Hardwood Sawmills
Carbon Footprints and Carbon Offsets

Results of the Long-Lived Carbon Sawmill Study

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This project was initiated to develop tools that hardwood sawmills could use to determine if participation in the Chicago Carbon Exchange (CCX) carbon offset market represented a viable source of revenue.
How Hardwood Mills Could Participate in the Carbon Offset Market

- Hardwood sawmills that produce dimensional stock (lumber, etc.) are producing a product that is relatively long-lived (long-lived wood products).

- Studies have shown that approximately 40 percent of hardwood mill production remains sequestered for significant time periods.

- This sequestration means that the sawmills can sell carbon credits on the offset market.

Market Requirements

- The CCX is (was) the only readily available exchange excepting long-lived wood products.

- Only certified timber (American Tree Farm, Forest Stewardship Council, Sustainable Forestry Initiative, etc.) can (could) be used in the determination of carbon sequestered and available for sale.

- Hardwood mills must procure certified timber and maintain a chain-of-custody certificate.
IN 2010 THE CCX CARBON MARKET CLOSED

The closing of the CCX carbon market left sawmills without a direct means of selling carbon credits based on their production of long-lived wood products.

This project was tied directly to the CCX and its acceptance of credits from long-lived wood products.

However, there are tools produced from this project that may be useful now or in the future for hardwood mills including:

• Ability of mills to calculate carbon footprints (greenhouse gas emissions).

• Benchmarks for chain-of-custody cost determinations.

• Data and procedures that may be useful for other carbon markets or over the counter sales of carbon.

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Study Objectives

1. Determine the carbon footprint (the CO2 equivalents (CO2e) of total greenhouse gas (GHG) emissions generated by mills) varying in production (1 to 20+ million bd ft/yr).

• The size of the carbon footprint determines whether the mill would be required to be a member of the Chicago Climate Exchange (CCX) or whether it could it be a member of a group (aggregator).

Study Objectives

2. Assess Chain-of-Custody (CoC) certification costs for hardwood sawmills.

• For a mill to participate in the CCX carbon offset market (either individually or aggregated) it must have a chain-of-custody certification from any of the recognized wood certification systems. Further only certified timber can be included in carbon generation calculation.
Study Objectives

3. Develop worksheets (incorporating data relationships developed from Objective 1 and 2 and pricing of carbon credits) that will allow hardwood mills to input operational information and determine probable gross and net revenues from participation in carbon credit markets and thresholds for mill output.

- The spreadsheets are available for use by sawmills to determine carbon footprints as well as too make decisions relative to participating in CCX based carbon offset markets.

Carbon Footprint Analysis

- The carbon footprint is a measure of greenhouse gas emissions and is generally expressed as the carbon dioxide equivalents (CO2e) of all the greenhouse gases produced including methane, nitrous oxide, carbon dioxide, etc.

- CO2e’s are determined by measuring all of the fuels used by the mill and applying a conversion factor that yields that amount of CO2e produced from the use of a mills fuel mix.

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Conversion factors of greenhouse gas emissions by fuel type.

Table 1. Conversion factors by fuel type used for determining Total Emissions in Carbon Dioxide Equivalents (CO2e)

<table>
<thead>
<tr>
<th>Mill's Emissions Contributor</th>
<th>Convert to MMBtu</th>
<th>Resulting CO2</th>
<th>Resulting Methane CH4 (mT)</th>
<th>Resulting Nitrous Oxide N2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity (direct)</td>
<td>0.003413</td>
<td>0.69000</td>
<td>0.03556</td>
<td>0.000013</td>
</tr>
<tr>
<td>Natural Gas (stationary direct)</td>
<td>2.025000</td>
<td>0.05306</td>
<td>0.00560</td>
<td>0.000100</td>
</tr>
<tr>
<td>Propane (stationary direct)</td>
<td>0.091010</td>
<td>0.06307</td>
<td>0.01000</td>
<td>0.000696</td>
</tr>
<tr>
<td>Propane (Mobile direct)</td>
<td>0.091010</td>
<td>0.00574</td>
<td>0.01000</td>
<td>0.000696</td>
</tr>
<tr>
<td>Diesel (Mobile direct)</td>
<td>0.138750</td>
<td>0.01015</td>
<td>0.01000</td>
<td>0.000696</td>
</tr>
<tr>
<td>Motor Gasoline (Mobile direct)</td>
<td>0.125000</td>
<td>0.00891</td>
<td>0.01000</td>
<td>0.000696</td>
</tr>
<tr>
<td>Sawdust (stationary direct)</td>
<td>16.000000</td>
<td>0.00000</td>
<td>0.05950</td>
<td>0.005900</td>
</tr>
<tr>
<td>Sawdust (stationary direct)</td>
<td>7.800000</td>
<td>0.00000</td>
<td>0.09530</td>
<td>0.005900</td>
</tr>
</tbody>
</table>

Annual board foot production of 5 mills and CO2e in metric tons (mT) by mill. Insufficient data was collected from mill B to warrant CO2e calculations.

Mills ranged from 346 mT CO2e annually to 8,096 mT. All of these were below the threshold of 10,000 mT for individual membership in the CCX.
Graphical display of board foot volume produced and GHG emissions (CO2e)

Variability of Production and CO2e
There is considerable variation in the relationship between emissions and production of the mills studied due to the types of fuels used (see table below).

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity (indirect)</td>
<td>kWh</td>
<td>3,018,918</td>
<td>365,610</td>
<td>3,577,000</td>
<td>8,458,163</td>
</tr>
<tr>
<td>Natural gas (stationary direct)</td>
<td>Mcf</td>
<td>656</td>
<td>727</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propane (stationary direct)</td>
<td>Gallons</td>
<td>3,388</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel (Mobile direct)</td>
<td>Gallons</td>
<td>56,422</td>
<td>9,250</td>
<td>69,132</td>
<td>201,600</td>
</tr>
<tr>
<td>Motor Gasoline (Mobile direct)</td>
<td>Gallons</td>
<td>8,642</td>
<td>10,200</td>
<td>16,747</td>
<td></td>
</tr>
<tr>
<td>Sawdust (stationary direct)</td>
<td>U.S. Tons (dry dust)</td>
<td>5,291</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>U.S. Tons (wet dust)</td>
<td>1,040</td>
<td></td>
<td></td>
<td>1,950</td>
</tr>
</tbody>
</table>

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Mill Carbon Footprint Calculator

Microsoft® Excel worksheet

Mill_Carbon_Footprint_Calculator.xlsx

Contains worksheets that allow individual hardwood sawmills (users) to determine their Green House Gas (GHG) emissions from their energy usage by fuel type.

The file also contains worksheets that show the mill production, fuel usage, and GHG emissions for each of the mills studied (reference mills) providing the user with comparative information.

This user opens the GHG Emission Calculator worksheet (enable macros) and inputs their name or mill designation and total annual mill output in Column B (A). The user then inputs the amount of fuel used (electricity, natural gas, propane, diesel, gasoline, or sawdust) into column E (B).
The worksheet uses conversion factors to determine the MMBtu of each fuel used and the metric tons of carbon dioxide (CO₂), methane (CH₄) and its CO₂e, nitrous oxide (N₂O) and its CO₂e, and total CO₂e by fuel type and total for the mill (C).

The file also provides worksheets for the GHG calculation for five reference mills. This provides examples to the user of the fuel usage and GHG of other hardwood sawmills in the region.

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Carbon Mill Study - Long Lived Wood Products (copyright UK 2012)

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Carbon Footprint Summary

• GHG emissions in CO2e were determined for 5 hardwood sawmills using a variety of fuel mixes

• CO2e to board foot production varied significantly depending upon fuel type

• The largest study mill with an annual production of 30 million board feet had a CO2e of approximately 8 mT below the threshold requiring individual membership in the CCX and thus could benefit from participation in carbon aggregators program.

Carbon Footprint Summary

Mill_Carbon_Footprint_Calculator.xlsx
(Microsoft® Excel Worksheet File)

A worksheet designed to allow individual mills to determine their GHG emissions in mT of CO2e.

Individual mills must enter their average annual board feet production and fuel usage by fuel type.

The worksheet calculates the mT of CO2e by fuel type as well as the total mT of CO2e.
Certification Costs

Chain-of-custody (CoC) costs are relatively similar regardless of the system:

• FSC requiring the purchase of FSC logs/timber
• SFI requiring SFI or ATFS wood
• PEFC (limited in U.S. to-date)

The cost that is incurred by an individual mill is based upon the following:

• whether a group or individual certificate is required
• internal costs associated with any changes in inventory handling or accounting procedures required by the CoC standards
• external costs including payment of certification fees and any consulting fees paid to obtain assistance either for initial certification or as a recurring cost for annual audit support

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Certification Costs

The following provides median costs associated with individual CoC certification for a hardwood mill producing lumber.

These costs were derived from data obtained from the Center for Forest and Wood Certification’s work with mills maintaining individual certification. www.forestcertificationcenter.org

Certification Costs - External

• $2,800 – annual cost for Certifying Body for auditing against standard 40-004 (FSC CoC)
• $1,200 – annual cost for Certifying Body for being audited against standard 40-005 (FSC controlled wood)
• $800 – FSC annual fee
• $75 – FSC brand pack
• $2,000 – (on average) for consulting – the consulting fee is required to provide assistance to industries to initially set up the chain-of-custody operations manual and can represent a one-time or annual cost depending upon the ability of the mill to handle the annual auditing process
• Total External Costs = $6,675
Certification Costs - Internal

- $1,923 – employee’s time for preparing for initial audit (based on two weeks for an employee making $50,000 per year)

- $5,000 – employee’s time for required day to day activities for maintaining certification (based on 10% of a yearly salary of $50,000)

- Total Internal Costs = $6,923

Recognize that the internal costs can vary greatly from operation to operation!

Certification Costs

External Costs $6,675
This includes FSC controlled wood certificate and recurring consulting fees. Without recurring consulting fees the annual cost would drop to $4,675. Generally all mills holding individual certificates can expect external costs to run close to $4,000 but can be negotiated.

Internal Costs $6,923
these costs are highly variable
## Certification Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Costs</td>
<td>$13,798</td>
</tr>
<tr>
<td>FSC Controlled Wood Certificate not required</td>
<td>-$1,200</td>
</tr>
<tr>
<td>If mill is small enough certification can be accomplished through a group</td>
<td>-$2,000 to $4,000 (based on group fees)</td>
</tr>
</tbody>
</table>

### CCX Long Lived Wood Products Market Calculator

Microsoft® Excel worksheet  
CCX_LongLivedWoodProducts_Market_Calculator.xlsx  

The CCX_LongLivedWoodProducts_Market_Calculator file provides the user the ability to determine the dollars generated from the sale of carbon credits and the profitability of doing so.
Market value and profitability can be determined using one or both of the worksheets labeled

- “Potential market value – multiple”
- “Potential market value – single”.

The former being used for the input of more than one mill or a series of alternative inputs for a single mill and the latter typically used for a single mill with one set of parameters.

In the worksheet for multiple mills in columns A, D, and E input that includes the total annual mill certification costs (D) (external and internal) material. The total annual mill sawn volume (bd ft) is entered (E) as well as the percentage of certified material processed (F).
(G) The user is provided the option of selecting an appropriate threshold profit margin for participating in the carbon market. This profit margin equates to the differential between carbon revenues and the total cost of certification. In the example this value has been set at $20,000.

(H) The user then selects the appropriate metric ton value for carbon from the worksheet or inputs a specific value. In the example shows $2.50 per metric ton.
Note that the worksheet contains several sets of columns allowing for differing carbon pricing including $5.00 (in the example) up to $15.00. The multiple columns allows the user to see the effect of carbon pricing differential on profit.

(I) The worksheet is set to signify in red the total value of carbon (column O) when the value does not meet the certification cost.

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(U) The worksheet also highlights in green when the carbon value exceeds the profit margin selected by the user. Note that in this example the highlighted values meeting the users profit margin occurs in column R which corresponds to a carbon value of $5.00 per metric ton.

The CCX_LongLivedWoodProducts_Market_Calculator also provides a worksheet entitled “Potential market value – single” that allows a user to provide data for a single mill.
The user inputs total annual mill production in million board feet, percent volume of certified material, and the mills annual certification costs (K). The worksheet also contains a range of carbon values (L) that can be changed.

The worksheet provides carbon value total for the mill, by MBF or BF. The total value of carbon sales for this example is $2,639 which is in red (M) indicating that this value is below the certification cost and represents a negative revenue for participating in the carbon market with carbon at $2.00 per metric ton and a certification cost of $5,000.00.
As carbon price increases so does the total value. At $5.00 per metric ton participation in the carbon market provides a positive return ($6,598). Note that this worksheet does not contain an input for a user defined profit margin.

SUMMARY

Two Microsoft® Excel files were developed to provide hardwood mills the ability to:

• calculate their Greenhouse Gas Emissions in mT CO2e by fuel type

• make decisions regarding participation in carbon offset markets accepting long-lived wood product sequestration using their:
  – certification costs
  – annual sawn lumber production,
  – % certified lumber produced
  – carbon prices
  – profit margin required

Average total and itemized chain-of-custody certification costs were also provided.
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