Sawmill Energy Use and Emissions in California

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Forest Industry Research Program

- State level harvest & industry analyses
- Logging utilization studies
- West-wide timber product output (TPO) reporting
  - Annual & quarterly Montana information
  - Annual logging & hauling costs for FS Northern Region
- Other forest economics & timber related projects
California TPO Activities

Mill Surveys
- 2000, 2006, 2012 – published through PNW Station
- 2016 – out for review
- >1.4 BBF Scribner of timber harvest annually
- >70 active facilities
- >$1.4 Billion in sales
- ~1.9 BBF of lumber

Logging Residue
- 2004 study published in WJAF
- Ongoing 2018-2021 data collection
- Dead tree analysis for CalFire
Harvested Wood Products (HWP) Carbon Storage

- Carbon storage estimates for HWP from California forests

- Use IPCC production accounting approach to quantify carbon storage

- 1) timber harvest time series  2) timber products info  3) primary products info

- Oregon and Washington, and ...

From Stockmann et al. 2012, Carbon Balance and Management
Introduction

• Sawmills account for $\sim\frac{1}{2}$ of US wood products energy demand (EIA 2013)

• Wood & bark residuals are common sources of energy for mills

• 65% of wood product industry energy from wood bioenergy (EPA 2007)

• 58% of energy for softwood lumber from wood bioenergy (AWC 2013)
California:

31.7 million acres of forest

80 active timber processors, 32 sawmills (2016)

>1.5 billion board feet Scribner of harvest (2016)

>80% of harvest used by sawmills
Sawmill Energy Use and Emissions in California

Methods

• TPO mill census (2016)
• Sawmill energy consumption questionnaire
• Logging utilization/residue info
• Energy contents & emission factors
Methods

On-site energy consumption questionnaire

- Fuels used for equipment
- Non-electric heat & steam
- Electricity – grid vs. on-site
  - Renewable vs. non-renewable
Methods

Mill-level estimates

• Electrical utility portfolios of fuels
• Energy contents & emissions
  - BTU per unit of fuel
  - Pounds of CO2, CH4, NOX, SOX, PM10
• Logging utilization/residue info
  - ~ 2 tons per MBF Scribner
Results

- 16 of 32 sawmills provided energy info
- Accounted for 92% of CA 2016 lumber production
- Used 1,120 MMBF Scribner of timber
- All mills used diesel fuel and electricity
- 8 mills burned wood for heat & steam and used electricity generated on-site
Energy consumption of California sawmills

- Wood: 87.7%
- Diesel: 3.8%
- Natural gas: 5.6%
- Gasoline & propane: 0.1%
- Electricity - nonrenewable: 1.6%
- Electricity - renewable: 1.2%
Energy consumption of Southwest sawmills

- Electricity: 35.0%
- Diesel: 60.7%
- Propane: 0.7%
- Gasoline: 3.1%
- Wood: 0.5%
Energy consumption of Montana sawmills

- Wood: 77.3%
- Electricity: 16.1%
- Natural gas: 1.2%
- Gasoline: 0.4%
- Diesel: 5.0%
On-site energy consumption
MMBtu per MMBF of lumber

<table>
<thead>
<tr>
<th>Fuel</th>
<th>California</th>
<th>Southwest</th>
<th>Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>202</td>
<td>673</td>
<td>192</td>
</tr>
<tr>
<td>Gasoline</td>
<td>4</td>
<td>35</td>
<td>16</td>
</tr>
<tr>
<td>Propane</td>
<td>2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Natural gas</td>
<td>297</td>
<td>n/a</td>
<td>39</td>
</tr>
<tr>
<td>Electricity</td>
<td>148</td>
<td>387</td>
<td>616</td>
</tr>
<tr>
<td>Wood &amp; bark</td>
<td>4,615</td>
<td>5</td>
<td>2,958</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5,267</strong></td>
<td><strong>1,108</strong></td>
<td><strong>3,829</strong></td>
</tr>
</tbody>
</table>
Fuel sources of utility-provided electricity consumed by 16 CA sawmills

- Biomass & waste
- Geothermal
- Wind
- Solar
- Hydroelectric
- Contract
- Nuclear
- Natural gas

Sawmill Energy Use and Emissions in California
Why do Southwest sawmills have such relatively low energy use per MBF and such high proportions of non-renewable energy?

- Most don’t operate dry kilns
- Don’t use mill residue for on-site energy
- Electricity mostly from non-renewables
Estimated emissions from on-site energy consumption by CA sawmills, 2016

<table>
<thead>
<tr>
<th>Emissions</th>
<th>Total tons</th>
<th>Pounds per MBF</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>909,099</td>
<td>976</td>
</tr>
<tr>
<td>PM10</td>
<td>380</td>
<td>0.4</td>
</tr>
<tr>
<td>CH4</td>
<td>88</td>
<td>0.1</td>
</tr>
<tr>
<td>NOX</td>
<td>2,990</td>
<td>3.2</td>
</tr>
<tr>
<td>SOX</td>
<td>163</td>
<td>0.2</td>
</tr>
</tbody>
</table>
Estimated CO₂ emissions from on-site energy consumption by CA sawmills, 2016

• Wood approx. 92% of surveyed sawmill CO₂ emissions; fossil fuels approx. 8%

• 2017 Forest Ecosystem and HWP Carbon Sequestration rate = 27.9 MMT CO₂/yr

• Wood emissions approx. 2.7% of total CO₂ sequestered by forests; fossil fuel emissions approx. 0.2%
• ~906,985 BDT of logging residue associated with timber used by mills

• Emissions *if* all this residue is burned

<table>
<thead>
<tr>
<th>Emissions</th>
<th>Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>986,451</td>
</tr>
<tr>
<td>PM10</td>
<td>3,741</td>
</tr>
<tr>
<td>CH4</td>
<td>3,437</td>
</tr>
<tr>
<td>NOX</td>
<td>1,764</td>
</tr>
<tr>
<td>SOX</td>
<td>1,066</td>
</tr>
</tbody>
</table>
Total on-site energy use per MBF of lumber

1.1 MMBtu per MBF = Southwest ave (2012)

3.8 MMBtu per MBF = Montana ave (2009)

5.3 MMBtu per MBF = California ave (2016)

3.1 to 7.6 MMBtu per MBF = National ave (2014, 2010)
Key Points

Regional/state differences are important.

California sawmills:

- Have relatively high energy use per MBF of lumber
- Most sawmill energy is from renewables (i.e., wood)!
- Not all mills operate dry kilns, not all kilns are wood-fueled.
Key Points

• Wood is the major emissions source: 92% of total emissions, 87% of total energy.

• Substantial logging residue is associated with the timber used by mills.

• Emissions from burning slash could be reduced with more biomass utilization.

• CA electricity portfolio ~35% renewables.
Acknowledgments

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