



Environmental Impact of Wood as a Building Material

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Life Cycle Assessment

- Scientific methodology to measure inputs and outputs of various products
- From “cradle to grave”
 - Raw material extraction
 - Manufacture
 - Distribution
 - Use
 - Maintenance
 - Disposal



LCA (cont)

- After inputs and outputs are measured, examines pollution, human health, and energy efficiency over the life of product
- Used to compare one product to another in end use applications
- Determining impacts must be site specific based on best available science



LCA History for Wood Building Materials

- In the 1970s, Consortium for Research on Renewable Industrial Materials (CORRIM) organized to expand 1976 report by National Academy of Science on impacts of producing and using renewable materials.
- Research plan completed in 1998 and full research on LCI data for wood-based structural products began



History (cont)

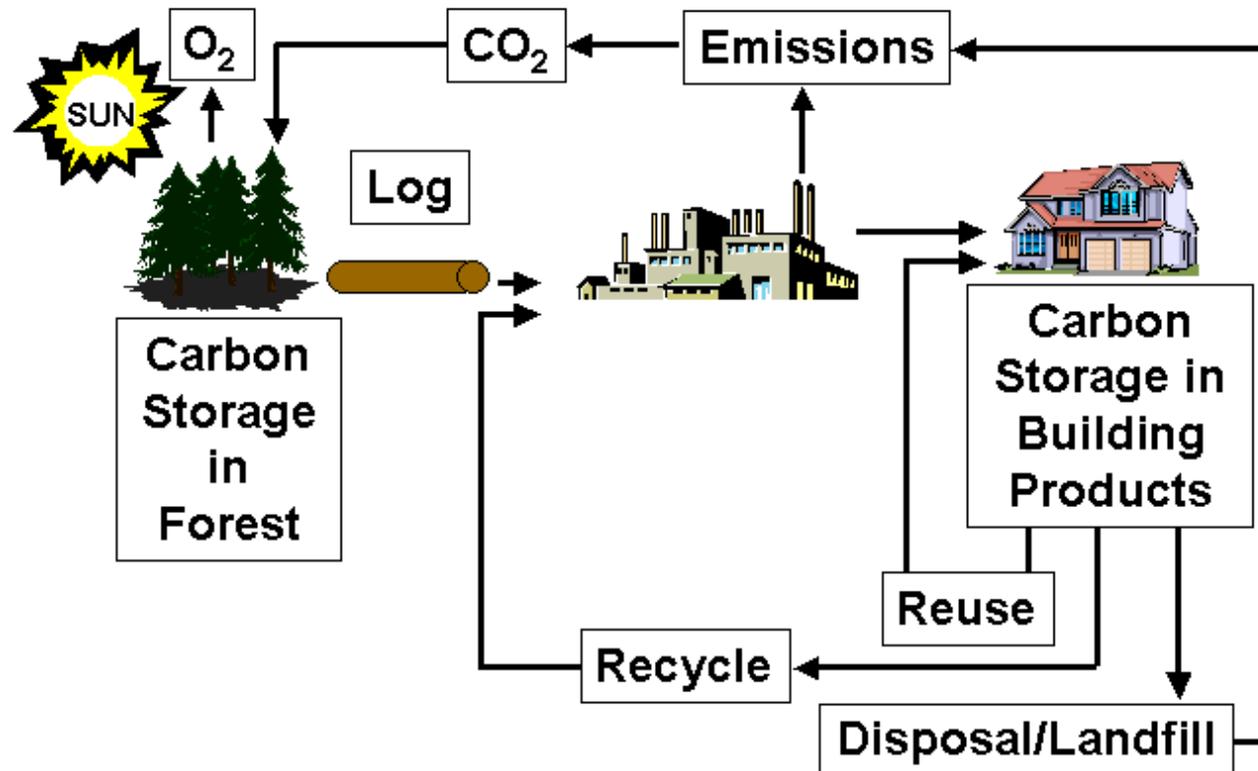
- Since 2000 LCI data has been collected on lumber, plywood, OSB, LVL, glulam, trusses, hardwood flooring, and many other components
- LCA adopted by NIST in their *Building for Environmental and Economic Sustainability (BEES)* Program comparing components
- Components have been included in building assembly comparisons
- Finally, whole building evaluation can also be done



CORRIM

- University of Washington
- Washington State
- Purdue
- University of Minnesota
- Oregon State University
- NC State University
- Louisiana State University
- FPL
- University of Idaho
- Mississippi State
- VPI

LIFE CYCLE ASSESSMENT OF WOOD BUILDING PRODUCTS



Highly dependent on Boundaries



Primary Impacts Measured

- Energy use
- Solid waste
- Global warming potential
- Air and water pollution indexes
- Resource extraction



Secondary Impacts Measured

- Global Warming Potential – CO₂
- Acidification (Air) Potential
- Human Health (Air)
- Eutrophication (water) Potential
- Smog Potential
- Ozone Depletion
- Total Fossil Energy



Individual Product

- Software available
- Compare Product A to Product B
- Basis for NIST BEES programs
- BEES Major Groups
 - Building maintenance
 - Building repair & remodeling
 - Building sitework
 - Equipment and furnishing
 - Interiors
 - Shells
 - Substructures



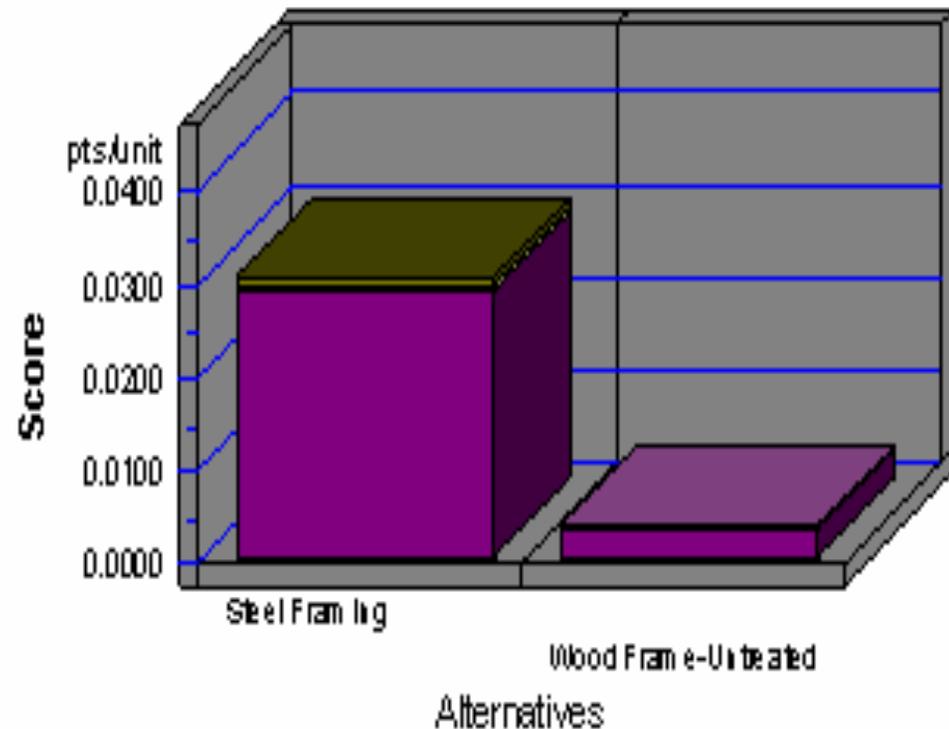
Example - Shell

- Exterior Enclosure
 - Ext sealers and coatings
 - Ext wall finishes
 - Ext Wall Systems
 - Framing
 - Wall Insulation
 - Wall Sheating
- Roofing
- Superstructure

Comparing Wood Stud to Steel Stud

Environmental Performance

■ Acidification
■ Cril. Air Pollutants
■ Ecological Toxicity
■ Eutrophication
■ Fossil Fuel Depletion
■ Global Warming
■ Habitat Alteration
■ Human Health
■ Indoor Air
■ Ozone Depletion
■ Smog
■ Water Inisle

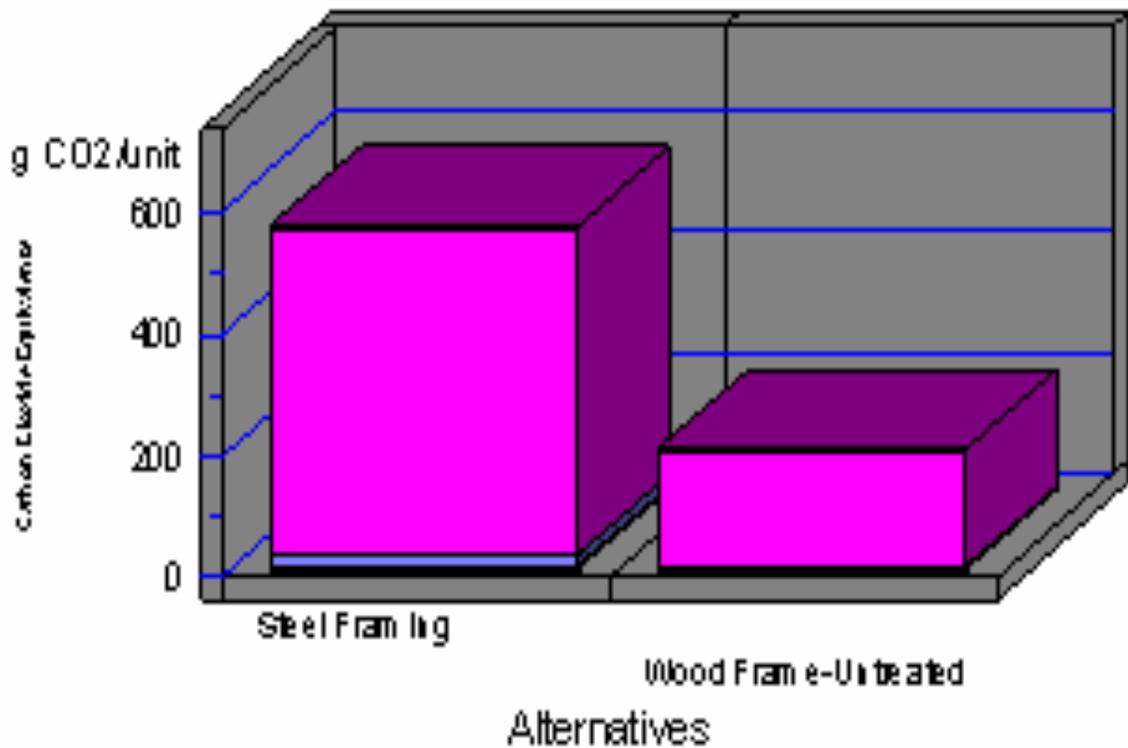


Note: Lower values are better

Comparing Wood Stud to Steel Stud

Global Warming by Flow

Carbon Dioxide
Carbon Tetrachloride
Carbon Tetrfluoride
CFC 12
Chloroform
Hexon 1301
HCFC 22
Methane
Methyl Bromide
Methyl Chloride
Methylene Chloride
Nitrous Oxide
Trichloroethane



Comparing Building Assemblies*

Minneapolis House	Wood Frame	Steel Frame
Embodied energy (GJ)	651	764
Global Warming Pot (CO2 kg)	37,047	46,826
Air Emission Index	8,566	9,729
Water Emission Index	17	70
Solid Waste (total kg)	13,766	13,641

Atlanta House	Wood Frame	Concrete Frame
Embodied energy (GJ)	398	461
Global Warming Pot (CO2 kg)	21,367	28,004
Air Emission Index	4,893	6,007
Water Emission Index	7	7
Solid Waste (total kg)	7,442	11,269

* CORRIM Final Phase I Report, 2011



Building Assemblies

- EcoCalculator by ATHENA
 - Spreadsheet format
 - User enters data for specific building
 - Based on Environmental Impact Estimator
- Basis for GreenGlobe LCA Credit Calculator
- Basis for pending USGBC credit calculator

EcoCalculator by Athena - Examples

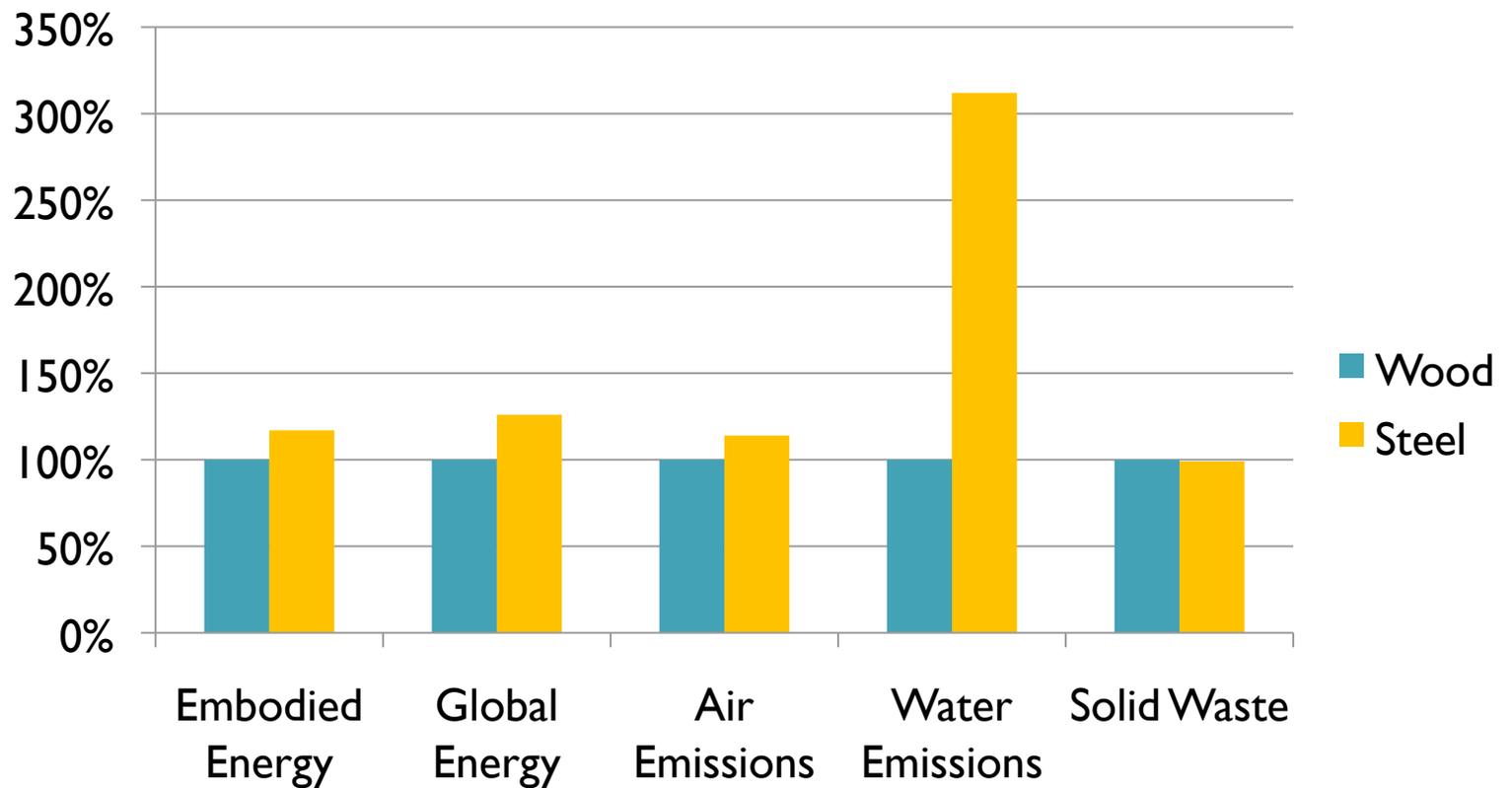
TOTAL IMPACTS BY BUILDING COMPONENT	Primary Energy (MMBtu) TOTAL	GWP (tons) TOTAL	Weighted Resource Use (tons) TOTAL	Air Pollution Index TOTAL	H2O Pollution Index TOTAL
COLUMNS & BEAMS	31	1	11	263	2.16
INTERMEDIATE FLOORS	5	0	2	62	0.83
EXTERIOR WALLS	10	1	1	151	0.07
WINDOWS	262	16	24	4477	0.93
INTERIOR WALLS	14	1	2	198	1.16
ROOF	293	15	49	3239	1.46
WHOLE BUILDING	615	34	90	8390	6.60



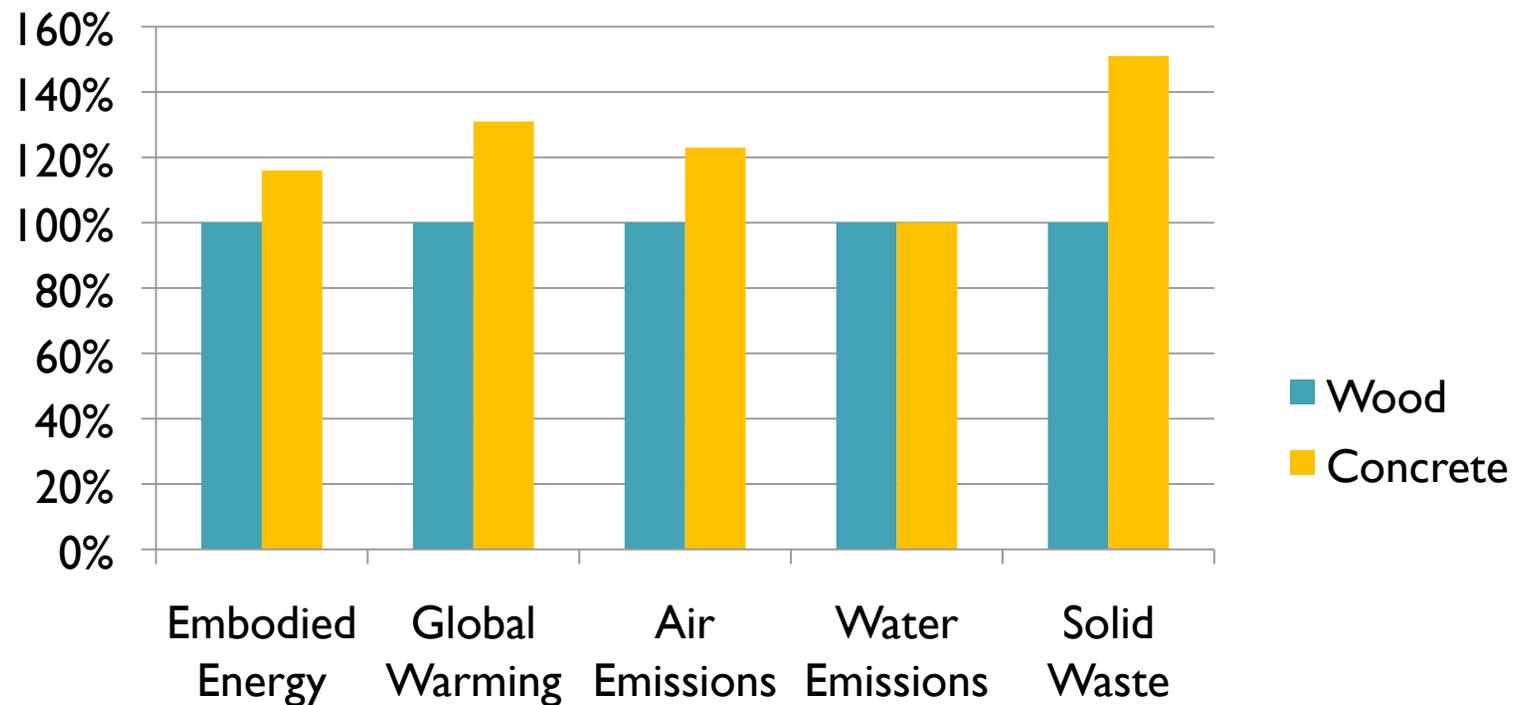
ATHENA EcoCalculator for Buildings

- Sum up each assembly for each type of building
- Hold one set constant and compare relative values for each building type
- Uses extensive LCI database
- Simulates over 1,000 different assembly combinations
- <http://www.athenasmi.ca>

Comparison of Wood-Framed to Steel-Framed House



Comparison of Wood-Framed House to Concrete Block House





Use and Promulgation

- GreenGlobe
- Environmental Product Declarations
- US Green Building Council
- NAHB – Green Home Building Guidelines



GreenGlobe

- GreenGlobe <http://greenglobe.com/>
- Primarily tourism and hotels
- Worldwide organization



Environmental Product Declarations

- [http://
www.environmentalproductdeclarations.c
om/](http://www.environmentalproductdeclarations.com/)
- Develop credible and transparent eco-labeling
- Provide LCA information on wood products similar to nutritional labels
- Maintain open markets



Environmental Product Declarations

- EPD is standardized (ISO 14025/TR) and LCA based tool to communicate environmental performance of product or system
- Declaration based on LCA and includes information about environmental impacts associated with product or service. Also includes product and company information.
- Certified EPDs are open for all products and services
- No evaluation of environmental information ... no predetermined environmental performance levels.
- Builds on well-structured and quantitative data certified by an independent third party.



US Green Building Council

- <http://www.usgbc.org/>
- US Green Building Rating System
<http://www.usgbc.org/ShowFile.aspx?DocumentID=6667>
- <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=2326>



NAHB Green Building Guidelines

- <http://www.nahbgreen.org/NGBS/default.aspx>



Summary

- LCA can be a useful tool if scientific and valid information is used
- More emphasis on selection of green building products