Forest-based biomass supply for the U.S. –

Evolution of the Billion Ton Study Estimates

Ensuring Forest Sustainability in the Development of Biofuels and Bioenergy in the Great Lakes States

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Billion ton supply report (BTS)

Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply

April 2005

Feedstocks for Biofuels (BRDi Report)

Increasing Feedstock Production for Biofuels
Economic Drivers, Environmental Implications, and the Role of Research
Definitions and Topics

- Biomass = wood and bark **not used for products** (small trees, tops, branches, mill residue, urban waste)
- Conventionally sourced wood = pulpwood, sawlogs
- Biomass units = oven dry tons
- Biomass prices = cost at roadside

- USDOE/ DOE Billion ton supply study (BTS) estimates
  - Potential forest-based biomass supply
- Building on the BTS Study –
  - Estimating county level biomass supply curves
- Results
  - BRDi Report – supply excluding federal land
  - Extension – supply including federal land
  - Supply detail for Great Lake States
## Forest-based biomass, potential sustainable supply – Million oven dry tons / year

<table>
<thead>
<tr>
<th>Source</th>
<th>Potential at late 1990’s harvest levels</th>
<th>With harvest increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logging residue</td>
<td>32</td>
<td>15</td>
</tr>
<tr>
<td>Other removals</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Fuel/ health treatments</td>
<td>49 / 11 TL / OF</td>
<td></td>
</tr>
<tr>
<td>Mill residue (unused)</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Urban wood</td>
<td>28</td>
<td>11</td>
</tr>
<tr>
<td>Sub Total</td>
<td>137</td>
<td>34</td>
</tr>
<tr>
<td>Residue used for energy or other use</td>
<td>141</td>
<td>54</td>
</tr>
<tr>
<td>Grand total</td>
<td>366</td>
<td></td>
</tr>
</tbody>
</table>

### Data Summary:

- **2006 timber harvest = 245 million odt (main stem of trees)**

### Note:
- TL: Top Line
- OF: Other Form
Building on the BTS Study

- **Objective**
  - Estimate county level biomass supply curves

- **Key assumptions**
  - **Lower cost biomass will come from integrated harvesting**
    - Combined harvesting for sawlogs, pulpwood and biomass
  - **Most pulpwood for energy supplied at higher costs**
  - **Scenarios for integrated harvesting**
    - Conventional harvesting taking some logging residue
    - Thinnings for fire hazard reduction and health treatments
  - **Sustainability limitations are included**
    - Limited removal of logging residue (65%)
    - Thinning treatments at limited pace (over 30 years)
Biomass sources – Flambeau River Biofuels, Park Falls, WI

Feedstocks sources at selected plant size

Source: John Geephart
Building on the BTS Study

- **County Biomass supply sources**
  - Integrated harvesting on timberland
    - **Logging residue method**
      - Remove 65%, cost = chipping at roadside + stumpage
    - **Thinning simulation method** (use FS FIA plots nationwide)
      - Thin high density stands over 30 year period
      - Cost = harvest /chipping + stumpage
      - Limitation – associated conventional roundwood harvest can’t exceed < state harvest in 2006
    - **Biomass supply** = average of two methods
  - **Other removal residue** - remove 50% (35% at $20, 65% at $30)
  - **Other forestland thinning** ( $60+ per odt at roadside)
  - **Mill residue** (unused portion) ($10/odt)
  - **Urban wood residue** – 10% of unused amount

- **Conventionally sourced wood** – pulpwood amount = decline since 80’s high, Cost ~$40 and more per oven dry ton
Results

At $44 - forest and agricultural biomass would provide 16 billion gallons of fuel

Forest biomass – 4 billion
Ag residue – 12 billion

Forest biomass supply

Non federal Forest
45 million odt/ year

All Forest
50 million odt/ year
Figure 6.5
Production and costs for forestland wood

Excludes federal forest land

Million dry tons

$/dry ton (roadside)

Urban
Conventional
Southern Plains
Southeast
Pacific
Northern Plains
Northeast
Mountain
Lake States
Delta
Corn Belt
Appalachian
Forest biomass supply at ~$44/odt at roadside

![Bar chart showing biomass supply by state and category.]

- **State**: WI, MI, MN
- **Category**: Non Federal, All Forest
- **Million Oven dry tons**
- **WI**: Non Federal ~1.6, All Forest ~1.8
- **MI**: Non Federal ~1.0, All Forest ~1.2
- **MN**: Non Federal ~0.4, All Forest ~0.8
Lake States Forest Biomass Supply – All Forest (cumulative)

$ per oven dry ton at roadside

Million oven dry tons

0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

0 10 20 30 40 50 60 70 80 90 100

MN
MI
WI
Ethanol equivalent of forest biomass supply

Megawatt capacity equivalent of forest biomass supply
Ongoing work

- Estimate **pulpwood supply curves** for bioenergy
  - Two supply sources
    - **Additional** harvest of pulpwood for bioenergy
    - **Shift of pulpwood supply** from current users to bioenergy

- Estimate **mill residue supply curves** – from residue used for fiber uses
  - Sift of mill residue supply from pulpwood /panels to bioenergy use
Summary points

- For the Lake States –
  - Integrated harvesting can supply (at $44/odt and 2006 harvest levels) (rough estimates)
  - Without / With Federal harvest
    - 3.3/ 4.0 million odt biomass
    - 260/ 320 million gallons ethanol OR
    - 355/ 433 megawatts of electric capacity
  - Higher production will require pulpwood/ currently used mill residue OR
  - Short rotation woody crops