Local and Resilient: Biobased Building in California

AIAEB
ZNCD
Day

April. 2, 2025

David Arkin, AIA, LEED AP – Arkin Tilt Architects

Remaining Global Emissions Budget

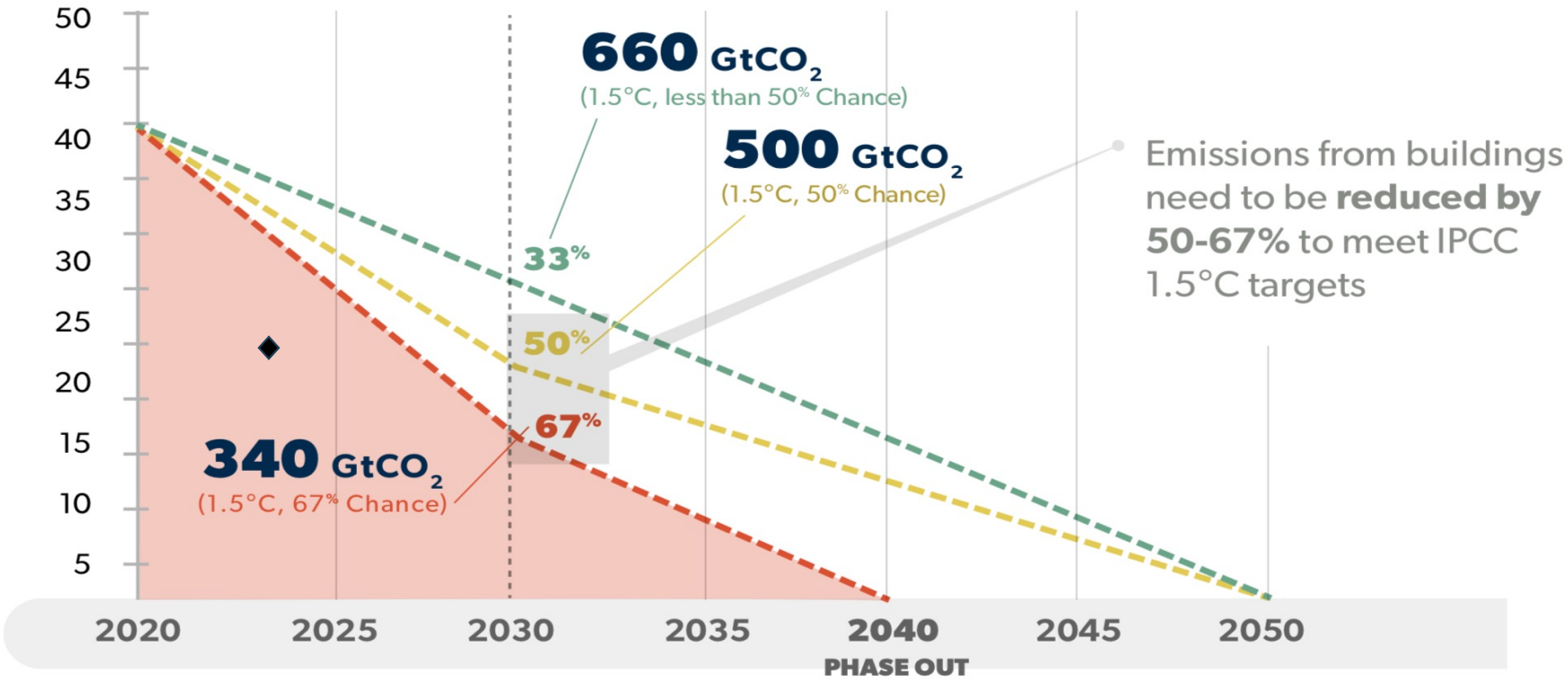
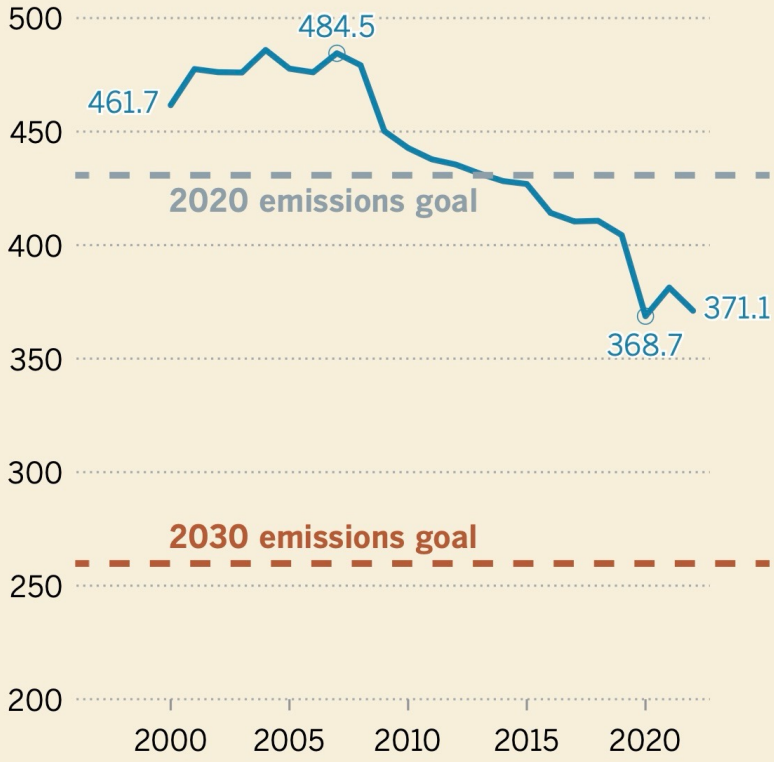


Figure 1: Emission reduction pathways to meet IPCC 1.5C targets Adapted from Architecture 2030.

California's greenhouse gas emissions decreased 2.4% in 2022

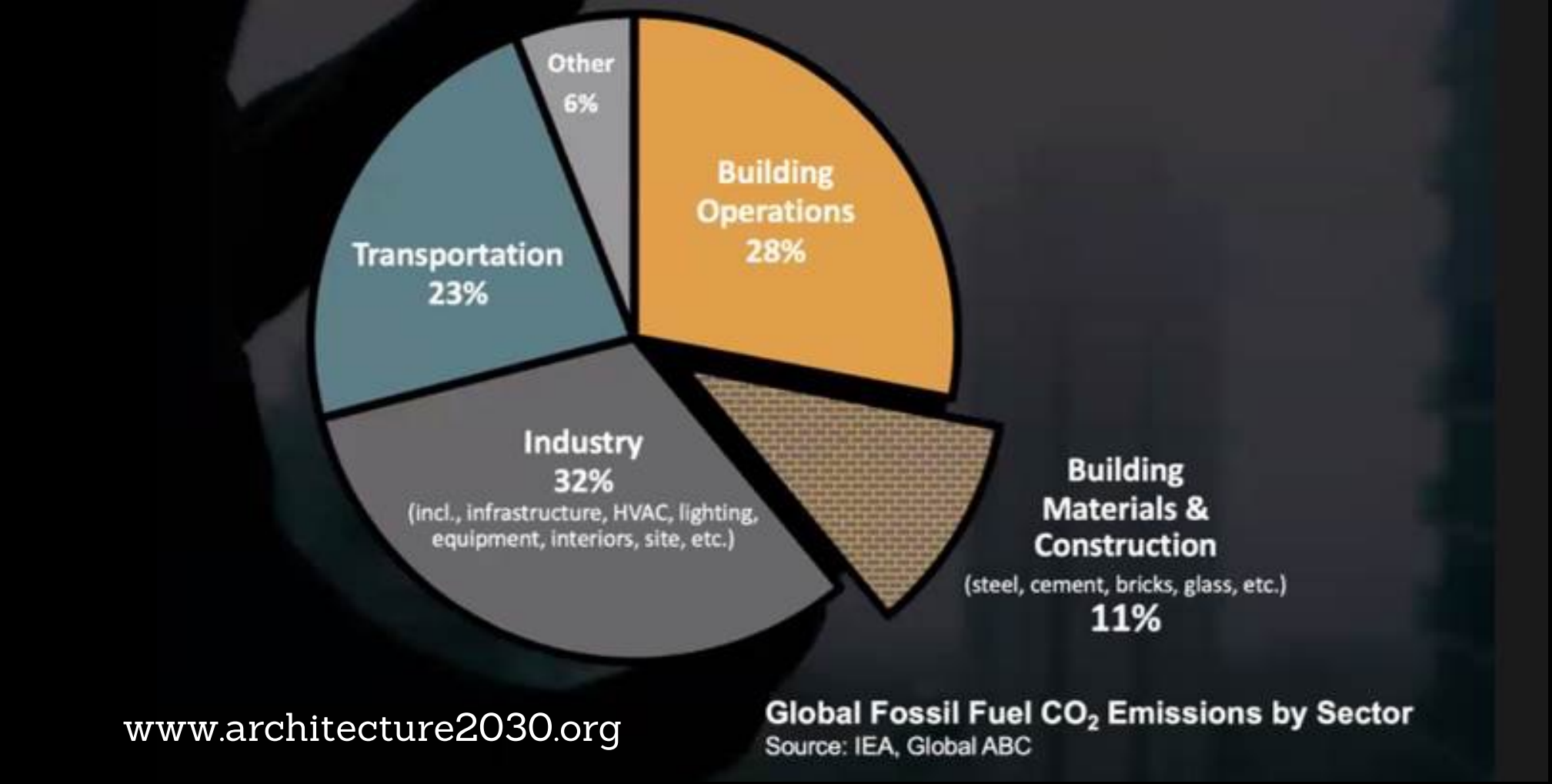
Metric tons of carbon dioxide equivalent, in millions



California Air Resources Board

Sean Greene LOS ANGELES TIMES

L.A. Times – Oct. 2024



www.architecture2030.org

Energy Use Intensity – E U I

kBTU/ft^2/year

Operational Carbon Impacts due to Energy Consumption including:

- Heating, Ventilation and Air Conditioning
- Lighting Loads
- Equipment and Plug Loads
- Other Ongoing Energy Needs Tied to Building Operation

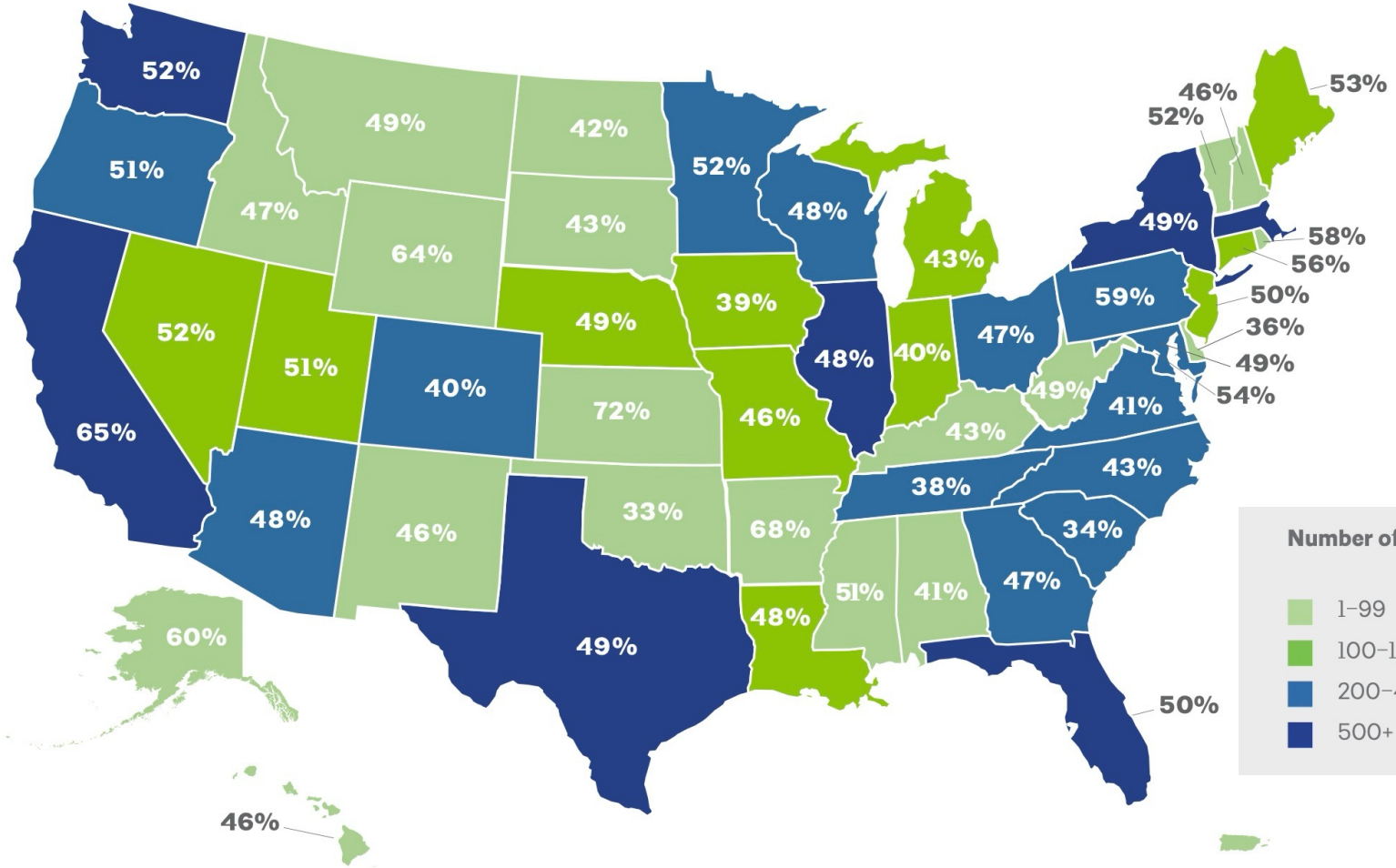
Pathway to zero emissions

Energy Efficiency + **Electrification** + **Renewable Energy**

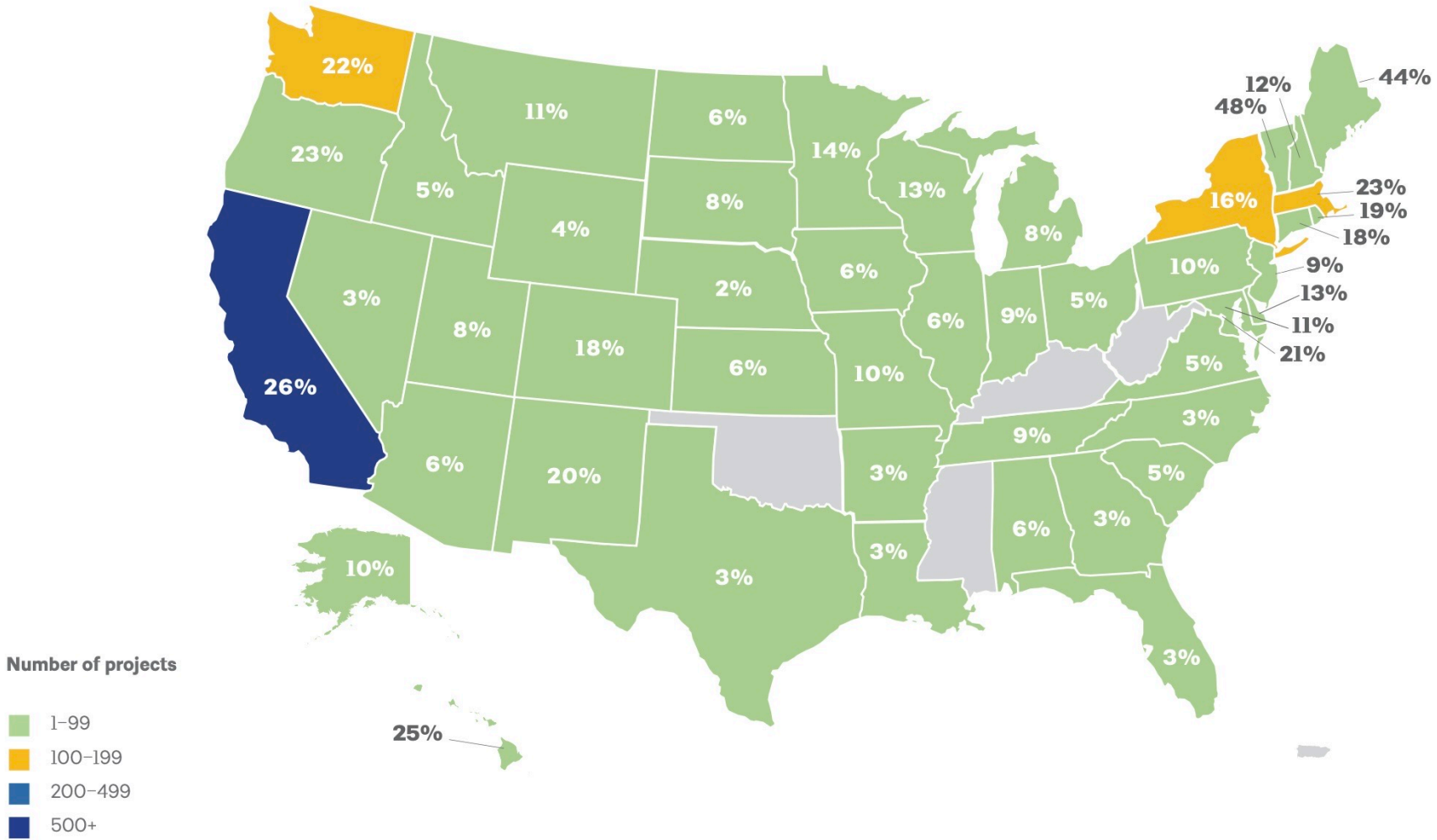
Achieving zero emissions from new buildings will require energy efficient buildings that use no on-site fossil fuels and are 100% powered by on- and/or off-site renewable energy.

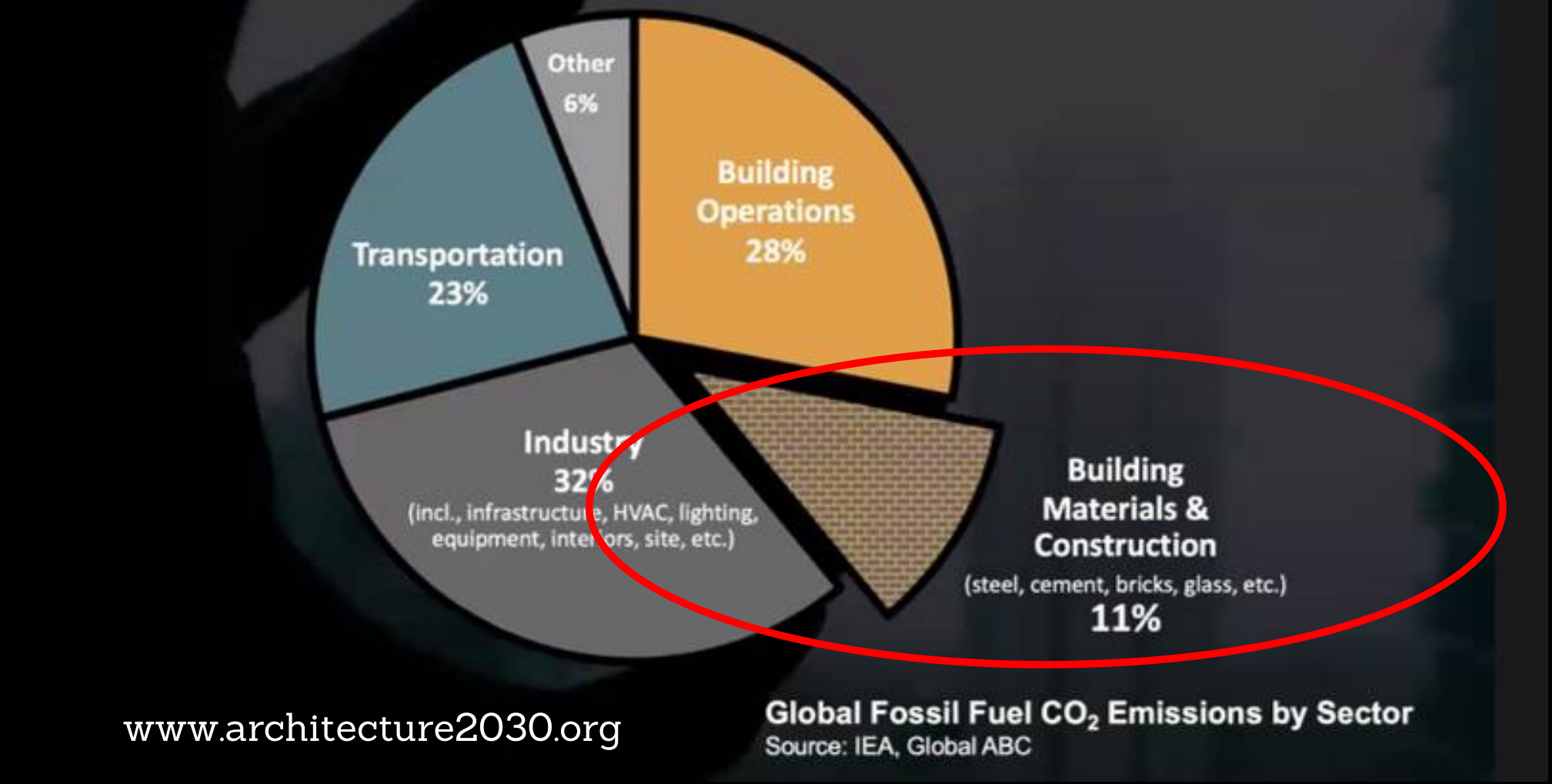
https://www.aia.org/design-excellence/climate-action/zero-carbon/2030-commitment

pEUI % REDUCTION BY STATE



PERCENTAGE OF TOTAL PROJECTS WITH RENEWABLE ENERGY BY U.S. STATE





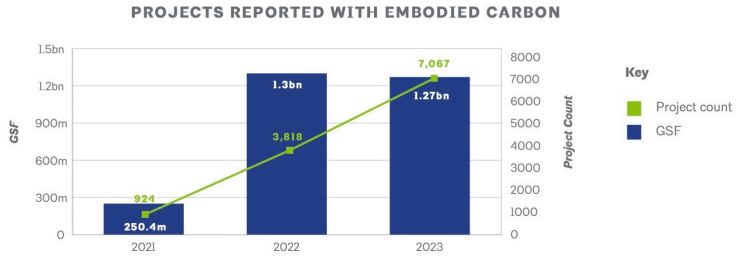
www.architecture2030.org

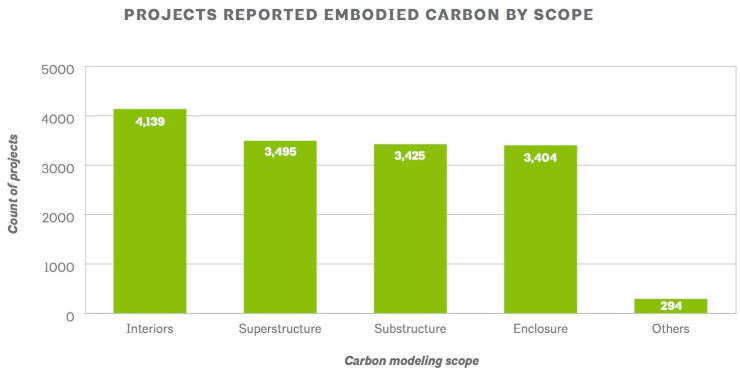
Embodied Carbon Intensity – E C I

$kgCO^2e/m^2$

Carbon Embodied in the Extraction, Production and Transport of Building Materials and Construction Activities, including:

- Excavation and Site Development Impacts
- Manufacturing and Transport of All Building Materials
- Energy Use During Construction (fuel and electricity)



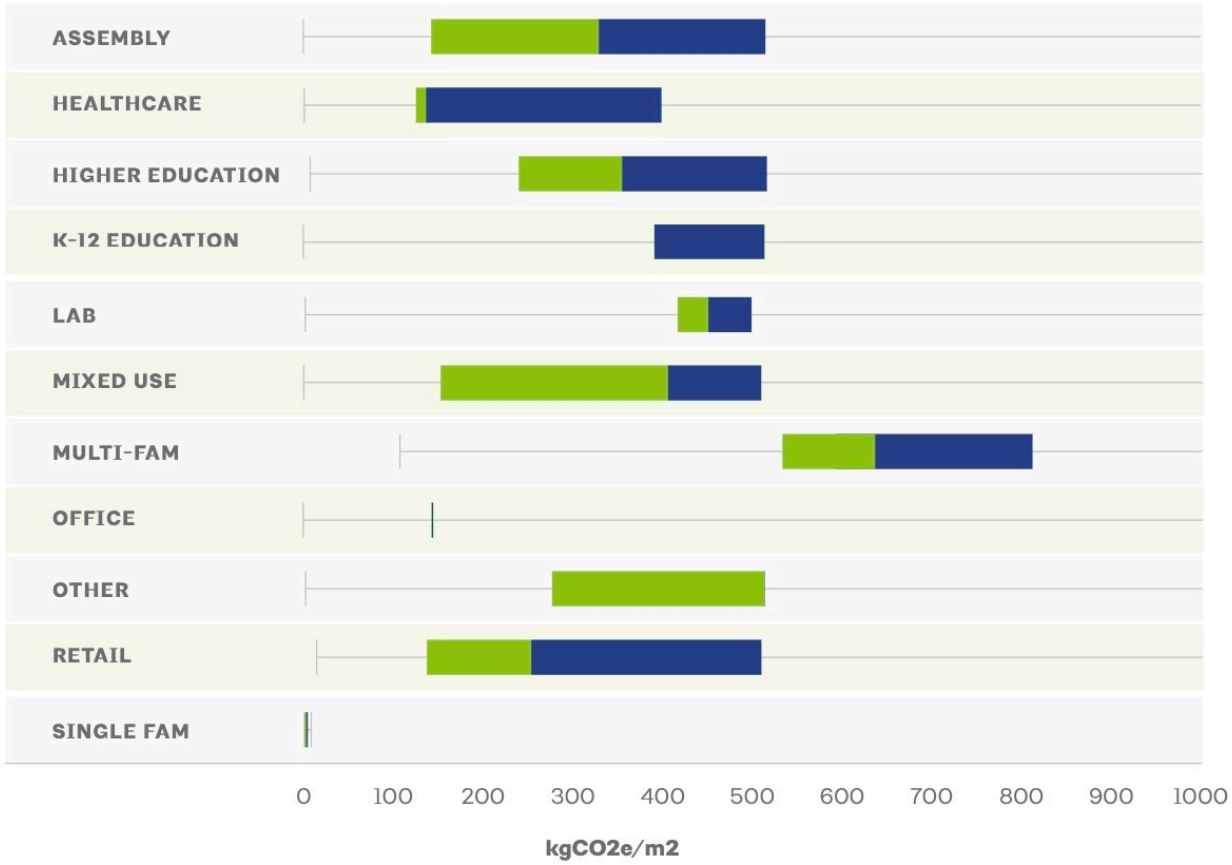


NUMBER OF PROJECTS REPORTED BY EMBODIED CARBON CALCULATION TOOL

Tool	2021	2022	2023
Tally	195	278	5,655
Build Carbon Neutral	317	398	382
EPIC Tool	-	-	296
OneClick	63	114	268
Other	136	2,940	247
cove.tool	-	-	41
CARE Tool	-	-	40
BEAM	-	-	33
EC3	200	48	29
Athena	12	34	26
TallyCAT	-	-	22
TallyLCA	-	-	12
ECOM	-	-	8
eTool	1	6	6
Autodesk Insight	-	-	2
Total	**924**	**3,818**	**7,067**

www.aia.org/resources/202041-the-2030-commitment

REPORTED EMBODIED CARBON INTENSITY BY USE TYPE IN $kgCO_2e/m2$



±400 kgCO2e/m2 average / ±200 kgCO2e/m2 low rise

Building LCA and Embodied Carbon Tools

EC3

Free
Web-based
Bim360 and Tally Import
Construction-focused
Focuses on Manufacturing Stage
Good for Commercial Buildings

Built-in EC3 Plug-in

OneClick LCA

Paid
Web-based
Imports from many tools
Design and construction focused
Good for all building types

Tally

Paid
Revit plug-in
Design-focused
Covers all Life Cycle Stages
Good for Commercial Buildings

EPIC

Free (beta)
Early Phase Integrated Carbon
First step strategies and targets
Not high-resolution or LCA

Building LCA and Embodied Carbon Tools

Athena Impact Estimator

Free
Standalone
Design-focused
Covers all Life Cycle Stages
Good for Commercial and Residential

BEAM

Free
Excel-based
Design-focused
Focused on manufacturing impacts
Good for Residential Buildings

Tally

Paid
Revit plug-in
Design-focused
Covers all Life Cycle Stages
Good for Commercial Buildings

Cardinal LCA

Free
Rhino plug-in
Focused on conceptual design
Manufacturing, Use, End-of-Life Stages
Good for Commercial Buildings

Building LCA and Embodied Carbon Tools

CARE TOOL

Free
Renovation Specific
Compares to Building New
Not high-resolution or LCA

BEAM

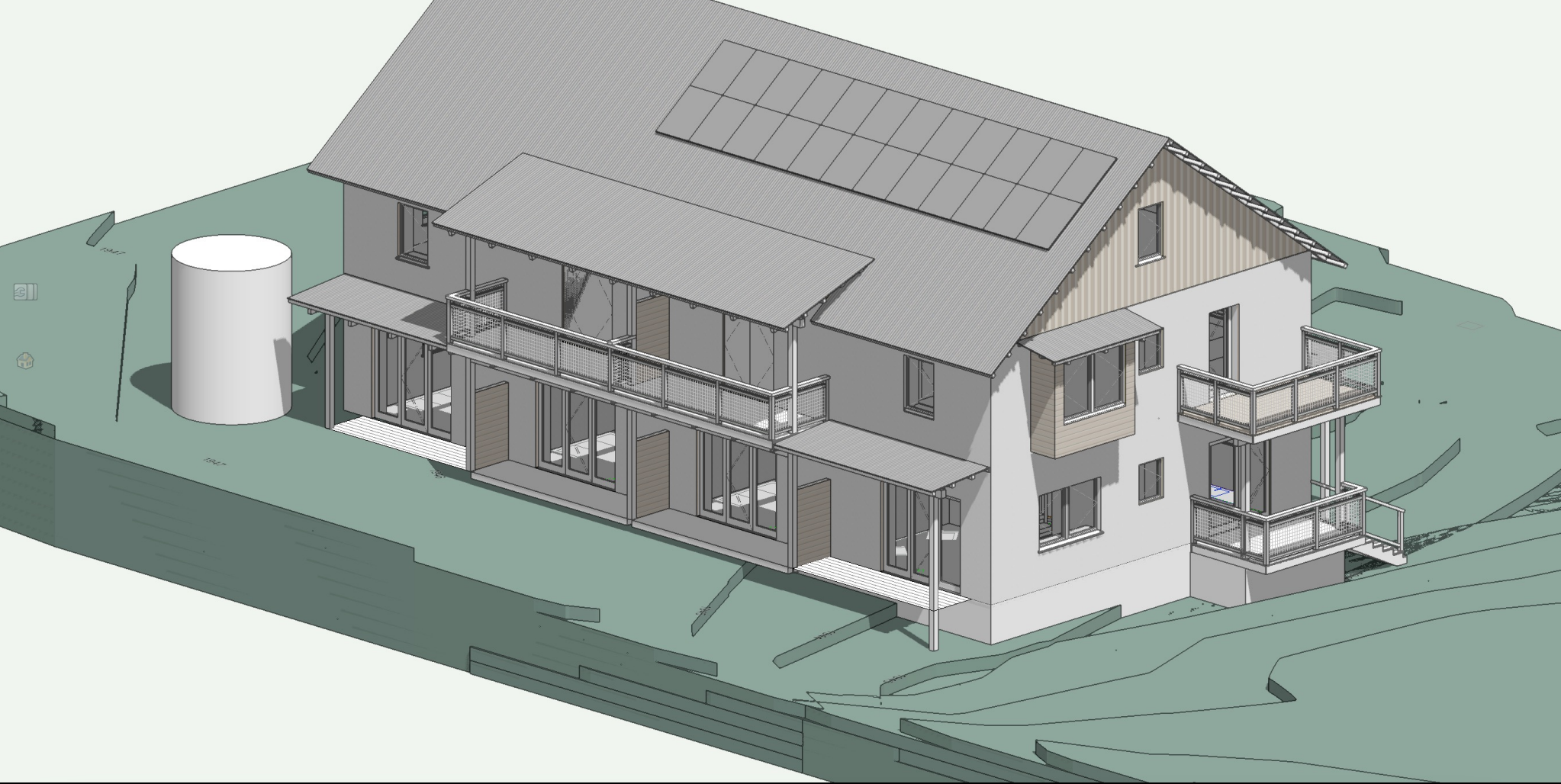
Free
Excel-based
Design-focused
Focused on manufacturing impacts
Good for Residential Buildings

VectorWorks

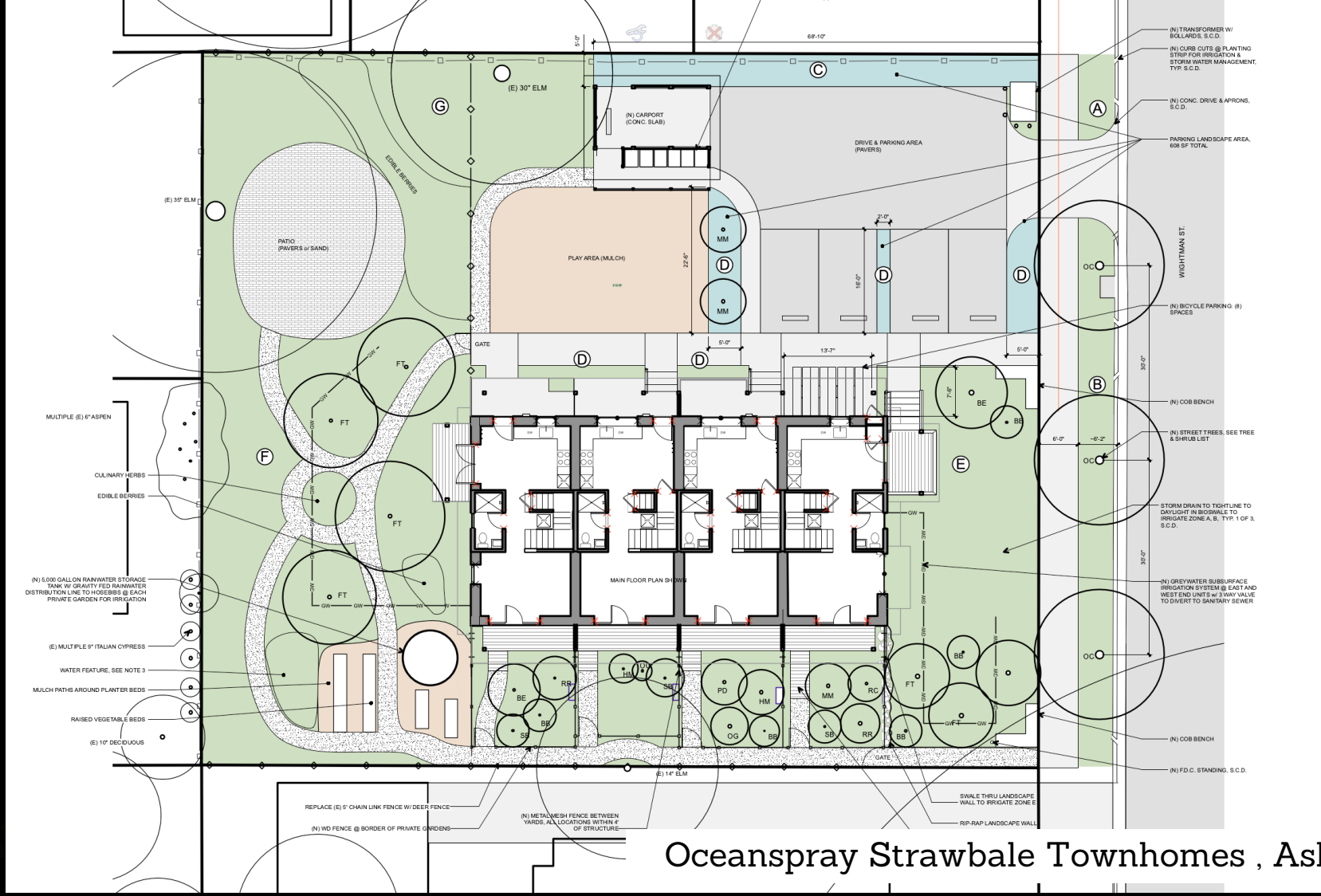
Built-in Plug-in to CAD Program
Bath Inventory of Carbon & Energy (ICE)
Covers all phases including Transportation
Inputs from BIM Takeoffs

EPIC

Free (beta)
Early Phase Integrated Carbon
First step strategies and targets
Not high-resolution or LCA



Oceanspray Strawbale Townhomes , Ashland, OR

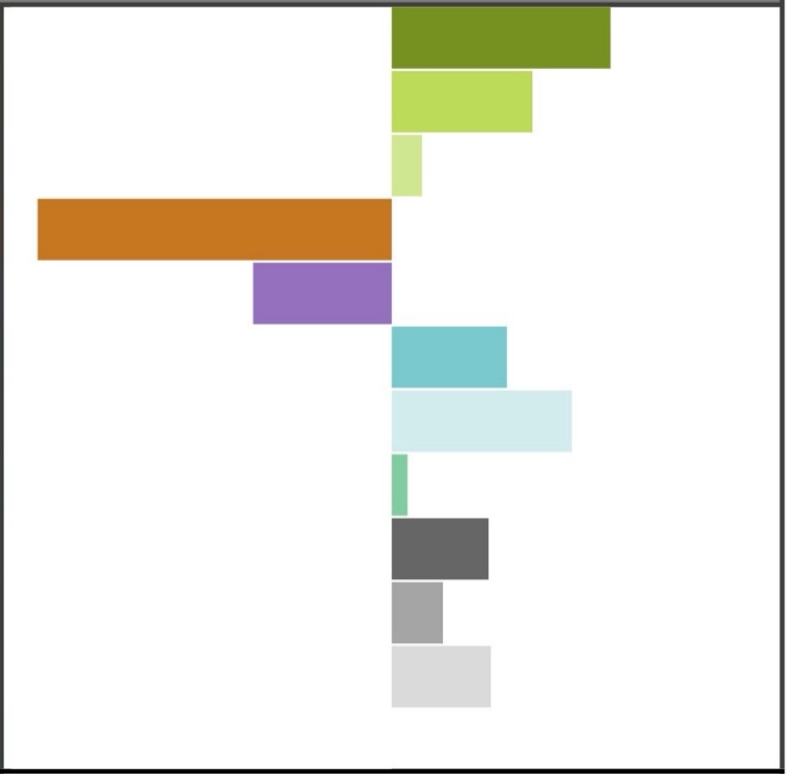


Oceanspray Strawbale Townhomes , Ashland, OR

Oceanspray Townhomes – Ashland, Oregon

MATERIAL CARBON EMISSIONS BY SECTION

Footings & Slabs	5,749	kg CO_2e
Foundation Walls	3,699	kg CO_2e
Structural Elements	798	kg CO_2e
Exterior Walls	-9,305	kg CO_2e
Party Walls	-3,642	kg CO_2e
Exterior Wall Cladding	3,028	kg CO_2e
Windows	4,734	kg CO_2e
Interior Walls	418	kg CO_2e
Floors	2,545	kg CO_2e
Ceilings	1,344	kg CO_2e
Roof	2,603	kg CO_2e
Garage	0	kg CO_2e
NET TOTAL	**11,972**	kg CO_2e



25 kgCO2e/m2

MATERIAL CARBON RESULTS

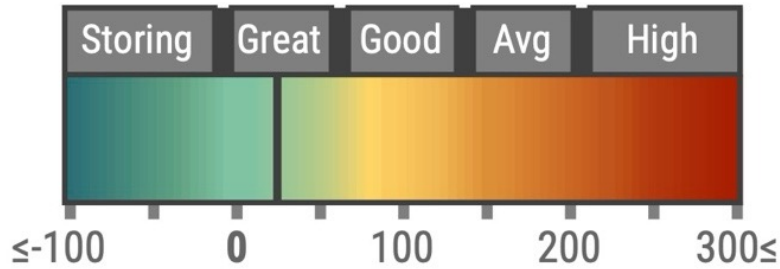
MCE

Net Project Emissions	**11,972**	**kg CO_2e**

MCI (Conditioned)

25	**kg CO_2e/m^2**

MCI by Area Type	Metric	Imperial
Total Area	**20.7**	**4.2**
Conditioned Area	**25.3**	**5.2**
	kg CO_2e/m^2	lb CO_2e/ft^2



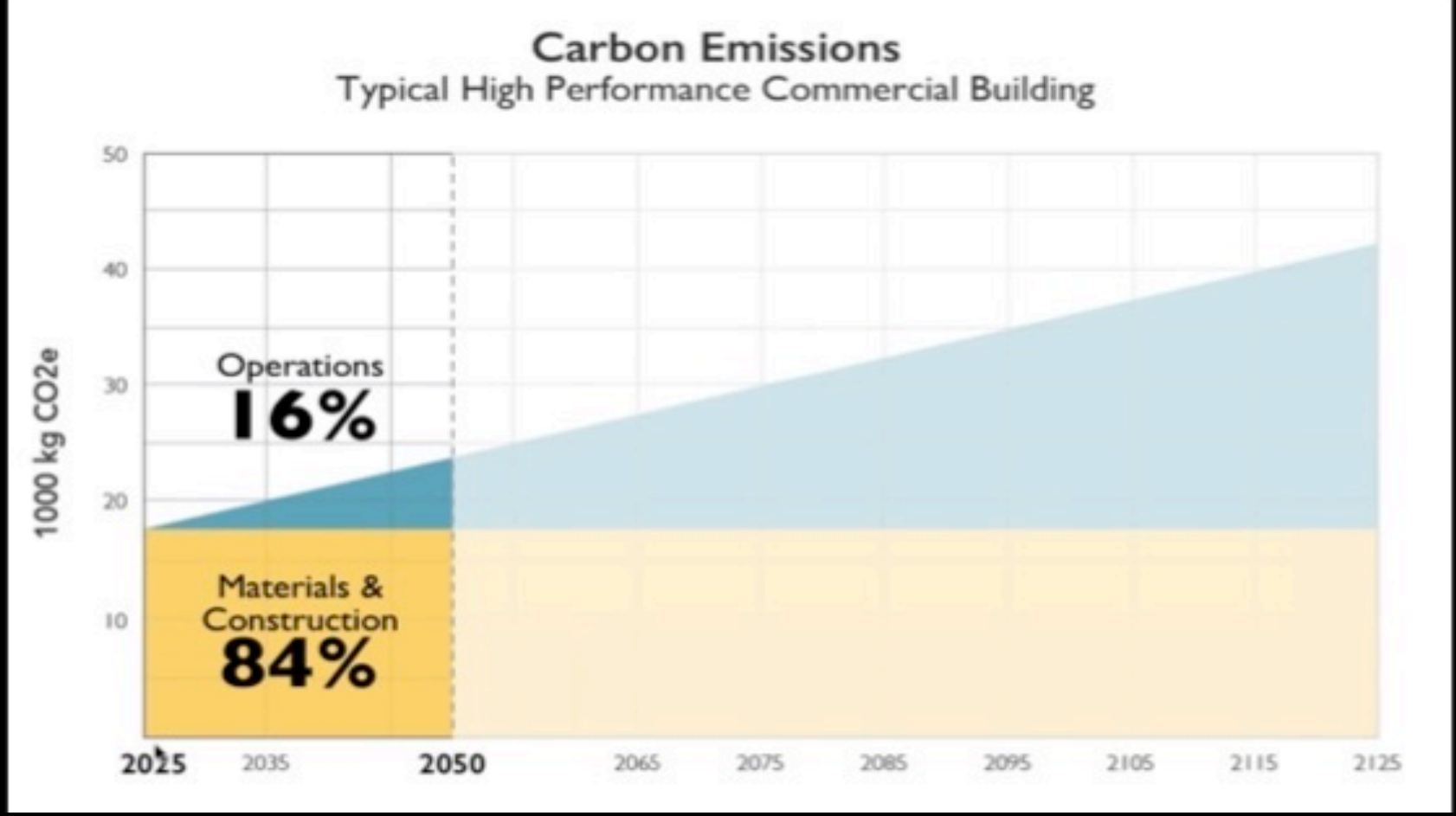
MCE: Material Carbon Emissions (net total)

MCI: Material Carbon Intensity (MCE per unit area)

BASELINE EUI: ±400 kgCO2e/m2 average / ±200 kgCO2e/m2 low rise

Oceanspray Townhomes – Ashland, Oregon

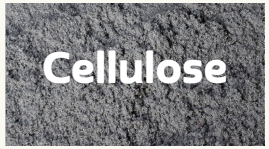
283
285



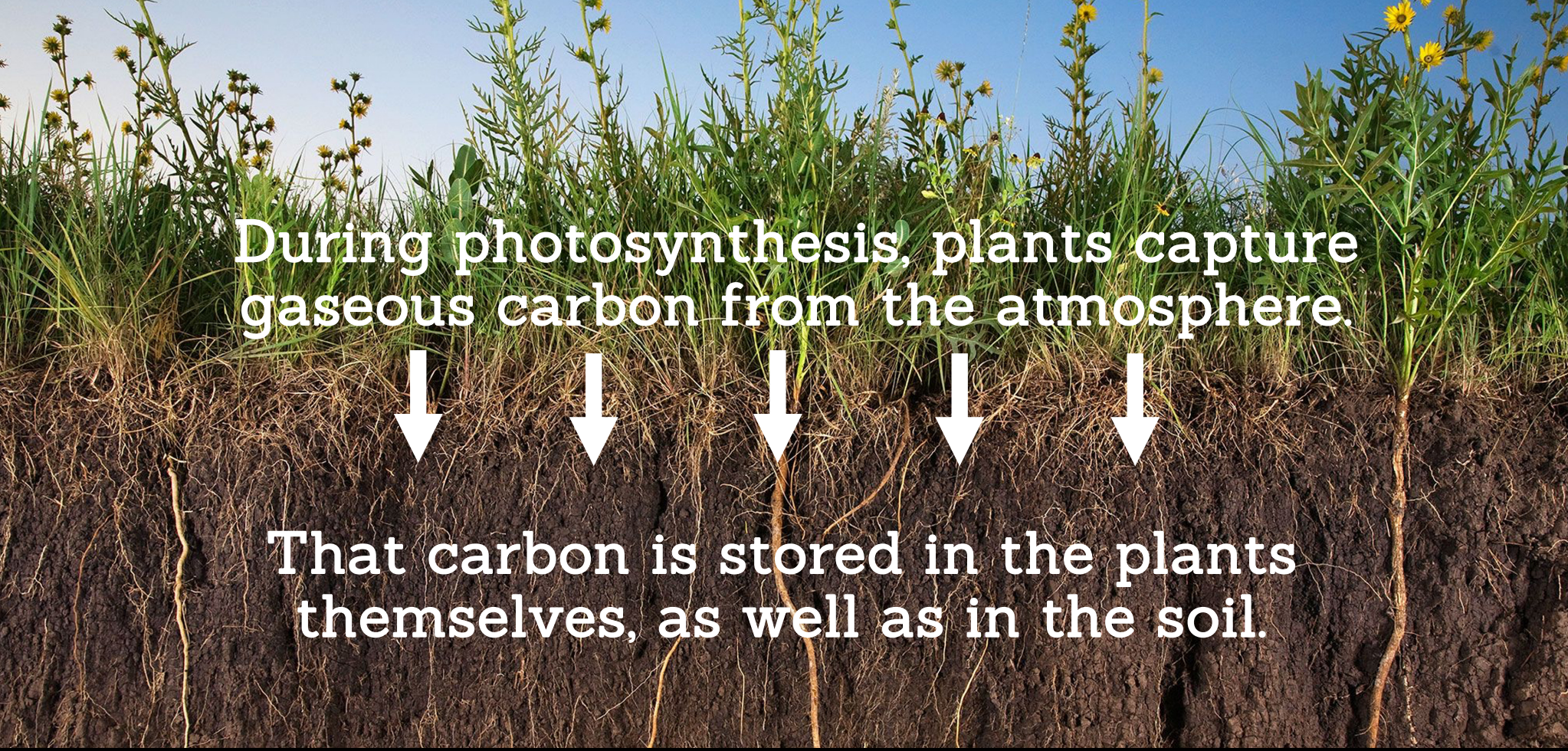
www.architecture2030.org

Definition of Bio-Based Materials

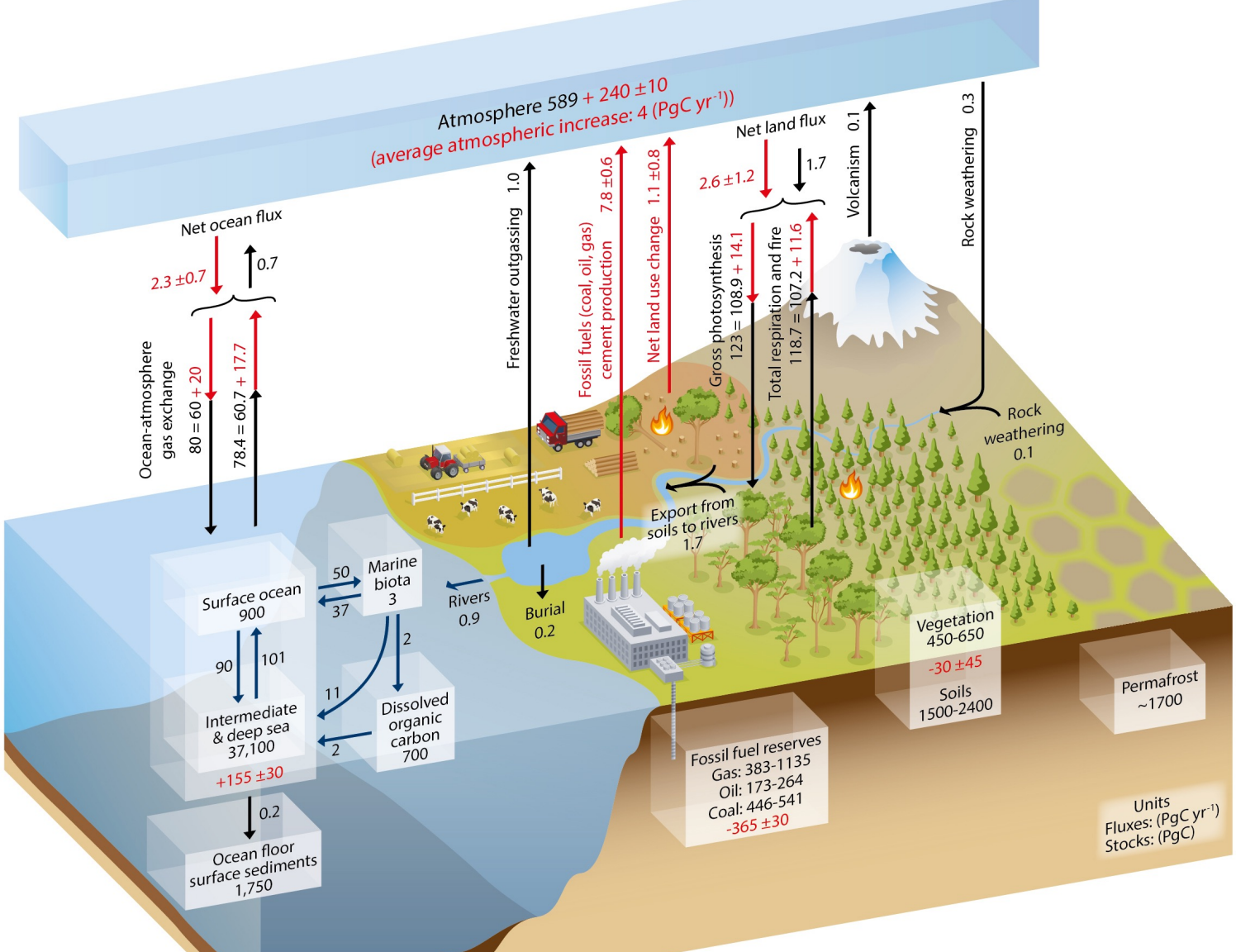
The USDA (United States Department of Agriculture) defines bio-based as products made from renewable biological resources. These products are derived from plants, animals, marine, or forestry materials, and provide an alternative to petroleum-based ones. Bio-Based specifically applies to materials or products with primary content derived from biological sources rather than fossil resources.



There are lots of plant-based, carbon-storing building materials, which are healthier and safer too!


During photosynthesis, plants capture gaseous carbon from the atmosphere.
That carbon is stored in the plants themselves, as well as in the soil.

2.16 billion tons of grain straw were grown globally in 2016. That's enough carbon storage to offset all current transportation GHG emissions and more than replace all current insulation materials.



Earth's Five Natural Carbon Sinks

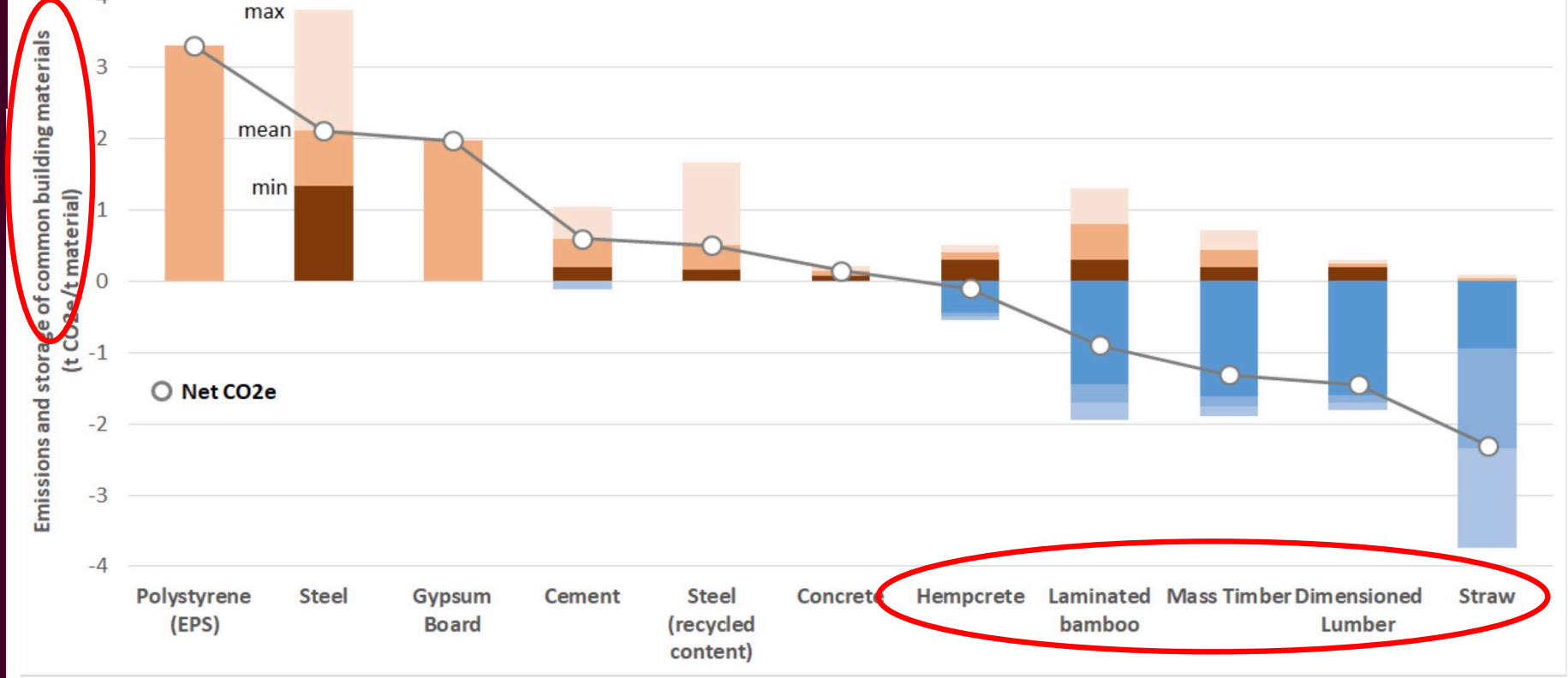
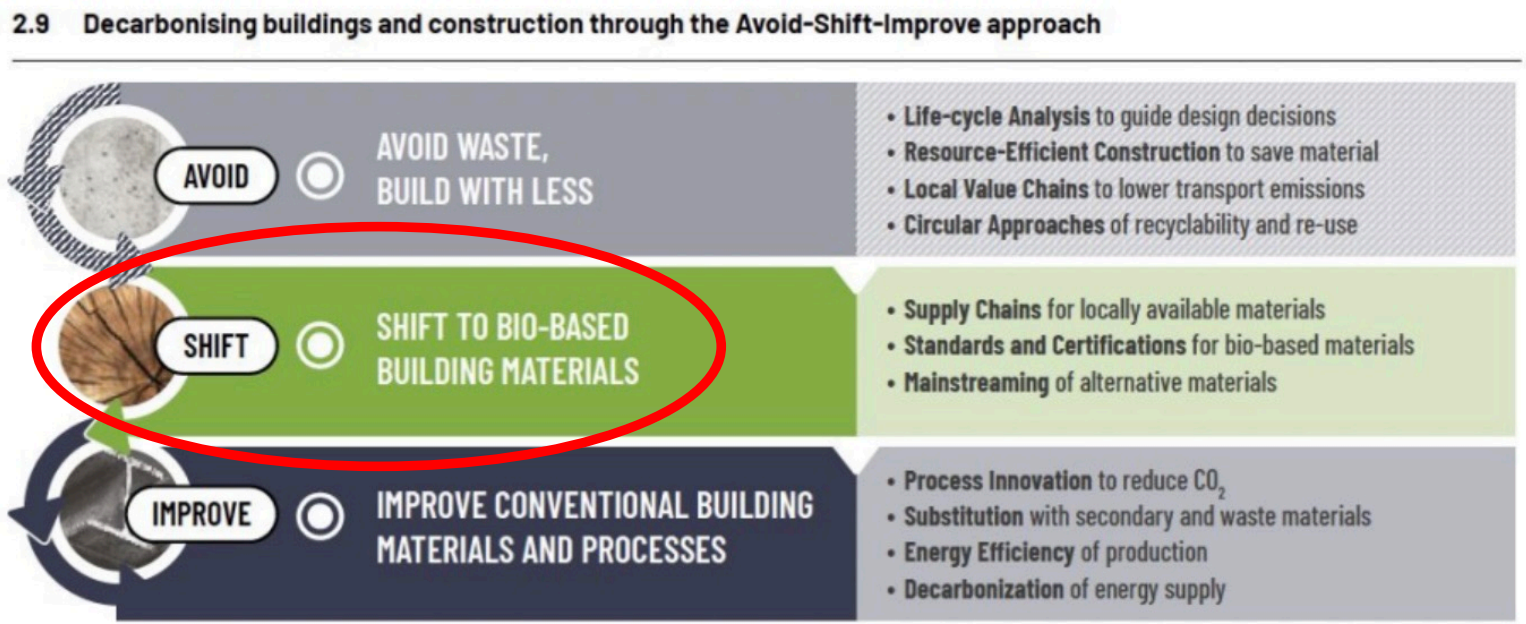


Figure 1. CO_2 emissions and CO_2 storage capacity of building materials where the net CO_2e is the difference between the mean emissions estimate and the mean storage estimate. Data from ref [13] and [14] evaluated on a life cycle assessment system boundary of A1-A3 (see Figure 2, below).

Buildings Can Become the Earth's Sixth Carbon Sink



GlobalABC Report on Building Materials and Climate – www.globalABC.org

ECHO PROJECT

Embodied Carbon Harmonization and Optimization

a collaboration between:

AIA

Materials Pledge Signatory

Human Health

Climate Health

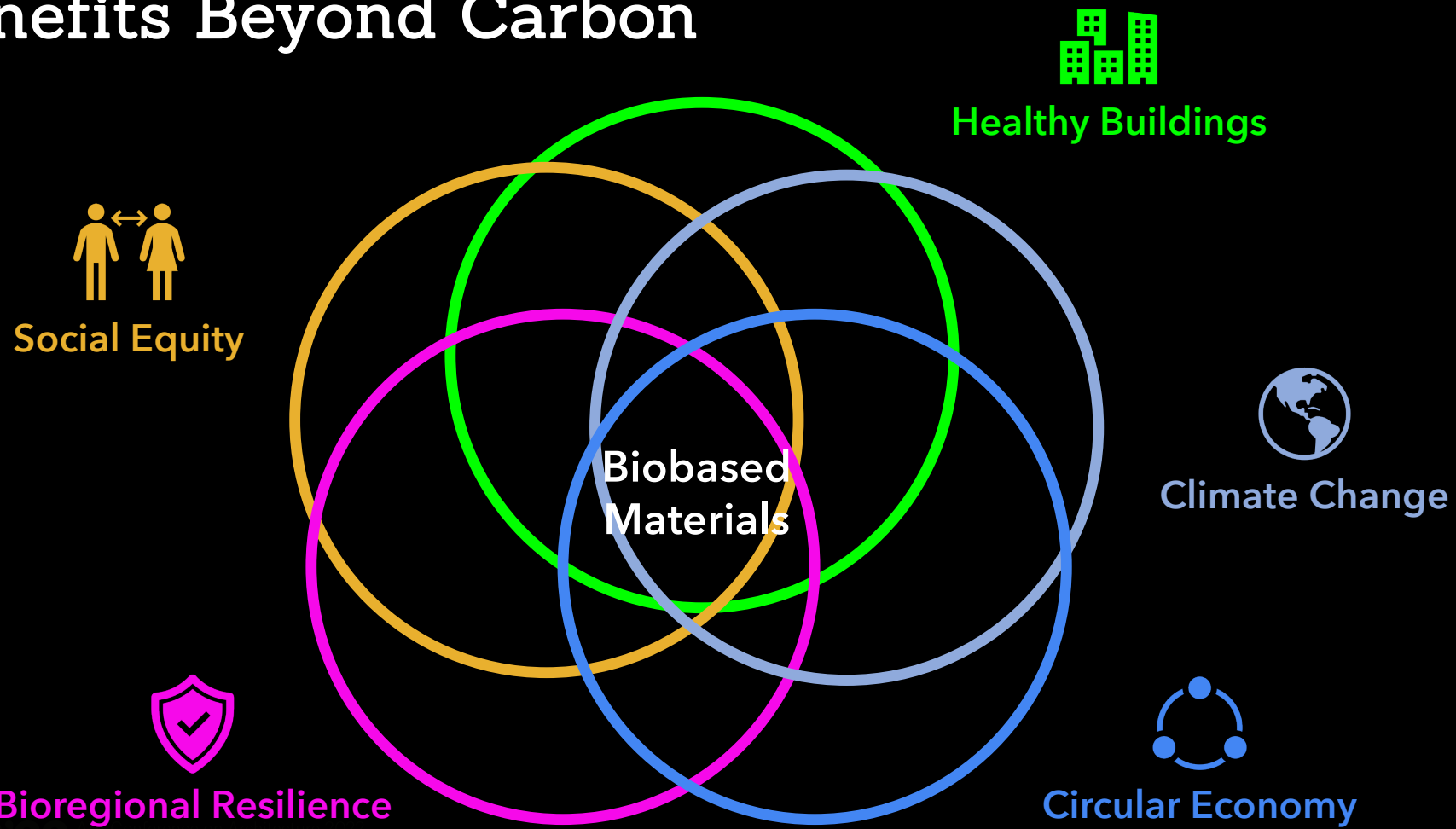
Ecosystem Health

Social Health & Equity

Circular Economy

https://www.aia.org/design-excellence/climate-action/zero-carbon/materials-pledge

Benefits Beyond Carbon



CARBON SMART MATERIALS PALETTE™

HOME | CARBON SMART MATERIALS PALETTE | ABOUT | 2030 PALETTE

CARBON-SMART MATERIALS

Low carbon/carbon sequestering materials

BAMBOO

HEMPCRETE

SHEEP'S WOOL

STRAW-BALE

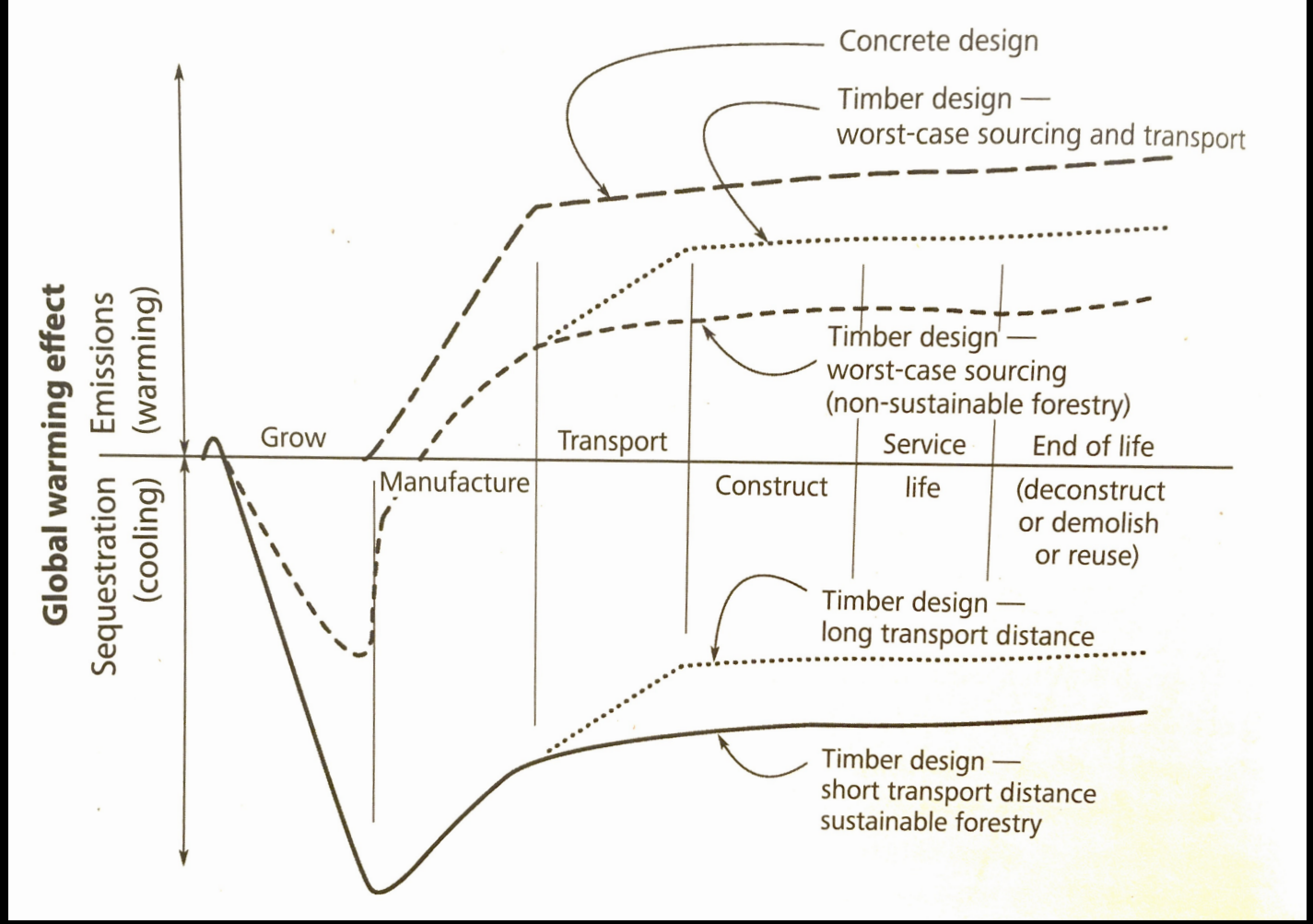
WOOD

www.materialspalette.org

Wood*

FSC, Salvaged & Reused Wood - Esalen Lodge, Big Sur, CA

Wood from HERE looks the same as wood from HERE



Comparison of carbon emissions between timber design and concrete design over life cycle of structural materials.

Credit: Arup / Bruce King The New Carbon Architecture

FSC CERTIFIED TIMBER

SALVAGED TIMBER

Esalen Lodge Renovation and Expansion

EXIT

EXIT

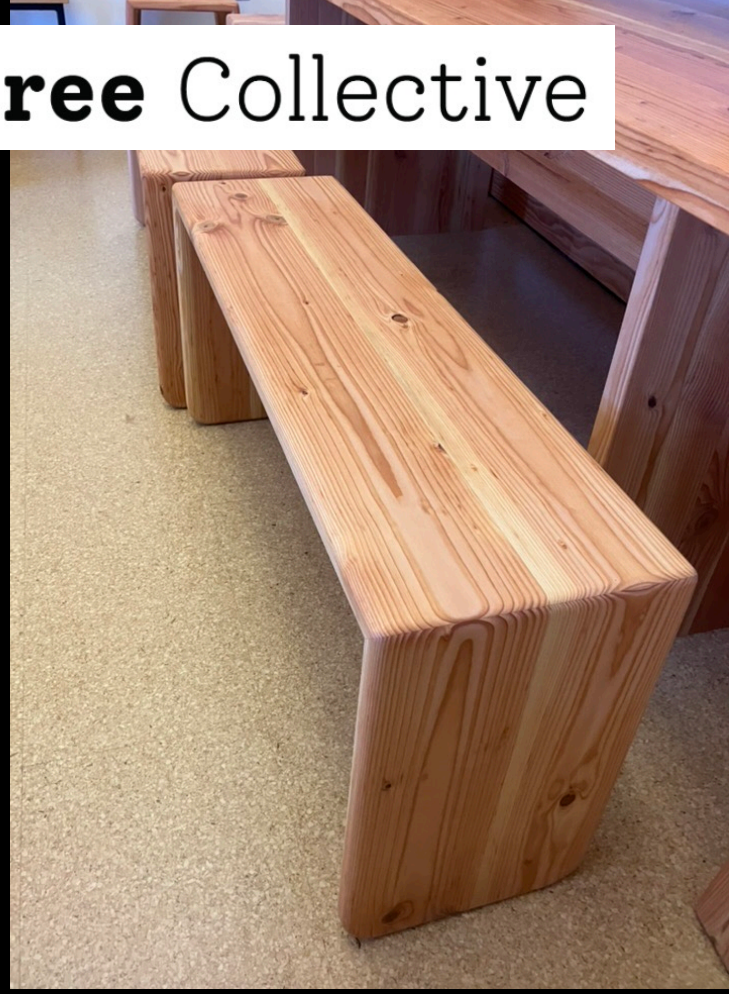
TIMBER TRUSSES (Instead of Steel or Concrete)

Ascent, Milwaukee – Korb + Assoc. Architects / CD Smith / Thornton Tomasetti

TALL TIMBER* (with appropriate sourcing)

Ascent, Milwaukee – Korb + Assoc. Architects / CD Smith / Thornton Tomasetti

TALL TIMBER* (with appropriate sourcing)



Forestree Collective

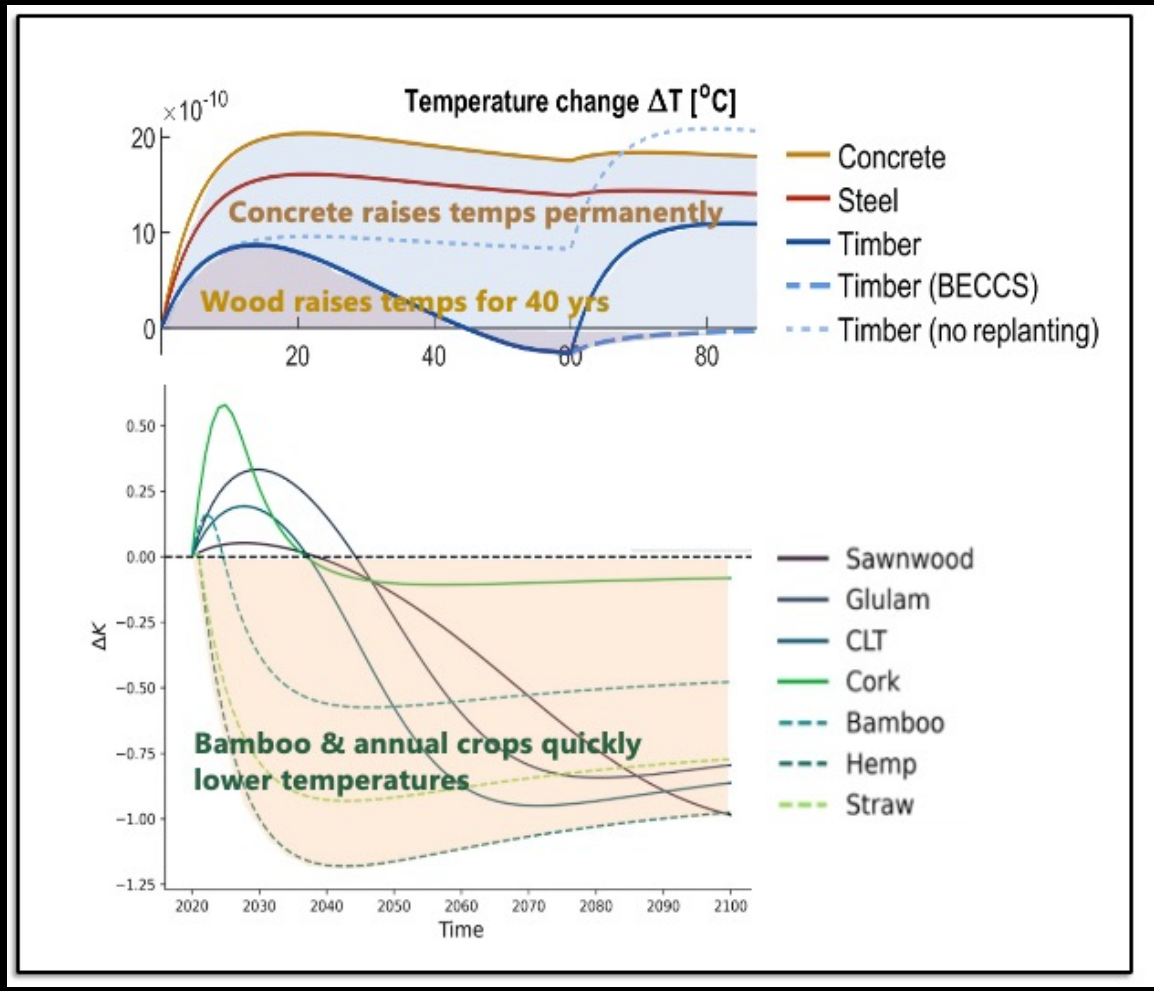
Forestree Collective Ligniloc Hardwood Nail-Laminated Timber Panels

Why does fast growth matter?

Time Value of Carbon and presence of tipping points

Fast-growing materials achieve net-cooling impacts much sooner due to short rotation periods

Traditional LCA approaches (static) do not account for the speed of regrowth (dynamic)



Bamboo

Simon Valez, Architect

Laminated Bamboo and Mass Timber Bamboo [MTB]

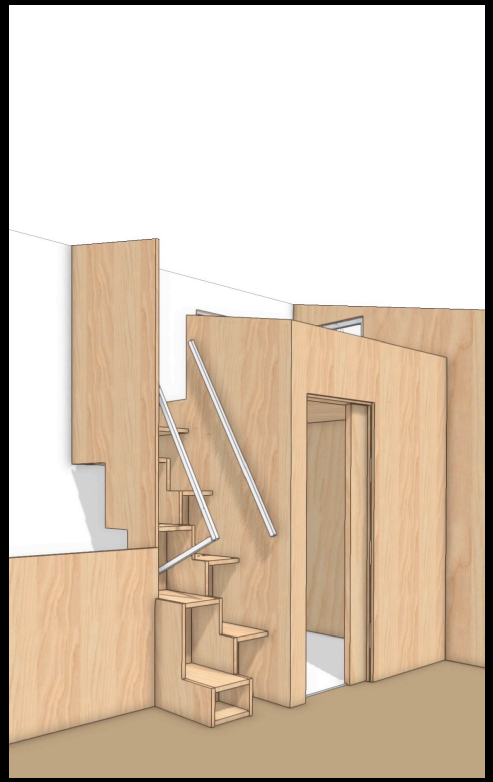
BAMCORE®

ENGINEERED BAMBOO FOR CARBON STORAGE

BamCore Panelized Wall System – Windsor, CA

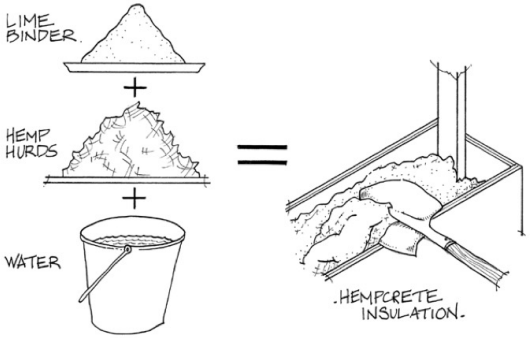
Palter ADU
San Mateo, CA

Palter ADU
San Mateo, CA



Ward-Waller ADU
Sacramento, CA

Image courtesy of Chris Magwood



The void space in a hempcrete mix creates pockets of trapped air and is part of the reason the material has desirable thermal properties.

Marks & Spencer Cheshire Oaks Store by Aukett Swanke

Image courtesy of Paula Baker-Laporte / EcoNest

International Residential Code (IRC) – Appendix AR

Kerst Residence – Menlo Park, CA

Adobe

Cob

Vallejo's Petaluma Adobe, Sonoma County, CA

[in the Building Code since ca. 1940]

Vine Hill Straw Bale Residence, Sebastopol, California

Simonton House – Purdum, Nebraska 1908

Burritt Museum – Huntsville, Alabama 1938

STACKED BENEFITS

- Annually Renewable– By-Product of Grain
- High Insulation Value – R-30 (1.2 – 2.0/in.)
- Thick Walls – Deep Jambs at Openings
- Good IAQ and Humidity Control
- STORES CARBON !
- Acoustic Control
- Structural Integrity
- Excellent Fire Resistance
- Durable and Long Lasting
- Thermal Mass and Time Lag
- User Friendly- Community Building

Appendix AS: Strawbale Construction

SECTION AS101 GENERAL

AS101.1 Scope. This appendix provides prescriptive and performance-based requirements for the use of baled straw as a building material. Other methods of strawbale construction shall be subject to approval in accordance with Section 104.11 of this code. Buildings using strawbale walls shall comply with the this code except as otherwise stated in this appendix.

SECTION AS102 DEFINITIONS

AS102.1 Definitions. The following words and terms shall, for the purposes of this appendix, have the meanings shown herein. Refer to Chapter 2 of the *International Residential Code* for general definitions.

BALE. Equivalent to straw bale.

CLAY. Inorganic soil with particle sizes less than 0.00008 inch (0.002 mm) having the characteristics of high to very high dry strength and medium to high plasticity.

CLAY SLIP. A suspension of clay particles in water.

FINISH. Completed compilation of materials on the interior or exterior faces of stacked *bales*.

PRECOMPRESSION. Vertical compression of stacked bales before the application of finish.

REINFORCED PLASTER. A plaster containing mesh reinforcement.

RUNNING BOND. The placement of *straw bales* such that the head joints in successive courses are offset not less than one-quarter the bale length.

SHEAR WALL. A strawbale wall designed and constructed to resist lateral seismic and wind forces parallel to the plane of the wall in accordance with Section AS106.13.

SKIN. The compilation of plaster and reinforcing, if any, applied to the surface of stacked bales.

STRUCTURAL WALL. A wall that meets the definition for a load-bearing wall or shear wall.

STACK BOND. The placement of straw bales such that head joints in successive courses are vertically aligned.

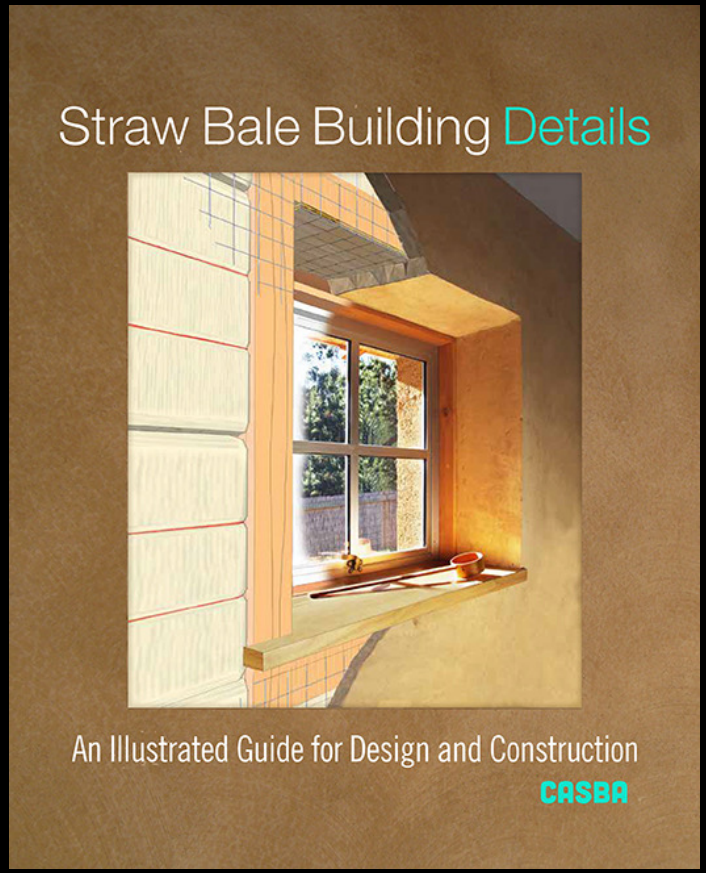
STRAW. The dry stems of cereal grains after the seed heads have been removed.

STRAW BALE. A rectangular compressed block of straw, bound by ties.

STRAWBALE. The adjective form of straw bale.

STRAW-CLAY. Loose straw mixed and coated with clay slip.

IRC CODE SECTION – IBC NEXT



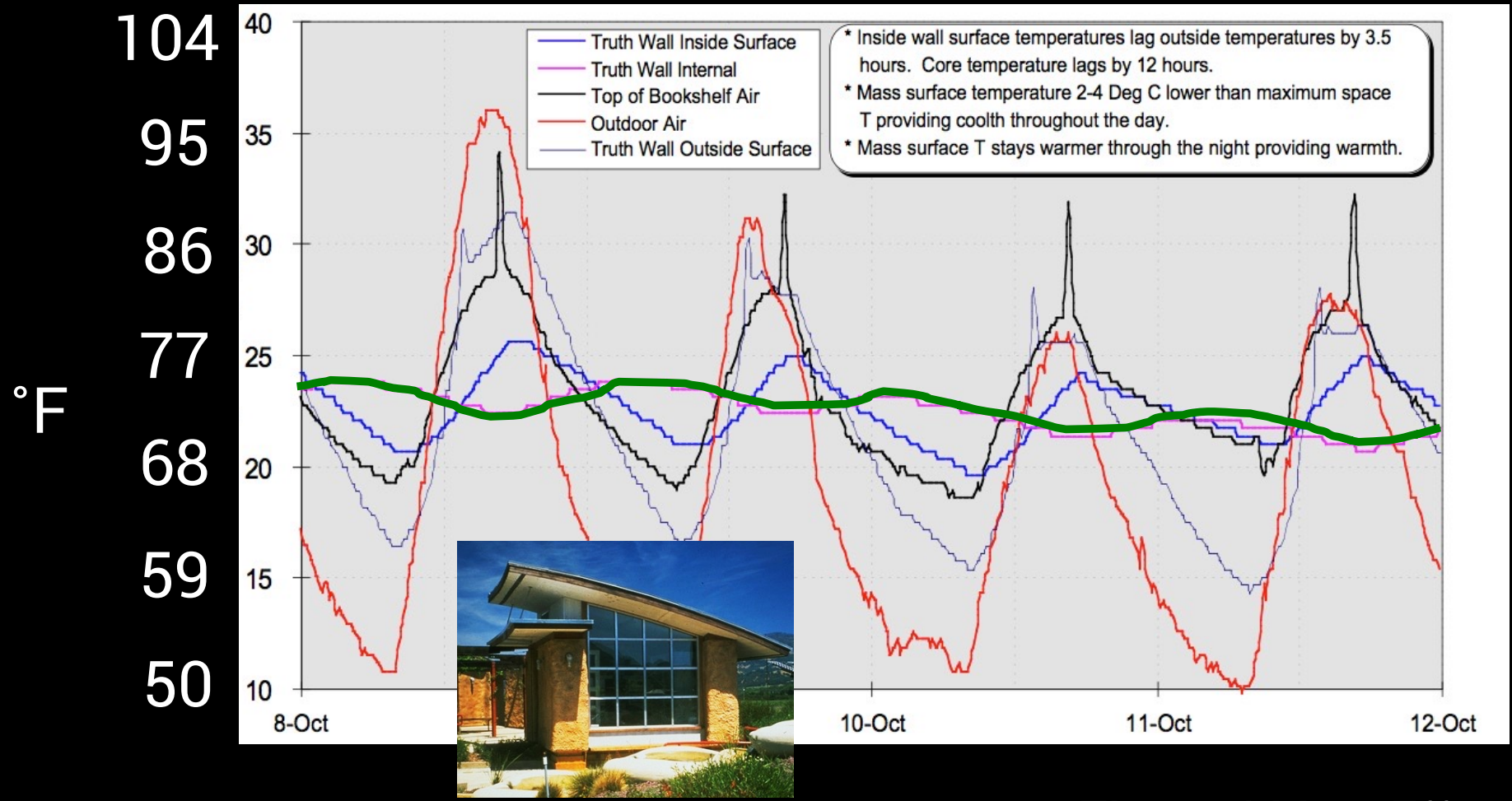
CASBA

Free Download of Code w/Commentary
from the California Straw Building Assoc.

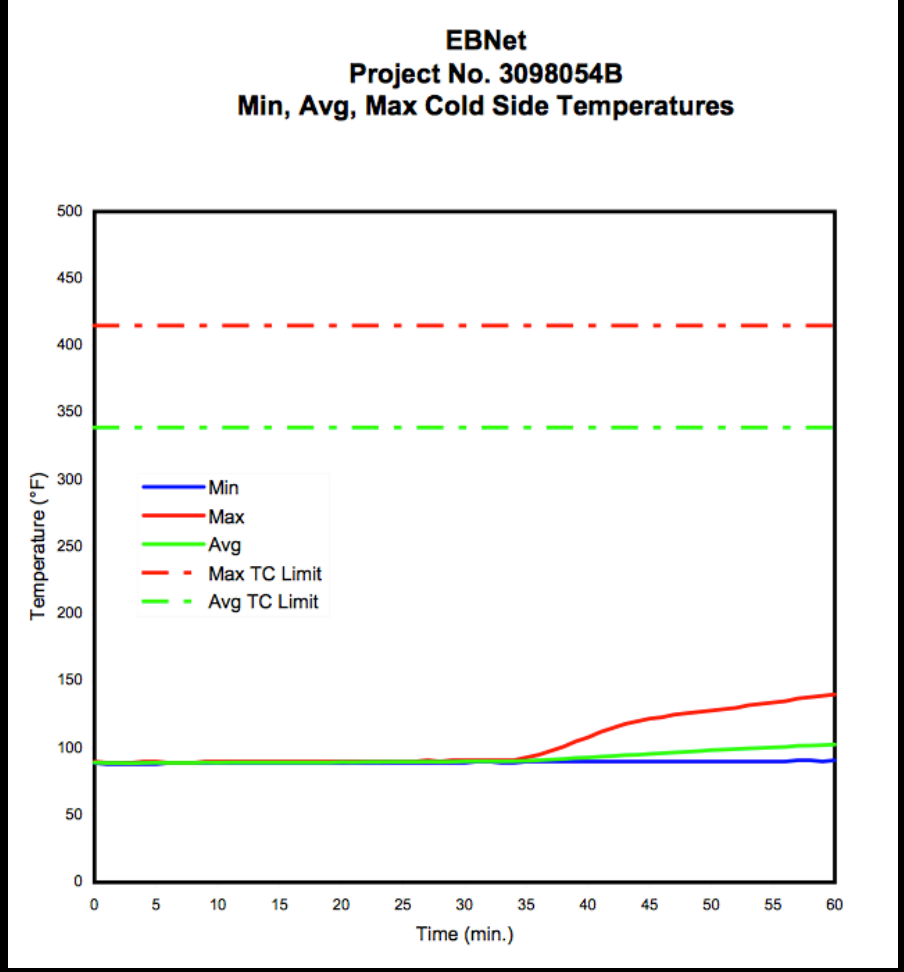
www.strawbuilding.org

Straw Bale Building Details
An Illustrated Guide for
Design and Construction

https://www.strawbuilding.org/
Straw-Bale-Building-Details/



Thermal Mass Effect



Fire Safety – ASTM Tested for 2 Hour Rated Wall

Norrbom Road Strawbale Home (wildfire survivor), Sonoma, California

Redwood Valley Fire – Oct. 2017 – photo by Edward Doody

Redwood Valley Fire – Oct. 2017 – photo by Edward Doody

STACKED BENEFITS

- Annually Renewable– By-Product of Grain
- High Insulation Value – R-30 (1.2 – 2.0/in.)
- Thick Walls – Deep Jambs at Openings
- Good IAQ and Humidity Control
- STORES CARBON !
- Acoustic Control
- Structural Integrity
- Excellent Fire Resistance
- Durable and Long Lasting
- Thermal Mass and Time Lag
- User Friendly- Community Building

Carbon storing prefab

PreFab
Straw
Panels

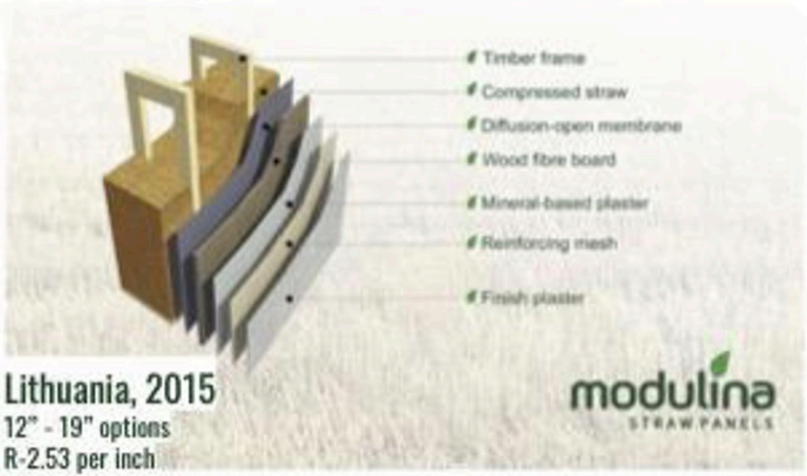
Endeavour Centre – PreFab Straw Wall Assembly

modcell
straw technology

UK, 2005
10" - 17" options
R-2.7 per inch

eco cocon

Headquartered
Slovakia, 2008
Manufactured
Lithuania
15.75" standard
R-2.43 per inch



Lithuania, 2015
12" - 19" options
R-2.53 per inch

modulina
STRAW PANELS

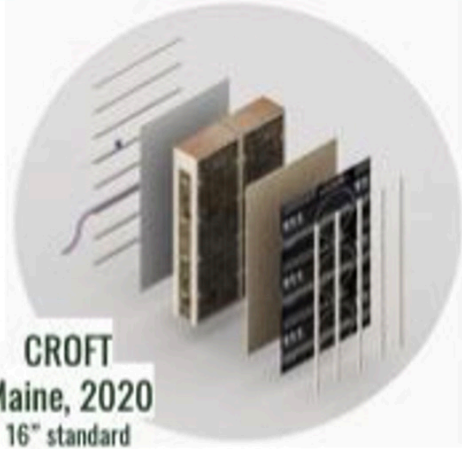
ISOL' en Paille

France, 2020
8.7" - 18" options
R-2.8 per inch

RAINBOW
ECOSYSTEM

Ukraine, 2016
15.75" standard
R-2.87 per inch

European Prefabricated Panel Systems



CROFT
Maine, 2020
16" standard
R-38.8

California, 2024
5.5"
R-value in refinement, objective
of near 4 per inch

VERDANT
PANEL

New Frameworks
Gryphon Panel

Vermont, 2021
14" standard
R-30 to 40

strawtegi.cottage

Utah, 2021
8" dense-filled + fiberboard
R-30

Savick
Canada, 2022
12-20" options
R-3 per inch

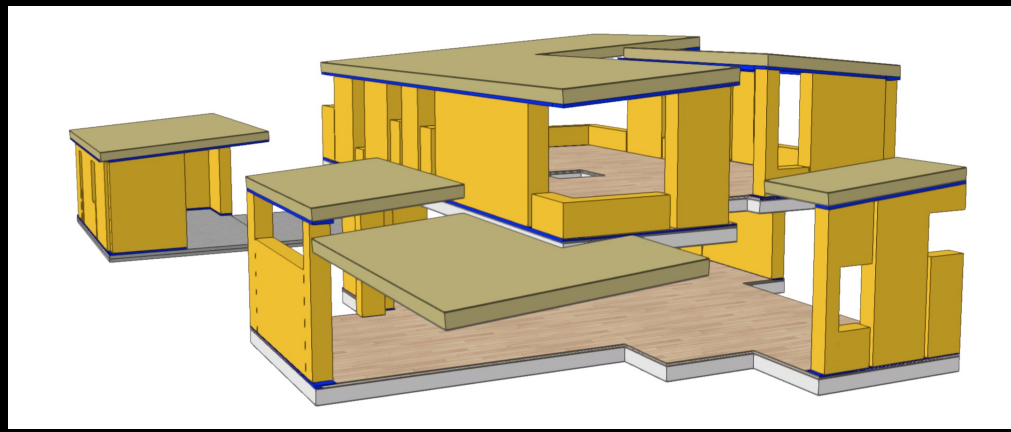
PLACECRAFT

StraBloc

Oregon, 2022
5.5" standard
R-10.5

North American Prefabricated Panel Systems

EcoCocon Panel System – Slovakia



Cereza Residence - Palo Alto, California

EcoCocon Panel System – Slovakia

Cereza Residence - Palo Alto, California

Rammed Earth Works Panel System

Cereza Residence - Palo Alto, California

Cork Insulation / Eucalyptus Columns

Cereza Residence - Palo Alto, California

Mahonia Building

Eugene, Oregon

34,000sf, $147/sq.ft.

10,886 kg CO2e storage
in straw / wood walls
salvaged resources
rainwater catchment
daylight and community

BOEBS – Bales On End Between Studs

Erica Ann Bush – Day One Design

Los Padres US Forest Service Station, King City, California – WRNS Studio

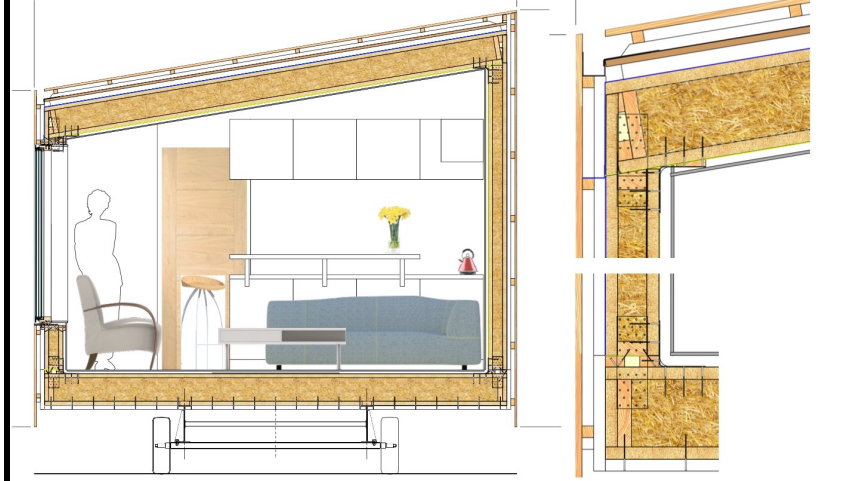
A22

Ridge Winery – Lytton Springs, California - Freebairn-Smith and Crane Architects

LigniCell - Compressed Straw Board (CSB):

40 thick	up to 3.2m long	800 wide
60 thick	up to 3.2m long	800 & 1200 wide

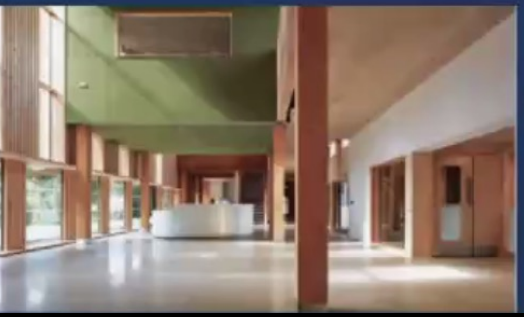
LigniCell



TAM 10.5 x 4.6m - 1 bed 36 m2

TAM (Infill Housing) – Bristol, UK – Agile Homes / Craig White Architect

MODCELL (panelized straw bale) – Inspire, Bradford, UK – White Design Architects



Timber, Thatch & Straw Panels - Enterprise Centre, Univ. of East Anglia, UK

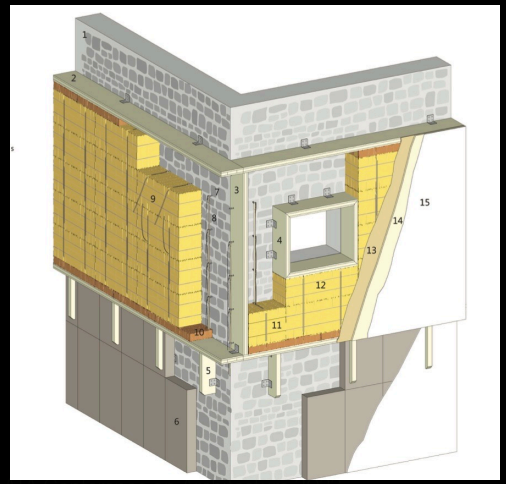
Prefab Straw Panels – Gateway Building, University of Nottingham, UK

Ludwigstein, Germany

Charles Peguy High School – Dumont Legrand Architectes

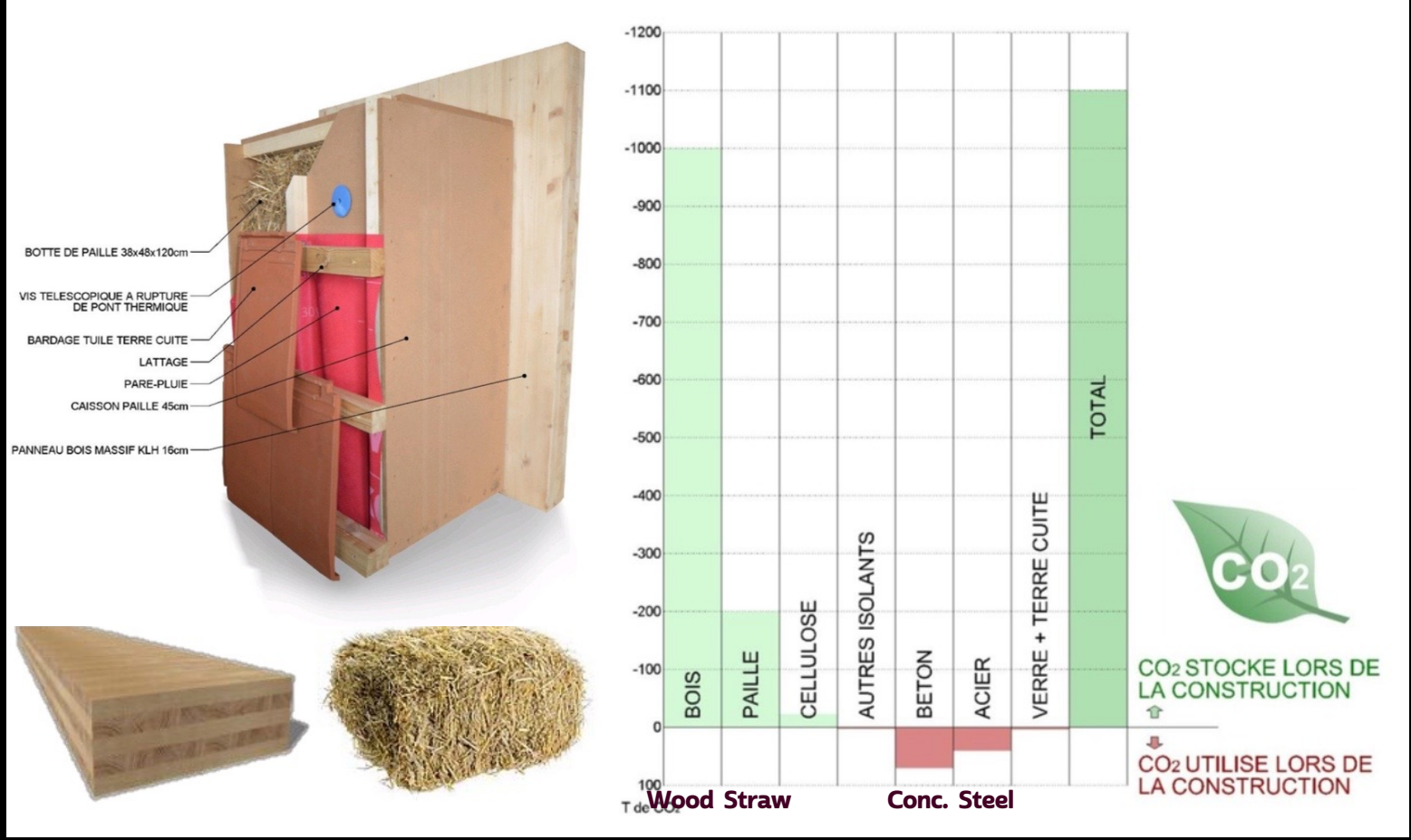
Jacques Chirac Recreation Center – Architecture Regenerative

Socopolis Office Building – 10i21a

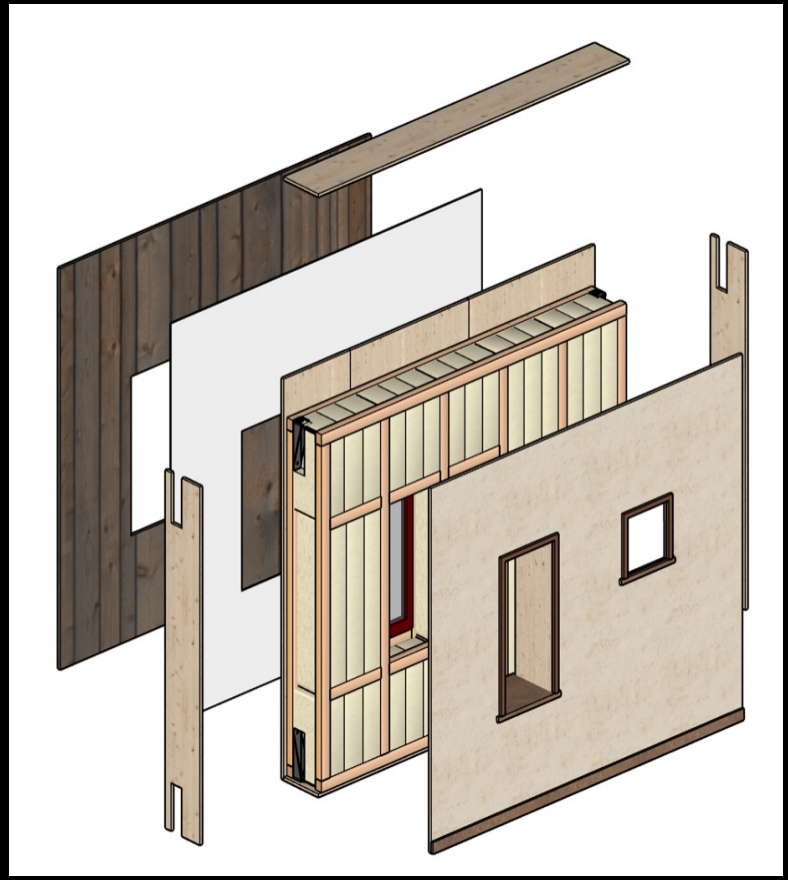


Wrapping Conventional Buildings - Landfabrik / Trait Vivant

Residence Jules Ferry, Saint Die, France – Antoine Pagnaux, ASP Architecture



Residence Jules Ferry, Saint Die, France – Antoine Pagnaux, ASP Architecture



East Bay Carbon Storing Prototype Building

43,225 sf.

-10kg CO2e/m2

1,100,000 kg CO2e stored in
Straw / Wood panels
HT-BRB Bracing
CLT Podium Deck

Carbon Smart Materials

https://www.clf-sfbayarea.org/east-bay-carbon-storing-challenge

Project Carbon Content

GRAND TOTAL kgCO2e	kgCO2e/m2
-57440	-10

Note: kg/m2 comes from total kg divided by habitable floor area

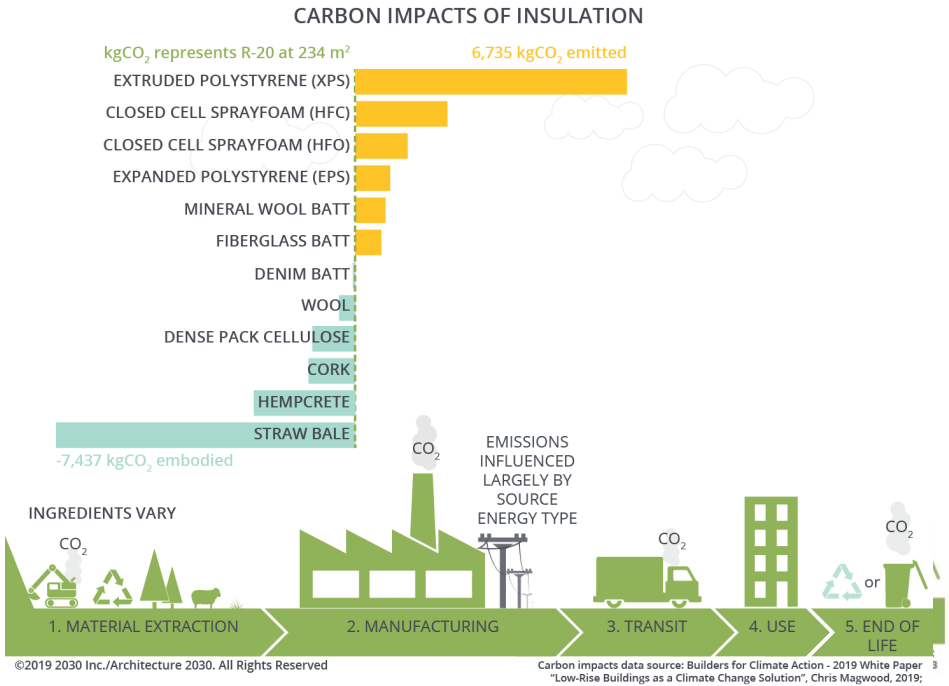
Project Carbon Content

EMITTED	STORED
387940	-445380

East Bay Carbon Storing Prototype Building – StopWaste CASBA ARUP Verdant S.E. Arkin Tilt Architects

Insulation & Products

INSULATION



©2019 2030 Inc./Architecture 2030. All Rights Reserved

Carbon impacts data source: Builders for Climate Action - 2019 White Paper "Low-Rise Buildings as a Climate Change Solution", Chris Magwood, 2019;

CARBON IMPACT OF INSULATION:

Insulation choices greatly affect the carbon footprint of the building in terms of embodied carbon and operational carbon emissions. Insulation can be either a significant contributor to the embodied carbon footprint of the building, or a carbon sink, depending on the choice of materials used. When selecting insulation, operational performance considerations (thermal performance, climatic requirements, air leakage rates, moisture resistance) should be balanced with embodied carbon targets.

Using natural materials and blown-in applications are the best way to reduce the embodied carbon of insulation.

Cellulose

Sheep's Wool

Hemp Wool

CAVITY INSULATION

Chopped Straw

Rice Hulls

Loose Fill Wool

CAVITY INSULATION

Cork

Compressed Straw Board

Wood Fiberboard

Hemp Board

SHEATHING / ENVELOPE WRAP

DURRA PANEL
Australia, 2002

rice house
Insulating panels
(RHSO)
Italy, 2016

STRAMIT INTERNATIONAL

SRL
Straw Resource Limited
Originally Sweden, 1933
Currently UK, 1945

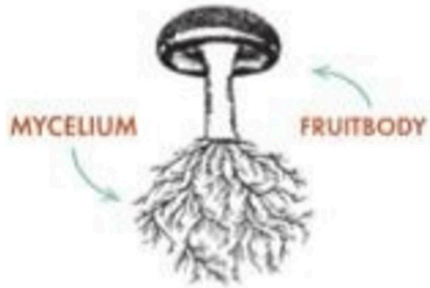
Originally Texas,
Currently Arkansas
2000
Agriboard™
A Smarter Way To Build

STRAWTEC
BUILDING SOLUTIONS
Rwanda, 2015

SHEATHING / ENVELOPE WRAP

Straw Panel Products

Hy-Fi Pavilion by The Living, New York, 2014



Good **insulation** (low thermal conductivity)
High **acoustic** insulation
Fire resistant (forms a protective char)
Fully **biodegradable**

ecovative
New York, In Development
MycoBoard & MycoComposite
R-3 per inch

MykoFoam
UK, Pilot Phase
Insulation panel

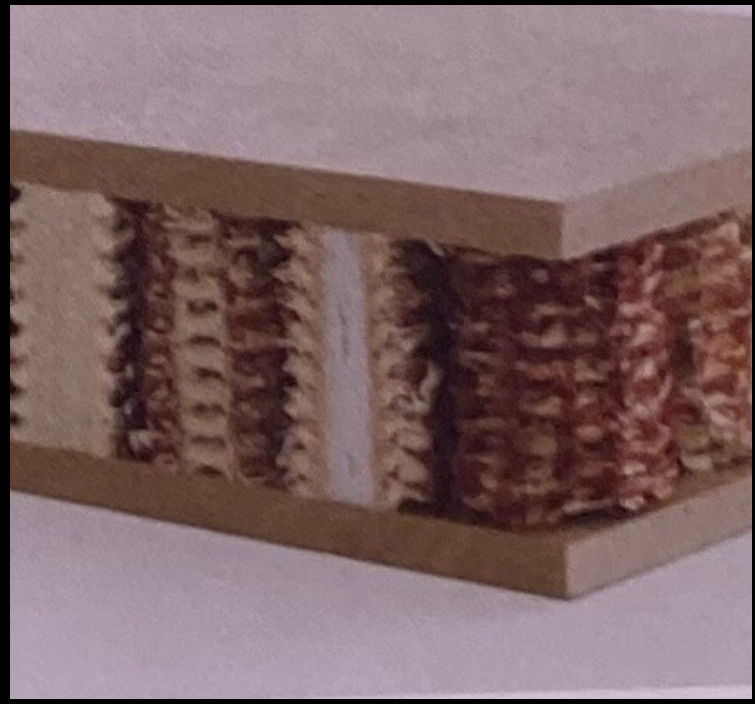
BIOHM
UK, In Production
Insulation panel

GROWN bio
Netherlands,
In Development
Insulation panel

MYCELIUM INSULATION & PRODUCTS

OKOM Structural Mycelium Building Products

Root Mat



Corn Cob Board

EMERGING INSULATION & PRODUCTS

Insulation batt
R-3.5 per inch
1.75" - 10" options
Cutting and harvesting of **"waste" grass**
3.6 tons of CO2 captured per acre = 7 family houses

Sheathing replacement for OSB
Made from fast-growing **perennial grass**
70% of carbon captured in the field is **retained** in the panel
Stores **8 tons of CO2** per house

EMERGING INSULATION & PRODUCTS

Cork

Wood

Bark

EXTERIOR CLADDING / INTERIOR FINISHES & FURNISHINGS

Stak Blocks

Rice Straw MDF

Wood Chip ICF

OTHER PRODUCTS & SYSTEMS

Farmworker Housing– Blue Dot Farm, Nicasio, CA

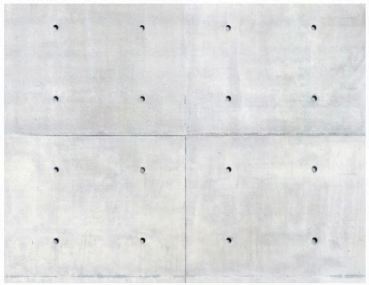
Eureka MDF Instead of Gypsum Board – Blue Dot Farm, Nicasio, CA

CARBON SMART MATERIALS PALETTE™

HOME | CARBON SMART MATERIALS PALETTE | ABOUT | 2030 PALETTE

HIGH-IMPACT MATERIALS

Predominant building materials with high-impact potential for emissions reductions



CONCRETE

STEEL

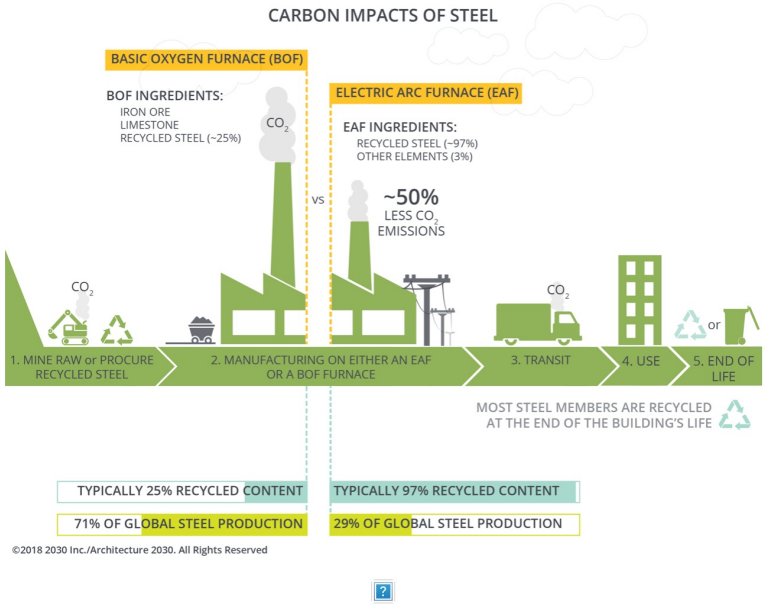
WOOD

CARPET

GYPSUM BOARD

www.materialspalette.org

STEEL

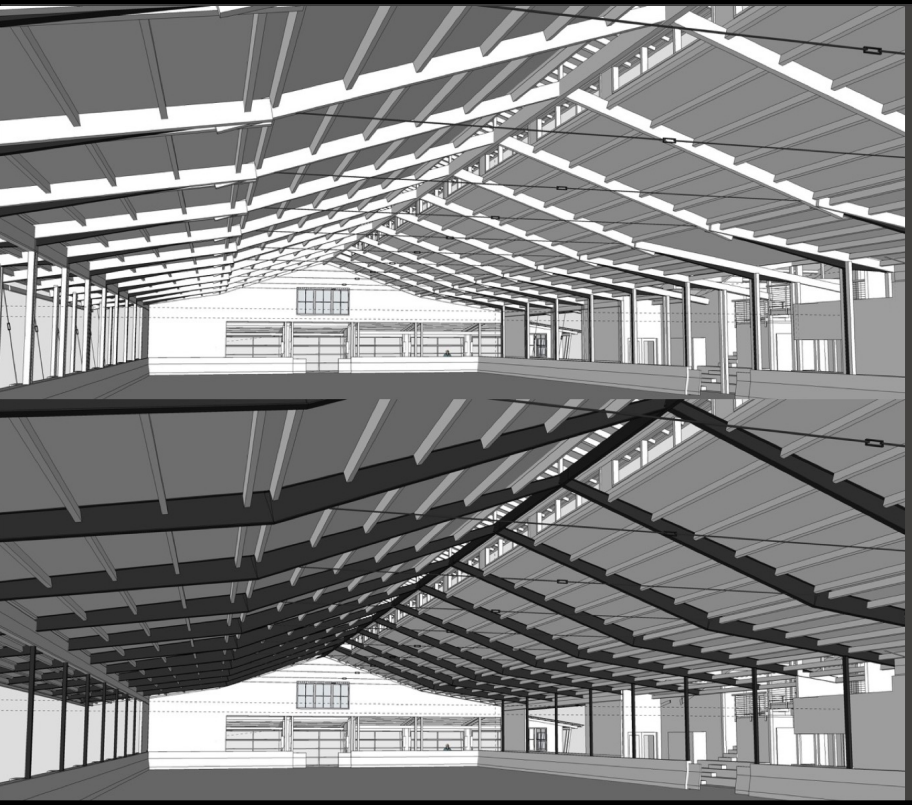


CARBON IMPACTS OF STEEL

Steel is manufactured in two types of factories. Large steel mills typically use *basic oxygen furnaces* (BOFs), which burns coal or natural gas to melt iron-ore to extract the iron, and then mixes the iron with scraps of iron and steel to make new steel. Most of the inputs to a BOF are mined, raw materials, so the recycled content level for BOFs is typically between 25%-37%. Recycled content is important because virgin steel can have an embodied carbon footprint that is up to five times greater than high-recycled content steel[1].

Smaller factories normally use *electric arc furnaces* (EAFs) to melt scrap iron and steel into new steel. These factories don't have the ability to process raw iron ore. As a result, the steel manufactured on EAFs has high levels of recycled content, up to

www.materialspalette.org



Wood Hybrid Truss

44,430 BTU per truss (primarily the steel)

Sequestered Carbon: 1357.2 lbs. (wood)

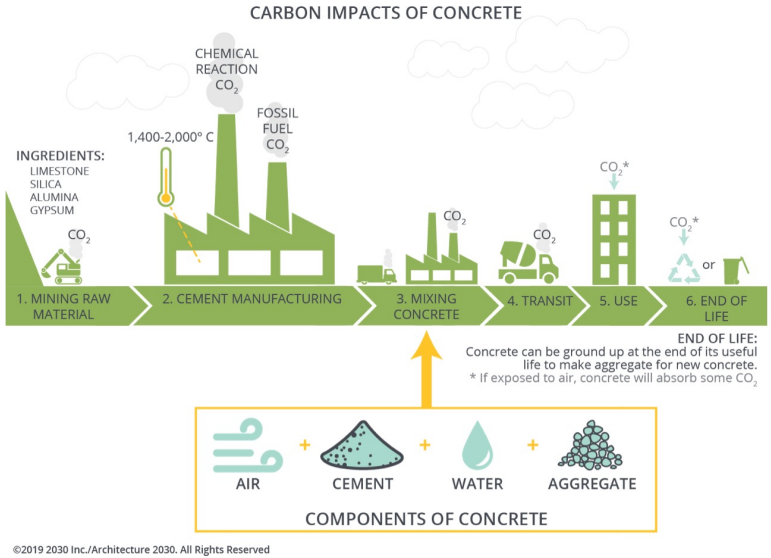
Long-Span Truss Carbon Comparison

Steel I-Beam Truss

71,330 BTU per truss

(60% more carbon, none sequestered)

CONCRETE



©2019 2030 Inc./Architecture 2030. All Rights Reserved

CARBON IMPACT OF CONCRETE

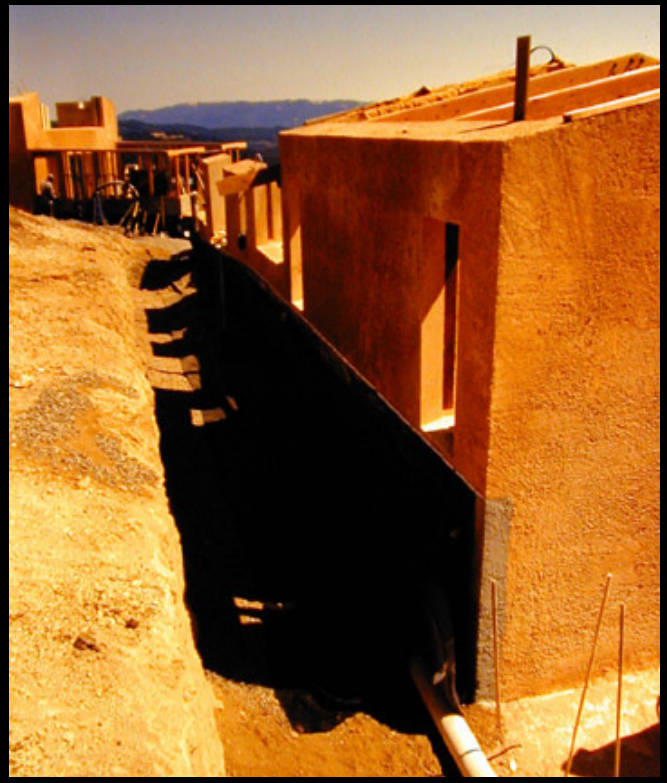
Concrete is the most widely used construction material in the world, and is responsible for 6-10% of global anthropogenic carbon dioxide (CO_2) emissions. Portland cement is the primary ingredient in concrete and is responsible for the majority of concrete's carbon emissions. CO_2 is released at two points during cement production: roughly 40% of the CO_2 generated is from the burning of fossil fuels in the manufacturing process, and the remaining 60% is from naturally occurring chemical reactions during processing. The proportion of ingredients in a concrete mixture can greatly influence its carbon impact.

Using less cement is the most effective way to reduce the carbon footprint of concrete.

www.materialspalette.org

Rammed
Earth

PISE



Earth Masonry Units

Low
Carbon
Footings

Clay
Floor
Slabs

pieranch farmhouse rebuild

Honor the past

The Amah Mutsun and indigenous wisdom:
Pie Ranch is on the unceded lands of the Quiroste Tribe of the Awaswas Nation. These lands are cared for today by the Amah Mutsun Tribal Band who are the direct descendants of the Indigenous peoples stolen away to Missions San Juan Bautista and Santa Cruz beginning in the late 18th century. Since 2013 we have been in an ongoing partnership with the Amah Mutsun Tribe and Land Trust working in a variety of ways to heal and relearn.

For the house rebuild, ecological and Indigenous stewardship informs the building systems and material selection. Curved, communal patio spaces and heavy wood plank details pay homage to Quiroste round houses and Yurok plank houses.

The Steele Family Dairy:
The Steele Family was famous for their butter and cheese, their support of the Union Army during the Civil War, and their desire to see the land and buildings protected in perpetuity for public education. The size, form, and exterior of the house are largely unchanged, keeping the feel of the historic Steele house built in 1863.

Amah Mutsun Round House, illustration by Edward Willie

Yurok Plank House, Sumêg Village

Steele Farmhouse, built c. 1863

Farmhouse site after CZU fire

Project Team

Arkin Tilt Architects
artfully integrates design and ecology with extensive experience in sustainable and carbon conscious construction systems.

Verdant Structural Engineers
specializes in efficient use of conventional building materials as well as environmentally sensitive building materials and methods such as straw bale, rammed earth, cob, adobe and bamboo.

Beyond Efficiency - Energy & Mechanical
consultants with expertise in energy optimization, green building, training & coaching to empower people to create enduring human-centered buildings.

Sherwood Design Engineers
applies innovation and elegant design to the creation and implementation of sustainable infrastructure.

Cormorant Fine Craftsmen
a full service building company specializing in residential new construction. Our work is rooted in time honored, artisanal skill and state of the art efficiency techniques. Owner Benjamin Riordan has been a builder for twenty years.

Meet today's needs

Living Space:
Reorganizes the interior space within the footprint of the previous house to provide more effective living, bathing, dining, and gathering spaces, including spaces for education and display of history.

Accessibility:
Gathering spaces and a bathroom are accessible to people of all mobility levels

Comfort:
Efficient radiant heating systems, weather sealing, and insulation.

Fire Resistant
Protects against future fires with Class-A fire resistant exterior assemblies.

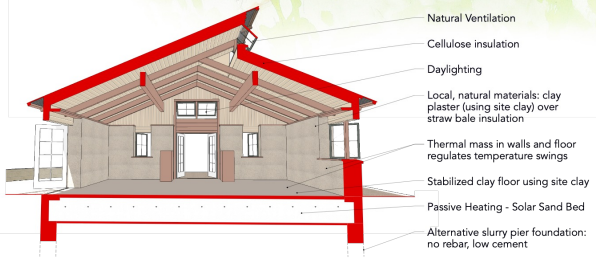
Model a sustainable future

Carbon sequestering & low carbon materials:
Local, low-impact and carbon storing materials: straw bale walls, clay slab floor, cellulose insulation, site lumber flooring, clay plaster, alternative slurry pier foundation (no rebar and low cement), earth masonry unit retaining walls, salvaged doors and trim.

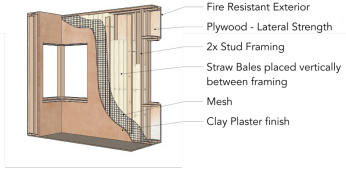
Passive daylighting, ventilation, and heating:
Orientation of openings with operable windows and shutters for solar control·
Solar hot water panels feed both domestic water and solar sand bed heating system, providing year-round radiant warmth·

Renewable energy: all electric operation, to be powered by future on-site solar PV system.

Water conscious: low-flow fixtures, rain collecting planter beds, and rain gardens.



Sustainability Strategies Diagram



Straw Bale Insulated Wall Diagram

United

Sierra Valley Preserve Nature Center – Straw-Cel w/Lime Plaster

Sierra Valley Preserve Nature Center – ATA at West Entrance – Biological Trail

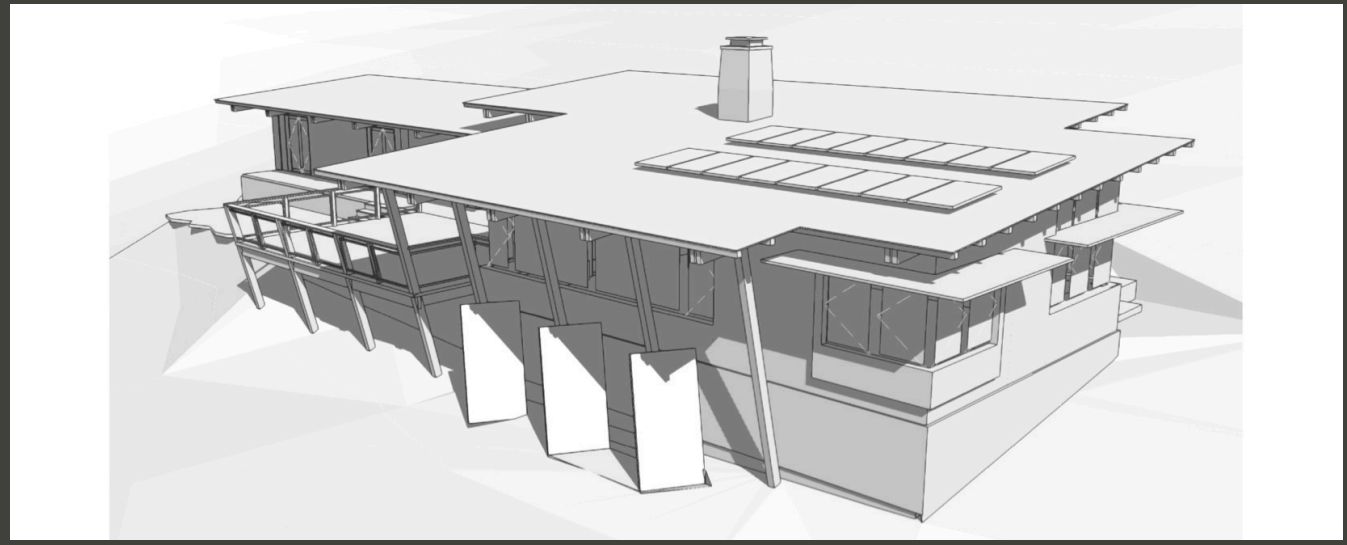
Rebuilding Story – Measures We'll be Taking

Fire Sprinkler System for Eaves and Decks

Photovoltaic Array with Battery Backup for PSPSs (may go off-grid, tbd)

Corrugated Zincalume Roof, Simple Slopes

Straw Bale Walls with Natural Hydraulic Lime Plaster inside and out



Patio at grade adjacent walls and below deck

Heavy Timber Deck and Roof Framing

High-Mass Solar Sand Bed Heating – Panels shaded Seasonally by Deck

Existing Foundation wrapped with Stone Wool and Watershed Block

Pythian Road Fire Rebuild, Santa Rosa, Califonia

Pythian Road Fire Rebuild, Santa Rosa, CA – Earth Block Making Demonstratio

Pythian Road Fire Rebuild, Santa Rosa, CA – Site Harvested and Milled Lumber

Pythian Road Fire Rebuild, Santa Rosa, CA – Pumice Insulation and Solar Sand Bed

Pythian Road Fire Rebuild, Santa Rosa, CA – Exo-BOEBS – Bale Raising Day

Pythian Road Fire Rebuild, Santa Rosa, CA – Deep Green Building & Remodeling

Pythian Road Fire Rebuild, Santa Rosa, CA – Massey Burke / Clay Plaster

Pythian Road Fire Rebuild, Santa Rosa, CA – Arkin Tilt Architects

BUILD SHELTER.

BUILD SHELTER.

NOT TOO BIG.

BUILD SHELTER.

NOT TOO BIG.

MOSTLY PLANTS.

[with thanks / apologies to Michael Pollan / ‘Food Rules’]

Resources

- architecture2030.org
- 2030Palette.org
- materialspalette.org
- carbonsmartbuilding.org
- embodiedcarbonnetwork.org
- strawbuilding.org
- ecobuildnetwork.org
- crownhillmaterials.com
- forestreecollective.com
- bamcore.com
- buildersforclimateaction.org
- carbonleadershipforum.org
- rmi.org
- strawbale.com
- ecococon.eu
- agile.property
- rammedearthworks.com
- okomwrks.co