Eucalypt Plantations in Florida USA: Economic Analysis of Current and Potential Uses

Dr. Jeff Wright
SARA

- Sustainable
- Affordable
- Reliable
- Available

- J. Lane, BioFuels Digest April 13, 2012
EU 27 Bio-energy Demand by 2020

• Renewable Energy Directive
  • 20% reduction in GHG from 1990 levels
  • 20% energy efficiency improvements
  • 20% energy from renewable sources
  • 10% increase in biofuels usage

• Source: Biorefining Magazine, February 2011.
## Life Cycle Emissions Including Production

<table>
<thead>
<tr>
<th>Fuel</th>
<th>CO2 emissions kg/GJ</th>
<th>CO2 emissions kg/MWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard coal</td>
<td>134</td>
<td>484</td>
</tr>
<tr>
<td>Oil</td>
<td>97</td>
<td>350</td>
</tr>
<tr>
<td>Natural gas</td>
<td>75</td>
<td>270</td>
</tr>
<tr>
<td>Wood chips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 25% MC</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td>Wood pellets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 10% MC</td>
<td>9</td>
<td>33</td>
</tr>
</tbody>
</table>

- Source: Biomass Power & Thermal October 2011
UK Renewable Energy
2020 Targets

• 20% of energy needs from renewable sources
• 75% of renewables as wind, solar…
• 25% of renewables as biomass
• 50,000,000 dry tonnes biomass total
• 30,000,000 dry tonnes biomass imported
  • 22 million tonnes wood pellets
  • 24-36 wood pellet facilities (1/3 in US South?)
• 20,000,000 dry tonnes biomass-domestic
  • UK Forestry Commission says 2 million tonnes by 2020 in bio-energy forest plantations
# Wood Bio-energy South

Projected Annual Wood Demand 2022


<table>
<thead>
<tr>
<th>State</th>
<th>Projects</th>
<th>New Tons*</th>
<th>Current PW Tons*</th>
<th>Harvest Residues**</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>8</td>
<td>4,947,460</td>
<td>22,319,461</td>
<td>5,100,000</td>
</tr>
<tr>
<td>AR</td>
<td>7</td>
<td>1,820,000</td>
<td>8,599,960</td>
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<tr>
<td>FL</td>
<td>18</td>
<td>10,574,125</td>
<td>8,810,364</td>
<td>4,700,000</td>
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<tr>
<td>GA</td>
<td>36</td>
<td>18,167,578</td>
<td>24,910,968</td>
<td></td>
</tr>
<tr>
<td>LA</td>
<td>4</td>
<td>3,300,000</td>
<td>13,202,538</td>
<td></td>
</tr>
<tr>
<td>MS</td>
<td>8</td>
<td>3,183,239</td>
<td>9,756,782</td>
<td>3,320,000</td>
</tr>
<tr>
<td>NC</td>
<td>13</td>
<td>2,796,000</td>
<td>6,516,913</td>
<td>3,617,000</td>
</tr>
<tr>
<td>SC</td>
<td>11</td>
<td>2,939,800</td>
<td>11,754,290</td>
<td>3,700,000</td>
</tr>
<tr>
<td>TN</td>
<td>6</td>
<td>3,150,000</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>TX</td>
<td>9</td>
<td>2,862,440</td>
<td>8,828,168</td>
<td></td>
</tr>
<tr>
<td>VA</td>
<td>15</td>
<td>2,207,300</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>145</strong></td>
<td><strong>62,813,654</strong></td>
<td><strong>125,294,759</strong></td>
<td></td>
</tr>
</tbody>
</table>

- *Green tons
- **Green tons estimated as available by state agency or USFS
Post Harvest Residue
Gadsen Co. Florida

Whole Tree Chipped
Conventional Tree Length Harvest

Bio-energy Availability = Zero on Many Logged Sites
Bio-energy Resources (?)

Urban waste

Logging site waste
Florida Harvest and Utilization Study, 2008
Resource Bulletin SRS-162

• Average total harvest 68 tons/acre (15 ton/acre residual)
• 331,000 acres harvested (191,000 acres/year clearcut)

• Softwood  85% utilized  15% residual
  • Residual 3.2 million tons (1.0 million tons stem wood, 2.2 million tons tops and limbs)
• Hardwood  74% utilized  26% residual
  • Residual 1.5 million tons (0.7 million tons stem wood, 0.8 million tons tops and limbs)

Residual at 15 tons/acre, 50% recoverable is 7.5 tons/acre
Need recoverable residuals from 80,000 acres clearcut for 50MW (600,000 tons/year)
Eastern US Hardwood Forest Plantation Opportunities

- Eucalyptus
- Hybrid Poplar
- Sweetgum, Cottonwood, Hybrid Poplar
- Sweetgum, Cottonwood
- Sweetgum, Eucalyptus
- Eucalyptus sp.
Conventional Eucalyptus

- **Uses**: Mulch, Hardwood Pulp & Biomass for energy
- **Species**: Eucalyptus benthamii
- **Sites**: Lower latitudes in the SE USA
- **Soils**: Somewhat poorly with good internal drainage to well drained soils
- **Silviculture**: Good understanding but will improve
  - Establishment cost > than pine
  - Coppice for additional rotations < than pine
- **Risk**: Freeze damage- Unknown pest
- **Productivity range**: 9-16 Gtons/ac/yr pulp wood rotation 7-8 yrs. Specific gravity 0.46 to 0.52.
- **Improvement activities**: Seed source testing, NCSU FPC screening
Eben – age 12 years
Eucalyptus benthamii (Eben)

- Most cold tolerant eucalyptus we have tested
- Current planting stock are seed collections from multiple sources which produce good but variable performance
- Large effort in US seed production

3-yr-old Eben planted near Jackson, AL
Eben seed production

Bellamy clonal orchard

Age one year – will be Seedling Seed Orchard
Native Eucalypts to Plantations
Species Introductions

*E. benthamii*  South Carolina USA
Age 6 years
Pawns to Clones
E. camalduensis, Age three years
Selected Ecam, Age Two Years
EH1 South Florida

Age 12 months

Age 4 months
EH1 Sebring Florida. Age Four Years.

14 dry short tons/acre/year
Mean Annual Increment - Green tons/acre/year vs Age - Sebring, FL

Age - years
Green tons/acre/year
EH1
FTE 427
FTE 435
Total Yield Sebring FL

Total yield - Green tons/acre vs Age - Sebring, FL (545 trees/ac)
Eucalypt Coppice Management

Coppice 3 months  

Coppice 18 months
E. urograndis at Age two years

40’ tall

4.5” DBH
Eucalypt for Mulch Production
Bio-energy Analysis

Field Crew – Brute Force

Lab Crew – Intelligent Force
Eucalypt potential for cellulosic ethanol

Bio-energy such as wood pellets and briquettes can be effectively manufactured from Eucalyptus

PIRAGLIA, ADRIAN; GONZALEZ, RONALDS; DENIG, JOSEPH; SALONI, DANIEL and WRIGHT, JEFF (2012). Assessment of the most adequate pre-treatments and woody biomass sources intended for direct co-firing in the US. BioResources 7(4):4817-4842.


Wood Pellets: NCSU Dr. Daniel Saloni
July 2012

Current Production by State
(Tons/year)

Total
3,124,110 tons/year

FL
567,600
GA
923,670
MD
66,000
NC
344,520
SC
462,000
VA
615,780
WV
144,540

Georgia is the largest producer with second fewest pellet plants
Wood Pellet Shipping Cost for the EU (1)

- SE US to EU       US$36
- Brasil to EU      US$44
- BC Canada to EU   US$67

(1) Dr. Daniel Saloni, NCSU, Department of Biomaterials
Global Pellet Production and Demand
(millions metric tonnes)

<table>
<thead>
<tr>
<th></th>
<th>Demand 2010</th>
<th>Demand 2020</th>
<th>Production 2010</th>
<th>Production 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>10.8</td>
<td>23.8</td>
<td>7.7</td>
<td>13.0</td>
</tr>
<tr>
<td>China</td>
<td>0.6</td>
<td>10.0</td>
<td>0.6</td>
<td>10.0</td>
</tr>
<tr>
<td>Japan/Korea</td>
<td>0.2</td>
<td>5.5</td>
<td>0.1</td>
<td>1.1</td>
</tr>
<tr>
<td>North America</td>
<td>3.4</td>
<td>5.6</td>
<td>4.9</td>
<td>11.0</td>
</tr>
<tr>
<td>Total</td>
<td>15.0</td>
<td>44.9</td>
<td>13.3</td>
<td>35.1</td>
</tr>
</tbody>
</table>

- (Pellet Mill Magazine, Fall 2011)
Stem Size Matters
Eucalypt Bio-energy Harvest

Plantation age 18 months
Harvesting Systems – Whole Tree Biomass

Bales at roadside $9.25/green ton

Whole tree chips at roadside $10.42/green ton

D. Mitchell, USFS, October 2012
Eucalypt Harvesting Systems
Eucalypt Bio-energy Systems

Tree length chipping

Co-generation with bagasse
### Range of Returns for Eucalypt Plantations (1)

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Origin</th>
<th>Cost/acre ($)</th>
<th>Harvest Age (green tons/acre)</th>
<th>Stumpage Prices @ return rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Seedlings</td>
<td>525</td>
<td>89</td>
<td>9.02 11.44</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Coppice</td>
<td>215</td>
<td>102</td>
<td>3.42 4.24</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Coppice</td>
<td>215</td>
<td>88</td>
<td>3.86 4.80</td>
</tr>
</tbody>
</table>

Effect of % cover area on freight distance & cost

Freight miles
Freight cost ($/BDT)

% of Cover area with desired biomass
US South Delivered Wood Fuel Prices

- Wood fuel defined as by product of pulpwood chipping

- Price in Q4 2011 was $20.32/delivered green ton (1)

- Plantation growing cost (stumpage)  $4-9/green ton
- Cut, chip, haul cost                $10-16/green ton

- Total                                $14-25/delivered green ton

- (1) Source: Forest2Market February 2012
Questions?

Jeff Wright
843 991 2911

Coltrane