Urban Wood Residue Availability for Biomass Energy

MREP Biomass Meeting
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Presentation by:
Jessica Simons,
Natural Resources Specialist
Why is Using “Urban” Wood Important?

200 million cubic yards of green waste

3-4 billion board feet of lumber

25% of 14 billion consumed in U.S.

30 million cubic yards of logs can be milled

Graphic courtesy of Sam Sherrill, author of *Harvesting Urban Timber* (2003)
Table 1—Woody yard trimmings generated, by population, 1993–2000

<table>
<thead>
<tr>
<th>Year</th>
<th>Population (×10^6)</th>
<th>MSW generated (×10^6 metric tons)</th>
<th>Per capita (kg)</th>
<th>Yard trimmings in MSW (×10^6 metric tons)</th>
<th>Per capita (kg)</th>
<th>Urban tree + woody yard residues in yard trimmings (×10^6 metric tons)</th>
<th>All sources</th>
<th>Forestry related</th>
<th>Household and others</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>259.9</td>
<td>191.5</td>
<td>737</td>
<td>30.2</td>
<td>116</td>
<td>13.3</td>
<td>11.6</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>263.1</td>
<td>194.3</td>
<td>738</td>
<td>28.6</td>
<td>108</td>
<td>13.5</td>
<td>11.8</td>
<td>1.7</td>
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<tr>
<td>1995</td>
<td>266.3</td>
<td>191.8</td>
<td>720</td>
<td>26.9</td>
<td>101</td>
<td>13.7</td>
<td>11.9</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>269.4</td>
<td>189.8</td>
<td>704</td>
<td>25.3</td>
<td>94</td>
<td>13.9</td>
<td>12.1</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>272.6</td>
<td>198.8</td>
<td>729</td>
<td>25.1</td>
<td>92</td>
<td>14.0</td>
<td>12.2</td>
<td>1.8</td>
<td></td>
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<tr>
<td>1998</td>
<td>275.9</td>
<td>202.7</td>
<td>734</td>
<td>25.1</td>
<td>91</td>
<td>14.2</td>
<td>12.3</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>279.0</td>
<td>209.5</td>
<td>751</td>
<td>25.1</td>
<td>90</td>
<td>14.3</td>
<td>12.4</td>
<td>1.9</td>
<td></td>
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<tr>
<td>2000</td>
<td>282.1</td>
<td>210.4</td>
<td>746</td>
<td>25.1</td>
<td>89</td>
<td>14.5</td>
<td>12.6</td>
<td>1.9</td>
<td></td>
</tr>
</tbody>
</table>


^Includes commercial tree care firms, municipal park and recreation departments, municipal and county tree care divisions, public utility maintenance departments, nurseries, orchards, landscapers, and others who provide professional tree-related services.

^Households and others assumed to generate approximately 15% of residues generated by forestry-related businesses.
Figure 4—Timber harvested from National Forests compared with urban tree and woody yard residues generated, 1996–2000.
Table 1. Wood waste generated; recovered, combusted, or not usable; and available for recovery in the United States, 1998.

<table>
<thead>
<tr>
<th>Source</th>
<th>Generated (million tons)</th>
<th>Recovered, Combusted Or Not Usable (million tons)</th>
<th>Available For Recovery Amount (million tons)</th>
<th>Recovery – Total Waste Wood Available (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal solid waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste wood</td>
<td>11.8</td>
<td>6.4</td>
<td>5.4</td>
<td>18</td>
</tr>
<tr>
<td>Woody yard trimmings</td>
<td>25.2</td>
<td>18.4</td>
<td>6.8</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>37.0</td>
<td>24.8</td>
<td>12.2</td>
<td>41</td>
</tr>
<tr>
<td>Construction and demolition waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>8.7</td>
<td>2.1</td>
<td>6.6</td>
<td>22</td>
</tr>
<tr>
<td>Demolition</td>
<td>26.4</td>
<td>17.4</td>
<td>9.0</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>35.1</td>
<td>19.5</td>
<td>15.5</td>
<td>52</td>
</tr>
<tr>
<td>Primary timber processing residues</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bark residues</td>
<td>24.5</td>
<td>23.9</td>
<td>0.6</td>
<td>2</td>
</tr>
<tr>
<td>Wood residues</td>
<td>65.8</td>
<td>64.5</td>
<td>1.3</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>90.3</td>
<td>88.4</td>
<td>1.9</td>
<td>6</td>
</tr>
<tr>
<td>Total waste wood</td>
<td>162.4</td>
<td>132.8</td>
<td>29.6</td>
<td>100</td>
</tr>
</tbody>
</table>
MI Urban Wood Residue Estimates

1994 Public Policy Associates study –
*Urban Wood Waste in Michigan Supply & Policy Issues*
- 659,328 tons generated
- 45% utilization rate
- 8,848,527 MBtus

1999 Oak Ridge National Laboratory study –
*Biomass Feedstock Availability in the U.S.*
- Estimated 826,224 dry tons available per year
  at delivered price of <$30/dry ton
Urban Wood Residue Sources

- Tree removals & trimmings
  (logs, limbs, stumps)
- Manufacturing byproducts
  (edgings, cutoffs, chips, shavings)
- Discarded packaging
  (pallets, skids, crates, dunnage)
- Construction/demolition
- Railroad ties
- Telephone poles
What is the Emerald Ash Borer?

- *Agrilus planipennis* Fairmaire
  (Coleoptera: Buprestidae)
- Dark green, metallic adult – ½ “ long
- Creamy white larvae with brown head

(not actual size)
• 10-15 million dead and dying ash trees in MI

• Cities & residents face high costs for removal, disposal, & replanting
• EAB bores just into cambium layer

• Leaves inner wood untouched

• Removing ~1” under bark removes infestation

• Generally, safe if:
  – kiln-dried,
  – fumigated,
  – bark-free, or
  – used as fuel
Where Does the Wood Go?

In Michigan:

- Eight marshalling yards in quarantine area + private yards
- MDA contract paid for grinding until June 2005 – disposal was free until that time
Ash Wood Disposal Yards

- Over 300,000 tons of wood processed from June 2004 – June 2005
- Most ground and sent to Genesee Power
- Some other value added products created
Uses for Ash Trees

- Lumber
- Railroad ties
- Firewood *(local use only)*
- Tool handles
- Baskets
- Mulch
- Fine woodworking
- Biomass energy production
Biomass Energy from Wood

- Renewable
- Local
- Reliable
- Sustainable
- Affordable
- Low carbon emission
- Minimal ash
- Very low metals and sulfur

- Good option for schools, hospitals, and other institutions facing high energy costs
- Can be used through new construction or boiler retrofit
### Example of Annual Home Heating Costs Using Various Fuels

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Gross heating value b</th>
<th>Efficiency (%)</th>
<th>Net heating value b</th>
<th>Fuel required for 1 million Btu of usable heat</th>
<th>Average cost/unit</th>
<th>Total annual fuel cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas</td>
<td>1.03 million Btu/1000 ft³</td>
<td>80</td>
<td>0.82 million Btu/1000 ft³</td>
<td>1,220 ft³</td>
<td>$7/1000 ft³</td>
<td>$854</td>
</tr>
<tr>
<td>Propane</td>
<td>91,200 Btu/gal</td>
<td>79</td>
<td>72,000 Btu/gal</td>
<td>13.86 gal</td>
<td>$1.25/gal</td>
<td>$1,730</td>
</tr>
<tr>
<td>Fuel oil #2</td>
<td>138,800 Btu/gal</td>
<td>83</td>
<td>115,000 Btu/gal</td>
<td>8.68 gal</td>
<td>$1.40/gal</td>
<td>$1,220</td>
</tr>
<tr>
<td>Seasoned firewood</td>
<td>20 million Btu/cord</td>
<td>77</td>
<td>15.4 million Btu/cord</td>
<td>0.065 cord</td>
<td>$115/cord</td>
<td>$747</td>
</tr>
<tr>
<td>Electricity</td>
<td>3,413 Btu/kWh</td>
<td>98</td>
<td>3,340 Btu/kWh</td>
<td>299 kWh</td>
<td>$0.08/kWh</td>
<td>$2,390</td>
</tr>
<tr>
<td>Premium wood pellets</td>
<td>16.4 million Btu/ton</td>
<td>83</td>
<td>13.6 million Btu/ton</td>
<td>0.073 ton</td>
<td>$120/ton</td>
<td>$882</td>
</tr>
</tbody>
</table>

a Based on 100 million Btu of energy for the heating season.

b 1000 ft³ = 1 million Btu; 1 million Btu = 10 therms.
Table 1. Overall efficiency of wood and other competing fuels

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Power plants (%)</th>
<th>Other uses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>33–35</td>
<td>45–60</td>
</tr>
<tr>
<td>Gas</td>
<td>40–50</td>
<td>85</td>
</tr>
<tr>
<td>Wood</td>
<td>22–25</td>
<td>65–80</td>
</tr>
<tr>
<td>Nuclear</td>
<td>32</td>
<td>NA</td>
</tr>
<tr>
<td>Oil</td>
<td>NA^a</td>
<td>80</td>
</tr>
<tr>
<td>Propane</td>
<td>NA</td>
<td>80</td>
</tr>
</tbody>
</table>

^aNot applicable.

Figure 1. Cost comparisons of fuel types in Wisconsin for large volumes. (1 MW = 3.413 million Btu/h).
Source: Mike Metcalf, Madison Gas & Electric, Madison, WI. May 2004.
Barriers to Using Urban Wood

- **Attitudes**
  - Municipalities, tree services, sawmills
- **Economies of scale**
  - Collection, markets
- **Transportation**
Michigan Example: Genesee Power Station

- Co-generation facility in Flint, MI
- Provides green power to ~25,000 homes
- Historically large user of wood waste in SE MI
- ~200,000 tons used/yr since 1995
- Displaces 100,000 tons of coal & 1.13 acres landfill space each year
Other MI Wood Biomass Operations

• Messersmith boilers in operation:
  – Wilson 7th Day Adventist Junior Academy—Wilson, MI—24 years
  – North Central Area Schools—Powers, MI—20 years
  – Mid Peninsula School (Mid-Pen)—Perkins & Rock area—18 years
  – Paradise School—Paradise, MI—18 years
  – Wakefield School—Wakefield, MI—17 years

• NEW -- Fiber By-products Corporation to open pellet manufacturing facility in White Pigeon
SE MI RC&D Council
Ash Utilization Options Project

• Began in June 2004

• Funding from USDA Forest Service Economic Action & WERC

• Goals:
  – Address the EAB in positive way
  – Recover value in urban wood “waste”
  – Reduce wood disposal costs
  – Create new markets for wood products
  – Create jobs
Ash Utilization Options Project

- **Demonstration Projects**
  - Urban sawmilling
  - Log treatment research

- **Training programs**
  - Timber harvesting
  - Log grading
  - Sawing
  - RR tie production

- **Urban wood resource inventory**

- **Education/outreach**
Urban Wood Resource Inventory

- Urban wood knowledge limited in SE MI
- Contracted for two-part study
- Results expected by summer 2006
Dr. Dave MacFarlane of MSU

Summer 2005 field inventory of SE MI urban trees

Recorded species, mortality, size, and quality

Dr. Sam Sherrill of the U of Cincinnati

Just began surveys of SE MI businesses

Collecting data on “brown” wood waste – pallets, construction debris, mill residues
Urban Wood Resource Inventory

Will show:

– Best economic options for processing & recycling wood

– Data for long-term, sustainable business plans

– Opportunities for new markets
Upcoming Research…

Wood disposal yard efficiency study
Dr. Pascal Nzokou – MSU

• Evaluate resources entering yards
• Evaluate products exiting yards
• Determine recovery rate
• Identify potential for improvement
• Identify barriers to recycling
Our Next Steps:

• Explore options for small local biomass projects (schools, institutions, businesses, etc.)

• Model: Vermont/Montana Fuels for Schools

   By April 2005, in Vermont –
   • 23 schools involved
   • Used 11,488 tons of wood chips
     (vs. 700K gal of fuel oil)
   • Total annual savings of over $370,000
     (Avg. cost - $31.81/ton for wood chips,
     $1.006/gal for fuel oil)
Boiler Assessment – Phase 1

• Goal: Identify boilers in MI that could be converted to use woody biomass (by either retrofit or replacement)
  – Develop database listing boiler characteristics statewide
  – Categorize boilers by institution/industry type
  – Assess owner interest in biomass energy/conversion and identify contacts
  – Prioritize candidates for conversions

• Contractor RFP to be released this spring
Boiler Assessment – Phase 2

- Goal: Following Phase 1 inventory, follow up with high priority candidates to conduct individualized feasibility studies
  - Provide managers with case studies/examples, resources/info on wood use
  - Conduct preliminary assessments
  - Complete full engineering assessments when applicable
  - Candidates with assessments can then follow up on opportunities for biomass incentives as available
New Demonstration Grants

- Accepting applications until March 31
- $30,000 grant for community projects
- $20,000 grant for kiln
- $5,000 for art show
Other Current Projects

• Regional urban wood conference
• Training programs
• Municipal support meetings
• Outreach
This project is made possible by a generous grant and significant technical support from the:

and sponsoring County Offices, Conservation Districts, Watershed Councils, and Municipal Governments in the RC&D Area.