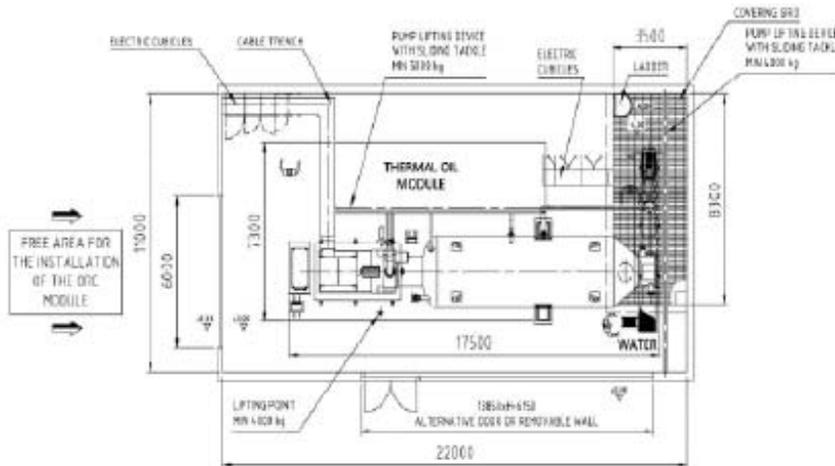
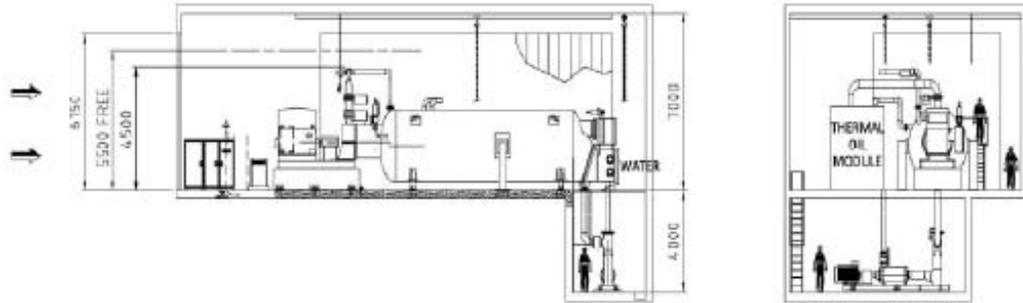
Nexterra's scope of equipment and services for the 2.4 MWe (gross) CHP System is as follows:

- Live bottom fuel storage bin
- Fuel bin out feed conveyor
- Disc screen and magnet
- Conveyor to metering bins
- Metering bins (2)
- Gasifier (16 ft. ID) (2)
- Syngas ignition burners (2)
- Syngas ducts from gasifier to thermal oxidizer
- Thermal oxidizer
- Combustion air fans and ducts
- Ash collection and conveying system to enclosed, sealed ash bins
- Ash bins (2)
- Thermal oil heater, complete with oil circulation system
- ID fan
- Electrostatic precipitator
- Stack
- Condensing economizer – 1 MWth
- Flue gas recirculation system
- Turboden 22 CHP Organic Rankin Cycle system
- Platforms, ladders and stairways
- Refractory, shipped loose for all required components
- Control software & PLC hardware
- MCC and motors
- Architectural pre-engineered metal building
- Freight
- Engineering
- Commissioning, start-up and training
- Spare parts

# System Layout

Turboden s.r.l.  
 Via Cernaia, 10 - 25124 Brescia, Italia  
 tel +390303552001 - fax +390303552011  
 info@turboden.it www.turboden.it

## Turboden 22-CHP/HR ORC room example



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We recommend to install the ORC module in a dedicated room, separated from the boiler room. This is meant to assure a proper ventilation of the ORC room, to protect it from powder or fire events which may be generated from items not supplied by Turboden. All dimensions indicated on the drawing must be considered as minimal space requirements for a standard installation. Spaces for water and thermal oil circulating systems, power connections, other customer side equipments and optional devices are not considered.

Cod. 06Q00087

# 4. Technical

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Typical installation includes:

- Mechanical and electrical installation
- Refractory installation
- Foundations for equipment and building

### *Typical Emission Level Guarantees*

Subject to the fuel composition meeting the requirements of Nexterra fuels specifications, the system specified will have the following guaranteed emissions performance:

Flue Gas Constituent	Rate (lbs/MMBtu)
Particulate (PM)	0.010
CO	0.050
NOx*	0.200*
VOC	0.010

### *Approximate Building Description & Footprint*

The recommended building would be an architecturally pleasing; pre fabricated steel clad building very similar to the current building at Dockside Green. Please see the proposed facility layout on the opposite page. The approximate fuel handling and building footprints are listed below:

- Building footprint: 130 ft by 65 ft.
- Fuel Handling Footprint: 60 ft by 70 ft.

### *Maintenance Cost*

Nexterra systems are designed and built to industrial standards and require minimal scheduled maintenance. Nexterra has developed a detailed estimating tool for establishing long-term maintenance costs. Over a 15 - 20 year period Nexterra estimates the cost to maintain the system will be approximately 1.5% of installed initial capital cost or:

- CHP 2.4 MWe System: \$110,000 - \$150,000/yr

This figure is used to develop the preliminary business case. More detail can be provided if required.

ORC maintenance costs are approximately an additional \$20,000 - \$25,000/year and this includes remote supervision of the ORC and remote assistance to the client, planned maintenance (typically once or twice a year during one day), and replacement of parts subject to wear.

# 4. Technical

## Budget Cost (Based on Nexterra Proposal dated 2/18/11)

Description	Cost Range	Remarks
Fuel storage & reclaim	\$550,000	
Gasification system & emission control	\$4,250,000	
ORC power generation	\$3,000,000	
Installation	<u>\$2,500,000</u>	
<b>Nexterra Installed Cost</b>	<b>\$10,300,000</b>	
Plus Building & Foundations	\$2,000,000	from Nexterra Proposal 2/18/11
Interconnection Cost	\$174,125	
Permits	\$283,593	based upon factored estimate
Water, Storm, Sewer improvements	\$126,000	based upon historical data and similar projects
Geo/Site work	\$358,200	based upon historical data and similar projects
Utilities	\$119,400	based upon historical data and similar projects
General Conditions	<u>\$1,723,682</u>	based upon historical data and similar projects
<b>Total Cost</b>	<b>\$15,085,000</b>	Note: Does not include Management Reserve of 15%

# 4. Technical

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## LEVEL OF ACCURACY OF ESTIMATES & ASSUMPTIONS

...and specify the level of accuracy of these estimates and the assumptions on which these estimates have been based.

This estimate is intended to portray an estimated price for the project based upon similar projects, budgetary pricing from equipment, material suppliers, historical proposals where applicable and locally adjusted unit cost items based on preliminary layouts, sketches, typical drawings, and some factored estimate items.

This estimate is based upon budgets and general arrangements provided by Nexterra for the ORC and Gasifier options of the proposed facility. Some historical data from similar projects components were used where appropriate and were modified to fit our present understanding of the project. Additionally elements were obtained by using a stochastic estimating method, in this case, a factored estimate.

The estimate should be considered as a Class 5 estimate according to the AACE International Estimate Classification System. This estimate is intended to provide the feasibility study a component in the assessment of initial viability of the project with a focus on the evaluation of resource needs and budgeting. ANSI Standard Reference Z94.2-1989 Name: Order of Magnitude Estimate.

### *Management Reserve*

If the project needs to provide an allowance for anticipated changes in scope, or to cover the costs for items that may be required but have not yet been specifically identified as being included in the current project scope, then that amount of cost, typically referred to as management reserve, should be identified and inserted by the county. Our recommendation given the early stage the project is the amount should be 18%; with the understanding the county needs to use this amount as a guideline to handle any anticipated changes or items may be required but not specifically identified. Please note these are not "Wish List" items but essentials.

Nexterra provided the base estimate and general arrangements. Those items not provided for in the Nexterra proposal were based upon a historical experience and similar projects by Mark Miller (please see resume provided later in this report).

## ABILITY OF THE PROPOSED SYSTEM TO BE COMMERCIALY REPLICATED

*Discuss the ability of the proposed system to be commercially replicated.*

This system is completely replicable that fits the cost of fuel criteria. Nothing about this system is unique or unobtainable. This system is also scalable. At current power purchase rates a 3MW project is financially unfeasible until cost-avoided rates meet or exceed \$128 per MW h. The greatest limitation is availability of fuel.

# 4. Technical

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## CONSTRUCTION RISKS

*Discuss all risks related to construction of the project...*

Planning and addressing risks for future construction projects has always been a somewhat uncertain venture due to the multiple variables that can have a significant impact on the cost, schedule, and quality of a project. The following are the most common risks associated with the construction of the project:

- Finalizing Heat and Mass balance calculations to verify project performance;
- Finalizing fuel specification, analysis and logistics;
- Obtaining air quality permits;
- Preliminary site layout and building general arrangement;
- Floor and elevation drawings;
- Meeting public comment criteria and garnering sufficient public support;
- Successfully implementing a project support campaign for a municipal revenue bond election as required by the Idaho Constitution relative to long-term public debt
- Obtaining finalization for Power Purchase Agreement & interconnection study;
- Finalizing green tag and carbon offset sale;
- Verifying motor and general equipment list; and
- Preliminary structural load analysis.

The risk for projects such as the biomass project proposed for Boise County is in costing a project that is two years in the future that will require a significant contingency factor included in the cost, which increases the cost to the project.

Manufacturers and suppliers of construction materials and production equipment have had to make severe adjustments in their work approach to keep up with the recent downturn in the world's economy. This forced many manufacturers and suppliers to dramatically cut their work forces and reduce production. Initially the impact was reduced demand and production. With the economy now starting to show some signs of recovery manufacturers and suppliers are very cautious about increasing their production until they are confident that the demand for their products will be stable or increase.

The risk to construction is that prices for materials and equipment have increased recently due to more demand chasing fewer resources. Recently we were told by both turbine and boiler manufacturers that increased demand has extended delivery time and in some cases increased the cost of the product.

The Turbine and Turbine Generating Industry is projecting a steady increase in demand through 2014 but very few manufacturers are looking to greatly increase their work force or facilities to meet the demand. The government recently commented that they do not foresee the unemployment rate returning to 5 % prior to 2015. The risk for the Biomass Industry is that we will probably see both increasing cost and delivery equipment, which will increase the cost of the project.

With the rise of China and India and the associated increase in demand we are also seeing an increase in the cost of materials such as copper and stainless steel. The increase in the cost of gas will also increase the cost of transporting products and/or increased cost of products made from petroleum.

# 4. Technical

## REGULATION & GOVERNMENTAL ACTION

*...and regulation and governmental action as they affect the technical feasibility of the project.*

Air quality is always a concern whenever you plan an industrial or commercial facility. A biomass power plant is no different from any other major facility. Idaho DEQ and Federal EPA regulations must be followed but aside from these regulatory a power plant should not degrade the quality of life in the area it is operating. Air quality considerations must meet or exceed regulations and at the same time not degrade the environment for local residents.

There are two special categories concerning atmospheric emissions. The first one is a nonattainment area – an area that already has EPA documented air quality issues. Nonattainment areas show violation or near violation of current EPA air quality standards; and they have air quality issues because either there are excessive pollutants being dumped into the atmosphere or the areas have poor emission dissipation rates. The second special category is a Class 1 area – National Parks, National Recreation Areas, and Wilderness Areas. Class 1 areas have pristine conditions and air quality degradation is severely restricted. While Boise County does not fall under the nonattainment status it does have some restrictions due to the proximity of Class 1 areas.

Since fine particles are frequently transported hundreds of miles, all 50 states—including those that do not have Class I areas—will have to participate in planning, analysis, and in many cases, emission control programs under the regional haze regulations. Steps states take to implement these regulations are expected to have the additional benefit of improving visibility and health in broad areas across the country, including in our cities and towns.

Visibility conditions in Idaho are among the best in the nation, according to data compiled by an interagency monitoring network. As required by the federal regional haze rule, DEQ has prepared a regional haze state implementation plan, which outlines the actions Idaho will take to ensure prevention of any future impairment of visibility in its Class I areas. DEQ anticipates that emission reductions resulting from current permitting, air shed plan development, and smoke management programs will enable the state to achieve the majority of the goals set forth in the rule.

Idaho DEQ has a process in place to apply and receive an air quality permit. This process involves modeling plant emissions and how they will affect the local and regional environment. There are several methods of modeling a facility. The models involve emission rates predicted from the facility and dispersion rates of those emissions. With this modeling the effect the facility will have on the local and regional environment can be accurately predicted and measured. This prediction of environmental effect is how Idaho DEQ handles the permit application; either deciding or approving the permit.

Idaho DEQ is accepting air quality permit applications without restriction in Boise County. Just because DEQ will accept applications does not mean an application will be approved.

# 5 Financial Feasibility

# 5. Financial Feasibility

## RELIABILITY OF THE FINANCIAL PROJECTIONS

*Discuss the reliability of the financial projections...*

The net operating cash flow that is available from the project will be used to pay the debt service. If the net operating cash flow is not sufficient to meet all principal and interest obligations for the term of the project, then either upfront capital will need to be contributed, power purchase rates will need to be higher, or fuel cost will need to come down.

Patrick Farley and Taylor Halliday of McKinstry Capital provided the financial projects contained in Section 2. Economic Feasibility. McKinstry Capital is well versed in public project finance and has been integral in structuring in many energy related projects, through not only evaluating the feasibility but also arranging the financing for them as well. Please see the resumes provided later in this report for more information on their qualifications.

## ASSUMPTIONS OF FINANCIAL STATEMENTS

*...and assumptions on which the financial statements are based including all sources of project capital both private or public, such as Federal funds.*

This report assumes tax-exempt funding in the form of a revenue bond initiated by the county. As required by the Idaho State Constitution, this would require a 66% or 2/3 majority vote of the eligible voting public to provide approval to the county to enter into long-term debt. It should be noted that this project has never assumed any tax obligation on the part of the constituents. The debt obligation would be met entirely from the guaranteed revenue associated with a 20 or 25-year power purchase agreement (PPA). The term of the revenue bond would be either 15 years in the event of a 20-year PPA, or 20 years in the event of a 25-year PPA.

Although there are potentially other funding mechanisms, particularly taxable debt, these are not explored at this time. Qualified Energy Conservation Bonds would be an alternative source of debt, but are available on a limited basis. In order to obtain a QECCB, the county would have to apply for an allocation. Due to the uncertainty of the availability of these debt vehicles, this analysis has used assumed revenue bonds.

In all cases the single most important component to successfully implement this project is securing a long-term investment-grade fuel contract to secure the guaranteed PPA. Credit-worthy resource allocation or a credit wrap provided by substantial landowners must be secured. Current lending standards will not tolerate any amount of risk associated with potential disruption of fuel supplies. As neither Federal nor State lands have the ability to provide long-term guarantees, all biomass resources residing on public lands has no value in securing this project.

This report includes three Pro Forma that demonstrate several key points associated with a small-scale biomass generation plant. Please see the Pro Forma in Section 2. Economic Feasibility for detailed descriptions.

## THREE YEARS PROJECTED BALANCE SHEETS, INCOME STATEMENTS & CASH FLOW PROJECTIONS

*Provide three years (minimum) projected Balance Sheets and Income Statements and cash flow projections for the life of the project.*

Please see the cash flows included in Section 2. Economic Feasibility. At this time, no other ancillary business is associated with this project.

# 5. Financial Feasibility

## ABILITY OF THE BUSINESS TO ACHIEVE THE PROJECTED INCOME & CASH FLOW

*Discuss the ability of the business to achieve the projected income and cash flow.*

The capacity of existing infrastructure provides for a plant no larger than 3MW. At current power purchase rates this becomes financially unfeasible without substantial capital assistance in the form of Federal grants. In lieu of this, power purchase rates must increase from \$88/MW h to \$130/MW h, which is not likely for several years (if ever). Additionally, there is no credit-worthy source for a 20-year investment-grade supply of fuel. Although there is an abundance of biomass resources – particularly on Federal lands, there is no policy allowing for the sustainable recovery of waste biomass from overgrown forests. Unfortunately, the present state of our forests may likely result in future catastrophic fires, with commensurate loss of property and even lives. Although the proposed Boise County biomass project would not solve this larger challenge, it could have a positive impact on the local economy and forest.

The following are three scenarios meant to demonstrate the cost requirements in order to make a small-scale biomass project feasible – none of which exist today (please see the Pro Formas in Section 2. Economic Feasibility for more details):

	Contributed Capital	\$/bdt	PPA Rate
Scenario #1	<b>\$11M-\$12M</b>	\$30.00/bdt	\$0.085
Scenario #2	\$0M	<b>\$3.32/bdt</b>	\$0.085
Scenario #3	\$0M	\$30.00/bdt	<b>\$0.1278</b>

## ASSESSMENT OF THE COST ACCOUNTING SYSTEM

*Provide an assessment of the cost accounting system.*

An assessment is normally completed on an annual reconciliation basis but the specifics are not provided at this level as the specifics are contingent upon the type of financing.

## AVAILABILITY OF SHORT-TERM CREDIT OR OTHER MEANS

*Discuss the availability of short-term credit or other means to meet reasonable business costs and the adequacy of raw materials and supplies.*

For this project, this section is not applicable. This project can only be implemented if it is secured against 20-year Power Purchase Agreement and minimum 20-year fuel supply. This would not be a pellet operation; it will be a power plant. This project assumes it will be fully funded including construction costs and commissioning and start up. The ongoing operational, fuel, and maintenance costs will come from annual revenue received from sale of power and possibly thermal heat. It is also assumed that this project will secure long-range investment-grade fuel contracts.

Fuel pricing should include annuity-based contracts that incorporate algorithms for fuel cost escalation or de-escalation, e.g., diesel, CPI, labor rates, etc. This may also include cash reserve escrow accounts that are set up to normalize pricing in years where escalation costs are extreme. This will provide sustainable annuity contracts for contractors that protect their financial interests, while maintaining fuel affordability and long-term stability. This model will focus on the lowest value fiber while emphasizing the energy value in terms of specifications, quality, moisture content, etc. The contractor will have to view this contract as an annuity that represents a small percentage of their total fiber contracts. As an annuity source it can protect the contractor from severe price/market declines but it also does not allow for the severe price/market spikes. Fuel suppliers may have to hold a performance bond as part of the contract.

# 5. Financial Feasibility

Construction period financing may be available for a project of this type, but many of the aspects discussed above (fuel price, PPA rate, construction pricing) need to be in place prior to soliciting lenders for short-term debt. If the project reaches a stage where these variables are known and there is will to proceed from the county, either a financial advisory firm or McKinstry Capital could begin to source short term, construction period, debt.

## SENSITIVITY ANALYSIS

*Provide a sensitivity analysis, including feedstock and energy costs.*

This project, as with most biomass projects, is sensitive to both the cost of fuel and the power purchase rate of electricity. As discussed above, if either variable can reach a certain price threshold, the project may prove viable.

## RISKS RELATED TO THE PROJECT, BORROWER FINANCING PLAN, OPERATIONAL UNITS & TAX ISSUES

*Discuss all risks related to the project, borrower financing plan, the operational units, and tax issues.*

As discussed throughout this report, the risk is the availability of an adequate fuel source.

Although there are potentially other funding mechanisms, particularly taxable debt, these are not explored at this time – nor would they make a significant difference in the financial feasibility of the project.

In all cases the single most important component to successfully implement this project is securing a long-term investment-grade fuel contract to secure the guaranteed PPA. Credit-worthy resource allocation or a credit wrap provided by substantial landowners must be secured. Current lending standards will not tolerate any amount of risk associated with potential disruption of fuel supplies. As neither Federal nor State lands have the ability to provide long-term guarantees, all biomass resources residing on public lands has no value in securing this project.

# 6 Management Feasibility

# 6. Management

## CONTINUITY & ADEQUACY OF MANAGEMENT

*Discuss the continuity & adequacy of management.*

Nexterra's gasification technology is simple, easy to maintain and highly automated. The system is efficient and reliable. It is designed to operate 350 days per year, with one planned maintenance outage every 6 months.

### *Operational Staff Requirements*

The gasification system proposed will operate automatically with minimal operator intervention. An easy to use and understand control system will provide the operator with all pertinent operating data and historic records. The operator can quickly assess the performance of the system from the control room. All operating personnel will be fully trained by experienced and qualified the contractor's trainers.

Regarding operation of the ORC equipment, the ORC plant is fully automatic in normal operating conditions as well as in shut down procedures without any need of supervision personnel. In case of fault conditions with system influencing effects, the ORC plant will be switched off automatically from the thermal oil circuit and from the electrical grid.

### *Modularity*

Nexterra systems can be installed in modular packages. Provision can be made for future expansion of the fuel storage bin, addition of gasifier units, as well as additional heat recovery and emission controls as the needs of the district energy system change.

### *Operations Support*

The contractor should have a dedicated customer support group to help customers with operational support and ensure maximum system uptime. In addition, the contractor can offer the following customer support:

- On-site operator training/technical support
- Remote system monitoring and technical support
- Onsite technical support for scheduled maintenances shutdowns

These will be bondable, trained professionals. The management plant will be based upon a 20-year sustainable operation plan.

### *Purchaser's Responsibilities*

The contractor would be responsible for the following scope of equipment and services:

- Delivery of fuel as specified to the receiving bin
- Site geotechnical
- Site preparation
- All boiler interconnects and hot water distribution piping
- Delivery of utilities to the gasification system, including electricity to the MCC and regulated gas supply to the ignition burners
- Securing permits to build and operate the gasification system
- Inspections and approvals outside of commissioning and start-up procedures
- Interconnection piping to hot water distribution infrastructure

# 6. Management

## *Projected Total Supply from Members & Non-Members*

The dependable operation of this facility is critical to ensure that there is no disruption in the power production against which the financial viability of the project depends. McKinstry will provide a combination of direct staff and contracted labor for the ongoing operations and maintenance of this facility. This will include the equipment-specific scheduled service needs relative to the technology provided (IC engines, ORC, etc.). This operations and maintenance program will be in place for a minimum of the term of the PPA.

## *Projected Competitive Demand for Raw Materials*

According to the Northwest Power and Conservation Council and the Biomass Power Association, there are only a few power facilities currently existing in Idaho (please see the maps on the opposite page). However, none of these facilities are located within the study resource area.

According to RISI, a 10 MW CHP biomass facility is planned for Yellowstone Power at the Emerald Forest Products sawmill facility in Emmett, Idaho. The table below summarizes the estimated size and fuel consumption requirement for the proposed facility. This fuel resource study assumed that the proposed Yellowstone Power biomass facility would be supplied exclusively with primary wood residuals from the Emerald Forest Products mill and therefore, if constructed, the biomass facility would not constitute a material draw upon the study resource areas.

Biomass Power Facility	Location	Size* (MW)	Est. Annual Consumption (bdt)	Est. Operation Date	Miles from Horseshoe Bend, ID
Yellowstone Power	Emmett, ID	10	58,000	4Q 2011	23

\*Source: RISI Wood Biomass Database. February 18, 2011.

\*\*Assumed 42% moisture content of estimated 100,000 green tons/year.

## *Procurement Plan & Projected Procurement Costs*

If pursued, the contractor will research and implement a revised financial model for fuel pricing that includes annuity-based contracts that incorporate algorithms for fuel cost escalation or de-escalation, e.g., diesel, CPI, labor rates, etc. This may also include cash reserve escrow accounts that are set up to normalize pricing in years where escalation costs are extreme. This will provide sustainable annuity contracts for contractors that protect their financial interests, while maintaining fuel affordability and long-term stability.

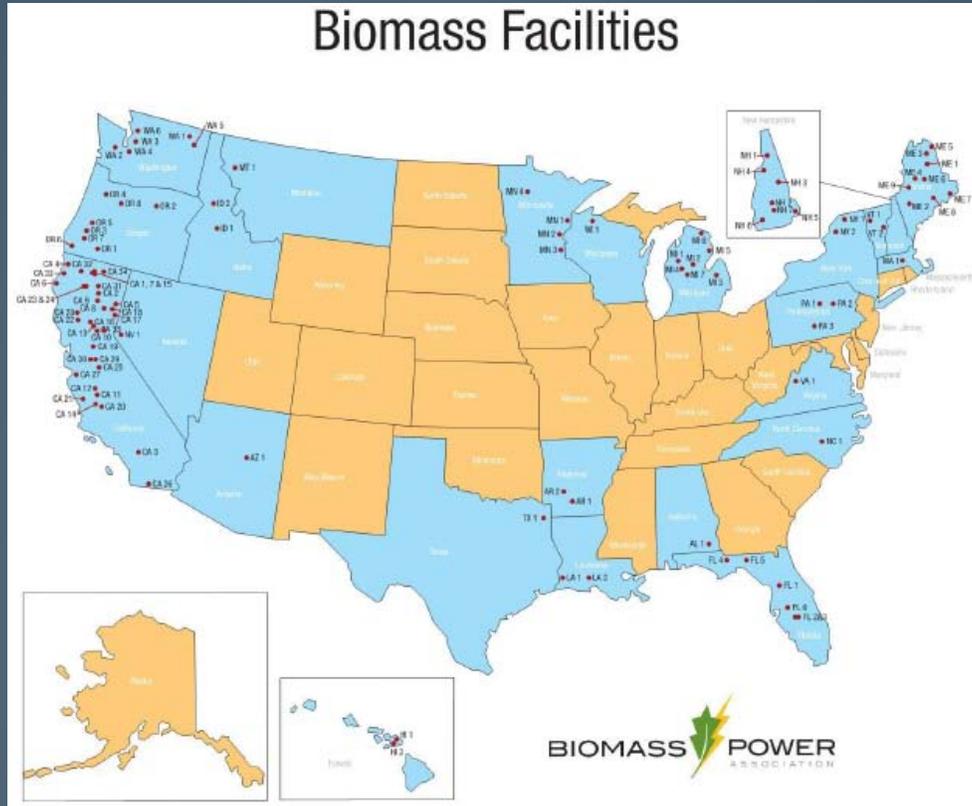
## *Form of Commitment of Raw Materials (Marketing Agreements, etc.)*

The projects only raw material agreements are the make-up water (which will be provided by the local utility) and the 24,000 bdt of woody biomass. In this case the woody biomass would be secured through a credit worthy source for a term equal to the PPA requirements. Pricing and delivery requirements will be fully bonded and will employ a structured cost mechanism which will control undue escalation by utilizing contractual mechanism for predictable algorithms for escalation and de-escalation — e.g. the cost of diesel, inflation, etc. However, these contracts will be structured on an annuity basis and may employ a third party credit wrap that include a “not to exceed” cost.

# Biomass Facilities



## Biomass Facilities



# 6. Management

## BORROWER/MANAGEMENT'S PREVIOUS EXPERIENCE WITH FEDERAL FINANCIAL ASSISTANCE

*Identify borrower and/or management's previous experience concerning the receipt of federal financial assistance, including amount of funding, date received, purpose, and outcome.*

McKinstry brings a wealth of knowledge acquired from experience with securing over \$45 million of ARRA funds since May 2009 supporting \$202 million in client projects. We have also secured over \$53 million in non-ARRA grants for our clients. We have experience throughout the spectrum of grant funding – we have been directly awarded grants, served as the general contractor for our grant-funded client projects, and/or simply served as a subcontractor on grant-funded projects.

McKinstry has attended and supported a handful of clients whom have been selected for a DOE on-site monitoring visit and audit. A report from a recent on-site visit praised our client with the following positive feedback:

- The monitoring team was pleased with the city's administration of the EECBG to date.
- The grantee provided a description and status of the current and proposed activities.
- Recipient is aware of Davis Bacon and Buy American requirements associated with the EECBG program.
- The grantee has demonstrated excellent management knowledge and understanding that includes passing EECBG terms and conditions through to bid specifications for contracted activities.

As an organization, McKinstry has received more than \$500,000 in ARRA funds, which is enough grant funding for a DOE audit of our own. With this in mind, we have developed internal processes to prepare us for a favorable audit.

McKinstry has been selected through a formal competitive process as an M&V Technical Contractor for the ARRA Funded Commercial Building Partnerships (CBPs) Program. The U.S. Department of Energy's (DOE) Commercial Building Partnerships (CBPs) reduce energy use across the entire U.S. commercial building sector using two key strategies:

- CBPs accelerate the deployment of energy efficiency measures by teaming organizations that have extensive building portfolios with researchers from DOE's national laboratories and technical experts from the private sector to design, construct, and validate low-energy building designs. Building owners and operators apply what they learn across their building portfolios. In addition, participants will document successes and lessons learned in publicly available case studies, which non-CBP building owners and operators can use to reduce energy use in their buildings.
- CBPs engage private-sector technical experts to assist participating organizations in the development of energy-efficient building designs. Bringing the private sector into the process increases the likelihood that the energy-efficiency measures and strategies used in CBP projects will move into the marketplace quickly and cost-effectively.

The work performed under this award will be performed in conjunction with Lawrence Berkeley National Laboratory (LBNL), the National Renewable Energy Laboratory (NREL), and the Pacific Northwest National Laboratory (PNNL). McKinstry will provide technical expertise to support measurement and verification to support CBP target goals of actual, measured energy savings of over 50% for new construction and 30% for existing buildings when compared to currently established baselines.

In addition, McKinstry completes 80% of business with public entities.

# 6. Management

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## RISKS RELATED TO THE BORROWER

*Discuss all risks related to the borrower as a company (i.e. Development-Stage) and conflicts of interest, including appearances of conflicts of interest.*

It is envisioned that this project will not be owned by county – will be owned by the Design/Build contractor. The financial risks are minimal because of 20-year nature of a Power Purchase Agreement. There is also an energy performance contract in effect that remedies any conflict of interest. In the industry a performance contract is considered an effective risk management tool.

In all cases the single most important component to successfully implement this project is securing a long-term investment-grade fuel contract to secure the guaranteed PPA. Credit-worthy resource allocation or a credit wrap provided by substantial landowners must be secured. Current lending standards will not tolerate any amount of risk associated with potential disruption of fuel supplies. As neither Federal nor State lands have the ability to provide long-term guarantees, all biomass resources residing on public lands has no value in securing this project.



# Qualifications

# 7. Qualifications

## RESUME, QUALIFICATIONS & EXPERIENCE OF AUTHOR

*Provide a resume or statement of qualifications of the author of the feasibility study, including prior experience.*

McKinstry is currently under contract for the engineering feasibility phases of a number of forest-based woody biomass CHP projects. These are design-build projects and include financial engineering and turnkey application, inclusive of design-build-own-operate-maintain (DBOOM) and design-build-operate-maintain (DBOM) options:



### **The Evergreen State College Woody Biomass Central Heating Plant**

Design and Installation of a 20,000 lbs/hrs central heating plant for TESC that will supply the entire campus heating demand. This system will utilize highly efficient ESP and SNCR NOX reduction technology that will make it the lowest emission biomass plant in the Western US.

### **University of Montana's Woody Biomass Central Heating Plant**

Design and Installation of a 30,000 lbs/hrs central heating plant for the University that will supply approximately 60% of the campus' peak heating demand. This system will utilize highly efficient ESP and SNCR NOX reduction technology that will make it perhaps the lowest emission biomass plant in the Mountain States.



### **South Park and Recreation District (CO)**

Design and Installation of a woody biomass boiler (pellets).

### **Shoshone County (ID) Renewable Energy Feasibility Study**

The purpose of the feasibility study was to determine the overall viability of a renewable energy facility in Shoshone County, which will be sized between 6–20MW depending on available fuel supply. .

### **Garden Valley School District (ID)**

Design and installation of a 2.8mmBTU school sized woody biomass boiler. This will use 600-900 tons of forest waste biomass per year. McKinstry obtained a \$2.75M USFS grant to implement this project.



### **City of Troy (MT)**

10 MW woody biomass. This will utilize healthy forest remediation as a source (pending contract).

### **South Routt School District (CO)**

Design and Installation of a woody biomass boiler (wood pellets). McKinstry's Colorado staff submitted grant applications on the district's behalf. Request for funding to the Department of Education, the Department of Local Affairs, and the Governor's Energy Office were submitted. In addition, McKinstry supported the district at numerous town hall meetings to pass a bond election. After a year of hard work to raise nearly \$3.8 million in grant and bond funding, this project became a reality in early 2008.



# 7. Qualifications



## University of Idaho

Construction of Biomass Fuel Storage and Drying Facility and a Remote Wood Chip Storage Facility. We are currently developing an 8MW plasma combustion biomass WTE facility.

## University of Idaho

Design and construction of a proposed 8MW plasma combustion CHP facility that will utilize both woody biomass and other University waste streams for conversion into energy and heat.



## Municipal Solid Waste-To-Energy – Private Projects

McKinstry is currently developing three 10-20MW municipal solid waste-to-energy (WTE) facilities, each of which has a component of biomass fuel from the local landfill. These projects are in partnership with technology companies and are subject to Non-Disclosure agreements.

## Enterprise School District (OR)

Design and Installation of a woody biomass boiler (wood chips).



## Snowflake White Mountain Power

New 24 MW Biomass Power Plant. Our contract was a professional services contract. We acted as the Owner's Representative during the project development, financing, design and procurement phases of the project.

## Biomass Products, LLC (ICG)

This project involved the design and construction of a new 20MW biomass power plant. The plant will utilize corn stover to generate electricity.

## BIOMASS FEASIBILITY STUDIES

McKinstry is also currently performing feasibility studies, assisting with project finance, and/or providing preliminary design services effort for the following projects:

- The University of Montana Biomass Gasifier Installation
- The Evergreen State College Biomass Gasifier Installation
- The Confederated Tribe of Warm Springs Indians New 20 MW Biomass Power Plant
- Shoshone County Biomass Feasibility Report
- Several other clients with whom we have non-disclosure agreements

## INDUSTRIAL BIOMASS

McKinstry's Industrial Construction Group projects completed in the past ten years include:

- Solar Turbines Rupert, Idaho Facility – New 10MW cogeneration plant
- Solar Turbines Glens Ferry, Idaho Facility – New 10MW cogeneration plant
- Georgia Pacific Toledo & Camas Facilities – New boiler & boiler rebuild
- Louisiana Pacific Thomasville, AL OSB Plant – Installation of a new biomass boiler.

# 7. Qualifications

As part of project development efforts, McKinstry is actively involved in public forest access policies, stewardship processes, and advocacy group collaborations. We are also driving the process to maximize the coupling of forest waste biomass resources – cyclic remediation – with base load energy plants in order to create a sustainable economic development and environmental remediation model.

Through McKinstry Capital, we monitor all federal CHP, biomass, and other alternative and renewable energy funding opportunities, incentives, tax credits, and grants. Where we see a match between a possible grant and project opportunity, we stand ready to immediately support our clients with grant writing strategies and support to maximize the probability of a successful grant application.

## RESUMES

Please see our team’s resumes immediately following this section for more information. We have provided resumes for:

David Naccarato

Karena Gilbert

Dan McCourt

Marvin Sauer

Keith Bucher

Mark Miller

John Rimer

Kevin Antonucci

Steve Brucker

Larry Persinger

Mike Porter

John Doherty

Mike Johnson

Patrick Farley

Mark Persinger

Joel Stobie

Todd Schaper

Jeff Fulcher

Jeff Davis



## EDUCATION

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- Masters in History, Eastern Washington University
- Bachelors in History, Eastern Washington University
- Bachelors in Anthropology, Western Washington University

## PROFESSIONAL AFFILIATIONS

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- Boise Metro Chamber of Commerce
- Boise Metro Chamber of Commerce Energy Task Force
- Idaho Governor's 25/25 Energy Task Force
- USFS Fuel for Schools
- Association of General Contractors
- Woody Biomass Utilization Group

## SPECIALTIES

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- Project & Business Development
- Demand & Supply-side Biomass Energy Projects
- Biomass, Geothermal, Solar and Anaerobic Digester Projects
- Regional Economic Development Projects
- Performance-Based Integrated Design-Build Construction Projects
- High-Performance Schools
- Industrial HVAC & Agri-Business Projects
- International Marketing, Sales & Project Development
- Innovative Financial Engineering, grants, incentives & utility rebates
- Demand & Supply Side Energy Management
- Integrated Community Partnerships
- Bond & Public Education Campaigns

## TENURE

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David has worked in the industry for more than 20 years.

## BUSINESS DEVELOPMENT MANAGER

David joined McKinstry in 2006 to manage business development and renewable energy projects for McKinstry's INW, Idaho, and Montana groups. David has been providing energy solutions since 2000, and has implemented over \$180 million in energy conservation, renewable energy, and infrastructure development projects. He has 25 years experience in business development throughout the US, Canada, Latin America, South America, East Asia, Europe, and the former Soviet Union. Twice Idaho's Governor has awarded him for his work in international business and trade.

David is the author of "Community Development Initiative" – a program designed to promote sustainable energy, infrastructure, and economic development solutions through public/private partnerships with institutions, universities, schools, communities and municipalities. David's expertise includes biomass, bio-fuels, renewable energy systems, energy conservation, and high-performance new construction. He is a strong supporter of integrated community partnerships focusing on sustainable economic and infrastructure development through the use of demand-side (conservation) and supply-side (generation) projects utilizing local energy resources (biomass, bio-fuels, geothermal, wind, solar, etc).

Mr. Naccarato specializes in financial solutions providing financial support through grants, incentives, and low-interest subsidies. To date he has assisted clients in obtaining over \$25 million in grants, incentives and financing subsidies. He is a frequent lecturer on biomass, renewable energy, business, and economic development.

## EXPERIENCE

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Blaine County (ID) Schools Energy Conservation & Geothermal Energy Project (\$30M)  
University of Montana Biomass Central Plant & Energy Conservation Project (\$10-20M)  
Garden Valley (ID) Schools Biomass Boiler Plant (\$3M)  
Boise County (ID) Biomass Generation Development Project (Est. \$15M)  
Shoshone County (ID) Biomass Generation Development Project (Est. \$35M)  
Caldwell (ID) Schools Energy Conservation & LEED New Construction Project (\$30M)  
University of Idaho Energy Conservation, Biomass & Facility Renovation Project (\$35M)  
Salmon (ID) Schools Energy Conservation Project (\$1M)  
City of Nampa (ID) Energy Conservation & Renewable Energy Project (Est. \$3-8M)  
Enterprise (OR) Schools Biomass & Energy Conservation Project (\$3M)  
Council (ID) School District Biomass & ESPC Project (\$3M)  
Kellogg (ID) School Biomass & Energy Conservation Project (\$10M)  
State of Idaho Capital Mall Energy Conservation Project (\$5M)  
Boise State University (ID) Energy Conservation Project (\$9M)  
Canyon County (ID) Energy Conservation Project (\$3M)  
Treasure Valley Community College (OR) Energy Conservation Project (3M)  
McCain Foods (Canada & Argentina) (\$2M)  
Cavendish Farms (Irving Corp. - Canada) (\$500K)  
PepsiCo Foods International (Poland, Korea, Turkey, China, Thailand) (\$4M)  
JR Simplot Company (WA & China) (\$2M)  
US AID Food Storage Project (Russia and Ukraine) (\$1M)  
Agricultural Storage & Refrigeration Project (Mexico) (\$1M)  
Lamb-Weston (Russia) (\$1M)  
Stover's Pommes-Frites (Germany) (\$500K)  
GOSAGROPROM & CENTROSOYUZ (USSR) (\$10M)



# Marvin Sauer



## EDUCATION

- Boise State University -Associates Degree in Electronic Technology
- Boise State University -ASHRAE Sponsored Refrigeration Design School

## ACCREDITATIONS

- Journeyman Electrical License

## SPECIALTIES

- Energy Efficient DDC controls design and commissioning
- System integration of DDC components
- Geothermal DDC Design
- Customer Training on DDC systems

## TENURE

Marvin has more than 20 years of experience in industrial and commercial direct digital control design.

## PROGRAM MANAGER

Marvin joined McKinstry in 2007 as a Commissioning Engineer for McKinstry Company's Idaho Branch, located in Boise. Since then, Marvin has successfully served in Energy Engineering, Project Design and Project Management roles. As Program Manager, Marvin's responsibilities include project management. He works directly and collaboratively with customers to develop projects from conception to the construction phase.

Many of Marvin's recent projects have involved woody biomass as a fuel source. An Idaho native, when Marvin joined McKinstry, he was responsible for commissioning services in throughout Idaho, Eastern Oregon, Washington and Western Montana. Marvin has been working with control systems for over 20 years and has been responsible for controls design, installation, startup and commissioning on various projects.

His project experience ranges from agricultural storage—involving millions of dollars worth of temperature, pressure, light, and humidity sensitive product—to lab environments in schools and hospitals. Key projects at Mountain Home Air Force Base included hangers for the B1 bombers requiring precise temperature and humidity control in the explosive environment of surface painting and fuel tank repair facilities. The target sighting and navigation equipment for these planes was calibrated in the Precision Measuring & Engineering Laboratory; Marvin designed, started, and commissioned the controls in this facility. Marvin has always seen system integration, customer support, and customer training as key to a successful project.

## EXPERIENCE

Idaho State Capital Mall - DDC, ESPC, and Geothermal	JR Simplot Company - DDC and HVAC Design
Boise State University - DDC, ESPC, and Geothermal	NAPI - DDC
Council School District - DDC, ESPC, and Biomass	McCain Food - Refrigeration UL Listing
Kellogg School District - DDC, ESPC, and Biomass	Lamb-Weston - DDC and Refrigeration
Snake River School District - ESPC	Rick's College - DDC and System Integration
Mountain Home AFB - DDC and System Integration	PepsiCo Food Int'l - DDC and HVAC Design
Treasure Valley Community College - DDC and System Integration	Emmett School District - DDC
Caldwell SD Energy Services - DDC design RCx & Cx	Caldwell SD New Construction- Design and Cx
Boise County Biomass CHP Study - Program Manager for Study	Lemhi County Biomass CHP Study - Program Manager for Study
Garden Valley SD Biomass - Program Manager	Basin School District Biomass - Program Manager
Blaine County SD ESPC - Program Manager	Blaine County SD Geothermal Study - Program Manager

# John Rimer



## EDUCATION

- Arizona State University - Bachelor's of Science, Mechanical Engineering, 1997

## SPECIALTIES

- Facility Engineering and Operations
- Maintenance Management Program Development & Consulting
- Predictive Maintenance
- CMMS
- Critical Environments Design and Management
- Emergency Response Management
- Commissioning
- Testing, Adjusting, & Balancing (TAB)
- Procedure Development
- Energy Management
- Facility and Program Auditing
- Facility Start-up & Training

## REFERENCES

Available upon request

## TENURE

John has worked in the industry since 1997.

## PROJECT DIRECTOR

John Rimer holds the position of Project Director and is the INW Technical Services Lead at McKinstry and is responsible for the Transition Services & Operations offerings for the Inland Northwest region. John has over 12 years' experience in facilities Operations & Maintenance in a wide variety of industries. He has in-depth experience in facility engineering and management, including maintenance management, commissioning, testing/adjusting/balancing (TAB), emergency response, computerized Maintenance Management System (CMMS) implementation and support, predictive maintenance, procedure development and management, and capital renewal planning.

John's expertise has supported a wide breadth of facility types and industries, including municipalities, higher education, K-12, data centers, biotech/pharmaceutical, high-tech/semi-conductor, pulp and paper, general manufacturing, and office spaces throughout the nation, including multiple LEED™ projects. He has a successful record of facility and program management and improvement. John takes a holistic approach to increasing operational efficiency and effectiveness and puts the best interest of the customer first.

Recent work has involved John in various engineering and management roles, such as program and project management and commissioning.

## EXPERIENCE

### Facility Operations & Maintenance Program Development: (Including Predictive Maintenance and CMMS implementation)

Agilent Technologies	Alcoa
Bermuda Electric Light Company	Boise Cascade
Budweiser	Dendreon
Intel	Kimberly Clark
Louisiana Pacific (LP)	Microsoft
Pioneer Cardboard	Rockwell Automation / Entek IRD
Sun Microsystems	Texas Utilities
US Borax	Weyerhaeuser

### Critical Environment Operations & Management: (data centers, computer labs, networks, telecomm, etc.)

Charles Schwab  
Washington Mutual  
Microsoft

### Commissioning, TAB, and Transitional Services:

Ada County	City of Boise
Garden Valley School District	Blaine County School District
Caldwell School District	Salmon School District
Boise State University	University of Idaho
City of Nampa	City of Payette

# Larry Persinger



## EDUCATION

- Georgia Institute of Technology, Bachelor of Science, Mechanical Engineering

## AFFILIATIONS

- CMAA (Construction Management Association of America)
- NWFPA (Northwest Food Processors Association)
- AACE International (The Association for the Advancement of Cost Engineering)

## QUALIFICATIONS

- Construction Management
- Program Management
- Marketing and Business Development
- Contract Negotiation
- Construction Industry Business Processes

## TENURE

Larry has worked in the industry since 1975.

## BUSINESS UNIT MANAGER

Larry Persinger holds the position of Business Unit Manager at McKinstry. Larry has over 35 years of experience in the construction industry in both the commercial and industrial arenas. He has worked in both field and office capacities ranging from project engineering to project management to corporate officer. Larry has been President of one of the 50 largest general contractors in the country, and Sr. Vice President of one of the ten largest electrical contractors in the U.S.

## PROJECT RELATED EXPERIENCE

### **Power Projects**

*The Evergreen State College:* Project management for a new 5 MW combined heat and power project.

*The University of Montana:* Project management for a new 5MW biomass combined heat and power project.

*Warm Springs Power:* Project development for a new 20MW biomass power plant currently in development.

*Snowflake White Mountain Power:* Preconstruction and financing activities for a new 24MW biomass power plant. Scope of work included budgeting, scheduling and purchasing functions.

*BioPro:* Program management activities for the development of two 20 MW biomass facilities including development, budgeting, scheduling, purchasing, construction management functions.

*Puget Power Corporation:* Project Manager for the construction of a new power generation flume for a hydro power plant. Flume is 10 miles long.

### **Pulp & Paper/Wood Products Projects**

*Georgia Pacific #6 Towel Machine:* Project controls and fluid supervision for new TAD machine at Wauna, OR.

*Louisiana Pacific OSB Plant:* Construction management for a new \$250 million OSB plant. Construction included a significant biomass boiler component.

### **High Tech Projects**

*Intel Corporation:* Various projects in all their manufacturing facilities in the Northwest and in Colorado Springs. Volume of work over \$30 million per year.

*Fred Hutchinson Cancer Research Center:* New research facility including labs, offices and animal spaces. Total cost of \$60 million.

### **Oil & Gas Projects**

*Chevron Co.:* Refinery maintenance projects over a period of three years.

*Rhodia Chemical:* New chemical process line installation.

### **Aerospace Projects**

*Boeing:* Airplane Development Center; \$115 million contract amount.

*Boeing Commercial Airplane Company:* Negotiated a permanent alliance with Boeing as one of four contractors to do all of Boeing's work nationwide.

# Mike Johnson, P.E.



## EDUCATION

- St. Martin's College, B.S.  
Mechanical Engineering

## ACCREDITATIONS

- Professional Engineering License (Mechanical) – Idaho
- Professional Engineering License (Mechanical) – Washington

## SPECIALTIES

- Project Development
- Performance-Based Contracting
- Energy and Resource Conservation
- Large Campus System Analysis
- EMCS System Evaluation & Optimization
- Facility Assessment
- Energy Engineering Studies
- Energy Simulation
- Project & Program Management
- Industrial Material Handling Equipment Design
- Mechanical System Design
- Electrical System Design
- Financial Analysis
- Securing Utility Rebates & Incentives

## TENURE

Mike has more than 16 years of Industry experience.

## OPERATIONS MANAGER

Mike Johnson joined the McKinstry team in April 2007, bringing with him vast knowledge and expertise in all aspects of development, engineering, and implementation of energy services and design/build projects. As Operations Manager, he is committed to his clients and provides them with a wide range of innovative and proven solutions to improve their facilities while conserving resources. Mike's demonstrated experience in the healthcare, educational, commercial, and industrial sectors, along with his customer service focus, ensures success in delivering the appropriate solution for all clientele.

Mike's career began in designing systems ranging from material handling equipment to traditional mechanical/electrical/data/plumbing systems. This experience provided a strong foundation and knowledge of the entire construction/fabrication process.

Approximately 12 years ago, Mike transitioned into the energy services and performance contracting market where he was responsible for engineering design, project management, and program management of numerous projects. During this timeframe he was also involved with financial engineering and assisted school districts with bond elections and public education campaigns.

Mike has been responsible for projects that range in value up to \$24,000,000 and span the classifications from simple systems to highly complex campus systems. His many years of experience in designing, building, and financially engineering projects allows for a creative approach that maximizes long-term or life cycle value for owners that reduce future cost impacts over multiple budget classifications.

## EXPERIENCE

Container Corporation of America  
State of Washington Capital Campus  
(multiple facilities)

Emerson Manner Assisted Living Facility –  
Hoquiam, WA

United States Postal Service (multiple  
facilities)

Chapel Hill Presbyterian Church

St. Peter Hospital – Olympia, WA

Pullman School District

St. Joseph Regional Medical Center –  
Lewiston, ID

Seattle Central Community College

Emmett School District

Tacoma Community College

Boise State University

State of Idaho – Capital Mall Campus

Council School District

Kellogg School District

Reynolds School District

Caldwell School District – Energy Services

Caldwell School District – Design/Build  
Construction

Group Health – Seattle Downtown Medical  
Center

# Joel Stobie



## EDUCATION

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- University of Idaho - Bachelors  
Science Mechanical Engineering

## SPECIALTIES

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- HVAC Building Modeling
- Measurement and Verification
- Building Auditing
- Energy Engineering
- Integrated Design-Build
- Program Management
- Renewable Energy Systems

## REFERENCES

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Available upon request

## TENURE

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Joel has worked in the industry since 2005.

## ENERGY ENGINEER

Joel has been with the McKinstry team since 2008 and brings to it four years of mechanical engineering experience. In the last two years with McKinstry he has led the Energy Engineering effort out of the Boise office, which has included building audits, savings calculations, and performance assurance. Joel previously spent a year as a design engineer gaining knowledge in mechanical and plumbing design. He also has experience in energy services and performance contracting. During this time he worked on several performance contracts including Boise State University, State of Idaho Capitol Mall, and Council School District. This experience with performance contracting has given him valuable knowledge of the PC process. Joel also has experience with renewable energy. During an Internship with the Idaho Energy Division, Joel conducted feasibility studies and site analysis for small scale wind power generation.

## EXPERIENCE

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Blaine County School District Performance Contract  
City of Ontario Performance Contract  
Salmon School District Performance Contract  
Boise State University Performance Contract  
State of Idaho – Capitol Mall Performance Contract  
Council School District Performance Contract and Biomass Boiler  
Snake River School District Performance Contract  
Kellogg Joint School District Performance Contract  
Portland Housing Authority Performance Contract  
Caldwell School District Performance Contract  
Garden Valley School District Biomass Performance Contract  
Yamhill Carlton School District Performance Contract  
Butte High School Energy Audit  
Dillon School District Energy Audit

# Jeff Fulcher, P.E.



## EDUCATION

- University of Idaho - Bachelors of Science Mechanical Engineering, 1998

## ACCREDITATIONS

- Professional Engineer - Mechanical ID, 2004

## PROFESSIONAL AFFILIATIONS

- ASHRAE President – Idaho 2008 - 2009

## SPECIALTIES

- Performance-Based Contracting
- Mechanical Systems Design
- Complex Systems Investigations
- Project Development
- Energy and Resource Conservation
- Demand Side Management Programs
- Directed Engineering Studies

## REFERENCES

Available upon request

## TENURE

Jeff has worked in the industry since 1998.

## SENIOR PROGRAM MANAGER

Jeff is a Professional Engineer with considerable design experience and is very capable of making critical design decisions. He approaches each project with breadth of knowledge, flexibility, and specialized expertise resulting in both project and client satisfaction. His expertise has supported many schools, colleges, universities, hospitals, and commercial customers by providing energy efficient designs and management of complex central plant systems for both facility upgrades and new construction projects. Jeff is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs through various energy services offerings.

Jeff has had the opportunity to be involved with many of the interesting projects throughout the Inland Northwest. Jeff also serves as a Past-President of the Idaho chapter of ASHRAE, which works to provide energy conservation products and services, along with several valuable resources.

## KEY EXPERIENCE

- ✓ Engineer of Record on some of the most technical projects throughout the State
- ✓ Central Plant Systems
- ✓ University Level Laboratory Systems
- ✓ Energy Services

## EXPERIENCE

City of Nampa: This project consisted of auditing three of the largest facilities in Nampa, including the Idaho, Civic, and Recreation Centers. Detailed measure lists were then developed and will be implemented over the next several years.

Salmon High School: This energy project consisted of replacing the existing heat pumps, adding a new direct digital control system, a lighting retrofit, and replacing the grid and tile system in the hallway. The project was completed on time and under budget and included several add alternates.

Canyon Springs High School: The existing Van Buren Elementary School was fully remodeled to the new Canyon Springs High School for the Caldwell School District. This project included a new parking lot, ADA improvements, partition remodel, and a new fire alarm system.

Boise State University – Student Union Building: This 70,000 SF expansion and 160,000 SF renovation included a state of the art commercial kitchen, new high efficient central plant heating and cooling systems, and an energy efficient VAV system with central air handling units.

Boise State University – Central District Cooling Loop: This project included a new chiller and cooling tower expanding the capability of the central district cooling loop. The project also included new secondary and tertiary pumps and integrated control systems.

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St. Alphonsus – New Pharmacy: This project involved a state of the art Pharmacy for one of the largest hospitals in the State. The pharmacy included critical pressure zones and material containment areas along with complex refrigeration systems.

GSA – USGS/BOR Office Building: A new 50,000 SF office facility for two government agencies utilizing a water loop heat pump system and fluid cooler. This project also utilized the city geothermal system.

Boise State University – New Central Plant: These projects included upgrading the central plant chilled water and heating system in both the Education and Science/Nursing Buildings. Included in the upgrades were new primary and secondary pumping systems and new control systems.

Idaho Department of Fish & Game: Three new office buildings were constructed for the Idaho Department of Fish & Game in Salmon, Jerome, and Lewiston. These buildings utilized advanced skin technology and HVAC systems.

Boise State University – Liberal Arts Building: Poor indoor air quality was the result of incorrectly designed and operating fume hood systems in several art and paint rooms. This project involved new fume hood designs, new exhaust fans, and a central station air handling unit with new VAV make-up air systems. New controls were included in the design.

Variety Excursions – Bear Lake Lodge: This project is currently under construction and consists of several resort facilities totaling over 50,000 SF. The project is off grid, and includes power generation, state of the art controls, remote monitoring, and high efficient HVAC systems. Power generation includes hydroelectric systems, biomass COGEN plants, 5 MWH of battery storage and over one MWH of generating capability. The central plant HVAC system includes magnetic bearing chillers, four pipe fan coil units, propane, electric and biomass boilers, and VFD pumping systems.

Boise State University – TEM Laboratory: This multimillion-dollar project included the most advanced TEM microscope in the State. The project also included a percholoric acid fume hood system and tight HVAC requirements for proper microscope function. A phoenix control systems was installed as part of this project.

The Idaho Spine Institute: This new medical office facility consisted of a new MRI machine, several exam rooms and advanced HVAC for proper pressurization throughout the space.

Boise State University: MPB Laboratory: This conversion project included a new Phoenix control system, new Laboratory fume hood exhaust system, several new fume hoods, and new central station air handling units to support the ventilation requirements.

Nampa Charter School – New High School: A new High School HVAC system was installed, including a new kitchen facility and science room spaces.

Forsyth – Dichlor Laboratory: This potato research facility included new fume hoods, air handlers, and VAV boxes along with tight pressure requirements.

Department of Health & Welfare: This project consisted of new central plant equipment including a new chiller, cooling tower and DDC system.

# Karena Gilbert, LEED®



## EDUCATION

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- Boise State University  
B.S. Construction Management
- OSHA – 10 Certified

## ACCREDITATIONS

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- LEED Accredited Professional

## QUALIFICATIONS

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- Project Development
- Project & Program Management
- Construction Management
- Scope Development
- Cost Estimating
- Project Planning
- Quality Control
- Risk Management
- Design Build
- Project Closeout

## REFERENCES

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Available upon request

## TENURE

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Karena has been working in the industry since 2006.

Karena Gilbert joined McKinstry in 2008, bringing with her experience that ranges from project planning to project closeout in both the public and private sector. Her ability to develop strong relationships with her clients, architects, engineers, and subcontractors ensures the highest levels of construction quality. These strengths, combined with her natural leadership ability and communication skills, make her a pivotal part of any team.

Karena has had the opportunity to be involved with many interesting projects in and out of the office. Karena participated in Project Green, a program that aired on CBS and was aimed at increasing the awareness of green building. She co-founded Green LEEDers, bringing together individuals who share a vision to foster sustainable development, and participated in the documentary Green is the Color of Money, which follows the design and construction of a Platinum LEED Building. She is passionate about sustainable building and attends many conferences to stay abreast of new ideas, incentives, and initiatives.

Karena has most recently been managing the Biomass Project in Garden Valley from project planning through construction management to project closeout. This biomass system includes a boiler and related fuel feed and storage system, will serve as the school's main heating source, and is almost entirely funded by a USFS grant.

## EXPERIENCE

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Garden Valley Biomass Project  
Washington Elementary School  
Van Buren Elementary School  
University of Phoenix  
Boise Air Traffic Control Tower  
The Lodge at Osprey Meadows  
Mid-Mountain Restaurant

# Keith Bucher, C.C.M



## EDUCATION

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- Boise State University  
B.S. Bachelor of Science  
Construction Management
- OSHA – 10 Certified
- Certified Construction Manager

## SPECIALTIES

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- Ground Up Construction
- Constructability Review
- Site Safety Administration
- Project Management
- Scheduling Budgeting/Estimating
- Scope Coordination
- Cost Control
- Project Closeout
- Tennant Improvement

## REFERENCES

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Available upon request

## TENURE

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Keith has been working in the industry since 2002.

## PROJECT ENGINEER

Keith joined the McKinstry team in February 2009 bringing with him seven years of contracting experience, including four years of design-build experience.

Keith has been involved in large- and small-scale construction projects both in the private and public sectors working under hard and negotiated bids. Keith brings strong skills in cost control, project management, site coordination, and time management. Keith provides each project with specialized knowledge resulting in a successful focus on both the project itself as well as client satisfaction.

Keith has most recently been overseeing field activity and scheduling on a LEED™ Silver elementary school for the Caldwell School District as well as being the point of contact for University of Idaho Fish Research Center.

## EXPERIENCE

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**Washington Elementary** – provided construction management, coordination of all subcontractors, constructed, and revised schedule.

**Van Buren Elementary** – provided construction management, coordination of all subcontractors, constructed, and revised schedule.

**St. Alphonsus Hospital Regional Ctr.** – Ran the project from the design phase through construction all the way to occupancy. Responsibilities were subcontractor coordination, schedule, cost control, client updates, and meetings.

**Capital Business Ctr.** – Ran the project from the design phase through construction all the way to occupancy. Responsibilities were subcontractor coordination, schedule, cost control, client updates, and meetings.

**Schucks Auto Parts** – Provided construction management to a national vendor with the responsibilities of running budget and all subcontractors. Ran coordination meetings between owner, architect, and contractors.

**Waters Edge Business Development** – Was in charge of constructing a new development from the power lines to roads. Managed the budget and subcontractors.

**Staley Dental Office** – Ran the project from the design phase through construction all the way to occupancy. Responsibilities were subcontractor coordination, schedule, cost control, client updates, and meetings.

**Sara Care Assisted Living** – Ran the project from the design phase through construction all the way to occupancy. Responsibilities were subcontractor coordination, schedule, cost control, client updates, and meetings.

# Kevin Antonucci



## EDUCATION

- Vinal Technical School  
Carpentry Degree

## QUALIFICATIONS

- Performance-Based Contracting
- Project Development
- GMP Contracts
- Project Execution
- Prolog Management Programs

## TENURE

Kevin has been working in the industry since 1991.

Kevin joined McKinstry in May 2009 as Superintendent for McKinstry's Inland Northwest Branch located in Boise, Idaho. Kevin's approach to each project combines his specialized expertise and success-oriented focus.

Kevin's dedication includes a strong work ethic with over 18 years experience in the commercial and residential construction industry while maintaining a professional attitude, promoting team concepts, ensuring job site safety, identifying potential cost savings and pitfalls, and delivering jobs on time and within budget to meet the customer's expectation. Additionally, his qualifications include working with major inspection and regulatory agencies on the East Coast such as STL, MTA, and OSHA.

Kevin is experienced in professional relations with customers, local operations personnel, contractors, engineers, legal counsel, and field personnel. His ability and desire to support, communicate with, and interact with each of these teams to assist with day to day operations and training while maintaining a strong common goal makes Kevin a leader in his field.

## EXPERIENCE

Project Name	Type of Project	Project Cost
Yale Hospital New Cancer Center	Healthcare	\$240M
Yale Hospital Enabling Project	Healthcare	\$6.5M
Yale Hospital E.R. Renovation	Healthcare	\$12.5M
Yale Hospital Internal Office Renovation	Healthcare	\$5.2M
Caldwell School District – Van Buren and Washington Elementary Schools	Design/ Build New Construction	\$23M
Garden Valley School District	ESPC	\$2.5M
Hagerman Fish Farm	ESPC	\$170K
Blaine County School District	ESPC	\$28M
Trumbull Elementary School	CM/GC New Construction	\$23M
Staples High School	CM/GC Addition and Renovation	\$75M
Fairfield Warde High School	CM/GC Addition and Renovation	\$12.7M
R.H.A.M. High and Middle School	CM/GC Addition and Renovation	\$60M
Cook Hill Elementary School	CM/GC Addition and Renovation	\$5.4M
Vernon Public Schools	CM/GC Addition and Renovation	\$4.3M
Silliman College Yale University	CM/GC Renovation	\$65M

# Mike Porter



## EDUCATION

- Washington State University M.S. in Mechanical Engineering, 1995

## SPECIALTIES

- Building System Operations and Sequences
- Facility Operations and Planning
- Energy and Resource Conservation
- Project Controls and Management
- Cost Control
- Project Development
- Commissioning
- Building Control System Design and Evaluation
- Facility Auditing

## TENURE

Mike has more than 15 years of experience in consulting, design, construction, and facilities.

## DIRECTOR OF OPERATIONS

Direct responsibilities for Mike include the development, design, and implementation of McKinstry Technical Services, plus the relationships and customer values associated with these responsibilities. Technical Services are those associated with complete building systems controls and communication system services, as well as the consulting and transitioning of facilities in order to ensure completed expectations as it relates to building intent, facility design, and operational success. Mike and his team are focused on entering an opportunity and providing a completely operational facility that meets all of the design and owner intent. Mike works to provide the link between the physical results of a contracting team and the reality of occupancy and operations for a client. His background includes four years in general contracting, four years in building automation controls design and management, five years in operations management focused on Energy Services, and three years focused on operations management of facility services.

## EXPERIENCE

Fred Hutchinson Cancer Research Center  
Phase II

University of Washington Oceanography  
University of Washington Mary Gates Hall  
Cancer Care Alliance  
1110 3rd Avenue Building (Seattle)  
Seattle Center Central Plant  
Boeing Kent Utility Upgrade  
Northshore School District ESCO  
Northshore School District KRC  
Savvis Data Center  
Nexus Data Center  
Seattle Central Community College

A Fortune 500 Software Company: Pebble  
Beach Campus

South Kitsap School District  
SeaTac South Terminal Expansion  
Tacoma Community College  
St. Joseph's Medical Center  
SeaTac Energy Conservation  
Boise State University  
WAMU Tower  
Seattle Art Museum  
Ask.com Data Center  
WSU Compton Union Building  
Capital Mall Idaho

# Patrick Farley



## EDUCATION

- Claremont McKenna College, Bachelor of Arts in Economics and Government, 1998

## QUALIFICATIONS

- Capital Formation
- Securitizations
- Securing Federal and State Tax Incentives
- Sourcing Lowest Cost of Capital Financing Solutions
- Keen Understanding of Tax Incentives and their Mechanics

## TENURE

Patrick has worked in the industry since 1999.

## MCKINSTRY CAPITAL MANAGER

Patrick Farley is a McKinstry Capital Manager and is actively involved in facilitating financing for McKinstry's customers' energy efficiency/conservation and renewable energy projects. In addition, Patrick evaluates new investment opportunities including corporate acquisitions, real estate development, renewable energy projects, and cleantech operating businesses.

Patrick's responsibilities include capital formation and optimization and serves as the primary contact between internal and external customers for financing and investment related activities.

Prior to joining McKinstry in 2008, Patrick started his career in the tax and management consulting industries and subsequently spent seven years developing commercial and multi-family real estate projects in the Western United States.

## KEY EXPERIENCE

- ✓ Prepared investment grade development/economic feasibility study for 20MW biomass boiler facility
- ✓ Acquired six operating businesses valued in excess of \$20M
- ✓ Financed \$100M of real estate

## PROJECT RELATED EXPERIENCE

**Tualitin Hills Park and Recreation District, OR:** Secured \$1.5M of financing for energy improvement measures.

**Colorado School for the Deaf and Blind:** Secured \$1.7M of financing for HVAC, lighting, and related energy improvement measures.

**General Biodiesel:** Assisted with securing \$1M WA State Energy loan program.

**Winona State University, MN:** Secured \$1.7M of financing for energy improvement measures.

**Great Falls School District, MT:** Secured \$4.2M of Qualified Energy Conservation Bond allocations.

# Todd Schaper



## EDUCATION

- Montana State University,  
Bachelor of Architecture, 1992

## TENURE

Todd Schaper has worked in the industry since 1992.

## PROGRAM MANAGER

Todd Schaper holds the position of Program Manager at McKinstry. Todd is responsible for project development, scheduling, team communication, and overall program management. In addition to the responsibility of developing and maintaining project budgets and project schedules, the main role as a Program Manager is to implement staff and resources to complete projects through all stages. Todd's experience in these areas makes him capable of making critical decisions across disciplines.

Todd's expertise has supported many schools, colleges, universities, hospitals, commercial and retail customers by taking responsibility for a variety of aspects in the project, from business development to developing fee proposals and contracts. Being a leader is a critical and an important qualification in this process. Todd has managed multiple teams and projects (regionally and nationally) of various scopes of work and delivery types – construction costs have ranged from \$100K - \$20M.

Todd is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs and improving their operations. He has had the opportunity to be involved with many of the most interesting projects throughout the Montana region.

## PROJECT RELATED EXPERIENCE

*The University of Montana Biomass Project, Missoula MT:* Served as Program Manager in developing the potential of a biomass/cogeneration facility at the Missoula, MT campus. Evaluation of combustion technology, fuel sources, air quality, developing construction and operational costs. Project is ongoing.

*Missoula Federal Credit Union, Missoula, MT:* Project manager while at another firm. Responsible for an integrated delivery process of this project with owner, contractor, engineering, and design staff. Researching and implementing innovative technology in all aspects of the project from the Owner's retail process and flow, mechanical and lighting systems, utilized energy modeling, and efficient building envelope materials. The project utilizes a variety of innovative mechanical designed systems from ground source, chilled beams and under floor air distribution systems. Project completion 2010.

*First Interstate Bank, Missoula, MT:* Project manager while at another firm. Responsible for a construction delivery process of an 118,000 sq. ft. core and shell with owner, contractor, engineering, and design staff. Project was designed and built seeking LEED® certification (currently under review). Implementing innovative technology through high efficiency mechanical system, re-use of existing site, ground source cooling, rain water collection, low flow fixtures, high efficient glazing. Project completion 2009.

*Jackson Contractor Office, Missoula, MT:* Project manager while at another firm. Responsible for an integrated delivery process of this project with owner, contractor, engineering, and design staff. Project was designed and built with the intent of LEED Certification (currently under review). Implementing innovative technology utilizing a high efficiency mechanical system, day lighting, site selection and construction technology.

*Avista Corporation, Spokane, WA:* Project manager at another firm. Worked with McKinstry as a consultant in the energy retrofit of an existing six story building on the Avista Campus. Responsible for architectural design being implemented around the energy upgrade and window replacement. Construction is ongoing.

# Jeff Davis, P.E.



## EDUCATION

- Montana State University - Bachelors of Science, Mechanical Engineering 1981

## ACCREDITATIONS

- Registered Professional Engineer in: Montana, Wyoming, Washington

## CERTIFICATIONS/LICENSES

- Certified Energy Manager
- ASHRAE
- APPA

## QUALIFICATIONS

- Power Plant Design & Construction
- Higher Education Facilities Management
- Utility Systems Management
- HVAC Design
- Facility Commissioning
- Energy Conservation
- Building Management Systems
- Certified Energy Manager Training program
- APPA Institute for Facilities Management
- LEED™ Training
- APPA Leadership Academy

## REFERENCES

Available upon request

## TENURE

Jeff has worked in the industry since 1982.

## PROJECT DIRECTOR

Jeff provides the professional expertise needed to transform the results of engineering endeavors into useful products and services. He provides each project with specialized expertise resulting in a success-oriented focus for both the project and client satisfaction.

Jeff has over 27 years of experience in the fields of mechanical design, construction, project management, and operations and maintenance with a strong emphasis in facilities management, energy conservation, and power industry. Jeff's experience includes administration, policies and procedures, budgets, leadership of personnel, operations and maintenance, management of energy and utility systems, and project design, construction, and commissioning. His broad experience in the power industry includes design, construction, start-up, testing, and operator training in a fast-track design build environment for a variety of plant types such as coal fired, biomass, waste fuel, and combined cycle.

## EXPERIENCE

### *Montana State University:*

- Central Heating Plant Upgrade
- HVAC Design for several renovations
- Lighting upgrades for several buildings
- HVAC System retro-commissioning
- Building controls systems replacements
- Building Energy Audits
- Building Energy Conservation Upgrades
- Preventive Maintenance Program Development
- Utility tunnel project
- Utility systems studies/upgrades
- Energy Conservation Program
- Engineering oversight for several new buildings on campus

*Chewton Glen Energy* – Ford heights, IL – 20 MW Tire fueled power plant

### *Alternative Energy:*

- Ashland, ME – 40 MW Wood Fired Power Plant
- Livermore Falls, ME – 40 MW Wood Fired Power Plant
- Sterling Power Partners* – Oneida, NY – 56 MW Combined Cycle Cogeneration Plant
- Ogden Martin* – Okahumpka, FL – 530 TPD/15 MW MSW Fired Power Plant
- Atlantic Richfield* – Tacoma, WA – Enhanced Oil Recovery Plant
- Martin Marietta* – Vandenberg AFB, CA – Space Shuttle Launch Complex
- Montana Power Company* – Colstrip, MT – 750 MW Coal Fired Plants

# Dan McCourt



## EDUCATION

- College of the Redwoods, Eureka, CA  
Industrial Electricity  
1985-1986
- Millwright Apprenticeship, Tulsa, OK  
1971-1974

## ACCREDITATIONS

- Welding Certification, 1974
- Boiler Control Certification, Cleavor Brooks Inc., Lebanon, PA 1984

## AFFILIATIONS

- Carpenters & Millwrights of America

## QUALIFICATIONS

- Scheduling, Task Planning, Project Tracking
- Developing Site Specific Safety Program
- Craft Coordination
- Engineering Coordination
- Vendor Coordination
- Quality Control
- Client-Contractor Communication
- Estimating – Material/Labor

## TENURE

Dan has worked in the industry since 1971.

## FIELD SUPERINTENDENT/RESIDENT CONSTRUCTION MANAGER

Dan McCourt holds the position of Supervisor at McKinstry. Dan has over 38 years of experience in the construction industry in both the commercial and industrial arenas. He has worked in both the field and office capacities ranging from project engineering to project superintendent. Dan has been involved in a variety of complex projects including pulp and paper, power generation, food and beverage, and mining and minerals.

## PROJECT RELATED EXPERIENCE

### Food & Beverage Facilities

- Project Superintendent, Darigold, Jerome, ID — New milk condensing plant.
- Project Superintendent, Darigold, Lynden, WA — Plant expansion including installation of new boiler.
- Project Superintendent, YoCream, Portland, OR— Plant expansion including new freezer and new process equipment room.
- Project Superintendent, Windsor Foods, Oakland, MS — New frozen foods line.

### High Tech Facilities

- Project Superintendent, Mikron Industries, Kent, WA — Plant expansion and process modernization.

### Heavy Industrial

- Project Superintendent, Chemicon Materials, Moses Lake, WA — Major plant expansion including new process and environmental systems.
- Project Superintendent, Timet Corporation, Toronto, OH — New titanium rolling line.
- Project Superintendent, Reclaim, Boardman, OR — Tire pyrolysis facility.
- Project Superintendent, Elementis Specialties, Charleston, WV

### Power

- Project Superintendent, Scott Paper, Renton, WA — Installation of General Electric 55 megawatt co-generation turbine.
- Millwright Superintendent, Fairhaven Power, Eureka, CA — Construction of a 50 megawatt co-generation power plant.
- Centralia Power Plant, Centralia, WA — Scheduled shutdown activities on boilers, turbines, and generators.
- Scott Paper (Kimberly Clark), Everett, WA — Installation of 50 MW power plant.
- Ultra Systems and Atlantic Golf Contractors, various cities, CA — Involved in multiple cogeneration projects ranging from 25 – 55 MW.
- Salt River Power, Phoenix, AZ — Overhaul of three 750 MW turbine/generator units.
- Edison Company, Southern CA — Multiple turbine/generator overhauls.
- Basin Electric Power Cooperative Laramie River Station, Wheatland, WY — Installation of three 570 MW GE power generating units.
- Kerr McGee Chemical Corporation, Trona, CA — Installation of two 25MW coal-fired General Electric units.
- Minnesota Power, Cohasset, MN — Plant shutdown work on turbine, generator, and boiler.
- Public Service of Oklahoma — Installation of one 350MW General Electric turbine and

generator, and one 350MW Westinghouse turbine and generator.

**Building Materials**

Project Superintendent, Louisiana Pacific Corporation, Thomasville, AL — Construction of a new \$240 million OSB plant.

Millwright Superintendent, Pioneer Aggregates, Dupont, WA — Construction of a 3000 ton/hr aggregate processing plant.

**Oil & Gas**

Millwright Superintendent, Conoco Oil, Downey, CA — Plant modernization and maintenance.

**Pulp & Paper**

Millwright Superintendent, Multiple Clients — Numerous projects for Boise Cascade, Weyerhaeuser, and Fort James.

# Mark Miller



## EDUCATION

- Bachelor of Chemical Engineering  
Clarkson University

## QUALIFICATIONS

- Contract Scheduling
- Project Management
- Cost Control
- Design/Build Projects Execution
- Project Value Engineering and Estimating
- Fast –Track Delivery

## TENURE

Mark has worked in the industry since 1972.

## PROJECT MANAGER/ESTIMATOR

Mr. Miller has over 35 years of experience in the construction industry. His background includes such diverse projects as large civil works overseas for the Corps of Engineers to major commercial and industrial projects. His experience ranges from pulp and paper to steel mills to telecommunications to high rise commercial buildings.

## PROJECT RELATED EXPERIENCE

### Pulp & Paper

Project Manager, Boise Cascade Research & Development Building, Portland, OR — 40,000 square feet, high tech paper research laboratory with executive offices and adjoining pilot plant

Project Manager, James River Corp. No. 3 Power Boiler Building, Camas, WA — Complete structural steel erection and upgrade of a new 6 story building inside an existing structure in the middle of an operating paper mill. Approximately 500 tons of installed steel and equipment

Project Manager, Norpac Longview No.3 Tissue Machine — Installed all structural concrete for a new tissue machine. Placed 36,000 cubic yards of concrete and 5,600 anchor bolts for the machine building, de-inking facility and storage warehouse.

Project Manager, James River Camas, WA and Wauna, OR — Conducted Shut-downs and rebuilt clarifiers. Repaired clarifier walls and installed/repaired new equipment, motors, piping, electrical, sweep arms and structural supports etc. Performed approximately 30 various plant upgrades and installations, both equipment and structural.

Project Manager, Boise Cascade Walula Mill, WA — Installed a relocated 200 ft M&D Digester and all affiliated structural, equipment and piping. Constructed a new chip storage area with conveyor handling system.

Project Manager, Weyerhaeuser Mill Springfield, OR — Installed a new 140 ft tall Chip Uniformity facility with equipment and all associated conveyors ( approx. 1000 lf).

Project Manager, GP Toledo, OR — Constructed a new Chip Warehouse and misc. small equipment and structural projects.

Project Manager, Longview Fibre Mill, WA — Repaired clarifier walls and installed/repaired new equipment, motors, piping, electrical, sweep arms and structural supports etc. Installed new screen room and affiliated conveyors.

### Food & Beverage

Project Manager, Kroger Swan Island Dairy, Portland, OR — Construction Manager for facility expansion, CIP room upgrades, HTST room upgrades, and relocation and upgrade of milk stacker line.

Project Manager, Blue Diamond Growers, Sacramento, CA — Preconstruction services for new almond production facility.

### Heavy Industrial

Project Manager, Oregon Steel Mills, Portland, OR — Mill modification project including slab turnover facility, compressor installation, burning pits modification, 60 and 200 ton overhead crane installation, West scarfing yard expansion, and transformer vault modification.



### **Power**

Project Manager, Snowflake White Mountain Power, Snowflake, AZ — Preconstruction and contract administration services for new 24 MW biomass power plant  
Estimating Manager, BioPro Rock Falls, Rock Falls, IL — Preconstruction and estimating services for a new 20 MW biomass power plant.

### **High Tech & Telecommunications**

Project Manager, Intel, Aloha, OR — Fab 15 + 15.5 semiconductor tool installation for 180 tools in operating Fabs  
Project Manager, Level (3) ILA Sites — Eighty discrete installations throughout the western half of the United States accomplished in under twelve weeks  
Project Manager, WCI Cable Landing Station, Pacific Beach, OR — Additions and upgrades to two state of the art telecommunications facilities hosting undersea cable traffic from Asia and Alaska to Oregon  
Project Manager, Alcatel Submarine Systems, Portland, OR — Underwater Fiber Cable Manufacturing Facility; 190,000 square foot manufacturing building encompassing 30,000sf office space and installation of all manufacturing equipment  
Project Manager, ATI Wah Chang, Millersburg, OR — Installed liquid oxygen production facility

### **Aerospace**

Project Manager, Boeing, Portland, OR — Installation of foundations and equipment for new 3 and 4 axis CNC vertical milling machines and relocation and installation of manufacturing equipment line from Boeing of Kent, WA to Boeing of Portland, OR  
Project Manager, Boeing Commercial Airplane Group, Portland, OR — Installation of antenna research facility; structural steel and concrete work with self-powered 100-foot high gantry building

### **Commercial**

Project Manager, Costco Wholesale, Aloha, OR — 105,000 square foot concrete tilt-up building, loading docks, 644 slot and parking lot  
Project Manager, Waikoloa Development Company, Oahu, HI — Estimating services for construction of new Waikoloa Shopping center

### **Engineering**

Electrical Construction Co, Portland, OR — Developed ISO 2000 Quality Management Program

### **Military Experience**

Captain, United States Army Corps of Engineers

# Steve Brucker



## EDUCATION

- BS Construction Management  
1985 - Washington State  
University
- MBA – University of Oregon  
2002

## ACCREDITATIONS AND AFFILIATIONS

- 

## QUALIFICATIONS

- Contract Negotiations
- Preconstruction Services –  
Cost Estimating & Scheduling
- Scheduling & Coordination of  
Construction Activities
- Distressed Project Turn-  
Around
- Cost Control
- Material Procurement &  
Expediting
- Employee Training
- Site Safety & Personnel  
Relations

## TENURE

Steve has worked in the industry since 1985.

## CONSTRUCTION MANAGER

Steve Brucker's experience in the construction industry spans more than 25 years. He has held a number of positions in during his tenure in the construction industry including projecting engineer, preconstruction manager, operations manager, distress project consultant, project executive and project manager. Steve's resume as construction manager includes a diverse range of projects budgets from short term distress project turn-arounds to capital projects in excess of \$100 million. The project types he has managed are diverse too, including semi conductor manufacturing facilities, industrial manufacturing and process facilities, heavy equipment setting and erection, higher education, public buildings, and K-12 education facilities

## PROJECT RELATED EXPERIENCE

### Commercial & Public Facilities

Portland International Airport – Terminal Expansion Project and Parking Garage  
Clark County – Clark County Community Health  
Bank of America – Branch Remodels at Stark and Mall 205  
Convention District – Preconstruction Services  
The Portland Clinic – New Surgery Center

### Dock

California Portland Cement – Cement Product Reclaim Systems  
PAC Paper – Finish Paper Product Line  
PGT – Natural Gas Pumping Station Retrofit  
Paragon – Concrete Building Materials Production Line  
Potlatch Corporation – Machine Gauging System

### High Tech Facilities

Director of Construction, Intel Corporation, Hillsboro, OR — Oversaw all electrical construction for Intel's D1D Phase 3 tool installation  
Director of Construction, Fujitsu Corporation, Gresham, OR — Oversaw all electrical construction for Fujitsu's fab retrofit and tool installation  
Project Manager, Intel Corporation, Hillsboro, OR — Construction Manager for a Fab 5 P652 plant conversion, Pentium Plant Conversion.  
Procurement Manager, Intel Corporation, Hillsboro, OR — D1C Conversion  
High Tech & Electronics Manufacturing  
Intel Corporation –  
FAB 5 P652 Pentium Plant Conversion  
RB1 Bridge Building  
RS3 & RS4 Media Streaming Build Out  
D1D Phase 3 Tool Install  
D1C Fab Conversion  
Fujitsu Corporation – Fab retrofit and Tool Install  
Shimizu America / Matsushita - Circuit Board Manufacturing Line

### Heavy Industrial

Project Manager, Portland International Airport, Portland, OR — Construction Manager for

terminal expansion project and parking garage construction.  
Project Manager, TOK Chemical, Hillsboro, OR — Construction Manager during civil, structural and architectural phases of a new ultra-pure chemical facility.  
Project Manager, STC Submarine Systems, Inc., Portland, OR — Construction Manager for a ship loading system, conveying equipment, and loading dock.  
Project Manager, Boeing of Portland, Portland, OR — Construction Manager for a gearline relocation, heat treatment facility, and cafeteria project.  
Project Manager, Shimizu America, Vancouver, WA and Forest Grove, OR — Construction Manager for new television manufacturing equipment assembly plant.  
Project Engineer, Serbaco, Multiple Projects  
Standard Oil of California- exhaust emissions project  
Oregon Steel Mills- furnace emissions and reclaim project  
Syntex Laboratories- pharmaceutical R&D lab emissions and reclaim project  
California Portland Cement- new baghouse, exhaust scrubbing systems and product reclaim systems  
Georgia Pacific Corporation – Toledo 2000 Project – New OCC Plant, Complete Paper Machine Rebuild Project  
Daishowa America Company, Ltd.  
Recycled Paper plant and warehouse,  
Sludge Screw Press  
No. 3 Paper Machine Rebuild  
Stone Container Corporation – Chip Screening Facility  
Fort James Corporation  
No. 3 Paper Machine Rebuild  
No. 5 Tissue Machine Installation  
No. 9 Paper Machine Rebuild  
Chip Screening Facility  
Sludge Screw Press  
Boeing of Portland  
Aircraft Gear Line Relocation  
Heat Treatment Facility  
Cafeteria Project  
Weyerhaeuser – Springfield, OR – Chip Screening Facility  
Smurfit Newsprint Corp  
No. 4 PM Dryer Modifications  
No. 6 PM Dryer Section and Winder Rebuild  
STC Submarine Systems - Ship Loading system, Conveying Equipment, Loading

#### **K–12 & Higher Education Facilities**

Humboldt State University – Behavioral Sciences Building  
Hillsboro School District – New K-12 Facilities  
Medford School District – Preconstruction Services for New High School  
West Linn – Wilsonville School District – West Linn High School Renovation and Addition

#### **Power**

Project Manager, Warm Springs Biomass, Warm Springs, OR — Pre-Construction specialist for a new 20 MW biomass power plant

### **Pulp & Paper**

Project Manager, American Tissue, St. Helens, OR — Construction Manager for construction of tilt-up warehouse and storage facility.

Project Manager, Georgia Pacific Corporation, Toledo, OR — Construction Manager for new OCC plant and complete paper machine rebuild project.

Project Manager, Daishowa America Company, Ltd., Port Angeles, WA — Construction Manager during construction of a recycled paper plant and warehouse, paper plant, sludge press building and equipment, No. 3 Paper Machine Rebuild.

Project Manager, Stone Container Corporation, Missoula, MT — Construction Manager for construction of a new chip screening facility.

Project Manager, Fort James Corporation, Multiple Projects

No. 3 paper machine rebuild- Wauna, OR

No. 5 tissue machine installation- Wauna, OR

No. 9 paper machine rebuild- Camas, WA

Sludge screw press installation- Camas, WA

Project Manager, Smurfit Newsprint Corporation, Oregon City, OR — Construction Manager for No. 4 paper machine dryer modifications.

Project Manager, Weyerhaeuser Paper Company, Springfield, OR — Chip uniformity project, Pneumatic transfer installation.

### **Tilt Up Concrete Construction**

Daishowa America – Recycled Paper Warehouse

American Tissue – Tilt-up Warehouse and Storage Facility

TOK Chemical – C/A/S Phases of Ultra-Pure Chemical Facility

# John Doherty



## EDUCATION

California State University,  
Sacramento,  
Bachelors of Science –  
Construction Engineering  
Management  
Minor – Business  
Administration

## AFFILIATION

CMAA (Construction  
Management Association of  
America)

## QUALIFICATIONS

Contract Scheduling  
Project Management  
Cost Control  
Design/Build Projects  
Execution  
Project Value Engineering and  
Estimating  
Fast –Track Delivery

## TENURE

John has worked in the  
industry since 1989.

## PROJECT MANAGER

Mr. Doherty has 20 years of experience in the construction industry in both the commercial and industrial arenas. He has worked in both field and office capacities ranging from project engineering to project management. Mr. Doherty has been employed by top 50 general contractors in the United States and has also been employed by a full service mechanical contractor. Mr. Doherty is well versed in all areas of Project Management including design development, estimating, contract administration, scope control, budgeting, scheduling, commissioning, and contract closeout.

## PROJECT RELATED EXPERIENCE

### Building Materials

Project Manager, Louisiana Pacific Corporation, Thomasville, AL  
Construction Management for new \$240 million OSB plant.  
Project Manager, Prestige Ready Mix, Groveland, FL

Design and construction of new block manufacturing facility including sitework and support facilities. Responsible for engineering, permitting, procurement, construction, and commissioning.

### Heavy Industrial

Program Manager, Elementis Specialties, Multiple Locations, USA  
Program management services for multiple capital improvement projects across the United States. Projects ranged in size from \$2 million to \$8 million.

### High Tech

Project Manager, ETEC, Hillsboro, OR

Installation of all mechanical systems for a new manufacturing facility. Work included central plant, distribution piping, plumbing, and HVAC. Project value \$2,000,000. Scope included installation and commissioning.

Project Manager, Novellus Systems, Inc., Tualatin, OR

Design build for new four building high technology manufacturing campus in Tualatin, OR. Directly responsible for all mechanical and process systems including a central plant and class 1 clean rooms.

Project Manager, Intel Corporation, Multiple Sites

Various projects ranging in value from \$200,000 to \$1,500,000. Installation and modifications to process piping and air systems. Installation of manufacturing equipment.

Project Manager, Cascade Microsystems, Multiple Sites

Various projects ranging in value from \$10,000 to \$750,000. All projects were design build and included piping and air systems.

### Power

Project Manager, BioPro, Rock Falls, IL

Preconstruction and contract administration services for new 24 MW biomass power plant.

Project Manager, Snowflake White Mountain Power, Snowflake, AZ

Snowflake White Mountain Power: Preconstruction activities for 20MW biomass conversion facility including estimating and purchasing functions.

Project Engineer, Colmac Mecca Power Plant, Mecca, CA

New 50 MW biomass power plant. Scope included engineering, procurement, and

construction. Directly responsible for schedule, cost controls, document control, and commissioning.

**Commercial**

Project Manager, Trendwest Resorts, Seaside, OR

Project Manager, Portland International Airport Expansion, Portland, OR

Expansion of existing ticketing, bagging, handling, and access roadway. Work was coordinated with minimal impact to airport operations..

# Mark Persinger



## EDUCATION

- Marylhurst University, Business Management
- University of Washington, Physics
- United States Navy, Nuclear Power School
- Nuclear Propulsion Plant Operator, Electronics
- Master Training Specialist, Navy Leadership Development Program

## AFFILIATIONS

- CMAA (Construction Management Association of America)

## QUALIFICATIONS

- Power Plant Engineering, Maintenance and Operations
- Project Controls
- Capital Equipment Procurement
- Contract Negotiation
- Conceptual Estimating

## TENURE

Mark has worked in the industry since 2007.

## PROJECT MANAGER

Mr. Persinger has 8 years of experience in the U.S. Navy and three years of experience as a project manager. In the Navy, Mark led the engineering department as a nuclear reactor operator. He has been responsible for a variety of large electrical and instrumentation refit projects and has overseen several plant shutdowns and startups.

## PROJECT RELATED EXPERIENCE

### Heavy Industrial

Project Manager, Specialty Chemical Products, Moses Lake, WA — Construction Manager for design and procurement activities of a new chemical plant producing both industrial and food grade products.

Project Manager, Terrafuels, Inc., Lake Oswego, OR — Construction Manager for development and funding of three new biorefineries in California and Oregon.

### High Tech

Project Manager, Microsoft, Denver, CO — Construction Manager for completion of a feasibility study and the engineering for the relocation of the data center.

### Power

Project Manager, University of Montana, Missoula, MT — Construction Manager for completion of a feasibility study for the installation of a biomass gassifier.

Project Manager, The Evergreen state College, Olympia, WA — Construction Manager for completion of a feasibility study for the installation of a biomass gassifier.

Project Manager, Yellowstone Biomass, Emmett, ID — Construction Manager for completion of a feasibility study for a new biomass power plant.

Reactor of Operator and Engineering Watch Supervisor, United States Navy, USS Maryland — Supervised the safe operation, maintenance, and repair of Nuclear Plant equipment. Managed and scheduled repair, maintenance, and overhauls of Nuclear Reactor Plant during tightly scheduled refit periods. Completed extensive repairs to critical Reactor Plant systems under rigid timelines and stressful conditions to meet ship's operational commitments. Tracked the calibration status and scheduled calibration jobs for over 900 instruments on the ship.

### Military Experience

Chief Petty Officer, United States Navy

# A Appendix

# Appendix A – Fuel Specifications

Design Fuel – Boise County		Revised 10/25/10
<b>Species</b>	Ponderosa, Lodge pole Pine, and all other conifer or deciduous species indigenous to the Boise County and South and Central Idaho Regions.	
<b>Source &amp; General Description</b>	<p>At least 50% of the fuel must originate from sustainable forest management and harvesting techniques. The source of this fuel will be from logging slash or other un-merchantable logging residues, and/or brush, small diameter trees (&lt;12"), stumpage, limbs and tops removed to reduce wildfire risk, improve forest health or operations to optimize waste fiber as part of a typical harvest or forest management practice. This includes harvesting of diseased or damaged non-marketable timber. The remainder can be obtained from wood processing facilities, landfills, urban thinning, or other appropriate sources. The facility/supplier must maintain records of fuel sources and provide them upon request. Resource base can consist of public (state, county, Federal and private holdings. All wood fuel is to be obtained in a safe and legal manner.</p> <p>Fuel can include urban woody biomass, but will not include grass, leaves or brush smaller than 3" in diameter.</p> <p>Fuel shall be free from non-combustible and non-biomass material, such as paint, nails, glues, chemical, sealers, rocks, and dirt. Fuel must not contain treated lumber or construction waste.</p> <p>The moisture content of the fuel shall generally not exceed 45% wet weight basis per delivery. Wet basis is calculated by <math>(\text{dry weight} \div \text{wet weight}) \times 100</math>. Desired range of moisture content is between 25% and 45%. Fuels below 20% average moisture content per delivery will generally not be permitted unless prior arrangements have been made (e.g., commercial pellets of 5% or less moisture may occasionally be used).</p>	
<b>Size</b>	<p>Fuel shall be reduced to a size range, which can be efficiently conveyed and fired in the biomass boiler installation. The desired size range is a minimum of ½" L x ½" W x ¼" D. Up to 50% of the fuel by volume can be up to 3" x 3" x 1." Up to 2% of the material by weight can be sawdust, smaller than 1/16" cubed, except that <b>no wood flour</b> (see # 2 below) is permitted. A total of 95% of the fuel by volume must be within this size range, including the 3" and under ½" material. Percentages are on a per delivery basis.</p> <p>Sander dust or wood flour, which is biomass comprised of very fine wood powder that feels greasy to the touch and becomes easily airborne, will not be permitted. Typically wood flour is defined as 60-80 mesh.</p> <p>Up to 5% of the fuel by volume could be up to 6" long sticks or peelings, as long as they are not larger than ¾ inch in width and depth, so they are able to continue feeding through the conveyance system without causing shutdowns or other system problems. Percentage is on a per delivery basis.</p> <p>Minimal needles (&lt;.001%) and bark (&lt;.01%) residue indicative of forest slash and grindings is allowed.</p>	

# Appendix A – Fuel Specifications

Ultimate Analysis:	Weight %	
	<u>Design</u>	<u>Range</u>
<b><u>Variable</u></b>		
Carbon, C	26.35	19.2-41.6
Hydrogen, H	3.21	2.0 – 4.8
Oxygen, O	23.74	14.4 – 35.2
Nitrogen, N	0.03	<0.35
Sulfur, S	0.02	<0.025
Chlorine, Cl	0.00	<0.025
Ash	1.65	<10
Moisture	45.00	20-60
<b>Fuel Heat Content</b>	4,650 Btu/lb as fired	
<b>Initial Ash Deformation Temp.</b>	2,100°F	

# B Appendix