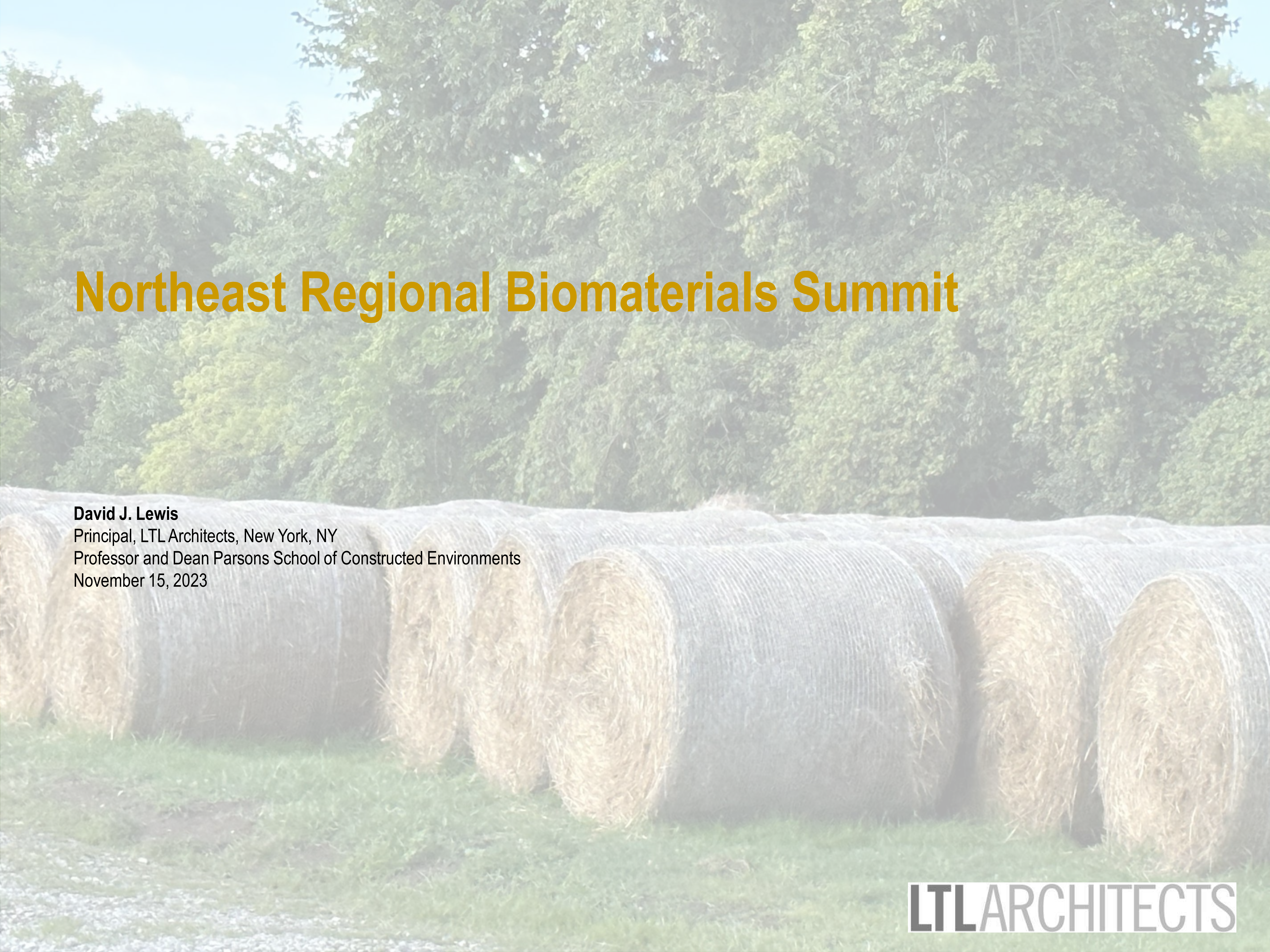
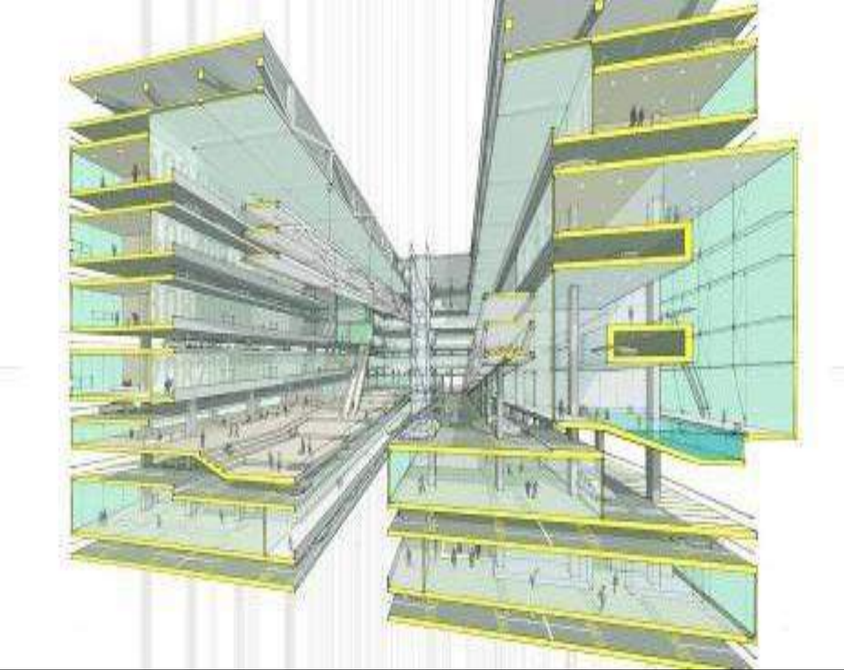
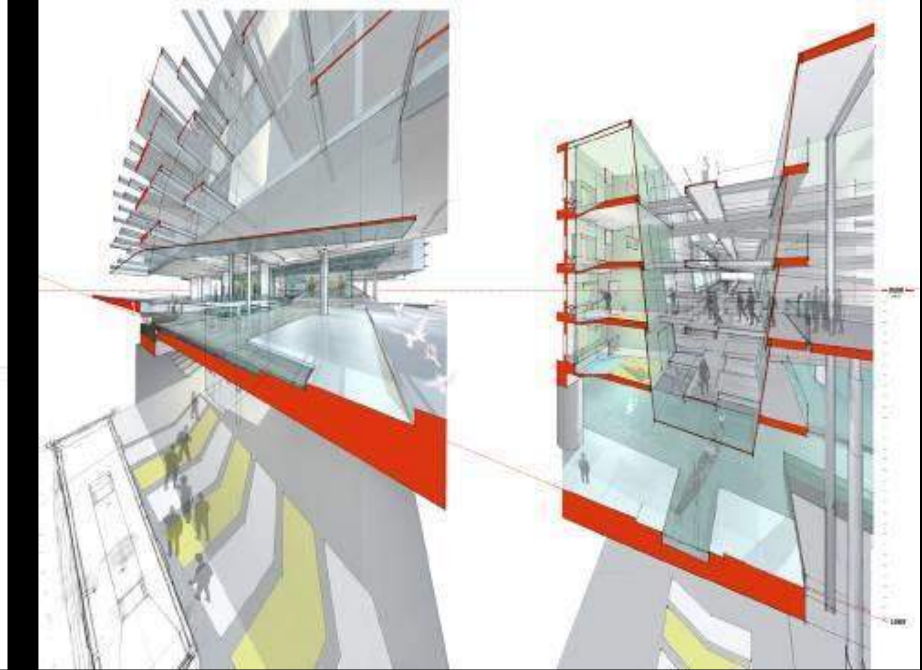


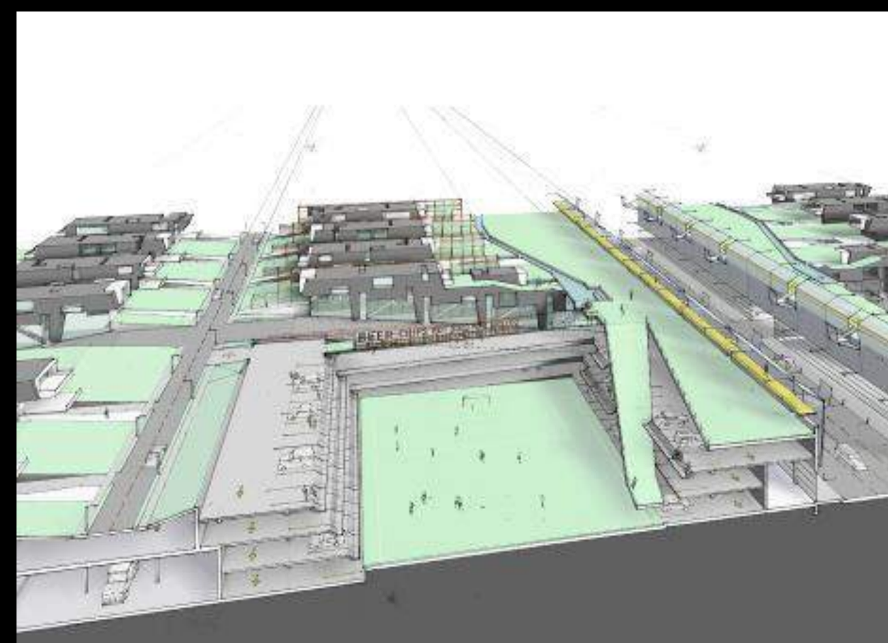
Northeast Regional Biomaterials Summit

David J. Lewis
Principal, LTL Architects, New York, NY
Professor and Dean Parsons School of Constructed Environments
November 15, 2023

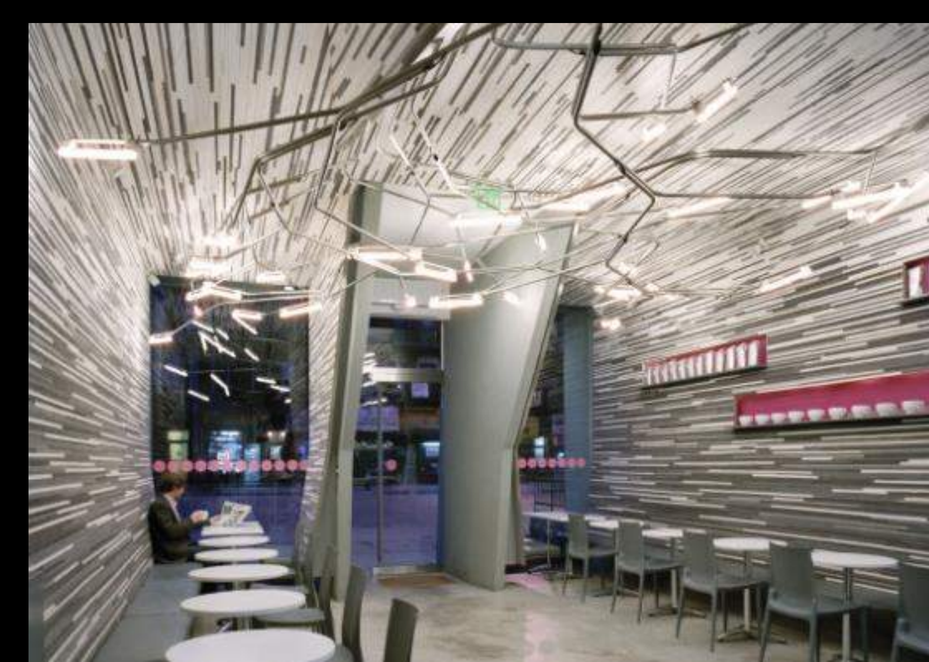
LTL ARCHITECTS







LTLARCHITECTS



***Mission**: Encompassing a unique confluence of disciplines, Parsons' School of Constructed Environments nurtures tomorrow's practitioners and guides them in designing **socially just, environmentally regenerative, and innovative cities, buildings, interiors, lighting, and products**. We foster the skills, values, and vision vital **to creating more integrated, equitable, and delightful worlds**.*

Parsons School of Constructed Environments: 926 Students

SCE

Architecture
BFA Architectural Design
Master of Architecture

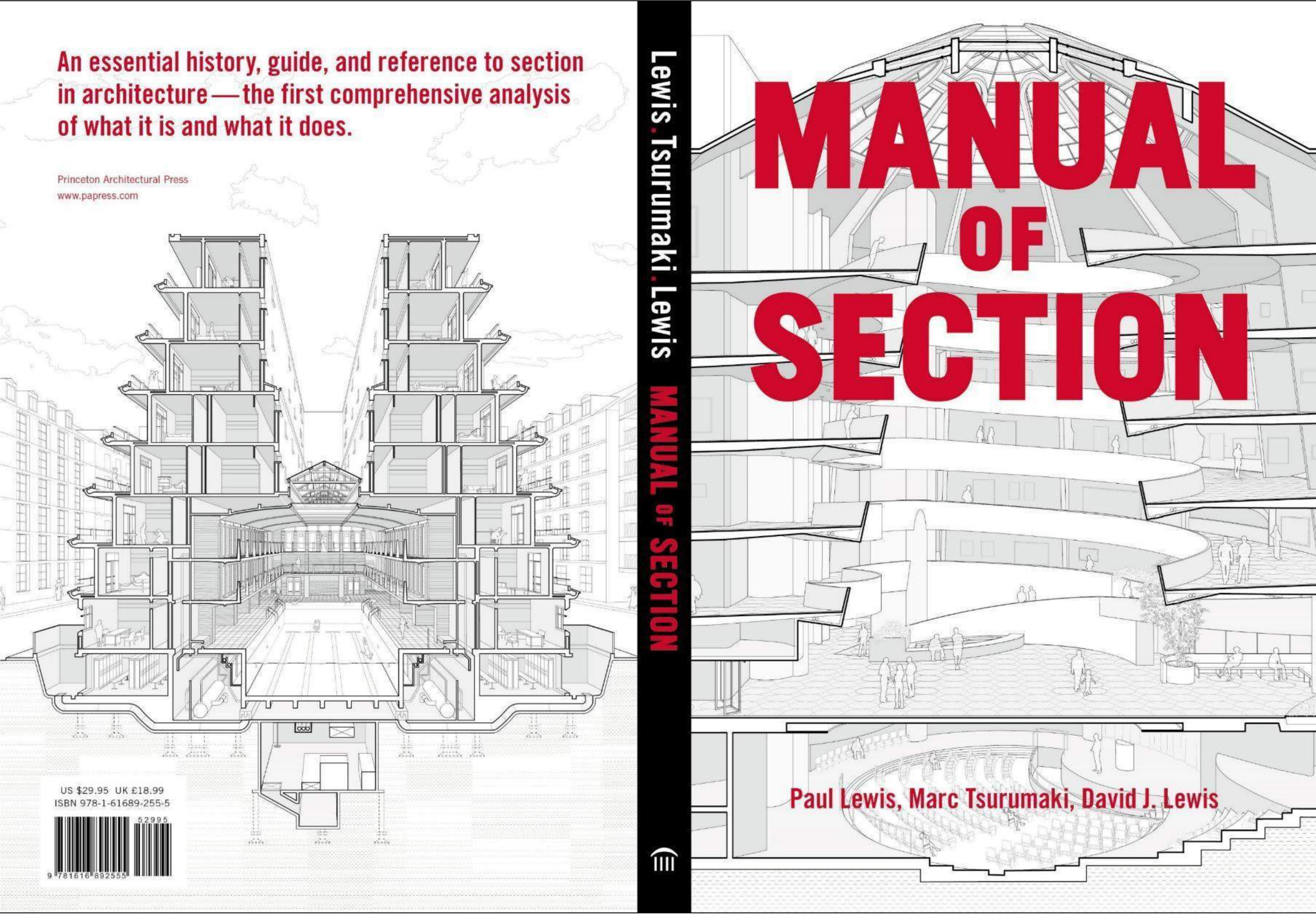
Lighting Design
MFA Lighting Design

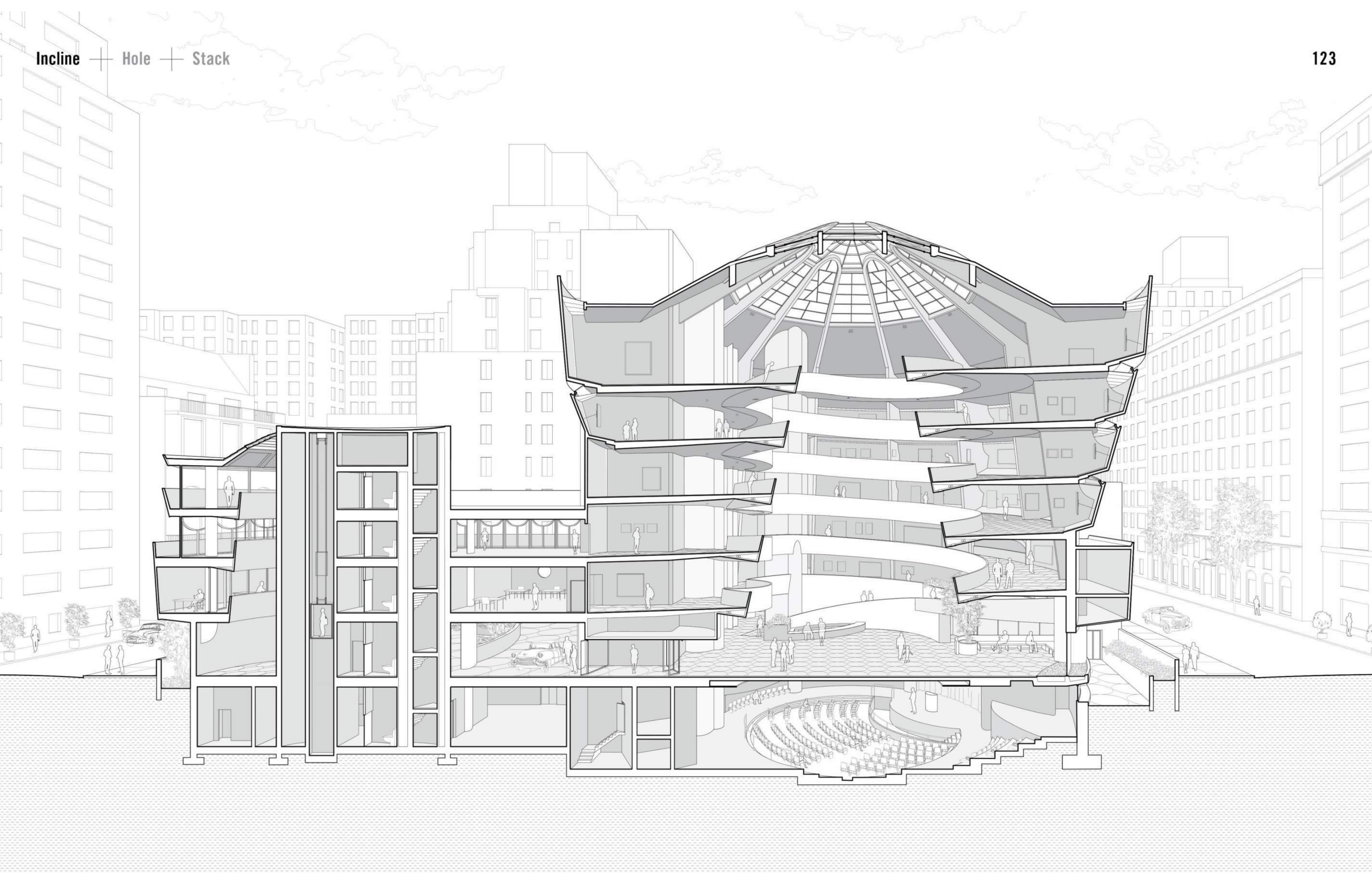
Interior Design
BFA Interior Design
AAS Interior Design
MFA Interior Design

Product + Industrial Design
BFA Product Design
MFA Industrial Design

Master of Architecture + MFA Lighting Design

MFA Interior Design + MFA Lighting Design

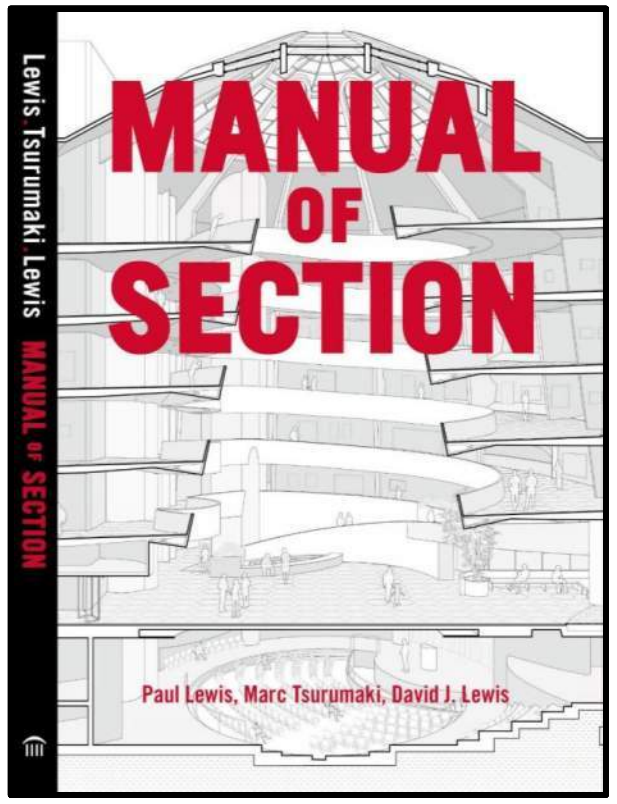

An essential history, guide, and reference to section in architecture—the first comprehensive analysis of what it is and what it does.
Princeton Architectural Press
www.papress.com
US $29.95 UK £18.99
ISBN 978-1-61689-255-5
52995
9 781616 892555
Lewis. Tsurumaki. Lewis
MANUAL OF SECTION
MANUAL OF SECTION
Paul Lewis, Marc Tsurumaki, David J. Lewis



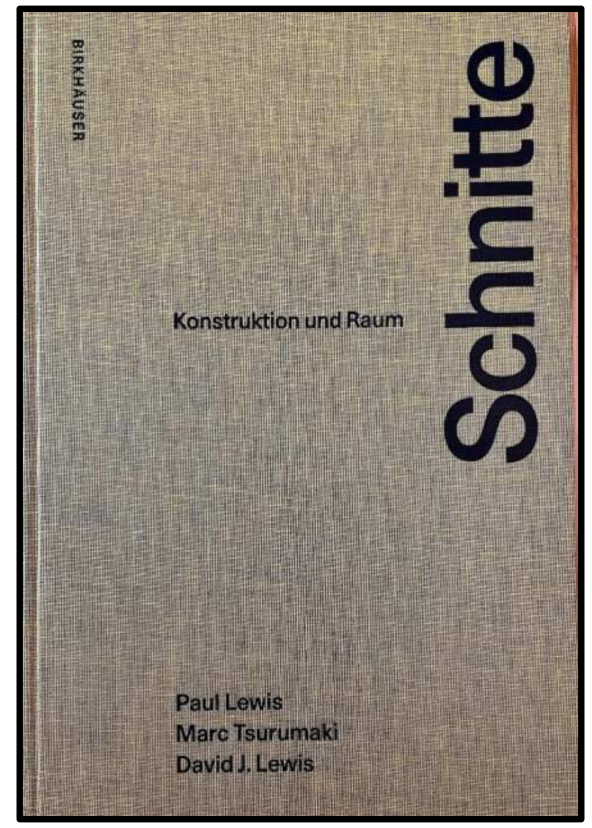
The Solomon R. Guggenheim Museum | New York, New York, USA

Frank Lloyd Wright | 1959

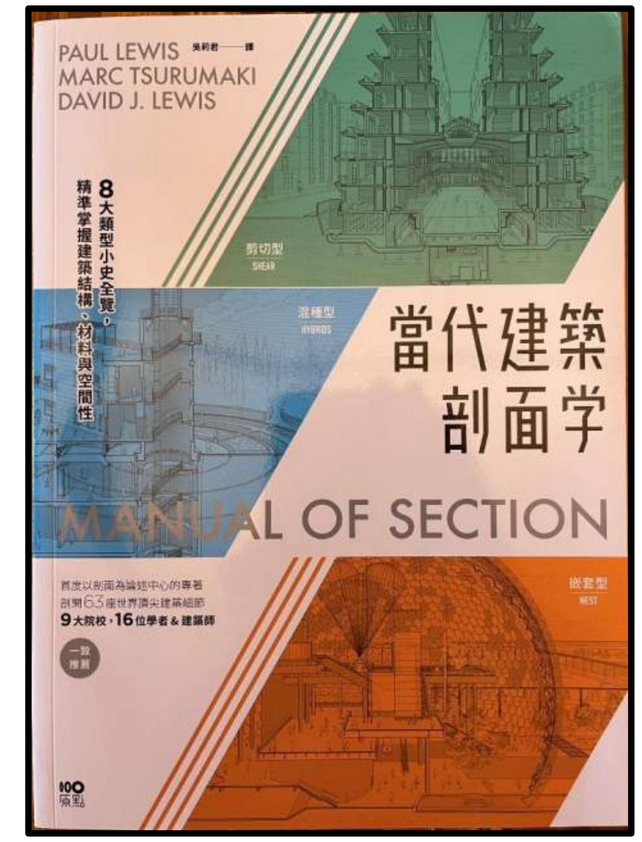
The main gallery of the Guggenheim Museum is an exemplary demonstration of an inclined section defining an entire building. Rising at a 3 percent grade and stretching more than 1/4 mi (0.4 km) in length, the continuous path expands in width as it moves upward, producing a conical void at the center of the museum and an inverted conical form on the exterior. A skylight supported by concrete ribs fills the 92-ft-high (28 m) atrium with daylight, while the continuous perimeter skylight enabled by recessions in the exterior profile was intended to backlight paintings to make them appear to float. The tapered concrete balcony and integral soffit conceal the air supply duct. The primary point of tension between the incline and level floor is at the bottom, where Wright folded the ramp up against itself to form a base. An exterior porte cochere separates the main gallery from the administrative wing. While the administrative wing echoes the circular form of the main gallery, the inclined section is confined to the gallery, as connection among the flat administrative floors is made through a service core, with a small atrium providing limited visible continuity. In the main gallery, the inclined section's physical continuity is complemented by the visual connectivity of the large atrium.



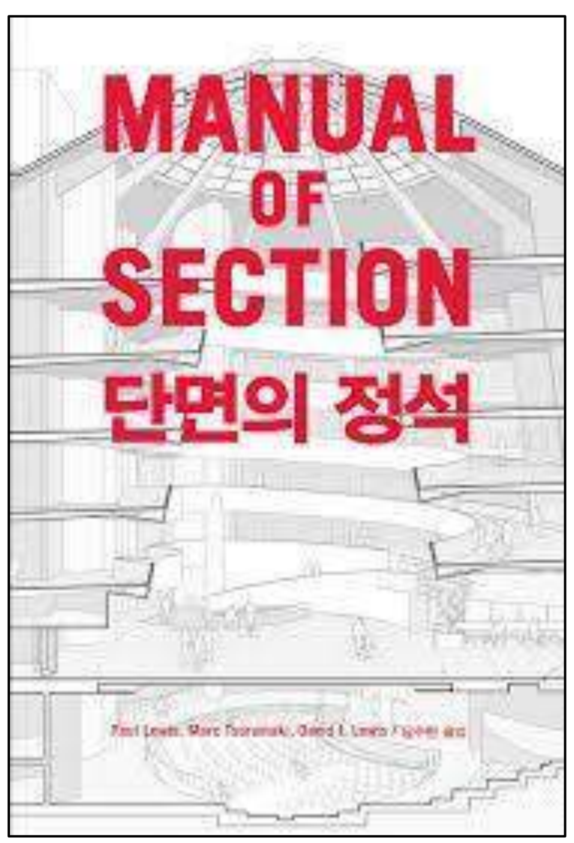
English



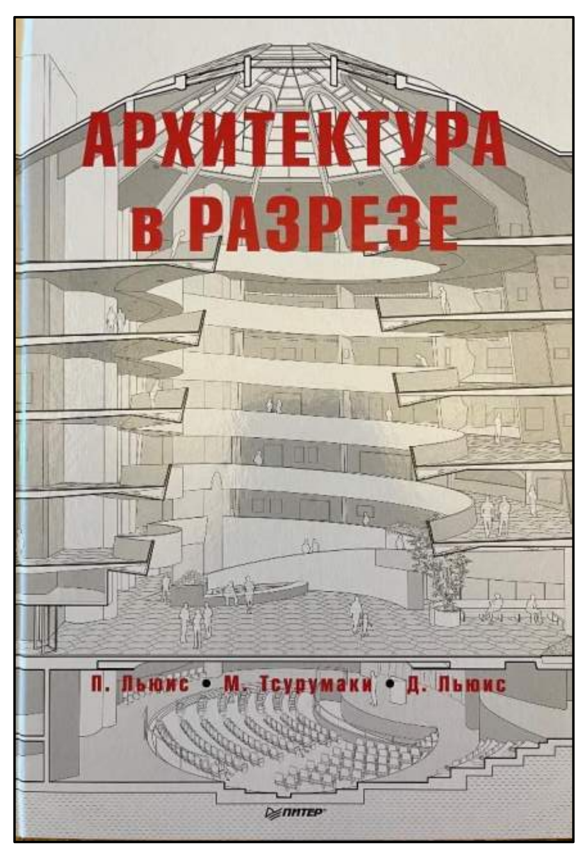
German



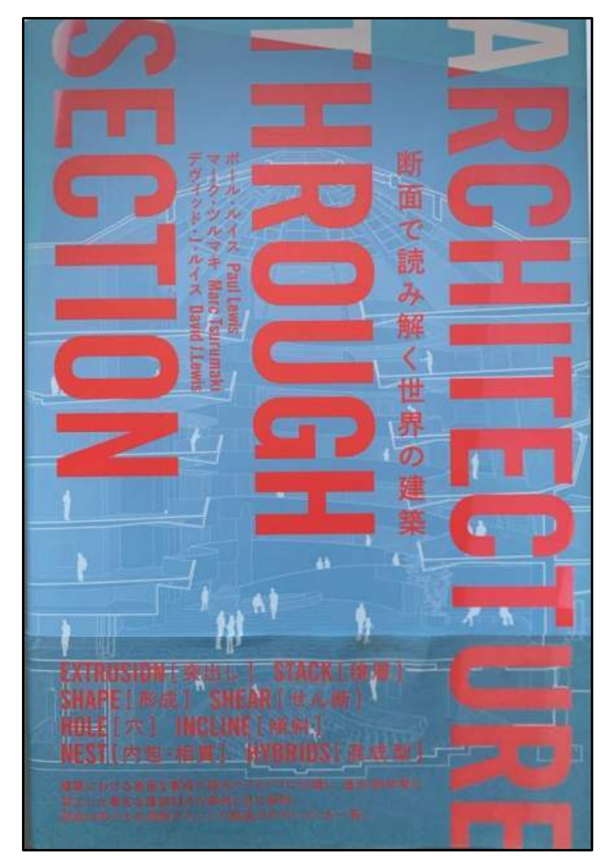
Taiwanese



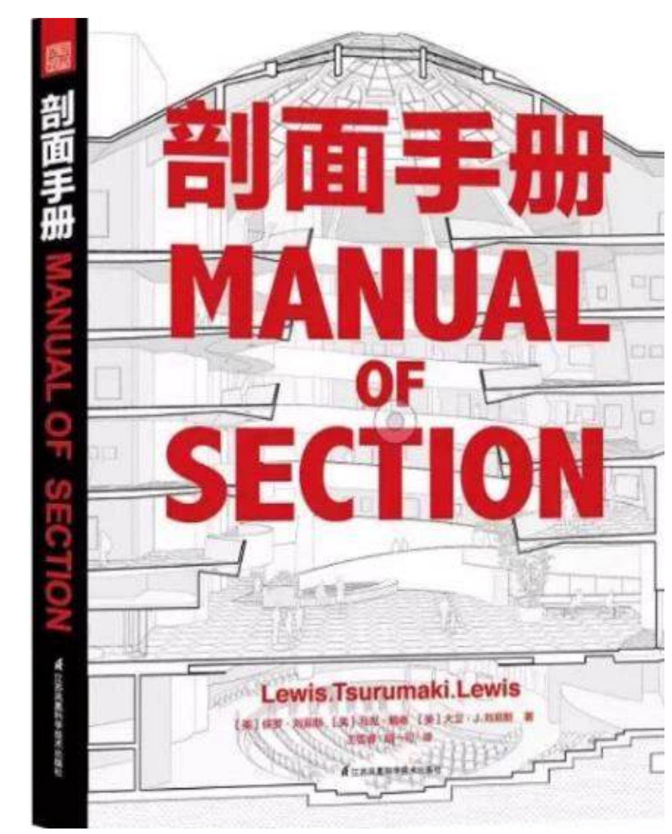
Korean



Russian



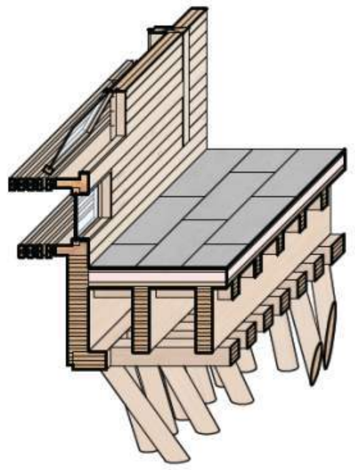
Japanese



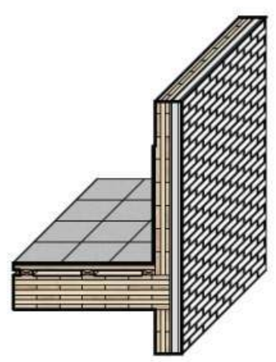
Chinese

LTLARCHITECTS

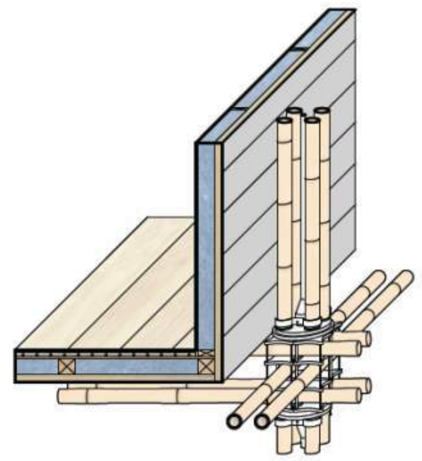
Building on *Manual of Section*, this book articulates how plant-based and low-carbon materials can produce a profound rethinking of section in houses.



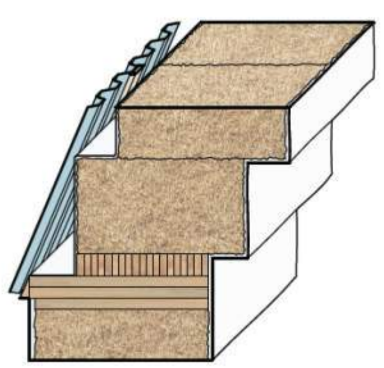
Wood Frame



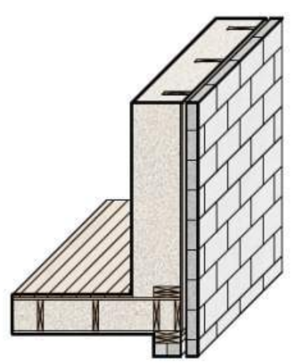
Mass Timber



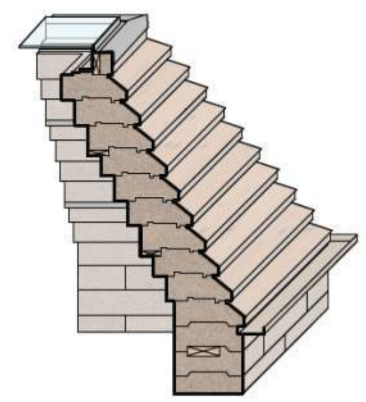
Bamboo



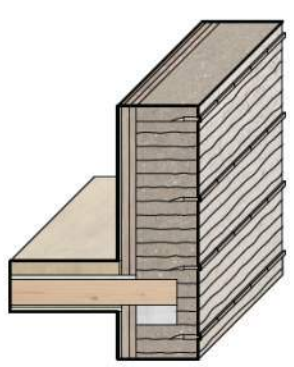
Straw



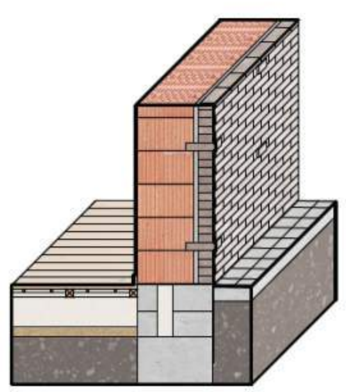
Hemp



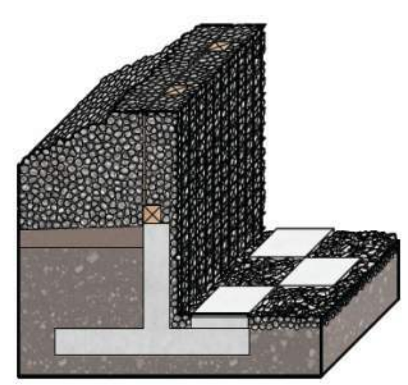
Cork



Earth



Brick



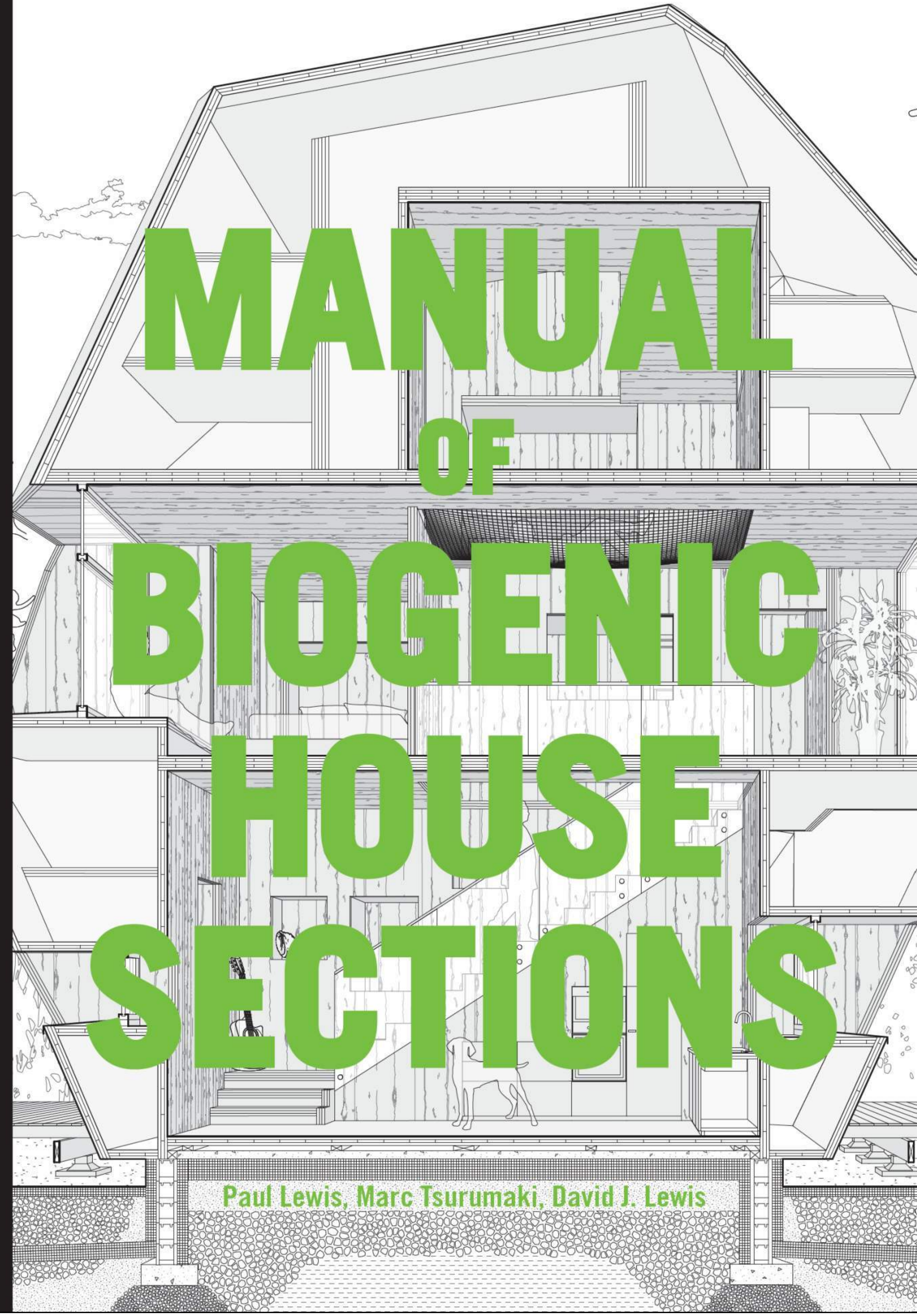
Stone

ISBN 978-1-957183-09-1 USD 39.95
53995
9 781957 183091 >

Lewis.Tsurumaki.Lewis

MANUAL OF BIOGENIC HOUSE SECTIONS

MANUAL OF BIOGENIC HOUSE SECTIONS

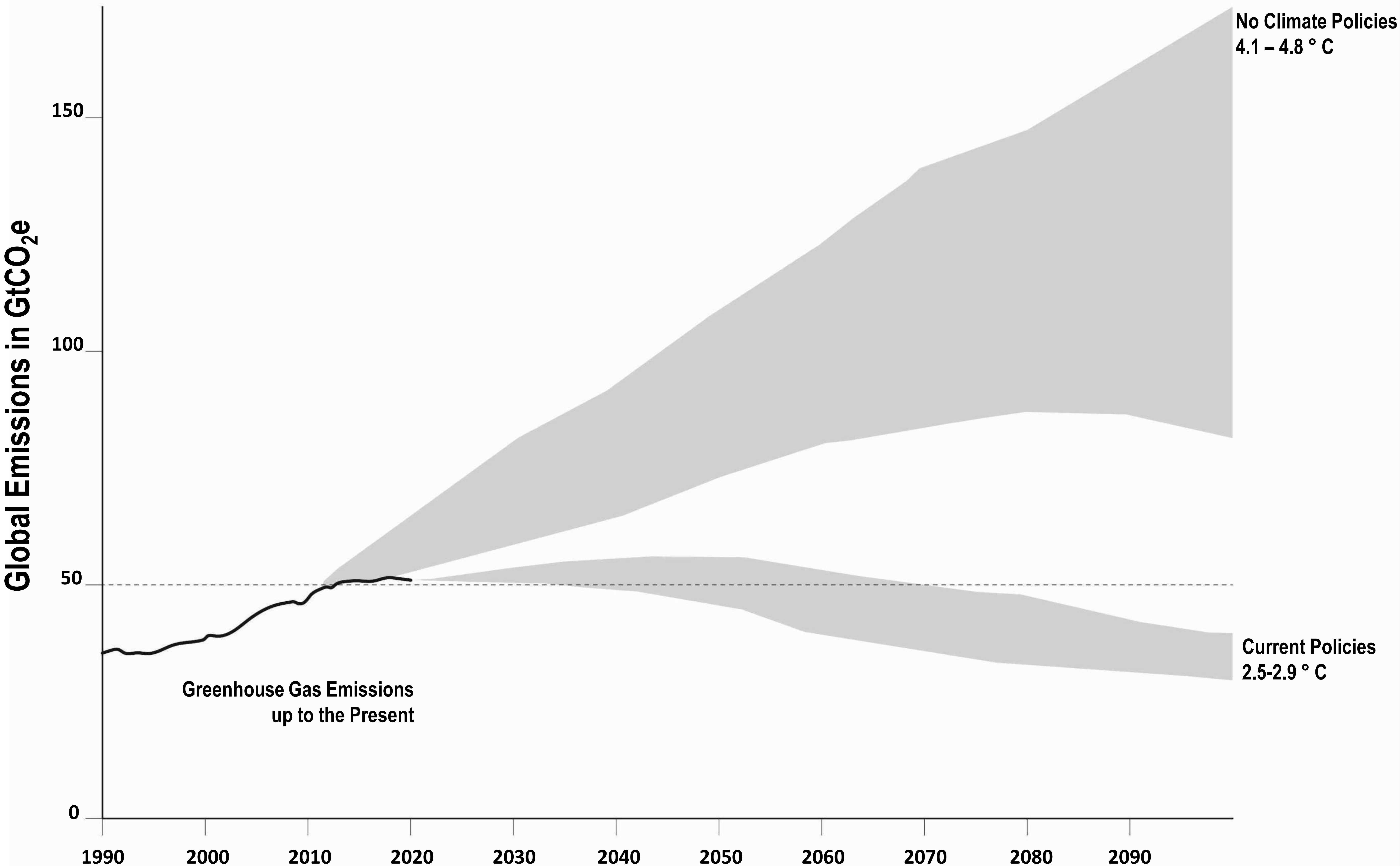


Paul Lewis, Marc Tsurumaki, David J. Lewis

LTLARCHITECTS

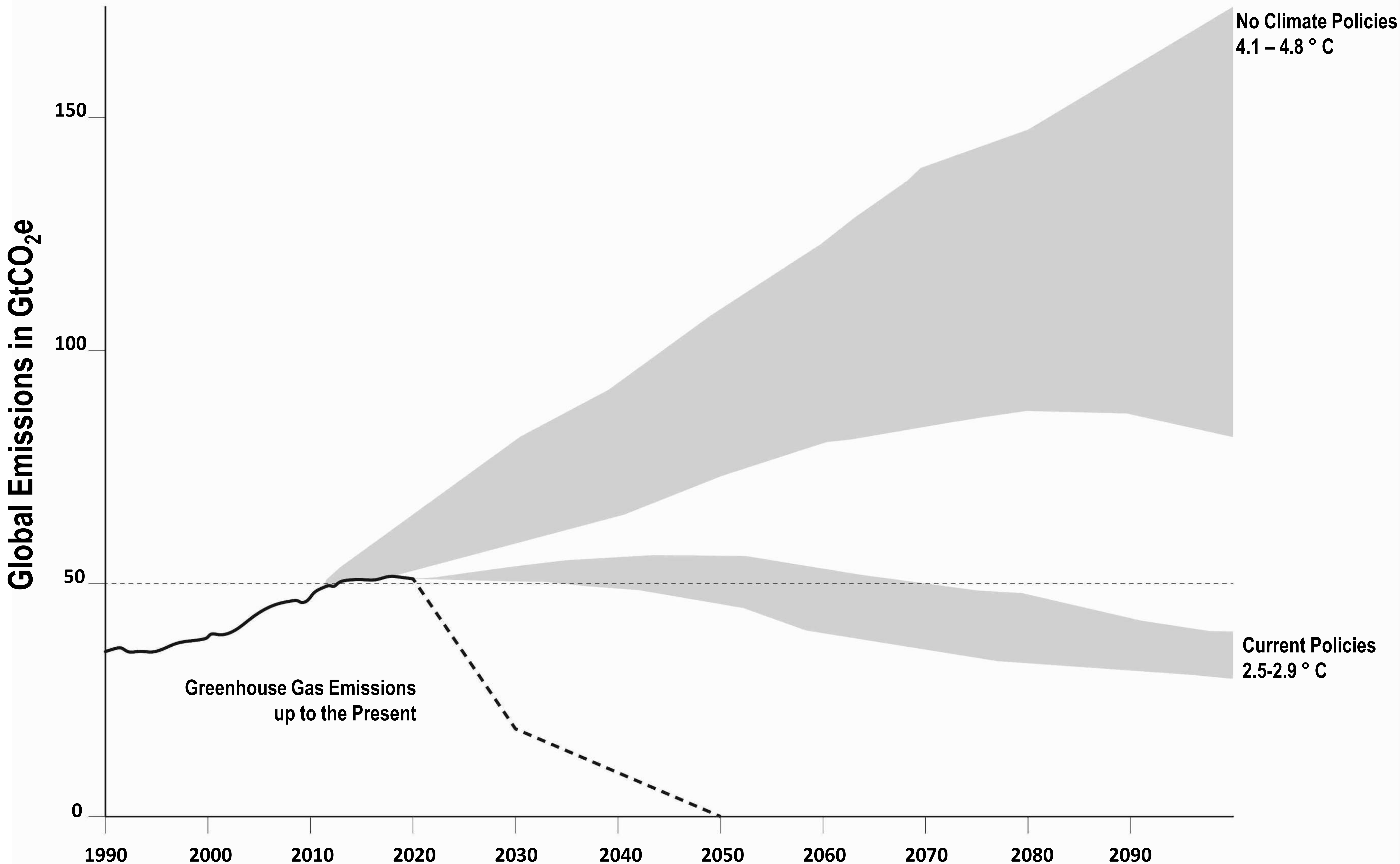

H&M

Global Greenhouse Gas Emissions and Warming Scenarios



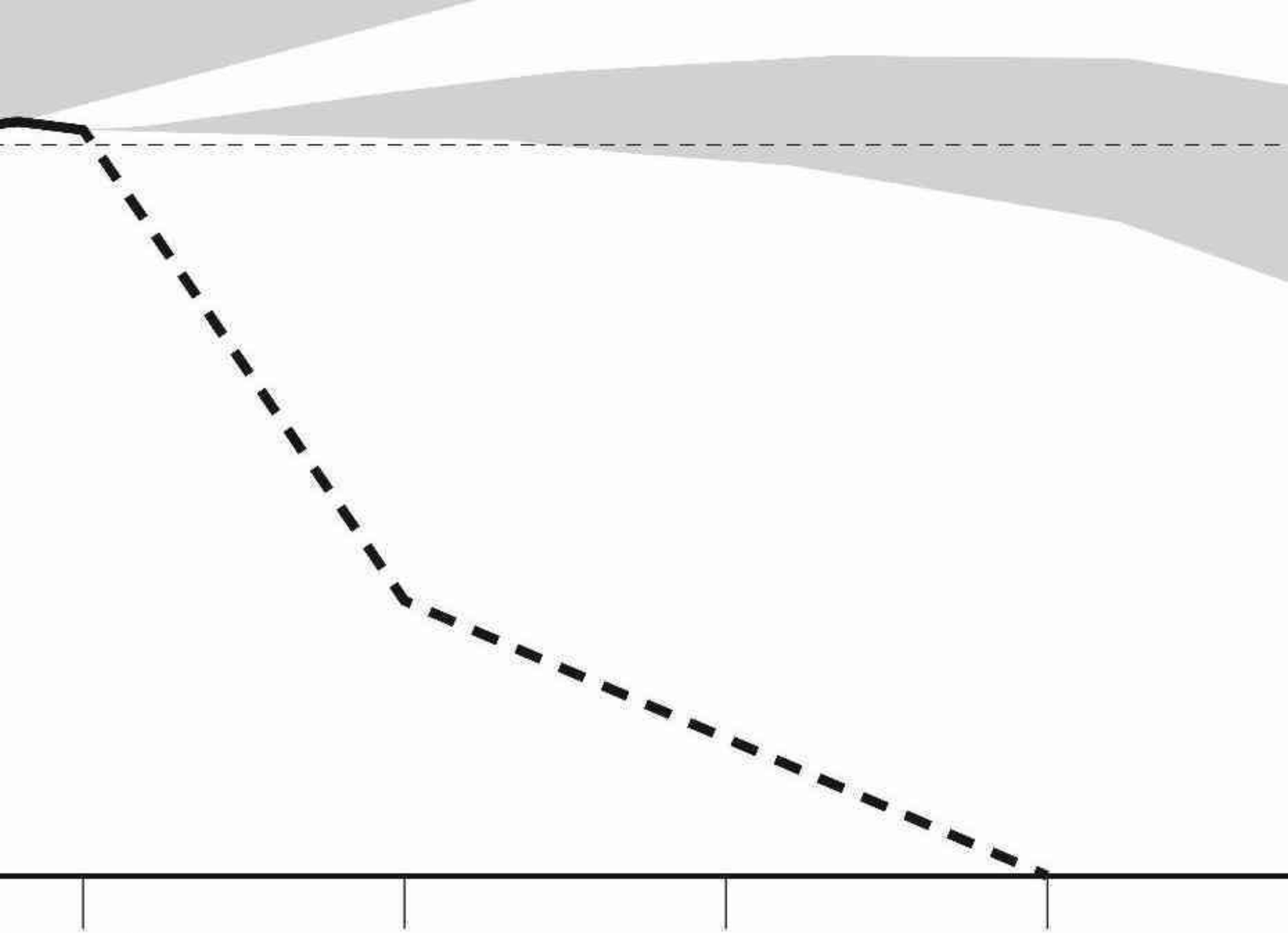
*Data: Architecture 20

Global Greenhouse Gas Emissions and Warming Scenarios



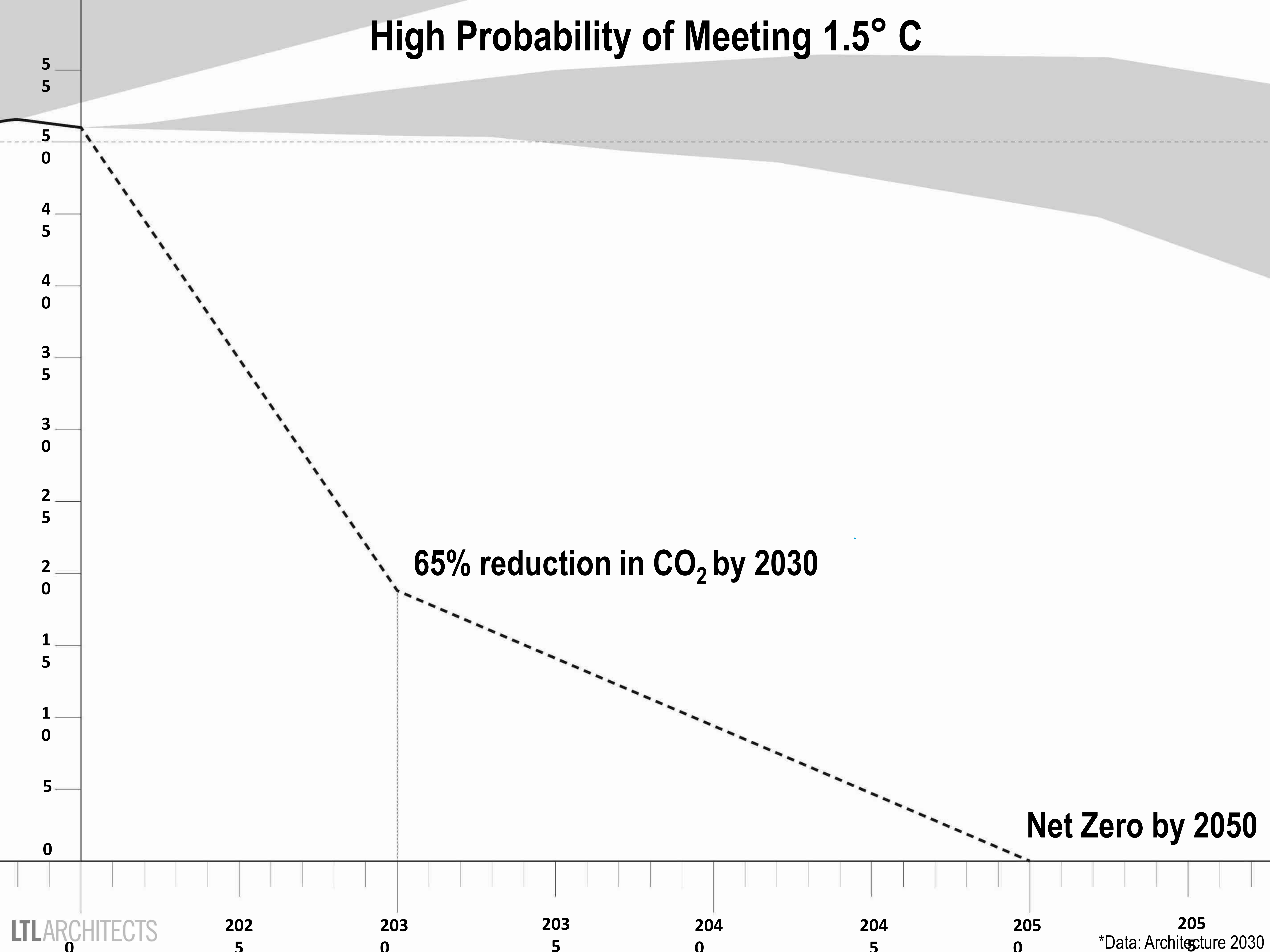
LTLARCHITECTS

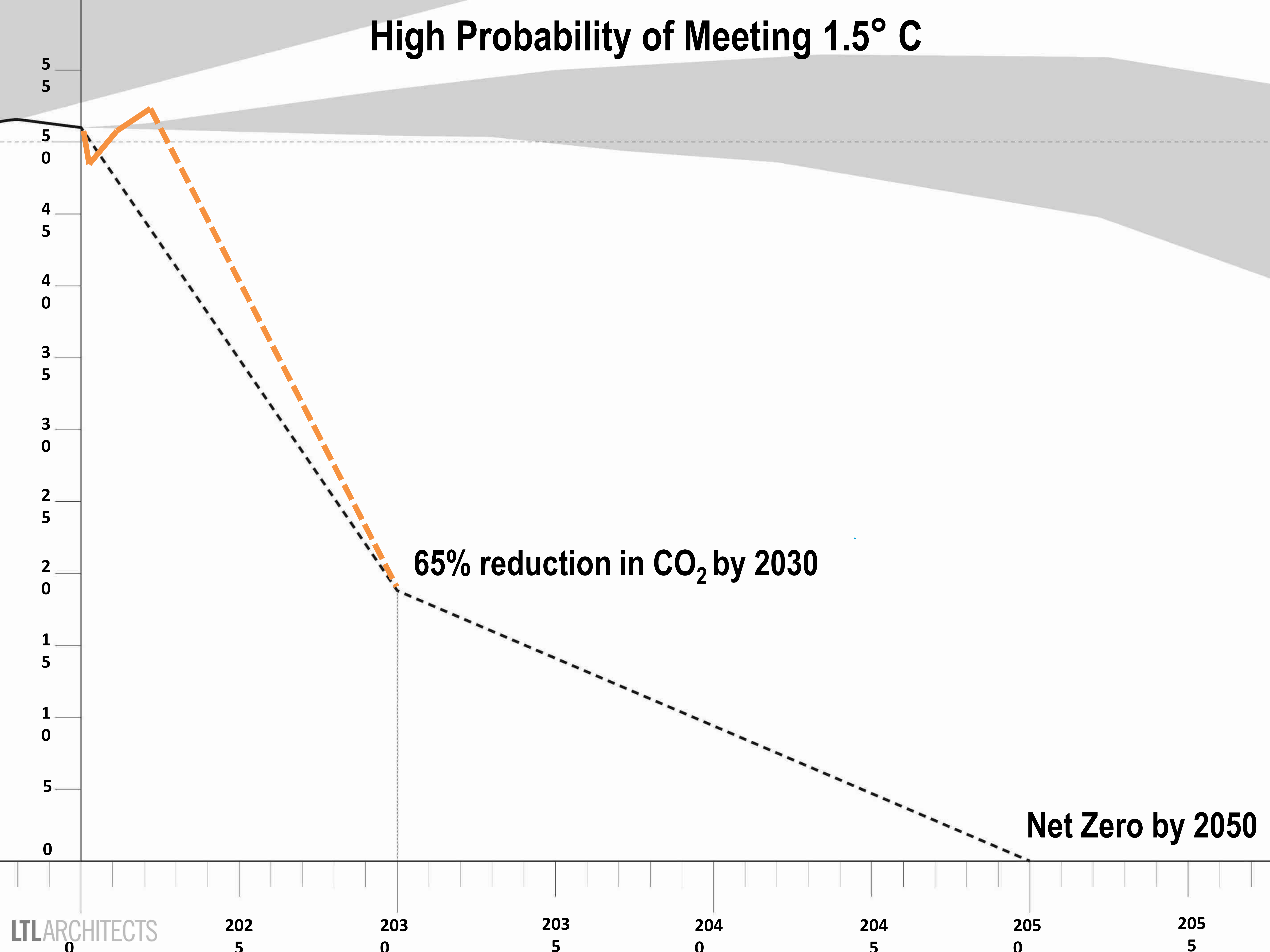
*Data: Architecture 2



LTLARCHITECTS

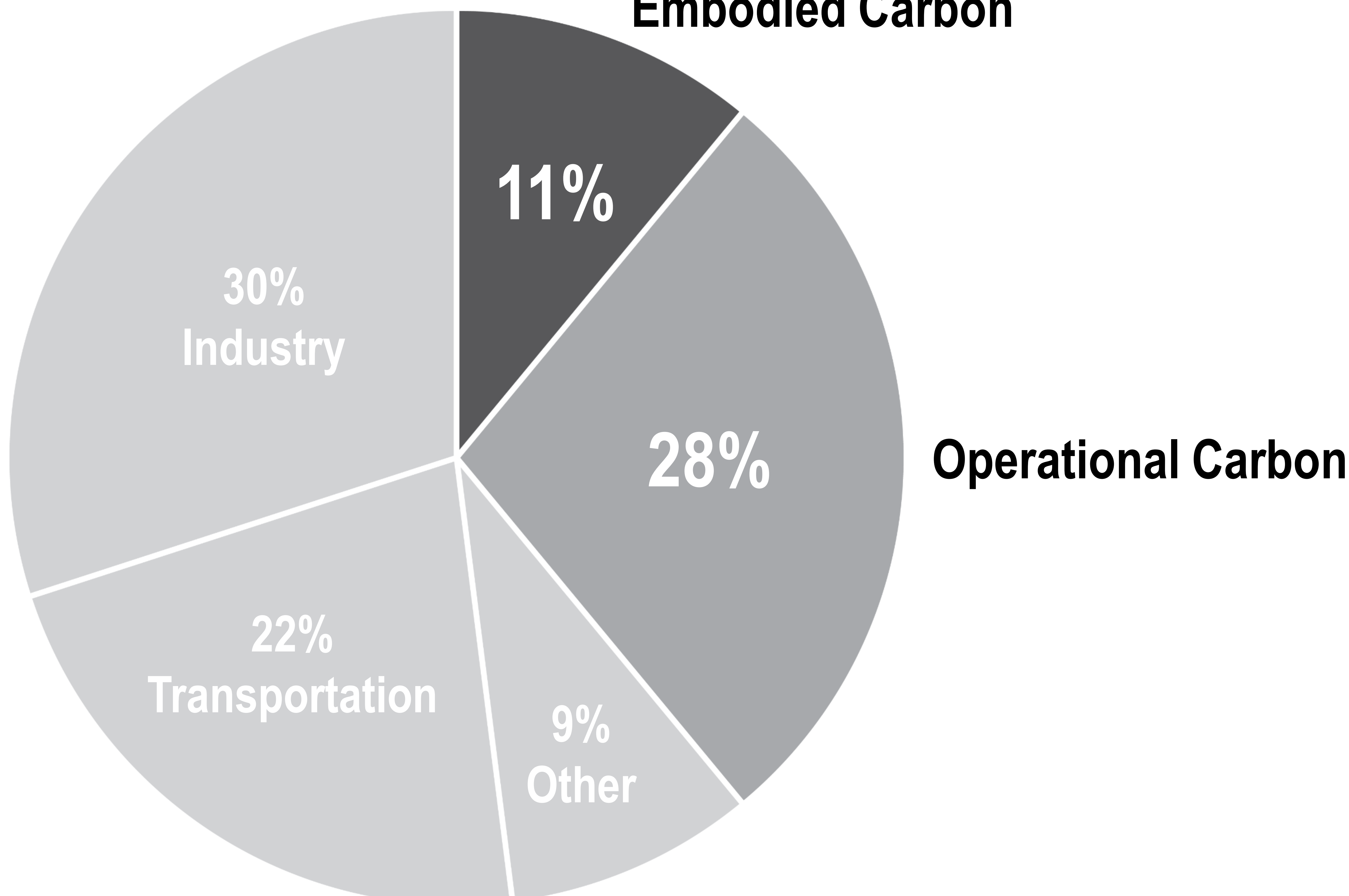
*Data: Architecture 2


High Probability of Meeting 1.5° C
65% reduction in CO2 by 2030
Net Zero by 2050
55
50
45
40
35
30
25
20
15
10
5
0
2020
2025
2030
2035
2040
2045
2050
2055
LTL ARCHITECTS
*Data: Architecture 2030



High Probability of Meeting 1.5° C
65% reduction in CO2 by 2030
Net Zero by 2050
55
50
45
40
35
30
25
20
15
10
5
0
2020
2025
2030
2035
2040
2045
2050
2055
LTLARCHITECTS

Buildings = 39% of Global Carbon Emissions

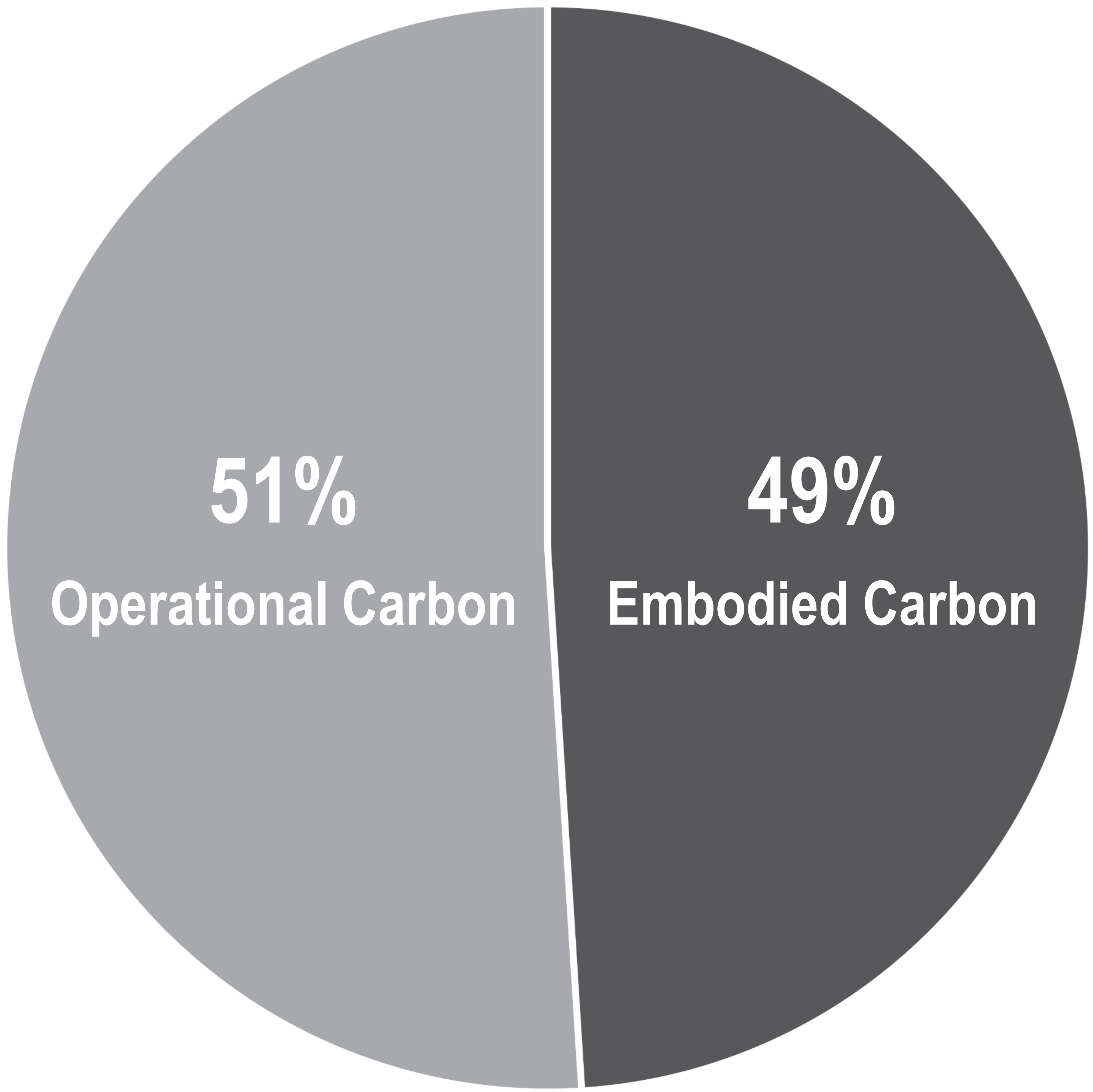


Global CO_2e Emissions by Sector

LTLARCHITECTS

*Data: Architecture 2030

Total Carbon Emissions of Global New Construction 2020-2050

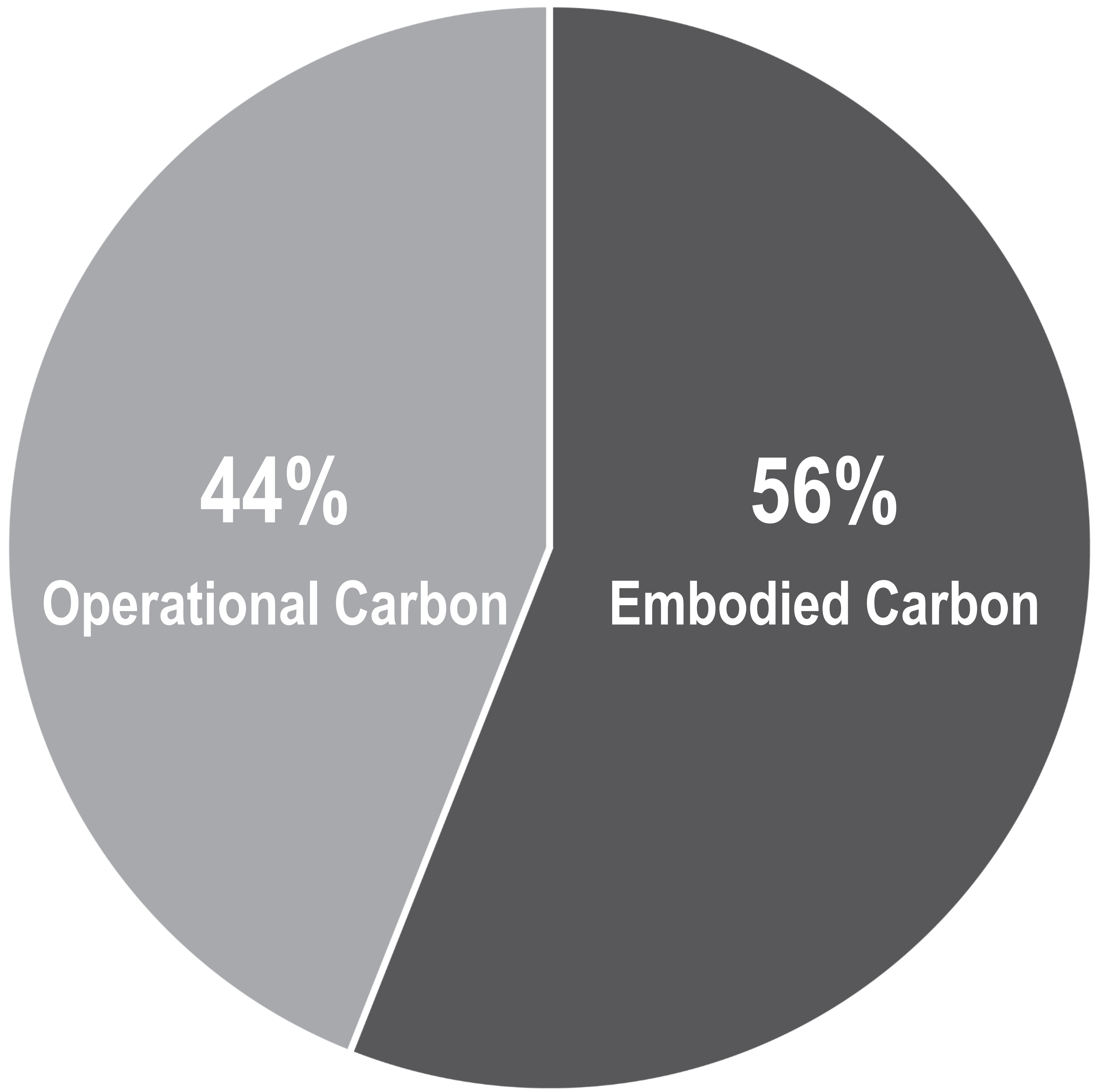


Business as Usual

LTL ARCHITECTS

*Data: Carbon Leadership Forum

Total Carbon Emissions of Global New Construction 2020-2050

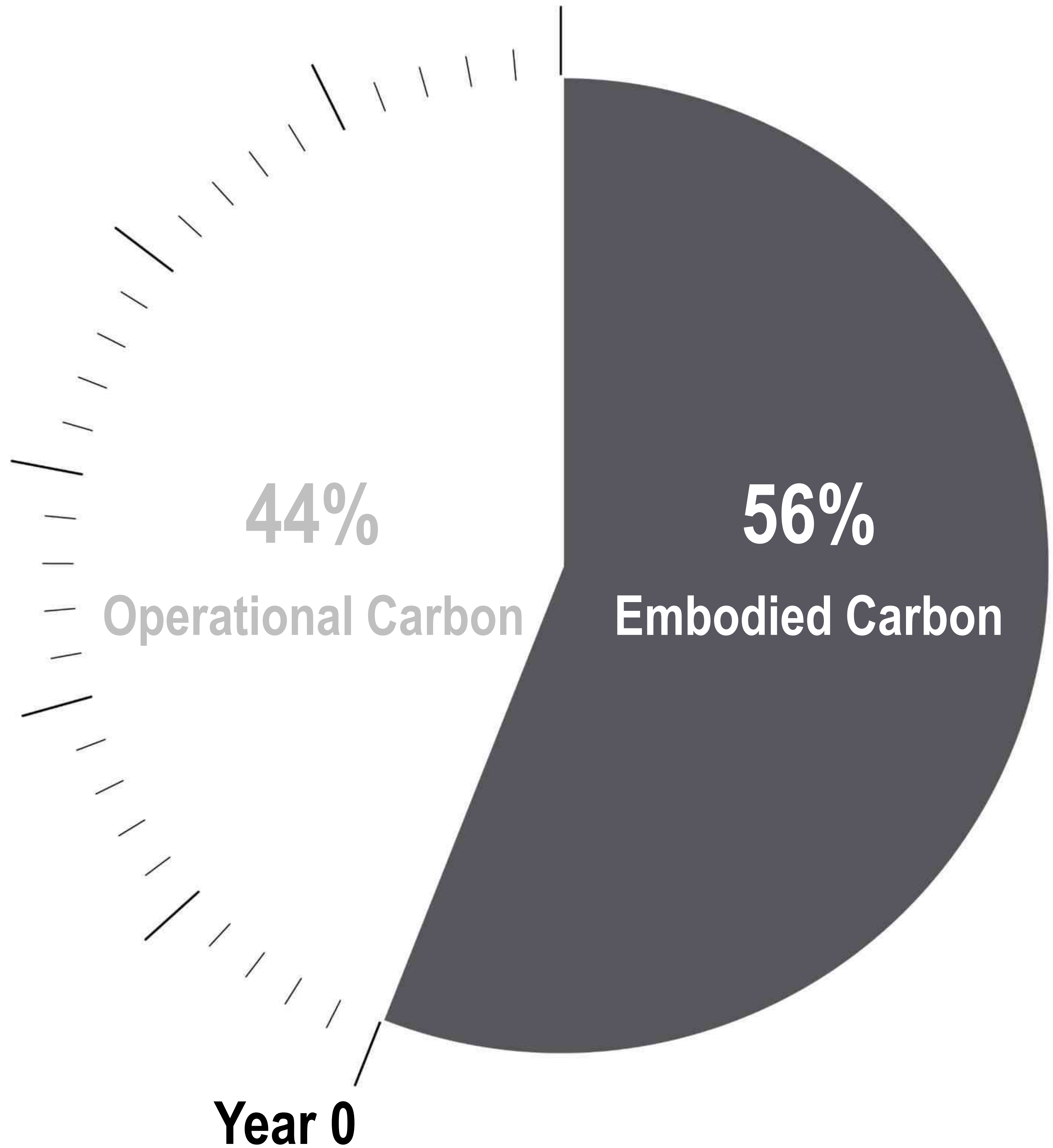


High Performance Building

LTL ARCHITECTS

*Data: Carbon Leadership Forum

Total Carbon Emissions of Global New Construction 2020-2050

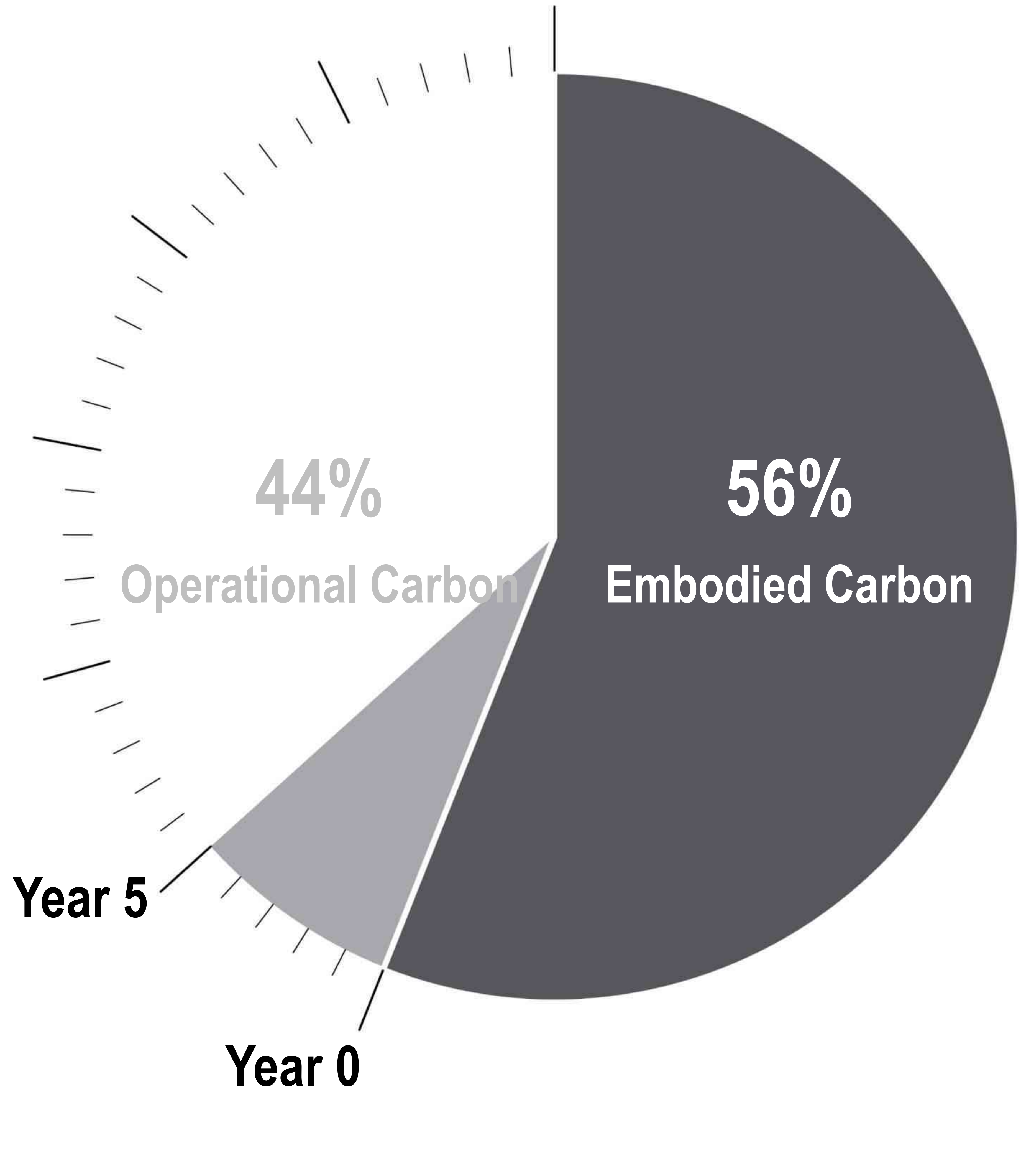


Upfront Carbon

LTLARCHITECTS

*Data: Carbon Leadership Forum

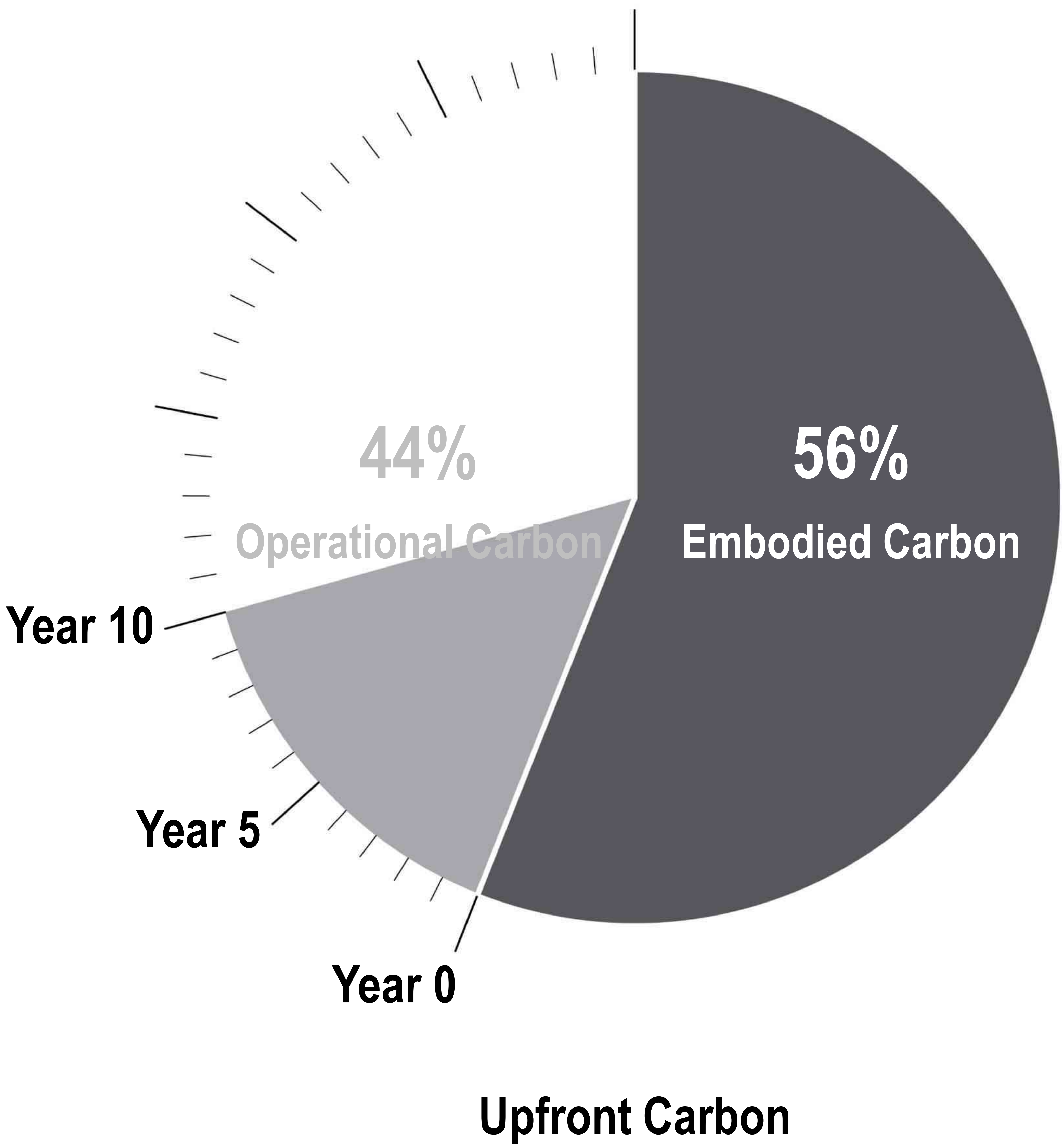
Total Carbon Emissions of Global New Construction 2020-2050



LTLARCHITECTS

*Data: Carbon Leadership Forum

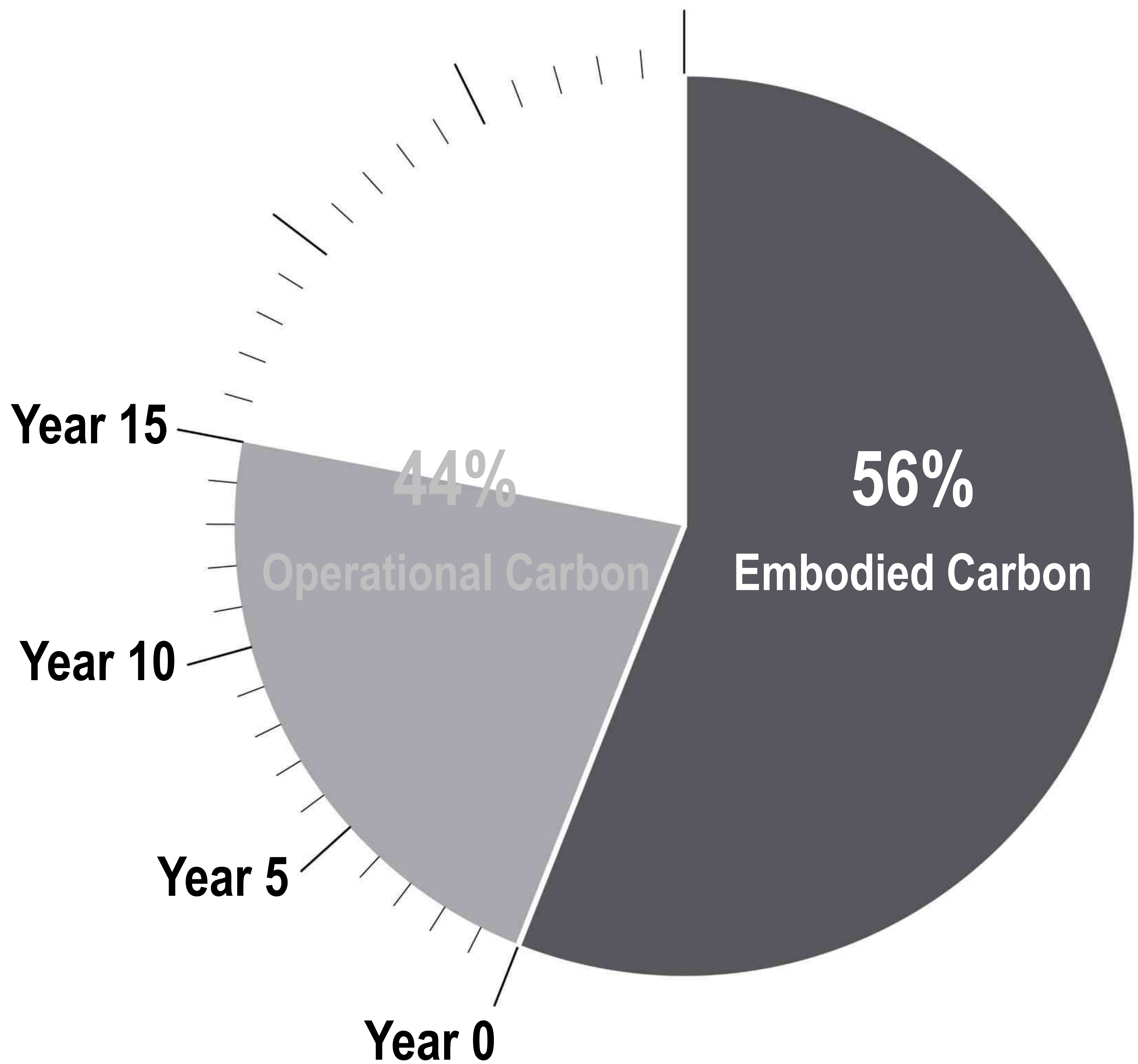
Total Carbon Emissions of Global New Construction 2020-2050



LTLARCHITECTS

*Data: Carbon Leadership Forum

Total Carbon Emissions of Global New Construction 2020-2050

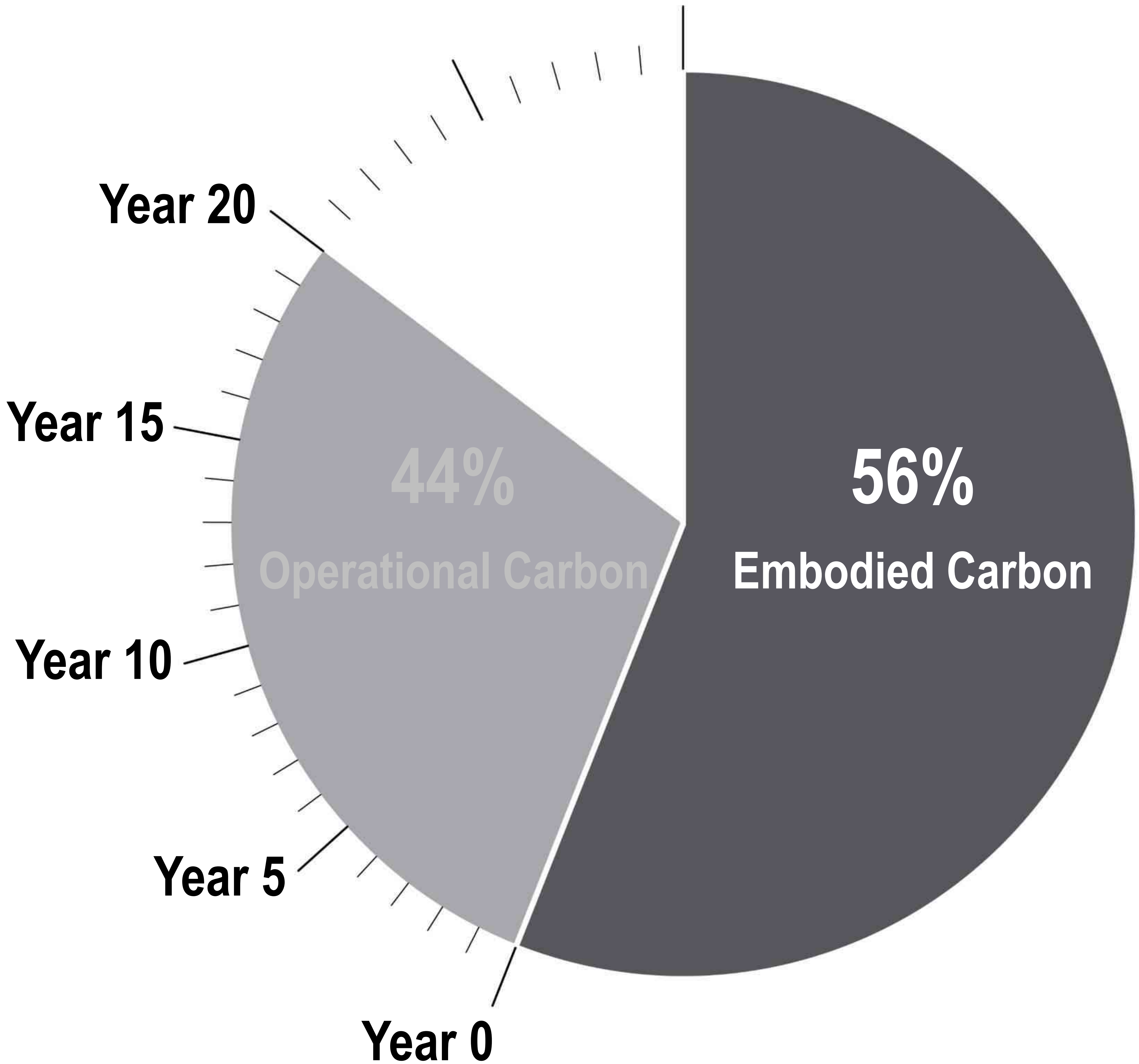


Upfront Carbon

LTL ARCHITECTS

*Data: Carbon Leadership Forum

Total Carbon Emissions of Global New Construction 2020-2050

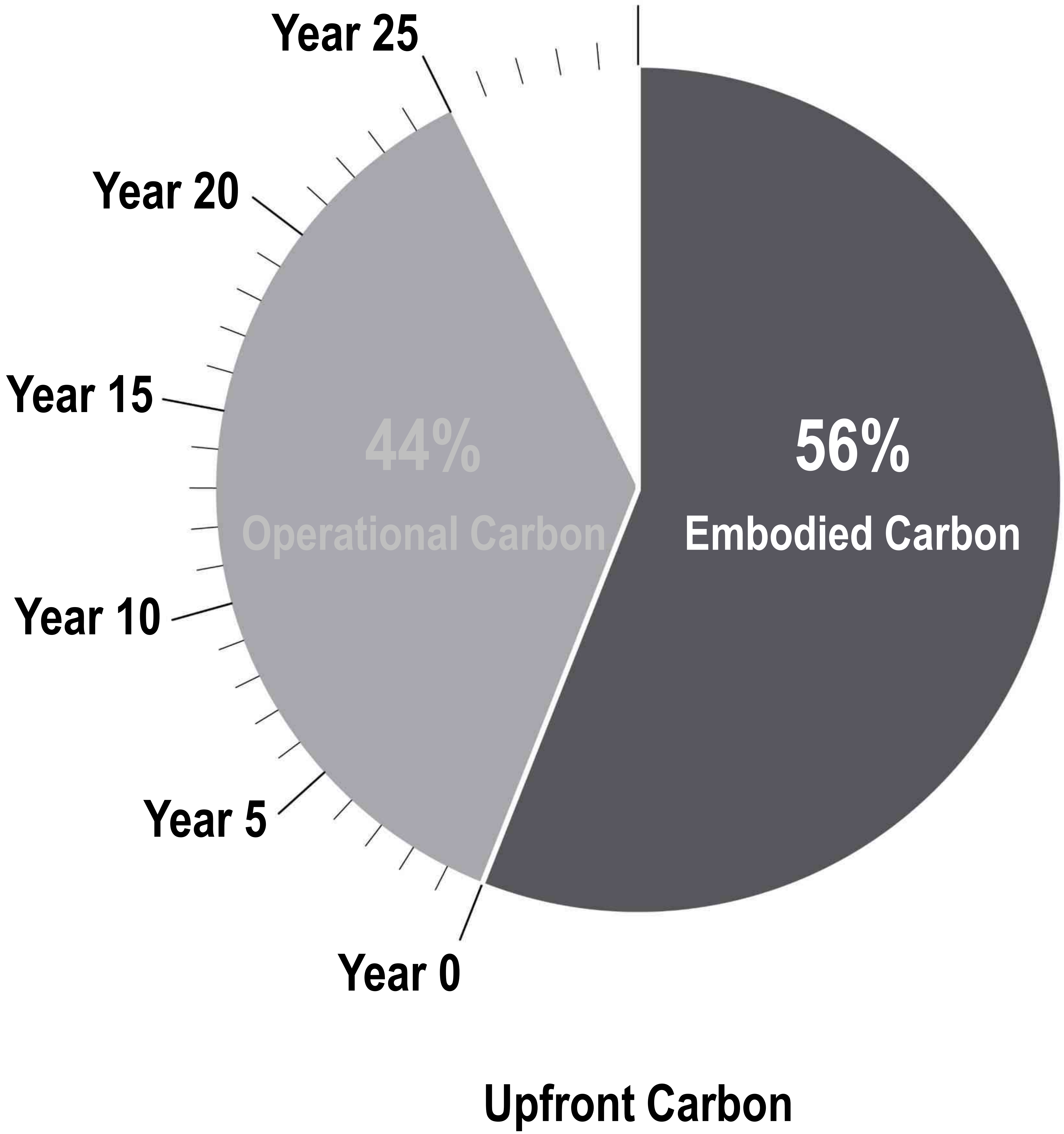


Upfront Carbon

LTL ARCHITECTS

*Data: Carbon Leadership Forum

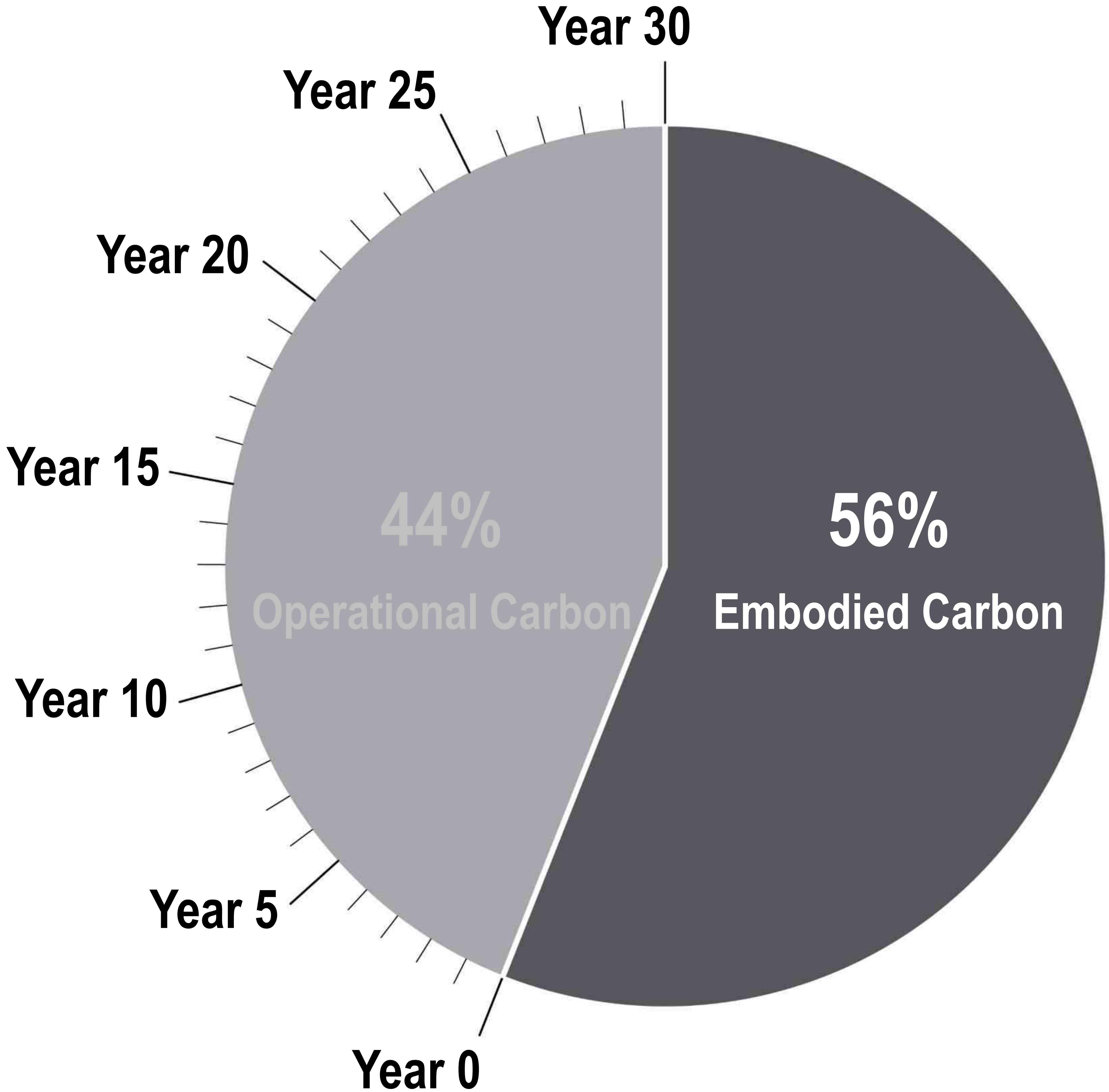
Total Carbon Emissions of Global New Construction 2020-2050



LTL ARCHITECTS

*Data: Carbon Leadership Forum

Total Carbon Emissions of Global New Construction 2020-2050



Upfront Carbon

LTL ARCHITECTS

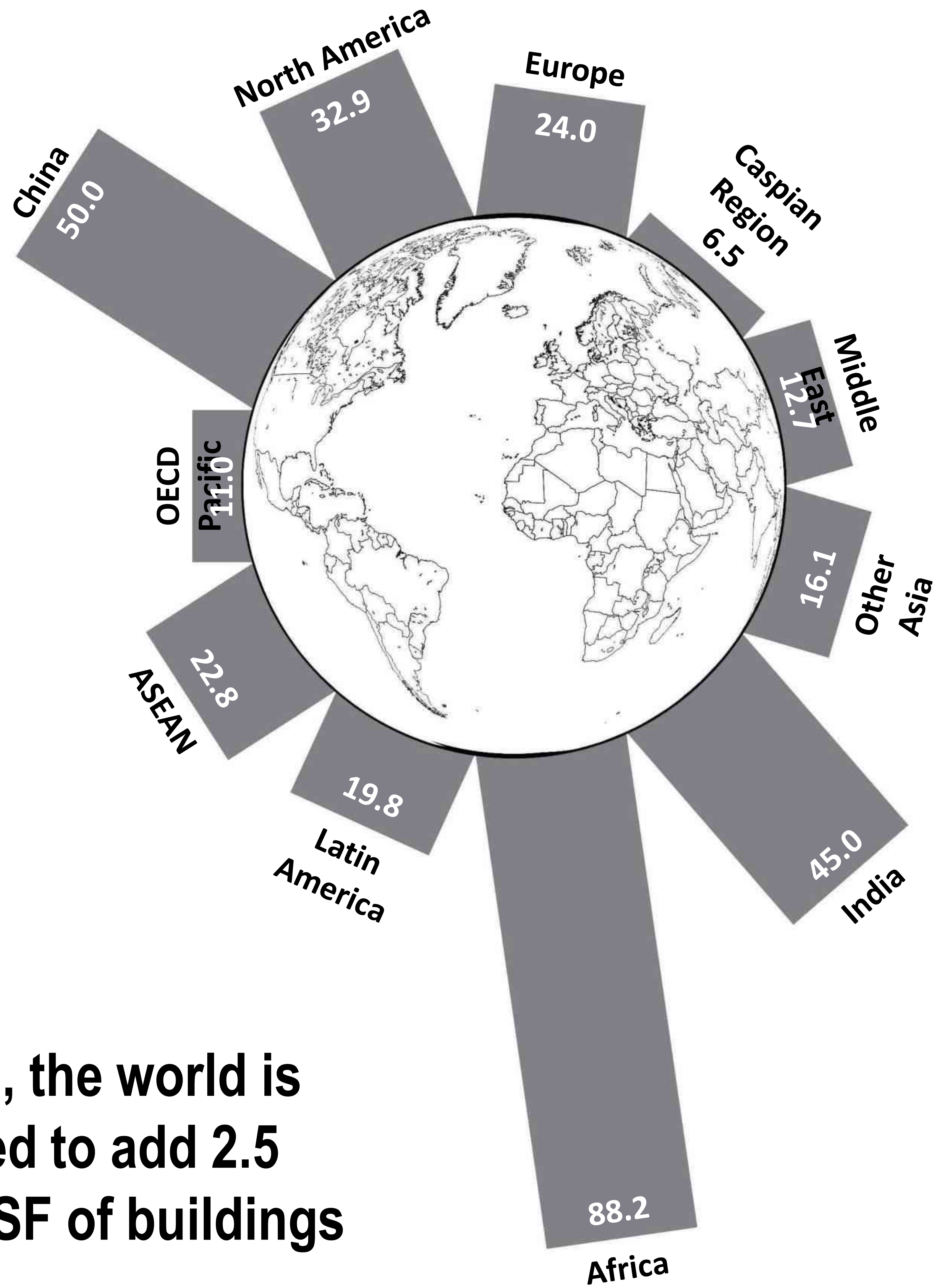
*Data: Carbon Leadership Forum

*Data: Architecture 2030

Building Floor Area Additions by 2060 in Billions M^2

*Data: Architecture 2030

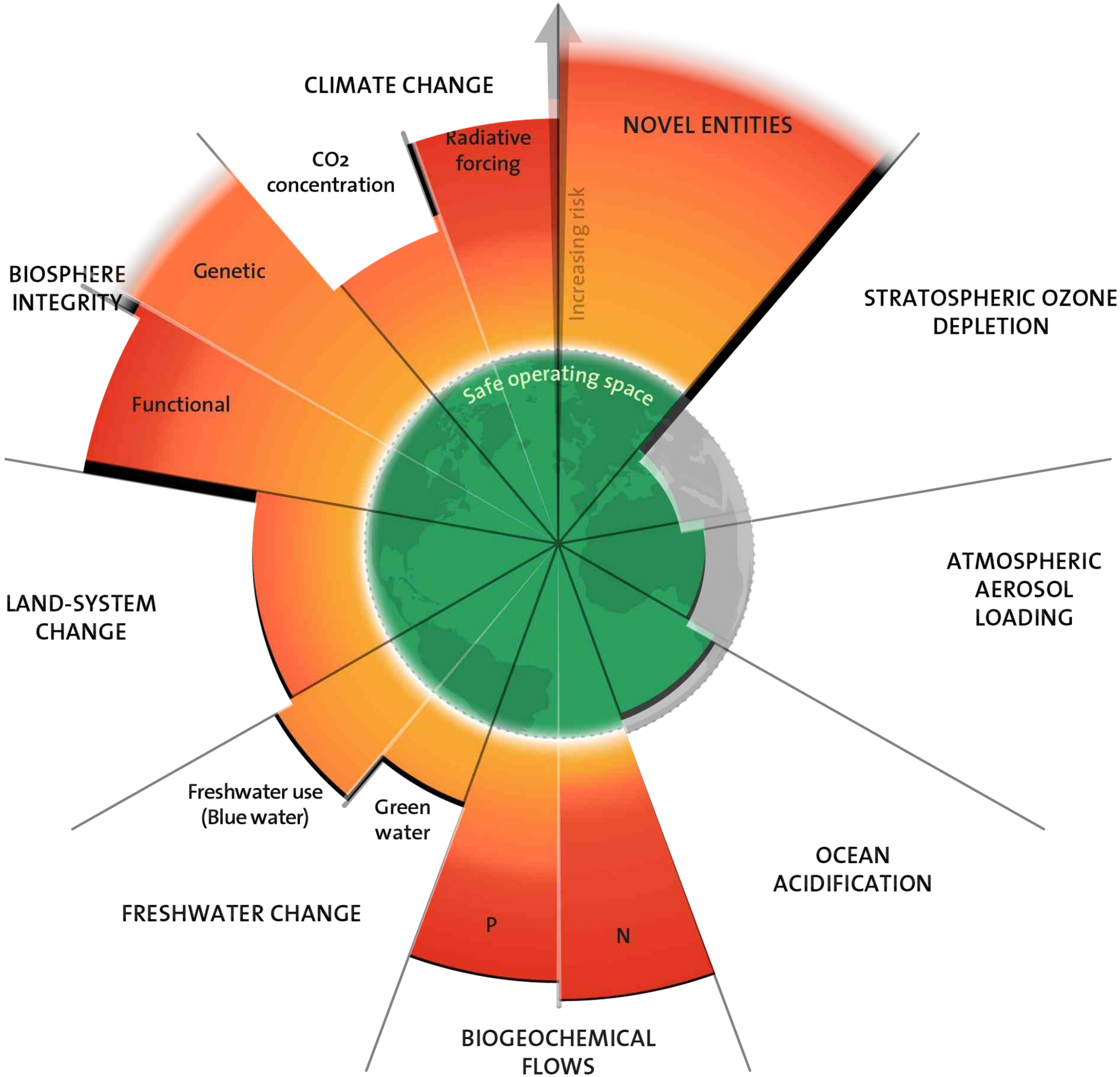
Building Floor Area Additions by 2060 in Billions M²



By 2060, the world is projected to add 2.5 Trillion SF of buildings

LTL ARCHITECTS

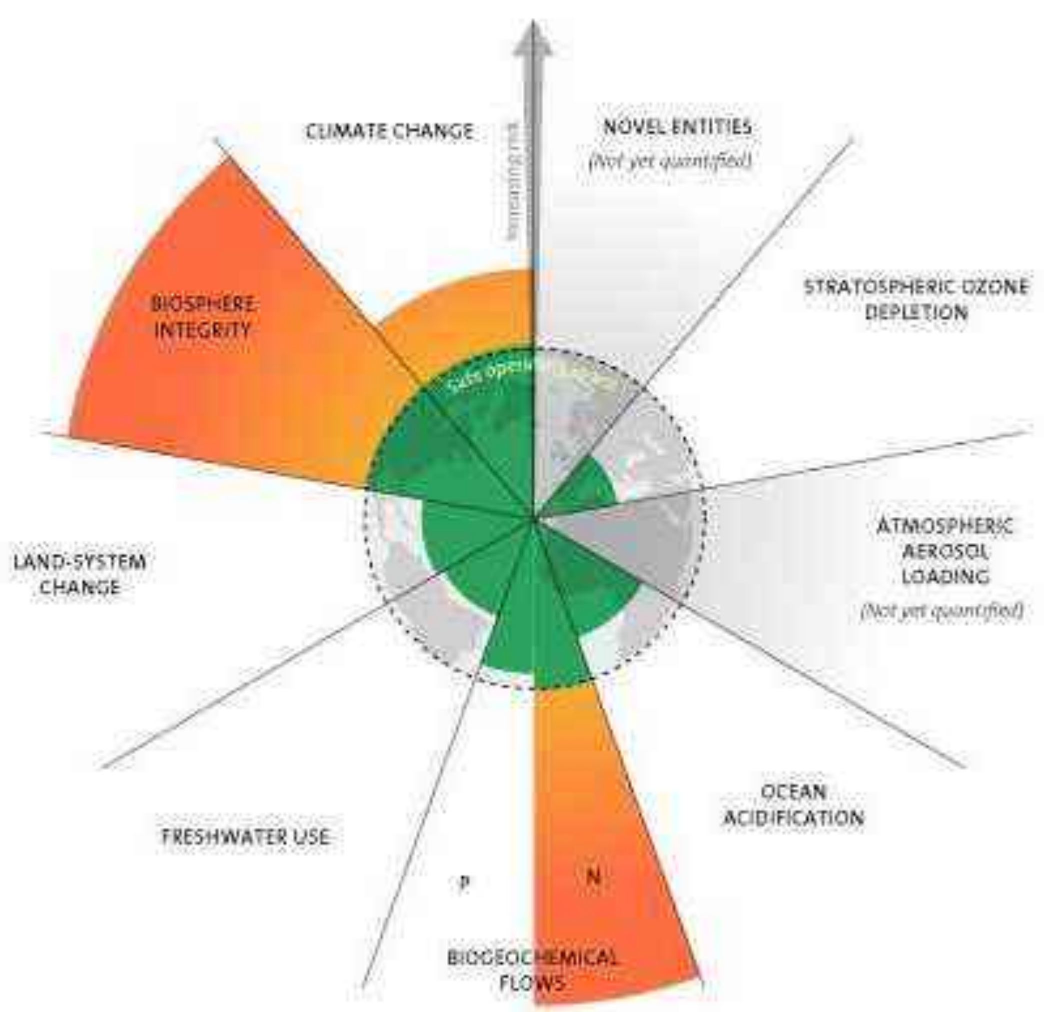
*Data: Architecture 2030



The 2023 update to the Planetary Boundaries

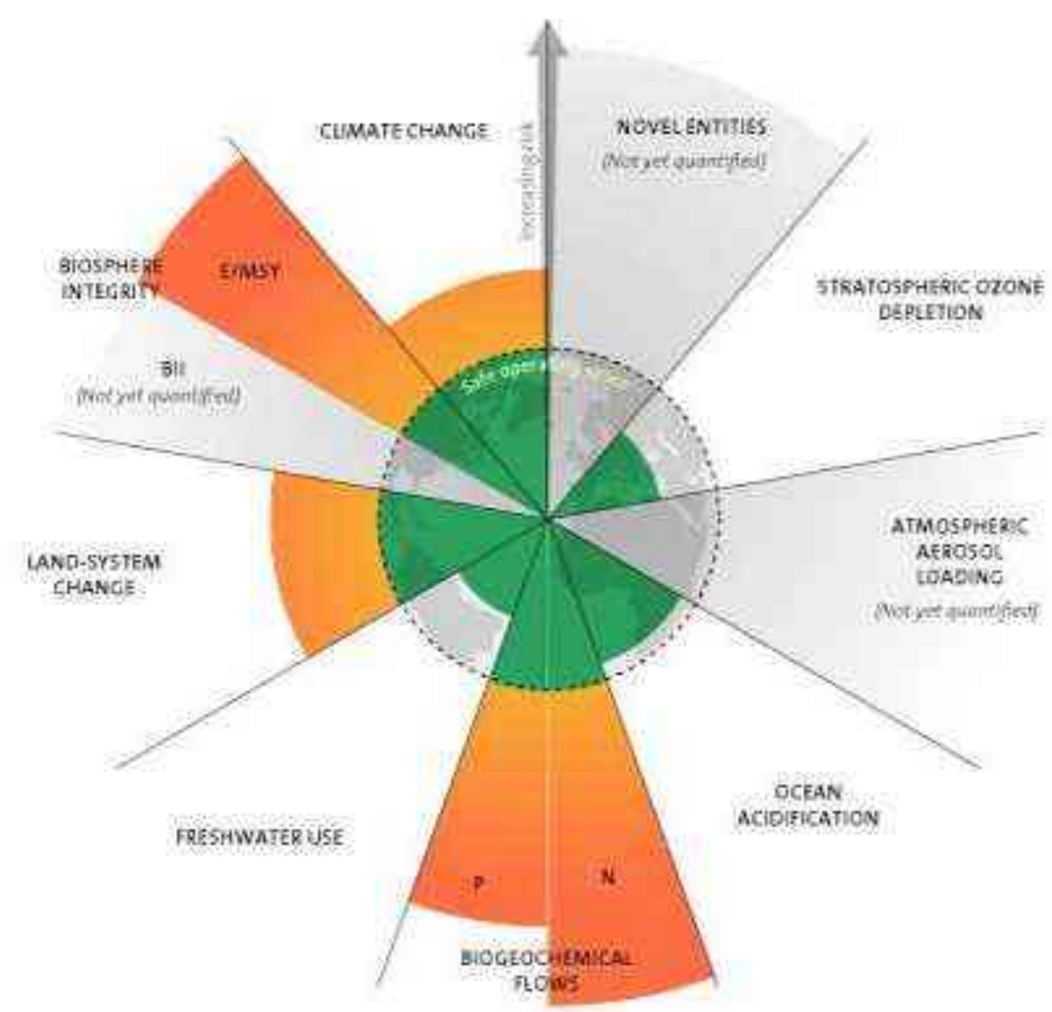
Stockholm Resilience Centre
Stockholm University

2009



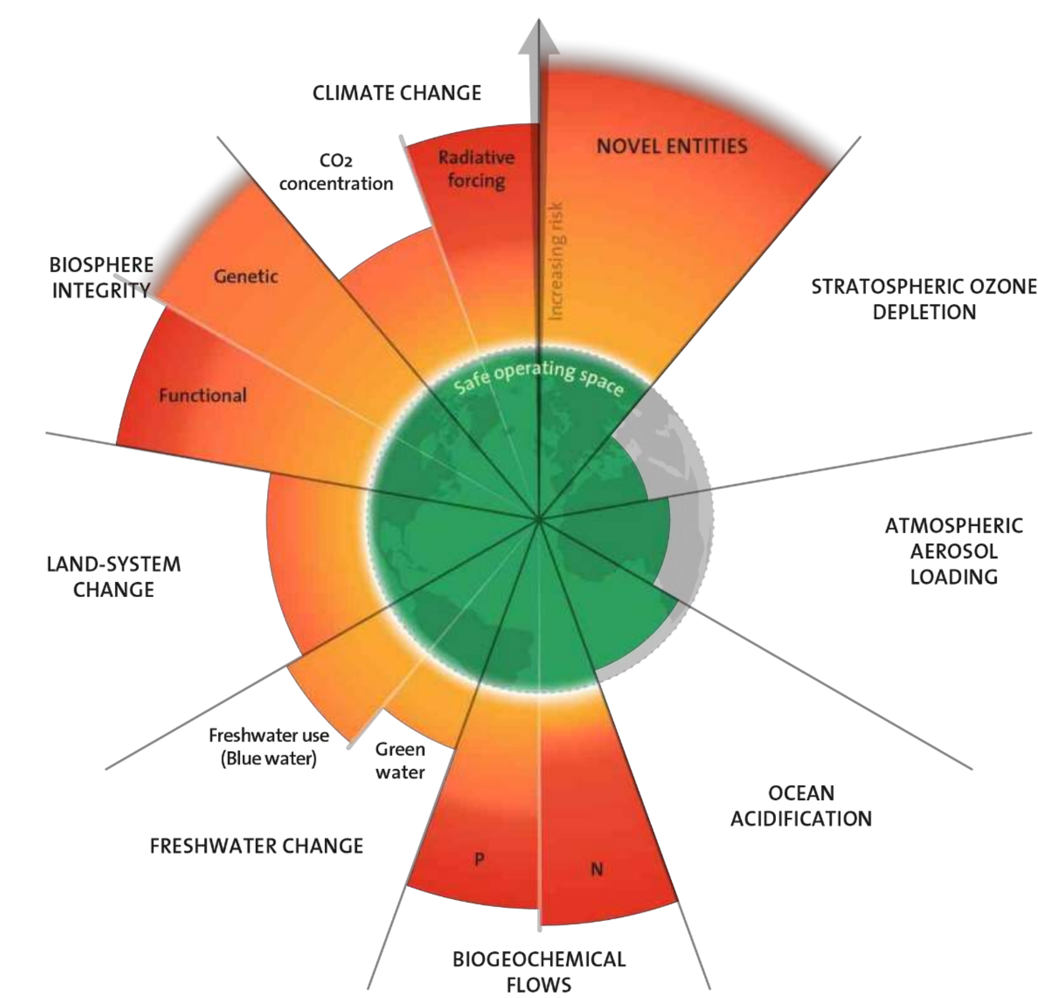
3 boundaries crossed

2015



4 boundaries crossed

2023

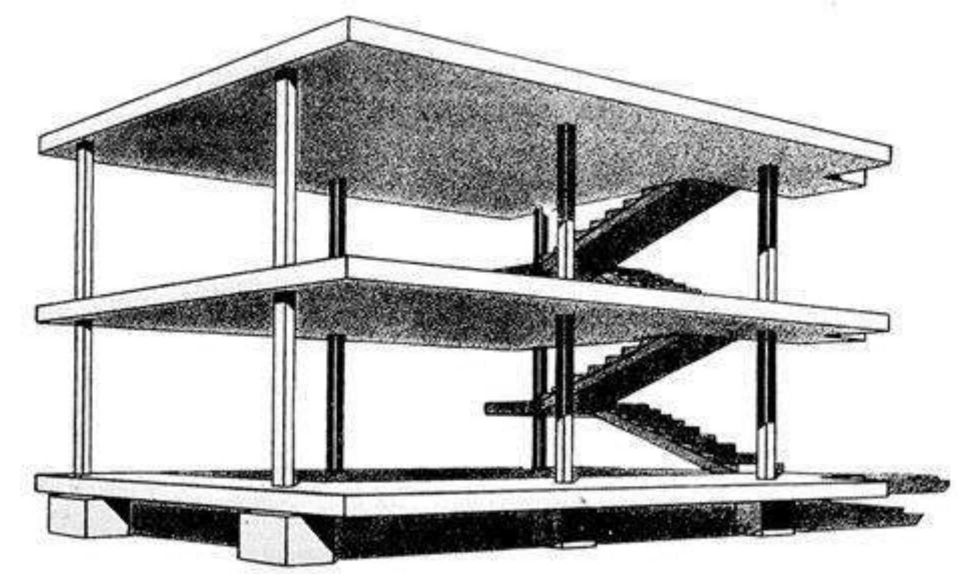


6 boundaries crossed

Stockholm Resilience Centre
Stockholm University

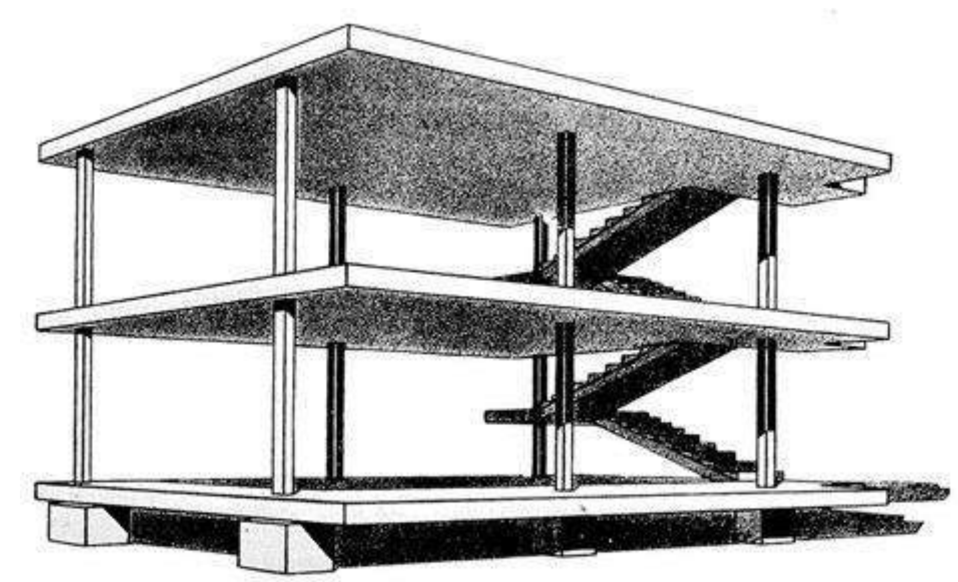
Legacy of Modernism

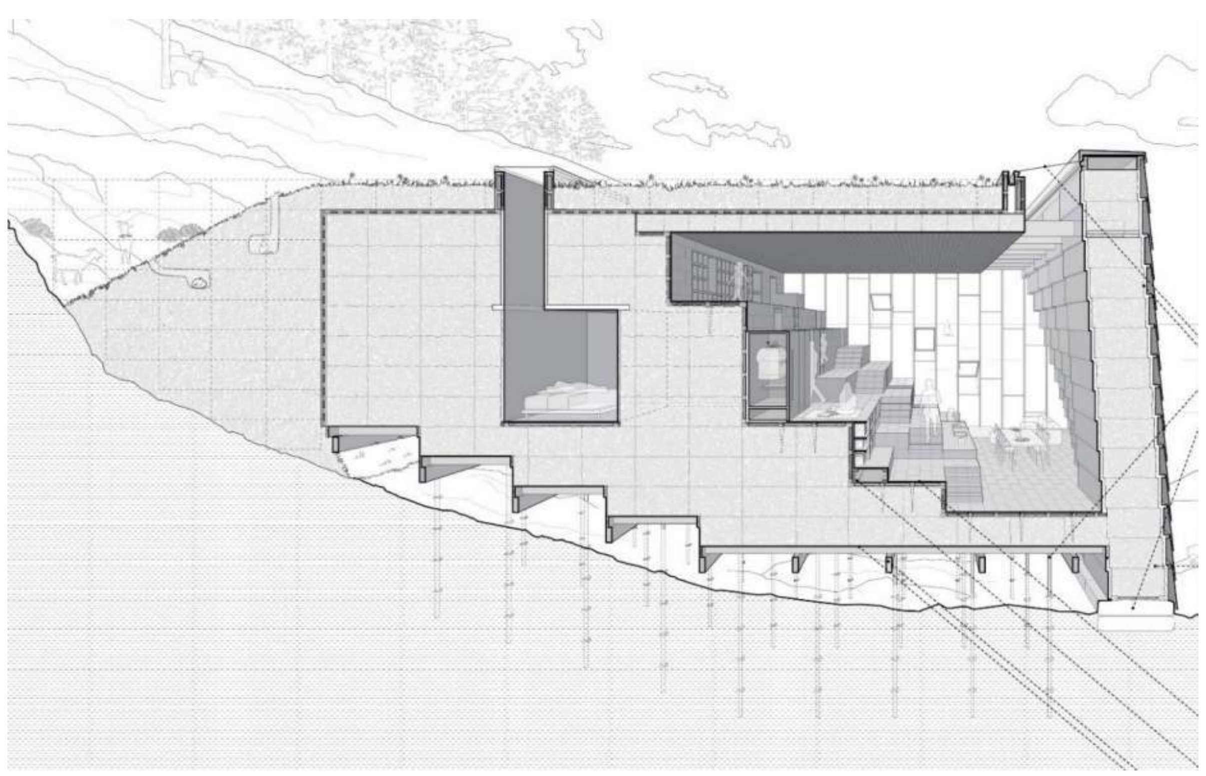
- Concrete, Steel, and Glass
- Carbon Intensive
- Linear / Extractive
- Global
- Environmental and Human Health Impacts
- Architect as Consumer



Legacy of Modernism

- Concrete, Steel, and Glass
- Carbon Intensive
- Linear / Extractive
- Global
- Environmental and Human Health Impacts
- Architect as Consumer





Biogenic and Geogenic Materials

- Plant and Earth Based Materials
- Low Carbon or Carbon Sequestering
- Renewable / Circular Life Cycles
- Local
- Regenerative and Healthful
- Architect Engaged in Material Cycles

LTLARCHITECTS

Notes All of the total embodied carbon numbers listed only represent life cycle assessment stages A1-A3, cradle to gate.

These numbers are estimates and reflect the best available published information as of May 2022. The use of a single number is for clarity of comparison, and should nevertheless be understood as an approximation, as specific material carbon data is subject to many variables.

The values given are drawn from publicly available carbon databases and EPDs as identified in the footnotes listed below. To be as consistent as possible, embodied carbon data was sourced from databases in the following order: Inventory of Carbon and Energy, version 3.0 2019, then Ökobaudat, then BEAM Estimator. Specific materials not contained in those databases were sourced from individual EPDs as noted.

Databases

[1] Inventory of Carbon and Energy, version 3.0, 2019
https://circularecology.com
[2] Ökobaudat
https://www.oekobaudat.de
[3] BEAM Estimator
https://www.buildersforclimateaction.org

Individual EPDs

[4] INBAR, Technical Report #35
https://www.inbar.int
[5] Herrljunga Terrazzo
https://www.epd-norge.no
[6] Sikalastic©-618
https://www.igbc.ie
[7] Vinyl Siding Institute - Industry Average
https://www.vinylsiding.org
[8] Asphalt Roofing Manufacturer's Association - Industry Average
https://www.asphaltroofing.org

Notes All of the total embodied carbon numbers listed only represent life cycle assessment stages A1-A3, cradle to gate.

These numbers are estimates and reflect the best available published information as of May 2022. The use of a single number is for clarity of comparison, and should nevertheless be understood as an approximation, as specific material carbon data is subject to many variables.

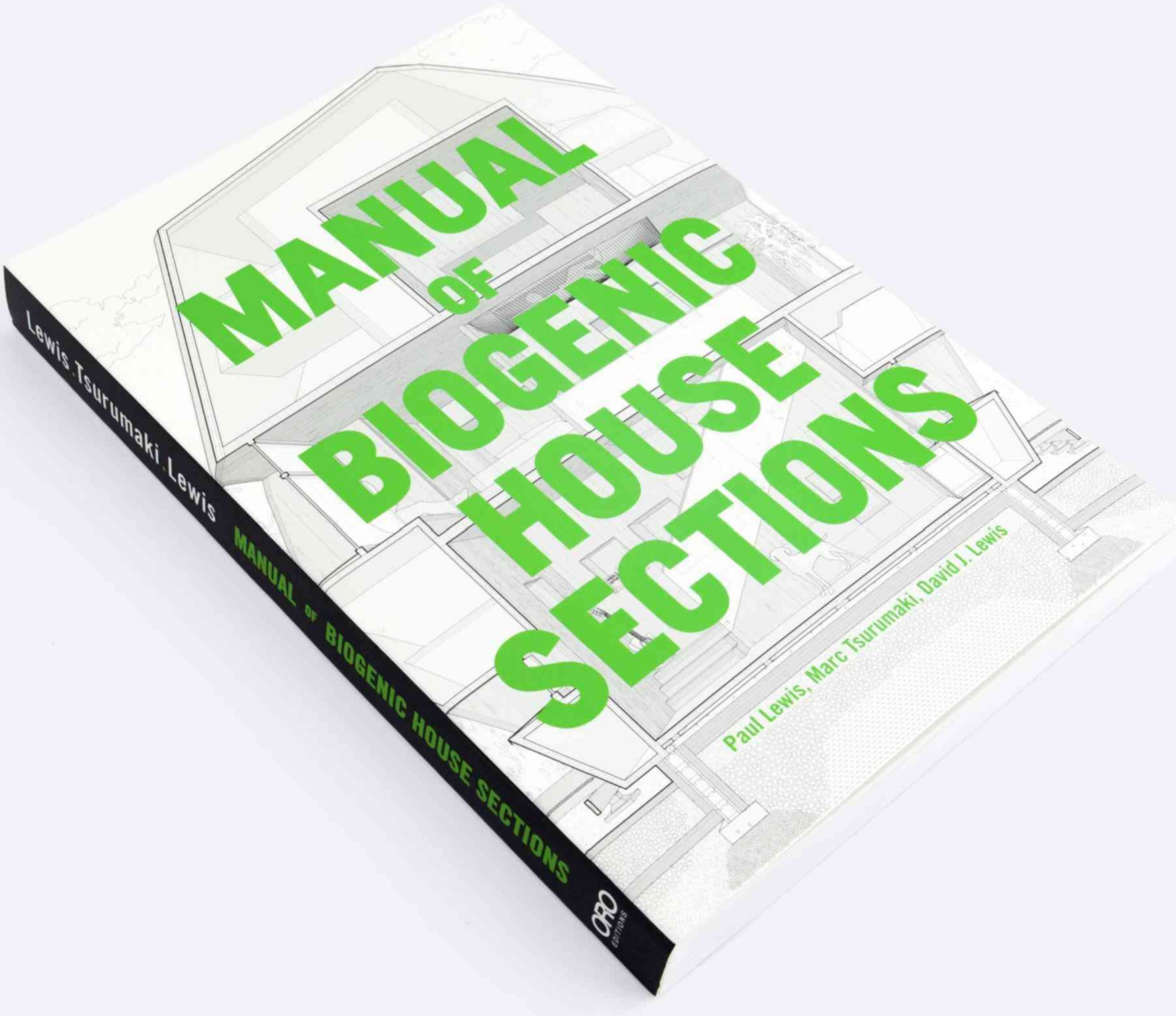
The values given are drawn from publicly available carbon databases and EPDs as identified in the footnotes listed below. To be as consistent as possible, embodied carbon data was sourced from databases in the following order: Inventory of Carbon and Energy, version 3.0 2019, then Ökobaudat, then BEAM Estimator. Specific materials not contained in those databases were sourced from individual EPDs as noted.

Databases

[1] Inventory of Carbon and Energy, version 3.0, 2019
https://circularecology.com
[2] Ökobaudat
https://www.oekobaudat.de
[3] BEAM Estimator
https://www.buildersforclimateaction.org

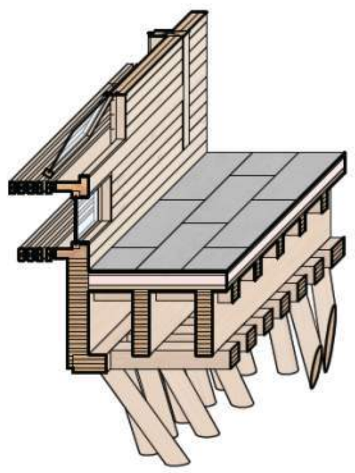
Individual EPDs

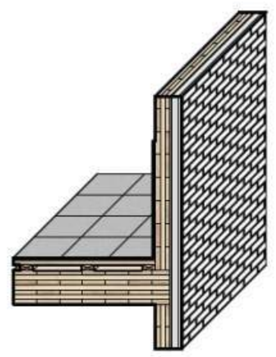
[4] INBAR, Technical Report #35
https://www.inbar.int
[5] Herrljunga Terrazzo
https://www.epd-norge.no
[6] Sikalastic©-618
https://www.igbc.ie
[7] Vinyl Siding Institute - Industry Average
https://www.vinylsiding.org
[8] Asphalt Roofing Manufacturer's Association - Industry Average
https://www.asphaltroofing.org

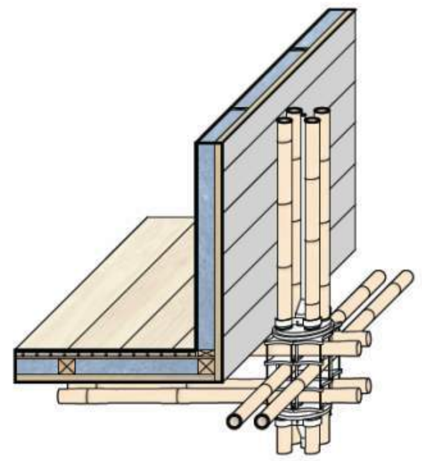


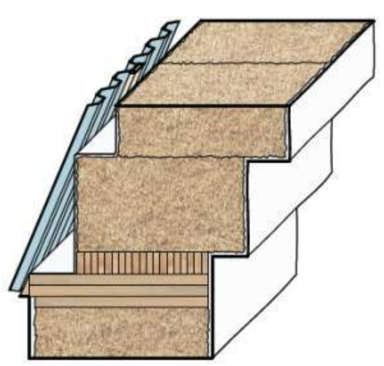
LTLARCHITECTS

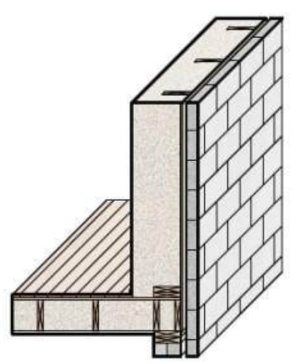
Building on *Manual of Section*, this book articulates how plant-based and low-carbon materials can produce a profound rethinking of section in houses.

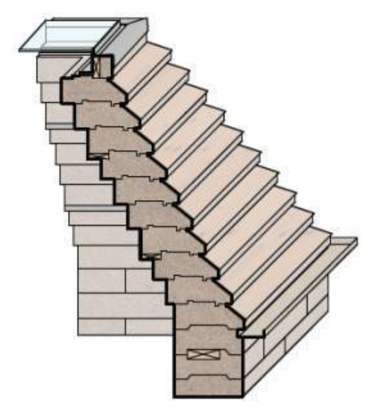

Wood Frame

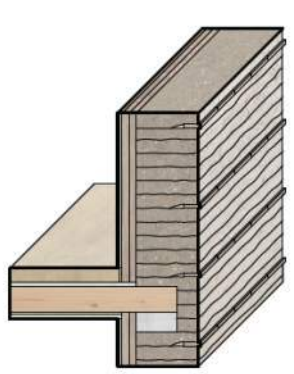

Mass Timber

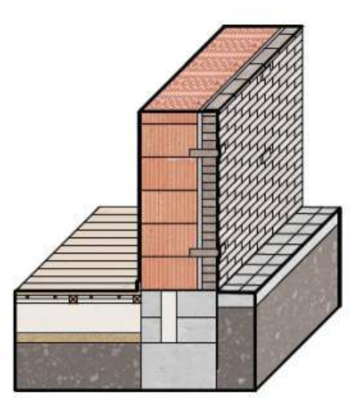

Bamboo

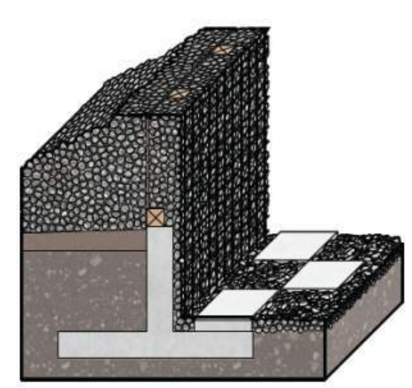

Straw


Hemp


Cork


Earth

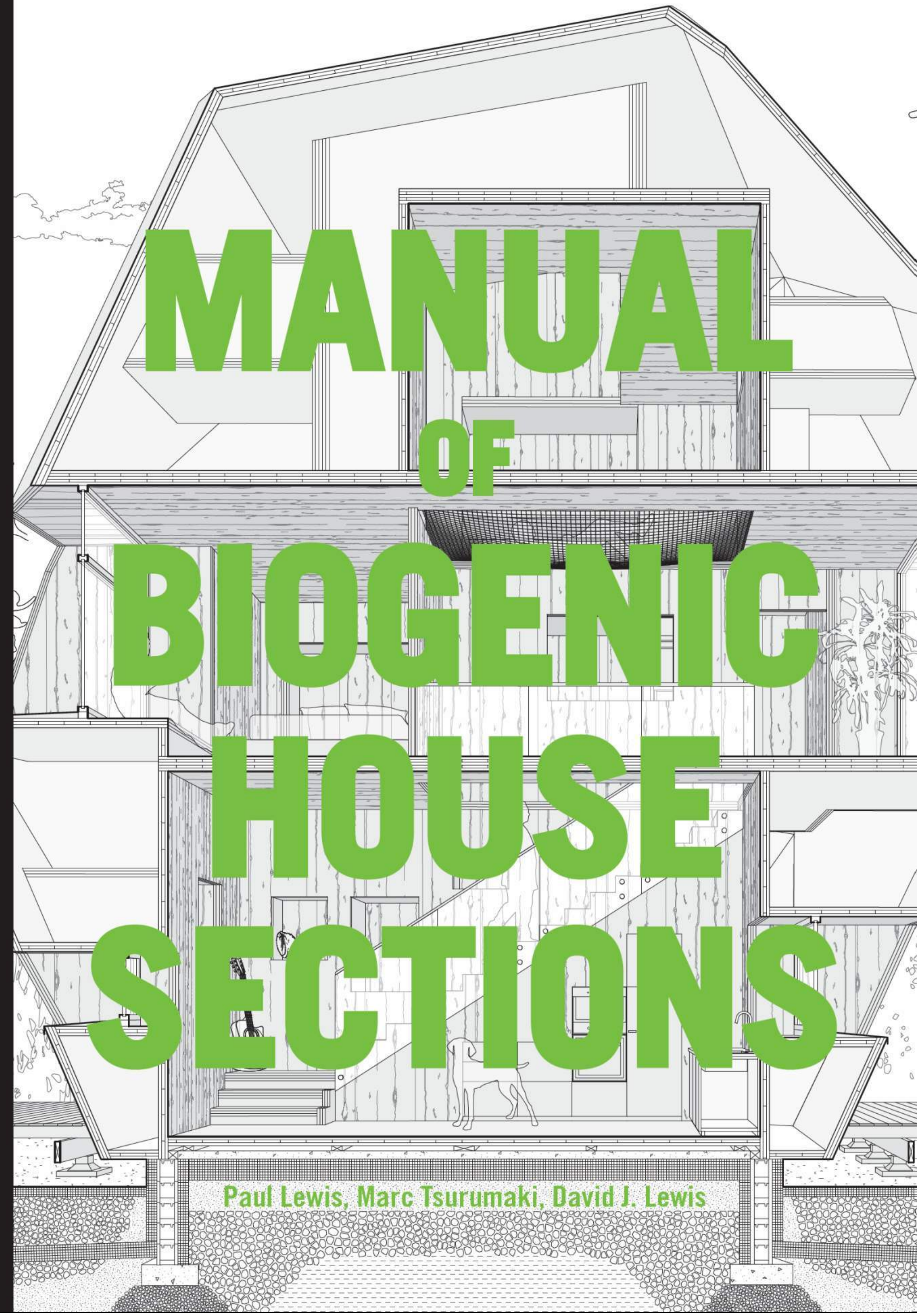

Brick


Stone

ISBN 978-1-957183-09-1 USD 39.95
53995
9 781957 183091 >

Lewis.Tsurumaki.Lewis

MANUAL OF BIOGENIC HOUSE SECTIONS



MANUAL OF BIOGENIC HOUSE SECTIONS

Paul Lewis, Marc Tsurumaki, David J. Lewis

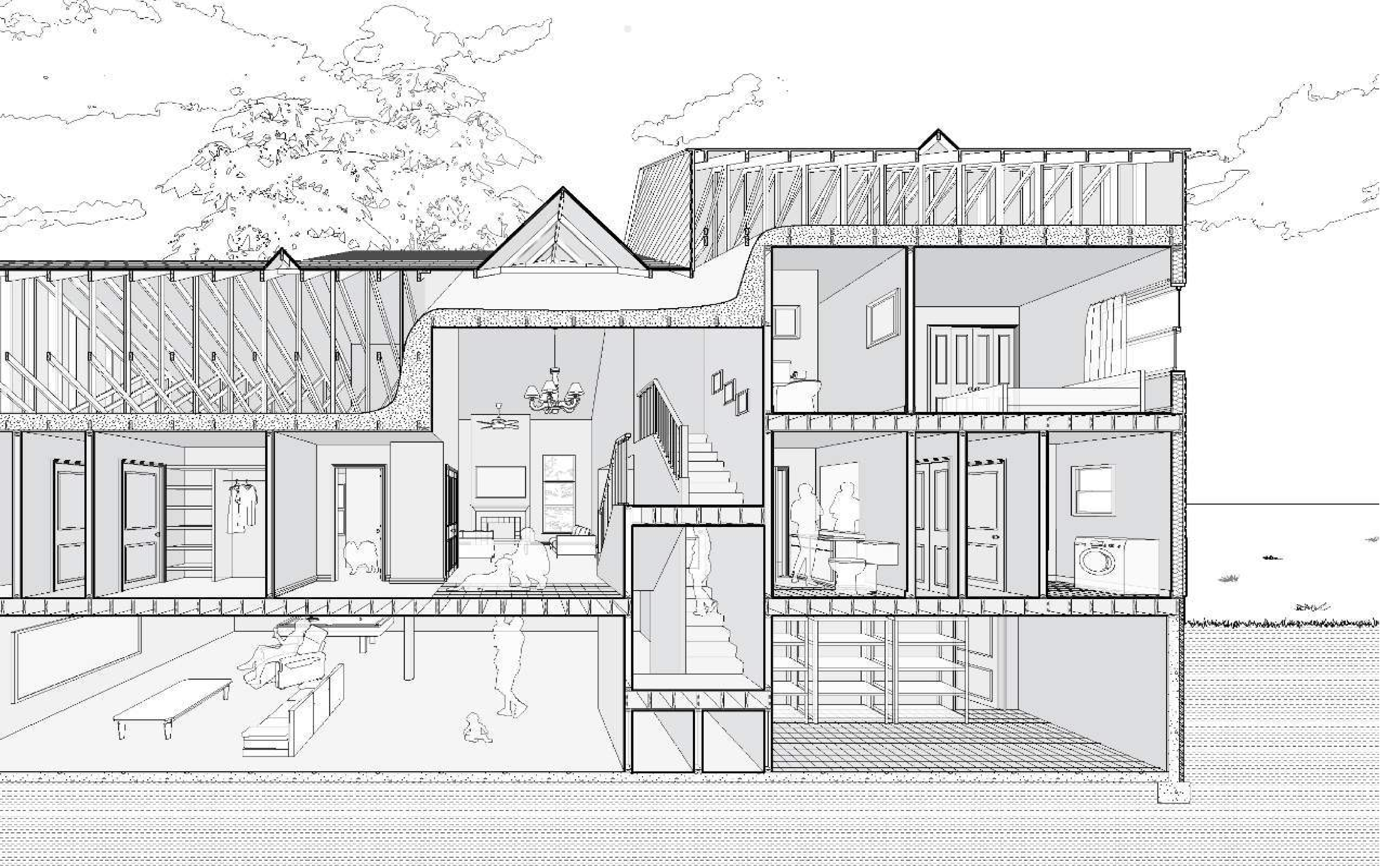
LTLARCHITECTS

Standard Single-Family House

United States of America | 2022

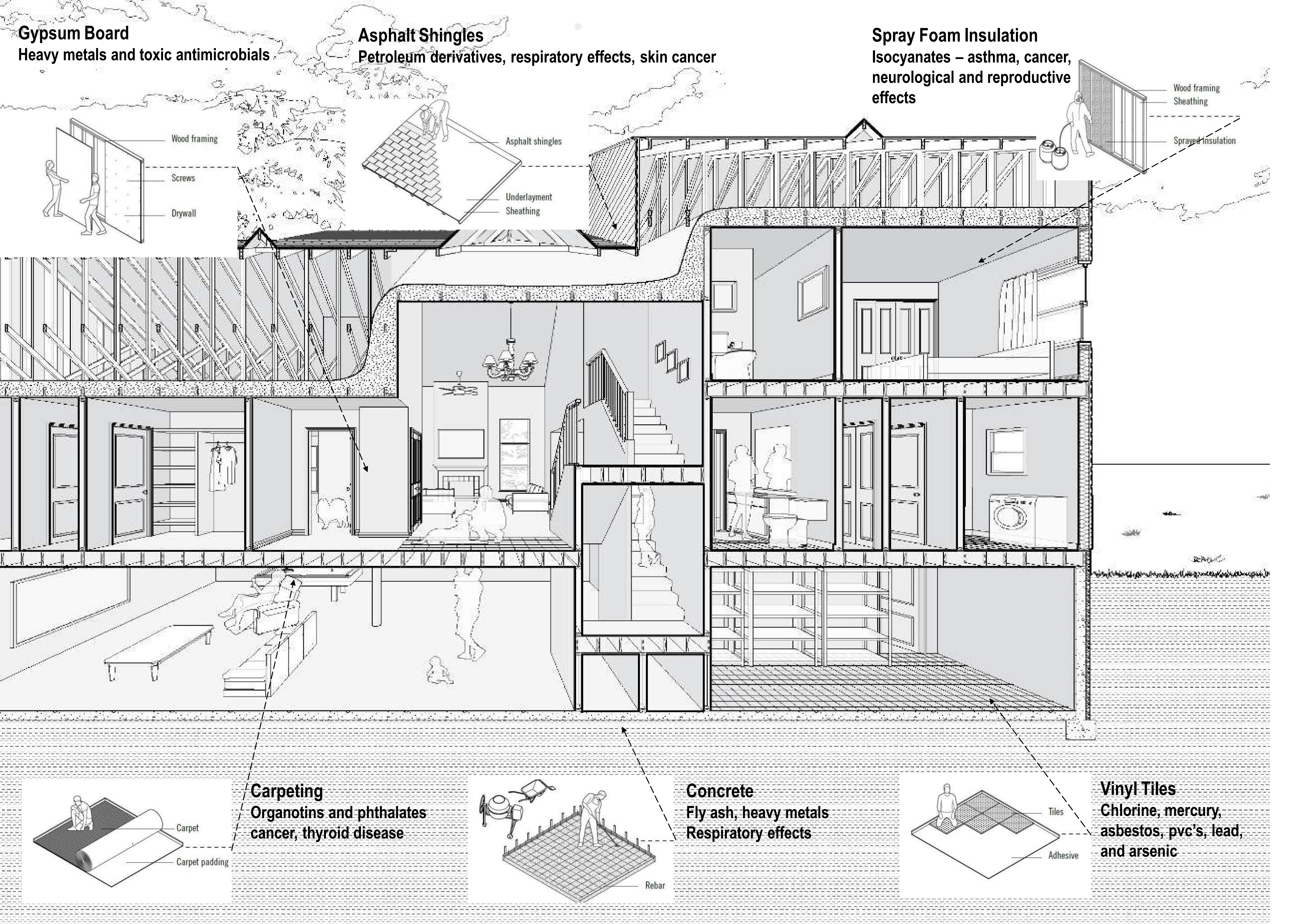
The standard single-family house, particularly in the United States, is characterized by three interlinked problems. First, they are mostly constructed of multiple, thin, lightweight layers of inexpensive material, many only doing one thing within the building assembly. Only the very thin veneers of exterior cladding and interior paint are visible, hiding these multiple layers. Second, with the exception of the wood frame, many of those materials are petroleum based, have high levels of embodied carbon, and similar levels of toxicity. Third, the average house has increased in size from 1,000 sq ft (93 sq m) in 1950 to 2,500 sq ft (232 sq m) in 2021. The embodied carbon of this illustrated standard single-family house is 31,600 $kgCO_2e$. The quantity is driven by the substantial use of concrete in the foundation and basement; by the insulation made from plastics (XPS, EPS, Polyiso), fiberglass and mineral wool; by the exterior cladding such as fired brick, vinyl siding and asphalt shingles; and by the plastic interior finishes, synthetic carpets, and vinyl floors. These materials are often difficult to reuse and usually end up in a landfill. The short-term economic benefits of these inexpensive materials is countered by the longer-term health consequence of the poor interior air quality and the global environmental impacts, of which global warming is just one problem.


1000 sf in 1950

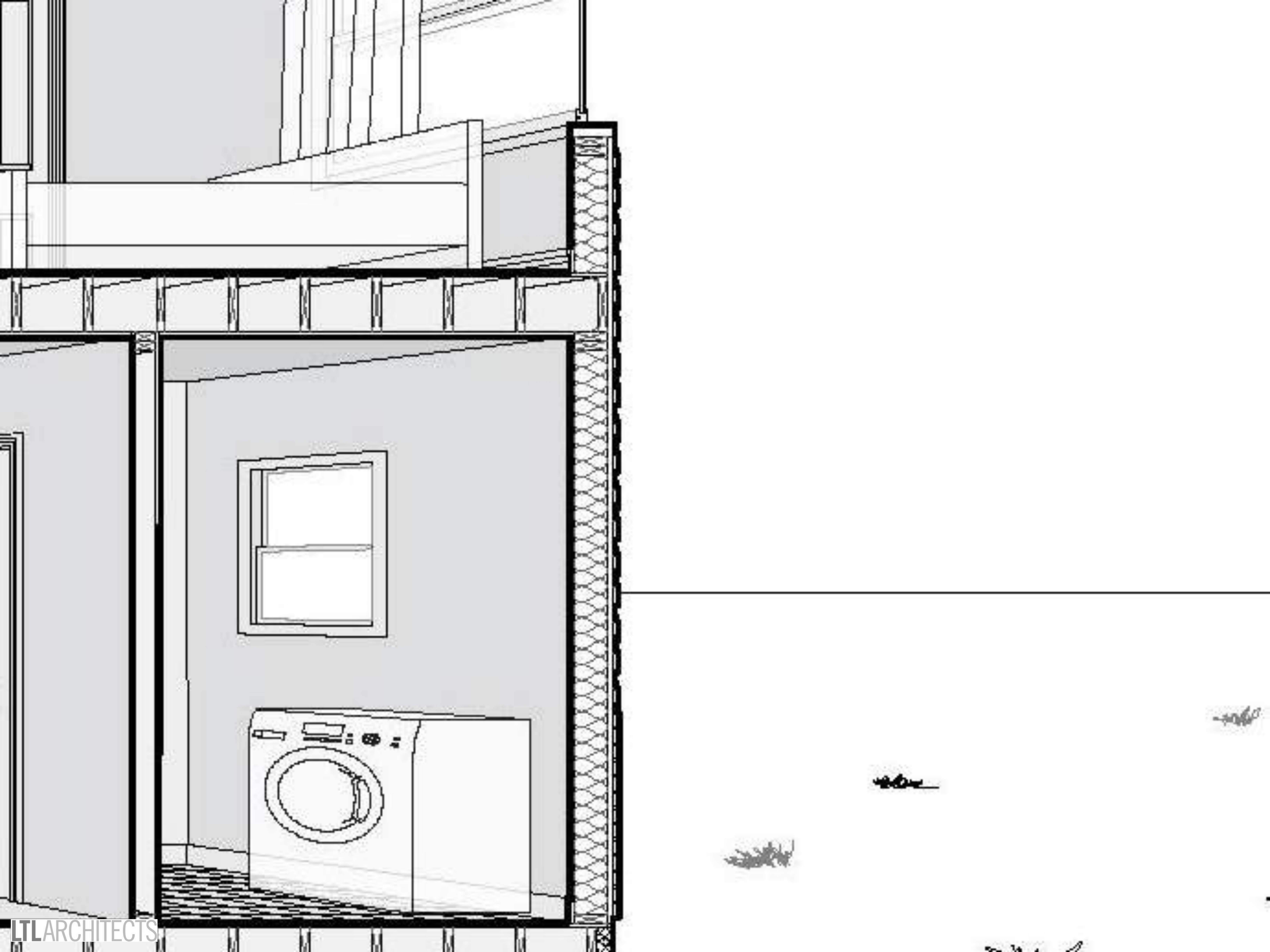


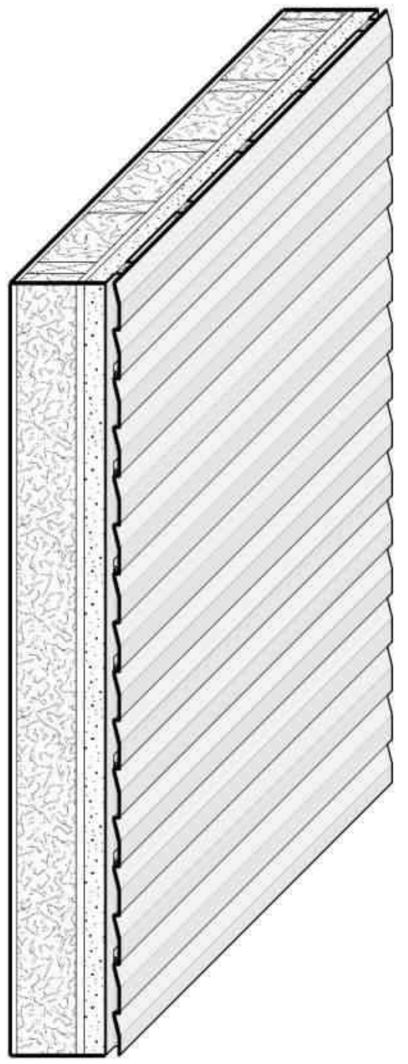
2500 sf in 2020

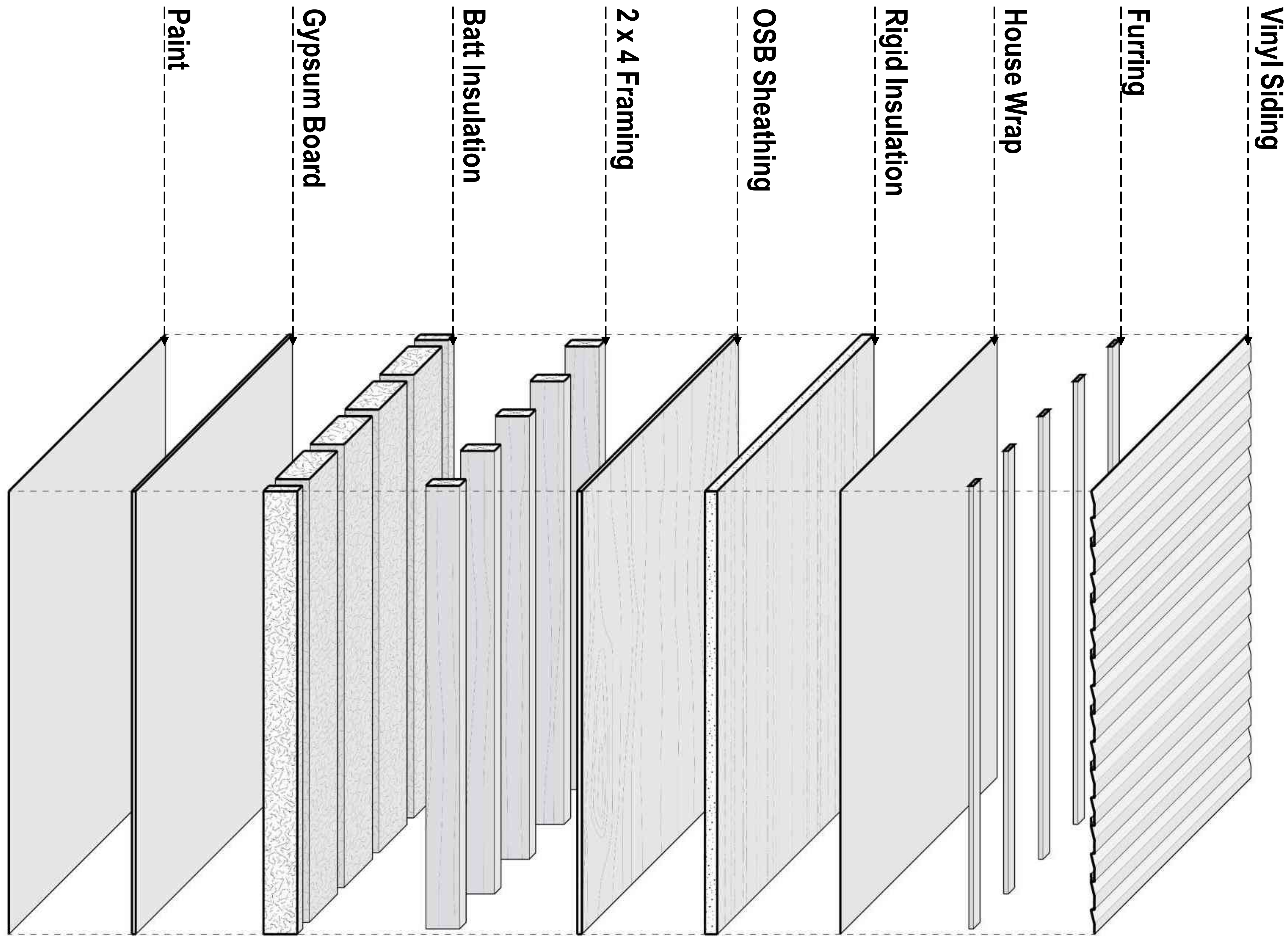
LTLARCHITECTS



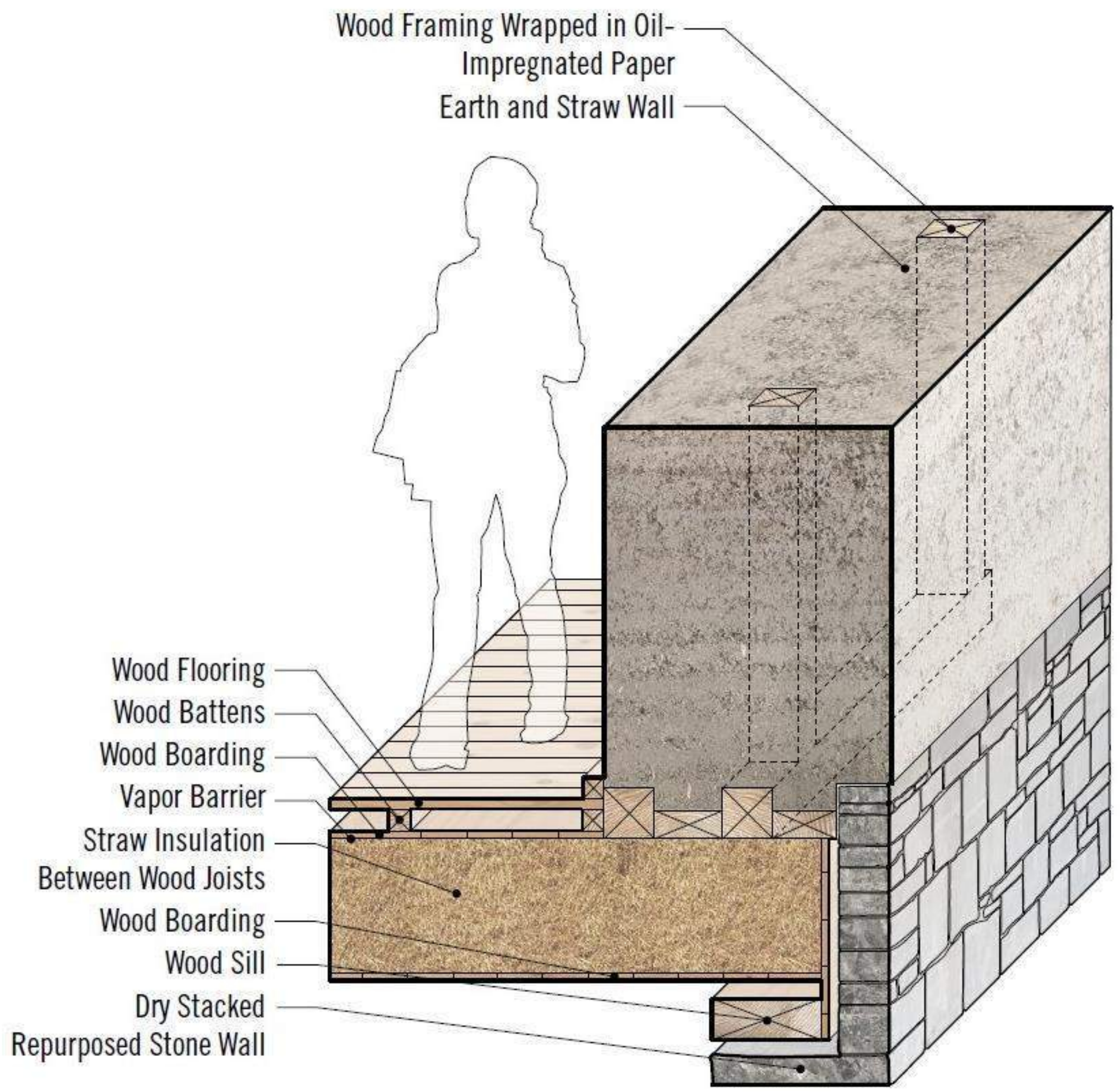
LTLARCHITECTS


LTLARCHITECTS



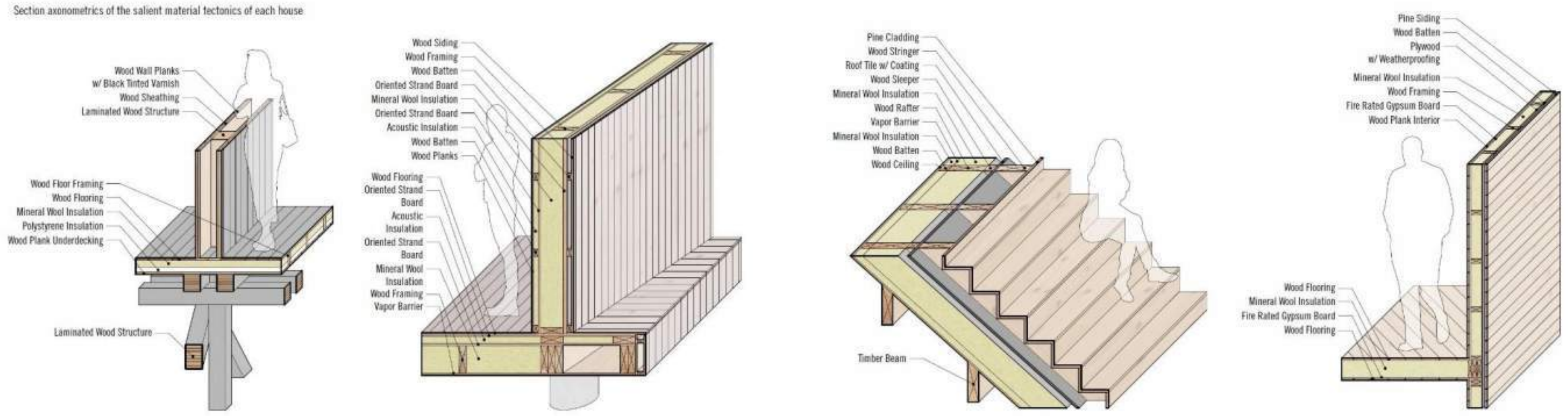


Lightweight, thin, single-performing, multiple, hygienic layers producing a strict binary between interior and exterior.


Wood Framing Wrapped in Oil-
Impregnated Paper
Earth and Straw Wall
Wood Flooring
Wood Battens
Wood Boarding
Vapor Barrier
Straw Insulation
Between Wood Joists
Wood Boarding
Wood Sill
Dry Stacked
Repurposed Stone Wall

Material Assemblies

Section axonometrics of the salient material tectonics of each house



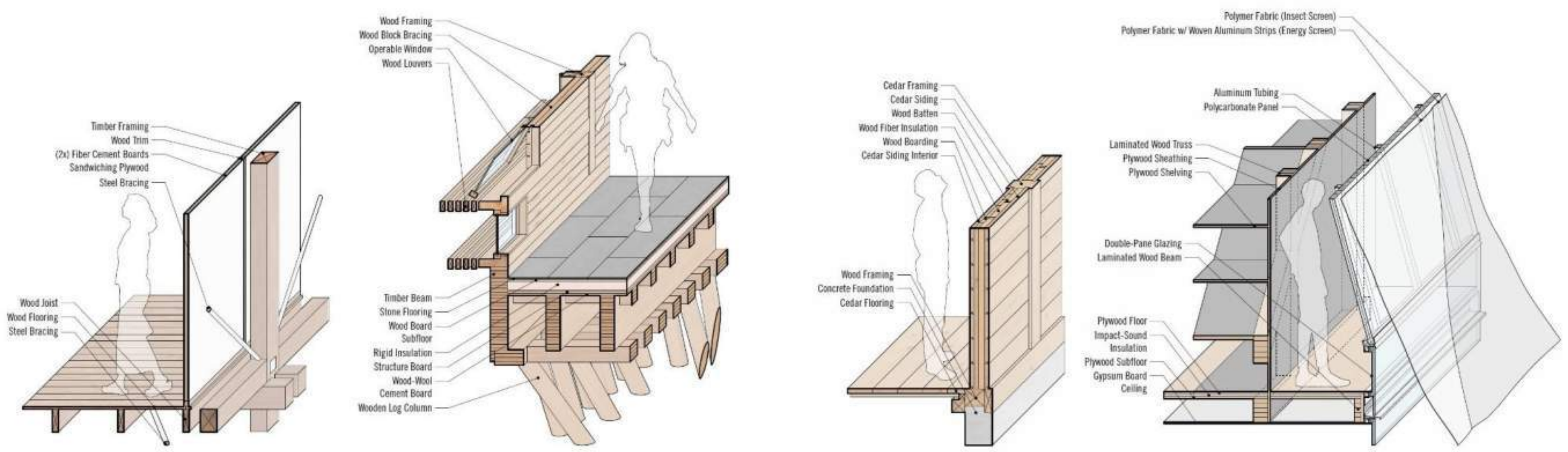
Wood Frame

Wood House Smiljan Radic

Zilvar House ASGK Design

Thunder Top Cabin Gartnerfuglen Arkitekter

Gago House Pezo von Ellrichshausen

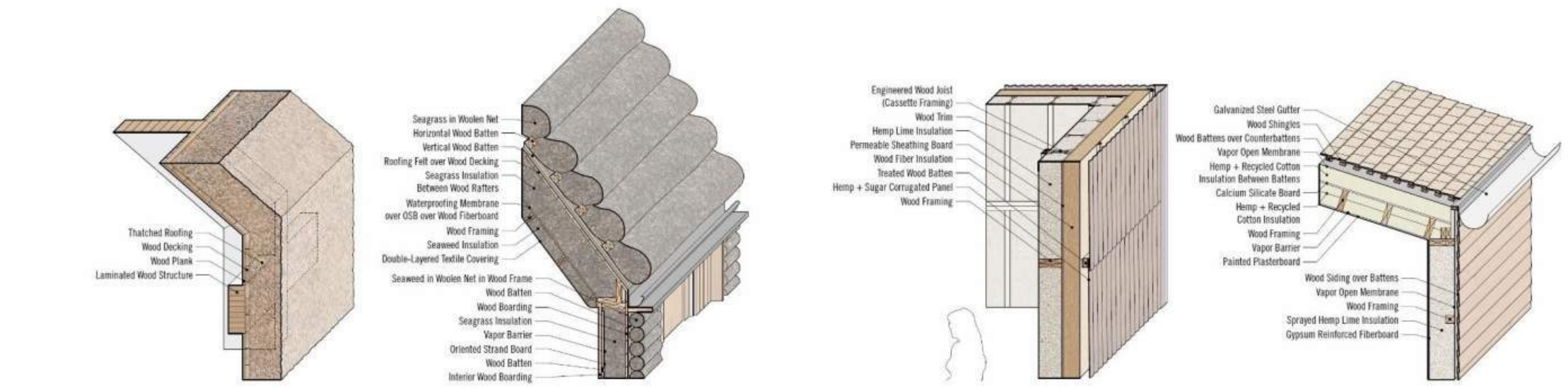


Helio Olga House Marcos Acayaba Arquitetos

House in Itsuura ADX

Ogimachi House Tomoaki Uno Architects

Wall House FAR frohn&rojas



Straw (cont.)

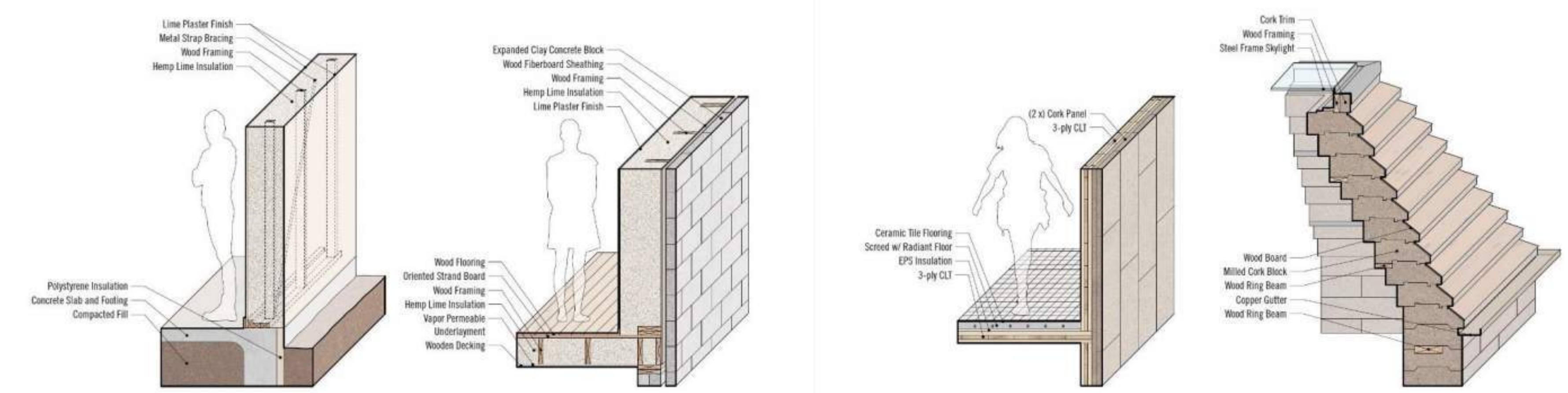
Dune House Archispektras

Modern Seagrass House Vandkunsten Architects

Hemp

Flat House Practice Architecture

Clay Field Riches Hawley Mikhail Architects



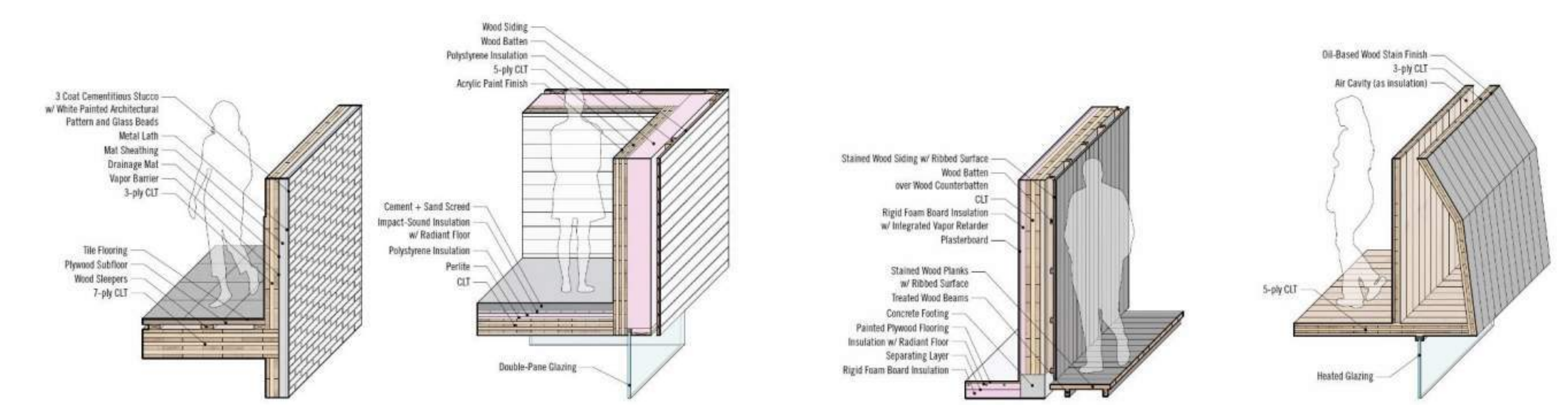
Mudgee Hempcrete House 2 Envirotecture

Low Energy House in Uccle Karbon' Architecture et Urbanisme

Cork

Two Cork Houses Emiliano López Mónica Rivera Arquitectos

Cork House Matthew Barnett Howland with Dido Milne and Oliver Wilton



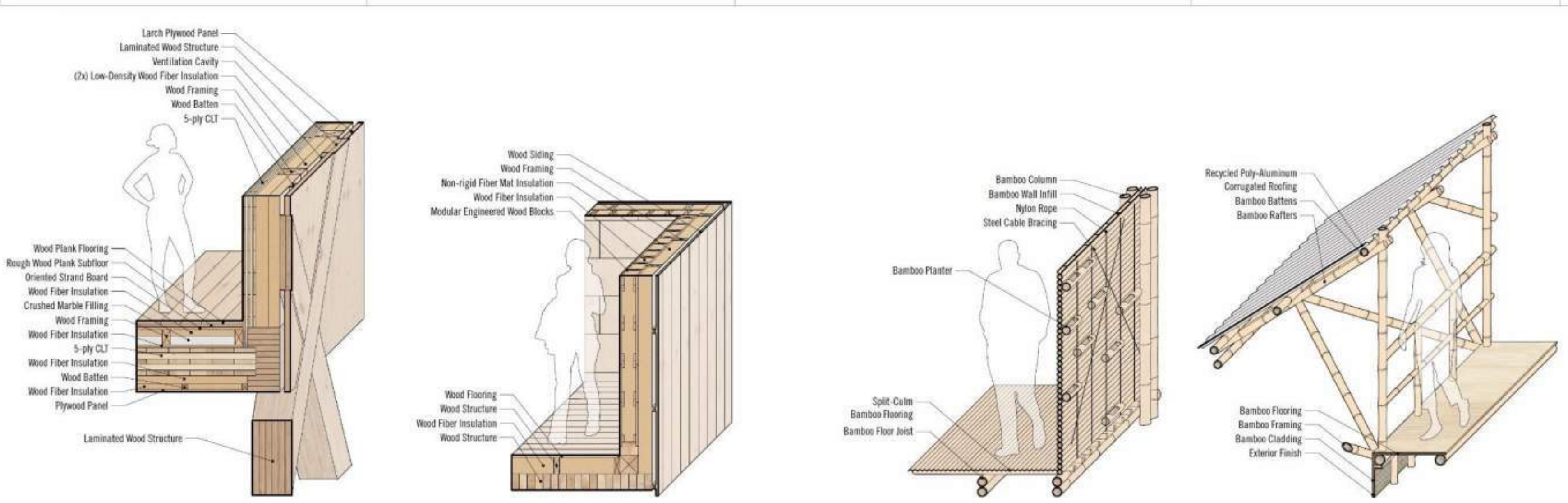
Mass Timber

Haus Gables Jennifer Bonner / MALL

House W Kraus Schönberg Architects

Sunken House Adjaye Associates

Meteorite Ateljé Sotamaa



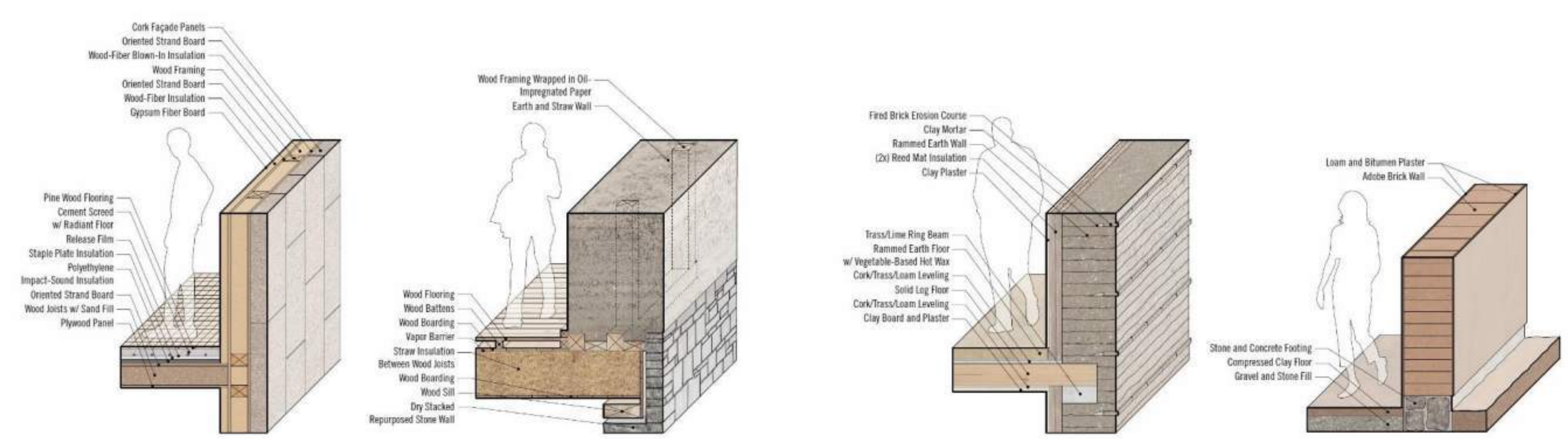
Kostner House and Studio MoDus Architects

House Köris Zeller & Moye

Bamboo

Blooming Bamboo Home H&P Architects

From the Territory to the Dweller Rozana Montiel Estudio de Arquitectura



Cork (cont.)

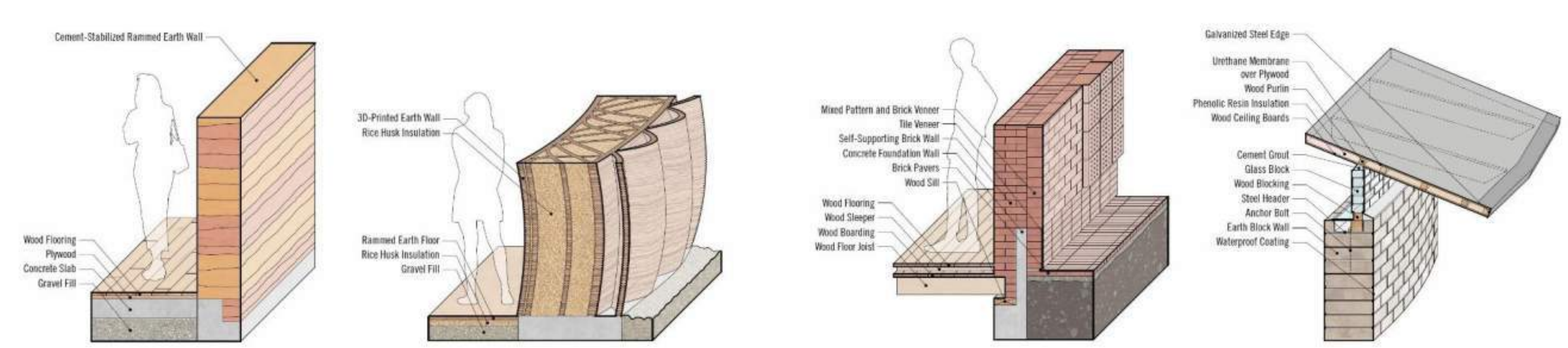
Cork Screw House rundzwei Architekten

Earth

Wohnhaus Flury spaceshop Architects

House Rauch Boltshauser Architects, Lehm Ton Erde Baukunst

Gando Teachers' Housing Kéré Architecture



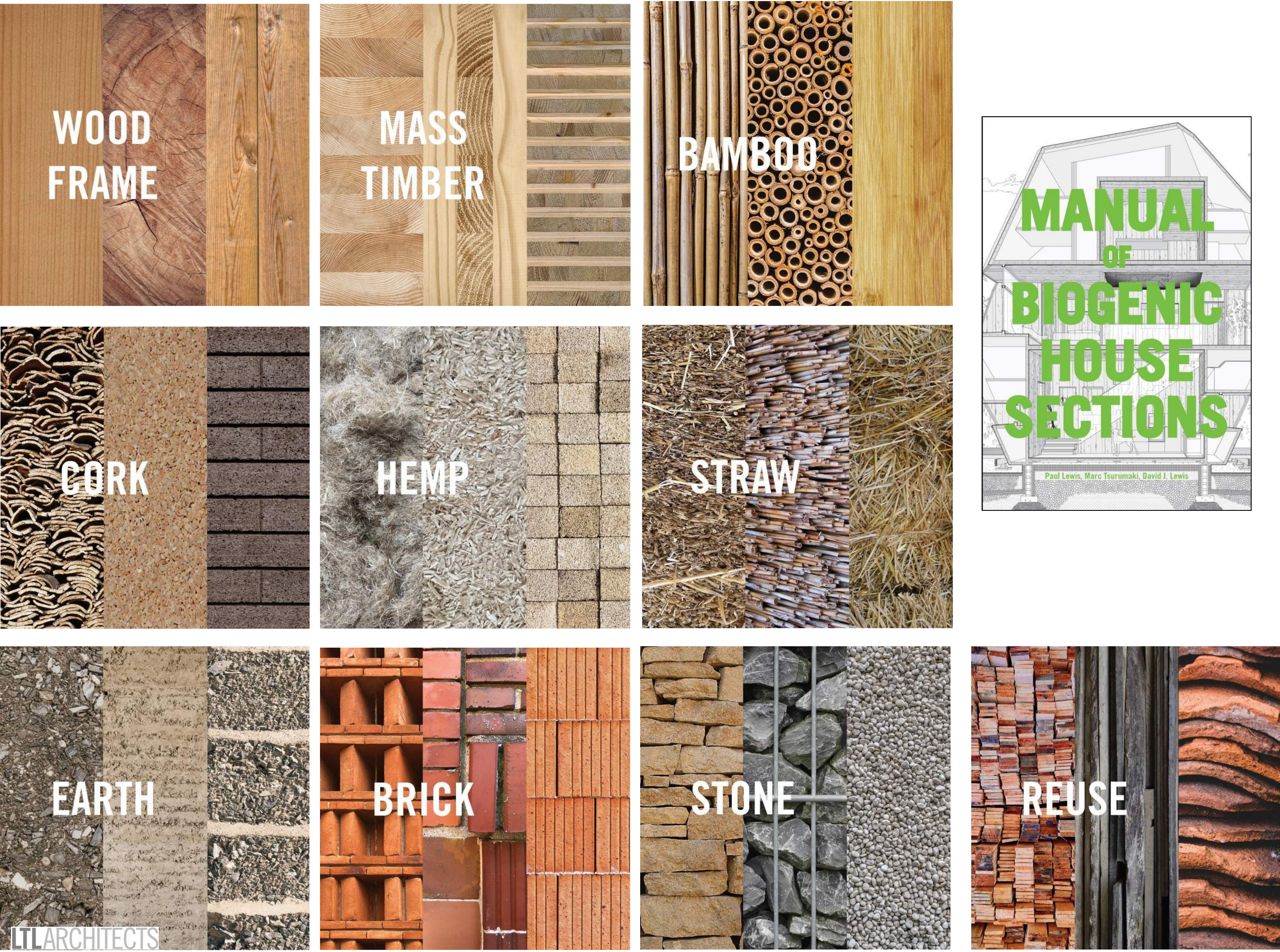
Dong Anh House Vo Trong Nghia Architects

TECLA - Technology and Clay Mario Cucinella Architects

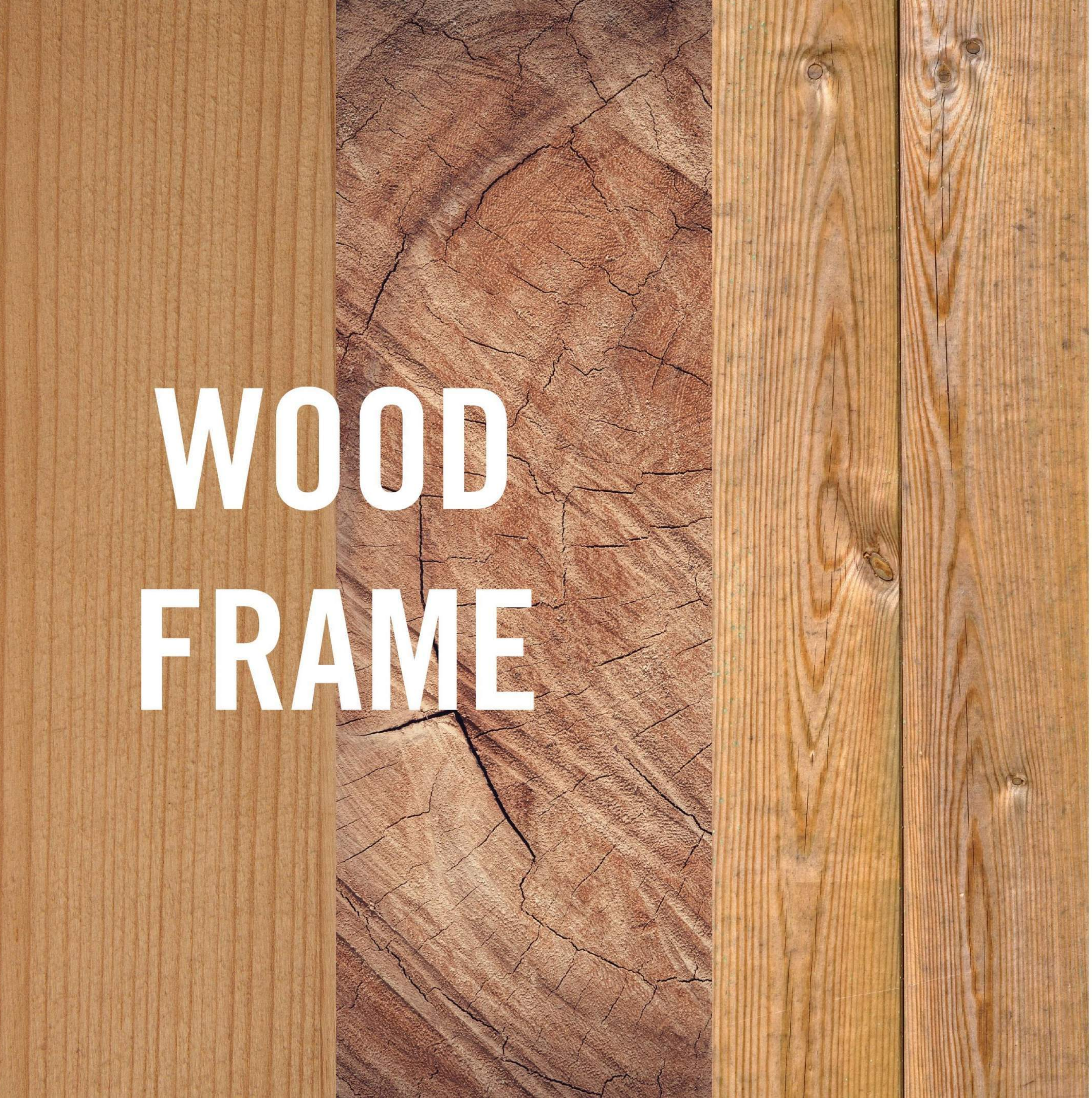
Brick

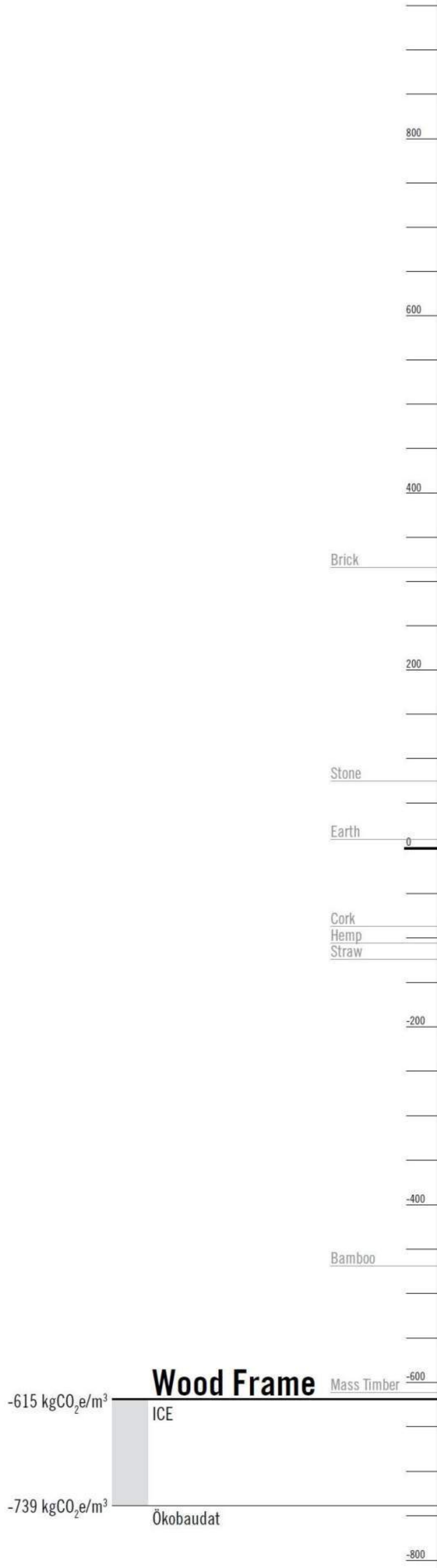
Muuratsalo Experimental House Alvar Aalto

Earth Bricks Atelier Tekuto


WOOD FRAME
MASS TIMBER
BAMBOO
MANUAL OF BIOGENIC HOUSE SECTIONS
Paul Lewis, Marc Tsurumaki, David J. Lewis
CORK
HEMP
STRAW
EARTH
BRICK
STONE
REUSE
LTL ARCHITECTS

WOOD FRAME

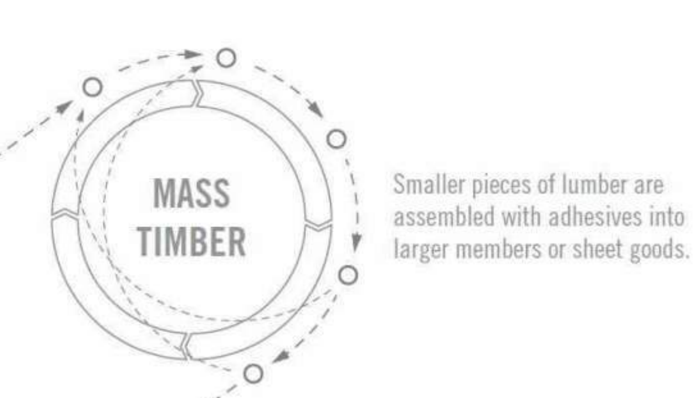


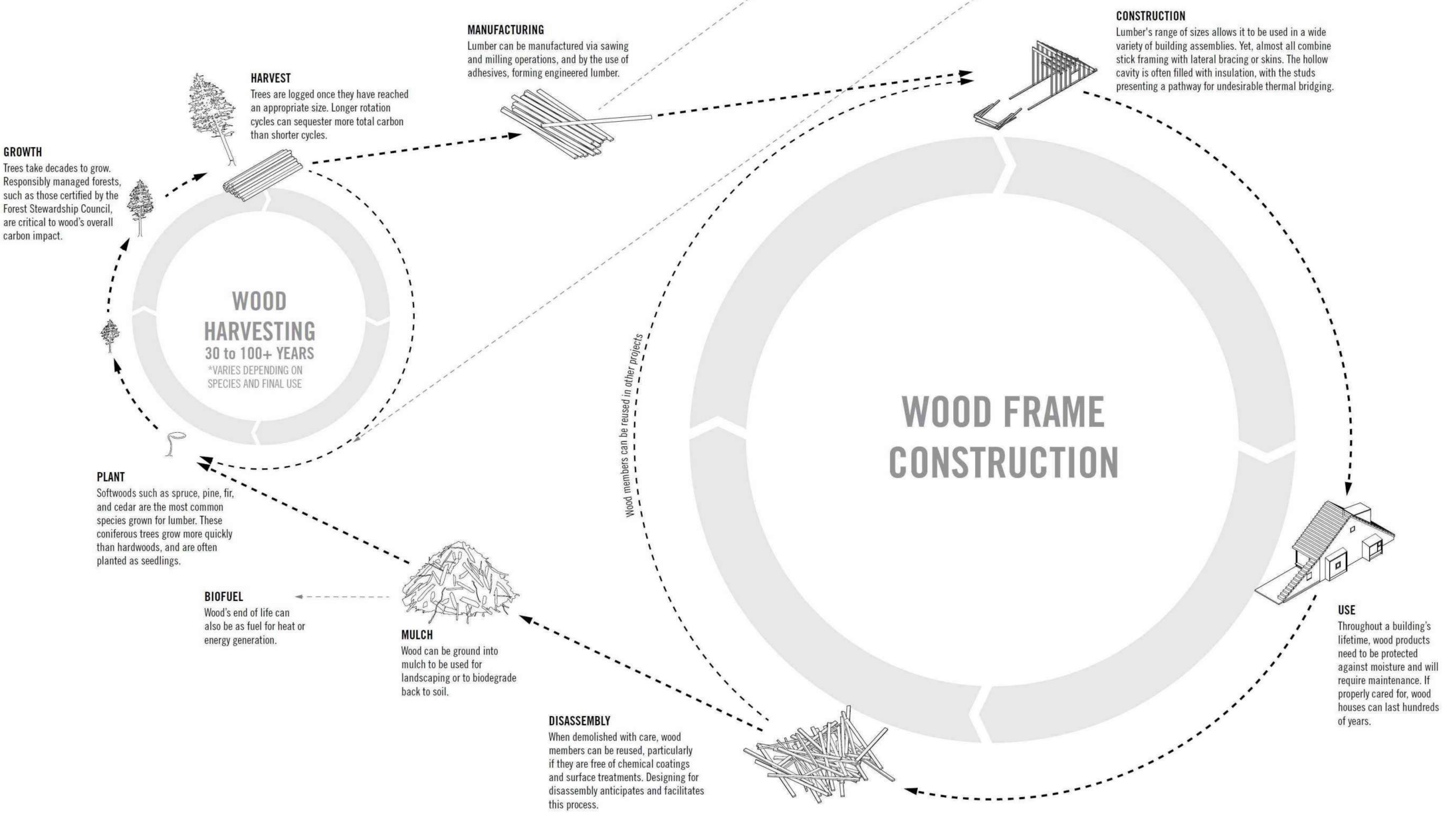


800
600
400
Brick
200
Stone
Earth
0
Cork
Hemp
Straw
-200
-400
Bamboo
-600
Wood Frame
Mass Timber
-615 kgCO2e/m3
ICE
-739 kgCO2e/m3
Ökobaudat
-800

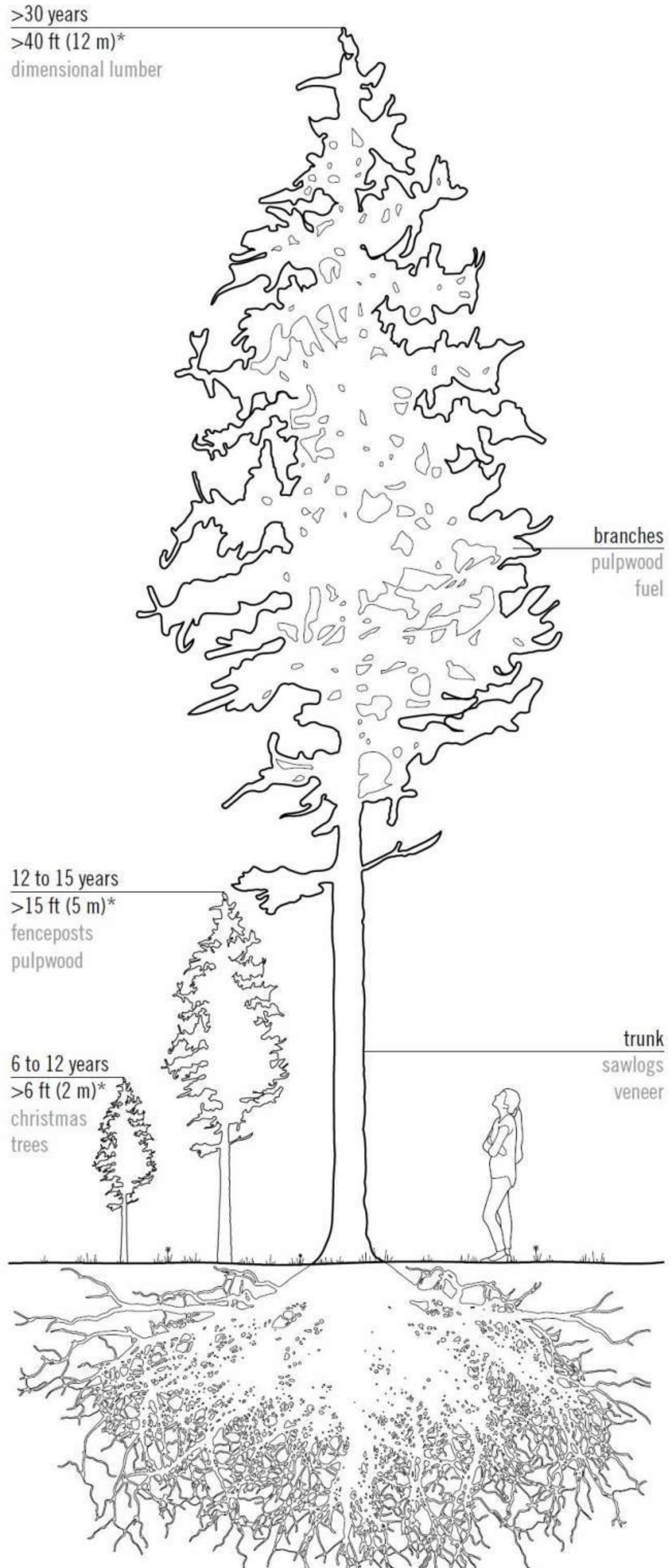
WOOD FRAME

Wood frames are the most common form of North American house construction, using standardized lumber dimensions and conventional 16 in to 24 in stud spacing. Although most wood frame construction is based on platform framing, with each floor resting on the walls below, other approaches include continuous vertical balloon framing and heavy timber post and beam. In each type, the stick construction is combined with lateral bracing, typically a stress skin of plywood or oriented-strand board. Although trees sequester carbon during their growth with about 50% of the dry weight of wood composed of carbon, lumber's value as a carbon sink is qualified by industrial harvesting, potential damage to forests, and the release of carbon stored in its soils and ecosystems. Responsible forest stewardship is a critical factor in lumber's net carbon benefits.





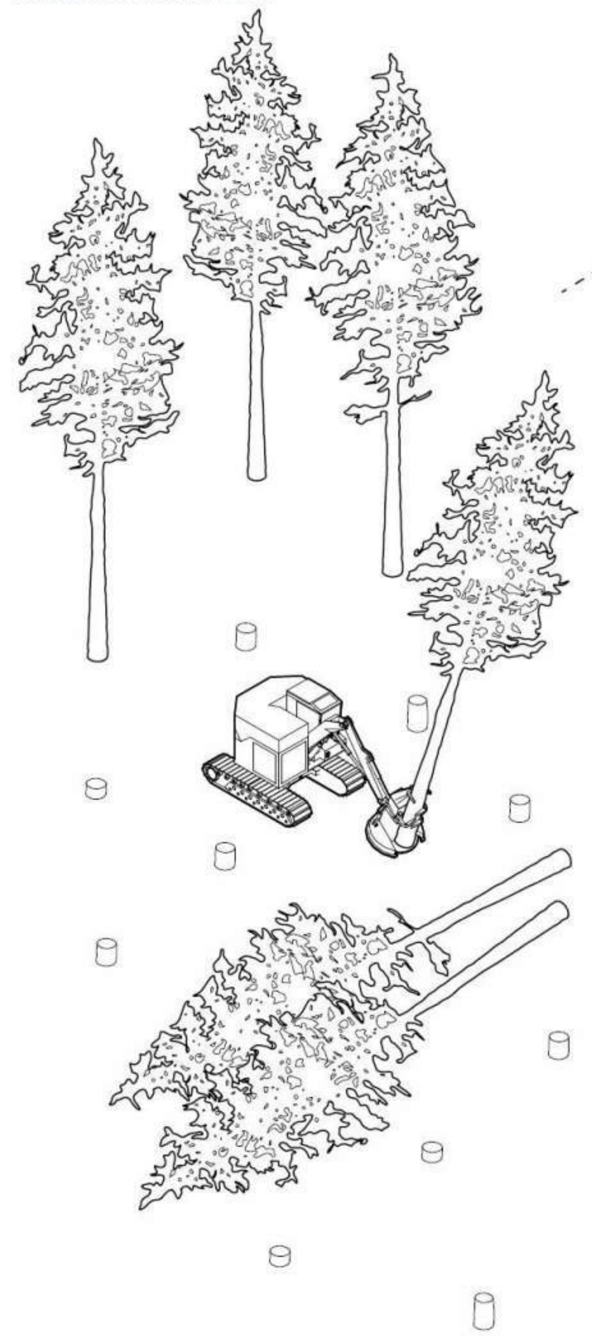
WOOD FRAME



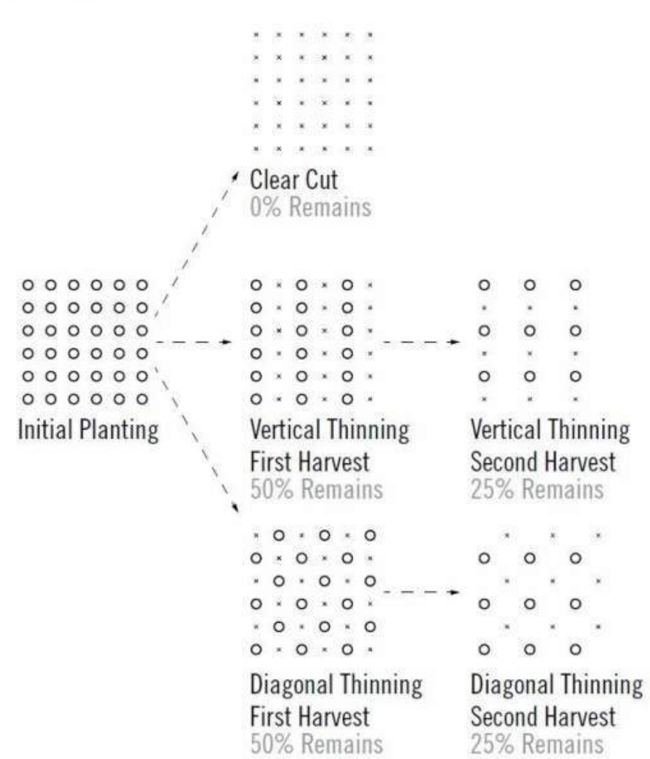
*height and timeframe are averages; actual values vary by species and environmental factors

LOGGING

Essential to wood's overall carbon and environmental impact, forest stewardship standards include longer growth cycles and time between harvest, smaller clear cuts, wider waterway buffers, and limits on herbicide use.

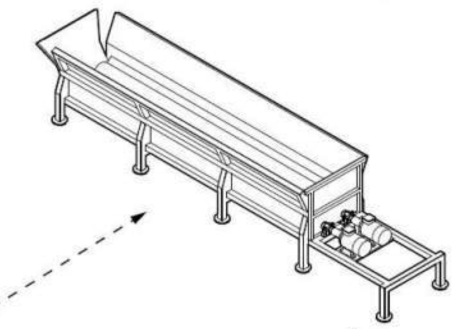


LOGGING STRATEGIES



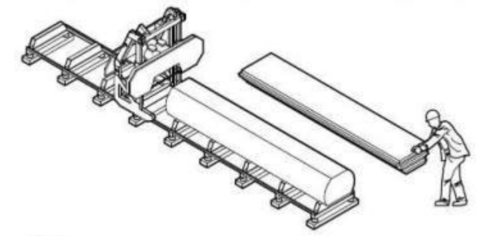
DEBARKING

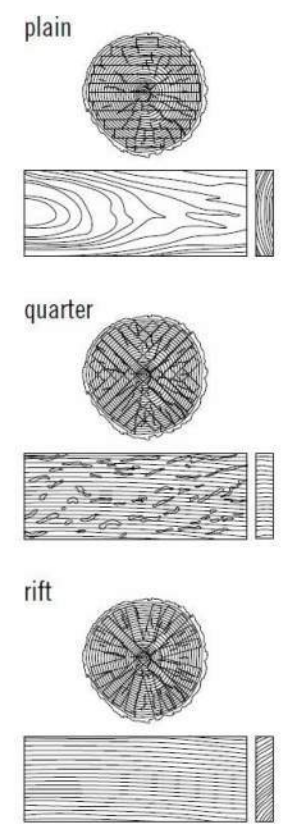
The tree trunk is stripped of its bark to achieve a consistent cylindrical shape.



CUTTING

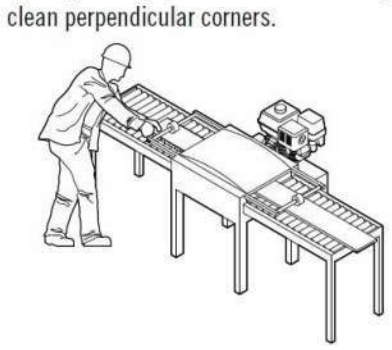
Logs are cut according to the desired grain pattern.





EDGING

The edges of boards are trimmed leaving clean perpendicular corners.

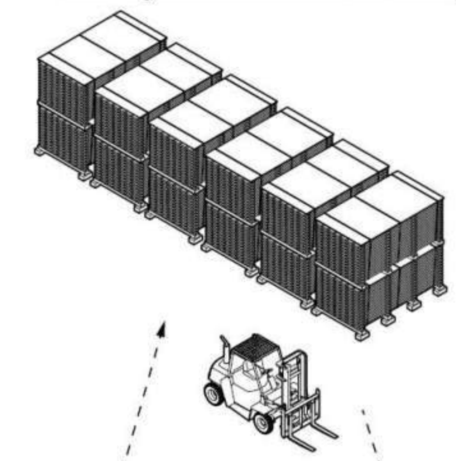


INSULATING

Wood framed walls leave a void between the studs which is often filled with insulation. More insulation can be added as a continuous layer outside of the studs which also provides a thermal break to the studs. Biogenic insulation includes cellulose, wood fiber, hemp, straw, wool, denim, and seagrass.

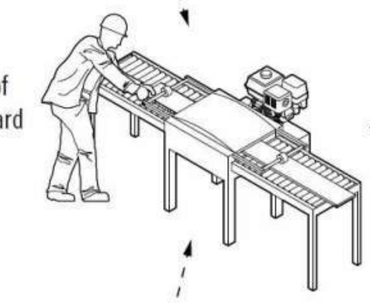
AIR DRYING

Boards are left to dry via natural means, which may take a year or longer. Drying is necessary to increase dimensional stability.



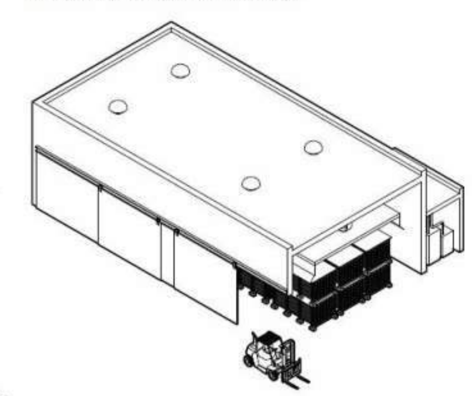
FINISHING

Planing and routing of the edges of each board produces their final dimensional profile.

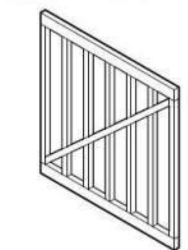


KILN DRYING

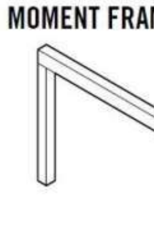
Large buildings dry the lumber via mechanical means. Drying is necessary to increase dimensional stability. Although much faster than air drying, kiln drying increases carbon emissions.



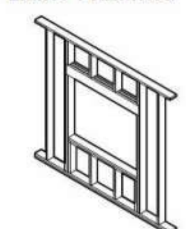
HALF TIMBER



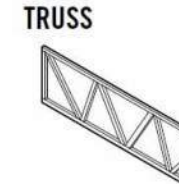
MOMENT FRAME



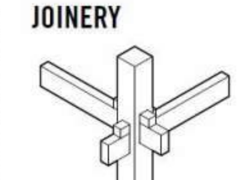
LIGHT FRAMING

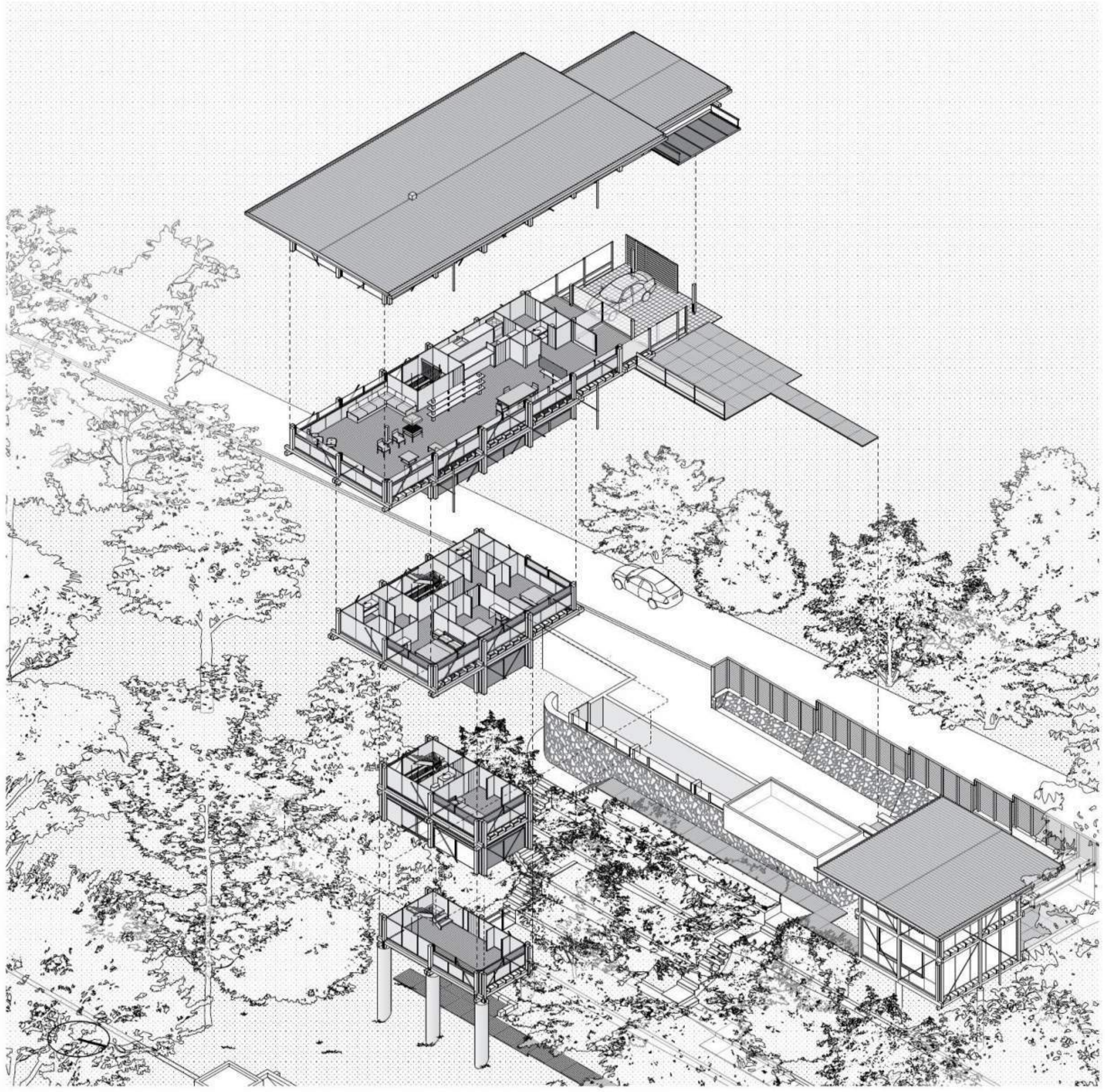


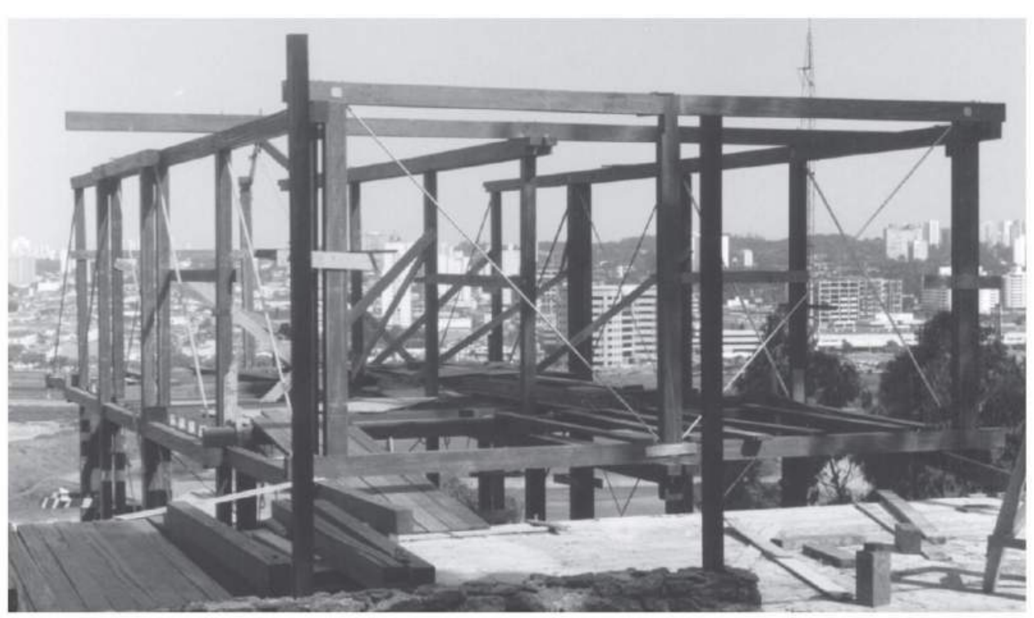
TRUSS

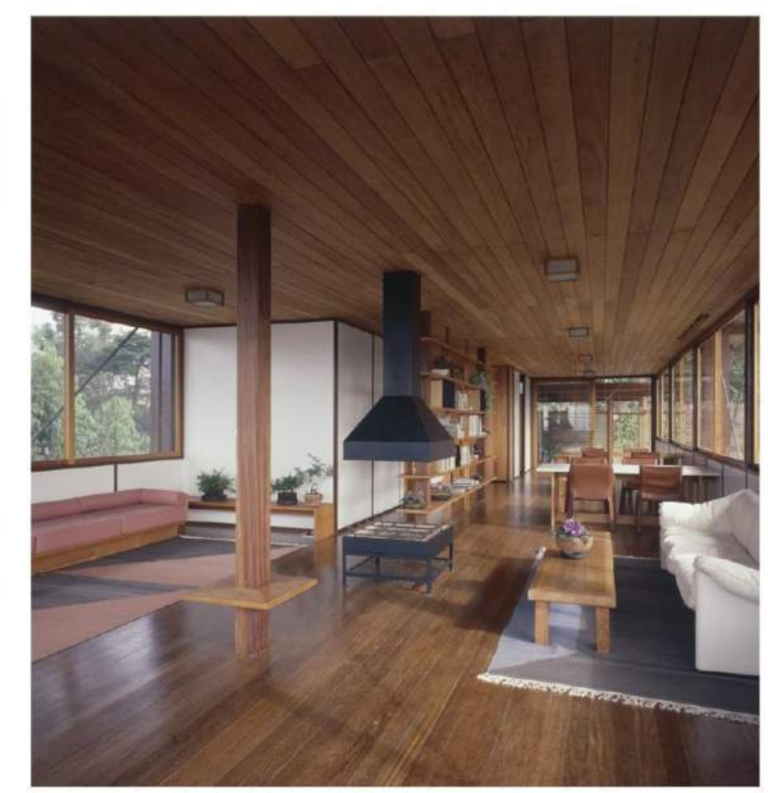


JOINERY





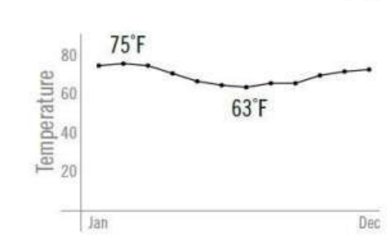


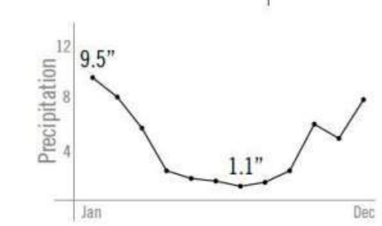


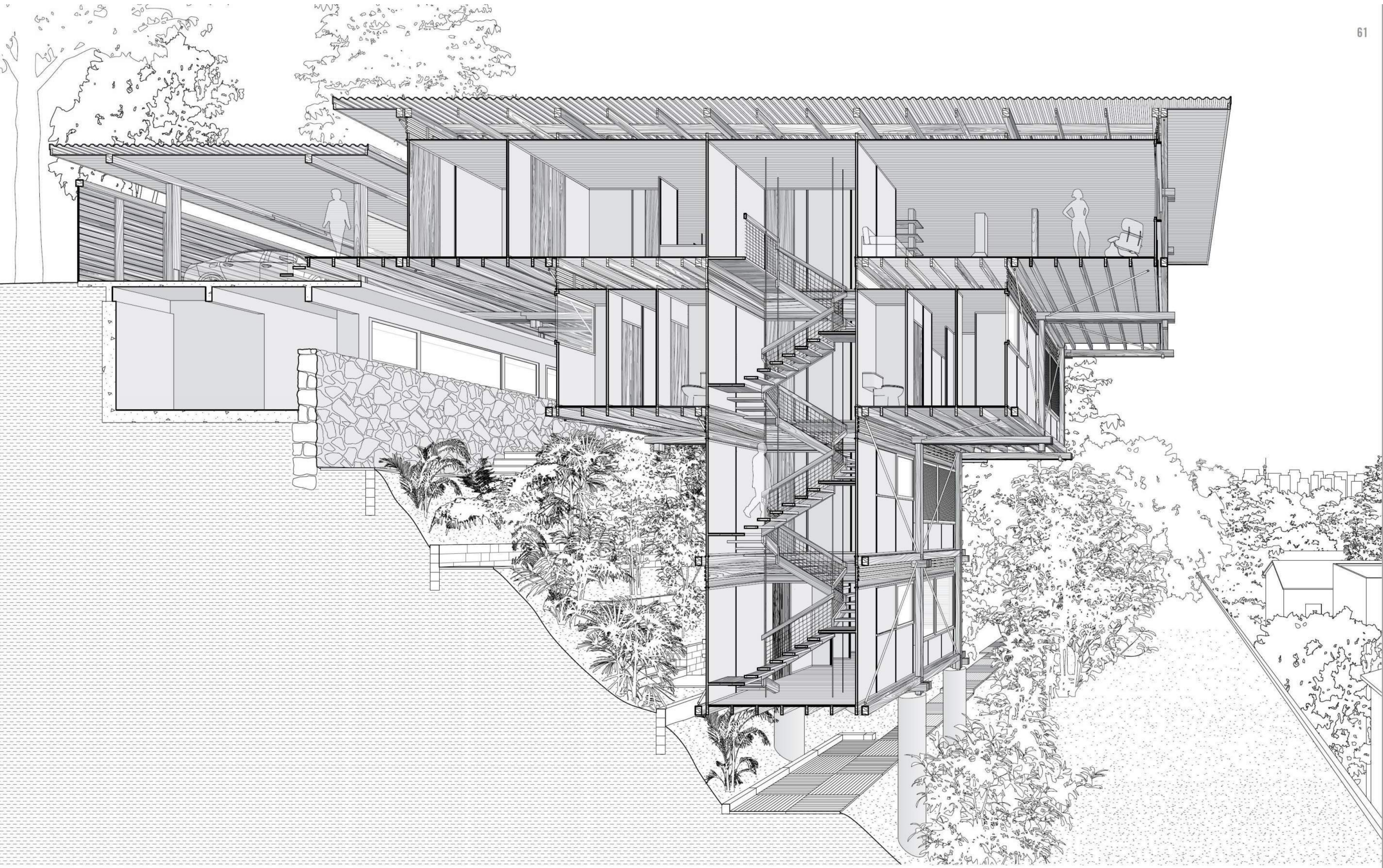
Helio Olga House | Marcos Acayaba Arquitetos

São Paulo, Brazil | 1990

Built as a more efficient and less expensive way to inhabit a steep slope, this house is constructed from a wood frame in an inverted stepped pyramidal section. As such, the house is supported by only six slender concrete piers at its base, but expands to a large living area on the top level contiguous with the upper elevation of the site. With its wood structure positioned on the exterior, the interior of the house comprises 20 cubes of space, with 10 forming the main living, kitchen, and dining floor; six on the floor below housing three bedrooms; and two additional levels of two volumes containing a guest bedroom and den. A single stair on the southern side connects vertically between all the levels. Continuous ribbon windows on each level provide panoramic views of the city to the east.



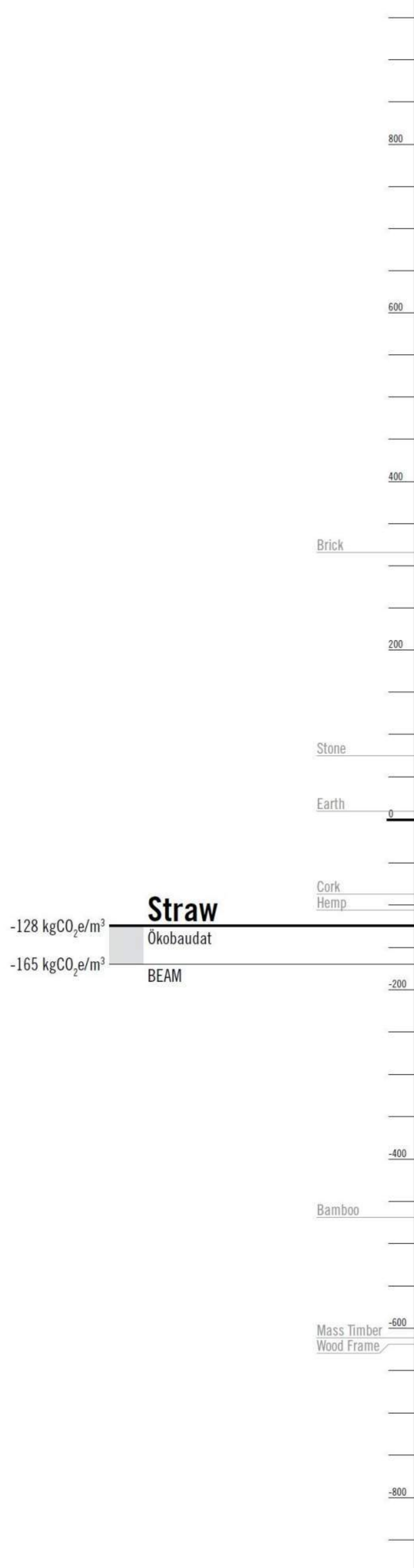




Helio Olga House

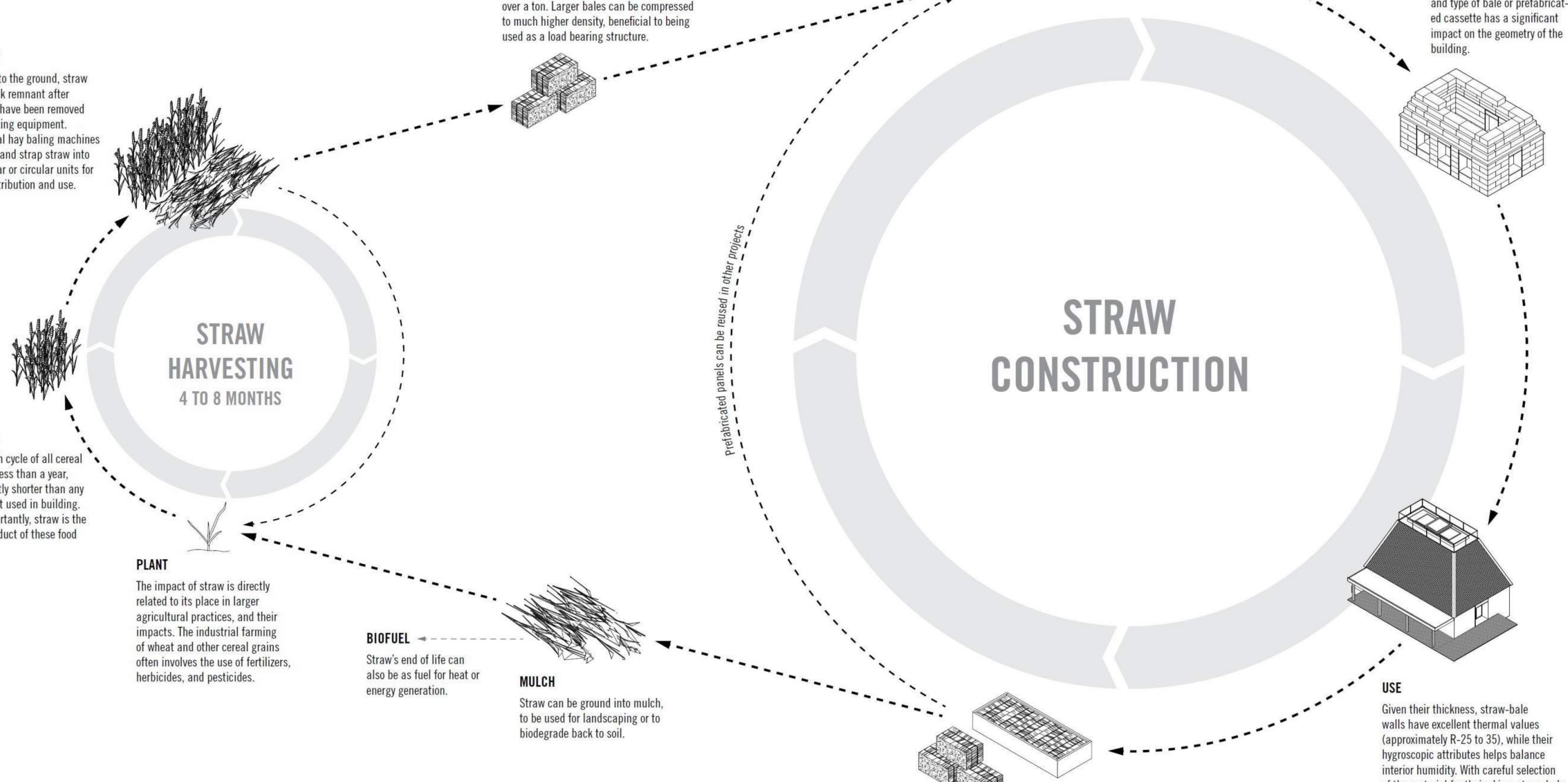
The house was constructed with prefabricated components, and its wood frame used as an exoskeletal structure. The corner joints were designed with intricate wood joinery, with as many as 10 separate wood members connecting through an interlocking array of bridal, mortise and tenon joints. The system allows additional posts to be added to the central columns without changing the thin profile of the grid. Wood members extend slightly beyond the joint, emphasizing the autonomy of the parts, while diagonal steel struts reinforce and visually register the structural cantilevers. The beams under the upper floor anchor to the top surface of the driveway, additionally securing the top portion of the house to the hill. Lighter-weight joists span above and below the frames, supporting smooth surfaces of wood floors and ceilings, and the gap between provides a ventilated cavity above and below each room. Lightweight walls internal to the frame produce a smooth, gossamer surface, much of which is glass. Wide roof overhangs shade the building, and continue the cascading form of this distinctive and tectonically explicit house.


STRAW


800
600
400
Brick
200
Stone
Earth
0
Cork
Hemp
Straw
-128 kgCO2e/m3
Ökobaudat
-165 kgCO2e/m3
BEAM
-200
-400
Bamboo
Mass Timber
-600
Wood Frame
-800

STRAW

Straw is a byproduct of critical food sources (wheat, rice, oats, barley, rye) and can be found throughout the world. After the seeds have been harvested, straw is the residual stock and not to be confused with hay, which is feedstock. Straw is about 40% carbon, and is transformed into a more useful form for construction by baling machines. Although globally it absorbs a massive amount of carbon dioxide each year, straw is left to decompose or is burned returning the CO_2 to the atmosphere. As a fast growing, inexpensive, ubiquitous, minimally processed, agricultural byproduct, straw has enormous capacity to sequester carbon as a building material. Primarily used as insulation with an R-value of 1.5 to 2 per inch, it can also be a load bearing material. In either condition, its clay, lime, or cementitious plaster skin is critical to its performance and aesthetic, and the source of much of its labor and cost as a building system.



HARVEST

Cut close to the ground, straw is the stock remnant after the seeds have been removed by harvesting equipment. Mechanical hay baling machines compress and strap straw into rectangular or circular units for easier distribution and use.

BALING

The size of the bales is contingent on the type of baler. These can range in size from a two-string rectangle weighing about 50 lbs (22 kg), to large round bales that can weigh over a ton. Larger bales can be compressed to much higher density, beneficial to being used as a load bearing structure.

PREFABRICATION

Straw as insulation can be combined with wood frames into prefabricated units in more controlled off-site factories. This avoids some of the moisture challenges of on-site construction with straw. Dry or wet skins can be applied off-site.

PLASTERING

Clay, lime, and/or cement is frequently used as a plaster skin, applied directly to the rough surface of both sides of straw-bales. Plaster skins are typically the air, water, and vapor controls of the assembly, as well as integral to the structural capacity of the straw wall.

CONSTRUCTION

Straw can be used as a load bearing structure, as infill to a structural frame, or within prefabricated units. The size and type of bale or prefabricated cassette has a significant impact on the geometry of the building.

USE

Given their thickness, straw-bale walls have excellent thermal values (approximately R-25 to 35), while their hygroscopic attributes helps balance interior humidity. With careful selection of the material for their skins, straw-bale walls can improve indoor air quality, and can have many times the thermal mass of a conventional stick framed wall.

DISASSEMBLY

Prefabricated panels can be designed to be detachable and reused. Straw-bale walls can decompose, particularly if their skins are clay-based or removable.

MULCH

Straw can be ground into mulch, to be used for landscaping or to biodegrade back to soil.

BIOFUEL

Straw's end of life can also be as fuel for heat or energy generation.

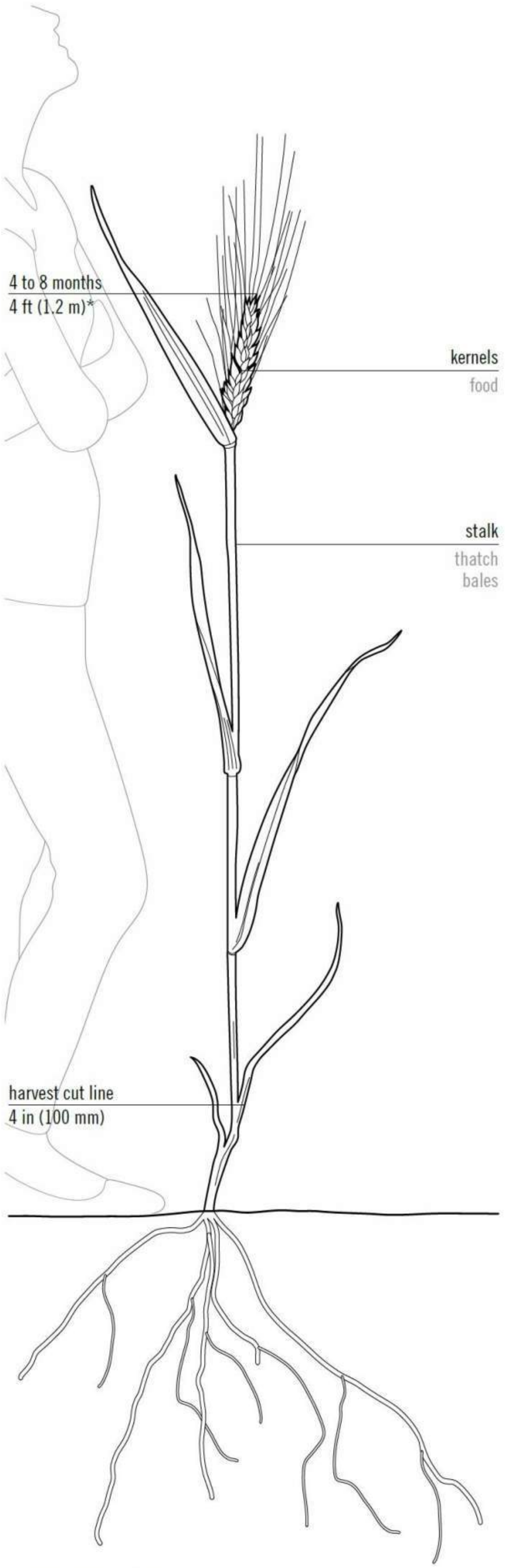
PLANT

The impact of straw is directly related to its place in larger agricultural practices, and their impacts. The industrial farming of wheat and other cereal grains often involves the use of fertilizers, herbicides, and pesticides.

GROWTH

The growth cycle of all cereal grains is less than a year, significantly shorter than any other plant used in building. More importantly, straw is the waste product of these food grains.

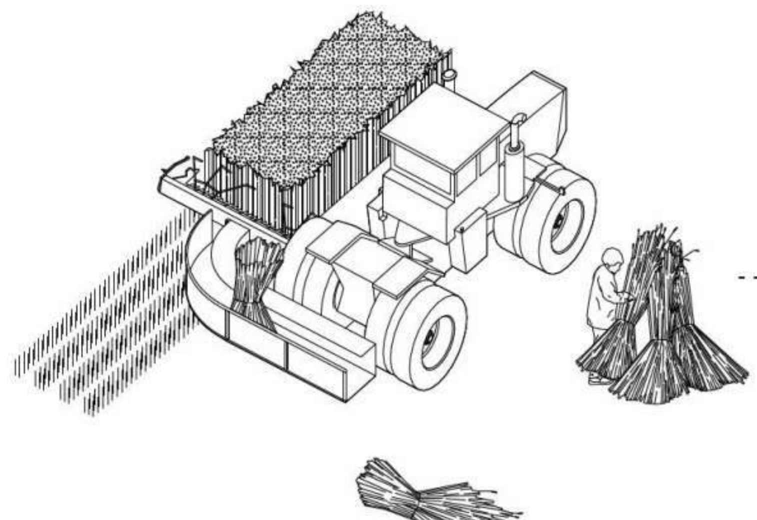
STRAW



*height and timeframe are averages; actual values vary by planting season and environmental factors

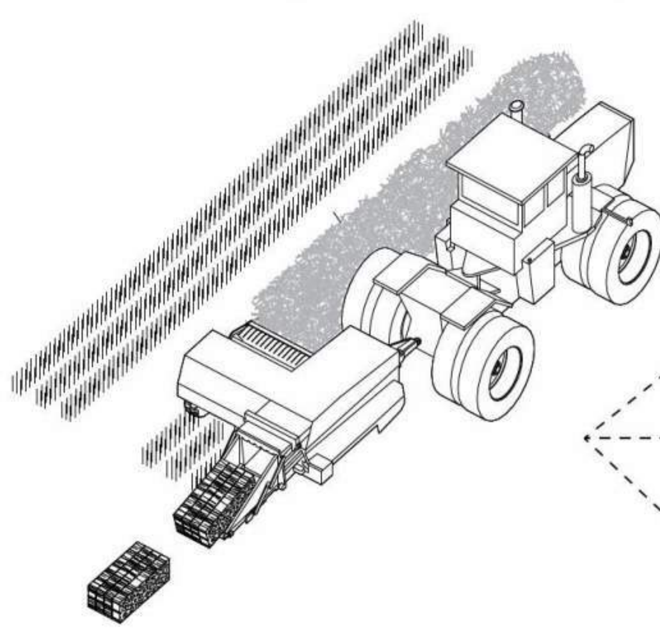
HARVESTING

Reeds for thatching are harvested into carefully formed bundles, while sea grasses are gathered from the shoreline. Straw is typically gleened from fields after the cereal grains have been removed.

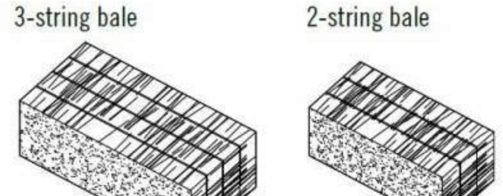


BALING

The most common grains used to make straw-bales are wheat and rice. Both are harvested and formed into bales after the seed kernels have been extracted and the stocks are sufficiently dry.
Although bale sizes vary depending on the baling equipment, two-string bales are roughly 14 by 18 by 36 in (360 by 460 by 910 mm) while three-string bales are roughly 16 by 23 by 46 in (410 by 580 by 1170 mm). Jumbo rectangular and circular bales can also be used. Most commonly, the bales are positioned flat with the strings within the walls, allowing the outer sides to be notched for posts.



3-string bale 2-string bale

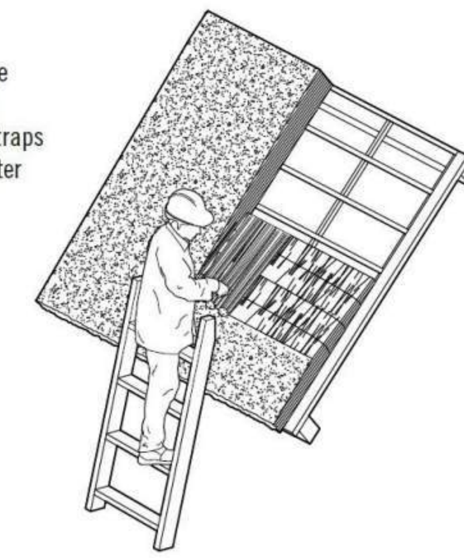


PLASTERING

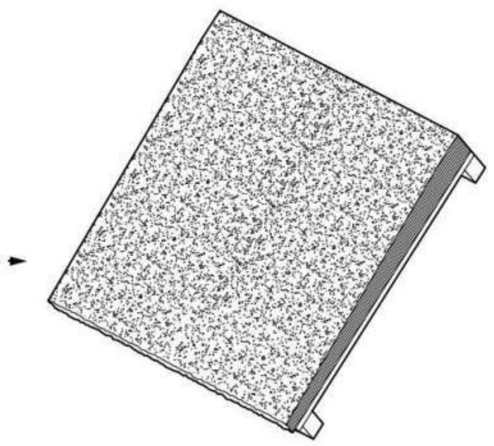
The plaster skin is a crucial component of straw-bale construction, contributing significantly to its structural capacity, and its resistance to fire, moisture, and vermin. Although slower drying, clay and lime plasters avoid the higher carbon emissions of portland cement-based plasters.

THATCH

Tightly-packed long reeds or straw are fastened in overlapping bundles to a steeply pitched roof with horizontal straps producing a thickness that sheds water and can serve as insulation.



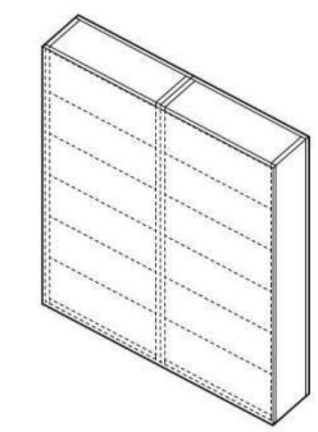
THATCHED ROOF



PRE-FABRICATED PANELS

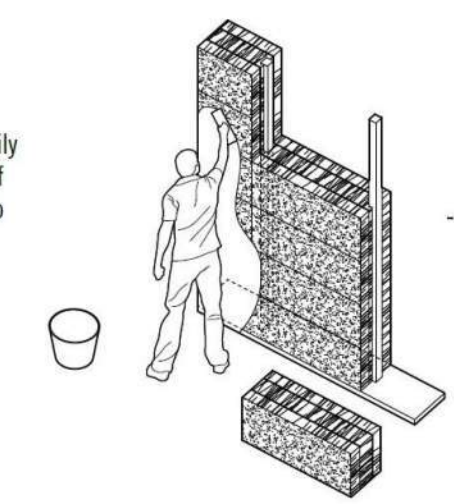
Straw-bales can be inserted into structural wooden frames to make pre-fabricated panels, increasing moisture control and construction precision. Skins can be added off-site or on-site.

PREFABRICATED ASSEMBLY

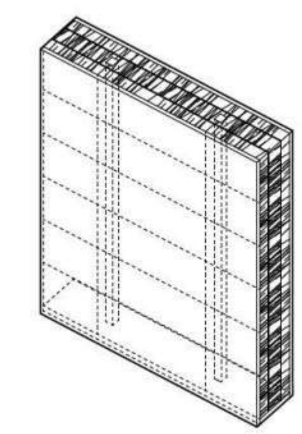


WOOD FRAME INFILL

The most common approach, straw-bales are stacked around or within a structural wood frame, serving primarily as insulation. With proper treatment of the skin, the straw-bale walls can also provide lateral bracing.



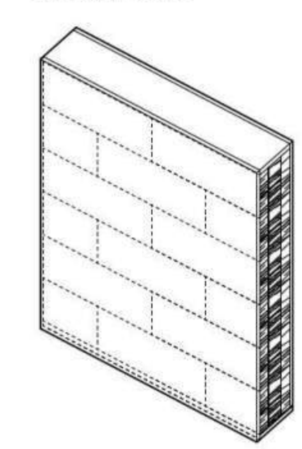
INFILL WALL

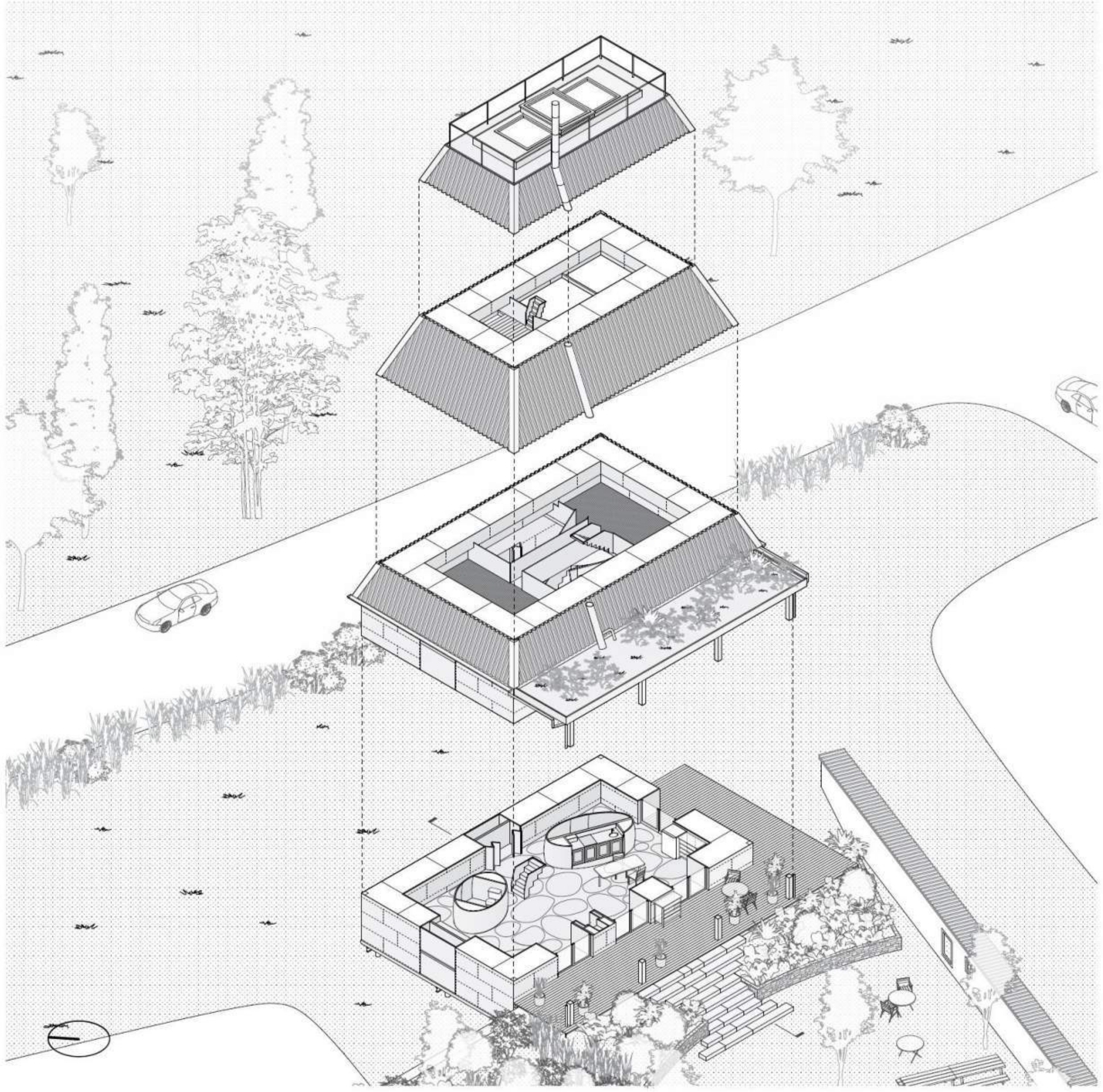


NEBRASKA LOAD-BEARING

Referencing the location of its first use in the late 1800s, Nebraska-style walls use the combined sandwich of thick plaster skins and straw-bales to be the load bearing structure. Typically just a single story, the straw-bale walls are compressed before the plaster is applied. A wooden top plate or ring beam transfers the roof load to the plaster skins which carry it to the foundations.

STACKED WALL

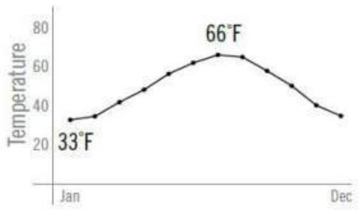


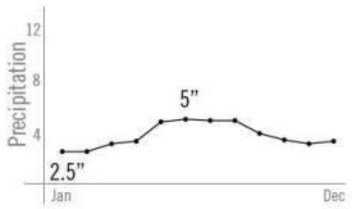


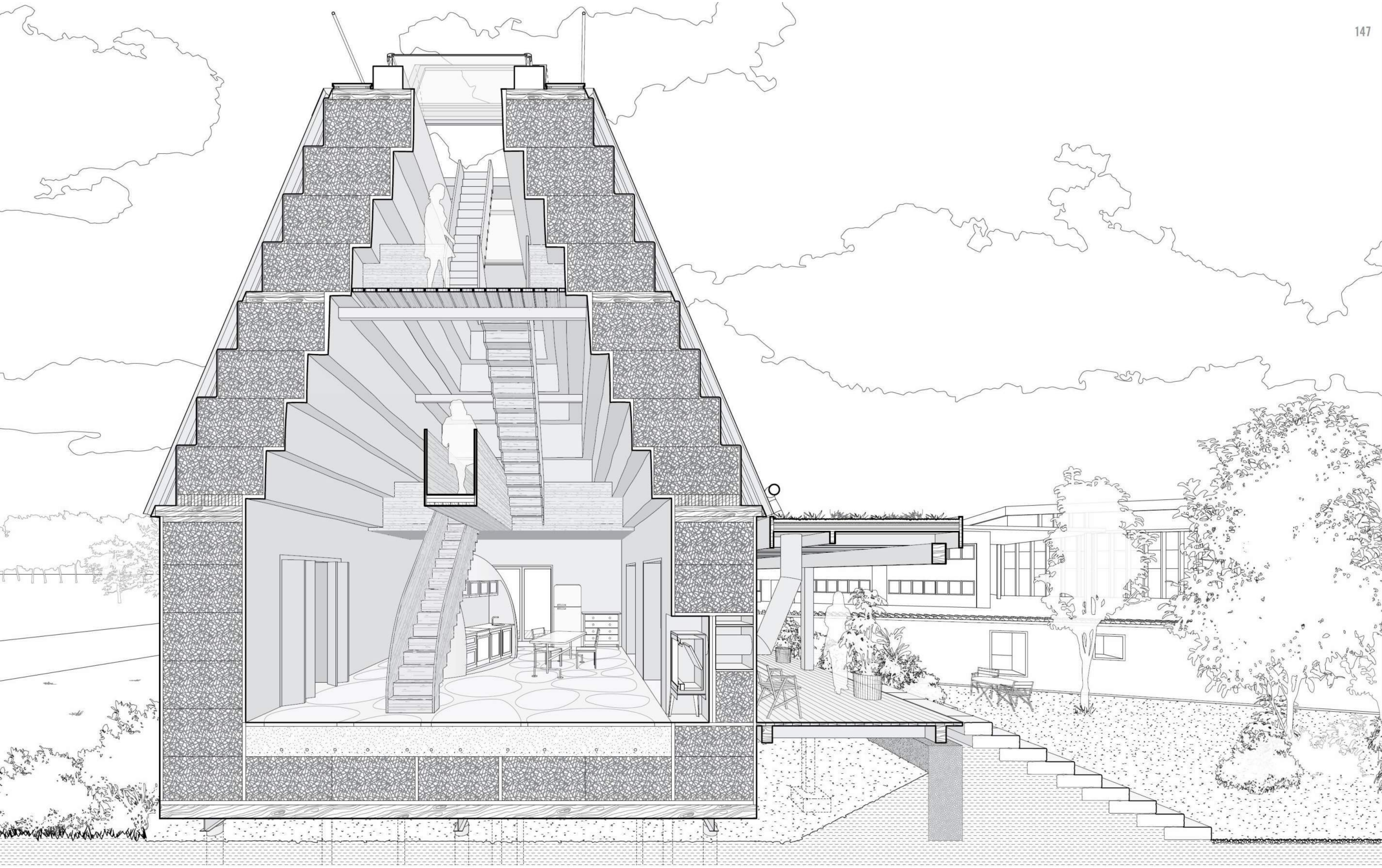
Gartist GmbH House | Atelier Werner Schmidt

Zurich, Switzerland | 2016

This pavilion is an ingeniously simple and consequential use of straw-bales as a building material, taking full advantage of their thermal, structural, volumetric, material, and ecological qualities. The floor, walls, and roof of this house are all constructed of very large and heavily compacted straw-bales. They are the load-bearing structure in the walls and the corbeled roof, augmented only through selective planes of larch wood that frame the windows and form horizontal ring beams in the roof. Lime plaster on the outside and white clay plaster on the inside of the straw adds to the bales' structural capacity and protects against water, fire, and vermin. The thickness of the straw achieves high thermal resistance, while also absorbing excess humidity. A small wood burning stove is rarely used. Bathroom and kitchen services are contained in lime-coated pods independent from the structural walls.

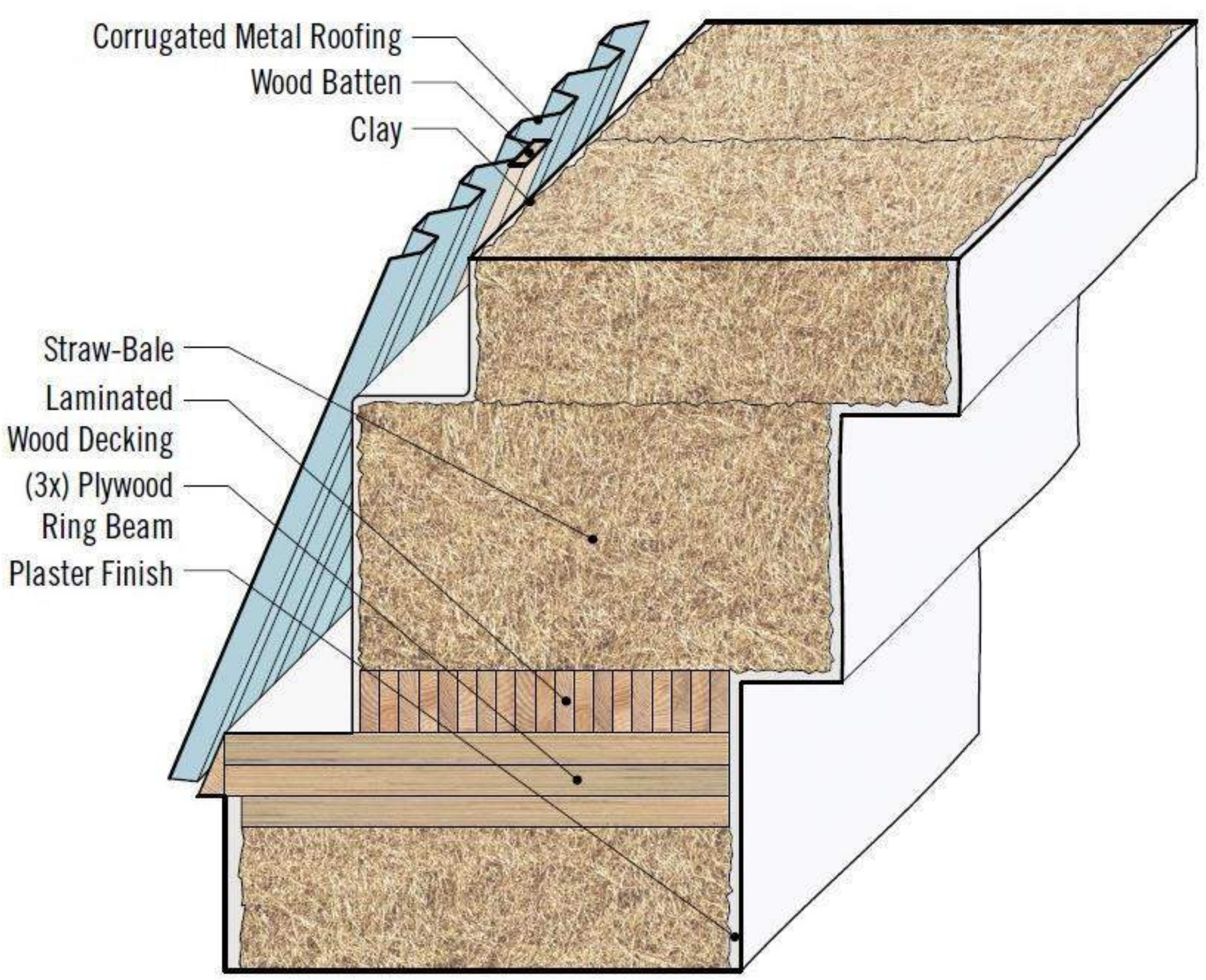






Gartist GmbH House

Raised on stilt piles and a solid wood raft above the damp ground, the thick floor is made from a grid of timber panels infilled with straw and topped with gravel, a radiant heating system, and 2.4 in (60 mm) slices of moraine stones. The load-bearing walls are comprised of 30 by 47 by 98 in (750 by 1200 by 2500 mm) bales, each weighing 661 lb (300 kg), erected by crane in about a week. These extremely thick walls allow the shape of the roof to be made by offsetting the upper eight rows of bales about 1 ft (300 mm) each, forming a corbeled structure. The keystone is a large skylight, filtering light down through the cascading thickness of this distinctive section. Stairs connect to lofted lounge areas nested inside the inverted ziggurat and permit roof access. The surface of the straw is enhanced by the smooth undulations of the interior clay plaster, allowing the different edges of the bales to be visible. Corrugated metal attached to vertical wood battens, and a layer of clay protects the outside of the staggered roof bales. This house pavilion celebrates the thickness of an inexpensive and minimally processed natural material and in the process stores the carbon contained in 75 metric tons of an agricultural residue within its envelope.

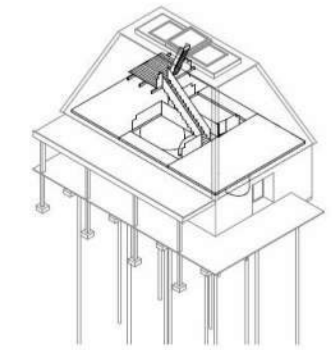


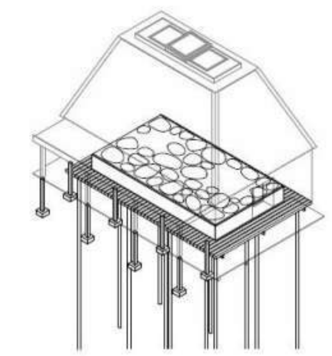
Straw

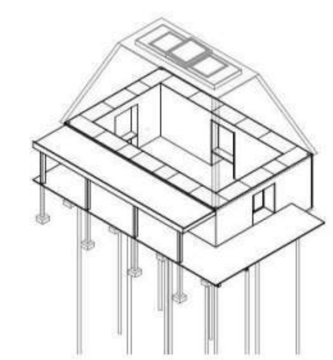
Gartist GmbH House
Atelier Werner Schmidt

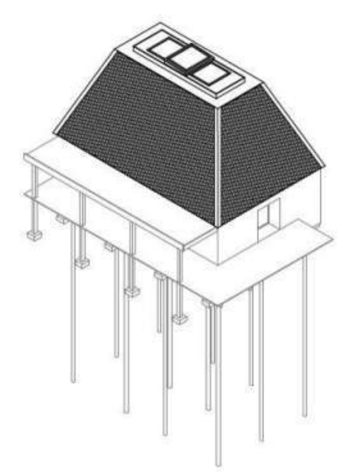
Straw

Gartist GmbH House
Atelier Werner Schmidt







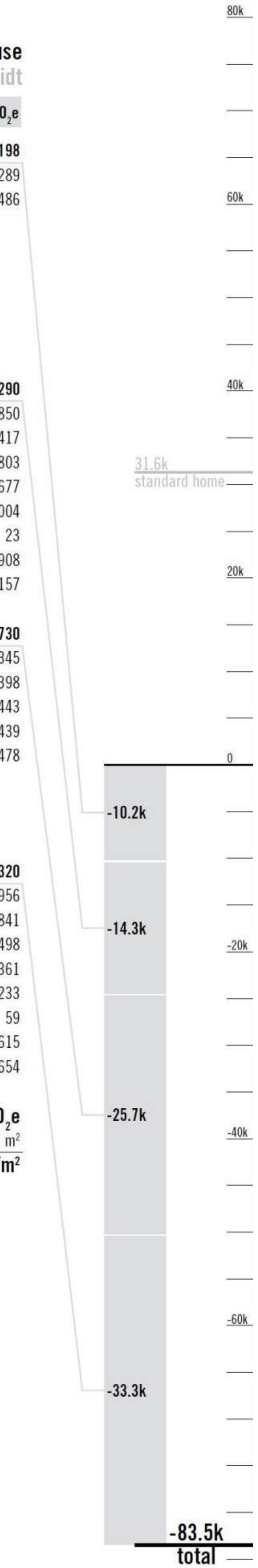


Location	Material	Quantity	$kgCO_2e$/unit	Total $kgCO_2e$
Interior				-10198
	Lime Plaster	1.52 m^3	190	289
	Dimensional Lumber	17.06 m^3	-615	-10486
Foundation				-14290
	Steel	0.16 m^3	17898	2850
	Concrete	9.82 m^3	246	2417
	Stone Flooring	2.42 m^3	746	1803
	Gravel	27.26 m^3	62	1677
	Cement Topping	2.30 m^3	438	1004
	Vapor Barrier	58.42 m^2	0.4	23
	Straw	46.09 m^3	-128	-5908
	Dimensional Lumber	29.54 m^3	-615	-18157
Exterior				-25730
	Lime Plaster	12.34 m^3	190	2345
	Clay Plaster	15.01 m^3	93	1398
	Glass	0.12 m^3	3593	443
	Dimensional Lumber	18.61 m^3	-615	-11439
	Straw	144.13 m^3	-128	-18478
Roof				-33320
	Galvanized Steel	0.14 m^3	21666	2956
	Lime Plaster	9.69 m^3	190	1841
	Aluminum	0.03 m^3	18373	498
	EPDM Membrane	39.89 m^2	9	361
	Glass	0.06 m^3	3593	233
	Bitumen Membrane	25.62 m^2	2	59
	Dimensional Lumber	20.52 m^3	-615	-12615
	Straw	207.91 m^3	-128	-26654

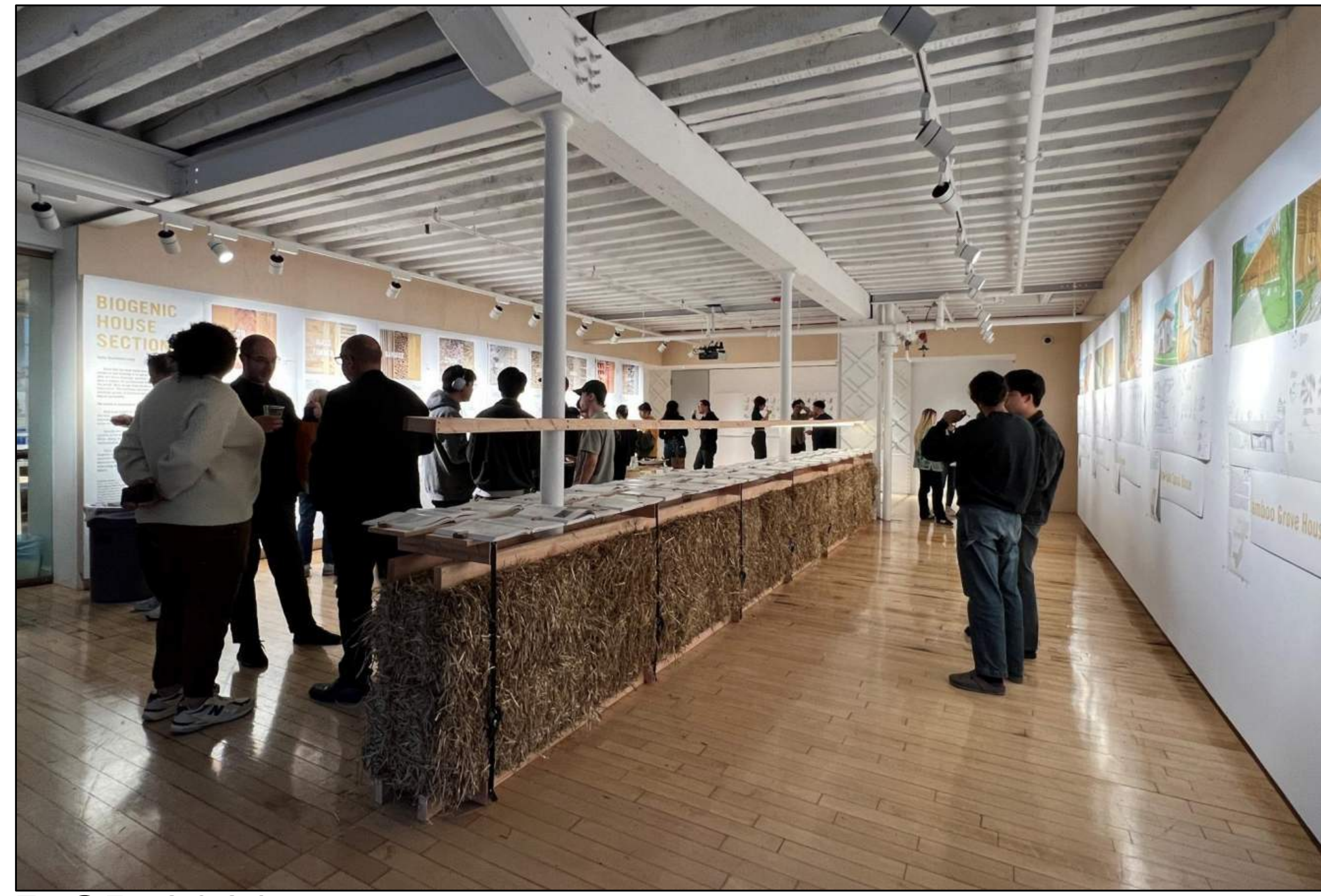
Total	**-83,538 $kgCO_2e$**
Area	171 m^2
Total per Area	**-488 $kgCO_2e/m^2$**

Assumptions:
Skylight and doors are double pane glass, 4 + 4 mm
Aluminum skylight frames are calculated as 20% of simplified frame volume
Metal roofing is 29 gauge galvanized steel
Aluminum skylight edge is 16 gauge
Windows and skylights are triple pane glass, 4 + 4+ 4 mm
Lime plaster on interior and exterior surfaces is 5 cm thick
Roof deck railing is 10 gauge galvanized steel
"Stone Flooring" value is used for stone in ground floor
Skylight opening is framed with lumber
Wood-framed partitions in bathroom and kitchen volumes
Clay sprayed on exterior of straw-bales is 5 cm thick
EPDM roofing membrane is used on green roof

Exclusions:
Metal lath in kitchen and bathroom walls
Stone steps and gabion wall
Green roof soil and plantings
Uncovered portion of deck
Fasteners
MEP
Fixtures
Concrete reinforcement
Flashing
Gutters and downspouts
Stove and stove pipe
Counters and casework



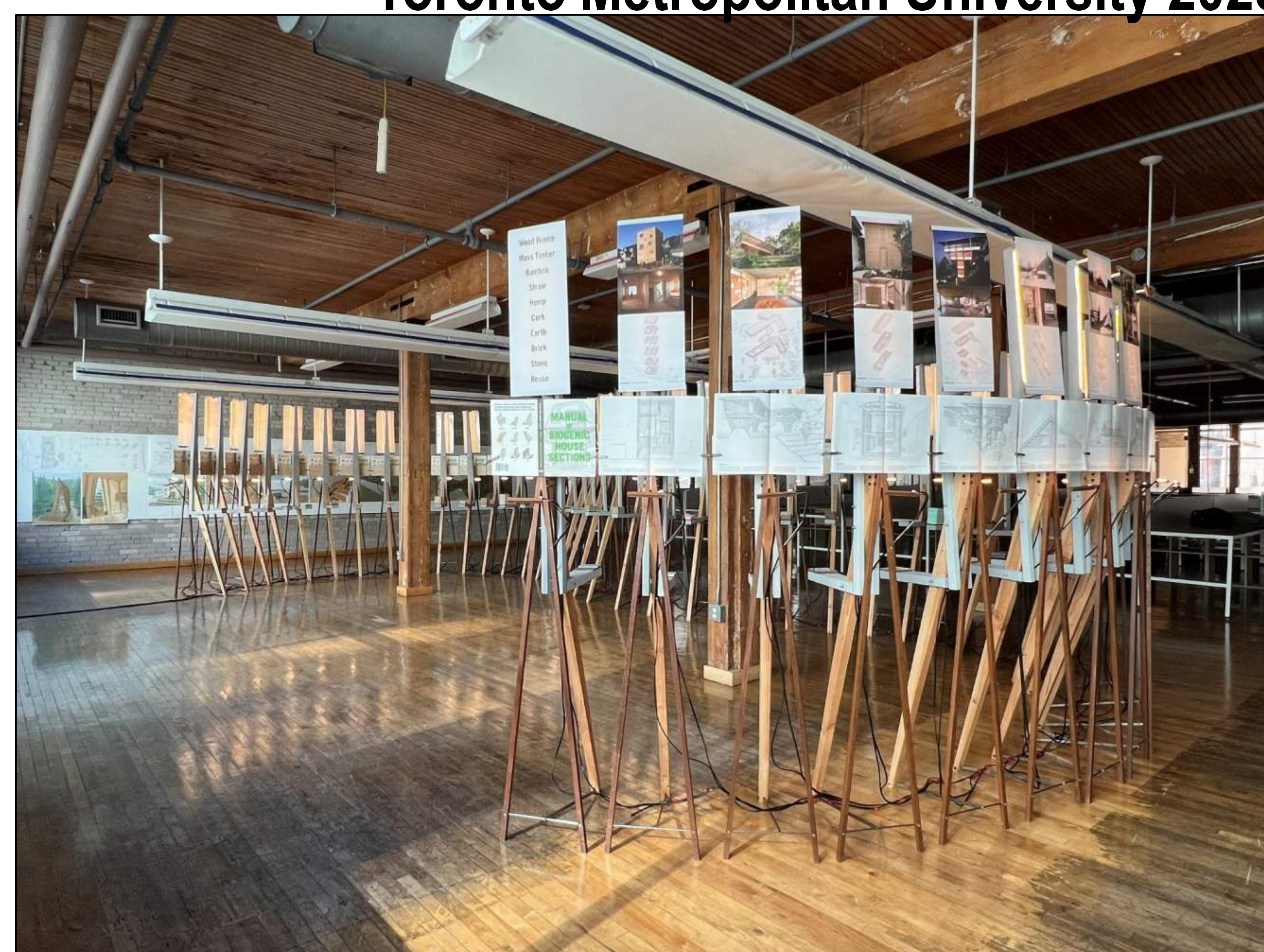
Princeton University 2022



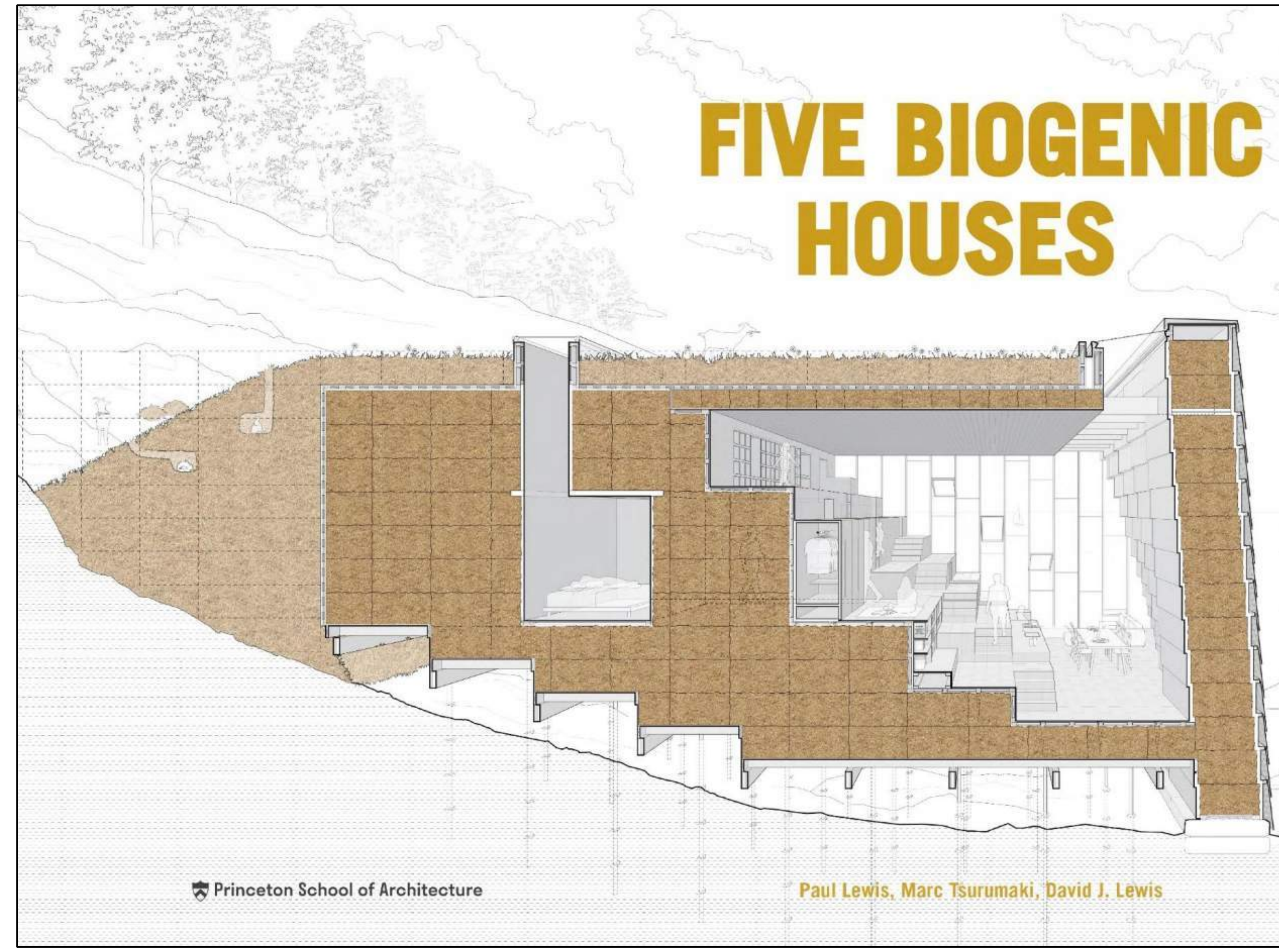
RISD 2023

Ohio State University 2023

Toronto Metropolitan University 2023

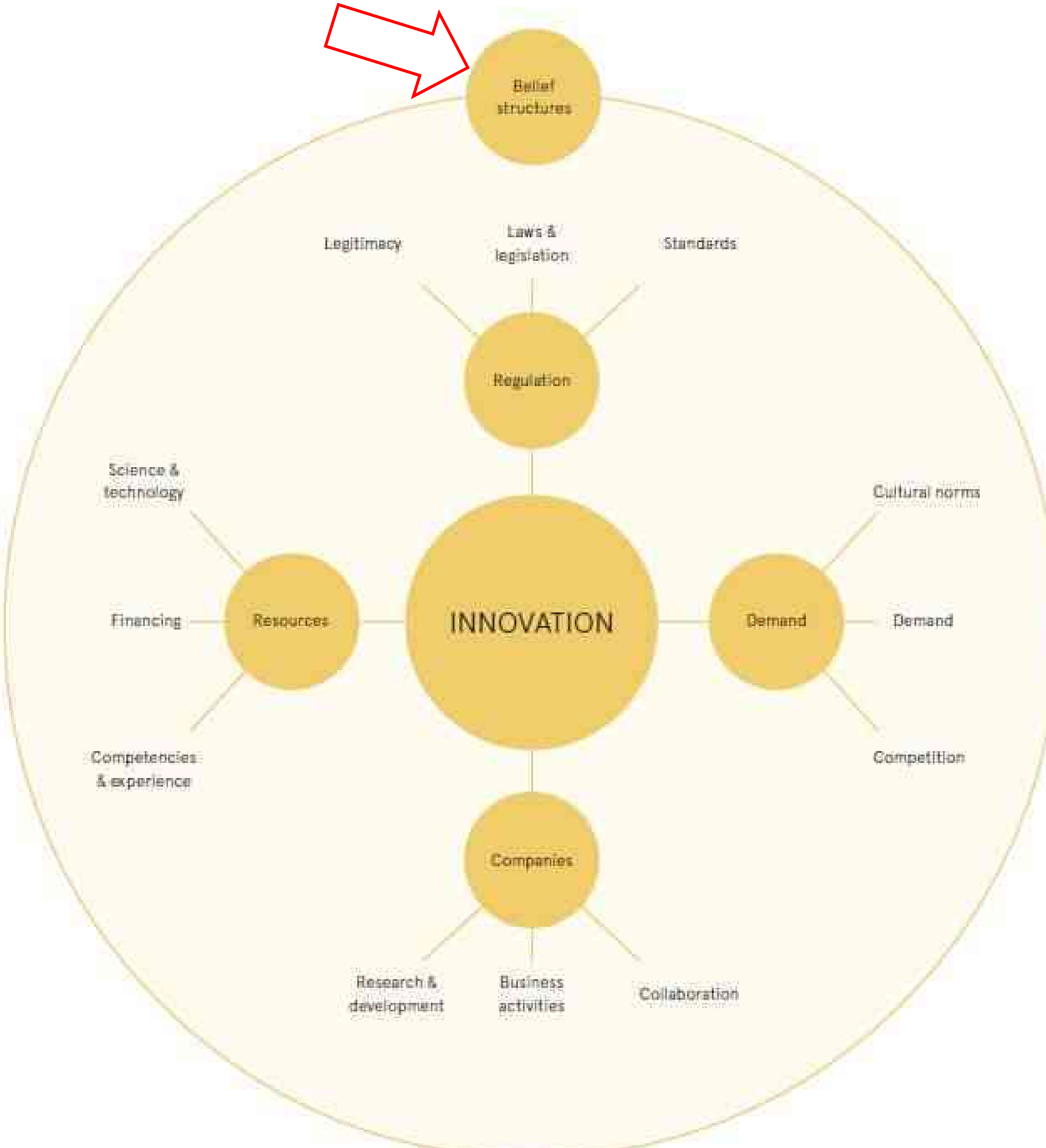


LTLARCHITECTS



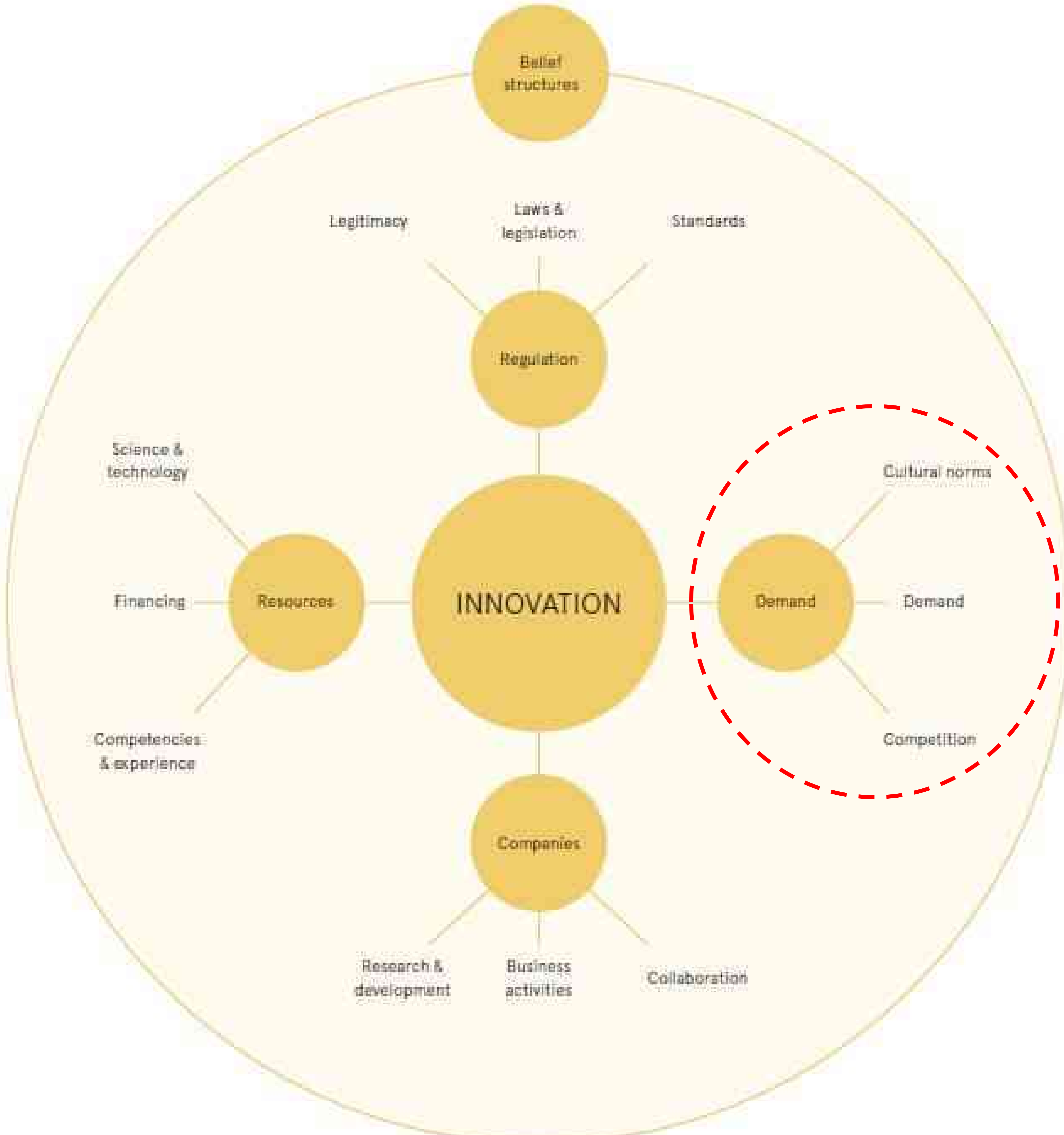
LTLARCHITECTS

LTLARCHITECTS



The institutional context of innovation. Innovation opportunities and barriers are shaped by four factors: regulation, available resources, demand and the commercial activities of companies. The inventor has to take these factors into account – adapt to them or change them – to make innovation happen. Figure is based on Van de Ven 1999.[4]

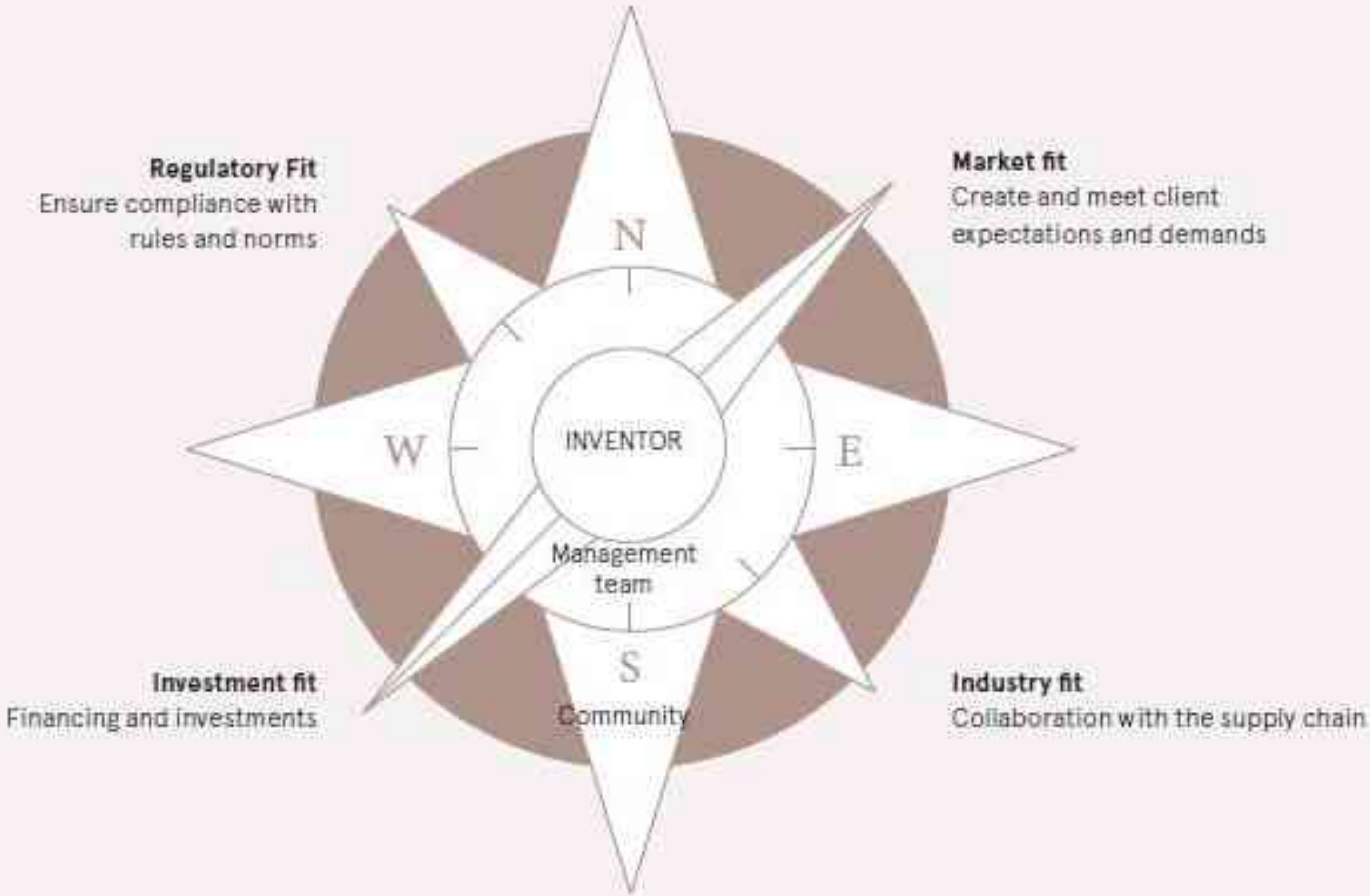
Source: *Innovation of Nothing*



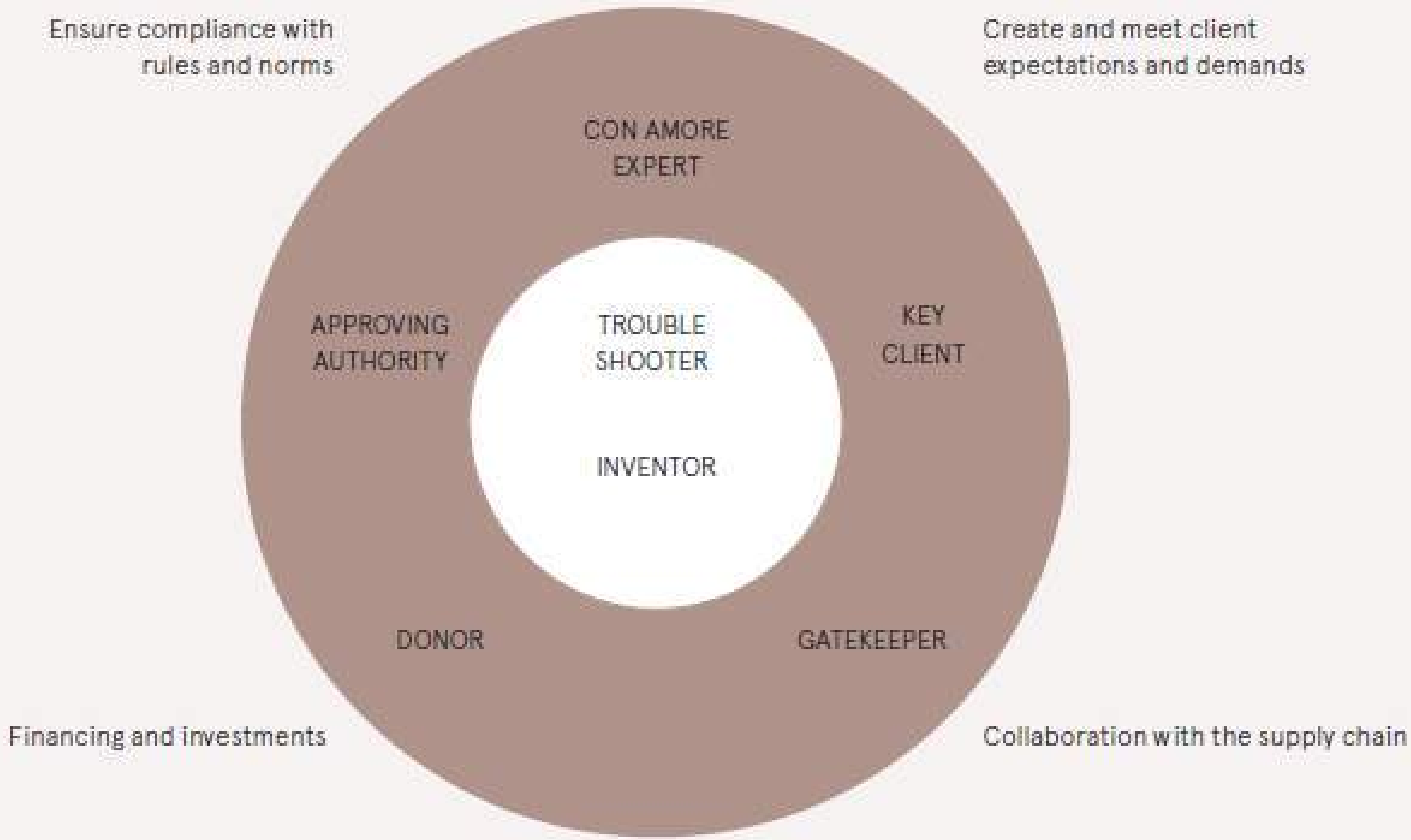
The institutional context of innovation. Innovation opportunities and barriers are shaped by four factors: regulation, available resources, demand and the commercial activities of companies. The inventor has to take these factors into account – adapt to them or change them – to make innovation happen. Figure is based on Van de Ven 1999.[4]

Source: *Innovation of Nothing*

Four dimensions that needs to be handled by persons, companies and communities in order to make innovation take place

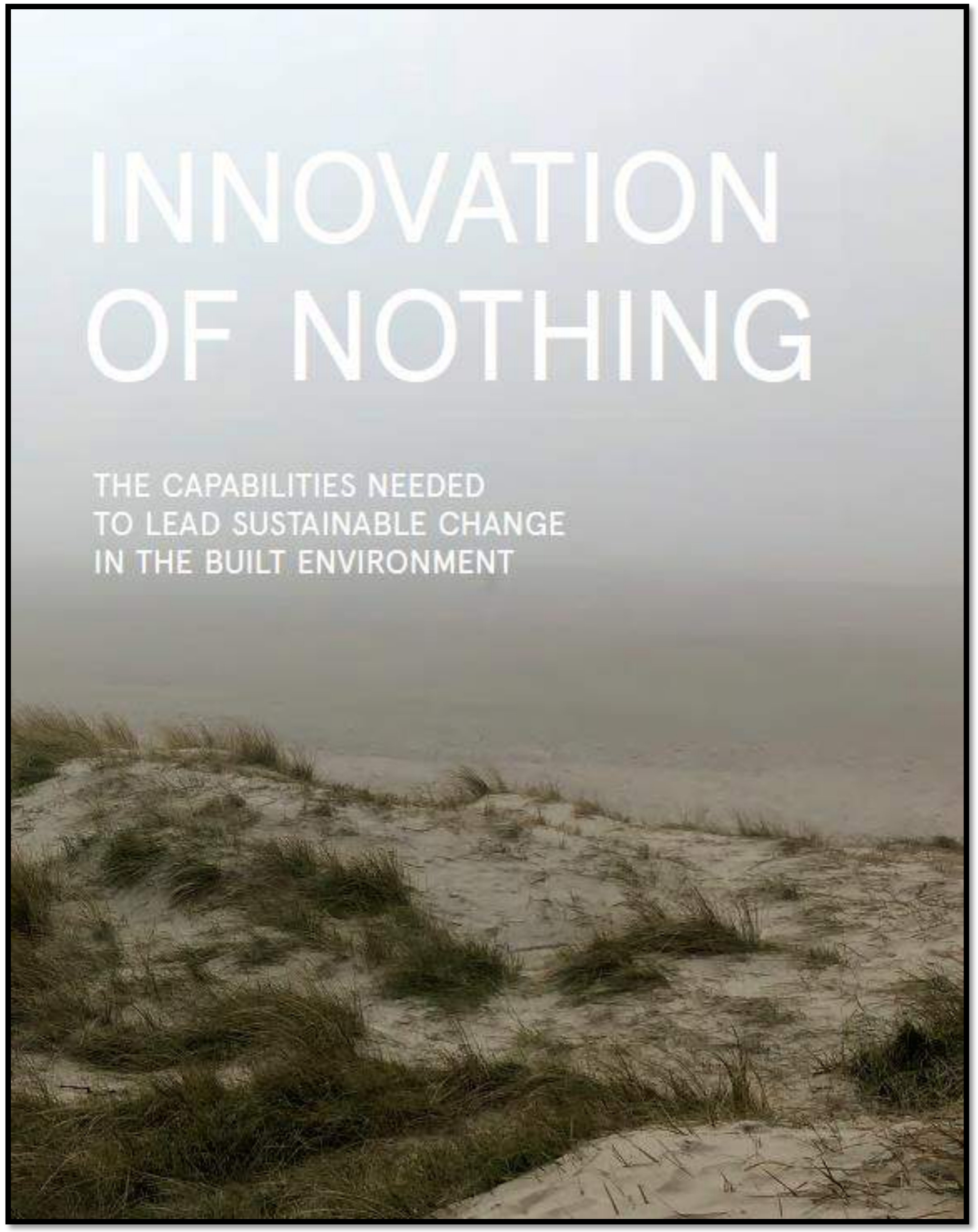


Source: *Innovation of Nothing*



The various roles in sustainable innovation are especially relevant in different stages of the innovation proces

Source: *Innovation of Nothing*



AUTHORS

Anne Beim
PhD, Professor, Head of Centre for Industrialised Architecture (CINARK), Royal Danish Academy – Architecture, Design, Conservation

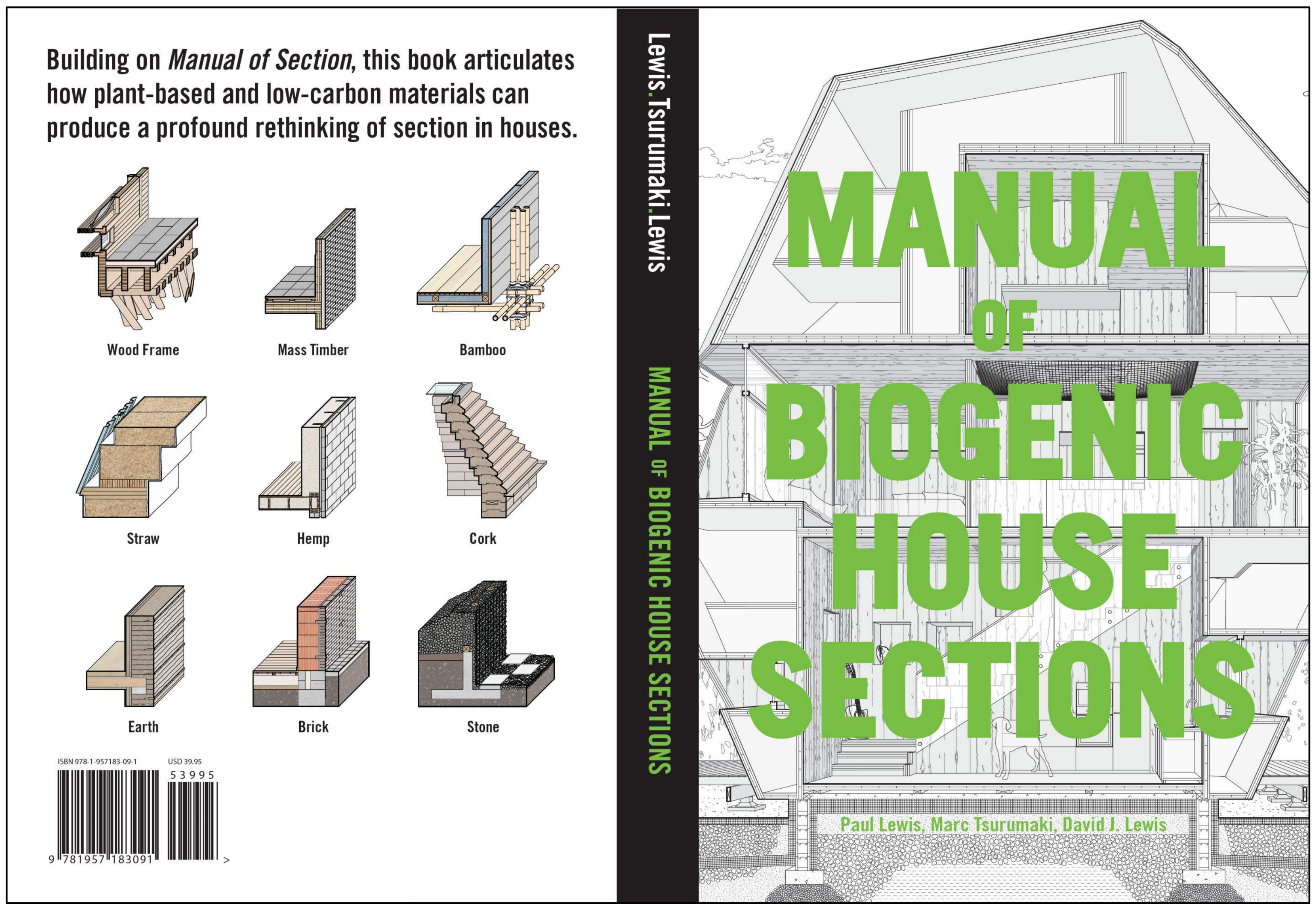
Ingeborg Hau
Consultant, Institute of Architecture and Technology, Royal Danish Academy – Architecture, Design, Conservation

Mikkel Thomassen
PhD, Partner, Smith Innovation, Postdoc, Institute of Architecture and Technology, Royal Danish Academy – Architecture, Design, Conservation

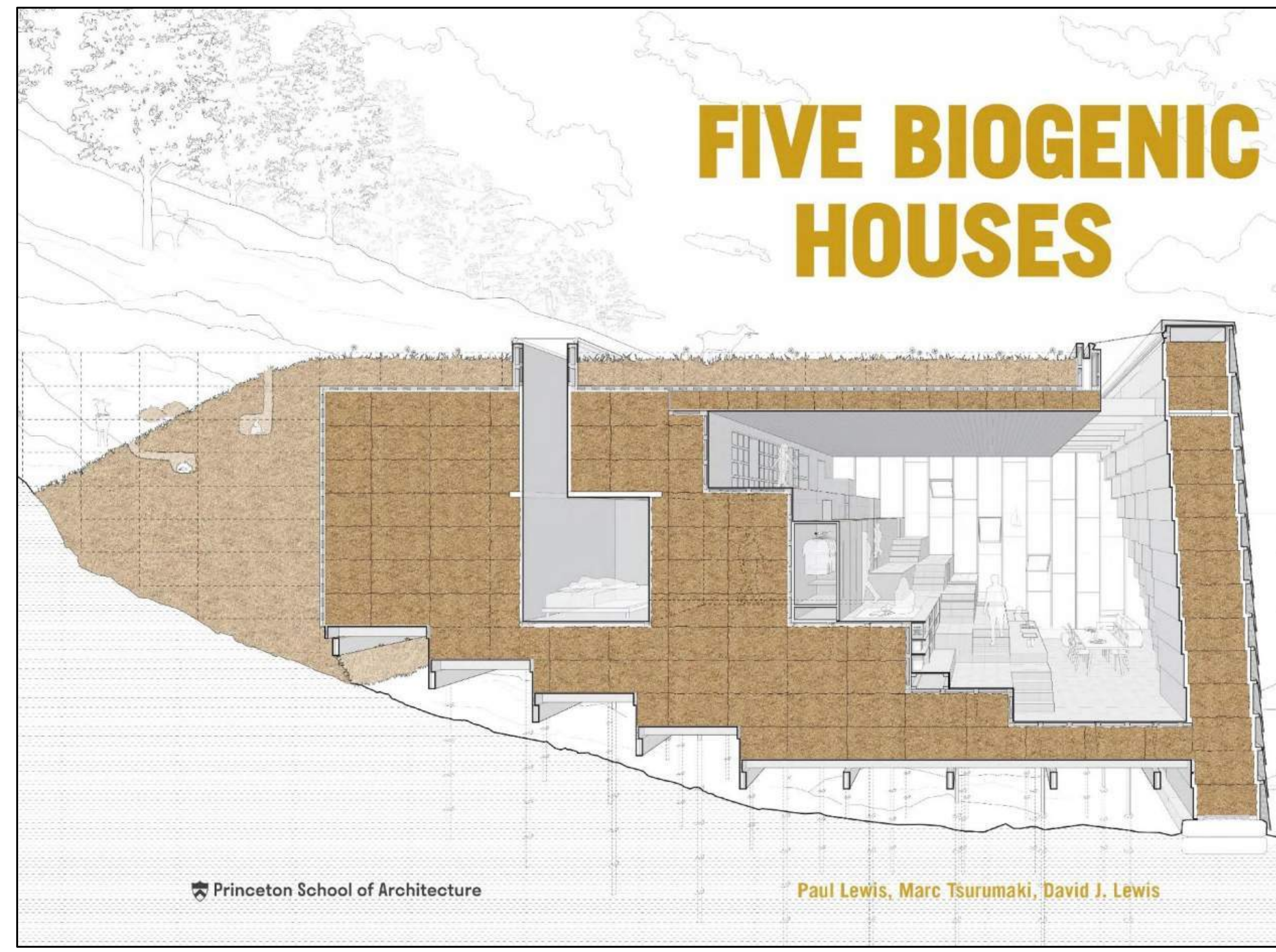
Natalie Mossin
Head of Institute, Institute of Architecture and Technology, Royal Danish Academy – Architecture, Design, Conservation

Pelle Munch-Petersen
PhD, Associate Professor, Institute of Architecture and Technology, Royal Danish Academy – Architecture, Design, Conservation

Thorbjørn Lønberg Petersen
PhD Fellow, Institute of Architecture and Technology, Royal Danish Academy – Architecture, Design, Conservation



Building on *Manual of Section*, this book articulates how plant-based and low-carbon materials can produce a profound rethinking of section in houses.
Wood Frame
Mass Timber
Bamboo
Straw
Hemp
Cork
Earth
Brick
Stone
ISBN 978-1-957183-09-1
USD 39.95
Lewis.Tsurumaki.Lewis
MANUAL OF BIOGENIC HOUSE SECTIONS
MANUAL OF BIOGENIC HOUSE SECTIONS
Paul Lewis, Marc Tsurumaki, David J. Lewis



FIVE BIOGENIC HOUSES
Princeton School of Architecture
Paul Lewis, Marc Tsurumaki, David J. Lewis

Biomaterials Summit
15 November 2023

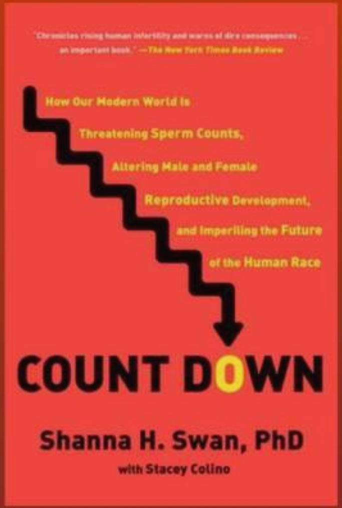
THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB

Designing with Material Health

Jonsara Ruth Associate Professor of Interior Design
Co_Founder Design Director, Parsons Healthy Materials Lab

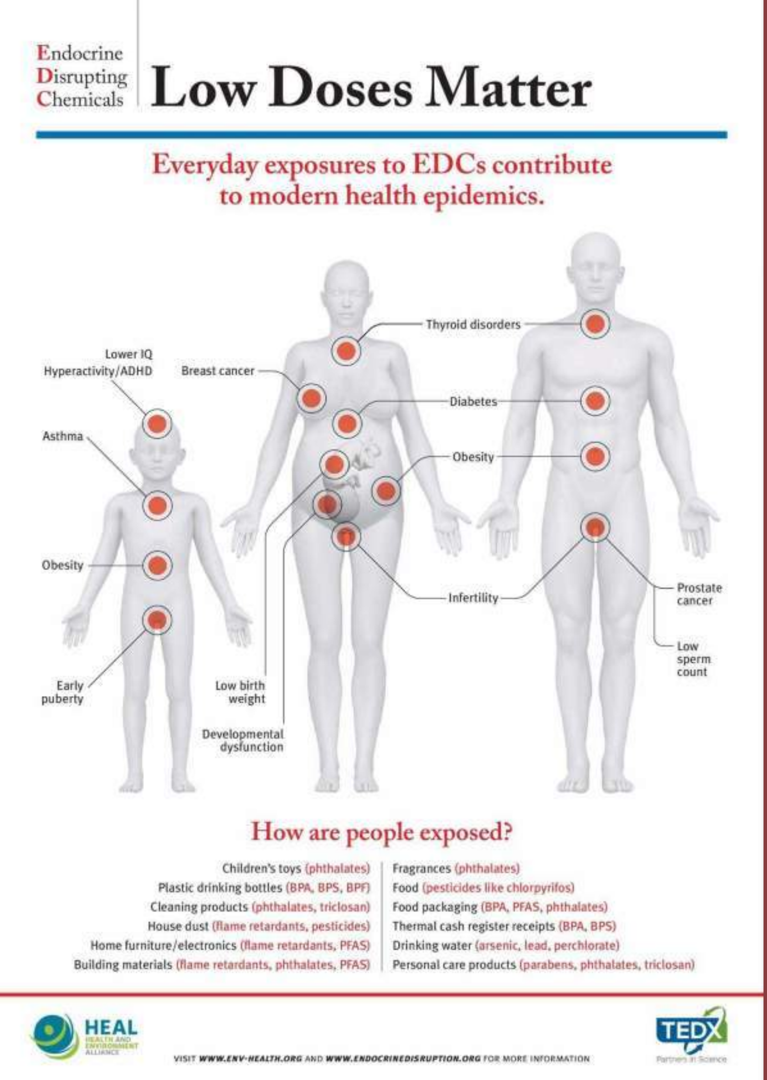
Melissa McGill, Without Edges, 2022

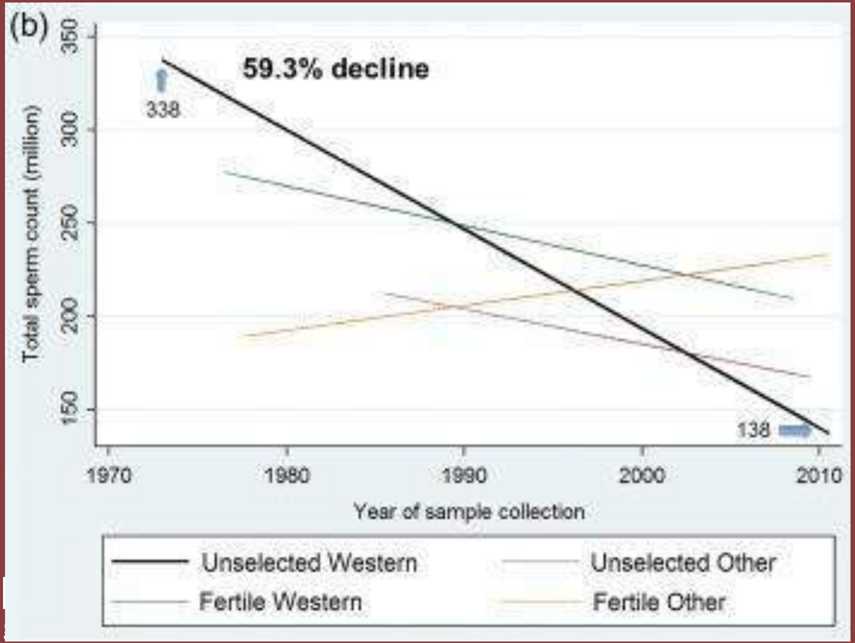
“In some ways, the sperm-count decline is akin to where global warming was forty years ago - reported upon but denied or ignored.”



Environmental Threats
To Reproduction

Shanna Swan, PhD
Professor, Environmental Medicine and Public Health
Icahn School; of Medicine at Mount Sinai





(**b**) Meta-regression model for mean total sperm count by fertility and geographic groups, adjusted for potential confounders.

Levine, Hagai et al. "Temporal trends in sperm count: a systematic review and meta-regression analysis." Human reproduction update vol. 23,6 (2017): 646-659. doi:10.1093/humupd/dmx022

THE NEW SCHOOL
PARSONS
HEALTHY
MATERIALS LAB


vinyl


polycarbonate

Climate Change, Toxic Burden, Loss of Biodiversity

Interconnected Triple Planetary Crisis

"These issues are inseparable….
to solve one, all of them must be addressed."

chemsec.org 15 Nov 2022

https://chemsec.org/chemicals-are-part-of-the-triple-planetary-crisis-here-are-6-things-that-must-be-done/

Winona Laduke, White Earth Reservation, USA

What if raw materials for future building products looked like this (field) instead of this (fuel refining plant)?


New Castle, Pennsylvania

What if new jobs and working conditions to make building materials involved agriculture?

Isohemp, Fernelmont, Belgium

What if building materials were regenerative and circular instead of business as usual?

What if the renovation of affordable, healthy, energy efficient homes look like this?

And what if the waste from building materials was 100% biodegradable and recyclable instead of filling our land with waste?

Parsons Healthy Materials Lab

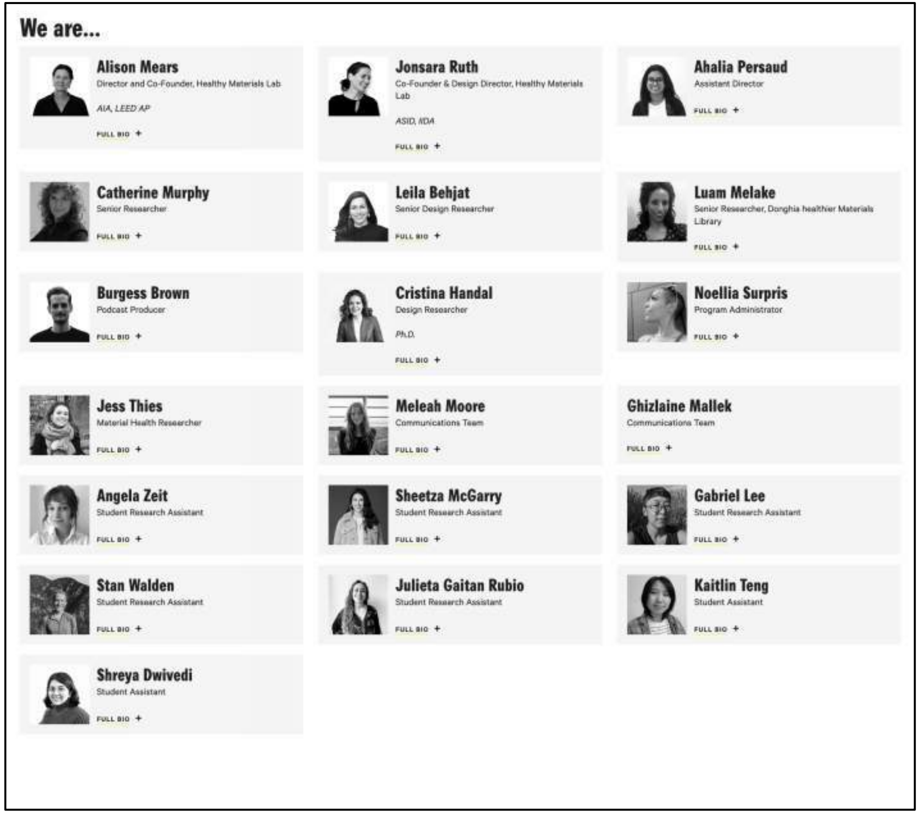
The path to healthier people and planet begins with healthy affordable homes.

Centering human health in design and construction will change the future for everyone.

Established May 2015
Parsons School of Design | The New School | New York City

THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB

PARSONS HEALTHY MATERIALS LAB TEAM



We are...

Alison Mears
Director and Co-Founder, Healthy Materials Lab
AIA, LEED AP
FULL BIO +

Jonsara Ruth
Co-Founder & Design Director, Healthy Materials Lab
ASID, IIDA
FULL BIO +

Ahalia Persaud
Assistant Director
FULL BIO +

Catherine Murphy
Senior Researcher
FULL BIO +

Leila Behjat
Senior Design Researcher
FULL BIO +

Luam Melake
Senior Researcher, Donghia healthier Materials Library
FULL BIO +

Burgess Brown
Podcast Producer
FULL BIO +

Cristina Handal
Design Researcher
Ph.D.
FULL BIO +

Noellia Surpris
Program Administrator
FULL BIO +

Jess Thies
Material Health Researcher
FULL BIO +

Meleah Moore
Communications Team
FULL BIO +

Ghizlaine Mallek
Communications Team
FULL BIO +

Angela Zeit
Student Research Assistant
FULL BIO +

Sheetza McGarry
Student Research Assistant
FULL BIO +

Gabriel Lee
Student Research Assistant
FULL BIO +

Stan Walden
Student Research Assistant
FULL BIO +

Julieta Gaitan Rubio
Student Research Assistant
FULL BIO +

Kaitlin Teng
Student Assistant
FULL BIO +

Shreya Dwivedi
Student Assistant
FULL BIO +

Healthy Materials Lab Advisory Committee

Ana Baptista
Chair of Environmental Policy and Sustainability Management Program, The New School
FULL BIO +

Kate Daly
Executive Director Center for the Circular Economy at Closed Loop Partners
FULL BIO +

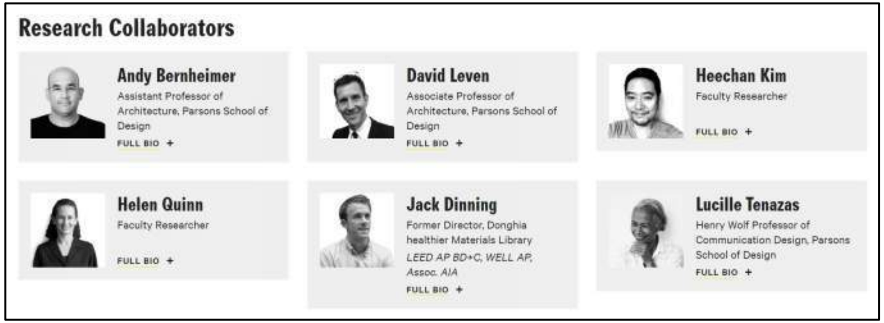
Joanna Frank
President and CEO, Center for Active Design
FULL BIO +

Dr. Maida Galvez
Associate Professor of Environmental Medicine, Public Health and Pediatrics- Icahn School of Medicine at Mount Sinai
FULL BIO +

Rolf Halden, Ph.D., P.E.
Center Director & Professor Biodesign Center for Environmental Health Engineering, Arizona State University
FULL BIO +

Seandra Pope
Founder & CEO, Rooted Consulting Group
FULL BIO +

Susan Szenasy
Director of Design, Innovation Metropolis Magazine
FULL BIO +



Research Collaborators

Andy Bernheimer
Assistant Professor of Architecture, Parsons School of Design
FULL BIO +

David Leven
Associate Professor of Architecture, Parsons School of Design
FULL BIO +

Heechan Kim
Faculty Researcher
FULL BIO +

Helen Quinn
Faculty Researcher
FULL BIO +

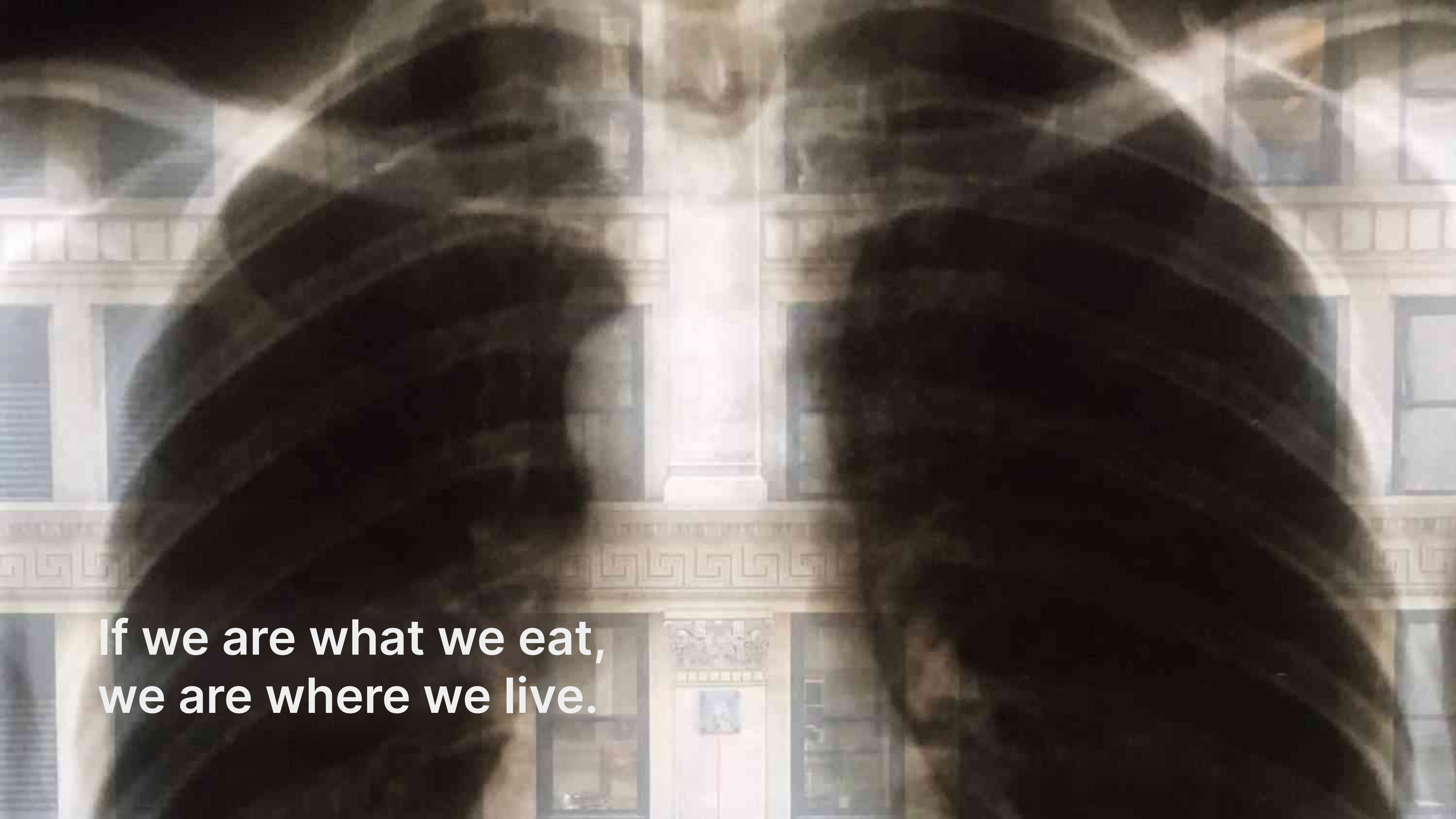
Jack Dinning
Former Director, Donghia healthier Materials Library
LEED AP BD+C, WELL AP, Assoc. AIA
FULL BIO +

Lucille Tenazas
Henry Wolf Professor of Communication Design, Parsons School of Design
FULL BIO +

THE NEW SCHOOL
PARSONS
HEALTHY
MATERIALS LAB

Building healthy affordable housing reduces toxics and embodied carbon + creates healthier lives for everyone.

1490 Southern Blvd, Bronx, NY. Bernheimer Architecture


If we are what we eat,
we are where we live.

US CHEMICAL REGULATIONS

86,000+
chemicals

→

only 250
tested

62,000 (99%)
chemicals were "grandfathered" in 1976

5 chemicals
(partially) restricted

- Asbestos
- PCBs
- Dioxin
- Chlorofluorocarbons
- Hexavalent chromium

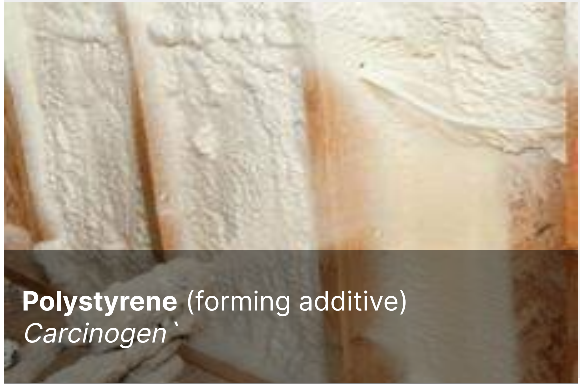
What’s in our walls?

THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB


A lot is invisible.
PARSONS
HEALTHY
MATERIALS LAB


A lot is invisible.
VOCs, APEs
Bisphenols
PFAS
Isocynates
Formaldehyde
Flame Retardants
PARSONS HEALTHY MATERIALS LAB

PROBLEMATIC CHEMICALS IN BUILDING MATERIALS



Polystyrene (forming additive)
Carcinogen

Formaldehyde (preservative), Expedites the gluing process - Curing agent
Asthmagen, Carcinogen

Arsenic (biocide), Wood Treatment - Pesticide
Reproductive Toxicant

Phthalates (plasticizer)
Endocrine Disruptor

Bisphenol A (BPA) (plasticizer)
Endocrine Disruptor

Polybrominated diphenyl ethers (PBDE) (flame retardants)
Endocrine Disruptor, Reproductive

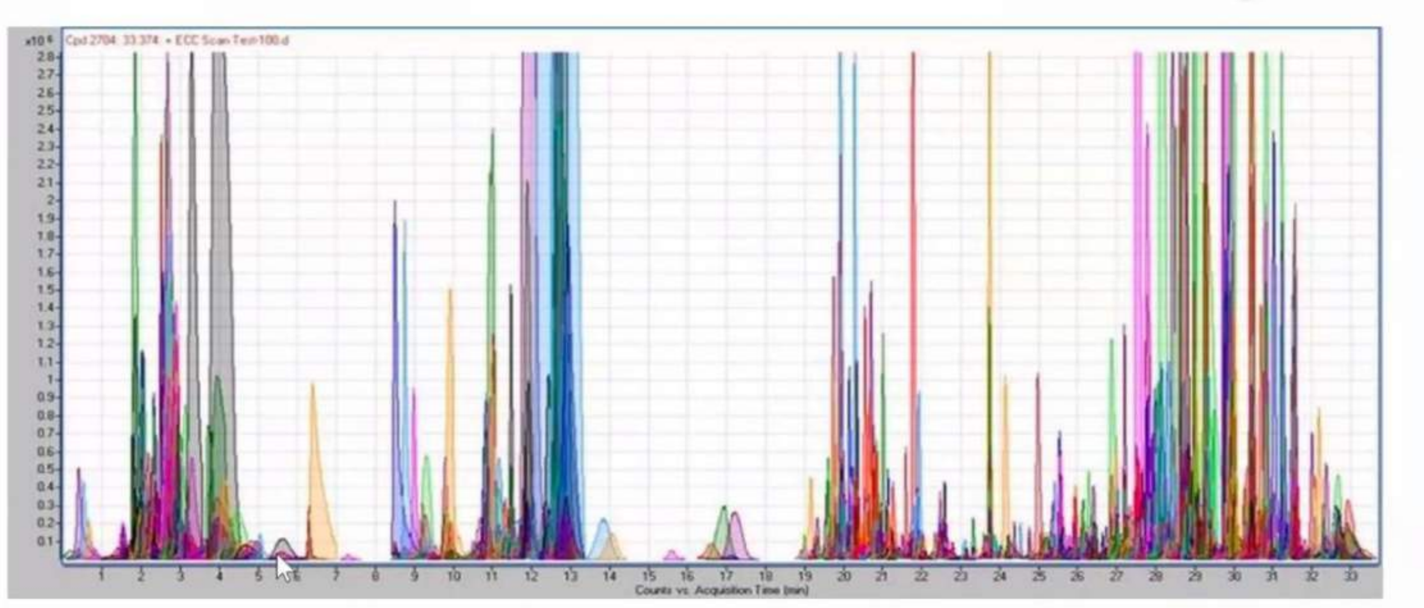
THE NEW SCHOOL PARSONS
HEALTHY MATERIALS LAB

PETROCHEMICAL BASED PLASTICS IN CONTEMPORARY CONSTRUCTION

Interiors:
Wall/ Window Coverings
Flooring
Shower Curtains
Furniture
etc.

THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB

MILLIONS OF INDUSTRIAL CHEMICALS IN OUR BODIES



A Chromatogram measures thousands (eventually millions) of chemicals in our body: nutrients, consumer products, air, water, etc.

Internal Exposome: Measure of Blood + Urine

Will Aid In Diagnostics:
- Early diagnosis or identify disease
- Predict speed of disease progression

Dr. Robert Wright Center for Exposomic Research Mount Sinai

THE NEW SCHOOL PARSONS
HEALTHY MATERIALS LAB

QUESTIONS TO ASK:

Material Health Thinking

What is it made of?

How is it made?

Where is it made?

Does it require finishes?

How will it be installed?

Who will be exposed in use?

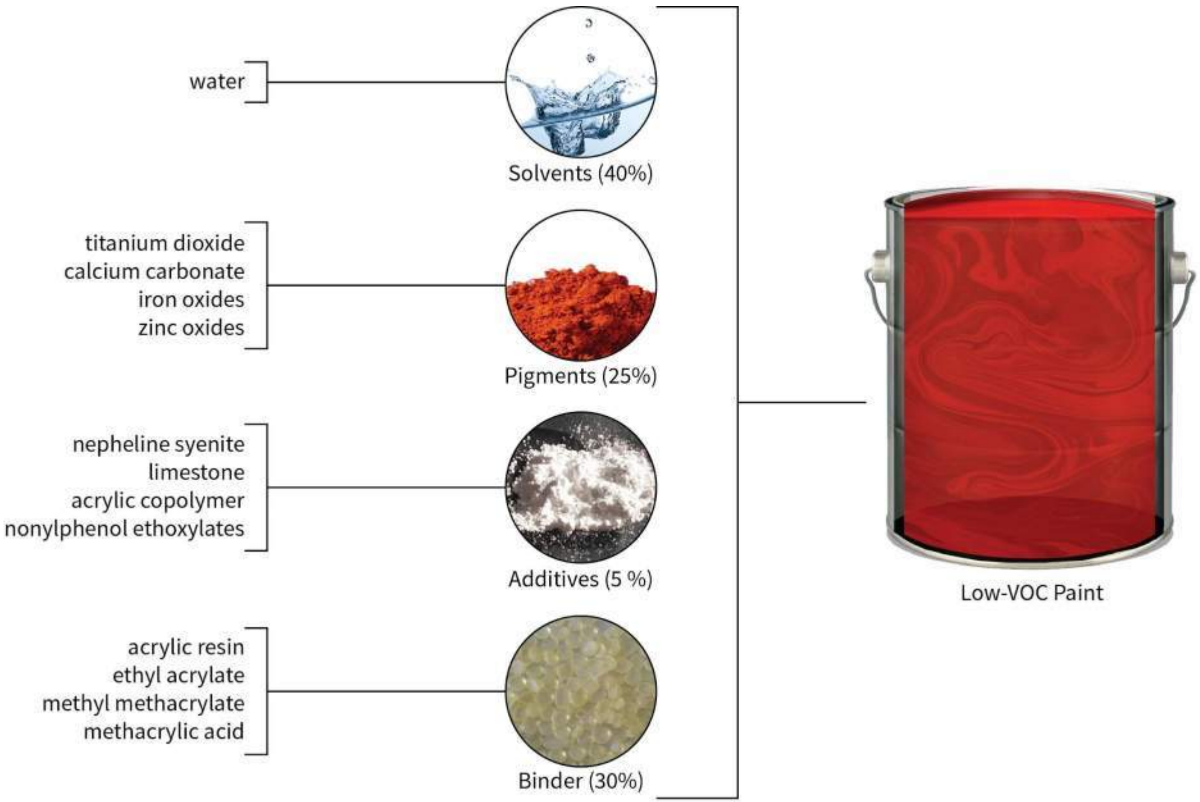
Where does it go at the end of its useful life?

Who is impacted throughout the lifecycle?

Paints Cover Most Interior Surfaces

Common Acrylic Latex Paint Begins as Fossil Fuels

What is in acrylic latex paint?



Mercedes Plessman, Parsons MFA ID '17

Plastic paints contain chemicals that are harmful to human health such as **VOCs, APEs + PFAS.**

THE NEW SCHOOL
PARSONS
HEALTHY
MATERIALS LAB

PLASTICS EMISSIONS WILL OUTPACE COAL BY 2030

https://www.beyondplastics.org/plastics-and-climate

THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB

PLASTIC PAINT

PLASTICS ARE NOW FOUND IN HUMAN BLOOD

https://www.sciencedirect.com/science/article/pii/S0160412022001258

THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB

Comparison: Modern Acrylic Paint vs. Historic Limewash

Low VOC Flat Acrylic Paint*

INGREDIENTS:

Water (solvent)
Limestone; Calcium Carbonate (extender)
Vinyl Acetate, Polymer w/ N-Butyl Acrylate (binder) *carcinogen*
Titanium Dioxide (pigment) *carcinogen*
Kaolin Clay (extender)
Propylene Glycol (freeze/thaw stabilizer) *endocrine disruptor*
1,3-Pentanediol, 2,2,4-Trimethyl-Monoisobutyrate (coalescent) *carcinogen*
Hydroxyethyl Cellulose (thickener) *endocrine disruptor*
Polyethylene Glycol Nonylphenyl Ether (surfactant) *persistent bioaccumulative toxicant (PBT)*
Polysiloxanes (defoamer)
Methylchloroisothiazolinone (preservative) *mammalian toxicant*
Polycarboxylic Acid, Sodium Salt (dispersant)
Polyurethane Based Associative Thickener (rheology modifier) *carcinogen*
2-(2-Butoxyethoxy)Ethanol (rheology modifier) *developmental toxicant*
Ammonium Hydroxide (pH buffer) *respiratory toxicant*

Italian Limewash, circa 600 AD*

INGREDIENTS:

Water (solvent)
Limestone; Calcium Carbonate (binder)
Polycarboxylic Acid, Sodium Salt (dispersant)
Iron Oxide (pigments, optional)

**Content based on Pharos Common Product Profile*

THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB

Healthy
Materials
Lab

Material Collections

Interior Paints 21 products

CATEGORY ▲	SUB-CATEGORY ▲
Paint / Biobased	Cellulose Resin
Paint / Biobased	Linseed Oil
Paint / Biobased	Soy
Paint / Mineral	Lime
Paint / Mineral	Lime
Paint / Mineral	Lime
Paint / Mineral	Lime Cassein
Paint / Mineral	Potassium Silicate
Paint / Mineral	Potassium Silicate

Paint / Mineral	Potassium Silicate	Romabio	BioGrip Primer	HPD	~~Declare~~	~~EPD~~	SDS
Paint / Mineral	Potassium Silicate	Romabio	Classico Limewash	~~HPD~~	~~Declare~~	~~EPD~~	SDS
Paint / Mineral	Potassium Silicate	Romabio	EcoDomus	HPD	~~Declare~~	~~EPD~~	SDS
Paint / Synthetic	Acrylic Latex	Benjamin Moore	Aura	~~HPD~~	~~Declare~~	~~EPD~~	SDS
Paint / Synthetic	Acrylic Latex	Benjamin Moore	EcoSpec Paint	~~HPD~~	~~Declare~~	~~EPD~~	SDS
Paint / Synthetic	Acrylic Latex	Benjamin Moore	EcoSpec Primer	~~HPD~~	~~Declare~~	~~EPD~~	SDS
Paint / Synthetic	Acrylic Latex	Benjamin Moore	Ultra Spec 500	~~HPD~~	~~Declare~~	~~EPD~~	SDS
Paint / Synthetic	Acrylic Latex	Imperial Paints LLC	Ecos Paint	HPD	Declare	~~EPD~~	SDS
Paint / Synthetic	Acrylic Latex	Sherwin Williams	ProMar® 200 Zero VOC	~~HPD~~	~~Declare~~	EPD	SDS
Surface Coating	Plaster	Clayworks	Clay Plasters	HPD	~~Declare~~	EPD	~~SDS~~
Surface Coating	Plaster	Earthaus Plaster	Lime Plaster	~~HPD~~	~~Declare~~	~~EPD~~	SDS

Lime Plaster

AVAILABLE AT THE DONGHIA MATERIALS LIBRARY

Limestrong's Artisan lime plasters are a healthier alternative to traditional wall finishes like paint. This plaster is made of lime, pumice, and a plant-based binder, all sourced from within the US. It is available in 3 finishes of varying levels of shine - Marble, Stone, and Sand. Limestrong uses natural pigments only and has created a palette of 98 colors using a combination of 8 naturally occurring minerals. These plasters are petrochemical and fragrance-free.

CATEGORY
Surface Coating, Plaster

MANUFACTURER
Earthaus Plaster

PRODUCT WEBSITE

MATERIAL COMPOSITION*
Calcium Hydroxide 50-75%, Amorphous Aluminum Silicate (Pumice) 25-50%, Crystalline silica, respirable powder 0.0001-1%

as reported by the manufacturer

COLORS
98 colors

CERTIFICATIONS & DISCLOSURES
- ~~Health Product Declaration (HPD)~~
- ~~Declare Label~~
- ~~Environmental Product Declaration (EPD)~~
- ✔ Safety Data Sheet (SDS)
- ~~Other~~

LAST UPDATED
November 04, 2021

Healthy Materials Lab

PDF Generated: Nov 12, 2023

Lime Plaster

Heritage's Natural Hydraulic lime plaster is a traditional recipe from hydraulic lime and silica sand only. It can be used for repairs of plaster and stucco for buildings originally constructed without Portland Cement. It is breathable, allowing for increased moisture ventilation. Hydraulic lime can cure even in damp/wet conditions and is most suitable as plaster on porous construction materials such as brick, or stone. The Lime Stucco/Plaster comes as a dry material, water is mixed in on-site.

CATEGORY
Surface Coating, Plaster

MANUFACTURER
US Heritage Group

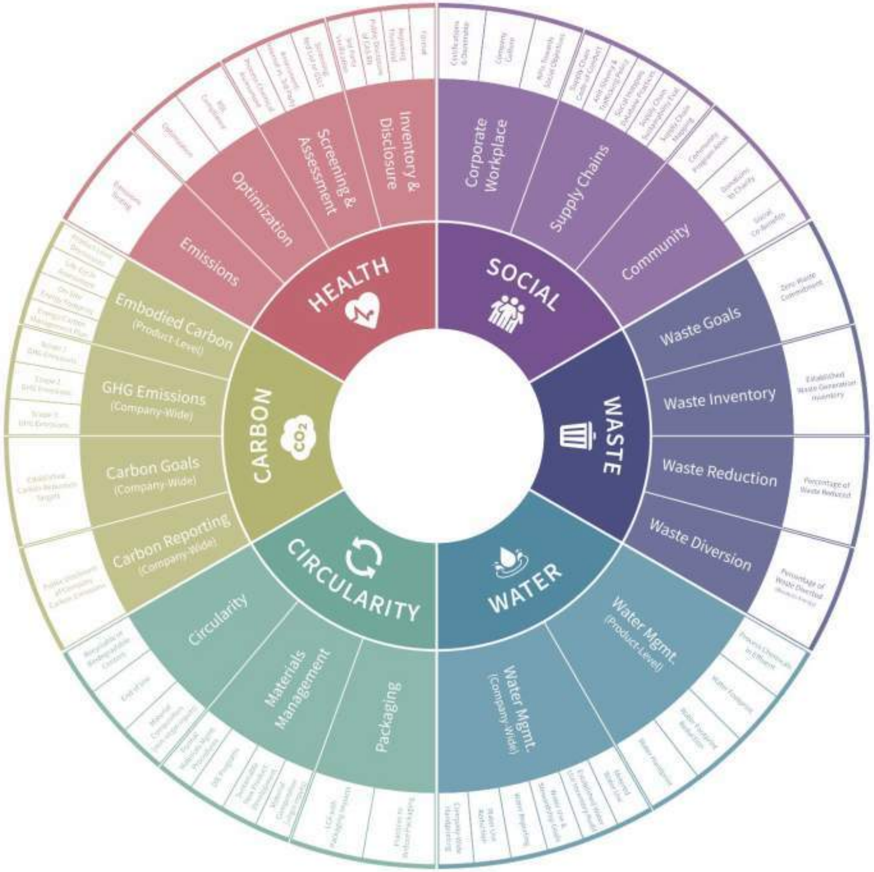
MATERIAL COMPOSITION*
50-75% silica sand, 25-50% Hydraulic lime
**as reported by the manufacturer*

CERTIFICATIONS & DISCLOSURES
- [ ] ~~Health Product Declaration (HPD)~~
- [ ] ~~Declare Label~~
- [ ] ~~Environmental Product Declaration (EPD)~~
- [x] Safety Data Sheet (SDS)
- [ ] ~~Other~~

LAST UPDATED
May 31, 2023

THE NEW SCHOOL PARSONS

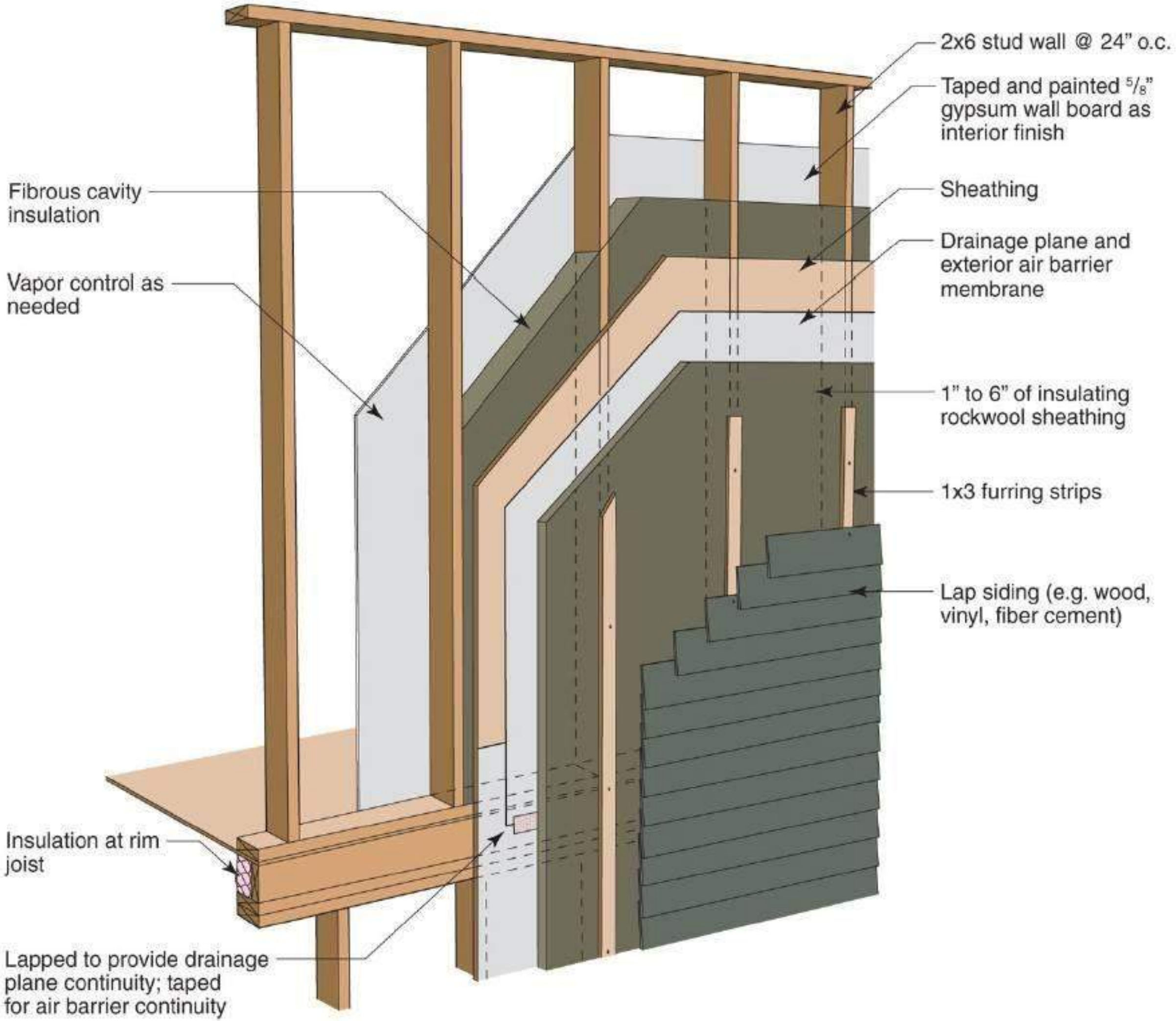
Material Health Lens



PARSONS DONGHIA healthier MATERIALS LIBRARY

BRIGHTWORKS SUSTAINABILITY

PARSONS HEALTHY MATERIALS LAB



THE NEW SCHOOL
PARSONS
HEALTHY
MATERIALS LAB

HempLime

HEMP+LIME

100% Recyclable + Biodegradable

Regulates Indoor Humidity + Climate

Carbon Sink-Net Carbon Sequestering

Energy Efficient Insulation

Naturally Fire Resistant

Mold and Pest Resistant

100 years certified

HempLime Insulation
PA Hemp Home
New Castle, PA

Hemp Fiber Test Acres Program

DON Services, New Castle, PA
2019 Harvest

THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB

PA HEMP HOME

HempLime Insulation
PA Hemp Home
New Castle, PA

Cameron McIntosh of Americhanvre filling small cavities by hand

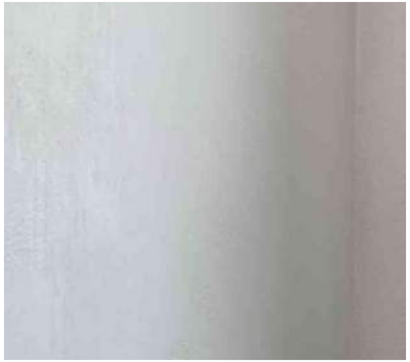
THE NEW SCHOOL
PARSONS
HEALTHY
MATERIALS LAB

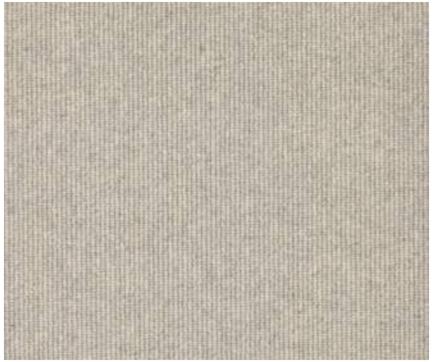
MATERIAL PALETTE

Formaldehyde Free Plywood
Columbia Forest Products

Engineered Wood Floors
HempWood

Unglazed Colorbody Porcelain Tile
Daltile





Lime Plaster with Lime Wash
Limeworks.us

Linseed Oil Paint
Ottosson - Earth + Flax

Wool Carpet
Aronson’s Floor Coverings

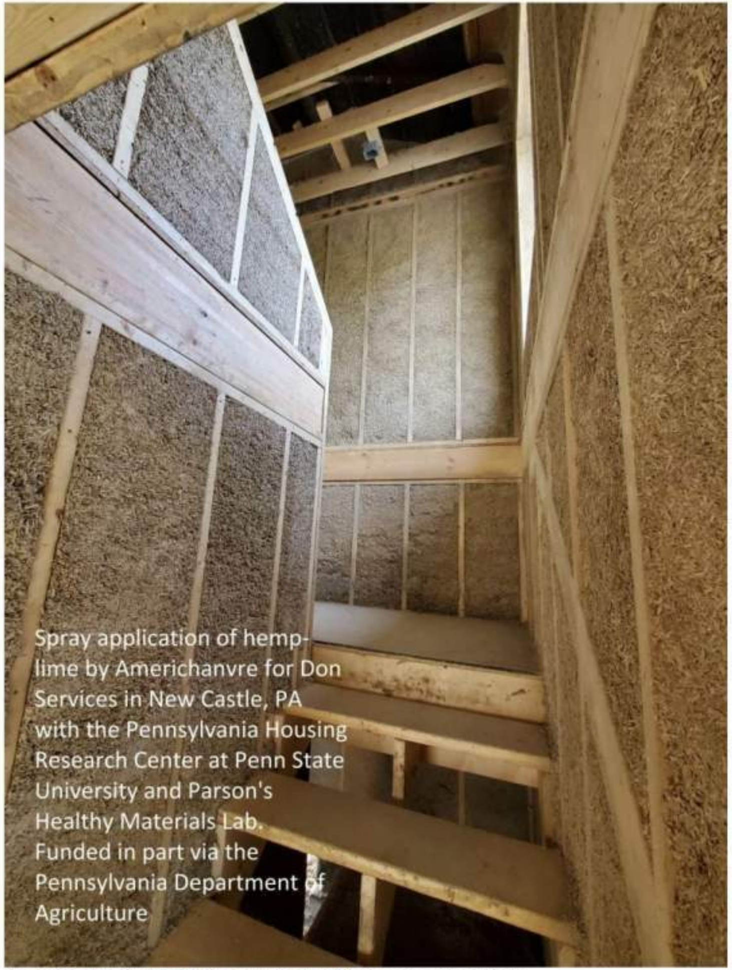
Solid Granite
Precision Countertops

TESTING HEMP + HEALTHIER MATERIALS’ IMPACT

Testing the Indoor Air Quality for VOCs, Formaldehyde, PFAS and other toxics

Sensors were installed to test the energy efficiency of the HempLime wall system

THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB


Spray application of hemp-lime by Americhanvre for Don Services in New Castle, PA with the Pennsylvania Housing Research Center at Penn State University and Parson's Healthy Materials Lab. Funded in part via the Pennsylvania Department of Agriculture

New Castle stairs photo courtesy of Cameron McIntosh

RATIONALE FOR SPECIFIC SECTIONS OF PROPOSED APPENDIX Y – HEMP-LIME (HEMPCRETE) CONSTRUCTION

SECTION AY101 - GENERAL: Hemp-lime is limited to use as a nonbearing, wall infill material. It primarily functions as insulation and a substrate for finish. Until further seismic testing is done, hemp-lime construction is restricted to use in Seismic Design Categories (SDCs) A, B, and C, except with an approved engineered design. Engineering analysis based on structural and materials tests and accepted engineering practice have determined hemp-lime's safe prescriptive use in SDCs A, B, and C, within the limits of the IRC's structural provisions and this appendix. Testing reports, structural analysis, and other supporting documents are available at: https://ushba.org/icc-supporting-documents/

SECTION AY102 - DEFINITIONS: Hemp-lime specific terms not found in the IRC are defined. Some definitions are consistent with identical or related terms defined in IRC appendices AR – Light Straw-Clay Construction, AS - Strawbale Construction, and AU - Cob Construction.

SECTION AY103 - HEMP-LIME CONSTRUCTION: Hemp-lime as a non-structural infill must comply with the Figures in Section AY103 or an approved alternative. The four Figures show different locations of the structural stud wall framing; interior, center, exterior, or double (interior and exterior). These Figures indicate the IRC sections that the foundation, wall framing, floor, and roof/ceiling assembly must comply with, unless otherwise stated in the appendix. They also identify code sections for other elements of a hemp-lime wall. Hemp-lime infill is limited to densities within a range of 12.5 to 25 pcf. This range encompasses the practical and commonly used hemp-lime densities.

SECTION AY104 - FINISHES: Hemp-lime infill requires vapor permeable finishes on the interior and exterior of the wall. The finish is necessary to create an air barrier and the high vapor permeability is required to allow vapor to move through the wall. As with many other building materials, hemp-lime infill must be sufficiently dry before finishes are applied. Hemp-lime is most commonly finished with plaster. Plaster is best applied directly to the hemp-lime infill.

SECTION AY105 - FIRE RESISTANCE: Hemp-lime is known for its fire-resistive properties through tests in Europe. When structural members are surrounded by hemp-lime infill, it can protect them from fire. However because ASTM E119 or UL263 tests have not yet been performed, a fire-resistance rating is not included in this proposal.

SECTION AY106 - THERMAL PERFORMANCE: Hemp-lime walls provide well-balanced thermal performance, with a combination of low thermal conductivity, thermal mass, and hygrothermal effects.

THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB

Introduction

1 Air and toxicity

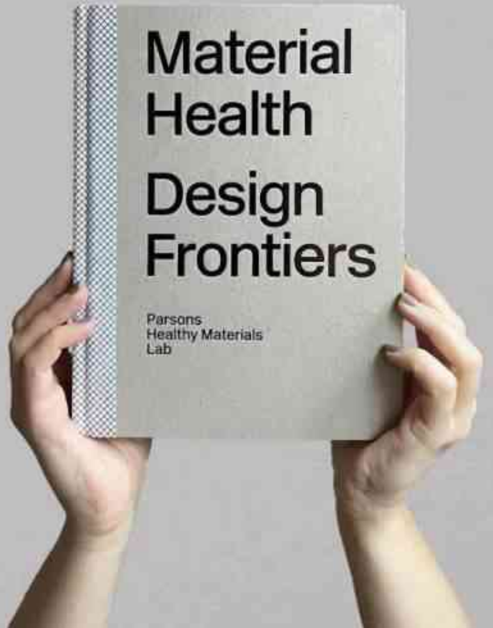
2 Carbon

3 Equity

4 Waste and circular economies

5 Ecosystems

6 Futuring Materials



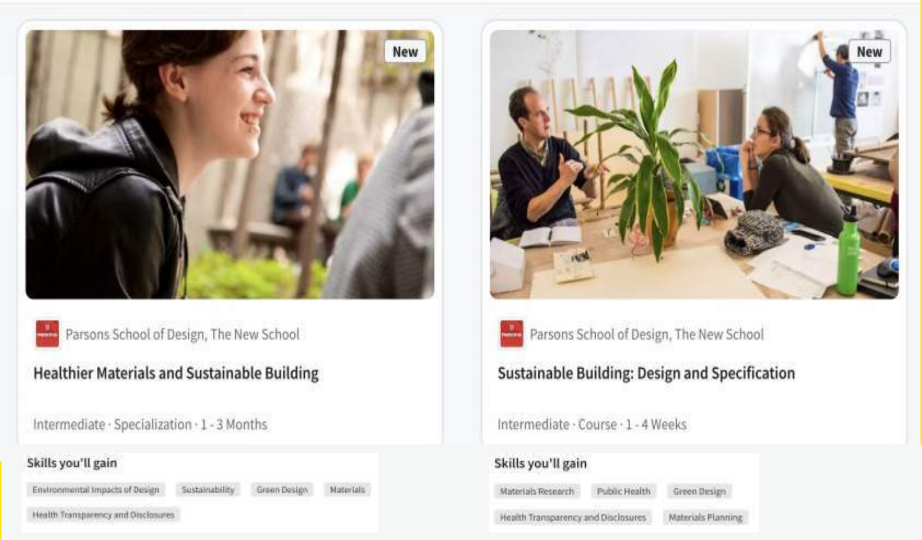
healthymaterialslab.org
@healthymaterialslab

Healthy Materials Lab centers human health in design, construction, and the production of materials to change the future for everyone.

THE NEW SCHOOL
PARSONS
HEALTHY
MATERIALS LAB

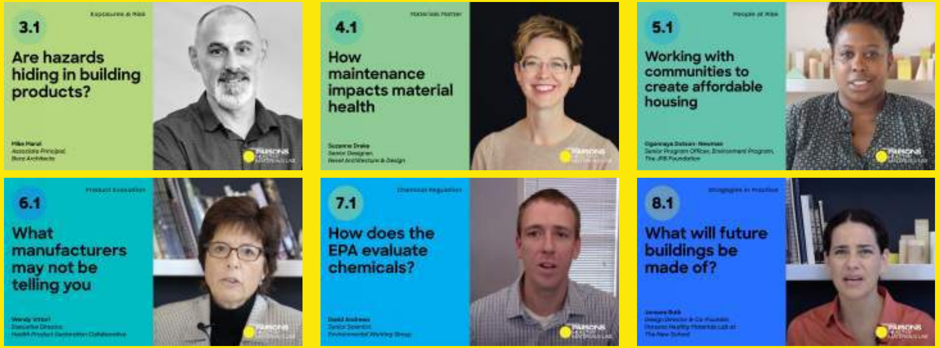
Online Material Health Education

coursera



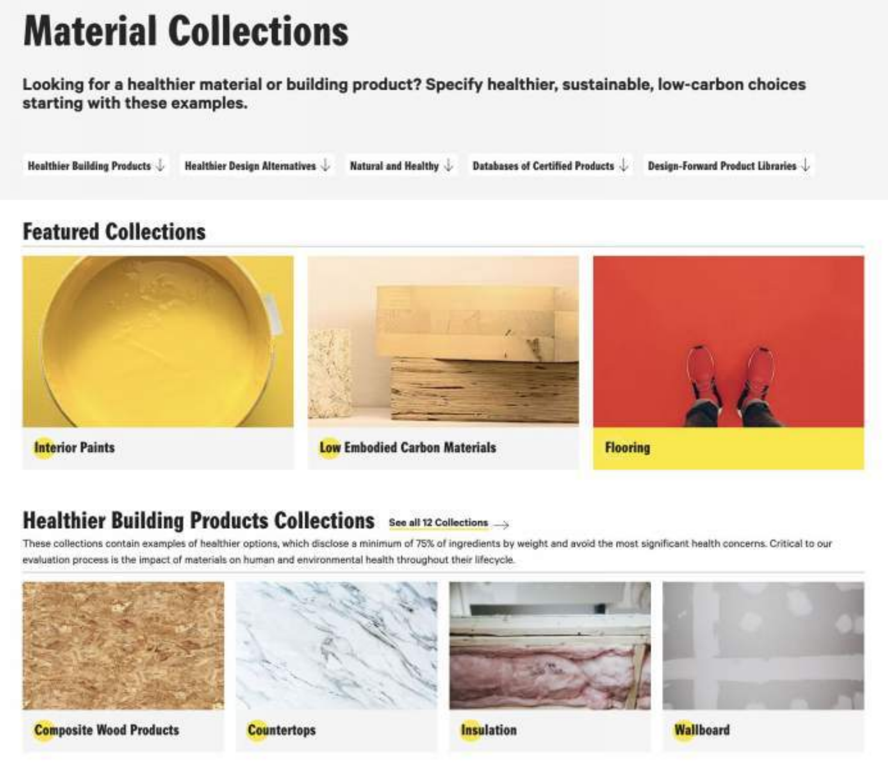
YouTube

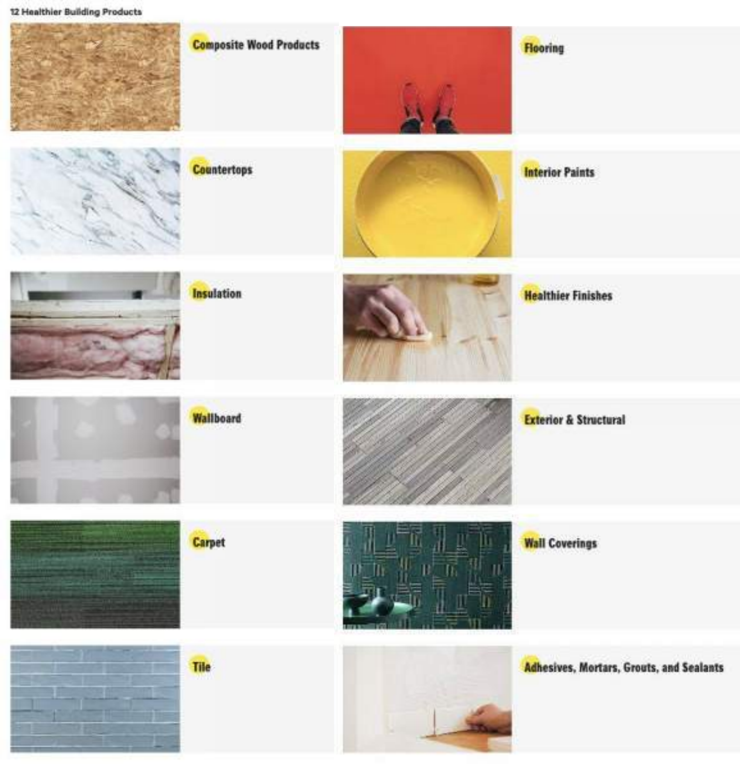
Free Material Health Courses



THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB

Healthier Material Collections





THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB


TRACE MATERIAL
A materials podcast
Season 1
Hemp
Season 2
Plastic
Season 3
Fungi

Consultation + Demonstration Projects

NYCHA = 170,000 Homes | Eliminate High VOC Paint

PA Hemp Home used as Supportive documentation for the proposed Hemp-lime Construction appendix for IRC

Determined By Design works with DCHA and others to create elevated healthy interirors and healhtier guidelines for all homes

Free Public Events

Fall for Material Health

NYTM | Archtober | mindful MATERIALS | IKEA | THE ARCHITECTURAL LEAGUE NY | THE NEW SCHOOL PARSONS HEALTHY MATERIALS LAB

healthymaterialslab.org

@healthymaterialslab

Supply, Production, Distribution: Biomaterials

One Story

Setting the table

Ace McArleton (he/him), Co-CEO New Frameworks

New Frameworks

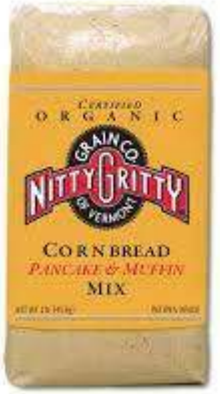
Low Impact. High Performance.

The Plant: Heirloom Organic Wheat

The Farm: Aurora Farms

David and Tom Kenyon, 6th & 7th Generation Settler Farmers in Charlotte, VT

The Food: Nitty Gritty Grains & Red Hen Baking



RED HEN BAKING CO
Since 1999
Vermont Artisan Bakers

The Panels Team: Farm to Building

JUSTICIA MIGRANTE

MIGRANT JUSTICE

The Design Process: Panelization

The Custom Buildings: Panel-only

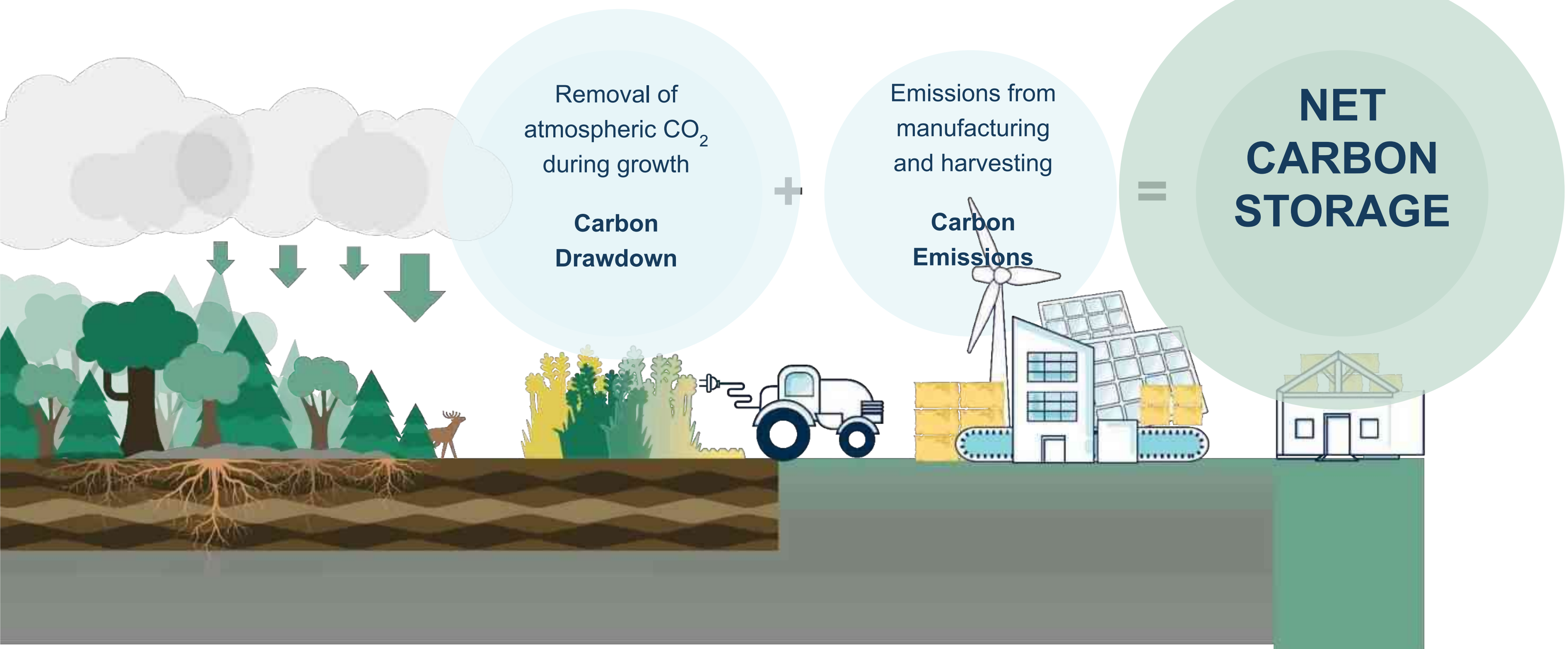
Image credit: Paul Lavold (photographer)
Love|Schack (architect)

The Kit Buildings: Casitas

The Kit Buildings: Casitas

The People: Joy, Justice, Innovation, Creativity, Together

Drawdown Systems Solution



Natural systems + human engagement = net carbon storage