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The Sponsors of Energize Connecticut, and in partnership with Connecticut Passive House, are pleased to offer *Passive House & All-Electric Homes Initiative* to support workforce development and help transform the energy efficiency and building construction industries in Connecticut.

CTPH

CONNECTICUT PASSIVE HOUSE

For more information, please visit EnergizeCT.com/passive-house
or email PassiveHouseTrainingCT@icf.com

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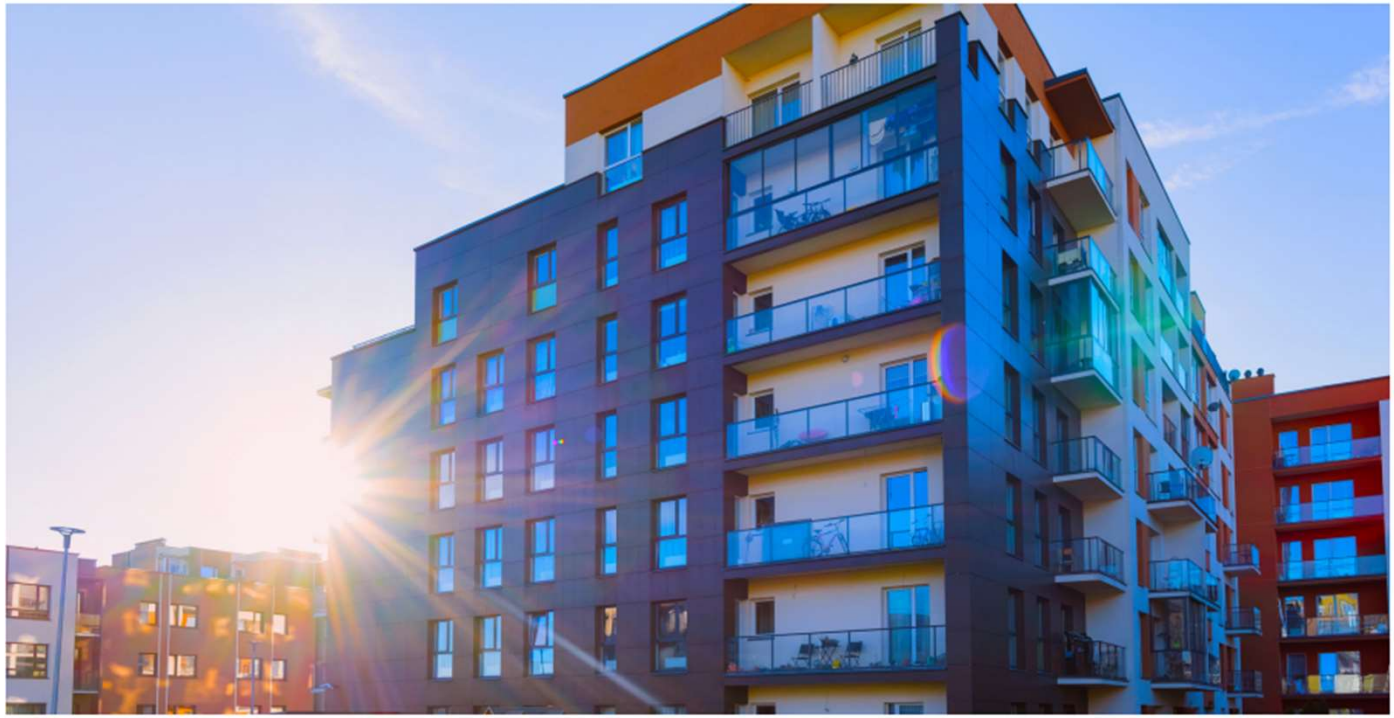
Take energy efficiency to a new level

Residential New Construction Passive House Multi-family buildings with five units or more



PASSIVE HOUSE INCENTIVE STRUCTURE FOR MULTI-FAMILY (5 UNITS OR MORE)				
Incentive Timing	**Activity**	**Incentive Amount**	**Max Incentive (Per Unit)**	**Max Incentive (Per Project)**
Pre-Construction	Feasibility Study[1]	Up to 100% of Feasibility Study Costs	N/A	$5,000.00
	Energy Modeling[2]	75% of Energy Modeling Costs (Before 90% Design Drawings)	$500.00	$30,000.00
		50% of Energy Modeling Costs (90% Design/50% Construction)	$250.00	$15,000.00
Post Construction	Certification[3]	Up to 100% of Certification Costs	$1,500.00	$60,000.00

1. Feasibility Study will require documentation in the form of a Feasibility Study report and invoice from the Passive House Consultant
2. Incentives will only be awarded prior to 50% Construction Drawings for Passive House projects. No incentives will be granted after 50% Construction Drawing set.
3. Certification may be either through PHIUS, PHI, or EnerPHit certification offerings.

Next steps you can take...
Contact your Energy Efficiency Representative or

Go to EnergizeCT.com or call 1-877-WISE USE for more details.

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The future of high-performance, all-electric homes starts here.

	LEVEL 1		LEVEL 2	
	Single Family (Detached Dwellings)	Multifamily (Attached Dwellings)	Single Family (Detached Dwellings)	Multifamily (Attached Dwellings)
Total UA Alternative Compliance or HERS Index Score †	Total UA ≥ 7.5% better than 2021 IECC or HERS Index Score ≤ 55		Total UA ≥ 15% better than 2021 IECC or HERS Index Score ≤ 45	
Heat pump for space heating ††	Required		Required	
Space Conditioning Connectivity & Controls †††	Optional		Required	
Heat pump for water heating	Required	Optional	Required ††††	
Hot Water Distribution †††††	Required		Required	
Envelope Infiltration Rate (ACH)	ACH50 ≤ 2.5	CFA > 850ft2: ACH50 ≤ 4.0 CFA < 850ft2: ACH50 ≤ 5.0	ACH50 ≤ 2.0	CFA > 850ft2: ACH50 ≤ 3.0 CFA < 850FT2: ACH50 ≤ 4.0
Duct Leakage Rate (CFM)	2021 IECC code minimum requirements		All ductwork must be located in conditioned space	
Balanced Ventilation Systems	Optional		Required HRV/ERV (≥70% SRE / ≥40% TRE)	
Induction Cooking	Optional		Required †††††	Optional
Electric Vehicle Readiness †††††††	Required		Required	

ALL-ELECTRIC HOME INCENTIVE STRUCTURE		
	Level 1	Level 2
Single Family	$7,500	$10,000
Single Family Attached	$3,000	$5,000
Multifamily	$1,500	$2,500

Next steps you can take...
Contact your Energy Efficiency Representative or

Go to EnergizeCT.com or call 1-877-WISE USE for more details.

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Thank You

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or email PassiveHouseTrainingCT@icf.com

CTPH

CONNECTICUT PASSIVE HOUSE

TIMBERHP

by GO LAB

INSULATE BETTER. LIVE BETTER.™

TIMBER + HP =

High Performance
Healthy Planet
Healthy People

High Performance

Building envelope, thermal, and acoustic solutions

A comprehensive, above-grade product line to create wind-tight, vapor-open assemblies offering stable, long-term R-values, improved temperature stability, and premium sound protection

Healthy Planet

Recyclable, renewable, non-toxic, and carbon negative

Made from residual wood chips to maximize the use of our renewable forest resource. As a high-value insulator with a negative carbon footprint, reduces a building's global warming potential on day one and everyday it operates

Healthy People

Moisture managing, safe, and sound absorbing

Installers benefit from the absence of dangerous fibers that harm skin and negatively impact air quality. Leads to the creation of safe, quiet indoor habitats, free of airborne toxins and trapped humidity

Introducing TimberHP

Wood Fiber Insulation made in America

Carbon Storing
The only insulation on the market to do this

High Performance
Manages air, moisture, conductivity, and

Highly Recyclable
sound

Nontoxic, Safe
When you cut it, you get sawdust

Class A/B Flame Spread
Leading to healthy indoor air quality

TIMBERHP

Thermal and Acoustic Solutions for Above-Grade Applications

Wood Fiber Insulation
Made in America
Coming 2023

TimberFill

Production Begins Q2
Certified Product Available Q3

TimberBatt

Production Begins Q3
Certified Product Available Q4

TimberBoard

Production Begins Q4
Certified Product Available Q1, 2024

INSULATE BETTER. LIVE BETTER.™

Solving Performance Demands Using Wood Fiber Insulation

Scott Johnston, CSI & CDT
TimberHP Senior Northeast
Business Development Manager
Scott.Johnston@timberhp.com

Paige Molly
TimberHP Territory Sales Manger
Paige.Molly@timberhp.com

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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AIA Continuing Education Provider

Learning Objectives

Learning Objective 1: Working knowledge of insulation products available on the market today and the impact of new building codes on the building envelope. Convey why now more than ever selecting the right insulation has a greater impact on our environment than ever before.

Learning Objective 2: Understanding of wood fiber insulation which includes a knowledge of positive sustainability implications; fire, bugs, and water; and why wood fiber stands up to these field liabilities and performs to code.

Learning Objective 3: Ability to explain the importance of code compliance and how climate zone impacts assembly design. Ability to understand thermal bridging and how to address the condition, especially in cold climate regions.

Learning Objective 4: Knowledge of Life Cycle Analysis modeling and how it is used to help better understand building materials impact on the environment. A strong understanding of Embodied Carbon Emissions and how product selection moving forward can help reduce its impact on the environment.

Course Outline

PART 1

Current Insulation Market

PART 2

What is Wood Fiber Insulation

PART 3

Code Compliance

PART 4

Embodied Carbon and Wood Fiber Insulation

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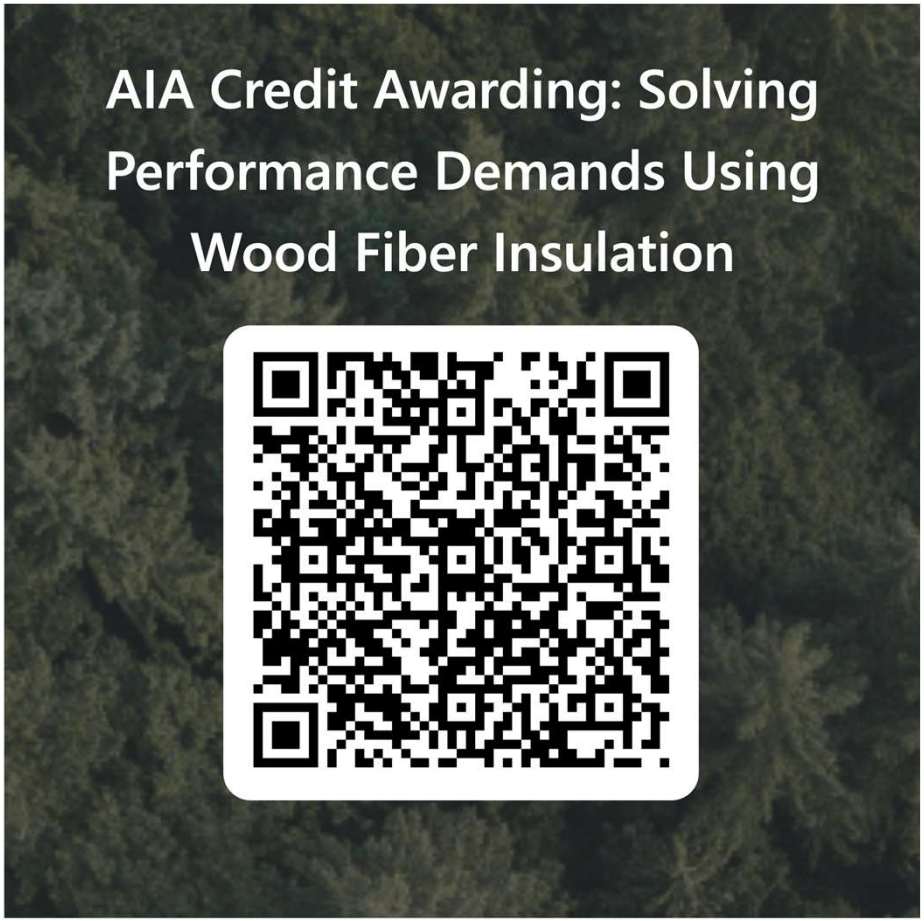
WEBINAR CREDIT INQUIRES:

alexandra.hodges@timberhp.com

OR

info@timberhp.com

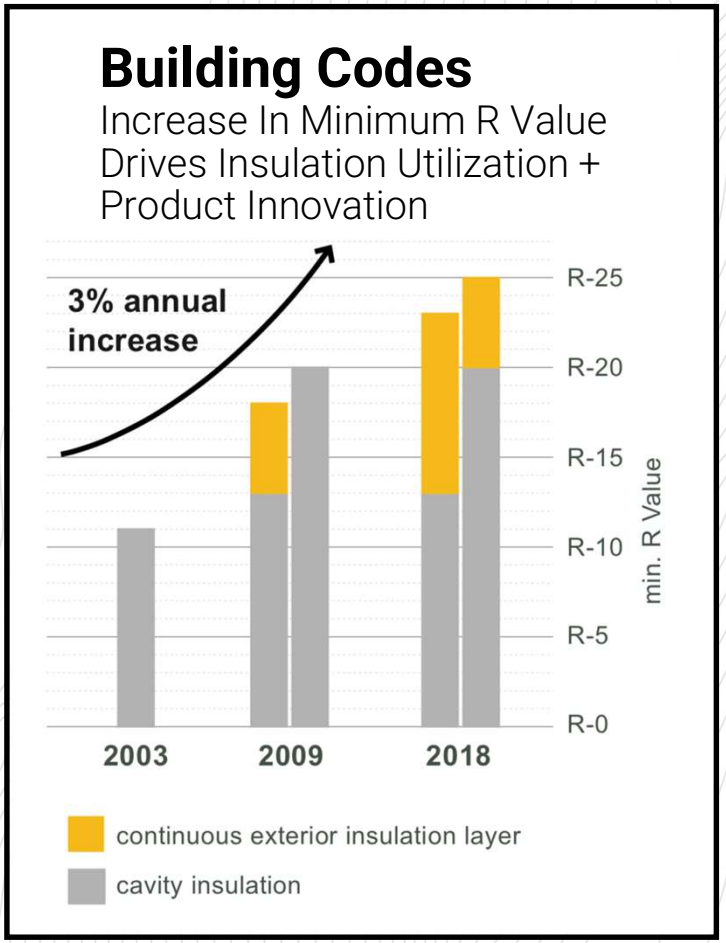


PART ONE

Current Insulation Market

Current Insulation Market

Increases to the minimum R-value (thermal value) within the mainstream US energy code—International Energy Conservation Code (IECC)—since 2006 have increased demand for insulation and driven new renovations.



Source: PR Newswire, MarketWatch, AIA 2030, Graphic from IECC

Reducing Thermal Bridging With Continuous Insulation – Today's Solutions

Framing accounts for 20 – 25 % of exterior wall

While modern regulations are driving demand, insulation solutions in the US are outdated

In the US, Fiberglass & Foam dominate the market with over 90% of market share

Source: AIA 2030, IAL Consultants, Gupta-Verlag

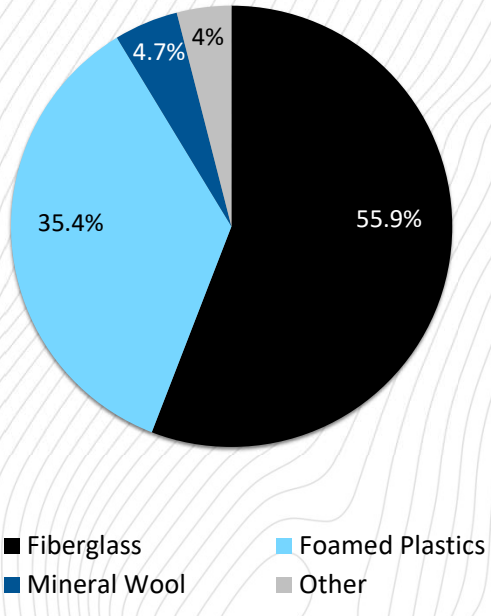
MINERAL WOOL

4.7%

FOAMED PLASTICS
35.4%

FIBERGLASS
55.9%

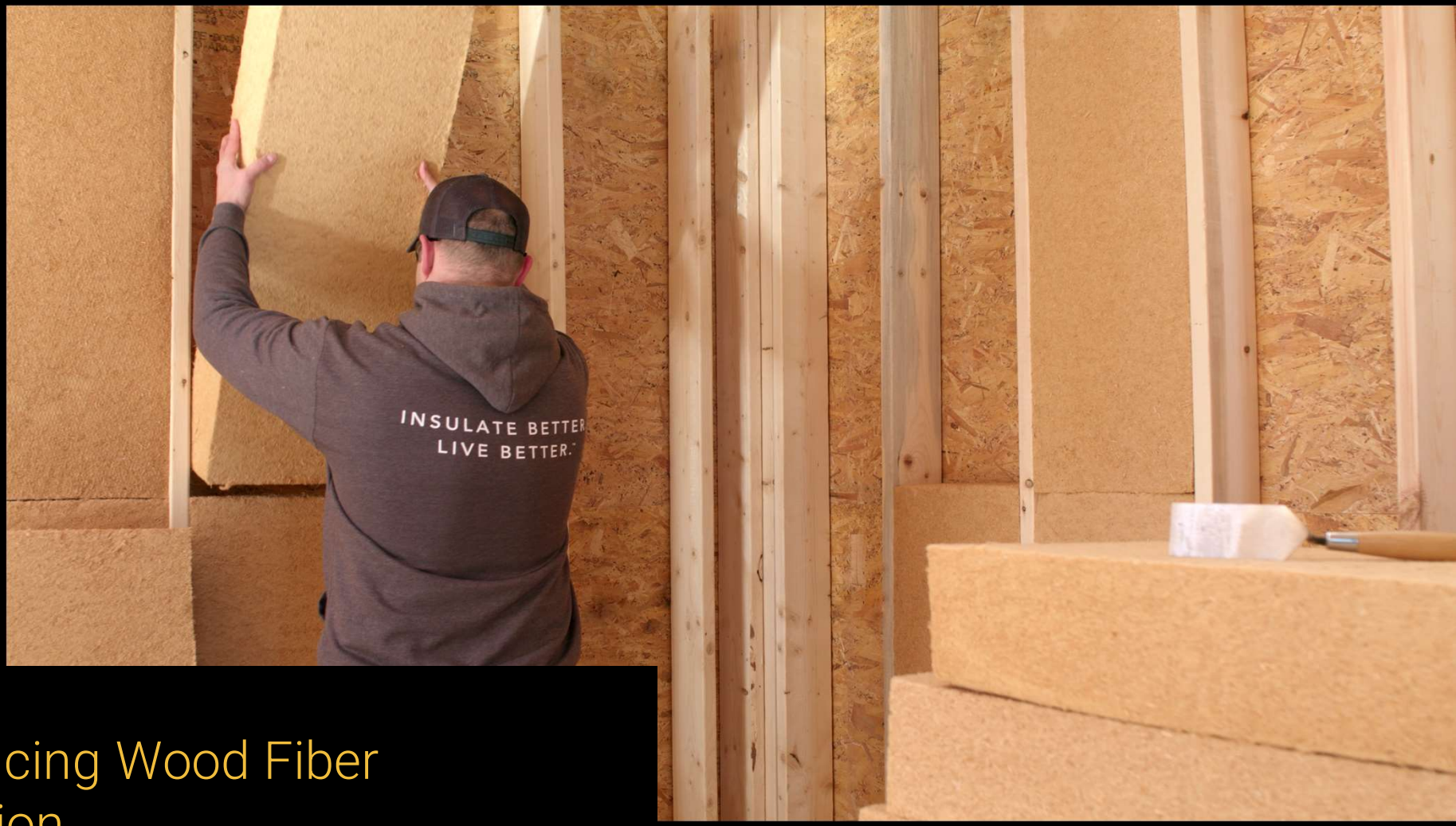
US INSULATION MARKET SHARE



Current insulation options are costly, unsafe, or unsustainable:

FIBERGLASS	FOAMED PLASTICS	MINERAL WOOL	CELLULOSE	COTTON
1938	1950s	1953	1950s	1970s
Glass	Oil-derived chemicals	Rock	Shredded paper products	Recycled denim
Though most are now formaldehyde-free they can still **off gas** due to binders. Commodity fiberglass allows for cavity **wind washing** and doesn't rebound at install.	If applied improperly can **cause fires** or hold in damaging **leaks and humidity**. Requires protective gear for **toxic** off-gassing. Cannot be removed without **damage**.	Is flame-retardant but an **extreme irritant** when handled with bare skin. Can be **hazardous**, difficult to cut, and is not easily disposable. High **embodied carbon** and still uses **formaldehyde**.	Is falling victim to **shrinking feedstock**, resulting in more plastics. Powdered flame retardant can make install dusty and lead to long-term **performance issues**.	Has very little feedstock and is quite **costly** to produce. Requires application of **powdered flame retardant**.

Source: MarketWatch, AIA 2030, Focus Groups with all three audience groups conducted in Boston, MA & Seattle, WA by Schireson Associates & Blackbird Global (March 2019).



PART TWO

Introducing Wood Fiber Insulation

Introducing Wood Fiber Insulation

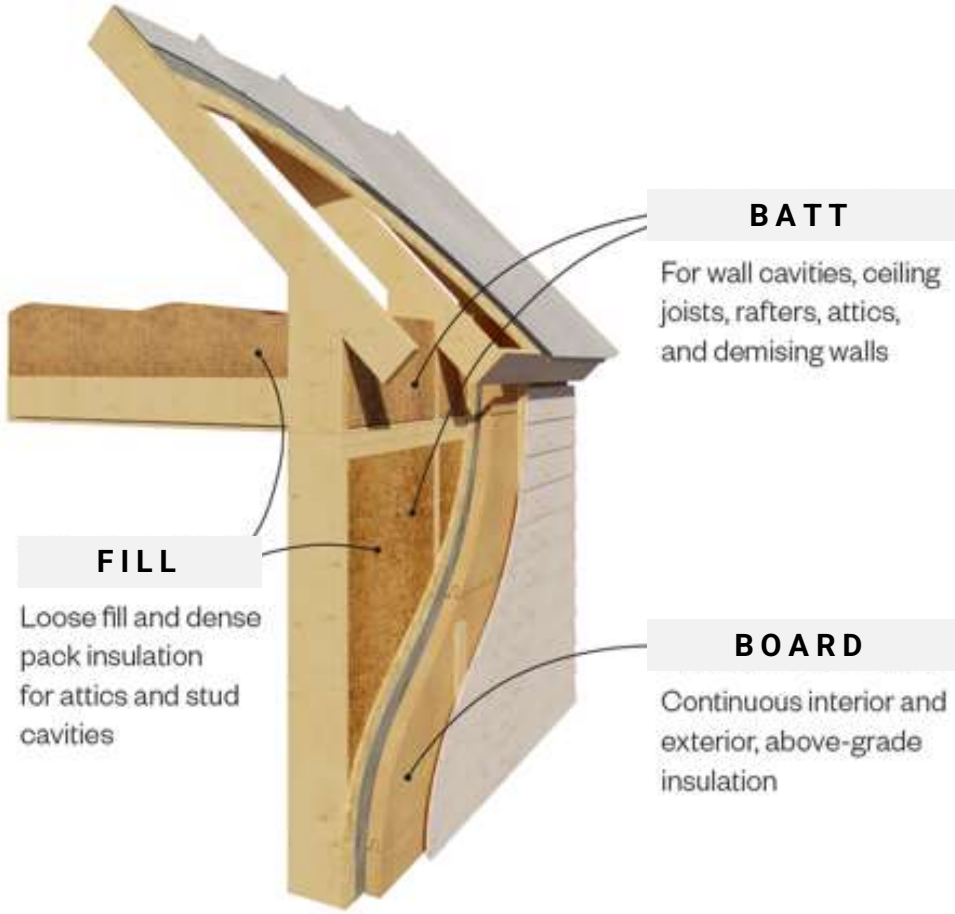
Carbon Storing
The only scalable carbon-negative insulation on the market

High Performance
Manages air, moisture, conductivity, and sound

Highly Recyclable
When you cut it, you get sawdust

Nontoxic, Safe
Leading to healthy indoor air quality

Class A/B Flame Spread
Offers a high degree of fire protection



European wood fiber insulation market shows product potential in North America

- 15 manufacturing facilities in Europe with 5 more under construction
- Estimated $800 m (~5% of total insulation market) for all three products (board, batt and loose fill)
- Freedonia forecast the European market will reach $1 b in demand by the end of 2023
- Product is sold at a 20% premium in a market that is only 25% wood frame construction

EUROPEAN SUPPLIERS OF WOOD FIBER INSULATION:

STEICO natürlich besser dämmen

GUTEX® DÄMMPLATTEN AUS SCHWARZWALDHOLZ

pavatex by SOPREMA

best wood SCHNEIDER®

UNGER DIFFUTHERM® Umweltfreundliche innovative Dämmsysteme

INTHERMO Meine natürliche Dämmung!

AGEPAN® SYSTEM

Freight costs combined with high production costs limit the sale of European wood fiber insulation in North America to select projects only where price is not a factor.

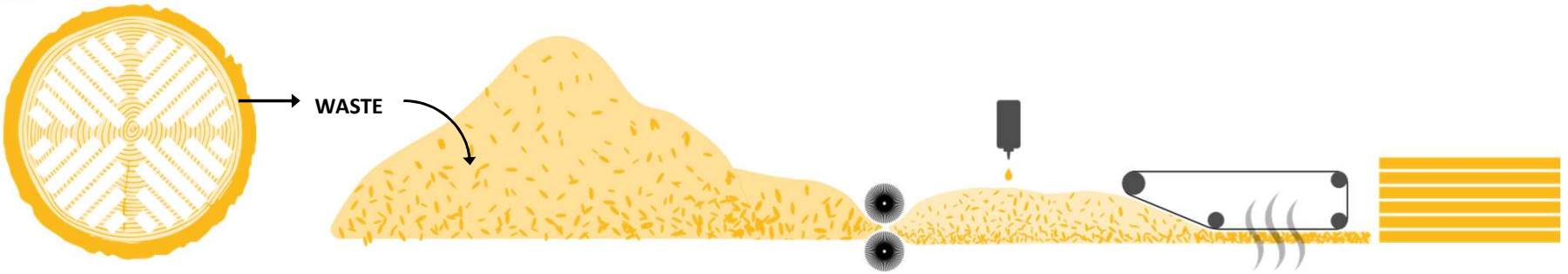
EUROPEAN SUPPLIERS OF WOOD FIBER INSULATION

Freight and high production costs limit the sale of European wood fiber insulation in North America

Utilizing an Abundant Waste Resource

Made from clean, species-agnostic, softwood residuals; insulating wood fiber composites are a perfect fit for the US wood products manufacturing sector.

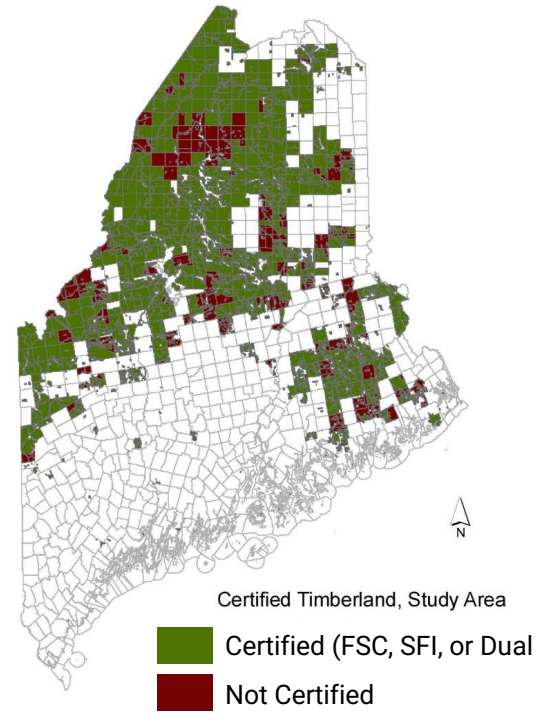
PROCESS:



Maine Makes the Difference

Since 2014, Maine alone has lost markets for over 4 million tons of low-grade wood that would have otherwise supplied paper and biomass mills

Wood fiber insulation production is able to provide a new market for those chips, supporting foresters and loggers throughout Maine and beyond



Reviving Our Forest Economy

With the decline in paper production, the robust wood baskets of the US and Canada need new manufacturers who create high-demand products from sawmill residuals and low-value fiber.

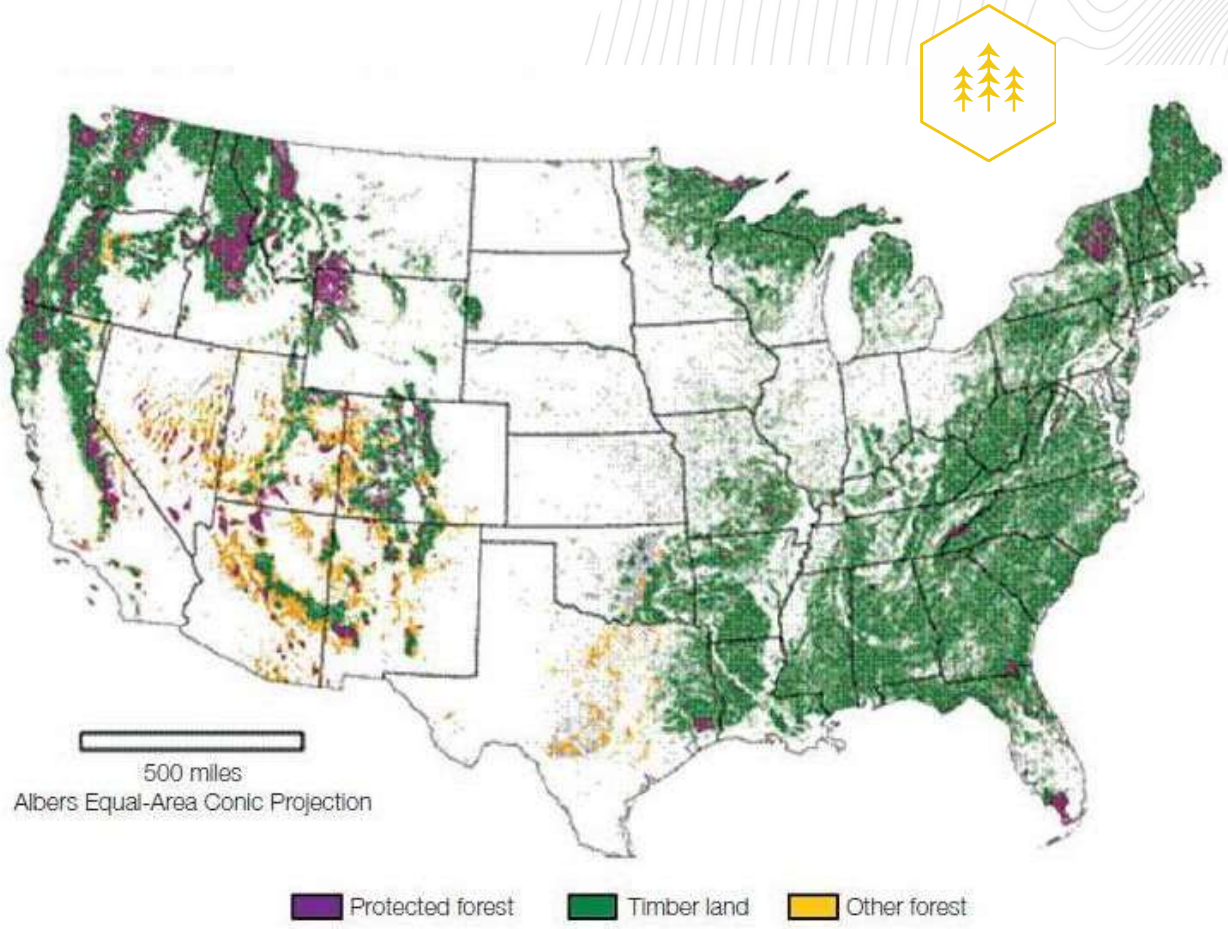
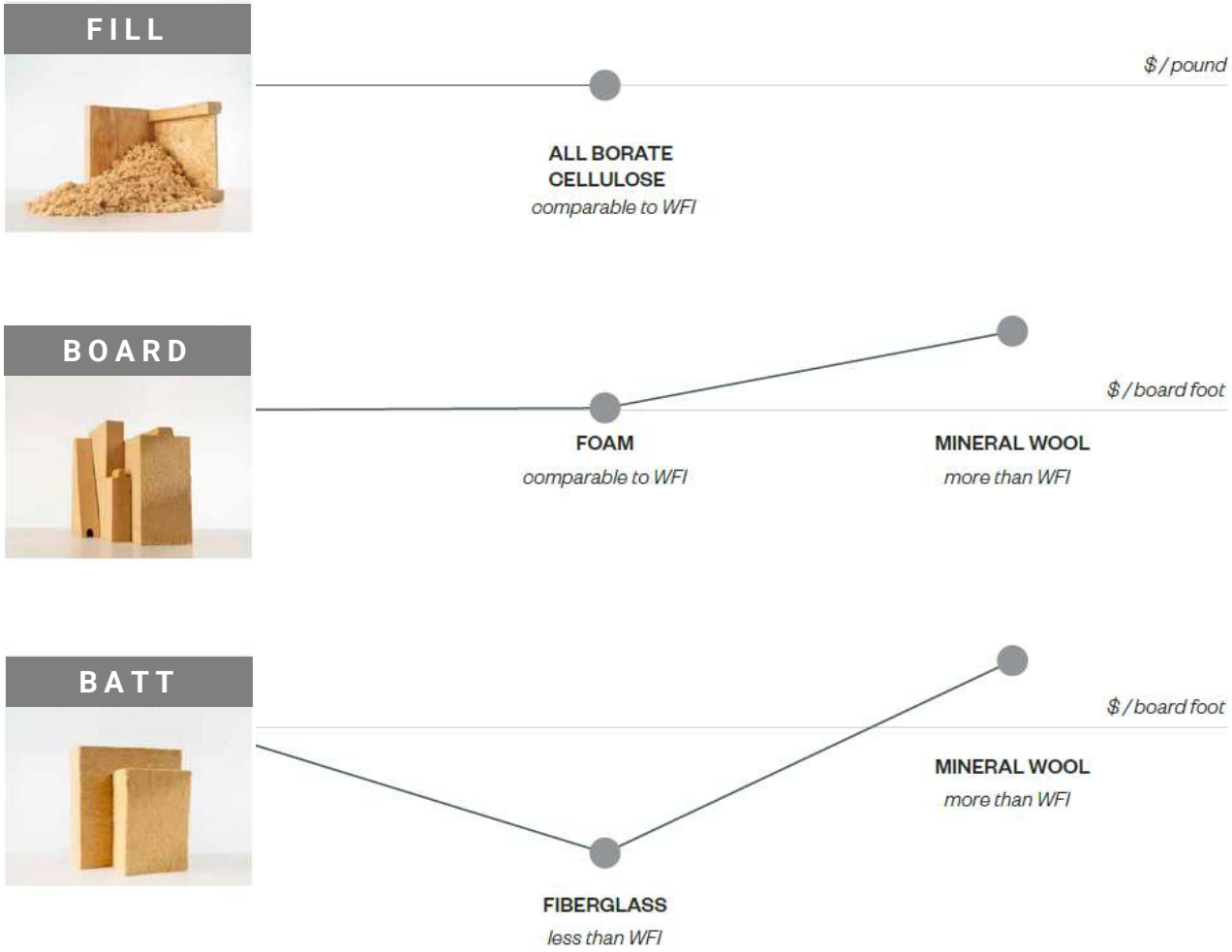


Image source: US Forest Service: www.fs.usda.gov

Domestically Produced Wood Fiber Insulation: Price Comparison*



*Within Madison Target Market

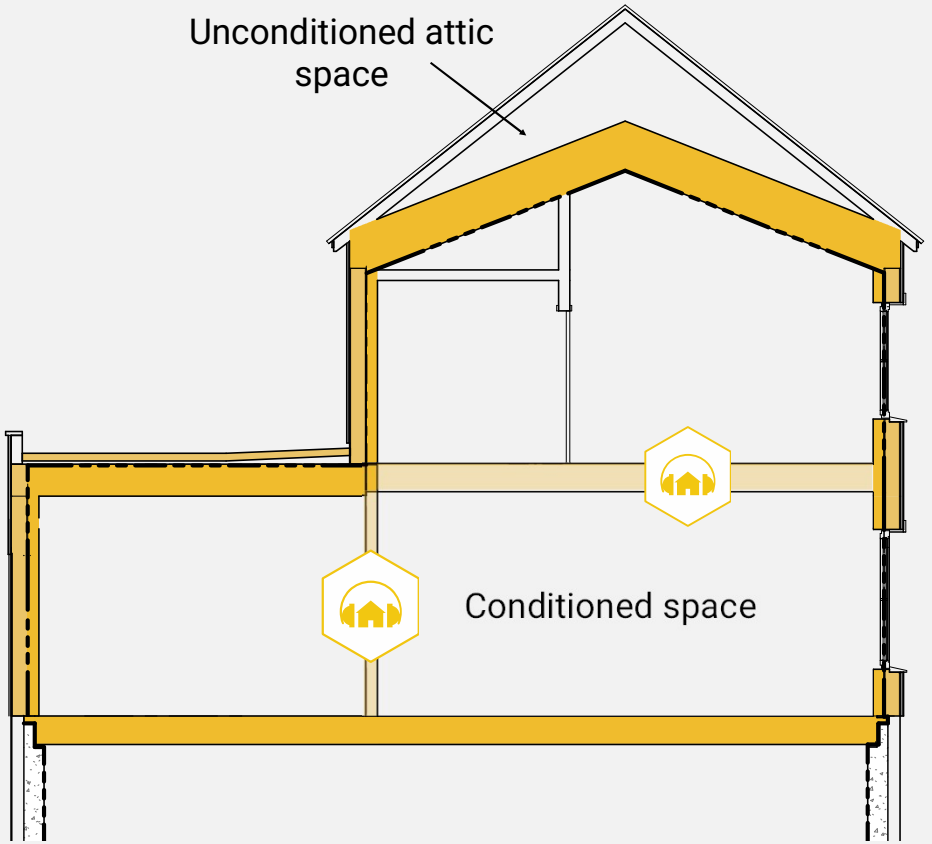
Market Position

Drop-In Replacement

- Affordable, low-risk replacement for foam, mineral wool, cellulose, fiberglass, and other traditional insulating products for above-grade assemblies
- Meet thermal and acoustic demands with the same product offering

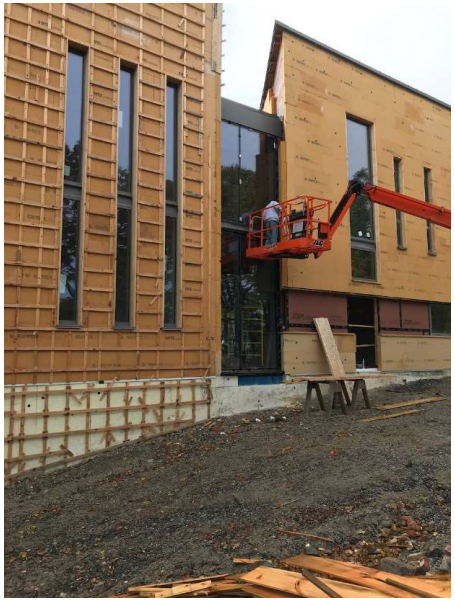
Comprehensive Above-Grade System

- Full-line of insulating products made from one material to address cavity, continuous, and attic blanket applications
- Prescriptive building envelope approach to create wind-tight, vapor-open assemblies

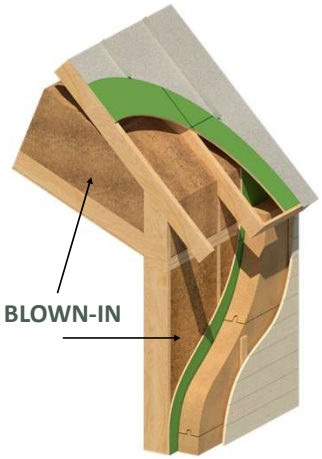


Market Fit

- Code-compliant building envelope, thermal, and acoustic assemblies for residential new construction and remodeling
  - Single-family and multi-family
- Commercial and institutional
  - Buildings 4 stories or less
  - Mass timber and cross laminated timber
- Factory-built solutions
  - Residential and commercial prefab
  - Panel, full-scale, modular designs
- Passive House, net zero, carbon negative, bio-based



Loose Fill and Dense Pack Insulation



R-3.8 / inch

APPLICATIONS

- Dense pack cavity insulation in stud walls and between rafters and joists
- Loose fill blanket insulation for attics

COMPOSITION

- Softwood fiber fire treated with boric acid

PRODUCT MERITS

- R-3.8/inch
- Achieve desired R-value with less volume compared to other blown-in options
- Shape and size of fibers prevent issues with settling, reducing voids and air pockets
- Boric acid full fiber penetration—Class A Flame Spread, mold/mildew and pest inhibitor
- Pure, consistent feedstock. Low dust, no toxins, free of printing ink, no foreign contaminants

Borate is more than a fire retardant; it inhibits mold and mildew growth and prevents pests.

Batt Insulation

R - 4 / inch

APPLICATIONS

- Thermal cavity insulation
- Acoustic insulation for interior spaces and demising walls

COMPOSITION

- Softwood fiber, polyamide binding fiber, boric acid

SIZING

- Wood and non-structural steel framing
- 16” and 24” OC
- 3”; 3.5”; 5.5”; 6”; 7.25”

DISTINCTIVE PRODUCT MERITS

- R-4/inch, vapor open
- Flexible, semi-rigid. Most durable batt on the market
- No toxins and no harmful fibers
- Boric acid full fiber penetration—Class A Flame Spread, mold/mildew and pest inhibitor
- Low thermal conductivity and high heat capacity

FRICTION FIT BATT INSULATION


TIMBERHP

Continuous Board Insulation

R–3.4– 3.7 / inch

APPLICATIONS

- Exterior continuous insulation
- Interior insulation of walls, floors, and ceilings

COMPOSITION

- Softwood fiber, PMDI Adhesive, and Paraffin

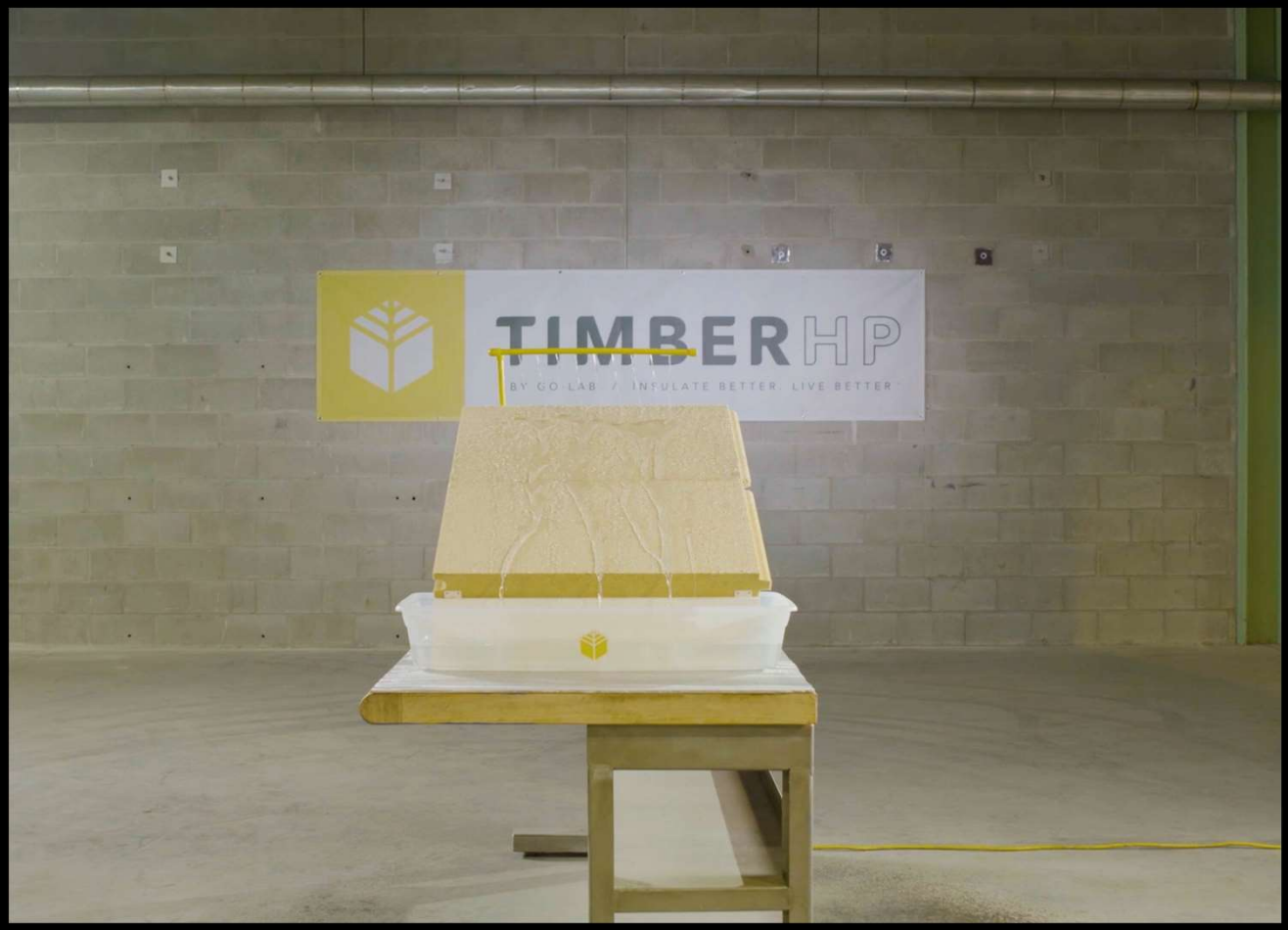
SIZING

- Thickness 1”-9.25” Width 2’ & 4’ Length 4’ & 8’

DISTINCTIVE PRODUCT MERITS

- **Stable R-3.4 to 3.7/inch**
- Hydrophobic and vapor open for superior performance
- High compressive strength (10 – 20 psi)
- Class B Flame Spread with no fire retardants
- Buffers changes in humidity and temperature

College of the Atlantic



Bulk moisture demonstration


TIMBERHP
BY GO LAB / INSULATE BETTER LIVE BETTER

High Performance

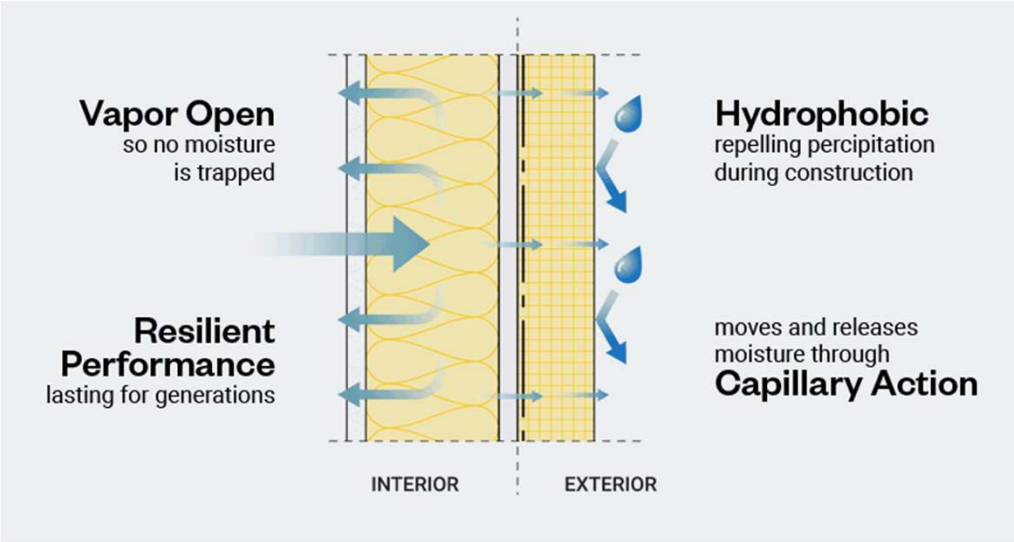
Wood Fiber Manages Moisture

Wood fiber insulation offers high vapor permeability (40 to 70 perms/inch) allowing for drying to both the inside and outside of buildings

Wood fiber can hold 15% of its weight in moisture without losing insulating properties

Through capillary action, moisture is spread out across the insulation and dries either to the inside our outside of the building depending on temperature, pressure, and humidity levels

- High structural resilience by reducing chance of rot
- More comfortable indoor humidity levels
- Healthier indoor air quality



High Performance

Insulation for all seasons

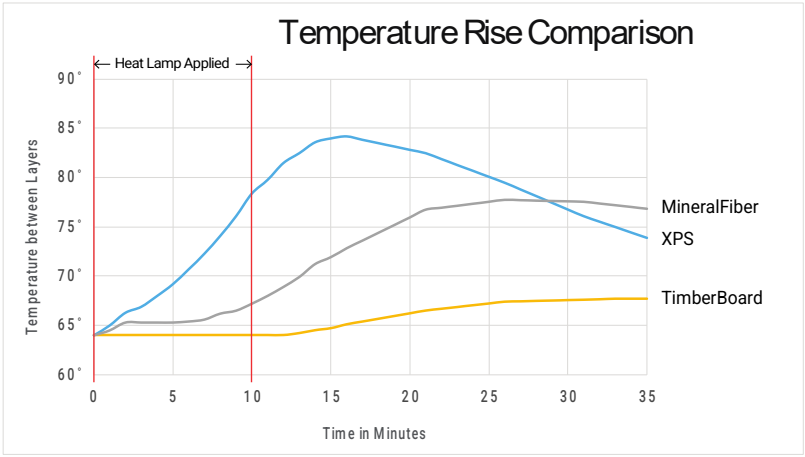
Low Thermal Conductivity & High Heat Capacity balance temperature swings in conditioned spaces, reducing heating and cooling loads.

Wood fiber absorbs heat slowly over time and radiates warmth out when cooler conditions exist

- Guards against summer heat
- Saves the heat we buy in the winter

Unmatched Heat Protection

Resulting from product density and the combined high heat capacity and low thermal conductivity of wood, wood fiber insulation delays heat transfer and increases temperature stability in our buildings.



Beyond R-VALUE

Healthy People

Opening the indoors

Vapor-open assemblies allow structures to breathe and indoor humidity to escape

No trapped moisture means less chance for mold and mildew, less chance for respiratory issues and allergies

Acoustics

Best-in-class acoustics and pure fiber are the building blocks for the new indoor habitat

Wood fiber batt steel frame wall Acoustic Performance

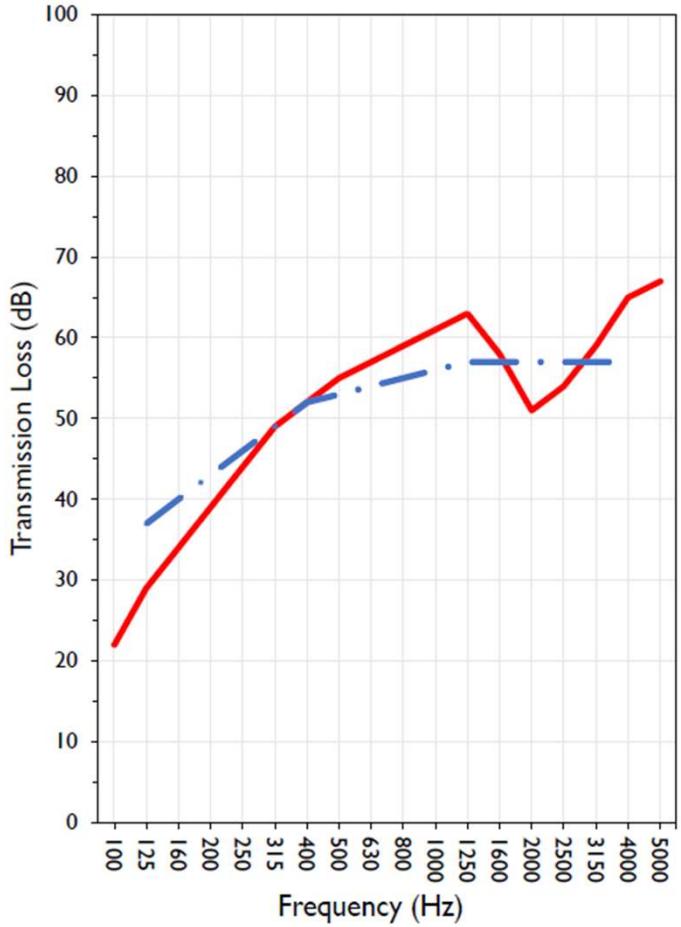
Wood fiber provides a compelling option.

Mineral Wool Batt

Acoustics					Assembly Number: ISS-08
STC:	45	OITC:	29	Report No.	NWTL140829-01

Assembly Components	
Finish material	5/8" gypsum
Size	3 5/8" Steel Stud
Spacing	16" oc
Thickness	3.5"
Resilient Channels	RC Deluxe, 16" OC

SOUND TRANSMISSION RESULTS



STC = 53

TOTAL DEFICIENCIES = 29

Wood fiber batt / wood frame wall Acoustic Performance

This same wall in a 2x4 profile achieved a sound transmission class (STC) of 50 vs. mineral wool at 47.

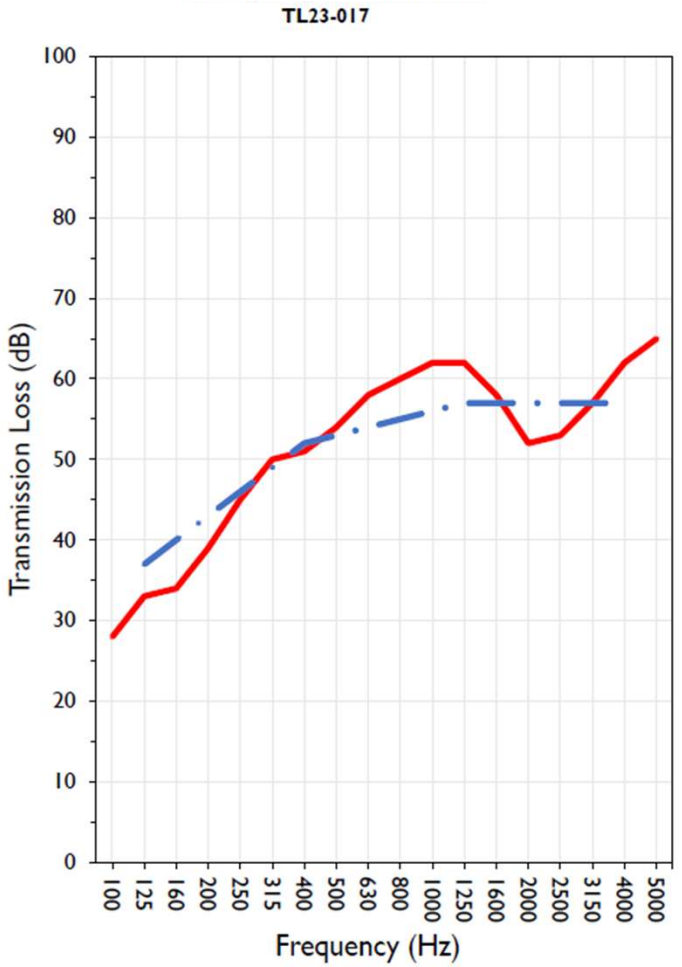
Both batt and fill @5.5” noise reduction coefficient (NRC) 1.15 (sound absorption)

Mineral Wool Batt

Acoustics					Assembly Number: IWS-20
STC:	53	OITC:	37	Report No.	TL21-357

Assembly Components	
Finish material	5/8” Type X gypsum
Size	2 x 6 Wood Stud
Spacing	16” oc
Thickness	5.5”
Wall Configuration	Single Stud
Resilient Channels	24” oc

SOUND TRANSMISSION RESULTS



STC = 53

TOTAL DEFICIENCIES = 25

Healthy People

Just Wood

Over 90% of every insulating product is softwood residuals

No toxins to breathe
No fibers to irritate skin

When you cut wood fiber insulation, you produce sawdust.

It can be handled and installed without wearing gloves, long sleeves, or chemical respirators. Installers appreciate insulation free of toxins and abrasives.

PART THREE

Code Allowed Applications for Wood Fiber Insulation

NATIONAL FIRE PROTECTION ASSOCIATION CODES,
INTERNATIONAL BUILDING CODE,
INTERNATIONAL ENERGY CONSERVATION CODE

US and Canada Code Compliance

ASTM C739 CAN/ULC-S703-
Standard Specification for
Cellulosic Fiber
ASTM 119/E84 CAN/ULC S102

ASTM C739 CAN/ULC-S703-
(Abridged) Standard Specification
for Cellulosic Fiber
ASTM 119/E84 CAN/ULC S102

ASTM (abridged) C208/209
Standard for Cellulosic Fiber
Insulating Board
ASTM 119/E84 CAN/ULC S102

Additional fire assembly testing UL listings (ASTM E119/UL 263)
Hygrothermal analysis code compliance and best practices
Sound testing (assemblies)
Evaluation Services Reports

NFPA 285 Definitions for Material Combustibility

- **Combustible Material:** will ignite and burn in the form in which it is used and under the conditions anticipated
  - Wood Framing, OSB
  - Cellulose, Foam, Wood Fiber Insulation
- **Non-Combustible Material**: will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat in the form in which it is used and under the conditions anticipated (Passes ASTM E 136 at 750C)
  - Brick/Concrete/Cement
  - Mineral Wool Insulation

IBC Construction Types Where Wood Fiber is Allowed

Type I	Type II	Type III	Type IV	Type V
Non-Combustible Structure	Non-Combustible Structure	Non-Combustible Exterior Walls/ Combustible Interior Structural Frames	Non-Combustible Exterior Walls/ Combustible Interior Structural Frames	Combustible Construction

- Each type has an “A” and a “B” sub-category, “A” has increased fire protection requirements

IBC Construction Types Where Wood Fiber is Allowed

Type I	Type II	Type III	Type IV	Type V
Non-Combustible Structure	Non-Combustible Structure	Non-Combustible Exterior Walls/ Combustible Interior Structural Frames	Non-Combustible Exterior Walls/ Combustible Interior Structural Frames	Combustible Construction

- Each type has an “A” and a “B” sub-category, “A” has increased fire protection requirements

IBC 2018 601

IBC Maximum Building Height

Building Use	Type I	Type II	Type III	Type IV	Type V
					
Assembly *	Unlimited	4	4	4	3
Education	Unlimited	4	4	4	2
Business	Unlimited	6	6	6	4
Factory	Unlimited	6	5	6	4
High Hazard	Unlimited	6	6	6	4
Institutional	Unlimited	5	5	5	3
Mercantile	Unlimited	5	5	5	4
Residential	Unlimited	5	5	5	4
Storage	Unlimited	6	5	6	5
Utility	Unlimited	5	4	5	3

* Where a building is equipped with an approved automatic sprinkler system, the maximum number of stories is increased by one

IBC 2012 501

IBC Maximum Building Height

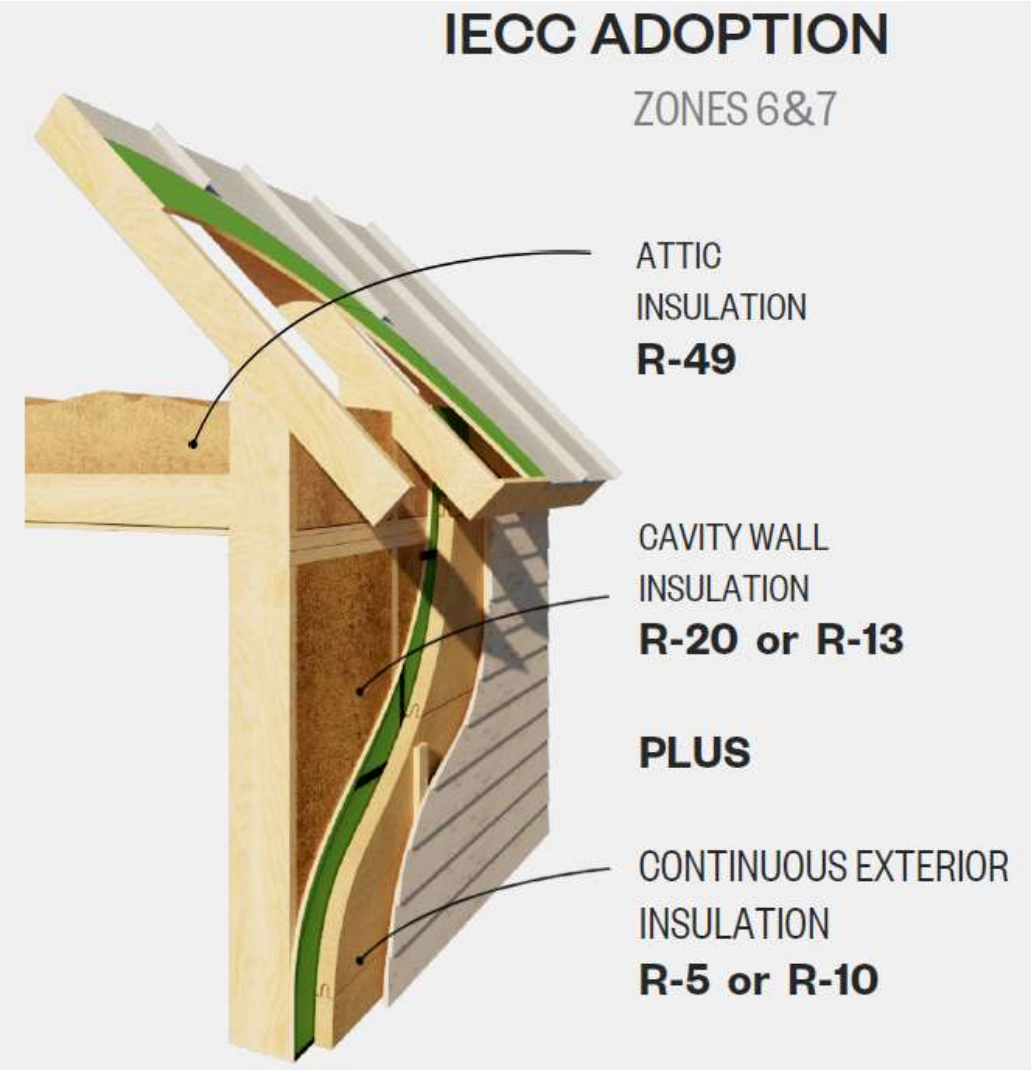
Building Use	Type I	Type II	Type III	Type IV	Type V
Assembly *	Unlimited	4	4	4	3
Education	Unlimited	4	4	4	2
Business	Unlimited	6	6	6	4
Factory	Unlimited	6	5	6	4
High Hazard	Unlimited	6	6	6	4
Institutional	Unlimited	5	5	5	3
Mercantile	Unlimited	5	5	5	4
Residential	Unlimited	5	5	5	4
Storage	Unlimited	6	5	6	5
Utility	Unlimited	5	4	5	3

* Where a building is equipped with an approved automatic sprinkler system, the maximum number of stories is increased by one

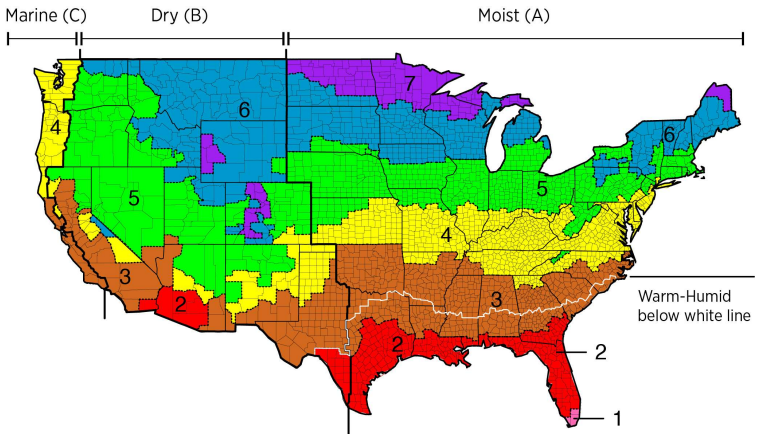
IBC 2012 501

Building Code Drives Tighter Buildings and Higher R-Values

- Not just more insulation, but continuous insulation
- Climate zone and basic requirements
- More insulation can mean more problems
- View the building envelope as a system



IECC 2018 Minimum Insulation Requirements



WALL	1	2	3	4 EXCEPT MARINE	5 & MARINE 4	6	7	8
METAL FRAMED	R-13 + 5 c.i.	R-13 + 7.5 c.i.	R-13 + 7.5 c.i.	R-13 + 7.5 c.i.	R-13 + 7.5 c.i.	R-13 + 7.5 c.i.	R-13 + 15.6 c.i.	R-13 + 17.5 c.i.
WOOD FRAMED	**R-20**	**R-20**	**R-20**	**R-20**	**R-20 + 3.8 c.i.**	**R-20 + 3.8 ci.**	**R-20 + 3.8 ci.**	**R-20 + 10 c.i.**

NR = Not Required ; c.i. = continuous insulation

Tighter Buildings Can Bring More Risk

TABLE N1102.1.3 (R402.1.3)
INSULATION REQUIREMENTS BY COMPONENT[a]

Climate Zone	Wood Framed Wall (R-Value)
1	13 or 0+10
2	13 or 0+10
3	20 or 13+5[h] or 0+15
4 except Marine	30 or 20+5[h] or 13+10[h] or 0+15[h]
5 and Marine 4	30 or 20+5[h] or 13+10[h] or 0+15[h]
6	30 or 20+5[h] or 13+10[h] or 0+20[h]
7&8	30 or 20+5[h] or 13+10[h] or 0+20[h]

a. R-values are minimums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed R-value of the insulation shall not be less than the R-value specified in the table.

h. The first value is cavity insulation, the second value is continuous insulation, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

Blower Door Testing
Leakage = Air Changes per Hour (ACH)

Testing R402.4.2.1
- OPTIONAL
- Approved 3rd Party
- Written Report

7 ACH50 or Less

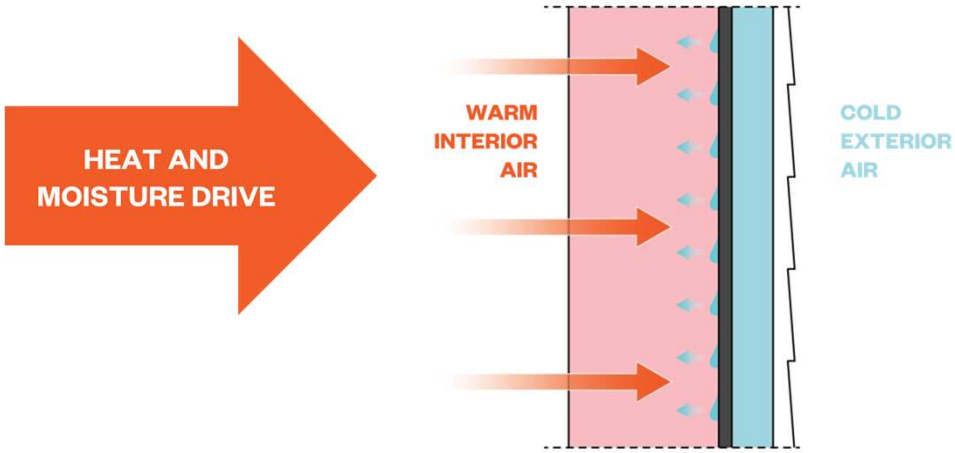
Testing R402.4.1.2
- **MANDATORY**
- Approved 3rd Party
- Written Report

Not Exceeding 3 ACH50

Calculation
- ACH50 (Air Change per Hour at 50 Pascals)

$$\frac{\text{CFM50} \times 60}{\text{VOLUME}} = \text{ACH50}$$

Houses don’t need to breathe... people do.

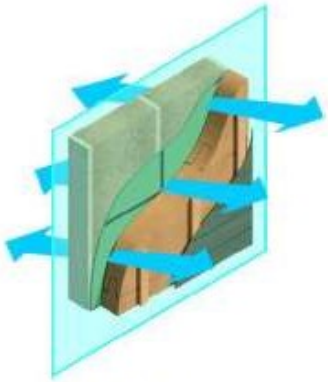


IBC 2018 Vapor Retarder Mandatory Requirements

INTERIOR SIDE OF FRAME WALLS						
VAPOR RETARDER	1&2	3 & 4 EXCEPT MARINE	MARINE 4	5	6	7&8
CLASS I	✗	✗	✓	✓	✓	✓
CLASS II	✗	✓	✓	✓	✓	✓
CLASS III * allowed if one of the conditions are met	✓	✓	✓ • Vented cladding over wood structural panels, fiber board or gypsum, or • Continuous insulation with R≥2.5 (2x4 wall) or R≥3.75 (2x6 wall)	✓ • Vented cladding over wood structural panels, fiberboard or gypsum, or • Continuous insulation with R≥5 (2x4 wall) or R≥7.5 (2x6 wall)	✓ • Vented cladding over fiberboard or gypsum, or • Continuous insulation with R≥7.5 (2x4 wall) or R≥11.25 (2x6 wall)	✓ • Continuous insulation with R≥10 (2x4 wall) or R≥15 (2x6 wall)

* Only Class III is allowed on the interior side of frame wall if foam insulating sheathing with a perm rating of less than 1 is applied on the exterior side of frame wall

IBC 2018 Vapor Retarder Mandatory Requirements



CLASS I ≤ 0.1 Perm

0.1 Perm < **CLASS II** ≤ 1 Perm

1 Perm < **CLASS III** ≤ 10 Perm

10 Perm < **Vapor Permeable**

- Vapor Retarder class shall be based on the manufacturer's certified testing or a tested assembly

	COMMON VAPOR RETARDERS
Class I	Sheet polyethylene
	Nonperforated aluminum foil
Class II	≥1" XPS
	Kraft-faced fiberglass batt
	¼" Plywood (exterior glue)
Class III	Latex or enamel paint
	OSB sheathing
Vapor Permeable	Wood Fiber Insulation
	Mineral Wool

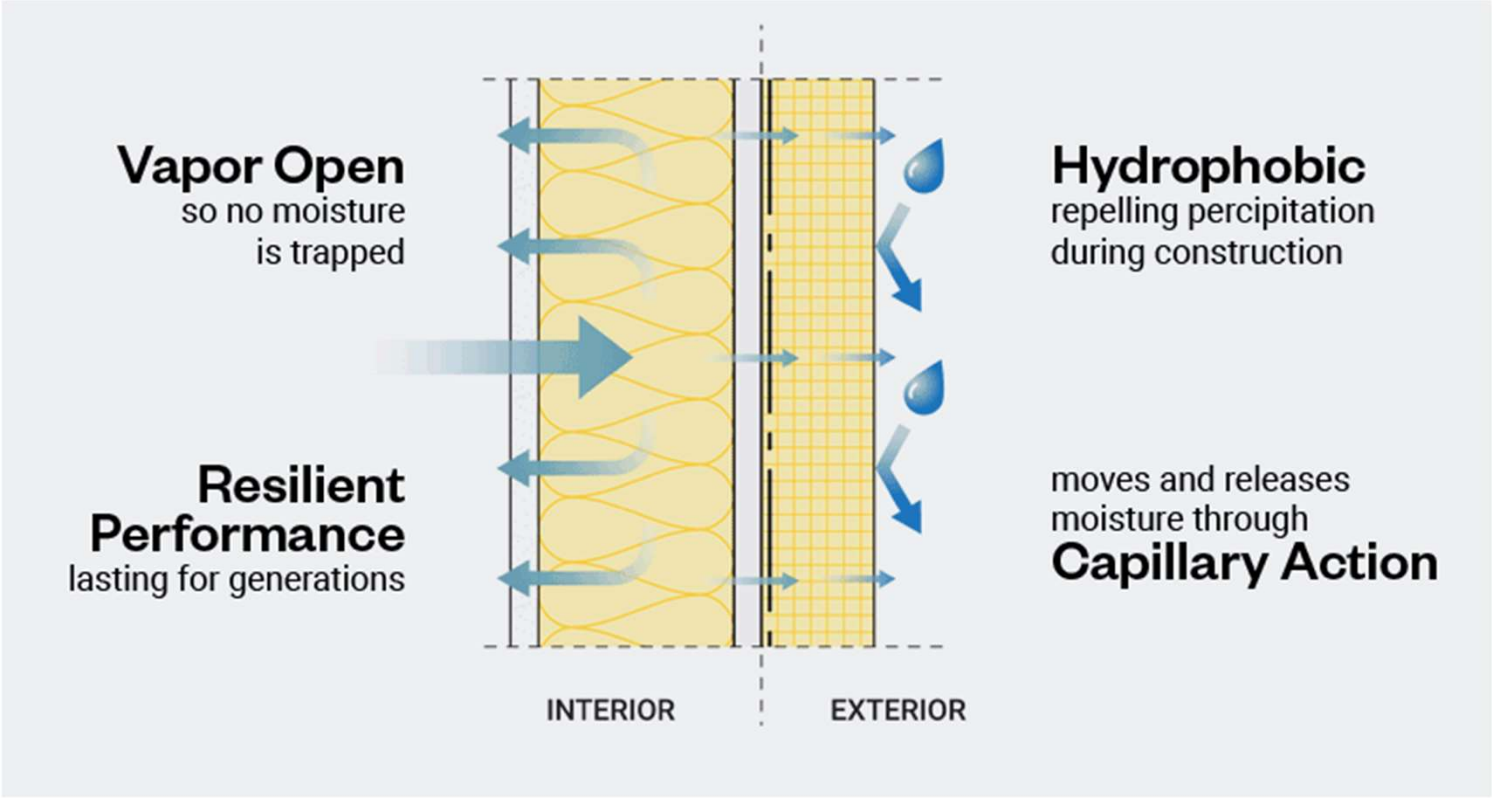
TABLE R702.7.1
CLASS III VAPOR RETARDERS : LATEX OR ENAMEL PAINT [a,b]

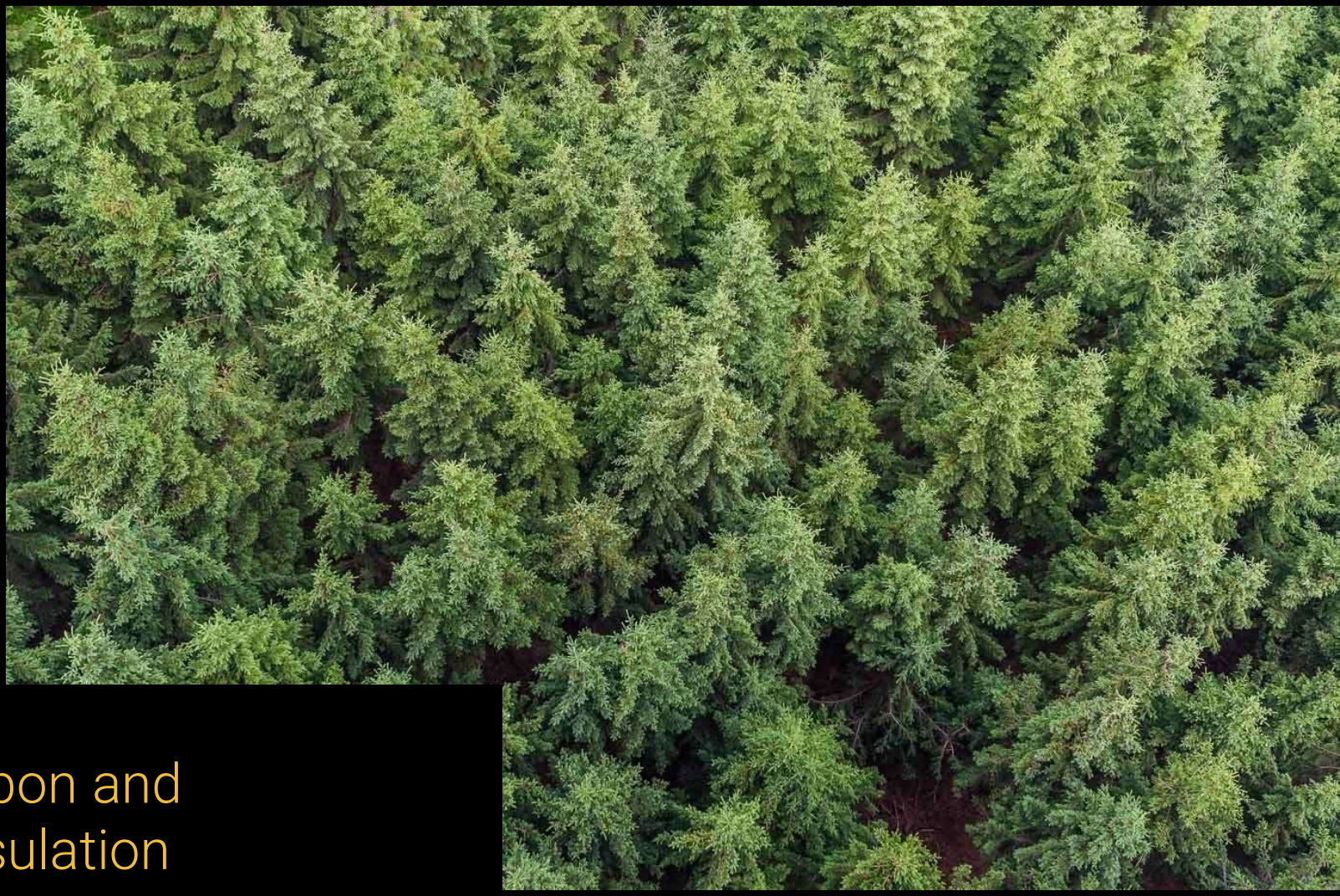
CLIMATE ZONE	CLASS III VAPOR RETARDERS PERMITTED FOR:
Marine 4	- CI with R-value ≥ 2.5 over a 2x4 wall - CI with R-value ≥ 3.75 over a 2x6 wall
5	- CI with R-value ≥ 5 over a 2x4 wall - CI with R-value ≥ 7.5 over a 2x6 wall
6	- CI with R-value ≥ 7.5 over a 2x4 wall - CI with R-value ≥ 11.25 over a 2x6 wall
7	- CI with R-value ≥ 10 over a 2x4 wall - CI with R-value ≥ 15 over a 2x6 wall
8	- CI with R-value ≥ 12.5 over a 2x4 wall - CI with R-value ≥ 20 over a 2x6 wall

a. CI = Continuous Insulation

b. The requirements in this table apply only to insulation used to control moisture in order to permit the use of Class III vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of Chapter 11.

Reduce Risk with Flow-Through Assemblies

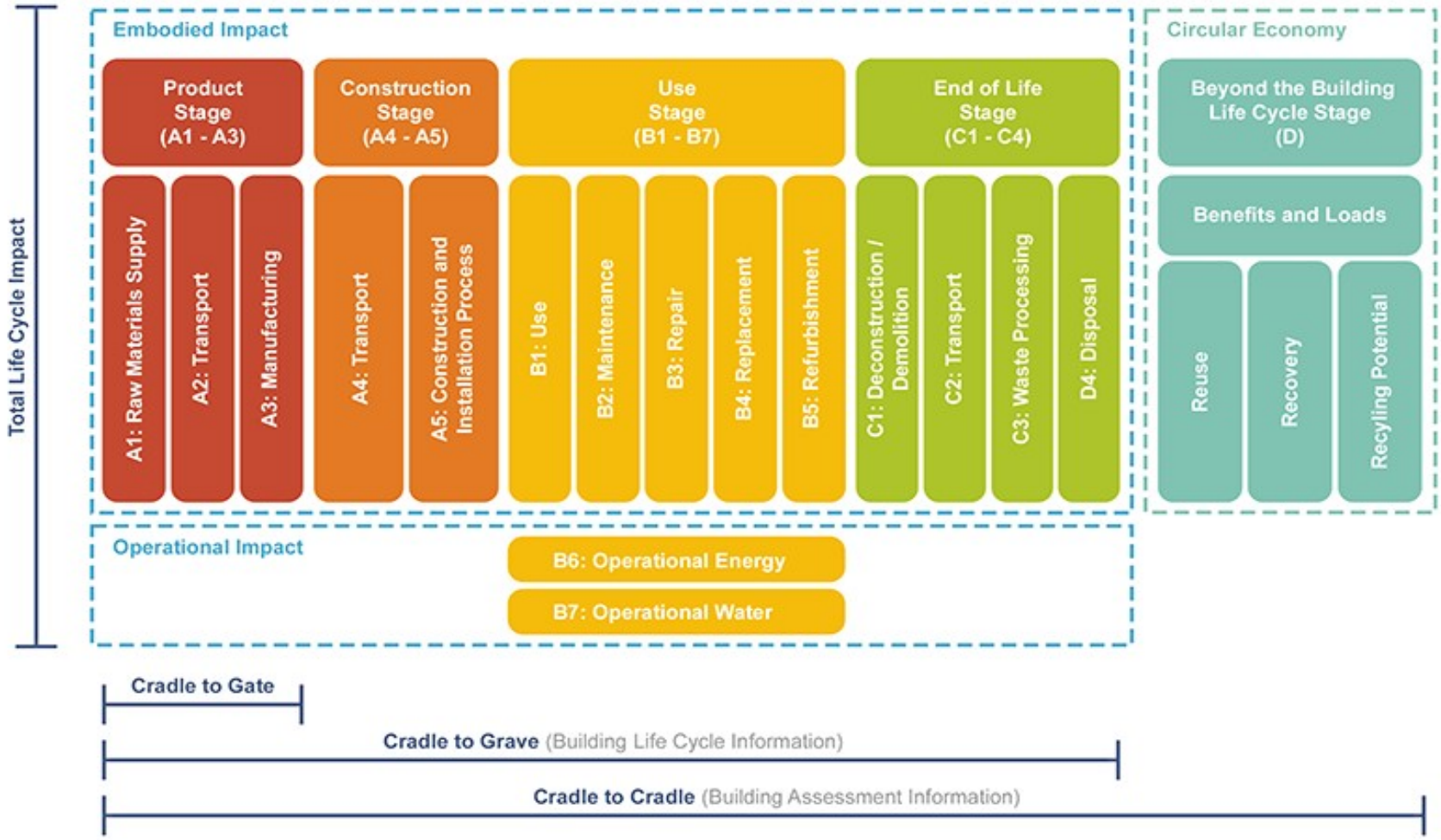




PART FOUR

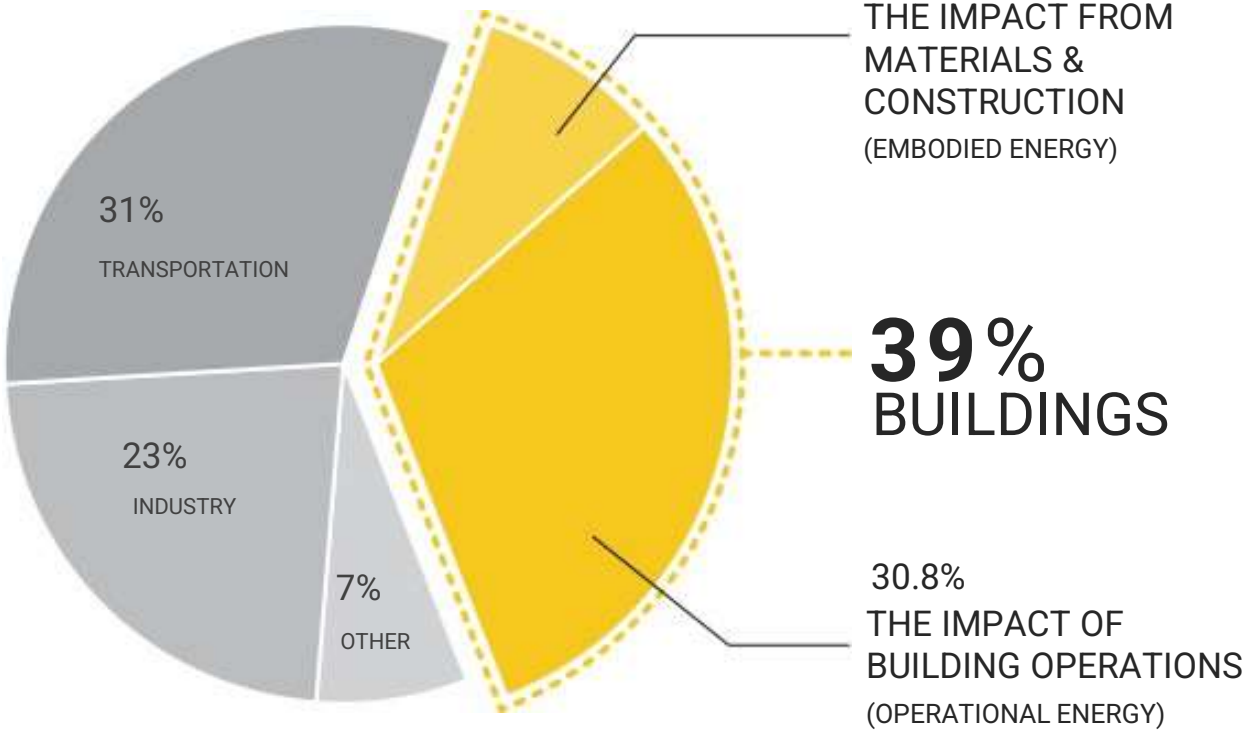
Embodied Carbon and Wood Fiber Insulation

Embodied Carbon - Life Cycle Analysis



Built Environment and Energy Consumption

(CO_2e emissions in 2017)



Source: Global Alliance for Building and Construction, *Global Status Report*, 2019; US EIA, *EIA International Energy Outlook 2017*, 2017.

The construction and operation of buildings in the United States alone is responsible for almost

2 Gigatons CO_2e emissions annually.

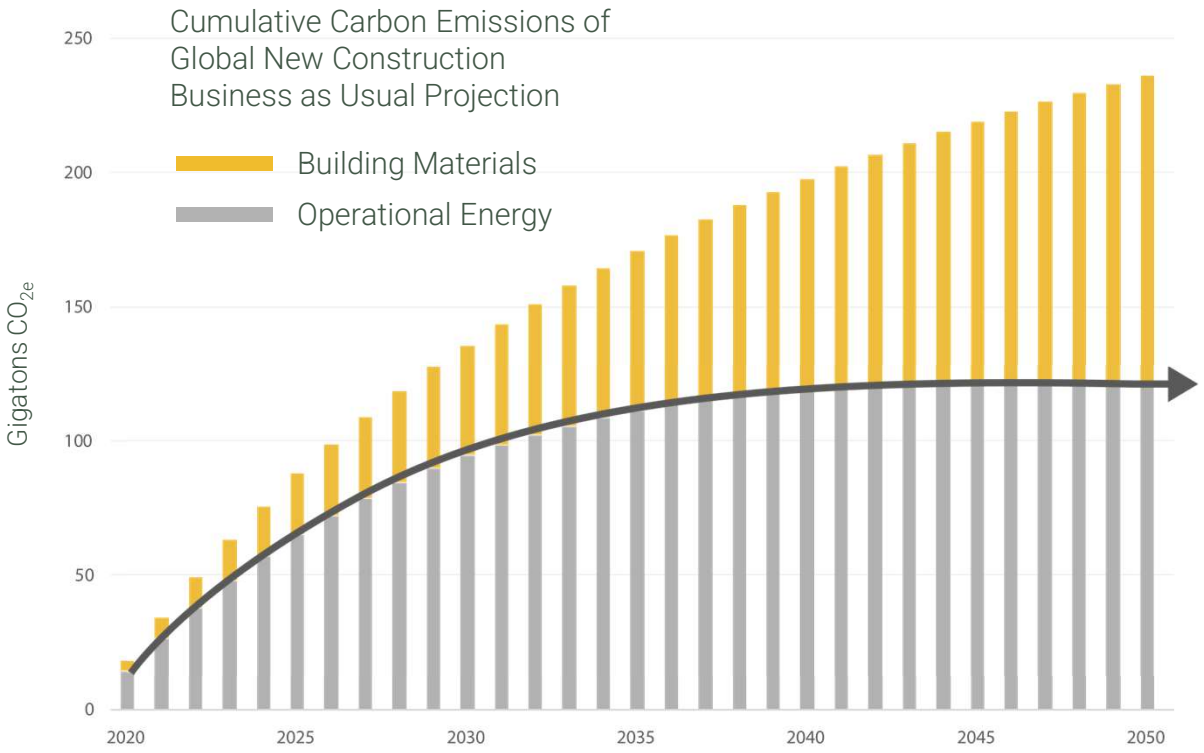
The prescription for dramatically reducing that impact is well understood and immediately technologically achievable.

Embodied Carbon from Building Materials is responsible for 8.2% of global GHG emissions

- **Embodied Carbon** is the amount of greenhouse gases emitted during the life cycle of a material
- **Life Cycle Analysis (LCA)** is a tool that quantifies a product's carbon footprint through a holistic view of its environmental interactions from cradle to grave
  1. Extraction and transportation of raw materials
  2. Manufacture of product
  3. Use of product
  4. End-of-life treatment (disposal or recycle)

Source: AIA 2030, UN Environment Global Status Report 2017; EIA International Energy Outlook 2017

Embodied Carbon is increasingly significant



Source: AIA 2030

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

Energy Retrofit Programs

+

Renewable Energy

↓

Reduced Operational CO_{2e}

Problem : The insulation market is dominated by fossil-fuel dependent products with devastating environmental impacts

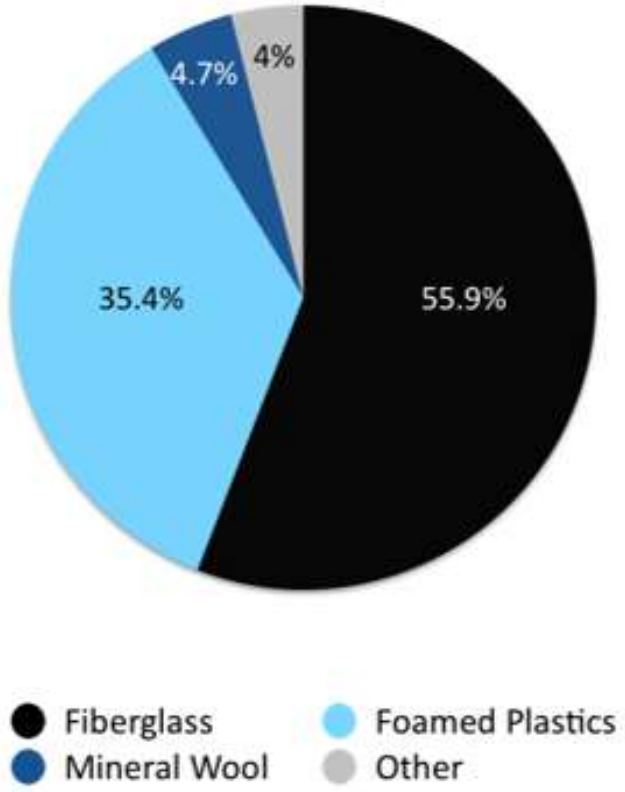
High Embodied Carbon
Irredeemable Global Warming Potential

Vapor closed, traps moisture
Leading to mold and mildew, health risks, and rot

Non-recyclable, made with toxins
Loaded with dangerous toxic ingredients

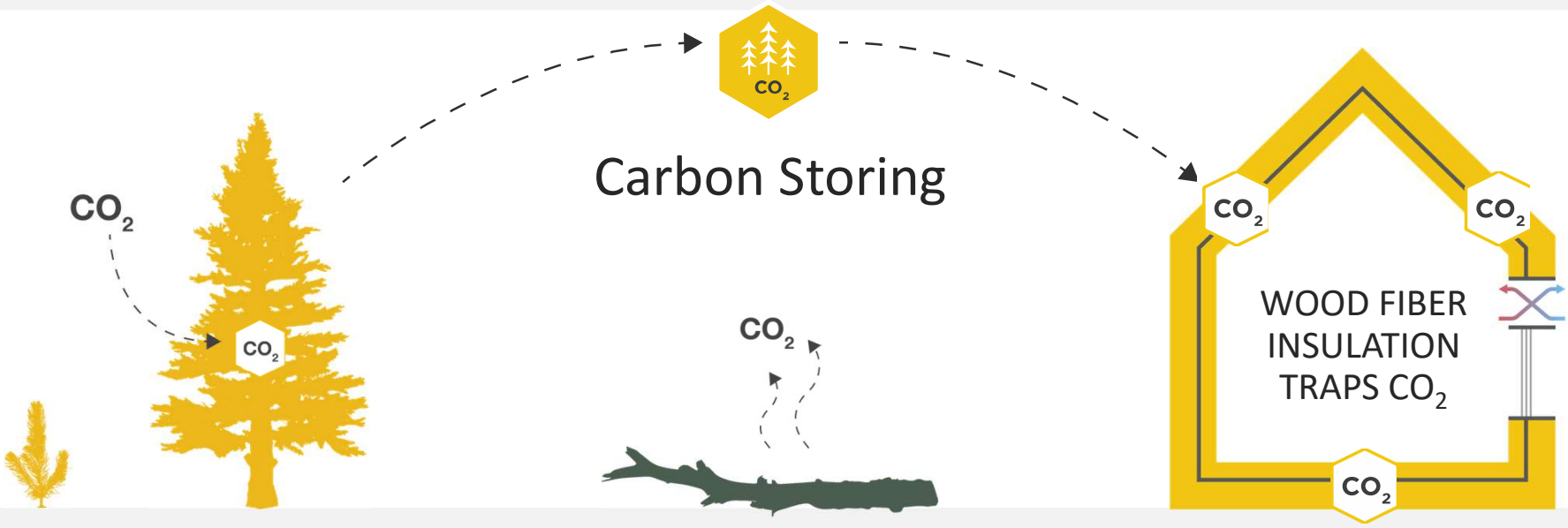
Harmful off-gassing
Leading to unhealthy indoor air quality

Highly flammable



Solution :
Wood Fiber Insulation

Carbon storing wood products used in construction yield a net benefit to the atmosphere

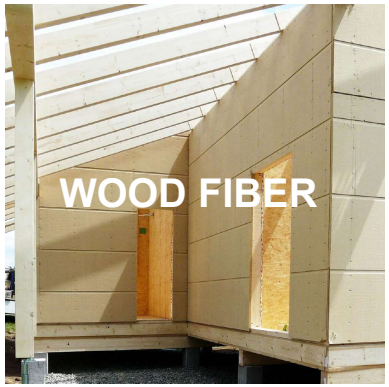


Atmospheric carbon dioxide is taken up by trees and, through photosynthesis, stored as carbon in biomass

At the end of the tree's life, when left to decay, this stored carbon returns to the atmosphere slowly

Harvesting trees as the source material for building products can delay the release of that carbon for the life of the building and potentially far longer

Carbon Footprint



-9 kg CO_2

Per 100SF @ R=1

2 kg CO_2

Per 100SF @ R=1

14 kg CO_2

Per 100SF @ R=1

15 kg CO_2

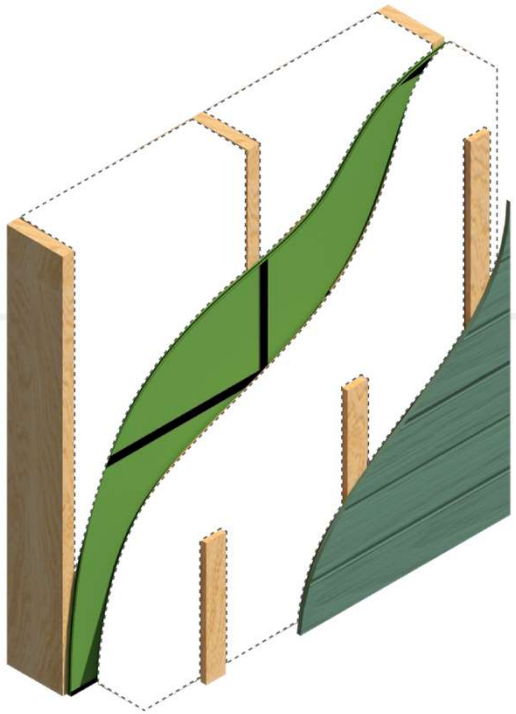
Per 100SF @ R=1

36 kg CO_2

Per 100SF @ R=1

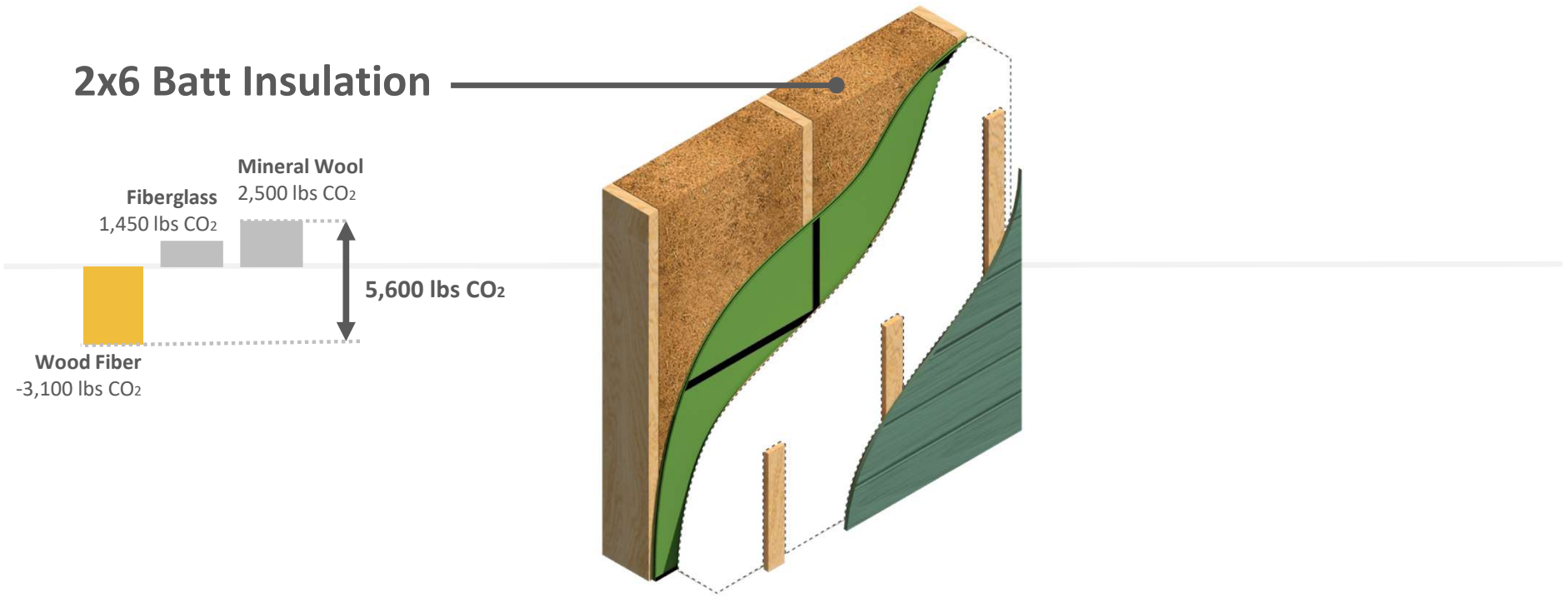
Embodied CO_2

1,500 SF Passive House Wall Assembly



Embodied CO_2

1,500 SF Passive House Wall Assembly

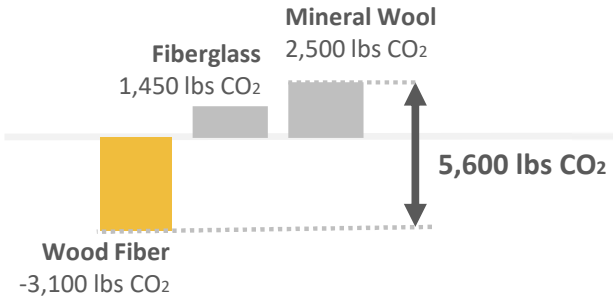


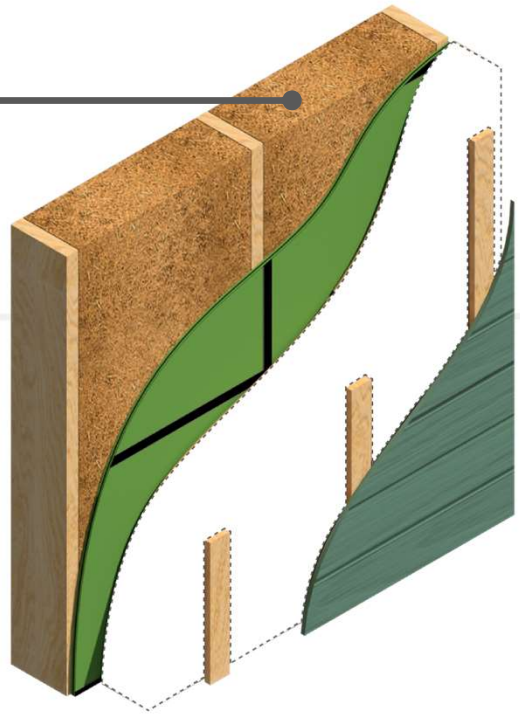
Embodied CO_2

1,500 SF Passive House Wall Assembly

The CO_2 savings for one house is equivalent to the emissions from driving 7,100 miles

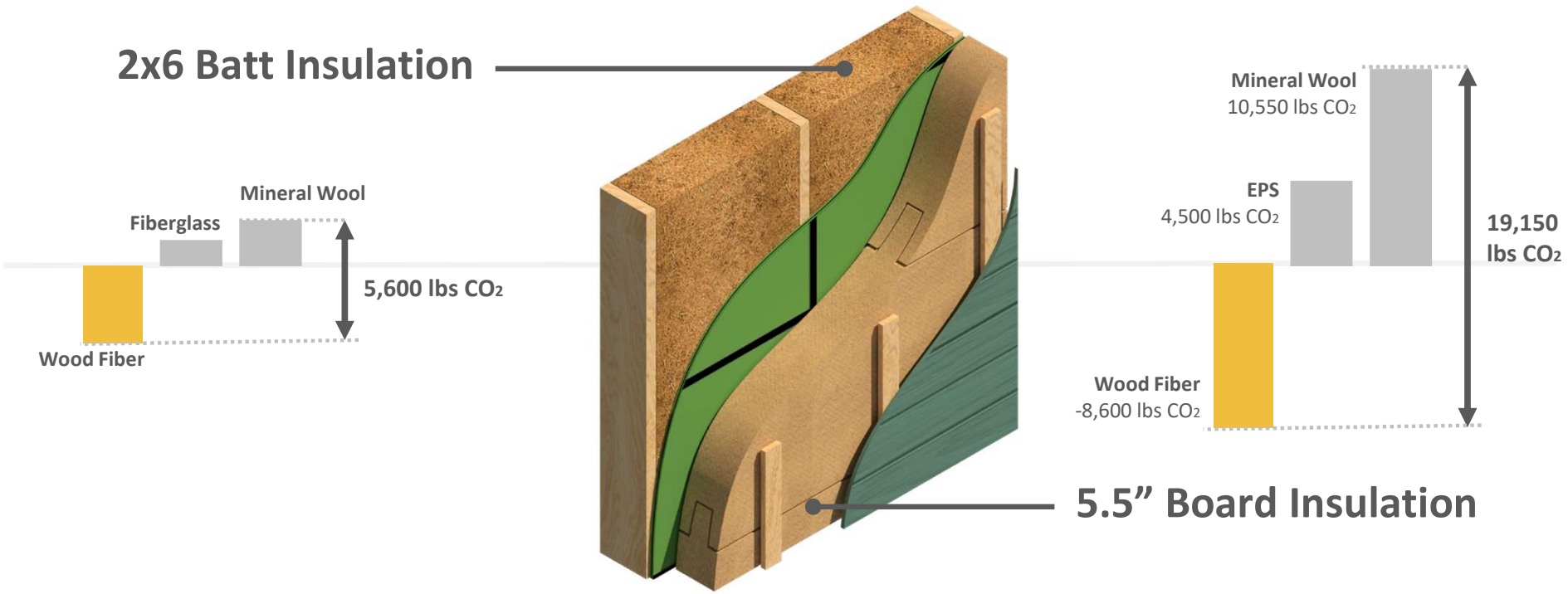
2x6 Batt Insulation





Embodied CO_2

1,500 SF Passive House Wall Assembly

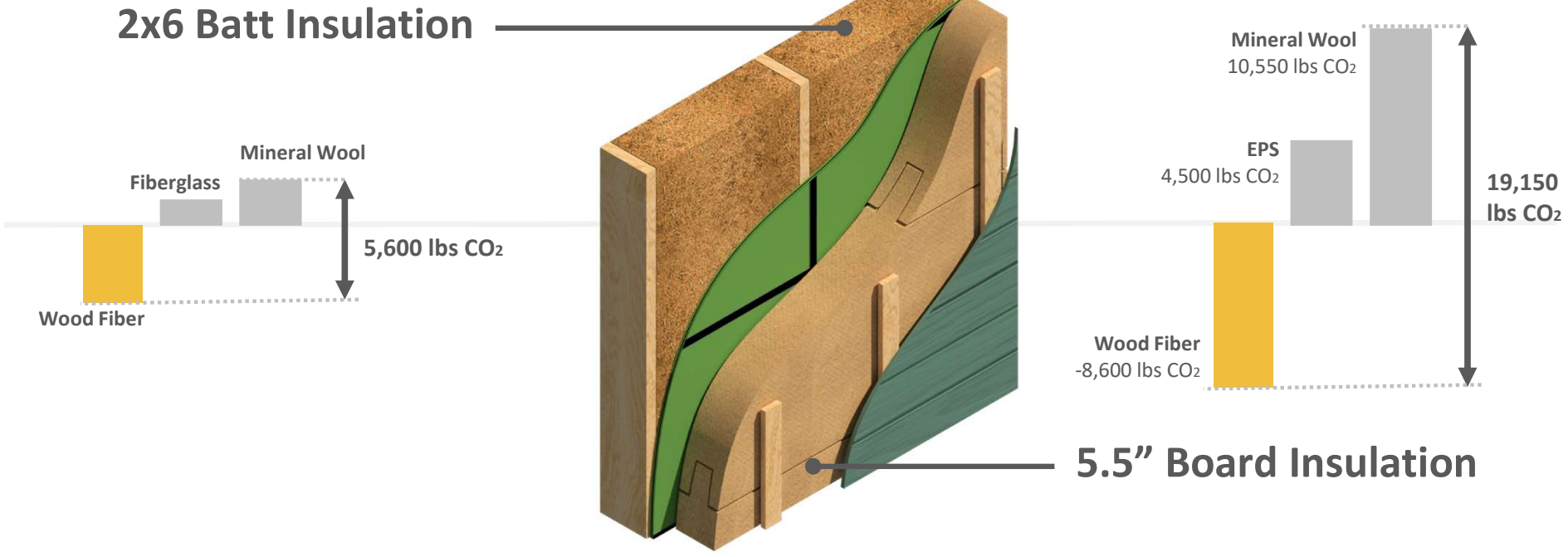


Embodied CO_2

1,500 SF Passive House Wall Assembly

The CO_2 savings for one house is equivalent to the emissions from driving 23,500 miles

2x6 Batt Insulation

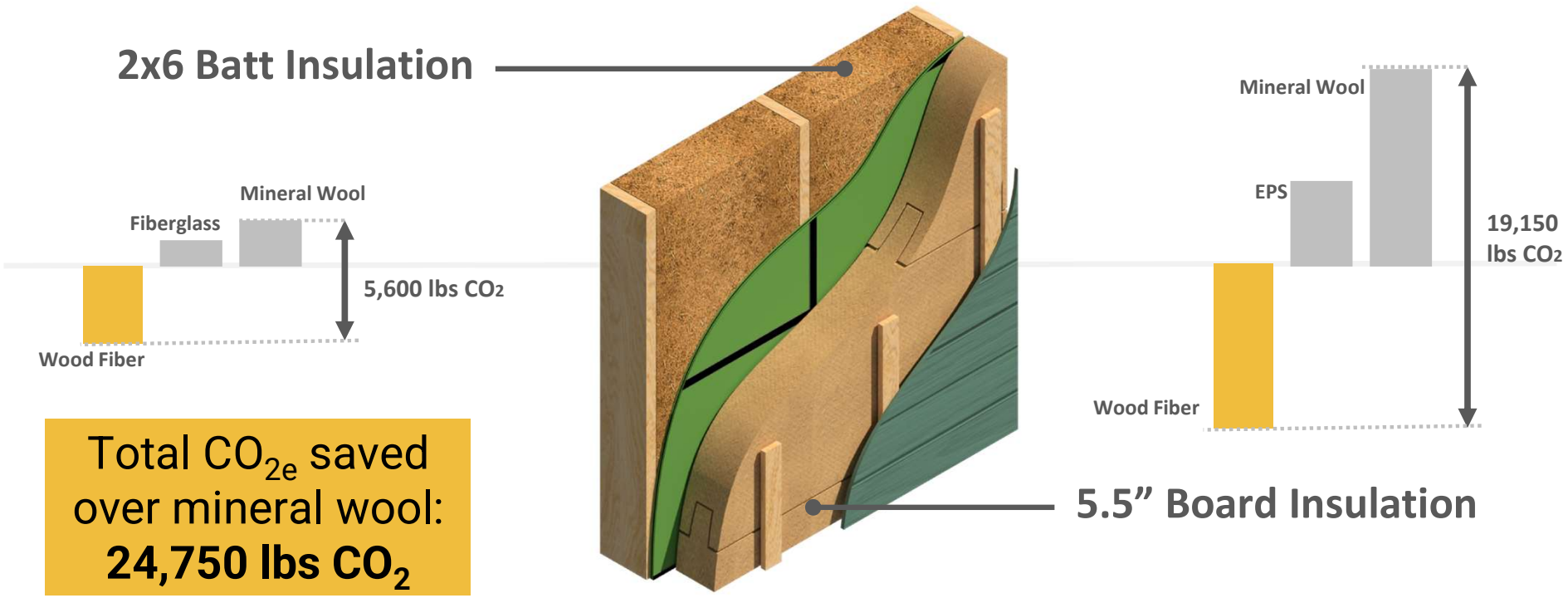


5.5” Board Insulation

Embodied CO_2

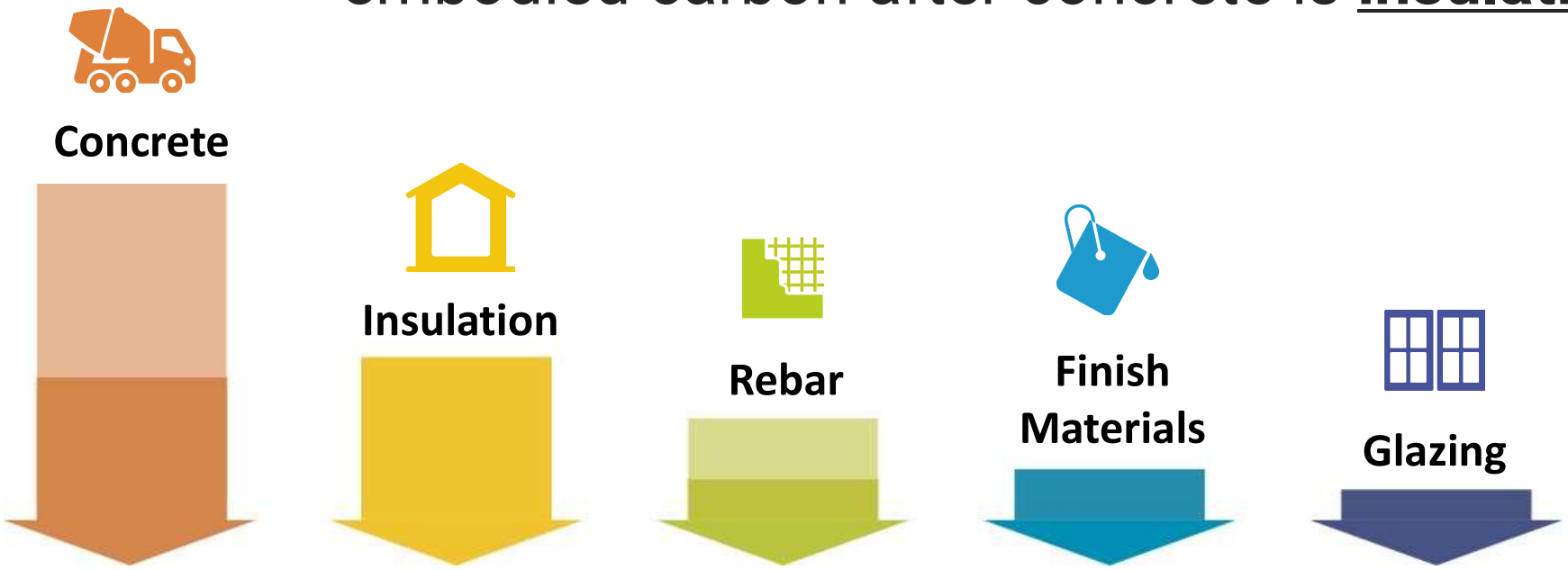
1,500 SF Passive House Wall Assembly

The total CO_2 savings for one house is equivalent to the emissions from driving 1 car for 2.5 years



Total CO_{2e} saved over mineral wool:
24,750 lbs CO_2

The greatest opportunity for reducing embodied carbon after concrete is **insulation**



TOP BUILDING MATERIAL CATEGORIES FOR **REDUCING EMBODIED CARBON**

Data Source: RMI