Koda Energy
Biomass to Energy for Economic Survival
What is Koda Energy, LLC.?

• Koda is a partnership between Rahr and SMSC that creates “green energy” from burning dry biomass fuels

• Koda’s combined heat and power plant power plant to be located on the Rahr property in Shakopee MN
Rahr Malting Company

- The Rahr family has made malt for 160 years.
- Operational in Shakopee since 1936
- The Shakopee plant currently employs over 100 highly skilled workers
- It is the 2nd largest malting facility in one location in the world.
Shakopee Mdewakanton Sioux Community (SMSC)

- A federally recognized Indian Tribe
- The largest employer in Scott County
- Nearly $700 million in annual revenues in Minnesota attributed to SMSC
Why a Biomass Energy Plant?

- Concern with long term energy costs & supplies
  - Electrical
  - Natural gas
- Ideal CHP location
  - 7x24 operation
  - Large electrical & thermal demand
- Environmental sustainability
What Will Koda Produce?

- Koda’s has two products
  - 16.5 MW of base load renewable energy
  - 125 MM BTU’s/hr of thermal energy
- Rahr will purchase all of the heat generated from this system to replace its natural gas use
  - >1.1 million mcfs of natural gas/year
  - Approximately = the use in 11,000 homes
- The electricity generated from this system will be:
  - Purchased by the partners at avoided energy costs
  - Sold to outside power purchasers in need of base load and/or biomass renewable energy “Green Power”
Biomass Fuels
(100% Agricultural Material)

• Biomass fuels will be supplied by Rahr, local agri-businesses and farmers in a 50 mile radius
• Fuel - 175,000 tons/year required
  – 56,000 tons/year available from Rahr’s by-products
    • Barley dust, barley thins, malt sprouts
    – Local Agri-business by-products
    – Dedicated energy crops
  – Waste wood (clean)
  – Initial start up based on Rahr, agri-business and wood waste.
Biomass Energy Values

<table>
<thead>
<tr>
<th>Biomass Type</th>
<th>BTU/LB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley Byproducts</td>
<td>7600</td>
</tr>
<tr>
<td>Malt Sprouts</td>
<td>8326</td>
</tr>
<tr>
<td>Barley Needles</td>
<td>7600</td>
</tr>
<tr>
<td>Barley Dust</td>
<td>7650</td>
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<tr>
<td>Hulls</td>
<td>7563</td>
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</table>
Grasses for Fuel

- 7000-8000 btu/lb (10%mst)
- Annual Harvest
- Bail Storage
- Creative options for land use?
- 5000-7000 acres for 15% of our fuel needs
- ~$2.50 - $3.00/mmbtu
- 4 ton/acre = ~64 mmbtu
# Biomass TPA

<table>
<thead>
<tr>
<th>Energy Crop</th>
<th>Land Currently Planted with Major Crops</th>
<th>Idle and Pasture Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgrass</td>
<td>2.0 to 6.7</td>
<td>1.7 to 5.7</td>
</tr>
<tr>
<td>Hybrid poplar</td>
<td>3.25 to 6.0</td>
<td>2.8 to 5.1</td>
</tr>
<tr>
<td>Willow</td>
<td>3.15 to 5.8</td>
<td>2.7 to 4.9</td>
</tr>
</tbody>
</table>

Source: Oak Ridge National Laboratory.
Key Biomass Characteristics for Koda Energy

• Cost
  – Material
  – Transportation

• Availability

• Physical Characteristics
  – Dry – <15% moisture
  – Low bulk density
  – Small particle size – dust & chaff
Key Fuel Based Emission Components

- Protein (nitrogen) - NOX
- Sulfur Content – SO2
- Silica content - Boiler fouling
- LB. Alkali/mmbtu
  - $>1.0$ high fouling potential
- Chlorine – HCl & Dioxin formation
- Moisture - CO
## Biomass fuel characteristics

<table>
<thead>
<tr>
<th>Biomass</th>
<th>N levels</th>
<th>SIO2</th>
<th>Lb. alkali/MMBTU</th>
<th>#SO2/MMbtu</th>
<th>Fuel use Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>2.2 %</td>
<td>17%</td>
<td>1.00</td>
<td>.5</td>
<td>Ok</td>
</tr>
<tr>
<td>Oat Hulls</td>
<td>0.79</td>
<td>75%</td>
<td>0.88</td>
<td>.2</td>
<td>Ok</td>
</tr>
<tr>
<td>Barley Screenings</td>
<td>2.2</td>
<td>40%</td>
<td>1.13</td>
<td>.4</td>
<td>Ok</td>
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<tr>
<td>Mill Feed</td>
<td>2.03</td>
<td>31%</td>
<td>0.83</td>
<td>.5</td>
<td>Ok</td>
</tr>
<tr>
<td>Malt sprouts</td>
<td>3.75</td>
<td>26%</td>
<td>1.89</td>
<td>1.0</td>
<td>poor</td>
</tr>
<tr>
<td>Grain dust</td>
<td>1.04</td>
<td>71%</td>
<td>2.36</td>
<td>.3</td>
<td>ok</td>
</tr>
<tr>
<td>Corn Stover</td>
<td>1.0</td>
<td>52%</td>
<td>2.34</td>
<td>.17</td>
<td>poor</td>
</tr>
<tr>
<td>Wood Shavings</td>
<td>.27</td>
<td></td>
<td>0.45</td>
<td>0.05</td>
<td>Very good</td>
</tr>
<tr>
<td>Switch Grass</td>
<td>.48</td>
<td>68%</td>
<td>.69</td>
<td>.14</td>
<td>Very good</td>
</tr>
<tr>
<td>Jesusaleum artichoke</td>
<td>0.5</td>
<td>13%</td>
<td>1.1</td>
<td>.11</td>
<td>good</td>
</tr>
</tbody>
</table>
Plant Design

• Boiler Options
  – Bubbling fluidized bed system
    • Better suited for higher moisture – lower quality fuels
  – Stoker system
    • Not ideal for burning “dust”
  – Gassifer design not efficient

• Suspension burning system chosen for Koda
  – Flame stability
    • Self sustaining combustion w/o natural gas – 100% Biomass fired
  – Lower emissions & higher efficiency than stoker
  – Low unburned carbon
  – Combustion temperature control to avoid slagging <1600f
  – Rapid response & 50% turn down capability
  – Fuel ground to a “powder like” consistency
Four - 250 HP Grinders to Prepare Fuel for Combustion
Post Grind Fuel Mix Sizing

US Mesh Size
Boiler Characteristics

- **Biomass Input**
  - 41,500 pounds/hour
  - 308 mmbtu/hr

- **Boiler output**
  - 900 psig
  - 900 F
  - 220,000 pph steam

- **Exhaust**
  - 127,000 acfm
  - 350 f

- **Boiler Efficiency 80%**
- **Overall Thermal Efficiency 70%**
Sister Biomass Plant In Thailand
Commissioned December 2005
Koda Energy LLC

Fuel Truck

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Koda Site Layout
Koda Energy Fuel Unloading & Storage

- Four day storage
- Flexible truck unloading
- 6 trucks per hour
- Fully automated
Economic Benefits to the Community

• $55 Million dollar construction project in Shakopee
  – Estimated construction payroll of $16,000,000
• Create new skilled jobs at Koda facility
  – $750,000/year payroll
• $6,000,000 year for biomass purchases in local area
  - 50 mile radius from Shakopee
• Additional job growth in area to support project
  – Fuel program
  – Infrastructure support
  – Estimate $1,500,000 million year
• Protect +100 jobs at existing malting facility
• Support +4,000 jobs at SMSC
Environmental Benefits

- Renewable base load energy production
- CO$_2$ emission reduction from avoided natural gas use for heat
  - 70,000 tons/year
- CO$_2$ emission reduction from electrical generation
  - 190,000 tons/year compared to coal emission for electrical generation
- SO$_2$ emission reductions of 500 tons/year compared against fully controlled coal plant emissions
- Mercury emissions extremely low
- Energy Crops
  - Sequestering carbon
  - Reduce soil erosion
  - Improved water quality
Construction Schedule

– Mechanical Complete - Sept 9 2008
– Substantial Completion – November 10, 2008
– Final Acceptance – December 26, 2008
  • All “punch lists” complete
  • Training complete
  • Boiler fully functional and capable of full operation
Encouraging Biomass

• Right Location
  – Energy users
  – Biomass availability

• Storage and transportation infrastructure development

• Government incentives
  – Section 45 tax credit extension
  – Energy crop programs

• Expanding carbon trading programs
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