Climate Change, Carbon and the Forest Sector

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Consortium for Research on Renewable Industrial Materials
A non-profit corporation formed by 15 research institutions to conduct cradle to grave environmental studies of wood products
CORRIM Research Mission
(a not for profit consortium of 15 research institutions)

Develop a database & tools to assess the environmental impact of the production, use, and disposal of wood in order to identify opportunities for improvement

✓ Established research plan and ISO based guidelines (1998)
✓ Phase I research completed (2004): initial supply & consuming regions, construction products and building uses
✓ Phase II research ongoing (2007): extended geography, products and improvement opportunities
✓ Phase III if funding available (2008+): Educational material for builders, architects, engineers, consumers, policy interests for green building criteria & purchasing standards.
The Simplified Storyline
(stare out the window - what do you see?)

How much wood do you see between where you are and the nearest forest?

How much steel & concrete do you see?

Where did these products come from and do they store carbon or produce emissions?
The Simplified Conclusion

The carbon stored in forests extends to all wood products.

Using steel & concrete instead produces carbon emissions.

The carbon pools in wood products & emissions from other products are growing steadily.
The not so Simplified Conclusion

Climate is integral to forest production & climate change is already impacting forest growth and mortality.

Insect epidemics and forest fires are impacting emissions.

Changing human uses of the land (conversions) directly impact carbon.
Politics vs. Reality

Politics: No program under discussion will realistically reverse increasing emissions.

- human induced climate change may be slowed but not reversed without an energy breakthrough that cuts fossil emissions

Science can measure emissions and climate and attempt to model climate impacts and causes but has yet to effectively model mitigation -- an inconvenient truth!
CORRIM measured every input & output for 20 product processing and housing life stages (Life Cycle Inventories)

- Pacific Northwest Wood Production
- Minneapolis House Cold Climate
- Southeast Wood Production
- Atlanta House Warm Climate
CORRIM’s Phase 1 Research

Forest Regeneration to Harvesting
- PNW and SE

Processing of Structural Materials
- PNW and SE
  - Lumber
  - Plywood
  - Glulam
  - LVL
  - I-joists
  - OSB (SE only)

Product
- “Gate-to-Gate”
- Construction of Virtual Residential Buildings to Code
  - Minneapolis wood and steel designs
  - Atlanta wood and concrete designs

Building Use and Maintenance
- Disposal or Recycle

“Cradle”

All environmental inputs & outputs (LCIs)

“Grave”
Summary Performance Indices:
Life Cycle Assessment (LCA) for Atlanta House

Concrete vs Wood Design (%)

- Embodied Energy: 16%
- Global Warming: 31%
- Air Emissions: 23%
- Water Emissions: 0%
- Solid Waste: 51%
Atlanta Walls: Global Warming Potential: GWP per component

- Gypsum
- Fiberglass
- Vinyl Siding
- Concrete
- Lumber
- Plywood

Wall Type

kg of CO₂ per 2000 sq. ft.

ATL - KD Lumber

ATL - Concrete

427%
Minneapolis Walls: GWP per component

Wall Type
- MN - Subs
- MN - Steel
- MN - KD Lumber

kg of CO₂ per 2000 sq. ft.
- Lumber
- Fiberglass
- Plywood
- EPS
- Vinyl Siding
- Gypsum
- Vapor

- Steel: 314% of MN - Subs
- MN - Steel: 44% of MN - Subs
- MN - KD Lumber: 44% of MN - Subs
Plywood versus OSB

- OSB sheathed KD-wood wall uses about 18% more fossil energy than the comparable plywood sheathed KD-wood wall (based on 2000 square foot wall)
Toxicity based on the “worst-offender”. The most toxic emission from the steel wall is cyanide. The most toxic emissions from the wood designs are phenols.
Floors: GWP per component

- **Lumber**
  - Wood I-joists: 2%
  - Wood Dimension Joists: 454%
  - Concrete Slab: 731%
- **Steel Joists**
Dimension lumber joists use 105% more fiber mass than the I-joist that benefits from stiffness and the reduced waste that results from cut to length procurement.
Detailed fossil fuel consumption across wall & floor designs
Forest Carbon Reaches Steady State
- Neutrality Concept -

Forest Carbon by Component

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<tr>
<th>Year</th>
<th>Metric Tons Per Hectare</th>
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<td>2035</td>
<td>700</td>
</tr>
<tr>
<td>2040</td>
<td>800</td>
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Legend:
- Stem
- Root
- Crown
- Litter
- Snags
Carbon in Forests, Products, Emissions, and Displacement Substitution

Averages over time intervals

- 0-45 Years
- 0-80 Years
- 0-120 Years
- 0-165 Years

Rotation Length in Years

Metric Tons per Hectare

- Forest
- Products, Emissions, and Displacement
- Substitution
ENVIRONMENTAL IMPROVEMENT OPPORTUNITIES - products

- Redesign of the house to use less fossil intensive products
- Greater use of low valued wood fiber for biofuel
- Wood substitutes for steel, or concrete produce substantially lower burdens
- Also for insulation, gypsum, cladding
- Engineered wood products use fewer acres allowing more substitution for steel & concrete
- Pre-cut sizes produce less waste
ENVIRONMENTAL IMPROVEMENT OPPORTUNITIES

- Forest Management -

- More intensive forest management
- More solid wood production
  - Manage for quality (density mgt, thin & prune)
- Even small carbon incentives for additionality
- Longer rotations produce less stored carbon and at a high cost although good for biodiversity -- only partially complementary
Easy or *not so easy* Improvements

- Intensive Short rotations that serve long lived product markets that displace fossil intensive substitutes - easy!
  - But the forest carbon goes down not up
  - Designers, builders and consumers dictate the use of wood, not foresters
  - It depends on the rules
Carbon Projects: Productive or not??
(California Rules)

Reforestation: Any treatment is positive (carbon stored) some more additive than others

- Forest carbon only - lowest and one time gain only
- Long lived product production – highest and growing with time

- Caveats: Risk of offsetting land swap would seem low -- although risk of reforestation regardless of credits could be significant.
Carbon Projects: Productive or not??

Avoid Deforestation (Forest Conservation): Positive unless it causes deforestation elsewhere

- Avoiding deforestation of a preserve – lowest one time gain
- Avoiding loss of long lived product production – highest and growing with time

- Caveats: Somewhat riskier but note that the leverage on keeping working forests working is the highest payout. Using renewable resources effectively is the key.
Carbon Projects: Productive or not??

Conservation Based Forest Management (applies to the existing acres in working forests):
Most will be counterproductive (*larger buffers, longer rotations, retaining more basal area*) they reduce displacement of energy intensive products, the largest source for emission offsets.

- If required by regulations -- no credit i.e. not additionality
- Caveats: Market Leakage-- Almost any action that will reduce harvest will be offset by some increased harvest elsewhere (meaning no net impact) and some non-wood substitution (substantial negative impact and growing). A net negative carbon pool.
Carbon Cap & Trade Markets: productive or not??

Cap New Utilities: Credit must go to new carbon storage not existing carbon
Existing forest is neutral carbon - only new forests count. And if they count carbon from a longer rotation as additionality it is counterproductive
What should count is cutting the forest to displace steel and concrete - a true carbon emission displacement. Can cutting trees be green? (yes when pumping more solar energy into carbon stored in buildings)
Carbon registries don’t even have the “sign” right on their accounting! Who can write the rules so they work?
Fossil Emission Taxes- the economists solution

- Tax the emission source that comes from mines. The market will bid up the price of solar resources and the wood in the forest and its uses relative to products made with higher cost fossil carbon.
- Offset the recessionary tax increase by a tax cut.
- The landowner gets paid by the market to reduce carbon emissions.
- We have a long way to go to get carbon tracking right.
- Measuring additionality is a set up for fraud.
- Every carbon look up table computed at current prices will be obsolete with the price required to reduce GWP
What will Carbon be worth?

- Under voluntary markets $10\$/ tonC
- $50/ tonC rising to $150 econ-models
- Equal to Timber SEV @ $50 or 3xSEV with value of displacement included
- 3 times Timber SEV @ $150 or 6xSEV w/ displacement

- The rules better be right because they will change management -
Forest fires release emissions with no savings in fossil fuel and retard regeneration of the forest.
Carbon & Fire Summary
(25 yr phase in treatment to reduce fires)

• NoAction (NA) on ONF: 5 million tonnes carbon released from burning, another 5 from decomposition

• BA45: 12 million tonnes more total carbon than NA from ONF;
  - 16 more tonnes per acre end of period
  - 26% more carbon than NA on average
  - 38% more from 2025 to 2050
  - 50% more by 2050
Carbon Pools across State & Private Inland West (per acre average)

Landscape Carbon - Forest, Products, Emissions, Displacement, Substitution by Component: State and Private Forests - base case

- Stem
- Root
- Crown
- Litter
- Dead
- Chips
- Long-Term
- Harvest
- Manufacturing
- Displacement
- Substitution
Does anyone care?

WTP for reduced emissions in a home purchase: Comparing wood vs. steel frame

Additional mortgage payment $/m

General Mail Survey
Total WTP

-50 0 50 100 150 200

Dollars

Reduction Amount (percentage (for air and solid)/ ton (for ghg))

CO2: Wood advantage
Air pollution: Wood advantage
Waste: Steel advantage
ENVIRONMENTAL IMPROVEMENT OPPORTUNITIES
- What is needed -

- Product development for lower burdens
- System designs for lower burdens
- Get ahead of setting environmental standards for products and design (LEED adapt LCI / LCA)
- Pollution standards set using LCI or Carbon credits that include all carbon pools, not just the forest, or adopt fossil carbon taxes
ENVIROMENTAL IMPROVEMENT OPPORTUNITIES
- What is needed (cont) -

- Get the avoidable future costs in an incentives account
- Fix the carbon trading rules or switch to a fossil tax
- Recycle wood for energy or products
- Market the environmental benefits of using the products from trees to store carbon
Predictions based upon current games

• Registries credit lengthening rotations but not carbon in the forest base case:
  – Result: increased emissions from steel, concrete & fossil energy as NIPF’s reduce logging

• Registry’s credit contributions to biodiversity as complementary
  – Result: counterproductive to carbon but a plus to biodiversity

• Subsidies for cellulose feedstock for energy (biofuel) like ethanol.
  – Result: reduced fiber for long lived products (counterproductive)
  – EWP leverages the amazing cell structure properties of wood, Biorefining breaks it down to start over,

• Green building codes begin to adopt LCI/LCA but there is no market push to change the decision process.
  – Result: some progress but many state laws have to be rewritten first

• Many opportunities for improvement are lost until after the mistakes are made and challenged.
Final Conclusions

• There are zillions of opportunities to reduce emissions and improve environmental performance.

• We have a long way to go to get the rules consistent with good science so they are not counterproductive.

• People care but are not paying for the value and have no metric to apply. Fossil energy is too cheap.

• The opportunity to do better is waiting.
Support Acknowledgements

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  - DOE & 5 companies funded the Research Plan
  - USFS/FPL, 10 companies & 8 institutions funded Phase I

• USFS, 10 companies & 6 institutions currently funding Phase 2

• Many product manufactures surveyed
The Details

CORRIM:  www.CORRIM.ORG

Athena:  www.athenaSMI.ca

LMS:  http://LMS.cfr.washington.edu

USLCI database:  www.nrel.gov/1ci