All-wood design and carbon storage in the built environment

Realtor Green Day 2022

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OPAL / BUILD

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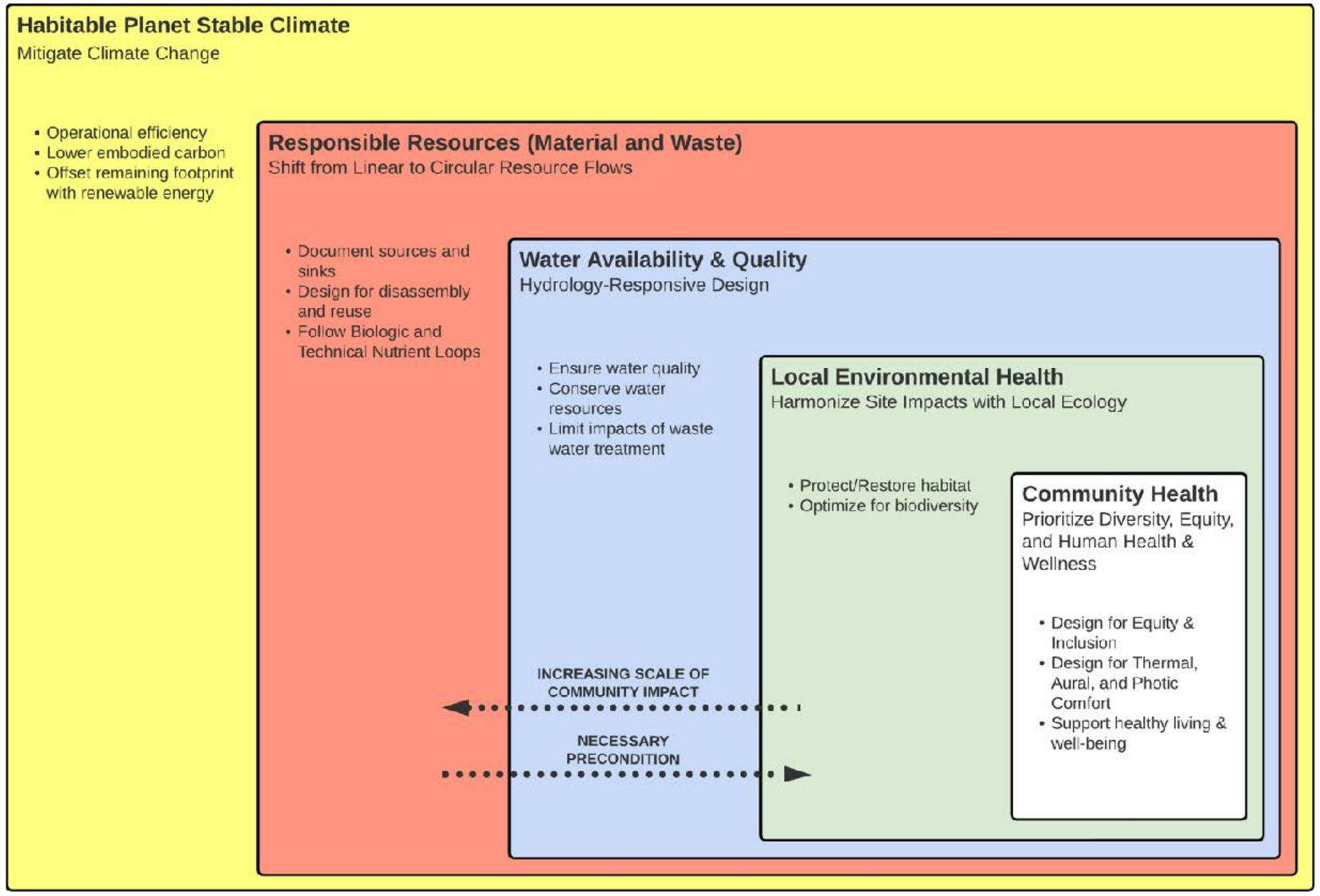
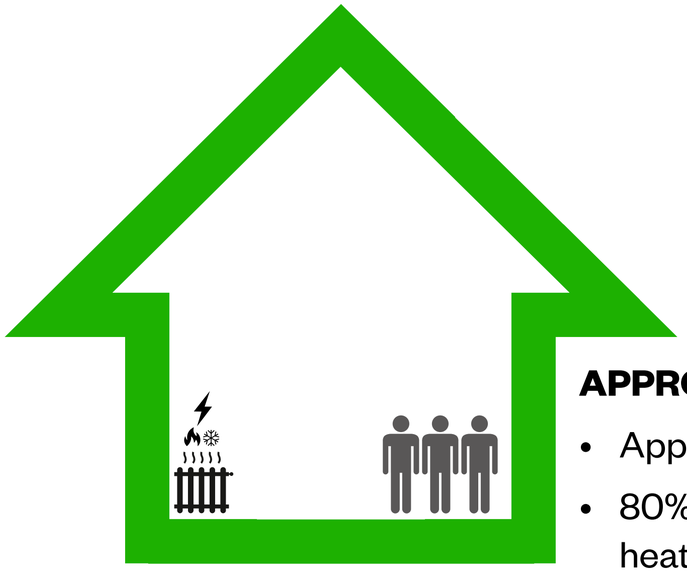
1. Dimensions of Building Ecology

Designing for Positive Impact

Building Ecology | Considering Scale of Impact

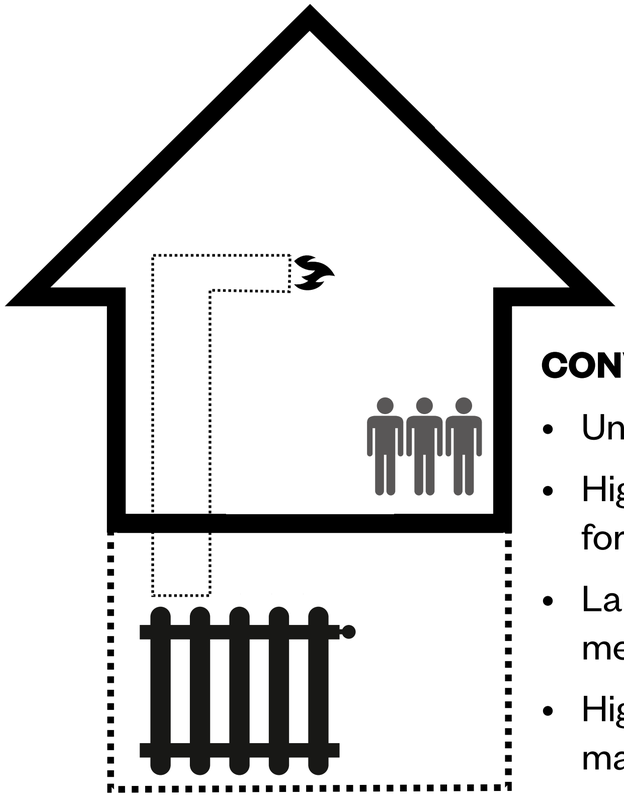


Building Ecology | What's Appropriate for Our Climate?



APPROPRIATE INSULATION

- Appropriate insulation for winter
- 80% reduction in energy required for heating
- Low first-cost for mechanicals offsets cost of appropriate insulation
- Smaller heating system
- Less mechanical space
- Lower run time leading to decreased maintenance cost
- Less fuel purchased (regardless of fuel type)
- Allows conversion to electricity as fuel
- System can cool as well as heat



CONVENTIONAL BUILDING

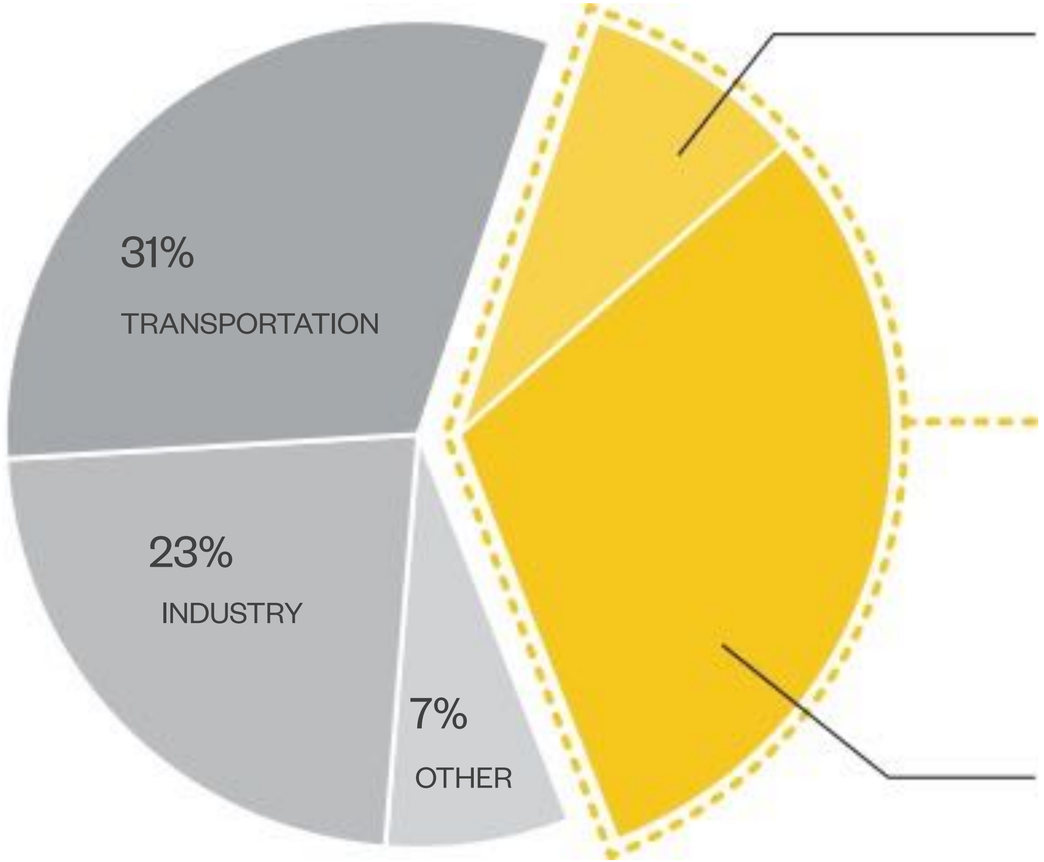
- Under-insulated
- Higher load leading to higher first cost for mechanicals
- Large systems requiring more mechanical space
- Higher run time leading to increased maintenance cost
- More fuel purchased (typically fossil fuel)
- Requires separate cooling system if not all-electric
- Additional cooling system *may* necessitate use of potable water for cooling

2. The problem:

Embodied Carbon

Built Environment and Energy Consumption

(CO_2e emissions)



8.2%
THE IMPACT FROM MATERIALS & CONSTRUCTION
(EMBODIED ENERGY)

39%
BUILDINGS

30.8%
THE IMPACT OF BUILDING OPERATIONS
(OPERATIONAL ENERGY)

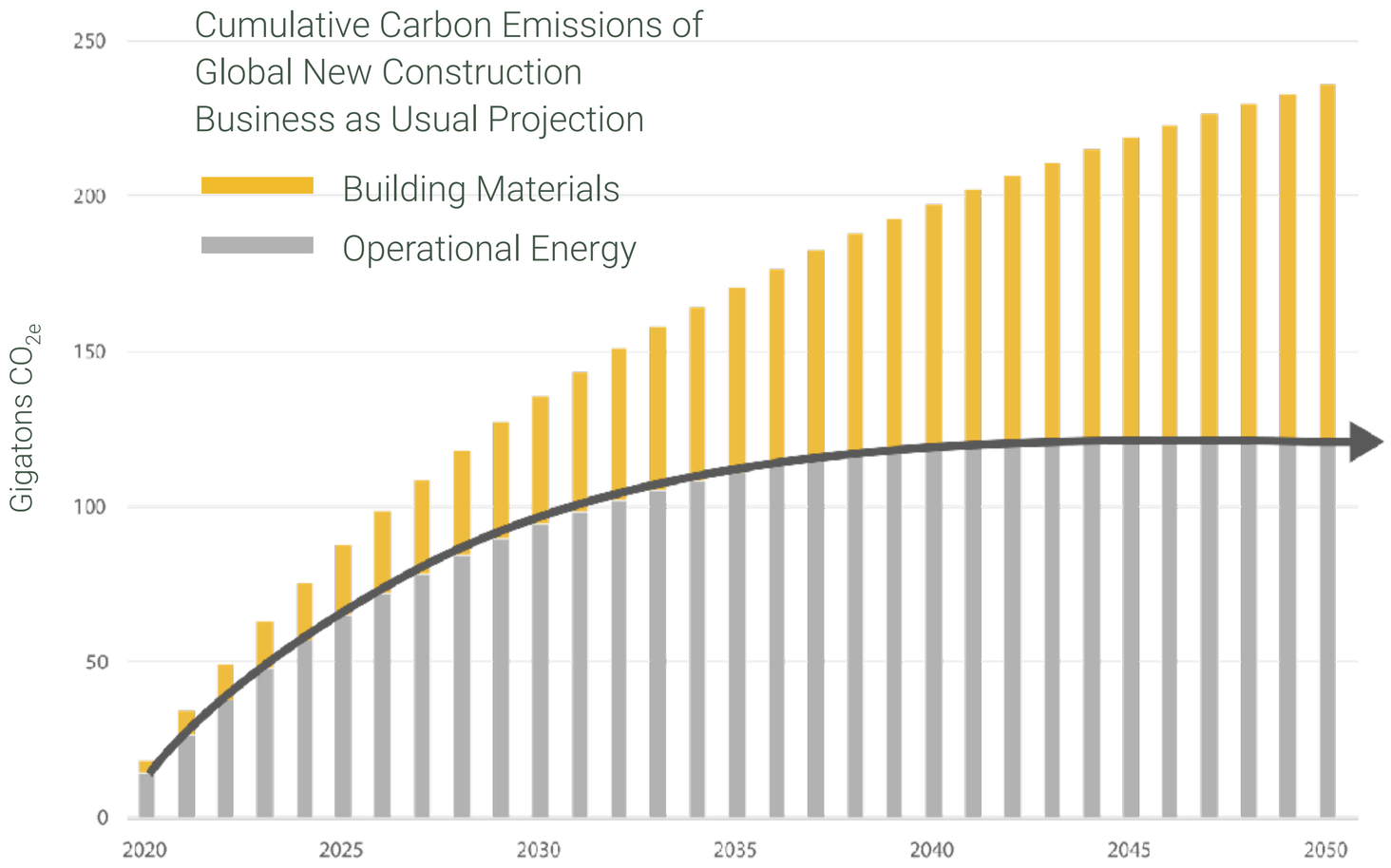
Source: Global Alliance for Building and Construction, *Global Status Report*, 2019; US EIA, *EIA International Energy Outlook 2017*, 2017.

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 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

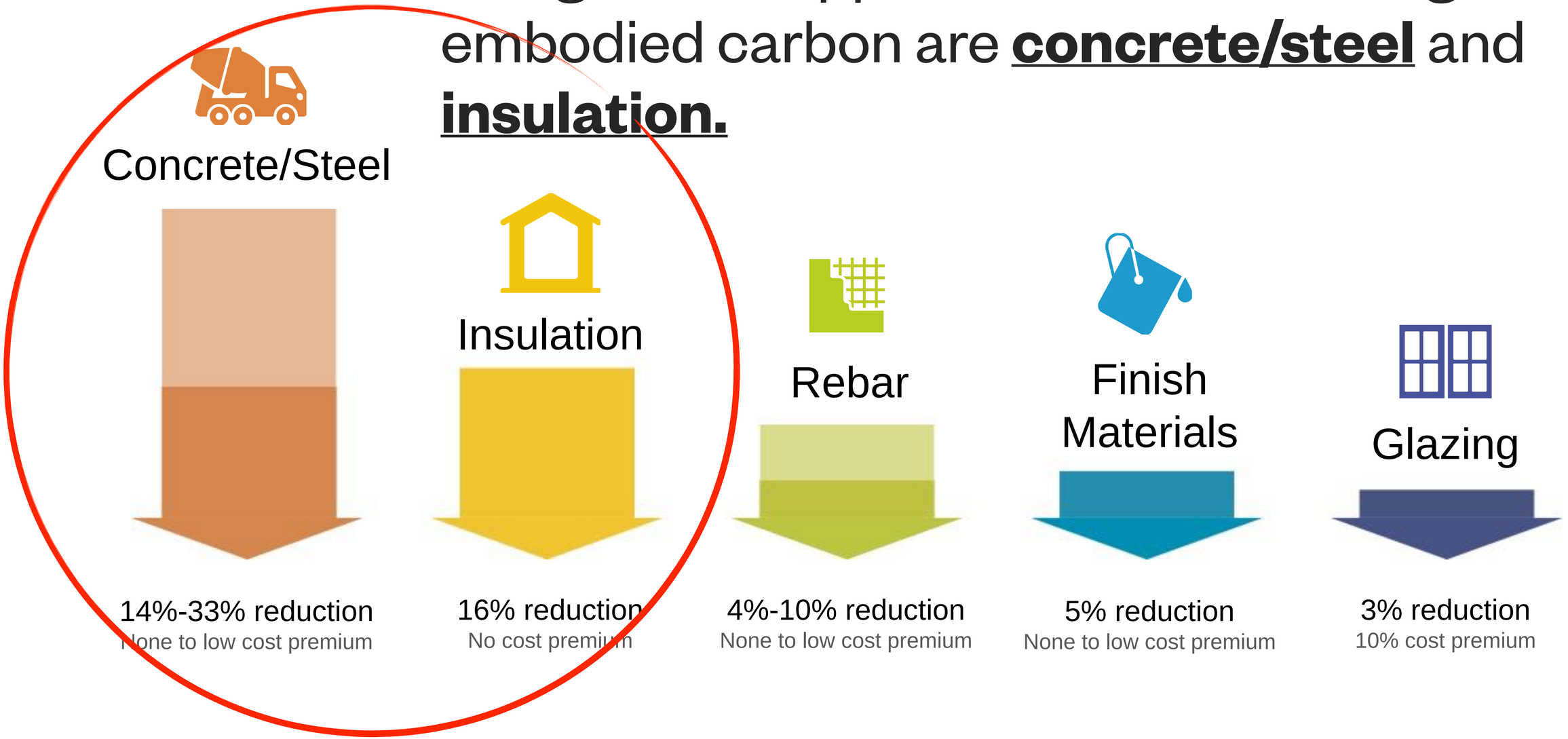
+

Renewable Energy

↓

Reduced Operational CO_{2e}

The greatest opportunities for reducing embodied carbon are **concrete/steel** and **insulation.**



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

Source: RMI

3. A Solution:

Wood-Insulated Panels (WIPs)

A structural / thermal / moisture enclosure solution system

Concrete/Steel

14%-33% reduction

None to low cost premium

Replace w/CLT

Insulation

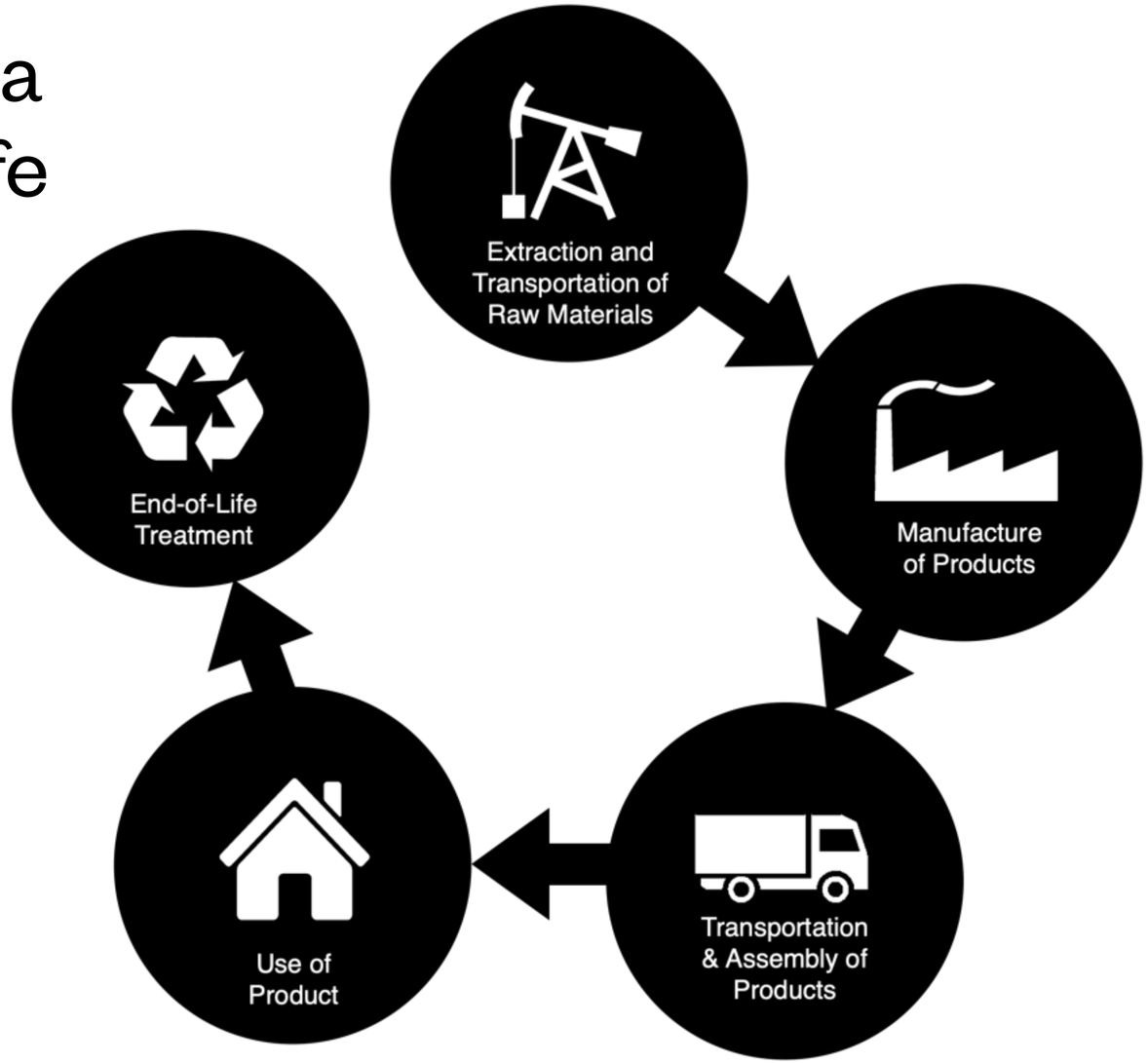
16% reduction

No cost premium

Replace w/WFI

Embodied Carbon from Building Materials are measured through a scientific modeling tool called Life Cycle Assessment (LCA)

The Cradle-to-Grave LCA technique quantifies a building material's carbon footprint through the following life stages:



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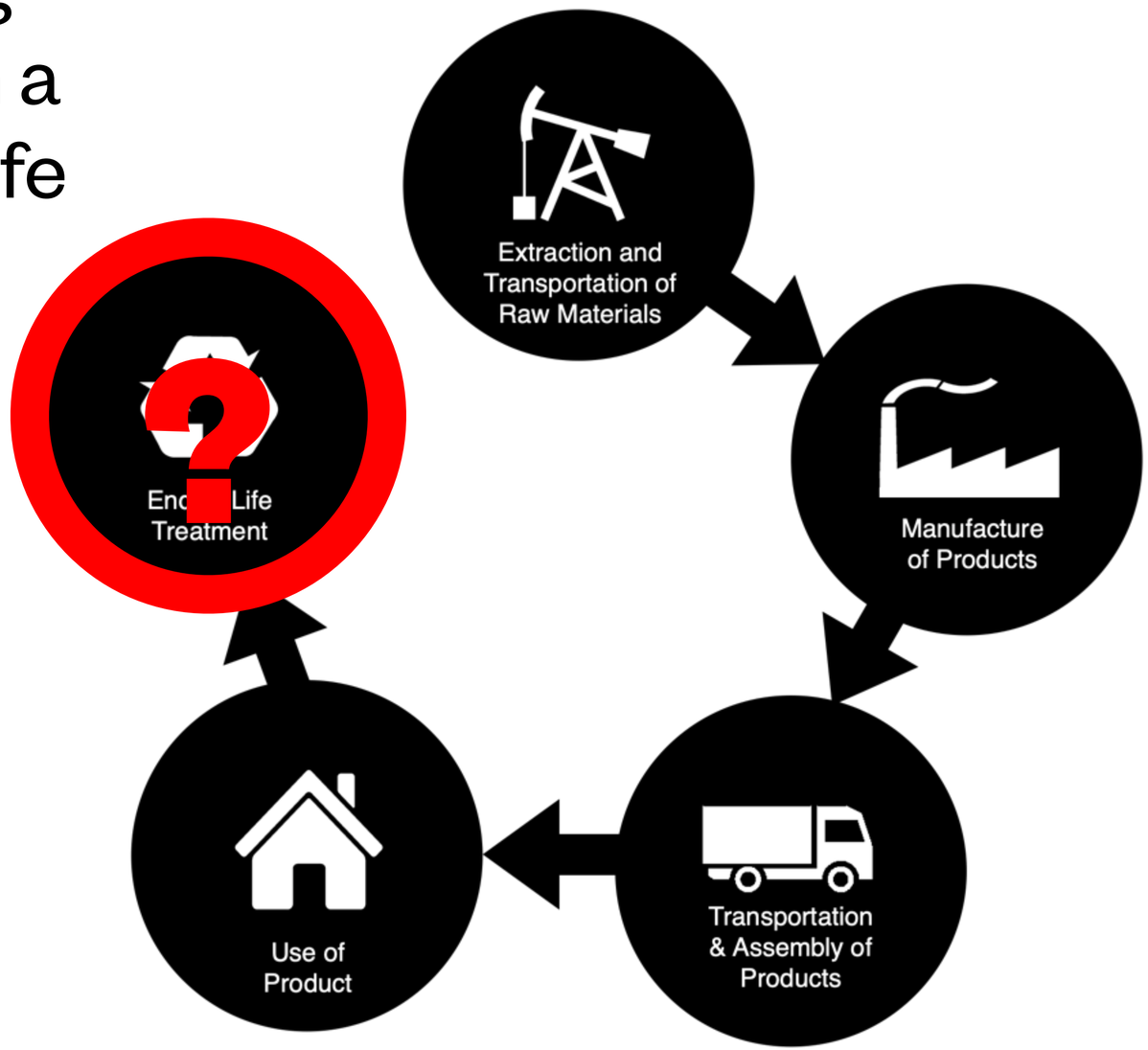
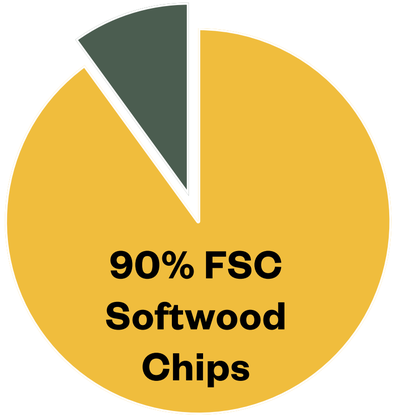


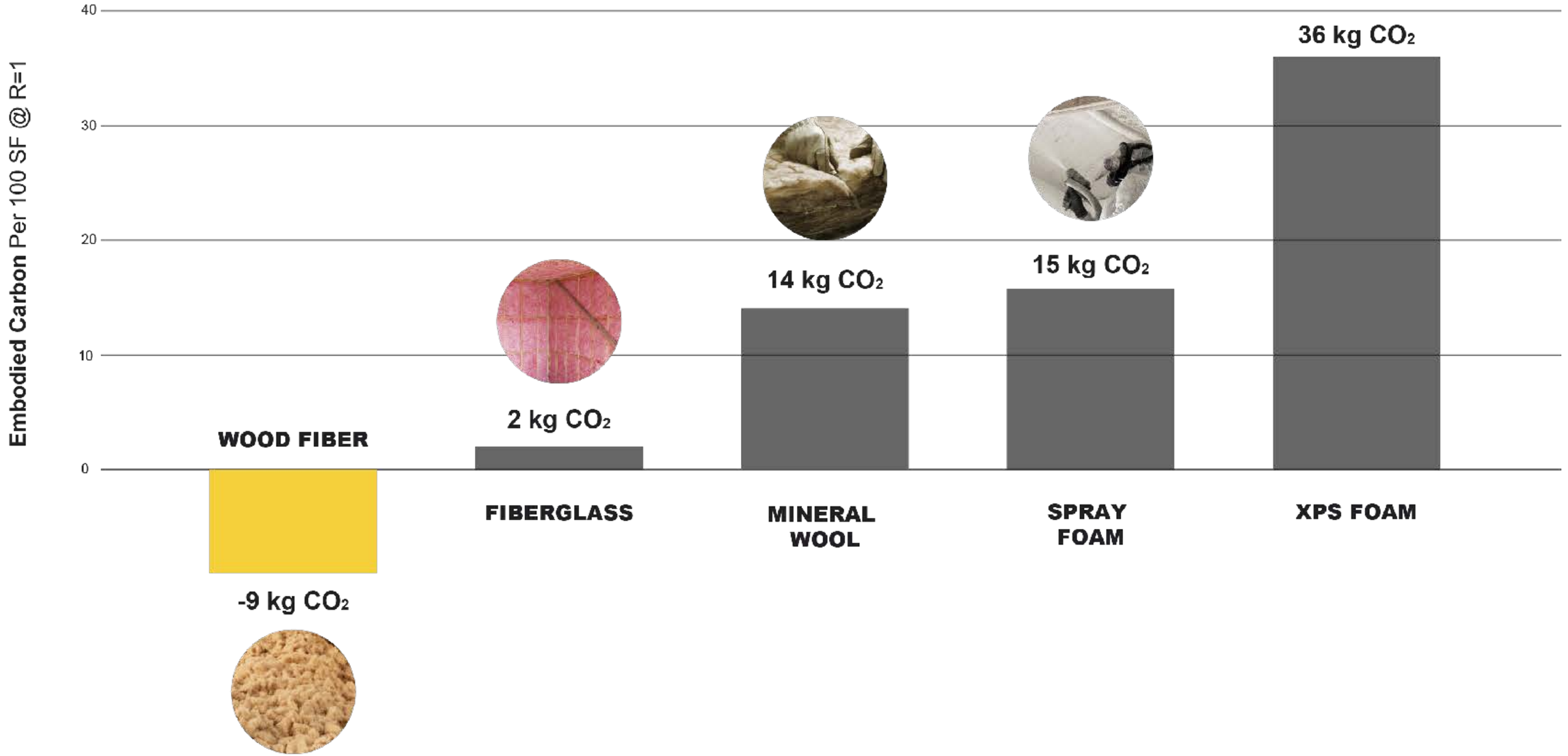
Insulation products made from wood fiber are a superior climate-friendly alternative to conventional insulation.

- Carbon Sequestering — only scalable construction insulation with the potential to address both operational and embodied carbon
- Renewable/ Sustainable — All products made from >90% Forest Stewardship Council softwood chips
- Recyclable — Post construction and demolition waste can be fed back into the process to make new product
- Nontoxic — Urea formaldehyde free

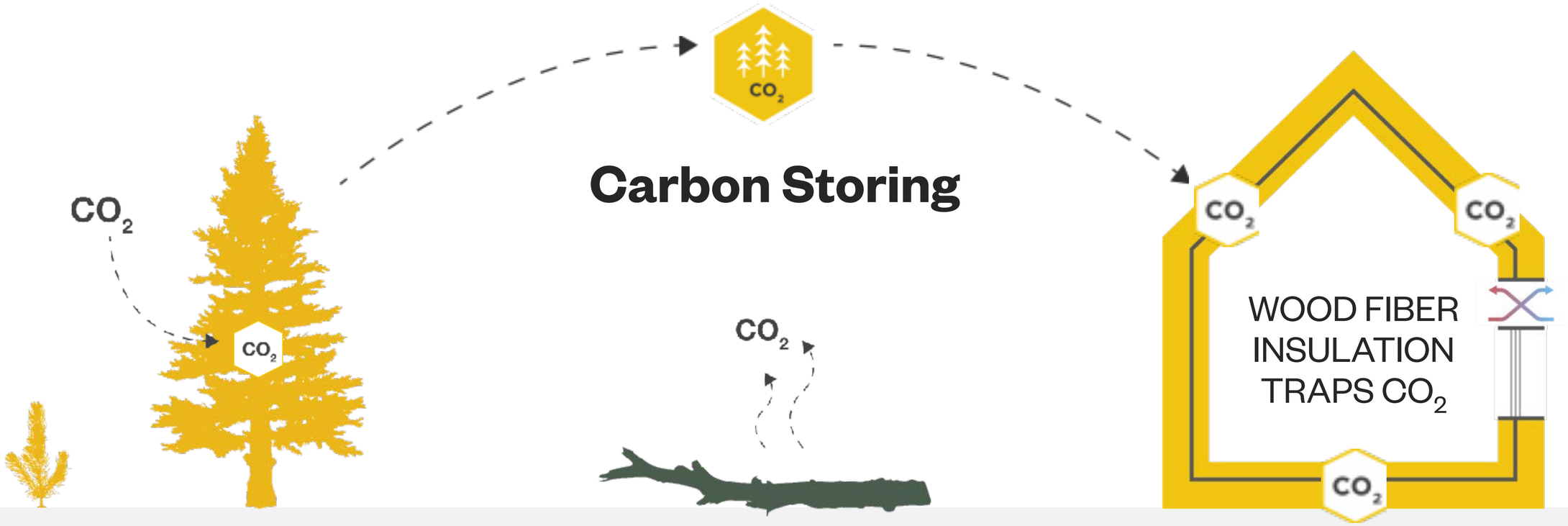


Source: IAL Consultants, Gupta-Verlag

Comparison to other insulation products:



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



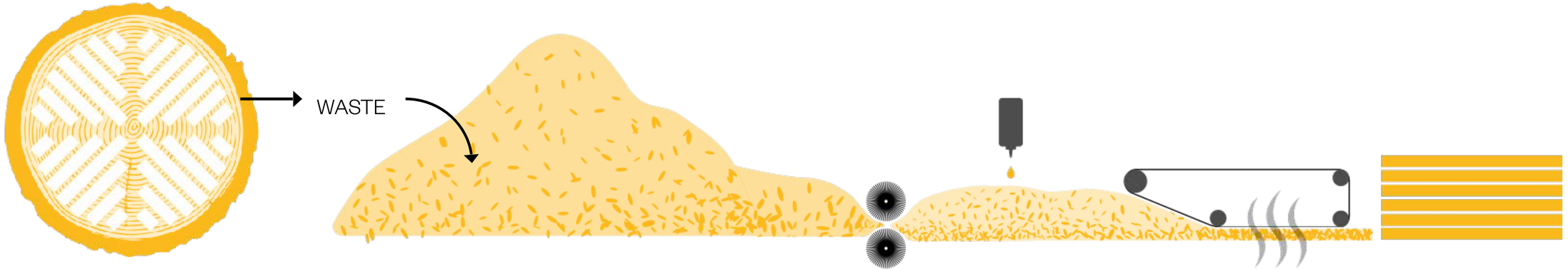
Atmospheric carbon dioxide is taken up by trees and, through photosynthesis, stored as carbon in biomass

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

Wood Fiber Insulation utilizes an existing waste stream as its primary feedstock

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



LUMBER IS MILLED FROM LOGS

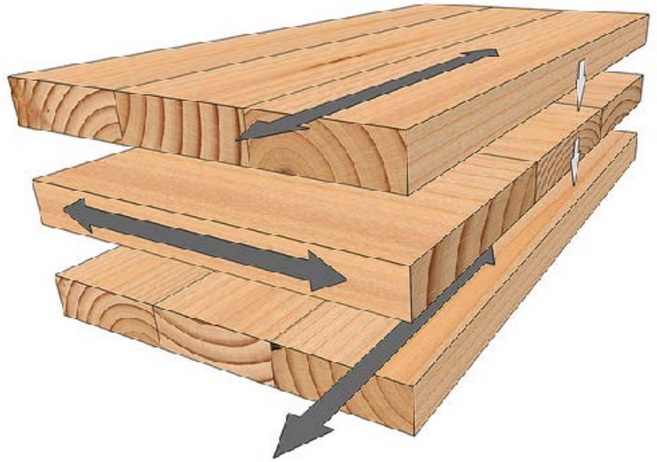
THE WASTE CHIPS ARE RECOVERED

FINELY GROUND

AND FORMED INTO INSULATION

+ CLT

- IBC-approved up to 18 stories
- NYC-approved up to 6 stories / 85ft
- Stores 590.97 kg CO2 eg/ 1 m^3
- 130 kg CO2 eg / 100 board feet
- 1.3 kg CO2 eg/ board foot
- Made from southern yellow pine, black spruce, doug fir, and other softwoods
- Able to be made from young, small-diameter trees
- Trees store most of their carbon in the first 5-10 years

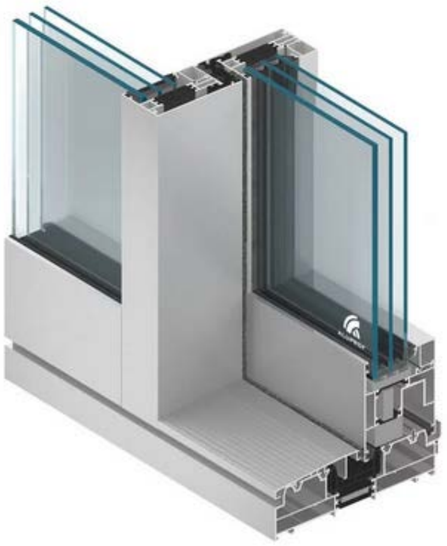


+ High-performance windows & doors

UPVC Windows

Aluminum Windows

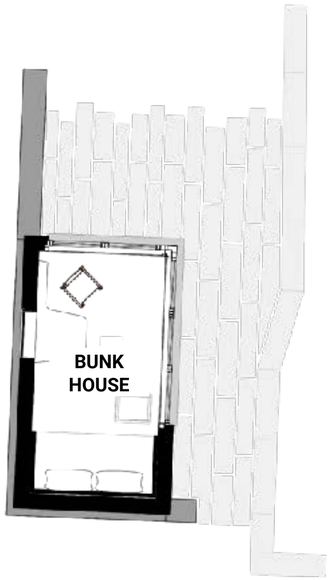
Aluminum swing door



Aluminum sliding door

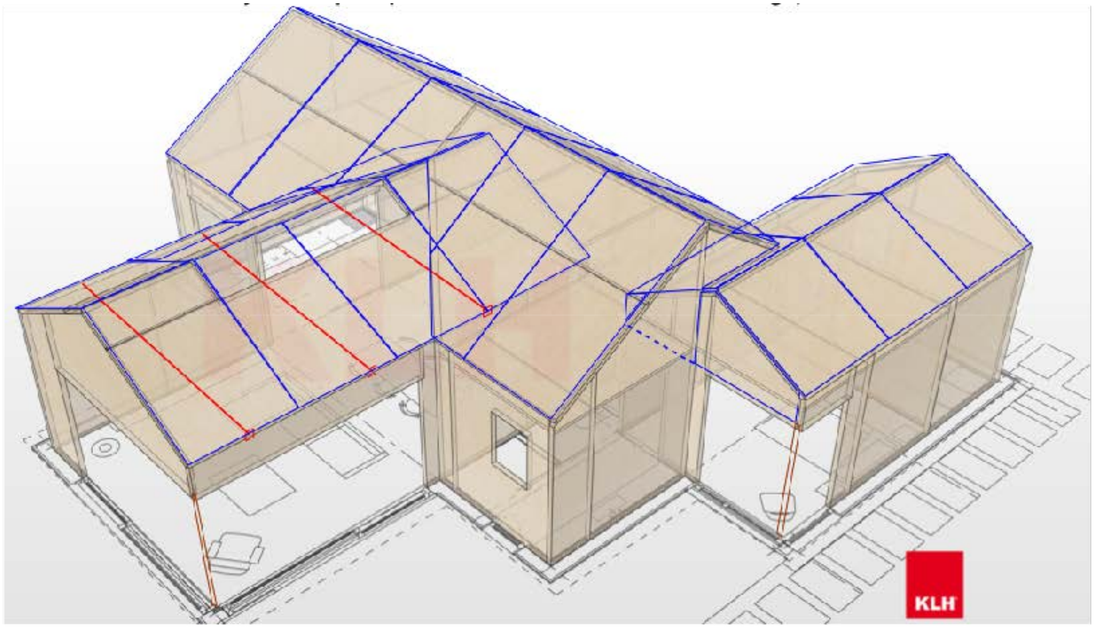
all wood,
all the time

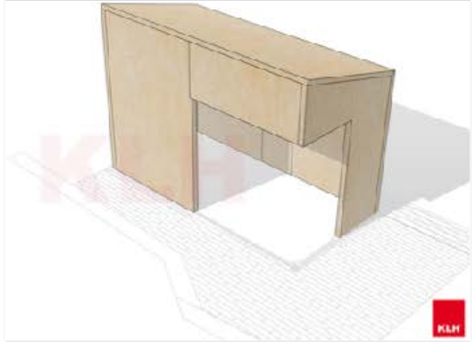
lake waramaug residence, CT

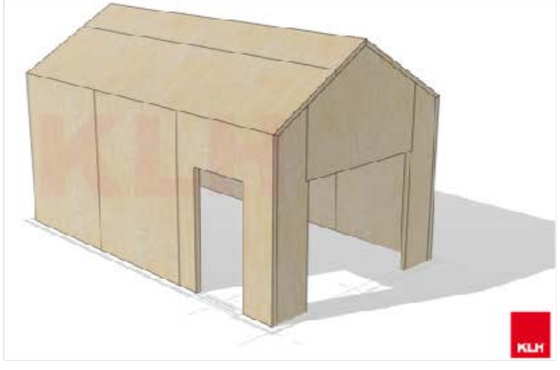


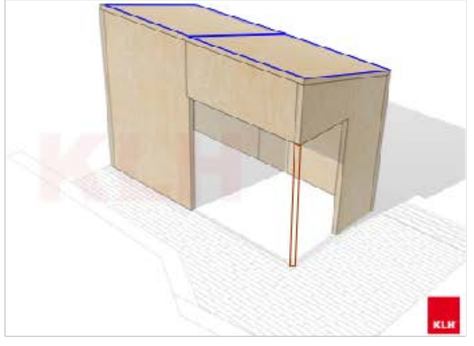
MAIN HOUSE AND BUNK HOUSE

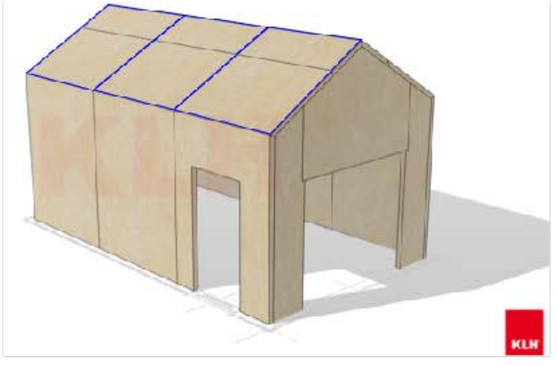
LAKE WARAMAUG RESIDENCE



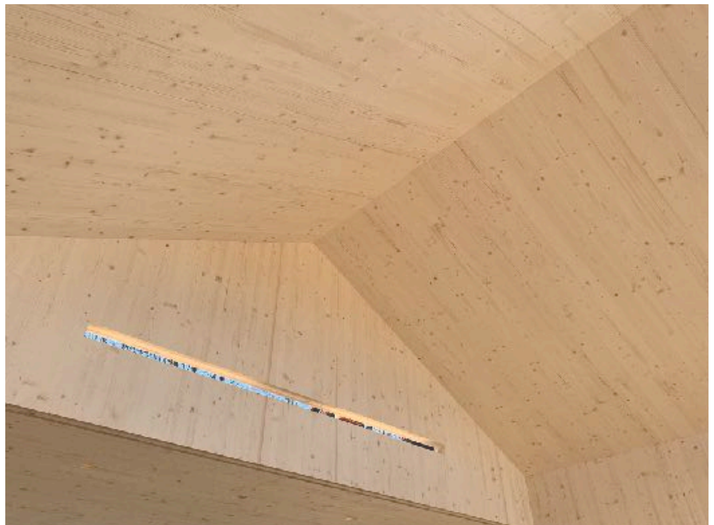


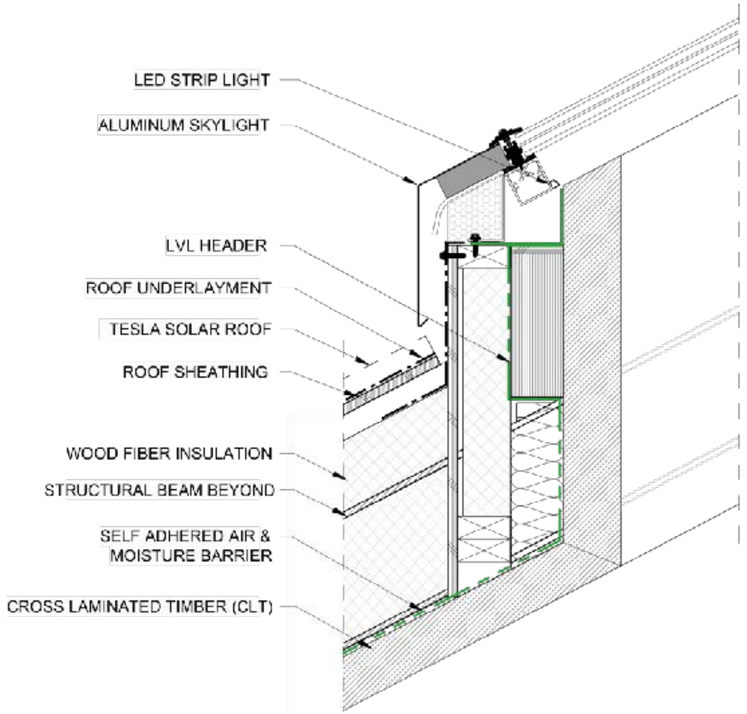


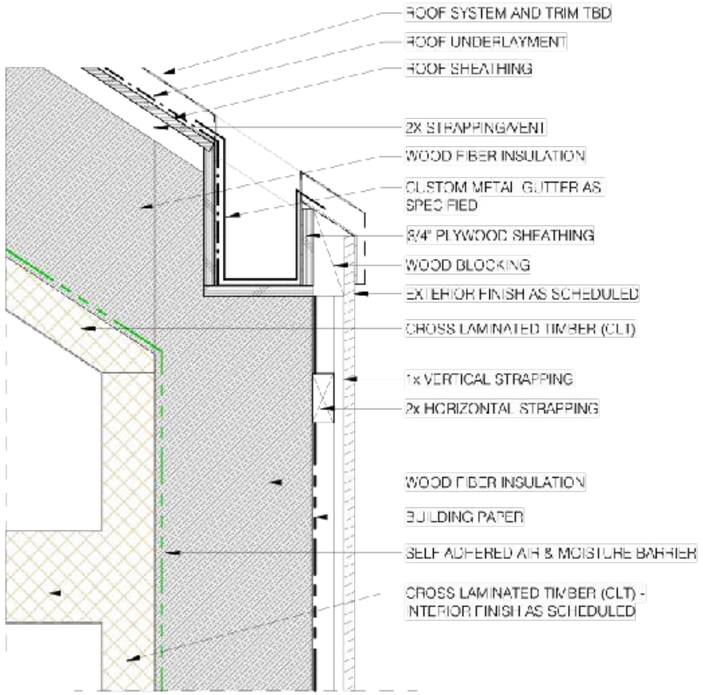


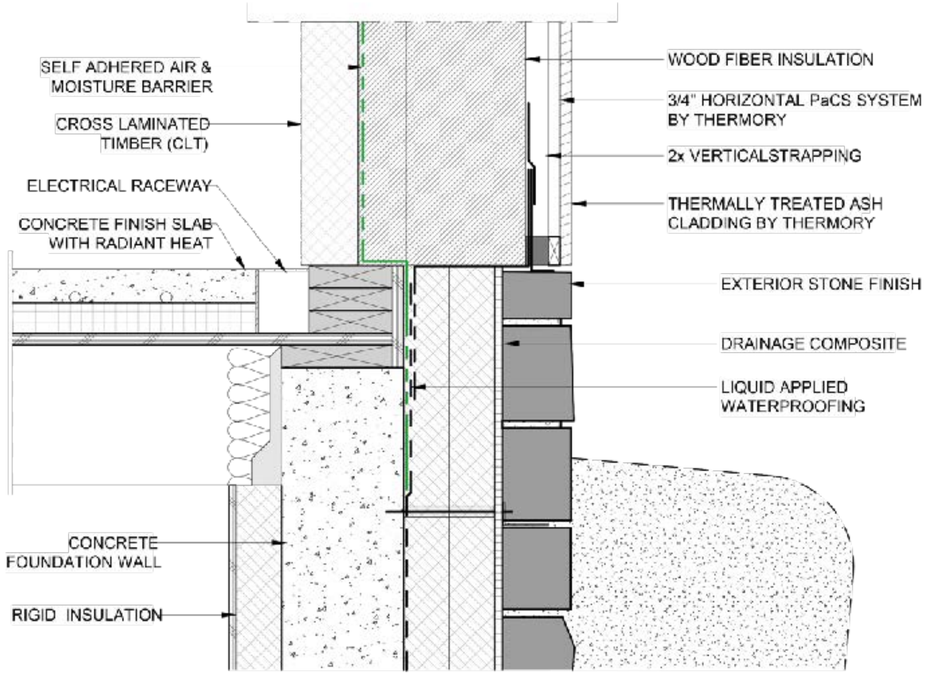


PROTOTYPE CLT CONSTRUCTION



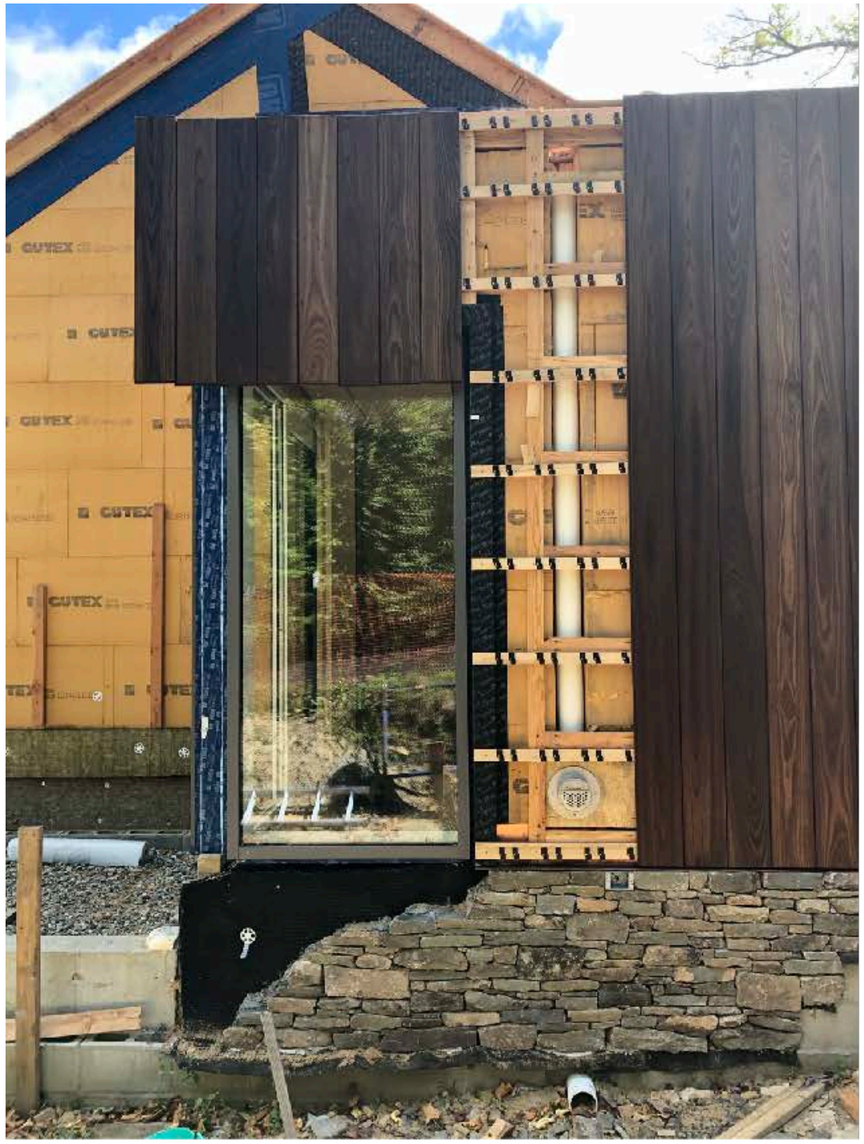


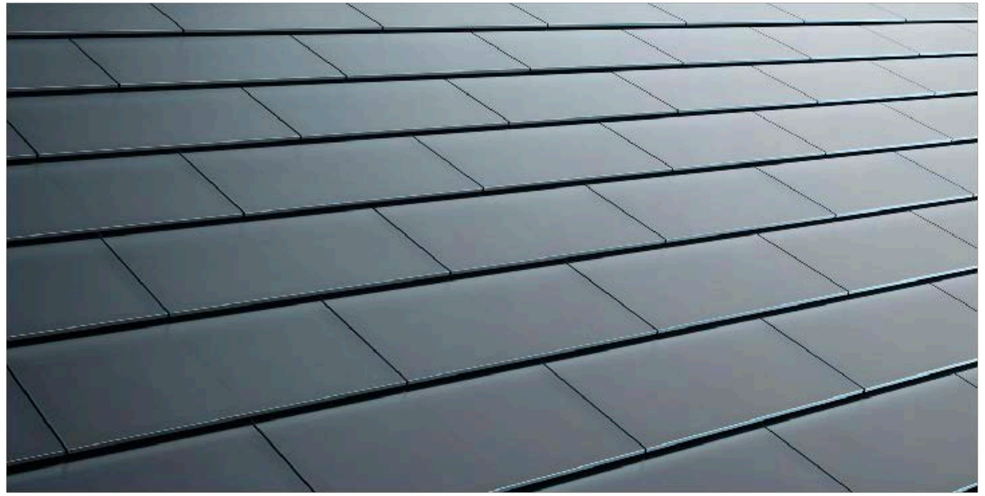


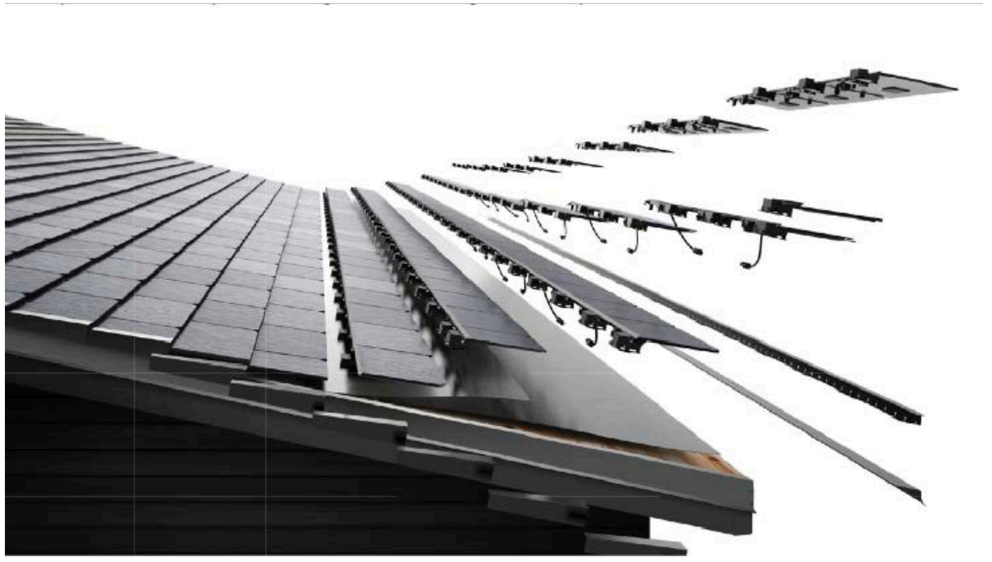


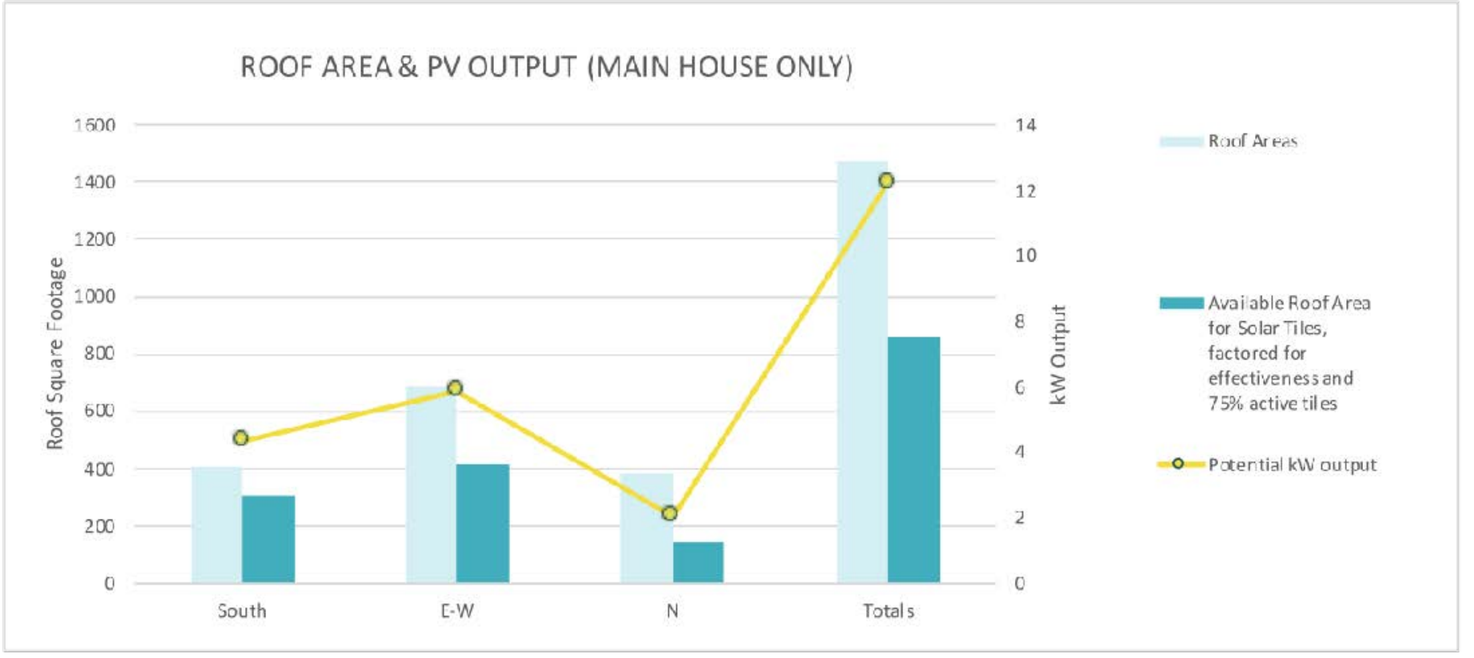
SECTION DETAILS

LAKE WARAMAUG RESIDENCE


CUTEX






ROOF AREA & PV OUTPUT (MAIN HOUSE ONLY)
Roof Square Footage
kW Output
1600
1400
1200
1000
800
600
400
200
0
14
12
10
8
6
4
2
0
South
E-W
N
Totals
Roof Areas
Available Roof Area for Solar Tiles, factored for effectiveness and 75% active tiles
Potential kW output

MASS OF WOOD PRODUCT

x

GWP PER MASS OF PRODUCT

Material mass data from internal LCA study using Tally 2017.

MASS OF WOOD PRODUCT

X

GWP PER MASS OF PRODUCT

↓

TOTAL GWP

22 TONS
CROSS-LAMINATED TIMBER

-25 TONS CO_{2e}

18 TONS
WOOOD FIBER INSULATION

-19 TONS CO_{2e}

10 TONS
OTHER WOOD PRODUCTS

-12 TONS CO_{2e}

Material mass data from internal LCA study using Tally 2017; wood fiber LCA data from 3rd party analyst (Sphera); Non WFI LCA data from internal study using Tally 2020

FULL BUILDING GWP ASSESSMENT

Account for GWP from all building materials, including concrete, steel and glazing

Wood fiber LCA data from 3rd party analyst (Sphera); Non-WFI LCA data from internal study using Tally 2020

79 tCO_{2e}

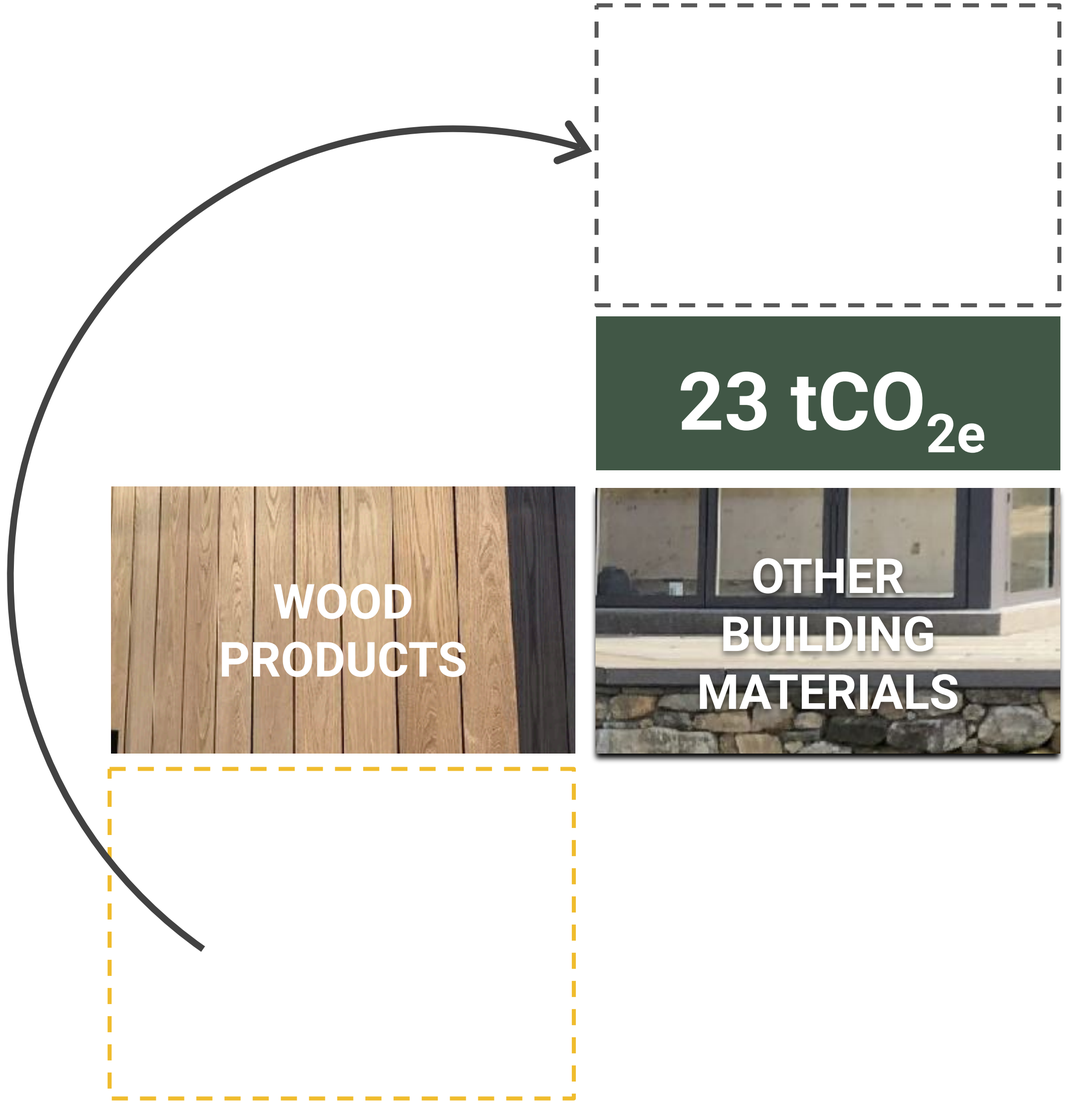
EMBODIED GWP FROM BUILDING MATERIALS

- 56 tCO_{2e}

SEQUESTERED GWP FROM WOODEN MATERIALS

23 tCO_{2e}

BUILDING EBODIED GWP



Wood fiber LCA data from 3rd party analyst (Sphera); Non-WFI LCA data from internal study using Tally 2020

ANNUAL OPERATIONAL GWP ASSESSMENT

Account for the building's primary energy consumption, including losses during transformation and distribution of energy.

0.66 kg CO_{2e}
Per SF/yr

0.22 kg CO_{2e}
Per SF/yr

0.04 kg CO_{2e}
Per SF/yr

0.44 kg CO_{2e}
Per SF/yr

-3.4 kg CO_{2e}
Per SF/yr

Energy-related LCA data from internal energy and GWP models

2,387 kg CO_{2e}
ANNUAL OPERATIONAL GWP

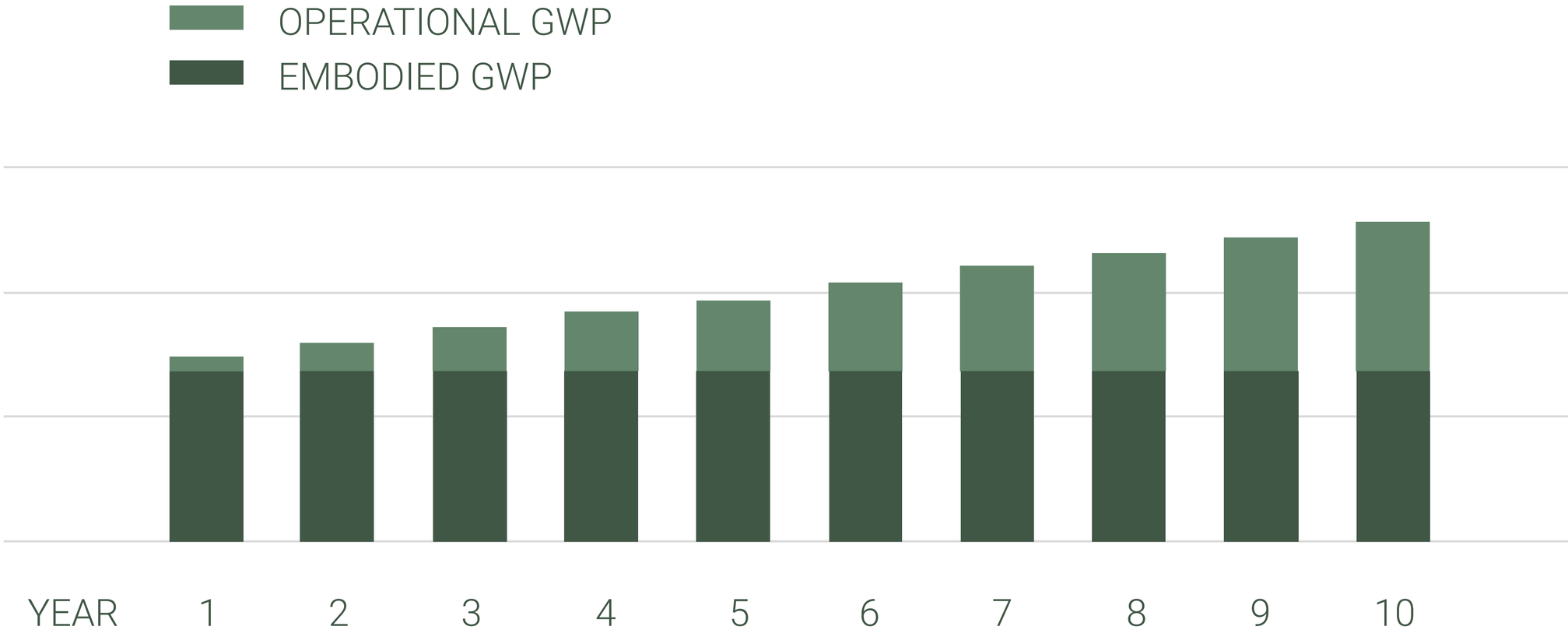
- 6,084 kg CO_{2e}
ANNUAL PV GWP PRODUCTION

- 3,697 kg CO_{2e}
NET GWP PRODUCTION

- 2.04 kg CO_{2e}
Per SF/yr

Energy-related LCA data from internal energy and GWP models

10 YEARS CUMULATIVE GWP



Energy-related LCA data from internal energy and GWP models

10 YEARS CUMULATIVE GWP

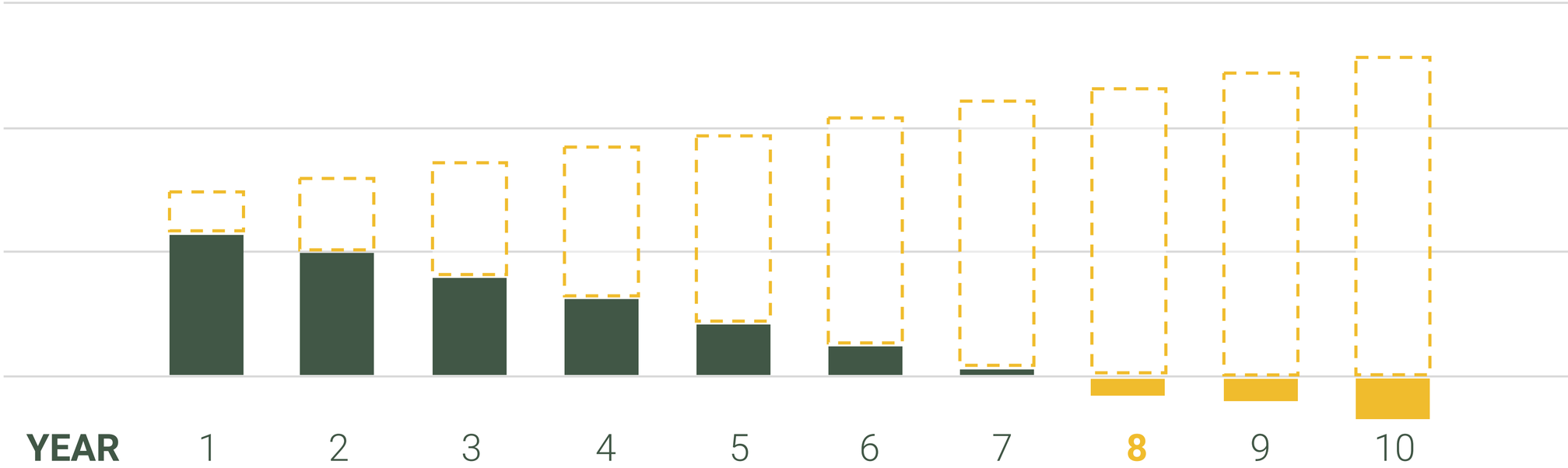
OPERATIONAL GWP

EMBODIED GWP

PV PRODUCTION GWP

CARBON PAYBACK

8 YEARS



Energy-related LCA data from internal energy and GWP models


WORLD CHANGING