MISSOURI’S UNIQUE POSITION REGARDING BIOFUELS

Fossil sources
Missouri’s grid is very dependent on feedstock imports. In-state production of coal, natural gas and oil is negligible. Seventy-seven percent of Missouri’s electricity is produced from coal with all but a small fraction of that imported from out-of-state. These imports account for more than $1 billion leaving the state. (Source: Missouri Comprehensive State Energy Plan (2015), pp 2)

Biofuels
As a major producer of agricultural and forest commodities in the nation, Missouri has an abundant and diverse biomass resource base, which holds a significant potential for bioenergy, biofuels and biochemicals. Various uncertainties like availability, sustainable management and technical and economic constraints have resulted in limited scale development of Missouri’s biomass resources. However, increasing environmental and energy independence concerns make biomass use, production and conversion a more promising option for Missouri. Increased use of biomass resources can reduce dependence on imported fossil energy sources, create more job opportunities and stimulate the rural economy. (Missouri Energy Resource Assessment (2013), pp 33)

Annually, the Missouri biofuels industry creates:
- More than 6,600 new jobs
- $14.8 million in net general revenues on average each year
- On average, $542 million in new economic activity/output each year

NORTHWEST MISSOURI STATE UNIVERSITY’S UTILIZATION OF BIOFUELS

Wood-fueled operations
- Operations summary
  - Wood-fueled boiler brought online in 1981
  - 24,000 pounds per hour capacity
  - Serves building heat, domestic hot water and absorption chilled water
- Motivations for the project
  - Supply and pricing stability
  - Local economic benefit
  - Sustainability
- Economic impact
  - 14,700 tons procured
  - $466,000 to 10 regional vendors (FY16)
  - Replacing with natural gas would have cost more than $600,000

Pellet operations
- Operations summary
  - Pellet boiler brought online in 1992
  - Basis for recycling in northwest Missouri as waste paper and cardboard are collected from campus and the community
  - Northwest grinds, pelletizes and transports fuel
  - 390 tons produced and burned (FY16)

Impact
- More than 80 percent of steam production is biofuels
- Biofuels constitute more than 50 percent of campus energy usage

Future
- Market conditions continue to look favorable for the program
- Northwest continues to evaluate ways to further utilize biofuels and other sustainable practices

ALTERNATIVE FUELS PROGRAM METRICS — FY16

Alternative fuels have accounted for more than 50 percent of the annual campus energy use.
- In 2016, the program kept more than $570,000 in the local economy and provides utility savings to the University of $258,000.
- Wood chips from local vendors provided 56 percent of the campus’ energy in FY16, while pelletized paper provided an additional 1.6 percent.
- Wood chips are the least expensive source of energy at approximately 68 percent the cost of natural gas and 15 percent the cost of electricity.
- In a typical year, 10,000 - 12,000 tons of wood chips and over 1,000 tons of paper pellets will be burned.
- Utilizing the stable local resource reduces exposure to volatility in the unpredictable natural gas market.
- The cost differential between wood and natural gas determines savings for a given year.

Savings of more than $15.4-million have been achieved through utilization of alternative fuels.
In FY13, Northwest engaged our facilities contractor, Aramark, for an energy program with escalating savings targets. A combination of capital investments and operational improvements have led to substantial net savings and provided an avenue for replacing outdated equipment.

### Capital Improvements
- Building automation system and other control improvements
- Specification of energy efficient equipment in renovations
- Campus lighting upgrade
- Installation of variable speed drives
- Additional measures at Central Plant in progress
- Installing electrical submetering
- More than $250,000 in incentives leveraged from electric utility to date

### Operational Measures
- Scheduling HVAC systems
- Modifying equipment sequences of operation
  - minimizing makeup air when not required
  - minimizing simultaneous heating and cooling/reheat
  - using discharge air temperature and duct static resets
  - wood fuel procurement negotiations

### Similar Operations
- University of Iowa
  - waste wood and oat hulls
  - supporting campus goal of 40 percent renewable energy by 2020
  - combined heat and power
- University of Missouri-Columbia
  - biomass fueled boiler placed into operation in 2010
  - 100,000 tons of waste wood use annually and
  - combined heat and power

### Results
- Peak electric summer demand down 25 percent from 5.1 megawatts (2011) to 3.8 megawatts (2016)
- Electricity consumption down 22 percent from 2,800 megawatt-hours (2011) to 2,200 megawatt-hours (2016)
- Financial savings of 20.6 percent ($724k) in FY16 with cumulative program savings of 18 percent ($2.6 million)
- Over 20,000 tons of avoided greenhouse gas emissions

### REDUCTION SAVINGS ANNUAL COMPARISON

### NORTHWEST’S ALTERNATIVE ENERGY NEEDS
- 100 year-old building
- 50 year-old boilers
- Power Plant = same location as 1905
  - campus expansion
  - campus changes
  - location, location, location
- Significant need for re-investment
  - Estimated cost to refit and upgrade existing plants with similarly sized, modern equipment = $33.6 million
  - Estimated cost to relocate the plants to another location and replace equipment with similarly sized modern equipment = $48 million
**AUGUST 1982**
Wood fuel boiler brought online

**OCTOBER 1993**
Paper pellet production begins

**2000**
Energy process patent granted

**2010**
Explored use of Pyrolysis Oil

**FY16**
Wood and paper fuels account for 58 percent of total campus energy consumption and 86 percent of steam production

**2014**
Installed high-efficiency burner
**ENERGY CONSERVATION**
**OCTOBER 2016**

**FY16 PERFORMANCE**
- Wood and paper fuels account for 58 percent of total campus energy consumption and 86 percent of steam production.
- $466,000 into local economy vs. $600,000+ for out-of-state gas.
- $60,000+ in FY16 savings through wood fuel contract negotiation.
- Refractory repairs and water level control replacement.

**SAVINGS**
- More than $2.6 million savings (48 months).

**ADDITIONS**
- Retrofitted old lighting systems and added controls, installed variable frequency drives, expanded control capabilities and established curtailment measures for breaks.

**UPGRADE REWARDS**
- $250,000 received for energy efficiency upgrades through utility rebate programs.

**FY16 UTILITY EXPENSES**

<table>
<thead>
<tr>
<th></th>
<th>Annual</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Chips</td>
<td>$575,875</td>
<td>$1,579</td>
</tr>
<tr>
<td>Paper Pellets</td>
<td>$23,946</td>
<td>$66</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>$149,213</td>
<td>$409</td>
</tr>
<tr>
<td>Electricity</td>
<td>$2,091,604</td>
<td>$5,730</td>
</tr>
<tr>
<td>Water</td>
<td>$466,344</td>
<td>$1,278</td>
</tr>
<tr>
<td>Total</td>
<td>$3,306,982</td>
<td>$9,060</td>
</tr>
</tbody>
</table>

**USER EXPERIENCE**
- Better control during occupancy.
- Spaces set back during unoccupancy and curtailments - University cannot continue to condition 2.3 million ft\(^2\) 24x7x365.

**Goal:** Add building systems information and scheduling to the web.

**FINANCIAL SAVINGS**