



# Building Sustainably: Wood's Role in Healthy Forests and Healthy Buildings

Presented by  
Mike Romanowski, SE, WoodWorks  
October 6, 2021

# State of Our Forests





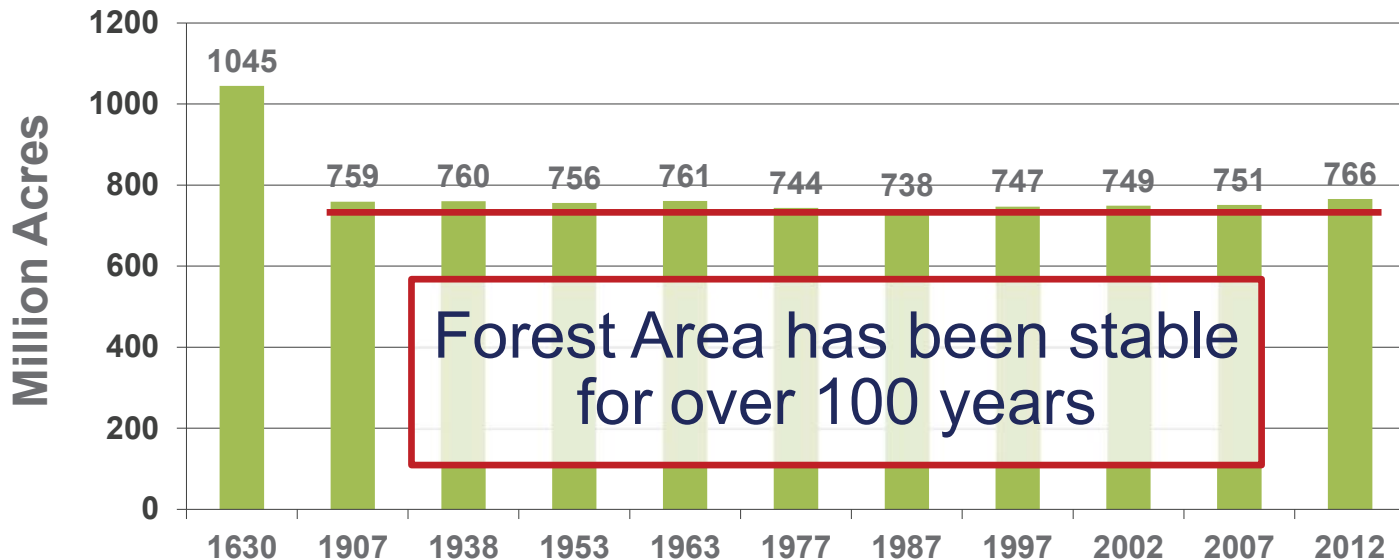


## Common Environmental Concerns About Specifying Wood

1. Is North America **running out of Forests?**
2. Does specifying wood products contribute to **deforestation?**
3. Is wood is a **renewable resource?**

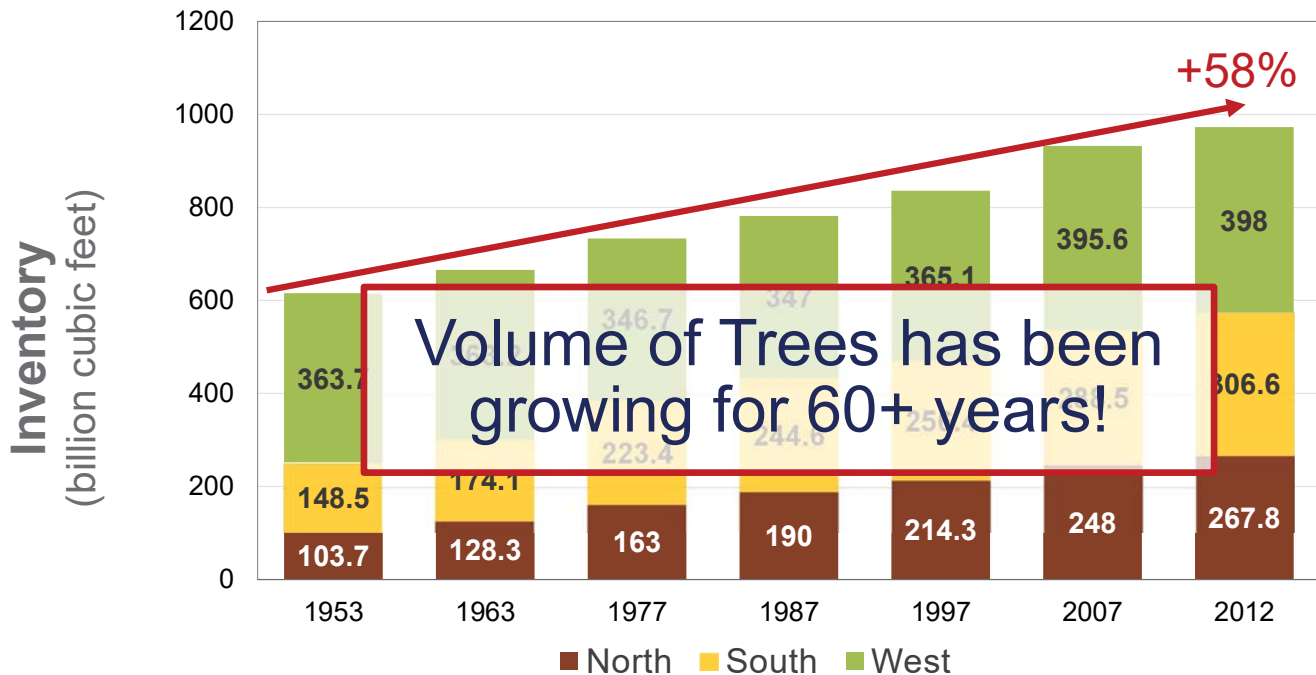
# US Forest Land:

Forest **Area** in the United States 1630 – 2012



Source: USDA-Forest Service, US Forest Resource Facts and Historical Trends FS-1035. (2014).

# State of our Forests: Timber Volume on US Timberland

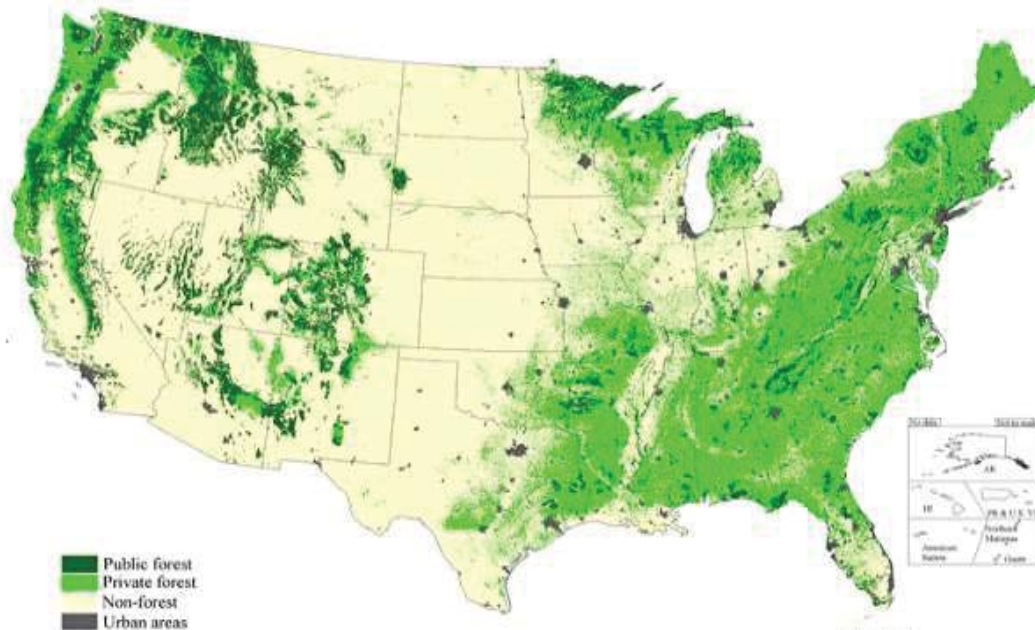


Source: USDA-Forest Service, US Forest Resource Facts and Historical Trends FS-1035. (2014).

# 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.



USDA Forest Service, State and Private Forestry,  
Cooperative Forestry Staff, Washington Office.



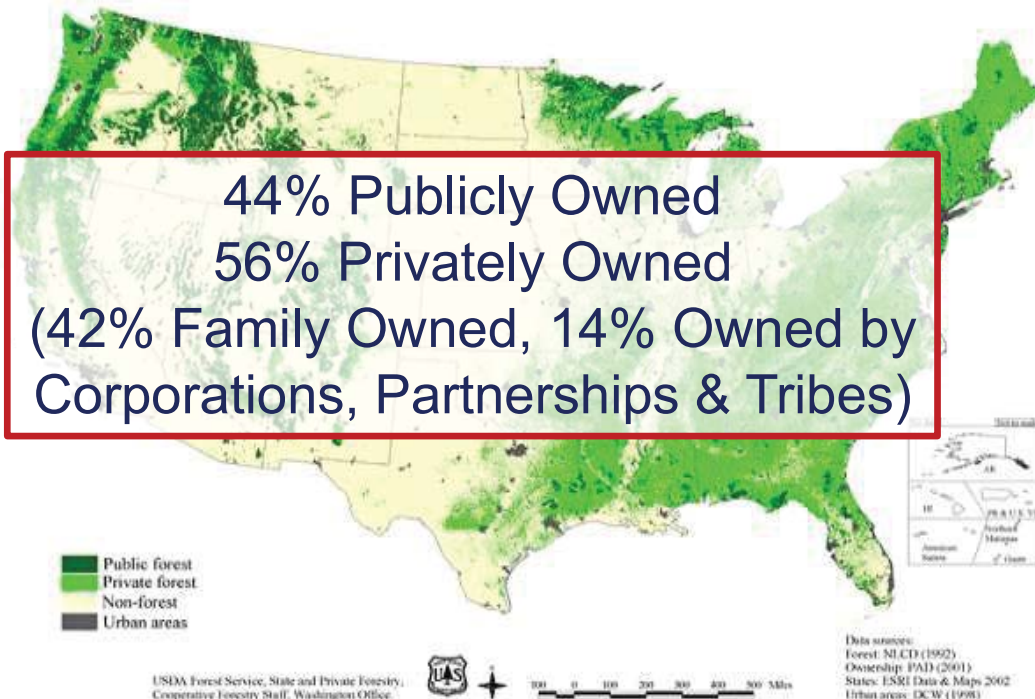
0 100 200 300 400 500 Miles

Data sources:  
Forest: NLCD (1992)  
Ownership: PAD (2001)  
States: ESRI Data & Maps 2002  
Urban areas: DCW (1998)

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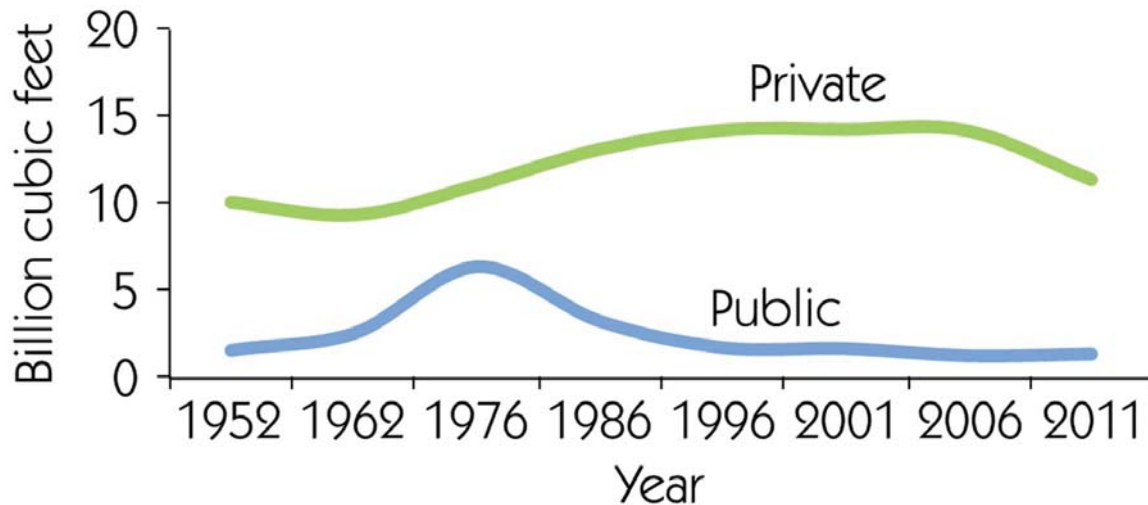


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# US Forest Harvest by Owner



Source: USDA-Forest Service, US Forest Resource Facts and Historical Trends FS-1035. (2014).

# 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”.

Source: State of the World's Forests 2012. United Nations Food and Agriculture Organization

Photos: Oregon Forest Resources Institute



# National Forest Management Act of 1976

National Forest Management Act of 1976

1

## 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, 13. Limitations on Timber Removal
- \*Sec. 14. Public Participation and Advisory Boards
- \*Sec. 15, 16. Regulations and Severability
- \*Sec. 12. Conforming Amendments to the Forest and Rangeland Renewable Resources Planning Act of 1974
- \*Sec. 13. Amendment to the Organic Act.
- \*Sec. 14. Timber Sales on National Forest System Lands
- \*Sec. 15. Validation of Timber Sales Contracts
- \*Sec. 16. Payments to States for Schools and Roads
- \*Sec. 17. Acquisition of National Forest System Lands
- \*Sec. 18. Amendment to the Knutson-Vandenberg Act
- \*Sec. 19. Amendment to the Act of June 12, 1960
- \*Sec. 20. Plan for Control of Dutch Elm Disease
- \*Sec. 21. Severability

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\* Act of October 22, 1976 (P.O. 94-588, 90 Stat. 2949, as amended; 16 U.S.C.

\* 472A, 476, 500, 513-516, 518, 521h, 528(note), 576B, 594-2(note), 1600(note), 1601(note), 1600-1602, 1604, 1606, 1608-1614)

### 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

1<sup>st</sup> 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**

[https://www.fia.fs.fed.us/library/brochures/docs/2012/ForestFacts\\_1952-2012\\_English.pdf](https://www.fia.fs.fed.us/library/brochures/docs/2012/ForestFacts_1952-2012_English.pdf)

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**

<https://1r4scx402tmr26fqa93wk6an-wpengine.netdna-ssl.com/wp-content/uploads/2020/08/Think-Wood-CEU-The-Impact-of-Wood-Use-on-North-American-Forests-Dec2019.pdf>



# **Natural Wood Material Biophilic Design**



# Architectural Connection to Forests



George Fox University – Canyon Commons  
Hacker | Photo: Jeremy Bittermann

# 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

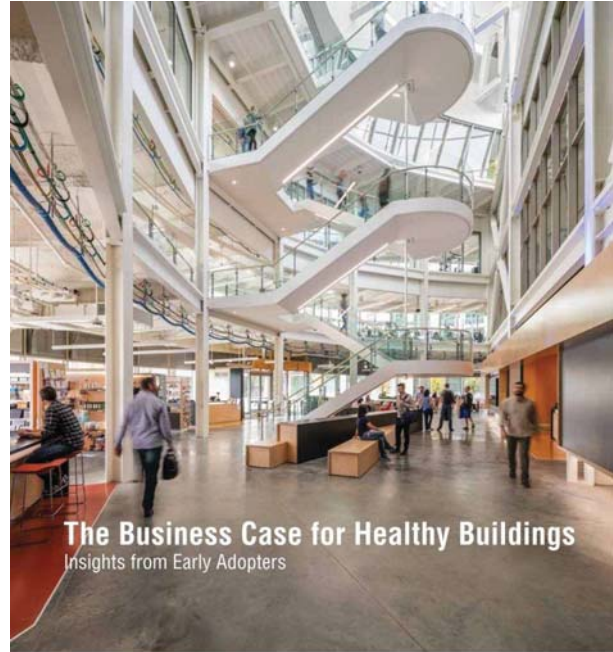
### Healthy Bldgs ROI (Survey of 200 Canadian Bldg Owners):

- 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 Columbia & 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."



# Feature Stairs

## Encouraging Exercise



Albina Yard  
LEVER Architecture | Photo: LEVER Architecture



The Bullitt Center  
Miller Hull Partnership | Photo: John Stamets



SAC Federal Credit Union HQ  
Leo A Daly | Photo: Brad Anderson



# Biophilic Design Patterns

## Nature in the Space

	Pattern	Stress Reduction	Cognitive Performance	Emotion, Mood & Preference
Nature in the Space	Visual Connection w/ Nature	✓	✓	✓
	<b>Non-Visual Connection w/ Nature</b> (smell, touch)	✓	✓	✓
	Non-Rhythmic Sensory Stimuli	✓	✓	
	Thermal & Airflow Variability	✓	✓	✓
	Presence of Water	✓	✓	✓
	Dynamic & Diffuse Light	✓		
	<b>Connection w/ Natural Systems</b>			✓

# How Might Wood Buildings Contribute to Biophilic Design?

## Nature in the Space

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

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

# Biophilic Design Patterns

## Natural Analogues

## Nature of the Space

	Pattern	Stress Reduction	Cognitive Performance	Emotion, Mood & Preference
Natural Analogues	Biomorphic Forms & Patterns			✓
	Material Connection w/ Nature		✓	✓
	Complexity & Order	✓		✓
Nature of the Space	Prospect	✓	✓	✓
	Refuge		✓	
	Mystery			✓
	Risk/ Peril			✓

# How Might Wood Buildings Contribute to Biophilic Design?

## Natural Analogues

## Nature of the Space

	Pattern	
Natural Analogues	Biomorphic Forms & Patterns	Design opportunity (symbolic patterns)
	Material Connection w/ Nature	Wood material connects us w/ nature
	Complexity & Order	Wood grain pattern – might it stimulate our senses?
Nature of the Space	Prospect	Design opportunity (distant views – atriums/ open offices)
	Refuge	Design opportunity (quiet spaces in an office warmed w/ wood)
	Mystery	Design opportunity (open wood screens)
	Risk/ Peril	Design opportunity (view down @ atrium)

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



Washington Fruit & Produce Co.  
Graham Baba Architects | Photo: Kevin Scott

# 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

[https://www.woodworks.org/wp-content/uploads/wood\\_solution\\_paper-Mass-Timber-Design-Cost-Optimization-Checklists.pdf](https://www.woodworks.org/wp-content/uploads/wood_solution_paper-Mass-Timber-Design-Cost-Optimization-Checklists.pdf)



The Bullitt Center  
Miller Hull Partnership | Photo: John Stamets

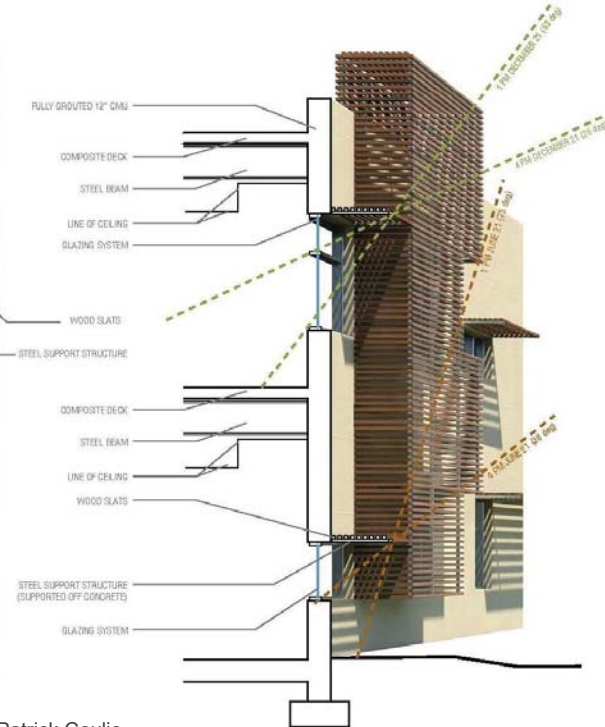


Venture Capital Office HQ  
Paul Murdoch Architects | Photo: Eric Staudenmaier

# 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)



GSA Office Building  
Page Southerland Page | Photos: Patrick Coulie

# 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)



Washington Fruit & Produce Co.  
Holst Architecture | Photo: Andrew Pogue

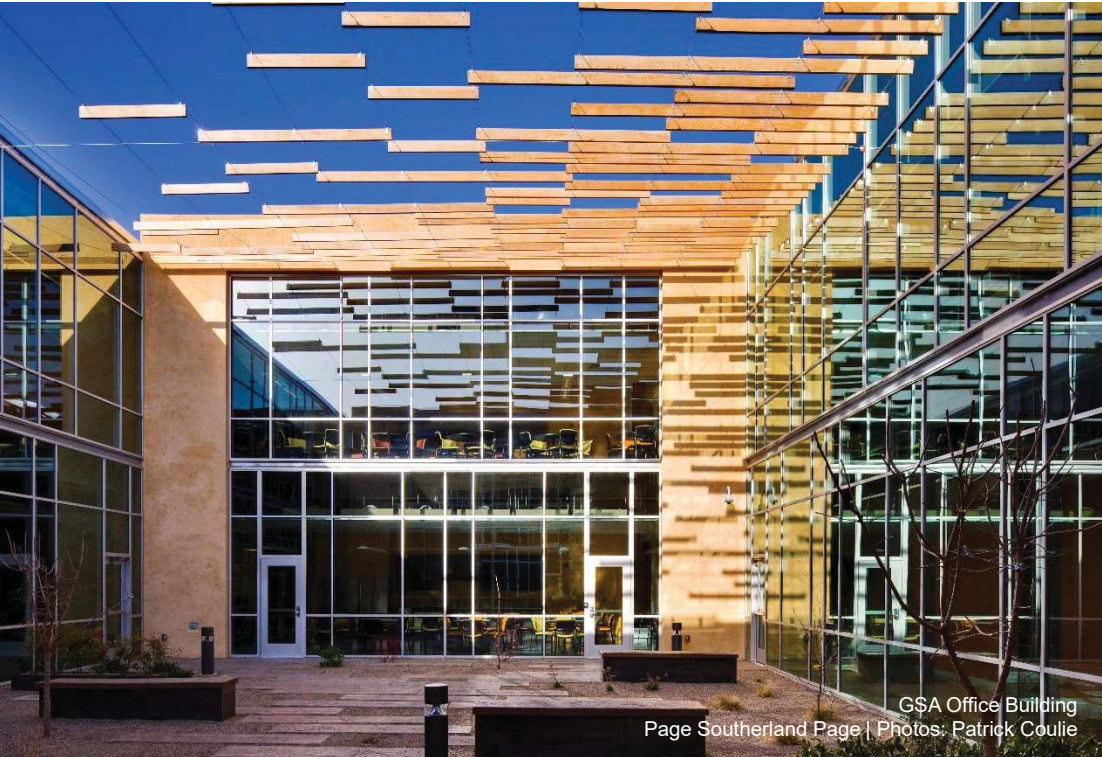


Cultural Crossing @ Portland Japanese Garden  
Kengo Kuma & Hacker | Photo: Jeremy Bitterman



# Dynamic & Diffuse Light / Complexity & Order

## Biophilic Patterns



GSA Office Building  
Page Southerland Page | Photos: Patrick Coulie



Venture Capital Office HQ  
Paul Murdoch Architects | Photo: Eric Staudenmaier



# **Office Buildings Biophilic Design**



# Wellness + Wood = Productivity

## Workplaces

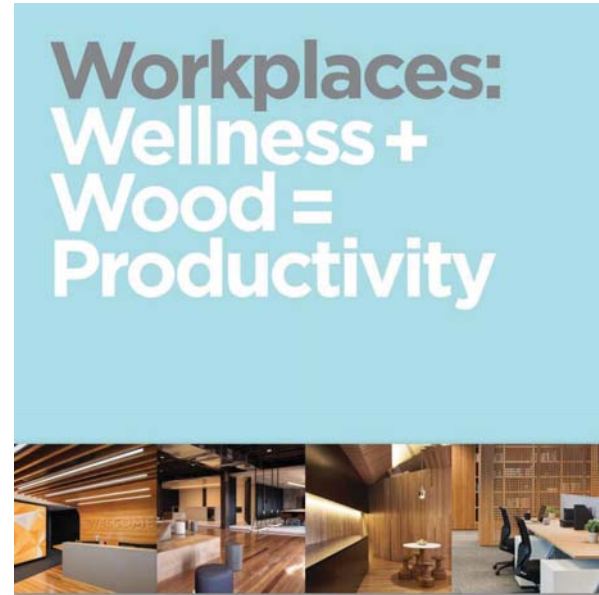
“Those in workplaces with a higher proportion of **visible wood** **feel more connected to nature** and rate their working environment far more positively.”

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



A report prepared for  
Forest & Wood Products Australia\*  
by Andrew Knox,  
Howard Parry-Husbands,  
Pollinate\*\*  
February 2018

Pollinate



# 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

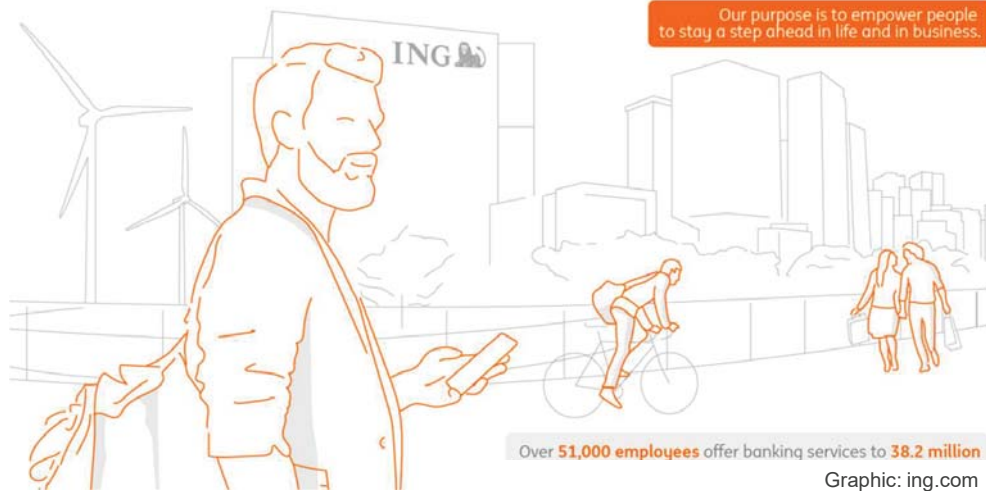
## Case Study

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

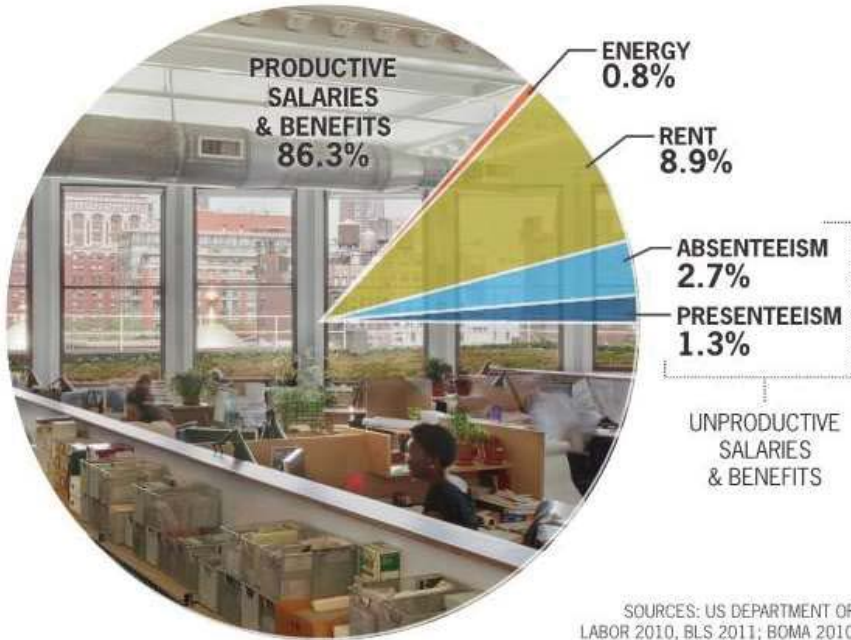


\* Source: *Economics of Biophilia*,  
Terrapin Bright Green, 2012



# Reduce Absenteeism

## Save \$



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

10% of employee  
absences attributed  
to architecture with  
no connection to  
**nature\***

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

# 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)



Clay Creative  
Mackenzie | Photo: Christian Columbus



T3 Minneapolis  
Michael Green Architecture | Photo: Ema Peter

# Heavy Timber Revolution: California's Hip New Commercial Block

## ICE Block I



Photo: Bernard Andre

Location: Sacramento, CA  
Architect: RMW Architecture & Interiors  
Engineer: Buehler Engineering

### IIIB

- 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

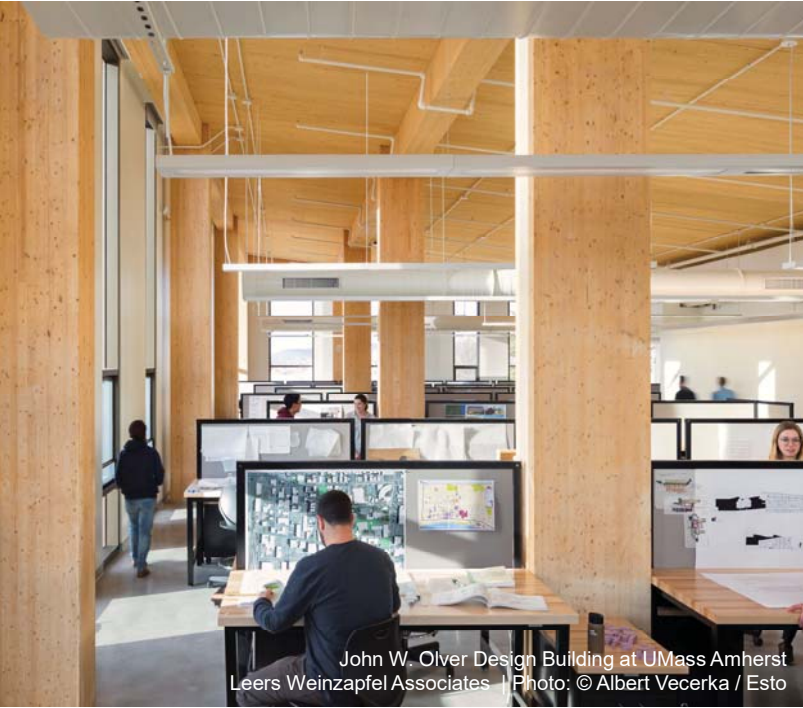


# Biophilic Design Schools



# 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



Photo: Timothy Hursley

### 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

Location: Fayetteville, AR

Architect: Leers Weinzapfel Associates; Mackey Mitchell Architects; Modus Studio (AOR)

Structural Engineer: Equilibrium Consulting; Engineering Consultants, Inc.



# Healthier Learning Environment for the 2<sup>nd</sup> Generation

## Cottonwood Valley Charter School E-Pod



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



**VB**

- 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



Location: New Haven, CT  
Architect: Gray Organschi Architecture  
Environmental Engineer: Atelier Ten

VB

- 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

# The Building as an Environmental Exemplar

## Tashjian Bee and Pollinator Discovery Center



Location: Chanhassen, MN  
Architect: MSR Design  
Structural Engineer: Meyer Borgman Johnson

VB

- 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

# 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



Photo: Mark Herboth

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



VB

- 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



Photo: Andrew Pogue

- 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.



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

# 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.





# 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



RISD North Hall, Architect: NADAAA Architects, Photo: John Horner

# 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 (Values indicate magnitude of impact associated with steel design as multiple of wood design impact)							
Fossil Fuel Consumption	Weighted Resource Use	Global Warming Potential	Acidification Potential	Human Health Respiratory Effects Potential	Eutrophication Potential	Ozone Depletion Potential	Smog Potential
1.4x	1.02x	1.6x	1.4x	1.3x	3.0x	1.5x	1.2x
COMPARISON OF ENVIRONMENTAL IMPACTS OF CONCRETE VS. WOOD DESIGN (Values indicate magnitude of impact associated with concrete design as multiple of wood design impact)							
Fossil Fuel Consumption	Weighted Resource Use	Global Warming Potential	Acidification Potential	Human Health Respiratory Effects Potential	Eutrophication Potential	Ozone Depletion Potential	Smog Potential
1.9x	2.3x	3.0x	2.4x	2.1x	4.7x	5.8x	2.4x

Source: Athena EcoCalculator



Source: USGBC

# Green Building Rating Systems

Rating systems exist for single-family homes to entire neighborhoods

New and existing construction



One DeHaro, Pfau Long  
Architecture, Photo: Paul  
Chinn | The Chronicle



# 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



Oregon Conservation Center, Photo: Jeremy Bittermann;  
Lara Swimmer; Shawn Records; LEVER Architecture



# Green Building Rating Systems

## System choices

**BREEAM**<sup>®</sup>



 **fitwel**

 **earthcraft**  
A Program of Southface



**LIVING  
BUILDING  
CHALLENGE**<sup>™</sup>



...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 ft<sup>2</sup> of building space globally.
- The newest version (V4.1) was released in 2019

# 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.

# 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.



# 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.”

# 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*



ICE Block I, RMW Architecture & Interiors, Buehler Engineering, Bernard André Photography

# 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.



Photo: Frank Rosenstein, Courtesy of Plum Creek

# 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.



John W Olver Design Building, Architect: Leers  
Weinzapfel Associates, Photo: ©Albert Vecerka/Esto



# 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



Federal Center South, Building 1202. ZGF Architects,  
Photo: Benjamin Benschneider

# 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. Mahlum 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.





# 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*



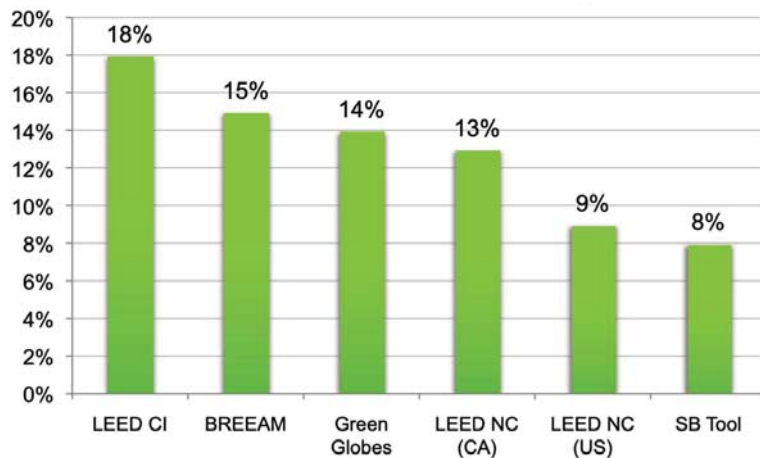
ICE Block I, RMW Architecture & Interiors, Buehler Engineering, Bernard André Photography

# 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.

Proportion of credits related to wood: commercial buildings



# Wood in Green Building Rating Systems

Rating System	Living Building Challenge
Building Types	New Construction and Major Renovations, large projects, high rises, multi unit residential
Market location	Cascadia region, US and Canada
Issues pertaining to wood	
Certified wood	<p>All wood must be certified FSC or be salvaged or be reused onsite timber.</p> <ul style="list-style-type: none"> <li>• Prerequisite 7 – Responsible Industry</li> </ul>
Recycled /reclaimed content	<p>All wood must be certified FSC or be salvaged or be reused onsite timber.</p> <ul style="list-style-type: none"> <li>• Prerequisite 7 – Responsible Industry</li> </ul>
Local sourcing of materials	<p>Assemblies and materials must be sourced within specified distances, between 250-3,000 miles.</p> <ul style="list-style-type: none"> <li>• Prerequisite 8 – Appropriate Materials/Services Radius</li> </ul>
Building techniques	n/a
Site protocols & waste	<p>Construction Waste must be diverted from landfills to the following levels: Metals (90%), all wood products (80%), concrete (80%)</p> <ul style="list-style-type: none"> <li>• Prerequisite 9 - Leadership in Construction Waste</li> </ul>
Lifecycle impacts	n/a
Carbon & global warming	<p>The project must account for the embodied carbon footprint of its construction through a one-time carbon offset tied to the building's square footage and general construction type.</p> <ul style="list-style-type: none"> <li>• Prerequisite 6 – Construction Carbon Footprint</li> </ul>
Indoor air quality	<p>All interior materials, finishes, paints and adhesives must comply with All interior finishes, paints and adhesives must comply with SCAQMD 2007/2008 standards.</p> <ul style="list-style-type: none"> <li>• Prerequisite T13 – Healthy Air: Source Control</li> </ul>
Competitive Materials	n/a

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

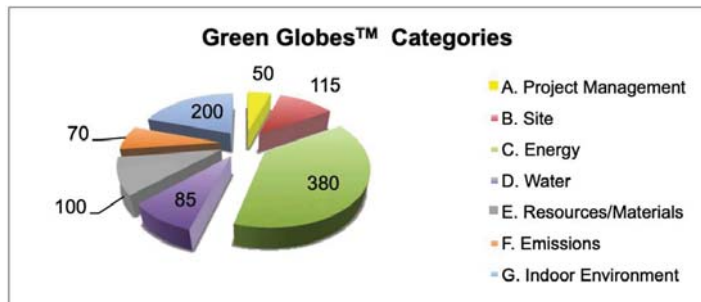
# Wood in Green Building Rating Systems

	LEED NC (US and Canada)	LEED CI
Building Types	New Construction and Major Renovations, large projects, high rises, multi unit residential	Commercial Interiors and Tenant Improvements, large projects, high rises, multi unit residential
Market location	US and Canada	US and Canada
Issues pertaining to wood		
Certified wood	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 minimum 5% by value of total wood-based materials being made from a rapidly renewable plant (with a ten-year or shorter harvesting cycle). <ul style="list-style-type: none"> <li>Canada: MR 6 – Rapidly renewable materials (1 credit)</li> <li>MR 7 – Certified Wood (1 credit)</li> </ul>	
Recycled /reclaimed content	LEED-NC and LEED-CI both award credits for reuse of materials (5-10% by value of all building materials, not limited to wood). LEED-NC Canada awards up to 2 credits for use of recycled content materials (Canada: 7.5-15%, US: 10-20% by value post consumer content, not limited to wood. Post industrial counts as one half the value of post consumer). LEED-CI awards a credit for use of a minimum of 30% salvaged furniture and furnishings, as well as up to 2 credits for use of recycled content materials and products (10-20% by value post consumer content, not limited to wood. Pre consumer counts as one half the value of post consumer). <ul style="list-style-type: none"> <li>MR 3.1 – Resource Reuse 5% (1 credit)</li> <li>MR 3.2 – Resource Reuse 10% (1 credit)</li> <li>Canada: MR 4.1 – Recycled Content 7.5% (1 credit)</li> <li>Canada: MR 4.2 – Recycled Content 15% (1 credit)</li> <li>US: MR 4 – Recycled Content 10-20% (1-2 credits)</li> </ul>	
Local sourcing of materials	LEED-NC (Canada) and LEED-CI both award up to 2 credits for use of regionally manufactured or extracted materials (10-20% by value of all building products and materials extracted or produced within 800km, OR within 2,400km and shipped via train/water, OR combination. Not limited to wood products). LEED-NC US offers up to 4 credits for 'Regional Priority' credits that are determined on a regional basis. <ul style="list-style-type: none"> <li>Canada: MR 5.1 - Regional Materials - 10% Extracted &amp; Manufactured Regionally (1 credit)</li> <li>Canada: MR 5.2 - Regional Materials - 20% Extracted &amp; Manufactured Regionally (1 credit)</li> <li>US: RP 1 – Regional Priority (1-4 credits)</li> </ul>	
Building techniques	n/a	
Site protocols & waste	n/a	
Lifecycle impacts	n/a	
Carbon & global warming	n/a	
Indoor air quality	LEED-NC (Canada) and LEED-CI both award a credit for reducing indoor air contaminants, by requiring that composite wood or agrifibre 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 emissions standards. LEED-NC (US) offers credits for reducing indoor air contaminants by requiring that composite wood or agri-fibre product have no added urea-formaldehyde resins, and that all flooring systems meet emissions standards.	

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

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

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 national leadership and excellence in the practice of water, energy and environmental efficiency to reduce environmental impacts.

### 70-84% THREE GREEN GLOBES



Demonstrates leadership in applying the best practices regarding energy, water, and environmental efficiency.

### 55-69% TWO GREEN GLOBES



Demonstrates excellent progress in achieving reduction of 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

## Green Certification Types

Choose your project type to learn more about how Green Globes works

NEW CONSTRUCTION (NC) ➤

MULTIFAMILY (NC) ➤

CORE & SHELL (NC) ➤

EXISTING BUILDINGS (EB) ➤

MULTIFAMILY (EB) ➤

MULTIFAMILY PERFORMANCE PLUS ➤

SUSTAINABLE INTERIORS(SI) ➤

# 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**



The Athena Impact Estimator for Buildings is an LCA-based software package that helps designers easily incorporate environmental information while in the early stages of a project.

# 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)



# 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





# Wood in LEED



Building Design  
and Construction

Interior Design  
and Construction

Building Operations  
and Maintenance

Neighborhood  
Development

Homes



**CERTIFIED**  
40-49 points



**SILVER**  
50-59 points



**GOLD**  
60-79 points



**PLATINUM**  
80+ points

# Wood in LEED



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

Credit Category	Max Points
Integrative Process	1
Location and Transportation	16
Sustainable Sites	10
Water Efficiency	11
Energy and Atmosphere	33
Materials and Resources	13
Indoor Environmental Quality	16
Innovation	6
Regional Priority	4
Total	110

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."



# 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.

# 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





# Wood in LEED

## V4 & v4.1



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

0	0	0	<b>Materials and Resources</b>		<b>13</b>
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
			Credit	Building Life-Cycle Impact Reduction	5
			Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
			Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
			Credit	Building Product Disclosure and Optimization - Material Ingredients	2
			Credit	Construction and Demolition Waste Management	2

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

# 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

# Wood in LEED

## V4 & v4.1



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

O	O	O	Indoor Environmental Quality	16
Y			Prereq Minimum Indoor Air Quality Performance	Required
Y			Prereq Environmental Tobacco Smoke Control	Required
			Credit Enhanced Indoor Air Quality Strategies	2
			Credit Low-Emitting Materials	3
			Credit Construction Indoor Air Quality Management Plan	1
			Credit Indoor Air Quality Assessment	2
			Credit Thermal Comfort	1
			Credit Interior Lighting	2
			Credit Daylight	3
			Credit Quality Views	1
			Credit Acoustic Performance	1

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

# 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

LIVING BUILDING CHALLENGE PETALS



# 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.

## MATERIALS PETAL

### PETAL INTENT

#### 10. RED LIST

#### 11. EMBODIED CARBON FOOTPRINT

#### 12. RESPONSIBLE INDUSTRY

#### 13. LIVING ECONOMY SOURCING

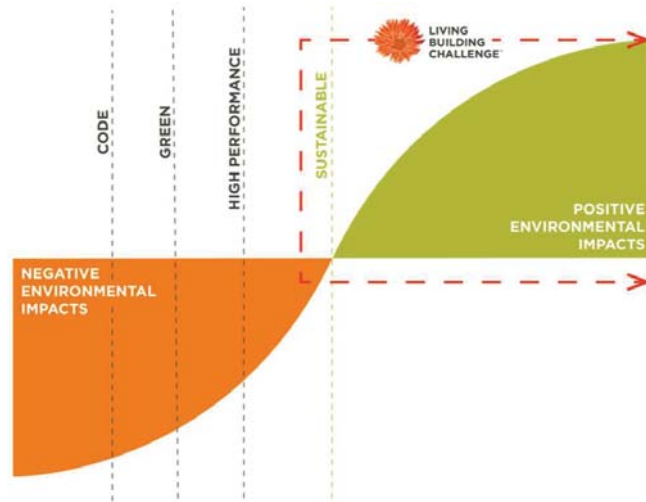
#### 14. NET POSITIVE WASTE

## 10. RED LIST IMPERATIVE

There are temporary exceptions for numerous Red List items due to current limitations in the mat Materials Petal Handbook for complete and up-to-date listings. The project cannot contain any of

### RED LIST MATERIALS OR CHEMICALS

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





# Wood in Living Building Challenge



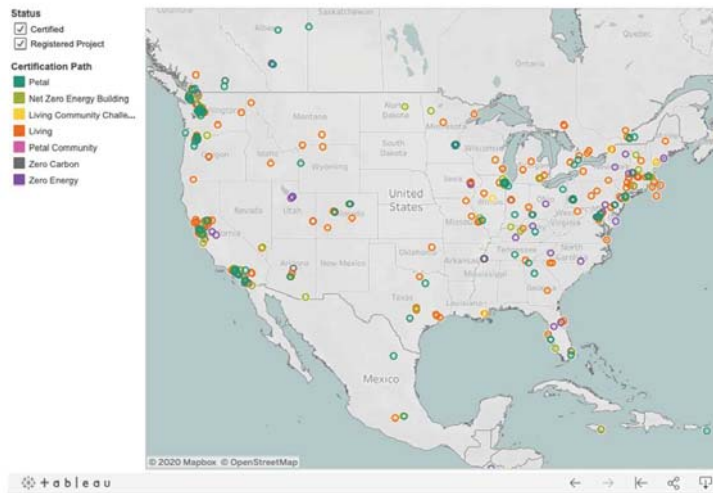
Projects can be 'Petal Certified' but can also extend to:

- 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

## REGISTERED & CERTIFIED PROJECT MAP



# 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
- 1<sup>st</sup> LBC Certified Office Building
- 80% Energy reductions
- PV array provides energy for building



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



**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 CO<sub>2</sub>



**Avoided greenhouse gas emissions:**  
1,158 metric tons of CO<sub>2</sub>



**TOTAL POTENTIAL CARBON BENEFIT:**  
1,703 metric tons of CO<sub>2</sub>

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#### EQUIVALENT TO:

Source: US EPA



**325 cars off the road for a year**



**Energy to operate a home for 145 years**

*Estimated by the Wood Carbon Calculator for Buildings, based on research by Sarthre, R. and J. O'Connor, 2010, A Synthesis of Research on Wood Products and Greenhouse Gas Impacts, FPinnovations. Note: CO<sub>2</sub> on this chart refers to CO<sub>2</sub> equivalent.*



# 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



Architect: Bruner/Cott & Associates  
Photos: Robert Benson Photography



# 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



Architect: ZGF Architects  
Photos: Rocky Mountain Institute, Tim Griffith, ZGF Architects



# 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

		Acceptability for Green Building Credits/ Certificates			
WBLCA Tool	Analysis	LEED v4 credits	LEED v4.1 credits	ILFI Zero Carbon Certificate	Green Globes
Athena Impact Estimator for Buildings	Detailed robust WBLCA	Yes	Yes	Yes	Yes
Tally	Detailed robust WBLCA	Yes	Yes	Yes	Yes
One-Click LCA	WBLCA w/ regionalized generic data & global EPD library	Yes	Yes	Yes	Yes

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

## Simplified Early LCA Analysis

		Acceptability for Green Building Credits/ Certificates			
LCA Tool	Analysis	LEED v4 credits	LEED v4.1 credits	ILFI Zero Carbon Certificate	Green Globes
Athena EcoCalculator for Commercial Assemblies	Early estimate simplified LCA (note: no longer updated, some data out of date)	Yes	Yes	No	Yes
Carbon Designer (One-click LCA add-on tool)	Early estimate simplified LCA w/ regionalized generic data	Yes	Yes	No	Yes

# Questions? Ask me anything.



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

