Bioenergy opportunities for MS

MS PSC Special Work Session
Renewable Energy in MS

August 17, 2016
Agenda

• Forestry and the economy
• Drax Biomass overview
• Drax’s experience with coal-to-biomass conversion
• Bioenergy opportunities for Mississippi
Economic impact of Mississippi’s working forests

- 64% forest coverage
- 19.8 million forested acres (+20% over 80 yrs)
- 75% private, non-industrial ownership
- $12.3 billion contribution to MS economy
- $3.4 billion annual wages paid out
- 70,000 jobs (5% of total workforce)
Drax Group – a vertically integrated biomass energy co.

Source

Generate

Supply
Drax Biomass operations

Headquarters… Atlanta, GA
- ~35 employees
- Leadership and most support functions

Morehouse BioEnergy… Bastrop, LA
- Fully commissioned in August 2015
- 60 employees
- Production capacity = 450,000 MT/year
- Rail-based infrastructure

Amite BioEnergy… Gloster, MS
- Fully commissioned in August 2015
- 60 employees
- Production capacity = 450,000 MT/year
- Truck-based infrastructure

Baton Rouge Transit… Port Allen, LA
- Fully operational in April 2015
- Multi-modal, deepwater port
- 10 employees (DBI and Host Terminals)
- 2 million MT/year handling capacity
- Up to 40 cargo vessels/year
Gloster, MS – an ideal location for a pellet mill

**Strong wood basket**
- Annual fiber demand = 1.0m MT/yr
- Total pine growth = 11.3m MT/yr\(^1\)
- Total pine drain = 6.7m MT/yr\(^1\)
- Growth-to-drain ration = 1.7:1\(^1\)
- Total pine inventory = 135m MT\(^1\)

**Favorable market conditions**
- Excess inventory due to mill closures
  - GP plywood mill (Gloster) – 0.5 m MT/yr
  - IP pulpmill (Natchez) – 1.4 m MT/yr
- Trained logging/hauling crews
- Available workforce with mill experience

**Existing infrastructure**
- Extensive road networks
- Proximity to deep-water port (60 road-miles to Baton Rouge)
- Mature trucking industry (Werner)

---

\(^1\) 2015 Total Pine Inventory and 2015 Growth-to-Drain (GtD) ratio. Figures from analysis by Forisk Consulting of Sub-Regional Timber Supply (SRTS) model
Our contribution to the local economy

$155m capital investment

60 full-time employees

$2.9m payroll in 2015

175 indirect jobs (logging/hauling/trucking)

$4.9m spend on local suppliers (2H ‘15)

$13m spend on fiber purchases in 2015
Wood pellet manufacturing at a glance

- Efficient, cost-effective bulk transport
- Low moisture content = higher BTU value
- Adaptable for use at coal-fired facilities
- Stringent specs = reliable plant operations

![Diagram showing the process of wood pellet manufacturing]

1. Feedstock delivery
2. Woodyard storage
3. Debarker
4. Chipper
5. Woodchip Screen
6. Dryer
7. Hammer mills
8. Pellet mills
9. Storage
10. Load-out facility
Drax Power Station, pre-conversion (1975)

UK’s largest power station... 4 GW (6 x 645 MW units)
Major emitter of CO2... 22 MM MT/yr at peak
Critical asset... 7-8% of total supply
Drax Power Station today

2 of 6 units fully converted to biomass, 3rd unit at 90% biomass
No loss of output, negligible impact on efficiency
20% of UK renewable generation, largest decarbonisation project in W. Eur
Coal-to-biomass: good for the environment

SO$_x$ emissions  
85%$^{1,2}$

NO$_x$ emissions  
50%$^{3,4}$

CO$_2$ emissions  
80%$^{5,6}$

$^1$FGD-abated coal versus unabated biomass  
$^2$Abated sulfur content of coal = 200-300 mg/m$^3$  
$^3$Unabated coal versus unabated biomass  
$^4$Normal operating conditions - Boosted Overfire Air system and low-NOx coal  
$^5$Fossil (geologic) emissions versus lifecycle (biogenic) emissions  
$^6$Includes emissions from production and transportation of biomass fuel
Coal-to-biomass: good for the grid

- **Reliable**: Renewable, low-carbon baseload generation
- **Flexible**: Output adjustable between 200-645 MW/unit
- **Dispatchable**: Responsive to changing load/generation patterns
- **Essential**: Balancing, freq. response, VAR support, blackstart svcs
Coal-to-biomass: good for ratepayers

✓ Utilizes existing grid infrastructure
✓ Reduces risk of stranded assets
✓ Offers alternative to costly pollution control upgrades
✓ Provides cost-competitive complement to wind and solar

<table>
<thead>
<tr>
<th>Technology</th>
<th>Levelized Cost of Elec. (DECC 2013)</th>
<th>System Integration Costs(^1) (Average 2020-2030)</th>
<th>Whole System Cost (WSC = LCOE + SIC)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>£/MWh (2012)(^2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onshore Wind</td>
<td>100</td>
<td>10-14</td>
<td>110-114</td>
</tr>
<tr>
<td>Offshore Wind</td>
<td>132</td>
<td>10</td>
<td>142</td>
</tr>
<tr>
<td>Solar PV</td>
<td>123</td>
<td>12</td>
<td>135</td>
</tr>
<tr>
<td>Biomass Conversion</td>
<td>108</td>
<td>-1</td>
<td>107</td>
</tr>
</tbody>
</table>

\(^1\)Includes costs of backing up intermittent generation and making the system flexible enough to adapt to fluctuations in demand; estimated relative to a benchmark technology (assumed nuclear power)

\(^2\)Costs denominated in real 2012 prices for ease of comparison to the DECC (2013) levelised cost of energy

Source: UK Renewables Subsidies and Whole System Costs; NERA Economic Consulting/Imperial College London – Feb 2016
Bioenergy (pellet) opportunities in MS

Value proposition

• Readily available, renewable resource – 19.5 million forested acres
• Pellets offer resource diversification in state energy policy
• Biomass a potential state compliance mechanism for EPA CPP
  ➢ Co-firing = flexible compliance option for achieving coal heat rate performance standard
  ➢ Conversion/Greenfield = non-zero emitting renewable generation source potentially eligible for credits under rate-based plan

Possible next steps

• Identify candidate facilities (existing coal-fired stations)
• Perform pellet test-burns
• Conduct feasibility studies (engineering, resource availability)
Questions?