HEATING THE MIDWEST
(OR AT LEAST THE UNIVERSITY OF MISSOURI)

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MU CHP PLANT

66 MW Generation - 950,000 lb/hr Steam

- 5 Boilers (4 Coal/TDF/Biomass, 1 Gas/Oil)
- 4 Steam Turbine Electric Generators
- 2 Gas Turbine Electric Generators (Gas/Oil)
- 2 Heat Recovery Steam Generators (Gas)

NEW BIOMASS BOILER

- Will supply 25% base load
- BFB design
PROJECT COST: $75.8 MM

TARGET COMPLETION: OCTOBER 2012
**BFB Specifications**

- Steam capacity: 150,000 lb/hr
- Outlet pressure: 950 psi
- Outlet temp: 850°F
- Feedwater temp: 300°F

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**MU CHP BIOMASS FUEL SOURCES**

- **Woody… 100 – 80% of total supply**
  - Non-Forest Derived Residue (non-FDR)... 90 – 80% of woody supply
  - Forest Derived Residue (FDR)... 10 – 20% of woody supply
  - Wood waste
  - Future fuels (dedicated energy crops)

- **Agricultural… 0 – 20% of total supply**
  - Corn cobs/stover
  - Future fuels (dedicated energy crops)
MU CHP WOODY BIOMASS FUEL SOURCES

- Non-Forest Derived Residues (non-FDR)
  - Primary forest products: slabs, edgings, cut-offs, sawdust, log cores
  - Secondary forest products: cabinet shops, cooperages, flooring, pallet plants
  - Wood waste: non-treated, clean-sawn lumber; pallets; r-o-w & park maintenance; urban tree damage

![Forest Product Facilities in Missouri](image)
MU CHP WOODY BIOMASS FUEL SOURCES

- Forest Derived Residues (FDR)
  - Harvest residues: Tops, branches, crooks, and other portions of trees resulting from commercial timber harvesting usually left in the forest.
  - Unacceptable growing stock: Trees that are considered structurally weak or having low vigor and lacking the potential to eventually yield a 12-foot saw log or survive for at least 10 years
  - Forest-grown trees that are damaged

http://projects.cares.missouri.edu/MoBAT/
ECONOMICS OF WOODY BIOMASS SUPPLY

<table>
<thead>
<tr>
<th>Activity / Item</th>
<th>Chip cost ($/ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stumpage</td>
<td>5.00</td>
</tr>
<tr>
<td>Equipment</td>
<td>12.04</td>
</tr>
<tr>
<td>Labor</td>
<td>5.69</td>
</tr>
<tr>
<td>Transportation (80 miles)</td>
<td>12.00</td>
</tr>
<tr>
<td>Delivered Cost</td>
<td>34.73</td>
</tr>
</tbody>
</table>

IMPORTANT POINT

Forest derived residues that are processed offsite and NOT meeting the criteria for non-forest derived residues are still considered to be forest derived residues

In other words... no ‘green-washing’
MU CHP OTHER BIOMASS FUEL SOURCES

• **Opportunity Fuels**
  - Short-term abundance of clean woody biomass from ice/wind storms or other natural disasters

MU CHP OTHER BIOMASS FUEL SOURCES

• **Future Fuels**
  - Dedicated energy crops, such as plantation-grown willow or hybrid poplar
MU CHP OTHER BIOMASS FUEL SOURCES

FDR SUSTAINABILITY STANDARDS

- **UNACCEPTABLE** FDR Biomass Fuels
  - Land conversion from forestland to either agricultural row crops or pasture
  - Land conversion from forestland to commercial development UNLESS seller can document through a zoning/building permit that such conversion was going to happen anyway
FDR SUSTAINABILITY STANDARDS
• All land from which FDR is sourced, public or private, will be managed according to a written forest management plan prepared by a professional forester as recognized by the Society of American Foresters (SAF)

FDR SUSTAINABILITY STANDARDS
• All FDR will be harvested in accordance with the Missouri Woody Biomass Harvesting Best Management Practices Manual, as may be amended during the contract period
FDR SUSTAINABILITY STANDARDS

• Each FDR harvesting team shall include at least one logger that, as a minimum, has completed the Missouri Forest Products Association’s Professional Timber Harvester Program or its equivalent from a neighboring state.

FDR SUSTAINABILITY STANDARDS

• No FDR will be obtained from any clearing operations unless either so prescribed in the written forest management plan for acceptable silvicultural reasons or deemed prudent as a result of a pest outbreak or natural disaster, and approved by a professional forester as recognized by the SAF.
FDR THIRD-PARTY AUDITS

• Prior to commencing harvest operations, the supplier must provide notice to MU
  • Description of harvest site; legal land description and/or GPS coordinates
  • Ownership name and contact information
  • Anticipated date(s) of harvest
  • Estimate of forest biomass to be removed

• Prior to completion of harvest operations, the supplier must provide notice to MU
  • Signed statement by an SAF-recognized professional forester that all sustainability standards specified in this section were met

FDR THIRD-PARTY AUDITS

• MU will hire an independent SAF Certified Forester to conduct periodic audits of randomly selected harvest sites.
• Supplier shall facilitate the inspections.
• Certified Forester will provide written report to both supplier and MU
CONSEQUENCES

Failure to comply may serve as grounds for contract termination

“Do what you can, with what you have, where you are.”
Theodore Roosevelt