Building Sustainably: Wood’s Role in Healthy Forests and Healthy Buildings

Presented by
Mike Romanowski, SE, WoodWorks
October 6, 2021
Common Environmental Concerns About Specifying Wood

1. Is North America running out of Forests?

2. Does specifying wood products contribute to deforestation?

3. Is wood is a renewable resource?
US Forest Land:
Forest Area in the United States 1630 – 2012

Forest Area has been stable for over 100 years

State of our Forests: Timber Volume on US Timberland

Volume of Trees has been growing for 60+ years!

US Forest Lands

**Forest Land Ownership**

This map displays the basic vegetation (forest vs. non-forest) of the conterminous United States as well as ownership (private vs. public). The lands displayed as "public" include Federal and State lands but do not generally include lands owned by local governments and municipalities.
US Forest Lands

Forest Land Ownership

This map displays the basic vegetation (forest vs. non-forest) of the conterminous United States as well as ownership (private vs. public). The lands displayed as "public" include Federal and State lands but do not generally include lands owned by local governments and municipalities.

44% Publicly Owned
56% Privately Owned
(42% Family Owned, 14% Owned by Corporations, Partnerships & Tribes)
**US Forest Lands**

**Forest Land Ownership**

This map displays the basic vegetation (forest vs. non-forest) of the conterminous United States as well as ownership (private vs. public). The lands displayed as “public” include federal and state lands but do not generally include lands owned by local governments and municipalities.

**Economic value of forest products is motivation for private landowners to keep land forested**
US Forest Harvest by Owner

Regeneration vs. Deforestation

Deforestation is the permanent conversion of forest land to non-forest land uses. Worldwide, agricultural expansion is the main driver of deforestation, but in the U.S., the rate of deforestation has been virtually zero for decades.

Forest Management
Forests are more than Lumber Factories

- We can balance the long-term and short-term desires and the multiple uses through responsible forest management.
- Best Management Practices (BMPs)
- State, Federal and Provincial monitoring and forest inventory programs
- Forestry Practices and Laws
- Professional Logger Training and Certification
- Sustainable Forest Management Systems

Photo: Green Diamond Resource Company
Good Forestry = Sustainable Forestry

“Forestry is the art and science of creating, using and conserving forests. The forestry profession was a pioneer in developing techniques for sustainable management and, later, techniques for the multiple use of forests. [...] The term sustainable forest management is synonymous with good forestry”.

Photos: Oregon Forest Resources Institute
National Forest Management Act of 1976

National Forest Management Act Of 1976

Sec. 1. Title
Sec. 2. Findings
Sec. 3. Reports on Fiber Potential, Wood Utilization by Mills, Wood Wastes and Wood Product Recycling
Sec. 4. Reforestation
Sec. 5. Renewable Resource Program
Sec. 6. National Forest System Resource Planning
Sec. 7. National Participation
Sec. 8. Transportation System
Sec. 9. National Forest System
Sec. 10. Renewable Resources
Sec. 11, 12. Limitations on Timber Removal
Sec. 13. Public Participation and Advisory Boards
Sec. 14. Regulations and Severability
Sec. 15. Conforming Amendments to the Forest and Rangeland Renewable Resources Planning Act of 1974
Sec. 16. Amendment to the Organic Act
Sec. 17. Timber Sales on National Forest System Lands
Sec. 18. Validation of Timber Sales Contracts
Sec. 19. Payments to States for Schools and Roads
Sec. 20. Acquisition of National Forest System Lands
Sec. 21. Amendment to the Knutson-Vandenberg Act
Sec. 22. Amendment to the Act of June 12, 1960
Sec. 23. Plan for Control of Dutch Elm Disease
Sec. 24. Severability

* 457A, 470, 500, 513-516, 518, 578h, 578i (note), 578j, 964-4 (note), 1600 (note), 1600-1603, 1604, 1608, 1609 (note)

Title
Sec. 1. This Act may be cited as the "National Forest Management Act of 1976". (16 U.S.C. 1600 (note))
National Forests of the United States
National Forests of the United States

U.S. Forest Service manages 188 million acres (294k sq. mi.) of National Forests

1st National Forest was the Yellowstone Park Timber and Land Reserve created in 1891

40 states have at least one National Forest

The largest area of National Forests is in Alaska, California, Idaho, Oregon, and Colorado
National Forest Management Act of 1976

Requires comprehensive land management for all U.S. National Forests in order to:

“Sustain the multiple use of its renewable resources in perpetuity while maintaining the long-term health and productivity of the land.”

Plans are required to address:

- Best available scientific information
- Public Participation
- Social, Economic, Ecological Sustainability
- Ecological Diversity
Sustainable Forestry Management Systems

- Wood from well-managed forests is sustainable over the long term.
- Forest certification shows that the wood comes from well-managed forests.
- The major North American programs are:

  - FSC
  - SFI
  - CSA
  - ATFS
Sustainable Forestry Management Systems

Similarities:

- Biological diversity
- Wildlife habitats / species diversity
- Special sites/values
- Soil & water resources
- Sustainable harvests
- Prevent illegal or unauthorized sources
- Protect from deforestation and conversion
- Aboriginal rights and/or involvement
- Independent audit required
- Audit of forest planning and practices
- Public disclosure required
- Chain of custody and label option
Resources

US Forest Resource Facts and Historical Trends
Contains much of the numbers from our forestry slides such as the acres of forested land and volume of trees in the US.

ThinkWood CEU The Impact of Wood Use on North American Forests
Natural Wood Material
Biophilic Design
Architectural Connection to Forests
The Business Case for Healthy Buildings
ULI Report

Global Wellness Real Estate Industry:
- $134 billion industry in 2017
- 6.4% annual increase since 2015
- $180 billion industry by 2022

Healthy Bldgs ROI (Survey of 200 Canadian Bldg Owners):
- 46% easier to lease
- 28% command premium rents
- 38% of those who reported value in healthy bldgs said they are worth 7% more than conventional ones

Millennials:
- 78% say workplace quality is important
- 69% would trade other benefits for good workplace

“Health and wellness-focused environments…can help reduce company operating costs and increase revenues and profits.”
Study of Wood vs. Non-wood Finishes
Wood and Human Health

- Univ. of British Colombia & FP Innovations study
- 4 rooms: white furnishings vs. wood furnishings; plants vs. no plants

“Stress, as measured by sympathetic nervous system activation, was lower in the wood room in all periods of the study.”

Source: Wood and Human Health
Feature Stairs

Encouraging Exercise
<table>
<thead>
<tr>
<th>Pattern</th>
<th>Stress Reduction</th>
<th>Cognitive Performance</th>
<th>Emotion, Mood &amp; Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Connection w/ Nature</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Non-Visual Connection w/ Nature</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>(smell, touch)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Rhythmic Sensory Stimuli</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Thermal &amp; Airflow Variability</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Presence of Water</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dynamic &amp; Diffuse Light</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection w/ Natural Systems</td>
<td></td>
<td></td>
<td>✓</td>
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</tbody>
</table>

Source: Terrapin Bright Green: 14 Patterns of Biophilic Design, 2014
### How Might Wood Buildings Contribute to Biophilic Design?

#### Nature in the Space

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Visual Connection w/ Nature</strong></td>
<td>Design opportunity (glazing/ courtyards)</td>
</tr>
<tr>
<td><strong>Non-Visual Connection w/ Nature</strong> (smell, touch)</td>
<td>Smell &amp; touch – might the soft wood feel &amp; wood scent contribute?</td>
</tr>
<tr>
<td><strong>Non-Rhythmic Sensory Stimuli</strong></td>
<td>Design opportunity (biomimicry)</td>
</tr>
<tr>
<td><strong>Thermal &amp; Airflow Variability</strong></td>
<td>Wood is a living material &amp; can help control temperature &amp; humidity</td>
</tr>
<tr>
<td><strong>Presence of Water</strong></td>
<td>Design opportunity (water features)</td>
</tr>
<tr>
<td><strong>Dynamic &amp; Diffuse Light</strong></td>
<td>Design opportunity (timber slats)</td>
</tr>
<tr>
<td><strong>Connection w/ Natural Systems</strong></td>
<td>Wood buildings support healthy forests</td>
</tr>
</tbody>
</table>

Source: Conversations and emails between Bill Browning (Terrapin Bright Green) and Melissa Kroskey (WoodWorks)
## Biophilic Design Patterns

### Natural Analogues

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<tr>
<td>Biomorphic Forms &amp; Patterns</td>
<td>Prospect</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Material Connection w/ Nature</td>
<td>Refuge</td>
<td></td>
<td>✓</td>
<td></td>
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<td>Biomorphic Forms &amp; Patterns</td>
<td>Design opportunity (symbolic patterns)</td>
</tr>
<tr>
<td>Material Connection w/ Nature</td>
<td>Wood material connects us w/ nature</td>
</tr>
<tr>
<td>Complexity &amp; Order</td>
<td>Wood grain pattern – might it stimulate our senses?</td>
</tr>
<tr>
<td>Prospect</td>
<td>Design opportunity (distant views – atriums/ open offices)</td>
</tr>
<tr>
<td>Refuge</td>
<td>Design opportunity (quiet spaces in an office warmed w/ wood)</td>
</tr>
<tr>
<td>Mystery</td>
<td>Design opportunity (open wood screens)</td>
</tr>
<tr>
<td>Risk/ Peril</td>
<td>Design opportunity (view down @ atrium)</td>
</tr>
</tbody>
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Source: Conversations and emails between Bill Browning (Terrapin Bright Green) and Melissa Kroskey (WoodWorks)
Material Connection to Nature (visual)
Biophilic Pattern

- Wood is a natural material – timber is sourced from trees in our forests.
- Exposing natural materials provides a connection to nature in this biophilic pattern
Material Connection to Nature (non-visual)
Biophilic Pattern

Other sensory connections to nature:

- Soft feel of wood – might this contribute to this biophilic pattern?
- Smell of wood in offices - might this contribute to this biophilic pattern?
- Smell of wood has surprised some designers who didn’t consider it in design
Material Connection with Nature
Biophilic Pattern

- Wood can be used as an extension of the outside environment to the interior
Visual Connection with Nature
Biophilic Pattern

• Bringing nature inside the building & providing views outside
People Pay More $$$ for a Connection to Nature

- People pay more for good views of nature (obvious w/ real estate prices)
- Potential for leasing velocity and/ or higher leasing rates for offices w/ natural wood materials*

*Source: WoodWorks: Mass Timber Cost and Design Optimization Checklists
Dynamic & Diffuse Light
Biophilic Pattern

- Varying intensities of light & shadow throughout the day are reminiscent of variations in natural daylight
  Helps circadian system (sleep, eating & bodily functions)*

* Source: 14 Patterns of Biophilic Design,
Terrapin Bright Green, 2014
(includes list of testing citations)
Complexity & Order
Biophilic Pattern

- Rich sensory information w/ a spatial hierarchy similar to those in nature.

* Source: 14 Patterns of Biophilic Design, Terrapin Bright Green, 2014 (includes list of testing citations)
Dynamic & Diffuse Light / Complexity & Order
Biophilic Patterns
Office Buildings
Biophilic Design
Wellness + Wood = Productivity
Workplaces

“Those in workplaces with a higher proportion of visible wood feel more connected to nature and rate their working environment far more positively.”

These people report:
- lower stress levels
- higher concentration
- improved overall mood

“Wood in the workplace is associated with higher productivity and reduced sick leave.”

Report based on survey of 1,000 typical Australians working indoors
Employee Retention
Healthy Building/ Biophilia

Cost of losing an employee
(assume: $33/ hr):
$ 1,000 termination
$ 9,000 replacement
$15,875 lost productivity
$25,875 total

Sources by Terrapin Bright Green:
• Economics of Biophilia, 2012
• 14 Patterns of Biophilic Design, 2014
 (includes list of testing citations)
Investing in Employees Pays off for Bank
Case Study

ING Bank, Amsterdam HQ
Design focused on connections to nature to enhance productivity of workers.
Results:
- Absenteeism decreased 15%
- Employees voluntarily tended to natural features
- Employees looked forward to coming to the office & productivity increased

* Source: Economics of Biophilia, Terrapin Bright Green, 2012
Reduce Absenteeism
Save $

- 4% Financial losses due to absenteeism
- Offices w/ access to nature serve as a release to outside stresses & cause less stresses

* Source: Economics of Biophilia, Terrapin Bright Green, 2012

Credit: Terrapin Bright Green | Catie Ryan

10% of employee absences attributed to architecture with no connection to nature*
Natural Materials for Warm Gathering Spaces
Amenity Spaces

- Modern amenities battle: Spaces for informal collaboration are in demand
- Amenities provide a place to recharge & interact
- Connection to nature proven most impactful through outdoor access*
- Connection to nature indoors through materials & views is beneficial*

* Source: 14 Patterns of Biophilic Design, Terrapin Bright Green, 2014 (includes list of testing citations)
Heavy Timber Revolution: California’s Hip New Commercial Block
ICE Block I

IBB

- 3 Story heavy timber over podium
- 87,460 sf
- Traditional heavy timber

“The building sold itself because of its unique character. There was no competition. A lot of the credit goes to the fact that it is a timber building.”

– Mike Heller, Heller Pacific
Tech Companies Invest in Healthy Corporate Campuses
Microsoft Silicon Valley Campus
Connecting with Nature & Targeting Environmental Goals
Microsoft Silicon Valley Campus
Biophilic Design
Schools
Wood Grain Pattern – Can it Stimulate our Senses?
Might Wood Help Increase Ability to Think and Learn?
A Living/ Learning Destination for Students
Adohi Hall, University of Arkansas

Location: Fayetteville, AR
Architect: Leers Weinzapfel Associates; Mackey Mitchell Architects; Modus Studio (AOR)
Structural Engineer: Equilibrium Consulting; Engineering Consultants, Inc.

IIIB

- 202,000 sf
- 708 bed student housing
- CLT and glulam framing

“...the wood-based construction system we developed forges a bond between setting, human comfort, and sustainability.”
– Andrea Leers, Leers Weinzapfel
Healthier Learning Environment for the 2nd Generation
Cottonwood Valley Charter School E-Pod

Location: Socorro, NM
Architect: Environmental Dynamics, Inc.
Structural Engineer: Walla Engineering, Ltd.

• 6,400 sf
• Wood trusses and framing w/ SIPs
• Operable wall extends multipurpose space outdoors
• Design echoes the simple shed structures of industrial and agricultural buildings in the area
The Building as an Environmental Exemplar
Common Ground High School

- 15,000 sf
- Black spruce CLT tension surface in a prefab stressed-skin assembly
- Treated glulam bridge deck on laminated timber piers
- Timber framing connects to forested site of agricultural fields and farm buildings

Location: New Haven, CT
Architect: Gray Organschi Architecture
Environmental Engineer: Atelier Ten
The Building as an Environmental Exemplar
Tashjian Bee and Pollinator Discovery Center

- 7,860 sf
- Glulam trusses at 4’ o/c for rhythm, LVL’s & SIPs
- Accoya wood cladding in natural and shou sugi ban finishes alternate yellow & black on the exterior
- A single-point perspective of repeating frame is transformed into a wood hexagon in the reflection of light on the floor

Location: Chanhassen, MN
Architect: MSR Design
Structural Engineer: Meyer Borgman Johnson
Biophilic Design Hospitality
Rethinking the Resort and Going Vertical with Mass Timber
Penticton Lakeside Resort

- 6-story, 70 suites
- 127,600 sf
- CLT panels, glulam beams & columns
- Cost savings from exposing wood (warmth of wood & less finishes)
- Resorts typically have wide open spaces whereas designers here provided grandeur with the vertical open atrium

Location: Penticton, BC
Architect: HDR & CEI Architecture
Structural Engineer: RJC Consulting Engineers
Biophilic Design
Healthcare Facilities
Spa-like Sculptural Doctor’s Office
Blue Ridge Orthodontics

VB
• 7,500 sf
• Spa-like experience to reduce patient stress
• T&G pine roof/ soffit soars over glazing that brings in natural daylight
• Patient chairs positioned w/ views of nature outside

Location: Asheville, NC
Architect: Clark Nexsen
Structural Engineer: Kloesel Engineering
Spa-like Sculptural Doctor’s Office
Blue Ridge Orthodontics

- 9-ft tall sculptural wall
- 136 layers of CNC-cut poplar plywood, assembled into sections off-site

Location: Asheville, NC
Architect: Clark Nexsen
Structural Engineer: Kloesel Engineering
Biophilic Design
Multifamily Residential
Innovative, Sustainable, Tall Timber Multifamily Carbon 12

- 42,000 sf
- 8-story tower
- 14 condos + 2 retail units
- CLT and glulam framing
- Each unit has light & ventilation from 3 sides

Location: Portland, OR
Architect: Path Architecture
Structural Engineer: Munzing Structural Engineering
Multifamily – Structural Warmth is a Value-Add
Green Building Rating Systems
Green Building Rating Systems
What are They?

A building certification system that rates or rewards relative levels of compliance or performance with specific environmental goals and requirements.

Analyzes project as a whole, going beyond (but factoring in) performance of individual products used in the project.

Source: WBDG
Green Building Rating Systems
What is their main goal?

To clearly define, implement, and measure green strategies and their outcomes and impacts.

Amtrak Cascades Station at Freighthouse Square, Architect: VIA Architecture, Photo: Chris Eden/Eden Photography

Source: USGBC
Green Building Rating Systems
What do they factor in?

Green building rating and certification systems require an integrated design process to create projects that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition.
Green Building Rating Systems
Why target certification?

The reasons for pursuing a green building certification for a project are varied:

• Verification of the green nature of the project

• Valuable educational and marketing tool for owners and design and construction teams

• Provide an incentive for clients, owners, designers, and users to develop and promote highly sustainable construction practices

• It is important to note that a building does not have to be certified to be sustainable and well-built.

Source: WBDG

Source: USGBC & ILFI
Green Building Rating Systems
What are the benefits?

There are a wide range of economic and environmental benefits to sustainable design, often achieved through the use of standards, rating, and certification systems. Examples include:

- Reduced embodied carbon
- Reduced building energy and water use
- Reduced construction waste
- Increased occupant comfort/satisfaction
- Increased building value, lease rates, ROI

Source: WBDG
Green Building Rating Systems
Single vs. multi-attribute

A few of these programs are single-attribute, focusing solely on water or energy, while others are multi-attribute addressing emissions, toxicity, and overall environmental performance in addition to water and energy. While the philosophy, approach, and certification method vary across these systems, a common objective is that projects awarded or certified within these programs are designed to reduce the overall impact of the built environment on human health and the natural environment.

Source: WBDG

| COMPARISON OF ENVIRONMENTAL IMPACTS OF STEEL VS. WOOD DESIGN |
|---------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 1.4x | 1.6x | 1.4x | 1.4x | 3.0x | 1.5x | 1.3x |

Source: USGBC

| COMPARISON OF ENVIRONMENTAL IMPACTS OF CONCRETE VS. WOOD DESIGN |
|---------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 1.9x | 2.3x | 3.0x | 2.4x | 3.1x | 4.7x | 5.8x | 2.4x |

Source: Athena EnviroCalculator
Green Building Rating Systems

Rating systems exist for single-family homes to entire neighborhoods
New and existing construction
Green Building Rating Systems
Which one should I use?

Ultimately, the type of certification system pursued for a project depends upon that singular project; none of these certification systems are one-size-fits all. Project variables that can influence rating system choice include:

- Location
- Size
- Budget
- Overall project goals
- Rating system cost & ease of use

Rating systems are regularly updated & changed
Green Building Rating Systems
System choices

BREEAM®
GREEN GLOBES® BUILDING CERTIFICATION
fitwel
earthcraft

LEED USGBC
INTERNATIONAL WELL BUILDING INSTITUTE™
Built Green®
NATIONAL GREEN BUILDING STANDARD™

LIVING BUILDING CHALLENGE™
CASBEE®
earth advantage institute

...and many more
Green Building Rating Systems
LEED

LEED® (Leadership in Energy & Environmental design) was developed by the U.S. Green Building Council (USGBC) and provides third-party verification that a building or community was designed and built in accordance with specified practices and performance measures within eight categories.

• Established in 2000

• Adherence to required elements and numerical scores across all categories is used in determining an overall project rating.

• Has certified more than 2.8 billion ft² of building space globally.

• The newest version (V4.1) was released in 2019

Source: Green Building and Wood Products
Green Building Rating Systems
BREEAM

The UK-based Building Research Establishment’s (BRE) Environmental Assessment Method, BREEAM, has rating systems for ten different building types. Within each, assessment of performance occurs within ten categories.

• Established in 1990
• Scores across all categories are added together to produce a single overall score that, along with evidence of compliance with specific requirements, determines the overall project rating.
• 425,000 buildings currently have certified BREEAM assessment ratings and two million have registered for assessment.

Source: Green Building and Wood Products
Green Building Rating Systems
Green Globes

Green Globes began in Canada as an offshoot of BREEAM. The Green Building Initiative (GBI) acquired the rights to distribute Green Globes in the United States in 2004, and in 2005 became the first green building organization accredited as a standards developer by the American National Standards Institute (ANSI).

- Includes new construction and continuous improvement in office buildings, multifamily, hospitals, and institutional.
- Web-based tool allows self-assessment of building projects, with third-party on-site inspection required for certification.
- One of two rating systems approved by the U.S. government for accreditation of federal building projects.

Source: Green Building and Wood Products
Green Building Rating Systems
Living Building Challenge

Living Building Challenge, a program of the Cascadia Green Building Council (a chapter of both the USGBC and Canadian Green Building Council) was developed in 2006.

• Now administered by the International Living Building Institute, it is meant to be the next step after LEED Platinum and a step before regenerative buildings.

• Intended “to define the highest measure of sustainability attainable in the built environment based on the best current thinking—recognizing that ‘true sustainability’ is not yet possible.”

Source: Green Building and Wood Products
Green Building Rating Systems
Credits for wood use

Generally, every prescriptive-based rating system offers a certain percentage of credits that can be achieved with the use of wood or wood products. In most cases, wood is recognized in the following areas:

- Certified wood
- Life cycle impacts
- Recycled/reused/salvaged materials
- Local sourcing of materials
- Material efficiency & waste minimization
- Waste minimization
- Indoor air quality

Source: Green Building and Wood Products
Green Building Rating Systems
Certified wood

Credits are awarded for wood that has been third-party certified as coming from a sustainably managed forest. Different rating systems allow for different certification programs, with some more inclusive than others.

While rating systems commonly reward projects that use certified wood, they do not require any demonstration that other materials such as concrete, steel, or plastic have come from a sustainable resource.

Source: Green Building and Wood Products
Green Building Rating Systems
Life cycle impacts

Many rating systems give credits for the use of products with lower embodied energy and lifecycle carbon impacts. Wood products regularly perform well in embodied carbon comparisons of building materials.
Green Building Rating Systems
Recycled/reused/salvaged materials

Many rating systems give credits for the use of products with recycled content.

Wood products that qualify include:

• Finger-jointed studs,
• Salvaged timbers,
• Medium-density fiberboard
• Insulation board

Source: Green Building and Wood Products
Green Building Rating Systems
Local sourcing of materials

Some rating systems place special emphasis on the use of local materials as an approach to reducing the environmental impacts of projects, rewarding materials sourced from within a certain radius—commonly 500 miles.

However, simply tracking transportation distances ignores such critically important factors as mode of transportation and the type, efficiency, and impacts of manufacturing processes.

Source: Green Building and Wood Products

Richard Woodcock Education Center, Western Oregon University. Mahium Architecture. Photo: DR Johnson
Green Building Rating Systems
Material efficiency & waste minimization

Many rating systems reward use of lower quantities of building materials.

Credit is often awarded for avoiding or diverting construction waste—e.g., through jobsite protocols that include pre-cut packages or off-site production of building modules.

Source: Green Building and Wood Products

Platte 15, OZ Architecture. Photos: JC Buck
Green Building Rating Systems

Indoor air quality

Most rating systems have strict limits on the use of products that contain volatile organic compounds (VOC’s). Many wood products are available that verifiably meet or exceed these guidelines.

Source: Green Building and Wood Products

Adohi Hall, University of Arkansas, Leers Weinzapfel Associates, Photo: Timothy Hursley; Kiara Luers
Green Building Rating Systems
Ancillary benefits of wood

Other key areas where wood may have further advantages that are currently not being considered in most of the ratings systems:

• **Acoustics** – Wood panel products are particularly useful in sound abatement and control strategies

• **New products in traditional applications** – i.e. wood fiber insulation

• **Thermal mass** – Use of wood framing in wall and roof assemblies can result in less thermal bridging

Source: Green Building and Wood Products
Wood in Green Building Rating Systems

The prevalence of wood in rating systems varies from 8% to 28% of the total available points. Varies with rating system and project type (commercial vs. multi-family vs. single family)

The degree of wood intensity in a project has a marginal impact on the number of total credits/points that can be achieved.

Source: Overview of Green Building Rating Systems and their Relationship(s) with Wood
# Wood in Green Building Rating Systems

<table>
<thead>
<tr>
<th>Rating System</th>
<th>Living Building Challenge</th>
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<tbody>
<tr>
<td>Building Types</td>
<td>New Construction and Major Renovations, large projects, high rises, multi unit residential</td>
</tr>
<tr>
<td>Market location</td>
<td>Cascadia region, US and Canada</td>
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## Issues pertaining to wood

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<th>All wood must be certified FSC or be salvaged or be reused onsite timber.</th>
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<tr>
<td>Local sourcing of materials</td>
<td>Assemblies and materials must be sourced within specified distances, between 250-3,000 miles.</td>
</tr>
<tr>
<td></td>
<td>• Prerequisite 8 – Appropriate Materials/Services Radius</td>
</tr>
<tr>
<td>Building techniques</td>
<td>n/a</td>
</tr>
</tbody>
</table>

## Site protocols & waste

<table>
<thead>
<tr>
<th>Construction Waste must be diverted from landfills to the following levels: Metals (90%), all wood products (80%), concrete (80%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifecycle impacts</td>
</tr>
<tr>
<td>Carbon &amp; global warming</td>
</tr>
<tr>
<td>Indoor air quality</td>
</tr>
<tr>
<td>Competitive Materials</td>
</tr>
</tbody>
</table>

*Source: Overview of Green Building Rating Systems and their Relationship(s) with Wood*
## Wood in Green Building Rating Systems

<table>
<thead>
<tr>
<th>LEED NC (US and Canada)</th>
<th>LEED CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building Types</strong></td>
<td>New Construction and Major Renovations, large projects, high rises, multi unit residential</td>
</tr>
<tr>
<td><strong>Market location</strong></td>
<td>US and Canada</td>
</tr>
<tr>
<td><strong>Issues pertaining to wood</strong></td>
<td>LEED NC and LEED-CI both award a credit for projects in which a minimum of 50% by value of all wood-based materials are certified in accordance with FSC principals and criteria. LEED NC (Canada) and LEED-CI also include additional credits for a maximum 5% by value of total wood-based materials being made from a rapidly renewable plant (with a two-year or shorter harvesting cycle).</td>
</tr>
<tr>
<td><strong>Certified wood</strong></td>
<td>MR 7 – Certified Wood (1 credit)</td>
</tr>
<tr>
<td><strong>Recycled content</strong></td>
<td>MR 4 – Recycled Content 10-30% (1-2 credits)</td>
</tr>
<tr>
<td><strong>Locally sourced material</strong></td>
<td>MR 5.1 Regional Materials - 10% Extracted &amp; Manufactured Regionally (1 credit)</td>
</tr>
<tr>
<td><strong>Building techniques</strong></td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Site protocols &amp; waste</strong></td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Lifecycle impacts</strong></td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Carbon &amp; global warming</strong></td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Indoor air quality</strong></td>
<td>LEED NC (Canada) and LEED-CI both award a credit for reducing indoor air contaminants, by requiring that composite wood or agri-fibre products, and laminate adhesives have no added urea-formaldehyde resins. LEED NC (Canada) offers a further credit for paints and coatings that have limited volatile organic compounds. LEED-CI offers a further credit for systems and furniture that meets specific emission standards. LEED NC (US) offers credits for reducing indoor air contaminants by requiring that composite wood or agri-fibre products have no added urea-formaldehyde resins, and that all flooring systems meet emissions standards.</td>
</tr>
</tbody>
</table>

Source: Overview of Green Building Rating Systems and their Relationship(s) with Wood
Wood in Green Building Rating Systems

For each system, note where wood gets points, what the tiers are and what the levels of certifications get

<table>
<thead>
<tr>
<th>Green Globes™ Categories</th>
<th>Total Points</th>
<th>Related to Wood</th>
<th>% Related to Wood</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Project Management</td>
<td>50</td>
<td>10</td>
<td>20.0%</td>
</tr>
<tr>
<td>B. Site</td>
<td>115</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>C. Energy</td>
<td>380</td>
<td>30</td>
<td>7.9%</td>
</tr>
<tr>
<td>D. Water</td>
<td>85</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>E. Resources/Materials</td>
<td>100</td>
<td>55</td>
<td>55.0%</td>
</tr>
<tr>
<td>F. Emissions</td>
<td>70</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>G. Indoor Environment</td>
<td>200</td>
<td>45</td>
<td>22.5%</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>155</td>
<td>15.5%</td>
</tr>
</tbody>
</table>

Source: Overview of Green Building Rating Systems and their Relationship(s) with Wood
Wood in Green Globes

GREEN GLOBES RATINGS:
Once an assessment is verified by a third party, properties achieving a score of 35% or more receive a Green Globes rating based on the percentage of total points (up to 1,000) achieved.

- **85-100%**: FOUR GREEN GLOBES
  - Demonstrates leadership in achieving national leadership excellence in the practice of water, energy and environmental efficiency to reduce environmental impacts.

- **70-84%**: THREE GREEN GLOBES
  - Demonstrates leadership in applying best practices regarding energy, water, and environmental efficiency.

- **55-69%**: TWO GREEN GLOBES
  - Demonstrates excellent progress in reducing environmental impacts and use of environmental efficiency practices.

- **35-54%**: ONE GREEN GLOBES
  - Demonstrates a commitment to environmental efficiency practices.

4 tiers, up to 1,000 points possible
Multiple certification types available

Source: Green Building Initiative
Wood in Green Globes
Potential points applicable to wood

3.5.1.1 Path A: Performance Path for Building Core and Shell

Athena Impact Estimator for Buildings or other LCA tool used during design to evaluate a minimum of two different core and shell designs, based on life cycle assessment (LCA) in compliance with the assessment guidance and resulting in selection of the building core and shell with the least anticipated environmental impact? IF YES – 33 POINTS

Source: Green Building Initiative
Wood in Green Globes
Potential points applicable to wood

3.5.1.2 Path B - % products have third-party sustainable forestry certifications – 20 points max

- Canadian Standards Association (CSA)
- Sustainable Forestry Initiative (SFI)
- Forest Stewardship Council (FSC)
- American Tree Farm System (ATFS)

≥ 40% (20 points)
25 - 39% (15 points)
10 - 24% (10 point)
0 - 9% (0 points)

Source: Green Building Initiative

Photo: Sustainable Forestry Initiative
Wood in Green Globes
Potential points applicable to wood

3.5.4.1 Construction Waste – 7 points max

Criteria: What percentage of the construction waste, including building demolition waste, will be diverted from the landfill?

74% (6 points)  |  50 - 74% (4 points)
25 - 49% (2 points)  |  < 25% (0 points)

3.5.6.1.2 Minimal use of raw materials – 1 point

One option: optimum value engineered (OVE) wood framing

Source: Green Building Initiative
Wood in LEED

Source: USGBC
Wood in LEED

Point Distribution in LEED v4 & v4.1 New Construction (NC)

<table>
<thead>
<tr>
<th>Credit Category</th>
<th>Max Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrative Process</td>
<td>1</td>
</tr>
<tr>
<td>Location and Transportation</td>
<td>16</td>
</tr>
<tr>
<td>Sustainable Sites</td>
<td>10</td>
</tr>
<tr>
<td>Water Efficiency</td>
<td>11</td>
</tr>
<tr>
<td>Energy and Atmosphere</td>
<td>33</td>
</tr>
<tr>
<td>Materials and Resources</td>
<td>13</td>
</tr>
<tr>
<td>Indoor Environmental Quality</td>
<td>16</td>
</tr>
<tr>
<td>Innovation</td>
<td>6</td>
</tr>
<tr>
<td>Regional Priority</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
</tr>
</tbody>
</table>

Source: USGBC

Primary areas of points related to use of wood
Wood in LEED
V4 & v4.1

The use of wood products can contribute up to 12 points, accounting for more than 10 percent of LEED v4’s total credits.

According to USGBC’s *Industry Materials Brief on Forest Products*, the “use of wood as a building material is among the most highly incentivized strategies in LEED.”

Source: Barbara Horwitz-Bennett & USGBC

Oregon Zoo Education Center, Opus Architecture, Photo: Christian Columbres
Wood in LEED
V4 & v4.1

Specifically, wood products qualify for credits in these 5 categories:

1. Building Life-Cycle Impact Reduction (5 points). Materials and products with comparatively low environmental impacts fare well in v4’s whole building life-cycle credit.

2. Building Product Disclosure and Optimization—Environmental Product Declarations (2 points). Many wood EPDs are available.

3. Building Product Disclosure and Optimization— Sourcing of Raw Materials (2 points). Projects can either specify wood from suppliers and manufacturers with a Corporate Sustainability Report or choose new wood products certified by the Forest Stewardship Council, Sustainable Agriculture Network or equivalent standard to contribute toward this credit.

Source: Barbara Horwitz-Bennett & USGBC
Wood in LEED
V4 & v4.1

Specifically, wood products qualify for credits in these 5 categories:

4. Building Product Disclosure and Optimization—Material Ingredients (2 points). Untreated and unfinished wood products as “inherently non-emitting sources” can contribute toward this credit.

5. Low-Emitting Materials (3 points). Untreated and unfinished wood products are also in line with this credit’s requirements

Source: Barbara Horwitz-Bennett & USGBC
# Wood in LEED

## V4 & v4.1

Point Distribution in LEED v4 & v4.1 NC – Materials and Resources

<table>
<thead>
<tr>
<th>Materials and Resources</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Y</strong></td>
<td></td>
</tr>
<tr>
<td>Prereq Storage and Collection of Recyclables</td>
<td>Required</td>
</tr>
<tr>
<td><strong>Y</strong></td>
<td></td>
</tr>
<tr>
<td>Prereq Construction and Demolition Waste Management Planning</td>
<td>Required</td>
</tr>
<tr>
<td><strong>Credit</strong></td>
<td></td>
</tr>
<tr>
<td>Building Life-Cycle Impact Reduction</td>
<td>5</td>
</tr>
<tr>
<td>Building Product Disclosure and Optimization - Environmental</td>
<td>2</td>
</tr>
<tr>
<td>Product Declarations</td>
<td></td>
</tr>
<tr>
<td><strong>Credit</strong></td>
<td></td>
</tr>
<tr>
<td>Building Product Disclosure and Optimization - Sourcing of</td>
<td>2</td>
</tr>
<tr>
<td>Raw Materials</td>
<td></td>
</tr>
<tr>
<td><strong>Credit</strong></td>
<td></td>
</tr>
<tr>
<td>Building Product Disclosure and Optimization - Material</td>
<td>2</td>
</tr>
<tr>
<td>Ingredients</td>
<td></td>
</tr>
<tr>
<td><strong>Credit</strong></td>
<td></td>
</tr>
<tr>
<td>Construction and Demolition Waste Management</td>
<td>2</td>
</tr>
</tbody>
</table>

1 point in Sourcing of Raw Materials can be obtained using Certified Wood Pilot Alternative Compliance Path (ACP)

Source: USGBC
Wood in LEED
V4 & v4.1

Point Distribution in LEED v4 & v4.1 NC – Materials and Resources – ACP for Certified Wood

WHAT IS AN ACP?
An Alternative Compliance Path allows LEED projects to achieve an existing green building credit, using an alternative approach to what is specified in the existing rating tool.

An ACP pilot is used to test and work out any kinks with the new pathway. If the ACP pilot credit is adopted, it will become part of the LEED rating system.

In order to count towards a LEED point, the user must first know that:
- 100% of the forest products are from legal (non-controversial) sources, and
- 70% from responsible sources, and
- The remainder must be certified sources as evidenced by a chain of custody certification (CoC).

Generates opportunity to use wood products certified to SFI, ATFS, or CSA

Source: Sustainable Forestry Initiative
Wood in LEED
V4 & v4.1

Point Distribution in LEED v4 & v4.1 NC – Indoor Environmental Quality

<table>
<thead>
<tr>
<th>Credit</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Indoor Air Quality Performance</td>
<td>4</td>
</tr>
<tr>
<td>Environmental Tobacco Smoke Control</td>
<td>2</td>
</tr>
<tr>
<td>Enhanced Indoor Air Quality Strategies</td>
<td>3</td>
</tr>
<tr>
<td>Low-Emitting Materials</td>
<td>4</td>
</tr>
<tr>
<td>Construction Indoor Air Quality Management Plan</td>
<td>3</td>
</tr>
<tr>
<td>Indoor Air Quality Assessment</td>
<td>3</td>
</tr>
<tr>
<td>Thermal Comfort</td>
<td>2</td>
</tr>
<tr>
<td>Interior Lighting</td>
<td>2</td>
</tr>
<tr>
<td>Daylight</td>
<td>3</td>
</tr>
<tr>
<td>Quality Views</td>
<td>2</td>
</tr>
<tr>
<td>Acoustic Performance</td>
<td>1</td>
</tr>
</tbody>
</table>

Use of wood products can contribute up to 2 points in this credit

Source: USGBC
Wood in Living Building Challenge

The Living Building Challenge (LBC) is widely considered the most stringent green building standard in the world. It attempts to emulate a flower by encouraging net-zero or net-positive impact on virtually everything the built environment touches. Its requirements are categorized under seven petals:

1. Site
2. Water
3. Energy
4. Health
5. Materials
6. Equity
7. Beauty

Source: ILFI
Wood in Living Building Challenge

Through detailed “imperatives” within each petal, LBC leaves little wiggle room. Everything is a prerequisite, unlike in LEED, where project teams can choose among credits.

10. RED LIST IMPERATIVE

There are temporary exceptions for numerous Red List items due to current limitations in the materials petal handbook for complete and up-to-date listings. The project cannot contain any of the following:

RED LIST MATERIALS OR CHEMICALS

- Allylocholines
- Asbestos
- Bisphenol A (BPA)
- Cadmium
- Chlorinated Polyethylene and Chlorosulfonated Polyethylene

Source: ILFI
Wood in Living Building Challenge

Projects can be ‘Petal Certified’ but can also extend to:

- Net Zero Energy Building
- Zero Carbon
- Living Community
- Petal Community

Many of the LBC petal-certified projects completed to date have implemented the use of wood and timber framing to meet the Materials Petal Imperatives

Source: ILFI
Living Building Challenge Projects
Bullitt Center, Seattle, WA

- Type IV construction
- 4 stories of glulam & NLT over a 2-story podium
- 52,000 sf

Architect: Miller Hull Architects
Photos: John Stamets, Nic Lehoux
Living Building Challenge Projects
Bullitt Center, Seattle, WA

- Net Zero Building
- Goal- 250 year life expectancy
- 1st LBC Certified Office Building
- 80% Energy reductions
- PV array provides energy for building

Volume of wood used: 24,526 cubic feet
U.S. and Canadian forests grow this much wood in: 2 minutes
Carbon stored in the wood: 545 metric tons of CO₂
Avoided greenhouse gas emissions: 1,158 metric tons of CO₂
TOTAL POTENTIAL CARBON BENEFIT: 1,703 metric tons of CO₂

Equivalent to:
- 325 cars off the road for a year
- Energy to operate a home for 145 years


Architect: Miller Hull Architects
Photos: John Stember, Nic Lehoux

LIVING BUILDING CHALLENGE™
Wood in Living Building Challenge
R.W. Kern Center, Amherst, MA

- 17,000 SF
- Glulam frame with T&G decking
- The building is self-sustaining—generating its own energy, capturing its own water, and processing its own waste
Wood in Living Building Challenge
RMI Innovation Center, Basalt, CO

- 2 stories, 15,600 sf
- 100 year design life | Targeting Net Zero Energy
- CLT floor with glulam frame
- Use of CLT allowed structure depth to be minimized, allowing natural daylight to penetrate further into building
LCA tools for Green Building Certifications
WoodWorks Expert Tip

What tools are available to help designers and owners compare the embodied carbon, or upfront greenhouse gas emissions (GHG), of commercial or multi-family buildings designed with different structural systems in the US?

View WoodWorks Expert Tip online at: https://www.woodworks.org/experttip/feb-2020/
# Whole Building LCA Tools

## Detailed LCA Analysis

<table>
<thead>
<tr>
<th>WBLCA Tool</th>
<th>Analysis</th>
<th>LEED v4 credits</th>
<th>LEED v4.1 credits</th>
<th>ILFI Zero Carbon Certificate</th>
<th>Green Globes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athena Impact Estimator for Buildings</td>
<td>Detailed robust WBLCA</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Tally</td>
<td>Detailed robust WBLCA</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>One-Click LCA</td>
<td>WBLCA w/ regionalized generic data &amp; global EPD library</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### LCA Tools for use in Pre-Design & Conceptual Design

#### Simplified Early LCA Analysis

<table>
<thead>
<tr>
<th>LCA Tool</th>
<th>Analysis</th>
<th>Acceptability for Green Building Credits/ Certificates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athena EcoCalculator for Commercial Assemblies</td>
<td>Early estimate simplified LCA (note: no longer updated, some data out of date)</td>
<td>Yes</td>
</tr>
<tr>
<td>Carbon Designer (One-click LCA add-on tool)</td>
<td>Early estimate simplified LCA w/ regionalized generic data</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Questions? Ask me anything.

Mike Romanowski, SE
Regional Director | CA-South, AZ, NM
619.206.6632
mike.romanowski@woodworks.org

901 East Sixth, Thoughtbarn-Delineate Studio,
Leap!Structures, photo Casey Dunn