

**The University of Montana**  
**Biomass Gasification Steam Plant**  
**Project Executive Summary**

**May 2011**

The purpose of this document is to inform the Board of Regents of the Biomass Project currently under consideration at The University Montana.

In 2007 The University of Montana became a charter member of the American University President's Climate Commitment (AUPCC). The first step in this commitment was to conduct a Green House Gas Inventory to identify the major sources of CO<sub>2</sub> pollution generated on the Missoula campus. This inventory was completed in 2007. The second effort required by the AUPCC was to use the Green House Gas inventory as the basis for the creation of a Climate Action Plan (CAP). The CAP was completed in 2009 and created a list of 15 separate strategies to manage or reduce CO<sub>2</sub>.

After implementing a number of the more easily attainable carbon reduction strategies, two high return strategies were identified for additional action: 1) substitution of a renewable energy fuel for the natural gas used at the UM steam plant, and 2) changing the energy use behavior of the faculty/staff/students via a campus wide campaign. This document focuses on Action #1. After considerable analysis and discussion it became apparent that a steam plant that uses biomass for fuel was the most effective way to convert from natural gas to a renewable energy fuel. For the purpose of this document, biomass is defined as the branches, bark, stumps, and other non-marketable forest waste left on the forest floor after a commercial logging operation is complete. In partial fulfillment of UM's Climate Action Plan, switching from natural gas to biomass will reduce UM's carbon footprint, approximately 22%.

The plant that the University proposes to construct has the following characteristics:

- The plant will use 70% less natural gas than the current steam plant. The plant will burn approximately 15,700 tons of biomass per year. This tonnage is less than 2% of the biomass used when Smurfit-Stone was producing fiber board.

- Using a proprietary gasification technology that produces ultra clean biomass combustion, air emissions (NOX, SOX, VOC, CO2, PM) produced by the plant will be fully permittable at the state and local levels.
- The new plant will be attached to the existing steam plant.
- For nine months of the year the plant will require two truckloads of biomass per day. During much of the summer months the plant will be idle.
- The woody biomass fuel will be sourced from the local forest products market (100 mile radius around Missoula) as well as UM's Lubrecht Experimental Forest.
- The new plant will have a classroom as part of its structure so that College of Forestry and College of Technology students can learn about the operation and maintenance of a gasification boiler system.

## **Project Cost Estimates and Construction Timeline**

At the onset of the biomass project, the University contracted with McKinstry, a performance contracting firm based in Seattle, to represent the University in negotiations with equipment suppliers, biomass providers, and local air emission regulators. This relationship essentially puts McKinstry in the role of general contractor for the project. We have secured a Guaranteed Maximum Price (GMax) from Mckinstry in the amount of \$16,000,000. This includes the basic gasification equipment, a brick/metal building to enclose the system, all air quality equipment, and other related equipment. McKinstry will turn over to the University a turn-key project. A project pro forma is a separate attachment to the Board Item.

### Time Line

- Acquire an air quality permit
  - Jan-May 2011
- Request permission to construct from the Board
  - May 2011
- Put project out to bid:
  - September 2011
- Commence Construction: Spring 2012
- Construction Complete: August 2013

## **Risk Management**

When this project transitioned from the concept phase to that of an operational project, it became very apparent that considerable research needed to be done to ensure that the right technology, fuel, air emissions equipment, etc. were selected. To that end, the following risk mitigation/due diligence efforts have been made:

- Trip to Vancouver & Victoria B.C. to meet with Nexterra (high tech manufacturer of biomass gasification equipment) to determine applicability of this type of equipment to our requirement.
- Numerous emails/phone calls to Nexterra customers to verify system performance.
- Contracted with McKinstry, a Northwest based performance contracting and energy services firm with considerable experience in biomass fired boilers to assist the University in understanding the dynamics associated with this type of project.
- Hired Fellon-McCord, a nationally known energy services firm to conduct a Missoula specific 20 year natural gas price projection.
- Solicited price quotes from numerous forest product firms to establish a reliable price range for biomass fuel.
- Sent 100 tons of Montana harvested hog fuel to Kamloops, B.C. for the purpose of conducting a multi-facet test at the Nexterra research facility. Air emissions, fuel pile characterization and burn tests were successfully conducted.
- Using our in-house engineering and financial staff, conducted independent evaluations of the various pro forma's provided by both McKinstry and Nexterra to validate project cost estimates.
- Hired by McKinstry, retained several engineering firms to conduct an independent analysis of the estimated characteristics of the gasification system.
- Partnered with the Montana Department of Natural Resource Conservation and the U.S. Forest Service to collaborate on "best practices" that could be incorporated into the project.
- Consulted with the U.S. Forest Service to determine regional fuel availability
- Hired a Professor from UM's College of Forestry to conduct an independent analysis of how biomass from the Lubrecht Experimental Forest can factor into the project.

- Secured an extended warranty from Nexterra; 1 year full labor and materials, 2 additional years of materials. In addition, Nexterra will provide three years of technical support and performance monitoring at no additional charge.
- Because this is a performance based contract with McKinstry, part of their guarantee is the performance (energy output) of the gasification system. This output guarantee has been quantified as 230,280 DKT per year.

In conclusion, we are very aware that whenever you deal with commodities such as natural gas, woody biomass pricing/availability, and the weather, an element of risk will always be present. This said, the due diligence we have done and the level of expertise we bring to the project will mitigate much of this risk.

## **Business Plan**

The pro forma for a biomass project is based on a number of operating assumptions. The following are the assumptions for this project.

- Natural Gas. The current NG price is \$6.90/deccatherm. The Fellow-McCord future price averages \$10.15. Future price increases, assuming a relatively constant price for biomass provide savings that will be used to pay for debt service on the project.
- Biomass. We have secured several five year contract offers for hog fuel at a price of \$40.00/bone dry ton.
- Gasifier performance. Nexterra's gasifier is rated, and tested, to deliver an efficiency rating in the 70% range.
- Operating at 70% efficiency the gasifier can provide UM's annual "base load" need for steam (194,579 million BTU's). Depending on average heating degree days, it will require approximately 15,700 bone dry tons of biomass to produce this amount of steam.
- Using biomass in lieu of natural gas will reduce displaced CO2 by approximately 8000 metric tons per year. In the renewable energy market, these displaced tons of CO2 can be sold to users of non-renewable energy such as coal fired electricity plants to help them meet their emissions targets. At the current rate of \$5.00/metric ton, we will be able to gain \$40,000/yr by selling these credits on the open market.
- We have secured a Guaranteed Maximum Price for the project of \$16,000,000.
- O&M of the plant, to include the salary of one additional operator, are estimated at \$365,000/yr.
- The new steam plant will be operated as an auxiliary enterprise, allowing for the cost of steam to be billed individually to users.
- We estimate that \$9,000,000 of Qualified Energy Conservation Bonds (QECCB's) will be available for this project. The U.S. government underwrites 70% of the interest costs associated with QECCB's. The remaining cost of the project will be financed with traditional revenue bonds. Estimated debt service is \$1.1 million/yr.
- For the purposes of debt service, the project will have a 20 year life.
- Overall, the project is expected to be a financial break-even operation.
- To insulate the project from unanticipated cost fluctuations we have built in a \$200,000 per year "risk reserve". This is similar to the reserve we have built into our current natural gas budget.

## **Performance Guarantee with McKinstry**

In the last legislative session, institutions such as The University of Montana gained access to a contracting method known as Performance Contracting (PC). PC essentially guarantees certain aspects of an energy efficiency related contract. In this case, the guarantee is structured around the operation of the overall biomass gasification system. Typically the guarantee identifies key factors within the system or a specific piece of equipment and quantifies the performance level required. All performance guarantees will be measured on an annual basis to ensure compliance. In this specific case, the following performance guarantees have been negotiated:

- The amount of steam needed to cover the “base load” of steam needed to heat the campus. We anticipate this will be 34,000 pounds/hour of steam. On an annual basis, McKinstry has guaranteed that the plant will produce 230,280 DKT of energy.
- The efficiency of the system which will result in savings from switching from natural gas to biomass. These savings will fund the debt service and operations of the biomass plant. We anticipate an efficiency rate of 70%+.
- A guarantee of air emission levels that will allow the plant to be permitted in Missoula.
- Repair and maintenance of the plant consistent with appropriate industry standards for similar equipment.

## **Technology Selection**

In May 2010 when this project transitioned from a concept to an operational project, several assumptions about the appropriate technology were made. These were:

- The technology selected must produce air emissions similar to that of natural gas and must be able to be permitted in Missoula
- The technology must produce steam at 175 PSI in amounts that will cover the “base load” needed by the campus. This equates to approximately 34,000 lb/hr of steam.
- The technology must be able to burn the biomass fuel available within a 100 mile area adjacent to Missoula
- The technology selected must be of an advanced nature so that it can be incorporated into the curriculum of the Energy Technician program at the College of Technology.

Using these criteria as a guideline, technical solutions were solicited from three vendors who offered distinctly different approaches to our requirements. The vendor that met our criteria most closely was Nexterra, a firm located in Vancouver, B.C. Nexterra’s solution is a multi-stage gasification system that uses an electrostatic precipitator to further minimize air emissions. Nexterra has similar plants in operation or planning at the University of South Carolina, Oak Ridge National Laboratory, Evergreen College and the University of British Columbia.

## **Fuel Supply Analysis**

For the purposes of this analysis two fuels were extensively analyzed; natural gas and woody biomass.

Natural Gas. Fellon-McCord, a nationally known forecaster of natural gas was engaged to produce a 20 year prediction of natural gas prices as it applies to the Missoula market. Perhaps the most critical thing that came from the report was that while natural gas will be at an unusually low price during the 2010-2012 period, the long term price escalation is projected to be approximately 3% per year over the 20 year period of the analysis. This produces an average price of \$10.15/mmbtu over the period versus a current price of \$6.90/mmbtu.

Biomass. There are two inter-related biomass characteristics that are key to this project. First, the fuel delivered must be three inches or less in size and must have a moisture content of 40% or less. These two factors will allow the fuel to perform at the required efficiency points in the gasifier. The second characteristic that is required is that the fuel be delivered to the plant at a price of \$40.00 or less per bone dry ton. In surveying a wide variety of forest product supplies in the Missoula area it was discovered that both the needed size of the fuel and the price of the fuel can be achieved. Of note, local suppliers are willing to enter into a five year contract.

## **Educational & Research Opportunities**

Lubrecht Experimental Forest.

Lubrecht Forest is affiliated with the College of Forestry and serves as a laboratory/classroom for many of the educational programs offered at the college. In working with Professor Beth Dodson from the College of Forestry, preliminary analysis of a sustainable wood harvest from Lubrecht is 5,000 tons per year. As a reference point, the biomass plant will consume approximately 15,700 tons of biomass per year. We anticipate that students will participate in the study of how Lubrecht will sustainably provide biomass to the gasification plant.

College of Technology.

Because of the advanced gasification technology that will be used at the biomass plant, and because the plant is located on campus, it is anticipated that the operation and maintenance of the plant will be incorporated into the Energy Technician program offered at the COT. This will provide students with an opportunity to see firsthand and work with some of the most advanced alternative energy technology available in the United States.

## **Sustainability**

When the University completed its Climate Action Plan approximately 15 different actions/strategies were identified that would help reduce UM's carbon footprint. With the current carbon footprint being estimated at 46,500 metric tons of CO<sub>2</sub> per year work to achieve a substantial CO<sub>2</sub> reduction will require both substantial and long term efforts.

To this end, the University has undertaken the following strategies to reduce it's CO<sub>2</sub> emissions:

- Use of compact fluorescent light bulbs
- Campus-wide use of ground water cooling
- Adoption of LEED Silver building standards
- In-house re-commissioning of existing buildings. Re-commissioning a building is to inspect and repair all of its operating systems - heating, cooling, lights, etc. – to ensure that they are working as designed.
- Purchase of energy efficient vehicles
- Purchase of Energy Star appliances only
- Energy efficient HVAC/window/lighting projects
- Campus wide behavior change campaign
- Installation of a biomass fired (renewable fuels) boiler to provide steam to the campus. Net of CO<sub>2</sub> emitted to deliver the biomass to the plant and the electricity used to operate the plant, CO<sub>2</sub> emissions will be 22% less from using biomass in lieu of natural gas

## **Environmental Regulatory Compliance Issues**

The conversion from the current fuel (natural gas) to woody biomass requires the University to acquire a new air quality emissions permit. This process is regulated by the Montana Department of Environmental Quality (DEQ) and, in some instances, Missoula County as well. The provisions of the air quality permit require that the new steam plant proposed by the University be in compliance with the Montana Environmental Policy Act (MEPA) as specified in MCA 75-1-101.

The University will comply with the required regulatory provisions outlined in the MEPA process. The exact requirements we must meet will flow from the information contained in the air quality permit application that will be submitted early in 2011. An initial evaluation of the plant's emissions (CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>x</sub>, VOC, and PM) indicates an Environmental Assessment rather than an Environmental Impact Statement will be required.

The University submitted an air quality permit application to Missoula County on 4 April 11. An Environmental Assessment (EA) as required by the Montana Environmental Policy Act was begun on 11 April 11.