OHIO WOOD WASTE MARKETS AND RESOURCE(S) STUDY

January 31, 2013

Prepared For:

CONSTRUCTION AND DEMOLITION ASSOCIATION OF OHIO
About The Study/Grant

• Granted by ODNR to the Construction and Demolition Association of Ohio [CDAO]

• Purpose was to...
  – Identify readily available wood waste sectors
    • Construction and demolition landfills and recyclers
    • Forestry residues
    • Material recovery facilities
    • Compost facilities
    • Other sources
  – Identify/quantify what is currently readily available
  – Identify general economics
  – Perform a limited waste sort to confirm similar studies
  – Make conclusions and observations regarding the overall findings
Participants

- Ohio Department of Natural Resources
- Ohio Environmental Protection Agency
- Ohio Forestry Association
- Construction Materials Recycling Association
- Construction and Demolition Association of Ohio
- Landfills and Recyclers
- Public Utilities Commission
- The Ohio State University
- West Virginia University [Appalachian Hardwood Center]
- Multiple non-profit trade associations
- Private and public sector interested parties, organizations and utilities
C&DD Disposal

• According to State supplied data, approximately 4,739,480 tons of C&DD was disposed 2011.
• The total amount of tonnage disposed at licensed C&DD landfills was 3,495,085 tons in 2011.
• There was approximately 1,244,402 tons of C&DD reported to be disposed of at 35 MSW landfills.
Waste Sort on C&DD

- GSE was tasked to develop a scope and subsequently perform a limited “Construction and Demolition Debris Waste Characterization Study” with a focus on wood content. GSE and CDAO, performed waste observation and estimation activities at three C&DD sites. The sites were located in the following areas:
  - Metropolitan
  - Suburban, and
  - Rural
- Waste sort was designed to confirm “long term” studies performed elsewhere in an effort to substantiate similarities without significant cost.
## Historical Studies for Wood Content

<table>
<thead>
<tr>
<th>Region/Source</th>
<th>Percent Total Wood</th>
<th>Year Data Published</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massachusetts</td>
<td>46.6 %</td>
<td>2004</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>31.5 %</td>
<td>2008</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>26.3 %</td>
<td>2003</td>
</tr>
<tr>
<td>Delaware</td>
<td>30.1 %</td>
<td>2006-07</td>
</tr>
<tr>
<td>California</td>
<td>19.9 %</td>
<td>2006</td>
</tr>
<tr>
<td>King County, WA</td>
<td>45.3 %</td>
<td>2002</td>
</tr>
<tr>
<td>Ohio</td>
<td>34.0 %</td>
<td>2004</td>
</tr>
<tr>
<td><strong>Averaged Total</strong></td>
<td><strong>33.4 %</strong></td>
<td></td>
</tr>
</tbody>
</table>
National Findings on Wood Concentrations Within C&DD Waste

• Highly urbanized areas may use more masonry materials
• The general economy (new home construction rates)
• Disaster and storm debris
• Seasonality
• Urban renewal (increased demolition)
• Geographical areas within the country may use different building materials.
Ohio Initial Findings

• Facilities had between 22% and 50% wood by volume or between 10% and 32% by weight.
• “Extractable wood is approximately 50% if using mechanized processing methodologies.
• Natural disaster events [e.g. hail storms and tornadoes] create a disproportionately high percentage of asphalt shingles when compared to national averages.
• When natural disaster debris was factored out, wood within Ohio’s C&DD averaged between 23% and 32% by weight.
Ratio of C&DD to Wood

• With 4,739,480 tons of C&DD disposed, the wood fraction could be upwards of 1,318,931 tons of wood [based on 32.4% wood]. Extractable wood, based on 50% extraction would be approximately 659,465 tons.

• Extractable wood is much lower today based on limited processing [markets for this wood will drive processing]

• Most wood [clean] extracted from C&DD used in the decorative mulch market.
GSE identified approximately 50% of the wood to be “clean”, 20% to be OSB and plywood and 30% to be treated, painted and/or engineered during the Ohio limited waste sort.
Other Commodities

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Facility A</td>
<td>23.3% - 45.1%</td>
<td>9.0% - 25.3%</td>
<td>7.5% - 1.6%</td>
<td>&gt;1.1% - &gt;1.1%</td>
</tr>
<tr>
<td>Facility B</td>
<td>50.4% - 82.3%</td>
<td>&lt;1.0% - &lt;1.2%</td>
<td>4.9% - 0.8%</td>
<td>&gt;1.0% - &gt;1.7%</td>
</tr>
<tr>
<td>Facility C *</td>
<td>&lt;12% - &lt;10%</td>
<td>9.6% - 27.9%</td>
<td>2.2% - &lt;1.0%</td>
<td></td>
</tr>
</tbody>
</table>

*Asphalt shingle generation is not specifically tracked by facility. Asphalt shingles generally ends up within fines and rubble materials

- Based on national averages, asphalt shingles could make up between 5% to greater than 20% of the waste stream.
- Facility A & B were observed to have significantly more asphalt singles than the national average.
- If the statewide of asphalt shingle generation rate was 12% shingles of the 4,739,480 tons of C&DD disposed, asphalt shingle disposal could be at least 568,737 tons.
- If shingle disposal was 24% by weight is would be we upwards of 1,137,475 currently being disposed.
## National Studies

### Characterization of C&D Waste - Literature Review and DSM Data (percent by weight)

<table>
<thead>
<tr>
<th>Study:</th>
<th>DSWA</th>
<th>Wisconsin</th>
<th>California</th>
<th>King Cty, WA</th>
<th>Ottawa</th>
</tr>
</thead>
<tbody>
<tr>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
</tr>
<tr>
<td>Concrete (and mixed rubble)</td>
<td>11.7</td>
<td>12.1</td>
<td>10.8</td>
<td>2.3</td>
<td>9</td>
</tr>
<tr>
<td>Wood</td>
<td>30.1</td>
<td>26.3</td>
<td>20.2</td>
<td>45.3</td>
<td>26</td>
</tr>
<tr>
<td>Drywall</td>
<td>4.1</td>
<td></td>
<td>20.2</td>
<td>45.3</td>
<td>26</td>
</tr>
<tr>
<td>Clean drywall</td>
<td>9.8</td>
<td>4.5</td>
<td>2.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>3.6</td>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
<td>15.3</td>
<td>22.1</td>
<td></td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Asphalt roofing</td>
<td>(2)</td>
<td>(2)</td>
<td>4.4</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Metals</td>
<td>2.9</td>
<td>3.9</td>
<td>4</td>
<td>10.9</td>
<td>9</td>
</tr>
<tr>
<td>Bricks</td>
<td>(3)</td>
<td>(3)</td>
<td>(3)</td>
<td>(3)</td>
<td>3</td>
</tr>
<tr>
<td>Plastics</td>
<td>1.6</td>
<td></td>
<td>0.8</td>
<td>3.1</td>
<td></td>
</tr>
</tbody>
</table>

1. Painted /demo drywall included in mixed C&D residues and not separately counted
2. Asphalt roofing included in Roofing
3. Included in concrete
Disposal At C&DD Landfills
Composting Facilities

• 4 types within the state [Class I through IV]
• Over 745,000 tons handled in 2010.
• Ten largest facilities accept almost 50% of the yard waste.
• Significant infrastructure in place already and market is strong for mulch and wood products [values vary between $30 and $50 per ton].
• Likely not a source as a raw material for new industries [e.g. Manufacturing or fuel].
Forestry Waste & Residues

• Forestry waste is generally placed into 3 categories:
  – *Forest Residues:* Includes logging residues, rough rotten salvageable wood, and excess small pole trees and material resulting from forest management operations [i.e. sawdust, tops, etc.].
  – *Primary Mill Residues:* Residues generated from manufacturers who use whole round logs to produce lumber and panel products. Residues can include chips, edging, sawdust, bark, trimmings, etc.
  – *Secondary Mill Residues:* Residues generated from manufacturing wood products such as cabinets, millwork, furniture, pallets, and paper manufacturers.
Data Collection

• Relied on the following primary contributors
  – Ohio Forestry Association
  – Ohio University
  – The Ohio State University [including the Forest Operations and Products Extension]
  – West Virginia University  [Appalachian Hardwood Center]
  – Historical Public Utilities Commission of Ohio & Ohio Division of Forestry reports
Most Recent Data

• Appalachian Hardwood Center compiled many fact from several previous studies.
  – Forest and mill residue [primary and secondary)]generated in Ohio is between 1.7M and 2.1M annually
  – Between 58% and 98% of these residues are already utilized [based on reporting year].
  – Based on 2009 data, mill residues equate to 396,036 that is potentially “available” [economically driven]
  – If forestry residue has the same available percentage, approximately 400,000 tons could be “available”.
Most Recent Data, continued

• Consumers of forestry and/or mill residues generally pay between $18 and $28 per ton [generally the biomass industry].
• When the price drops for forestry residues, foresters leave the material in place and do not take it to market.
• Specialty residues [e.g. decorative mulch] may yield significantly higher pricing.
• There are no recent surveys such as collecting data from forest product manufacturers and surrounding states, which may yield better quantitative data.
• Further studies for will be available soon from West Virginia University [Appalachian Hardwood Center] at http://ahc.caf.wvu.edu/joomla/
Total tons based on calculated harvest and 8 tons/acre avg (1,201,610 tons)
Total tons of logging residue in OH – TPO 2007 (949,735 Tons)

Total estimated logging residue = 949,735 Tons

TPO Logging Residue 2007
Estimated Tons/Year
< 10,000
10,001 - 20,000
20,001 - 40,000
40,001 - 60,000
> 60,000

Total tons is considerably lower – what is the estimated tons/acre based on TPO?
Utilization of mill residues

Available Quantities Wood

• There is likely several million tons of unused biomass/wood generated within the state of Ohio.
• A significant portion of the unused wood is being disposed of at C&DD and MSW landfills.
• Based on current economics and/or lack of “need”, greater than 40% of the mill residues that are generated are not currently being reused [2009 data].
• Out of the approximate 0.9 to 1.2M tons of forestry residues generated [dependent upon the approach used to calculate the amount of waste generated], it appears that there could still be a significant amount of residue still “available”.
• Compost facilities [or at least the materials delivered to them] are likely not a source for raw material
Ohio’s Wood Consumers

- Organic products [compost and mulch]
  - Highly established market
  - Uses forestry/mill residues and limited C&DD
- Biomass energy facilities [electricity and steam] for utilities or manufacturing such as paper mills
- Other niche business
  - Pellet manufacturers
  - Pallet manufacturers
  - Pressboard manufacturers [historically]
Wood For Fuel – Does It Compare?

<table>
<thead>
<tr>
<th>Material/Fuel</th>
<th>Btu Per Pound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forestry Residue (wet wood)</td>
<td>3,500 to 4,500</td>
</tr>
<tr>
<td>Dry Wood (kiln dried lumber)</td>
<td>6,500 to 7,500</td>
</tr>
<tr>
<td>Coal</td>
<td>8,800 to 11,000</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>19,300</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1,015 (per cubic foot)</td>
</tr>
</tbody>
</table>

GSE conducted research on the economics of using natural gas versus wood fuel.

- Wood fuel can cost anywhere between $2.00 and $3.33 (e.g. $30 to $50 per dry ton of wood) for 1,000,000 BTUs.
- Natural gas, costs $3.58 per 1,000,000 BTU.
- When deciding to use wood fuel, other variables such as fuel handling, ash disposal, storage, procurements, etc. must be taken into consideration.

Wood Fuel Use In Ohio

• Many facilities are permitted to co-fire [e.g. supplement coal plants.
• Biomass users currently pay between $18 and $28 per ton for green waste (3,500 to 4,500 Btu per pound)
• With natural gas prices low, there has been a steady decline of biomass use (in some instances greater than a 50% reduction).
• Use is well below capacity
## Who’s Currently Permitted?

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Plant Capacity (MW)</th>
<th>Owner</th>
<th>Proposed Wood Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Killen</td>
<td>600 MW nameplate capacity</td>
<td>DP&amp;L and Duke</td>
<td>U to 10% wood cellulose pellets co-fired with coal.</td>
</tr>
<tr>
<td>Conesville Generating Station Unit 3</td>
<td>165 MW</td>
<td>Columbus Southern Power Company</td>
<td>Proposes a test period and then unspecified level of various biomass sources.</td>
</tr>
<tr>
<td>Bay Shore Unit 1</td>
<td>136 MW</td>
<td>FirstEnergy Solutions Corp</td>
<td>Proposes using up to 5% 25% wood use depending upon burner.</td>
</tr>
<tr>
<td>Beckjord Generating Station</td>
<td>1125 MW</td>
<td>Multiple units with Duke Energy &amp; DP&amp;L</td>
<td>Proposes co-firing up to 100% wood and agricultural biomass materials, with initial testing.</td>
</tr>
<tr>
<td>Miami Fort Generating Station Units 7 &amp; 8</td>
<td>1020 MW</td>
<td>Duke Energy Ohio and DP&amp;L</td>
<td>Proposes a variety of biomass materials up to 10%.</td>
</tr>
<tr>
<td>R.E. Burger Units 4&amp;5</td>
<td>312 MW</td>
<td>First Energy Generation Corp.</td>
<td>Proposes a test phase up to 20%, then “principally biomass” 51-100% by 2013, with a variety of biomass materials.</td>
</tr>
<tr>
<td>South Point Biomass Generation Plant</td>
<td>200 MW</td>
<td>South Point Biomass Generation, LLC</td>
<td>100% wood waste, projected in-service date in 2012.”</td>
</tr>
</tbody>
</table>
Biomass Proposed Geographical Locations Throughout Ohio
Is There Capacity?

• There is plenty of capacity
  – Conceptually 1.6M bone-dry tons at South Point Power.
  – Several million tons if biomass was co-fired with coal.
  – Additional capacity could be necessary at small boilers for steam and power use at pulp/paper mills
Why Isn’t Biomass Used in Higher Quantities As a Fuel?

• Economics/Incentives
• There are concerns:
  – In some instances will require facilities to retrofit (e.g. sizing, storage, etc.)
  – Concerns about how post consumer wood will impact existing air permits and how QA/QC can be maintained
  – Concern about the new US EPA Boiler MACT and Cross-State Air Pollution [CASPR] Rule(s)
  – How certain wood types will impact any Renewable Energy Credits (RECs)
Other Wood Uses

• Pallet manufacturing
  – Limited usage in 2011 (53,000 tons/25% post consumer)
  – Limited C&DD use
  – Pay $15 to $21 per ton
  – Will consider more C&DD if it meets specifications

• Pellets
  – Undetermined
  – Use in other states
  – 13 Plants located in bordering states and 2 in Ohio

• Pressboard
  – No market currently.
  – Indication of historical uses
  – Tafisa in Canada uses vast quantities of post consumer wood for pressboard
Questions & Comments

• ???????????????????????????????????????????????

Action Items

1.
2.
3.