Cradle to Gate LCI Comparison of US Wood Products Manufacturing

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WoodLife

FPS
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Cradle-to-Gate LCI Comparison of US Wood Products

- Softwood lumber
  - PNW
  - Inland NW
  - NE/NC
  - SE
- Hardwood lumber
  - NE/NC
- Hardwood flooring
  - NE/NC
Gate-to-Gate LCI’s

1. **Forest Resources-Inland Northwest**
   - Leonard Johnson, Bruce Lippke, Elaine Oneil, Jeff Comnick, Larry Mason

2. **Forest Resources- NE/NC**
   - Elaine Oneil, Leonard Johnson, Bruce Lippke, James McCarter, Marc McDill, Paul Roth, James Finley

3. **Inland Softwood Lumber**
   - Fran Wagner, Maureen Puettmann, Leonard Johnson

4. **NE-NC Hardwood/Softwood Lumber**
   - Richard Bergman, Scott Bowe

5. **NE-NC Hardwood Flooring**
   - Steve Hubbard, Scott Bowe
Geographical Regions

- PNW
- Inland NW
- NE/NC
- NE/NC, Extended
- SE

Softwood Lumber
Hardwood Lumber
Hardwood Flooring

Softwood Lumber
Hardwood Flooring
System Boundaries

1. Forestry operations
   - Establishment,
   - Management,
   - Harvesting

2. Wood production
   - Softwood lumber
   - Hardwood lumber and Flooring

3. Transportation
   - Logs to mill
System Boundaries

Energy, Fuels and Materials

1. Growth/Management/Harvesting

2. Wood Products Process

3. Transportation

Products & Co-products

Emissions
- Air
- Water
- Solid

System Boundary
# Reference Unit = 1 m³

<table>
<thead>
<tr>
<th></th>
<th>Planed dry lumber (m³)</th>
<th>Rough dry lumber (kg)</th>
<th>Solid Strip Flooring (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Softwood Lumber</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• PNW</td>
<td>1 (=413 kg)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>• Inland NW</td>
<td>1 (=436 kg)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>• NE/NC</td>
<td>1 (=392 kg)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>• SE</td>
<td>1 (=510 kg)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Hardwood Lumber</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 (=572 kg)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Hardwood Flooring</strong></td>
<td></td>
<td>667</td>
<td>1</td>
</tr>
</tbody>
</table>
Environmental Factors

• **Resources**
  – Fuels
  – Wood

• **Energy**
  – Fossil based
  – Biomass

• **Emissions**
  – Air
  – Water
  – Landfilled
Results
Fuel Sources
## Resources – Wood

Requirements allocated per m³ of finished product

<table>
<thead>
<tr>
<th>Softwood Lumber</th>
<th>Logs (m³)</th>
<th>Bark (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNW</td>
<td>1.05</td>
<td>41</td>
</tr>
<tr>
<td>Inland NW</td>
<td>1.11</td>
<td>33</td>
</tr>
<tr>
<td>NE-NC</td>
<td>1.08</td>
<td>53</td>
</tr>
<tr>
<td>SE</td>
<td>1.16</td>
<td>94</td>
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</table>

<table>
<thead>
<tr>
<th>NE-NC Hardwood</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumber</td>
<td>1.24</td>
<td>74</td>
</tr>
<tr>
<td>Solid strip flooring</td>
<td>1.44</td>
<td>86</td>
</tr>
</tbody>
</table>
Total Energy

3,705 MJ/m³ PNW
3,189 MJ/m³ Inland NW

3,038 MJ/m³ Softwood L.
6,034 MJ/m³ Hardwood L.
6,710 MJ/m³ Flooring

3,492 MJ/m³ Softwood L.
Transportation

<table>
<thead>
<tr>
<th>Region</th>
<th>Energy MJ/m³</th>
<th>Distance (km)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNW</td>
<td>60% 113 km</td>
<td>913 kg</td>
<td></td>
</tr>
<tr>
<td>Inland NW</td>
<td>60% 129 km</td>
<td>1,362 kg</td>
<td></td>
</tr>
<tr>
<td>NE-NC</td>
<td>97% 109 km</td>
<td>1,058 kg</td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>100% 92 km</td>
<td>1,371 kg</td>
<td></td>
</tr>
<tr>
<td>HW Lumber</td>
<td>87% 126 km</td>
<td>2,521 kg</td>
<td></td>
</tr>
<tr>
<td>HW Flooring</td>
<td>9% 283 km</td>
<td>1,533 kg</td>
<td></td>
</tr>
</tbody>
</table>
Emissions

- Type of fuel
- Energy requirements
  - Green weight of wood (density)
  - Transportation distance
36-43% Biomass
39-44% Nat. gas

CO₂ biomass = 116-160 kg/m³
CO₂ fossil = 90-92 kg/m³

CO₂ biomass = 176-431 kg/m³
CO₂ fossil = 85-164 kg/m³

36-43% Biomass
39-44% Nat. gas

CO₂ biomass = 116-160 kg/m³
CO₂ fossil = 90-92 kg/m³

CO₂ biomass = 176-431 kg/m³
CO₂ fossil = 85-164 kg/m³

71% Biomass
10% coal
10% crude
Summary

- Fuel type used for manufacturing and transportation will have the greatest influence on type and quantity of environmental impact.
Summary

- Manufacturing life cycle stage is the greatest consumer of energy
Summary

- When the primary energy is biomass, this greatly reduces the environmental impact by offsetting the demand for fossil fuels.
Thank you