THE OUTLOOK FOR FOREST BIOENERGY

Cellulosic Supply Chains for Bioenergy

Ben D. Spong, PhD
Extension Specialist
WVU Appalachian Hardwood Center
ben.spong@mail.wvu.edu

Why is wood biomass an important component of an energy portfolio?

Advantages of woody biomass:

- Is available
- Is renewable & sustainable
- Minimal heavy metals and sulfur
- Can reduce waste streams
- Does not increase atmospheric levels of CO₂
- Locally produced
- Proven technology

Source: woodforgood.com
Existing Examples

- Important to show that wood can be used outside the forest products industry
- In WV, other than residential use, no good examples outside forest products industry

Warren State Hospital, Warren PA

- 200 patients, 400 faculty and staff
- Steam for heat, hot water
- 71 tons wood residue/day
- Saves $400,000 annually over natural gas
Eastern Correctional Institute, MD

- Houses 450 inmates
- Installed 2.5 MW generating plant to assure uninterrupted power
- 50,000 tons green wood chips per year
- Cut fuel costs by 63%

Mt. Wachusett Community College Gardner, MA

- Closed loop, two pipe hydronic heating system
- ~$4 million invested
- 8MBtu combustion unit
- 03/04 heating season approx. $275,000
- 50kw downdraft gasifier
- Syngas powers a Honda generator
Mountain View School District, PA

- 200,000 square feet
- Uses ~1500 tons wood chips per year
- Savings average ~30k / year

Fuels for Schools Program

- Active in Western US
- VT - started in 80s
  - Over 30% of public school students attended a wood-heated school
  - Burning ~ 10,000 tons annually – 32 schools
### Wood Cost

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Heating Value</th>
<th>Cost/Unit</th>
<th>Cost/MMBTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Wood</td>
<td>4900 BTU/lb</td>
<td>$30/ton</td>
<td>$3.06</td>
</tr>
<tr>
<td>Coal</td>
<td>12,200 BTU/lb</td>
<td>$71.15/ton</td>
<td>$2.92</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1,028,000 BTU/MCF</td>
<td>$3.85/MCF</td>
<td>$3.75</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>144,000 BTU/Gal</td>
<td>$3.00/Gal</td>
<td>$20.83</td>
</tr>
</tbody>
</table>

### Biomass Feedstock Consumption

*Perlack et al. Biomass as a feedstock for bioenergy and bioproducts industry*
US Forest Derived Biomass Resources

Perlack et al. Biomass as a feedstock for bioenergy and bioproducts industry

Annual Wood Residue Production WV

Total 2.4 M DT (~5 M GT) of residue/byproducts per year.
- 1.3 M DT of logging residue, 55%.
- 950,000 DT of mill residue (39%).
  - 40,000+ GT weekly
  - 80% from sawmills and 20% from secondary manufacturers
  - 50% chips, 30% sawdust, and 20% bark
  - Urban tree & pallet residues
Potential for wood biomass in WV

- ~10,000 tons to produce 1 MW
- 5 M tons of wood residues
- Potential for 500 MW from wood waste
- This would be 10% of WV power consumption from waste wood alone.
- Could substantially increase this capacity through markets for wood produced from forest improvement cuttings and reclamation work

Why is this 10% important?

- WV produces 15,000 MW
- Consumes 5,000 MW
- Portfolio standard requires 500MW from renewable sources by 2015 (10% WV production)
- Under WV portfolio, developers of renewable energy projects get:
  - 1 Credit for project that meets standard (GenPower)
  - 2 Credits for renewable source (wind, biomass and others)
  - 3 Credits for renewable source on mine site

Could be generated with waste wood at this point!
WHAT WILL THE FUTURE BRING?

First Energy Plant – Shadyside OH

- 300 MW Facility
- Switching from coal to woody biomass
- Needed >$300 million in pollution controls
- $200 million for conversion
- Ohio Environmental Council and Consumers Council in opposition – concerned about sustainability of biomass
Mingo County Power Plant

• 28 MW – 400,000 Tons/yr
• $150 Million investment
• Surface mine location

Baard Energy - Ohio River Clean Fuels

• Coal/Biomass Gasification plant – Wellsville OH
• Starting at 600,000 green tons/year
• Producing Diesel and Jet Fuel
• Injecting CO₂ for oil field recovery
Also on horizon – cofiring (again)

• RFP recently in Ohio
• Some interest beginning in WV – especially for blending biomass/wood and shipping via barge out of state

What is cofiring?

• Direct co-firing
  • Biomass and coal are burned simultaneously
• Indirect co-firing
  • A biomass gasifier is used to covert biomass to syngas which is then burned with coal
Why co-fire biomass and coal?

- Concerns over potential global environmental impacts of fossil fuels used for power generation
- Is more related to carbon management than renewable portfolios
- Coal-fired power plants have three general opportunities to reduce CO2 emissions:
  1. Increase their efficiency
  2. CO2 removal and/or sequestration
  3. Biomass co-firing

Benefits and Challenges?

**Benefits**
- Extensive knowledge base
- Little or no loss in total efficiency
- Can make up 15% of total energy input with only feed system and burner modifications
- 15% co-firing produces 18.2% decline in GWP emissions (Mann and Spath 2001)
- Create markets for under-utilized forest resources. Also densified fuel opportunities

**Challenges**
- Biomass fuel preparation, storage and delivery – infrastructure costs can be high
- Permitting process can be difficult
- Biomass fuel cost and availability
- Fly-ash utilization
- May increase corrosion and slag formation in boilers
- May impact SCR systems
Main challenge – biomass supply side

- 14,000 MW from coal/year
- 15% co-fire → 2,100 MW
- 10,000 tons/MW – need 21 MM tons/year
- About 16% available
- Will compete with other sectors
- Today procurement for biomass energy is “cost” restricted

Biomass, Cofiring and Linkage to Terrestrial CO₂ Offsets (another driver)

- WV has 12 million acres of forestland
- About 10.5 million acres are private
- This forest sequesters CO₂
- Argument – we should be ready - “IF”
How much are we sequestering?

- ~ 85 million tons of CO₂ released from power plants in WV per year (US Energy Information Administration)
- During growth forests sequester about 4 Tons C/ha/year (range 3.5-10 tons/ha)
- Converting to CO₂ → 1 Ton C ≈ 3.7 units CO₂
- Total intake ~ 20 million Tons CO₂
- Represents ~23% of total electrical emissions
- Ready to “rock and roll”, right?

Wrong...

- Typically can’t count existing growth under climate programs
- Need to increase the annual carbon storage rate and increase terrestrial carbon accumulation over lifetime of “project”
- Projects include:
  - Forest Management
  - Afforestation
  - Reforestation

WV landowners with >1000 acres, 4.8 million acres total
What can we do to gain credit?

- Enter active offset project - *First option* – afforestation – establishing forest cover on mineland sites
- Potential to offset 1.5% of annual CO₂ emissions from energy production in WV
- Approximately $660 million needed to offset same amount in recent geologic sequestration project
- Cost of afforestation project on all capable lands (34,000 acres) would be ~$34 million
- 95% reduction in overall project cost for same amount of CO₂ offset

**Another Option – Forest Management**

| Year | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
|------|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| AVG NMR |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| AVG BAU |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

**Additionality ≠ AVG BAU – 0**
**Additionality = AVG NMR – AVG BAU**

Must understand temporary vs. permanent storage. Define the system boundary.
Opportunities

- Encourage WPC to actively seek out potential users of wood fiber for energy – no reason that they should not be entrepreneurial
- Work to facilitate scaled co-firing as an important component of energy strategy.
  - Understand how complete lifecycle of biomass use can impact bottom line – not purely a production cost dynamic
  - Develop projects that have synergies with existing wood products industry
- Develop a better understanding of CO2 sequestration potential of forestland.
  - Become a leader in active systems management
  - Promote continued wood products development
  - Allow us to become a leader in terrestrial sequestration