Electrification Journeys: How Two Companies Decarbonized Their Manufacturing Processes

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Curated by Stephen Stuart

Northeast Sustainable Energy Association (NESEA)
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Learning Objectives

Demystify Electrification, Inspire Others to

1. Define the concept of embodied carbon in building materials.

1. Analyze the implications of electrifying manufacturing and importance of transparency in EPDs.

1. Communicate the benefits of sourcing low embodied carbon materials.

1. Advocate for material manufacturers to modernize their approach to sustainability.
Understanding a Building’s Carbon Footprint

Embodied Carbon

Manufacturing
Emissions
(extraction through manufacturing of building product)
The Eureka Effect
Electrification of plants/manufacturing.
Manufacturing

Recycled Feedstock
Carbon Neutral Electrons

Transportation

Lightweight
Bulk deliveries

Installation

2 for 1 install
Eliminate EPS/XPS
Made from clean, species-agnostic, softwood residuals; insulating wood fiber composites are a perfect fit for the US wood products manufacturing sector.

PROCESS:

MILLED LUMBER

WASTE

THE WASTE CHIPS ARE RECOVERED

FINELY GROUND

AND FORMED INTO INSULATION
From Seedling to Sawmill to Site

Here’s a look at how wood works to create value, minimize waste, provide employment, and protect forests through its sustainable cycle of growing, harvesting, and replanting.

1. Forest
   - Working together to maintain a healthy forest. Sustainable forestry generates forest products which provide an economic incentive for landowners to keep forests as forests, avoiding deforestation—while protecting water, wildlife, and recreation. The forest sector plants over 763 million seedlings per year (University of Washington CINTRAFOR Research, 2021).

2. Sawmill
   - Sawmills transform wood from logs to lumber, by debarking, squaring and cutting each log into its most efficient yield. There is very little waste involved in the process, every piece of the log is used, including residuals like bark and wood chips.

3. Distribution
   - Lumber makes its way to customers. Lumber is transported—via rail or truck—to a distribution center, a retailer, or in some cases, directly to a construction site. Residuals are used to create other products we use everyday like mulch, paper, or cardboard.

4. Building Site
   - Wood buildings store carbon throughout their service lives. From dimensional lumber to mass timber, wood is often the go-to framing choice for single family homes, multifamily, and commercial buildings. Wood is also well-suited to off-site prefabrication, offering cost, quality, and scheduling advantages. Assembling wood buildings as a prefabricated “kit of parts” has the added benefit of being a low-carbon alternative.
Operational sources of carbon emissions on site:

**Electrical Energy Demand:**
Equipment fans, pumps, motors etc. estimated energy consumption: 20,000 megawatt-hours per year make sense, not front loaders.

**Thermal Energy Demand:**
Steam generation for fiber drying and building heat. Estimated thermal load: xx MMBtu

**Transport and handling:**
Materials and finished goods, demand not determined but small. Will electrify somethings that make sense, not front loaders.
Addressing emissions from electric usage: Maximum projected load ~10MW for the facility

- 29MW of on-site generation with direct line
- Hydro facility output: projected 10MW 95% of the year
- Energy Efficiency implementation: Load reduction targets via lighting retrofit, fans and refiner optimization with minimum load need and var. frequency drive motors
Thermal Energy: Projected Demand 30MW
direct, onsite natural gas pipeline

Largest consumption in process:
1. Dryers
2. Boilers
3. Space heating

Strategy now:
• employ all feasible conservation technologies; closed loop drying.

Future replacement of energy source:
• Biomass via CHP, combined heat and power $60M cap ex.
• Renewable natural gas via digestion. Projected efficiency 69% (!) $40m. Does not yield enough fuel to meet facility needs.
Biomass utilization **directly impacts** responsible forestry

Using biomass from wood harvests we:
- reduce wildfire risk
- Maximize yields, reducing volume harvested
- **Divert and eliminate traditional fossil fuel sources**
- Great fit for our needs: steam demands are low grade heat, perfect for biomass application, surplus can heat building.
Paper industry decline; filling some of that void

Residual market could grow in many areas
Potential from MMW and C&D waste streams

Is there enough?
Yes! plenty of raw material

<table>
<thead>
<tr>
<th>Category</th>
<th>Consumption (M³)</th>
<th>% of Harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulp &amp; Paper</td>
<td>222,869,941</td>
<td>50.80%</td>
</tr>
<tr>
<td>Lumber &amp; Veneer</td>
<td>82,512,000</td>
<td>18.81%</td>
</tr>
<tr>
<td>Wood Chips &amp; Residuals</td>
<td>64,762,168</td>
<td>14.76%</td>
</tr>
<tr>
<td>Panels</td>
<td>35,413,100</td>
<td>8.07%</td>
</tr>
<tr>
<td>Wood Fuels</td>
<td>20,048,722</td>
<td>4.57%</td>
</tr>
<tr>
<td>Roundwood Exports</td>
<td>13,131,700</td>
<td>2.99%</td>
</tr>
<tr>
<td><strong>Total Roundwood</strong></td>
<td><strong>438,737,631</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>
The construction and operation of buildings in the United States alone is responsible for almost **2 Gigatons** $\text{CO}_2$ emissions annually.

The prescription for dramatically reducing that impact is well understood and immediately technologically achievable.

Embodied Carbon - Life Cycle Analysis

- Product Stage (A1 - A3)
- Construction Stage (A4 - A5)
- Use Stage (B1 - B7)
- End of Life Stage (C1 - C4)
- Beyond the Building Life Cycle Stage (D)

- Total Life Cycle Impact
- Operational Impact
  - B6: Operational Energy
  - B7: Operational Water

- Operational Economy
  - Benefits and Loads
    - Reuse
    - Recovery
    - Recycling Potential

- Cradle to Gate
- Cradle to Grave (Building Life Cycle Information)
- Cradle to Cradle (Building Assessment Information)
Embodied Carbon is increasingly significant

By 2050, it is projected that embodied carbon will take up almost half the total carbon emissions from new construction.

energy retrofit programs + renewable energy

Reduced Operational CO$_2$e

Cumulative Carbon Emissions of Global New Construction Business as Usual Projection

Source: AIA 2030
Atmospheric carbon dioxide is taken up by trees and, through photosynthesis, stored as carbon in biomass. At the end of the tree’s life, when left to decay, this stored carbon returns to the atmosphere slowly. Harvesting trees as the source material for building products can delay the release of that carbon for the life of the building and potentially far longer.
Carbon Footprint

2 kg CO₂
Per 100SF @ R=1

14 kg CO₂
Per 100SF @ R=1

15 kg CO₂
Per 100SF @ R=1

WOOD FIBER

FIBERGLASS

MINERAL WOOL

SPRAY FOAM

XPS

-9 kg CO₂
Per 100SF @ R=1

36 kg CO₂
Per 100SF @ R=1
The greatest opportunity for reducing embodied carbon after concrete is insulation.
Discussion Questions

What is the first step someone aspiring to electrify can do?
What is the next milestone in electrification for Glavel + TimberHP?
Which is more critical, radical or incremental change?
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