ARCHITECT

architectmagazine.com
The Journal of The American Institute of Architects

Time to quit.

Architecture must quickly kick the CO_2 habit and get on the right side of climate change. Energy efficiency was just the first step. Next up is shifting to renewables and cutting emissions from building materials.


legrand®

COMMERCIAL SHADING SOLUTIONS

SEIZE THE DAYLIGHT

Daylight is the best kind of light — and daylighting control from Legrand lets you bask in the best of what each day brings. Introducing Commercial Shading, the perfect complement to Legrand's high performance dimming and customizable lighting controls. Don't chase the sun, let Legrand's Shading Solutions optimize your daylight blend — on into the sunset. **legrand.us/shades**

Contents
The Carbon Issue
Guest Edited by Architecture 2030

Volume 108, number 1. January 2020.

Volume 108, number 1. January 2020. ARCHITECT® (ISSN 1935-7001; USPS 009-880) is published monthly by Hanley Wood, 1152 15th Street NW, Suite 750, Washington, DC 20005. Periodicals postage paid at Washington, DC, and at additional mailing offices. POSTMASTER: Send address changes to ARCHITECT, P.O. Box 3494, Northbrook, IL 60065. Canada Post Registration #40612608/G.S.T. number R-120931738. Canadian return address: IMEX, P.O. Box 25542, London, ON N6C 6B2. For subscription inquiries, address changes, and single-copy sales ($10 in the U.S., $15 in Canada, $20 for other countries, payable in advance in U.S. dollars) write to ARCHITECT, P.O. Box 3494, Northbrook, IL 60065 or call 847.291.5221 or toll-free 888.269.8410. REPRINTS: Call or email Wright's Media: 877.652.5295 or hanleywood@wrightsmedia.com. DISCLOSURE: ARCHITECT® will occasionally write about companies in which its parent organization, Hanley Wood, has an investment interest. When it does, the magazine will fully disclose that relationship. PRIVACY OF MAILING LIST: Sometimes we share our subscriber mailing list with reputable companies we think you'll find interesting. However, if you do not wish to be included, please call us at 888.269.8410.

EVERYTHING YOU WANT TO SEE, NOTHING YOU DON'T

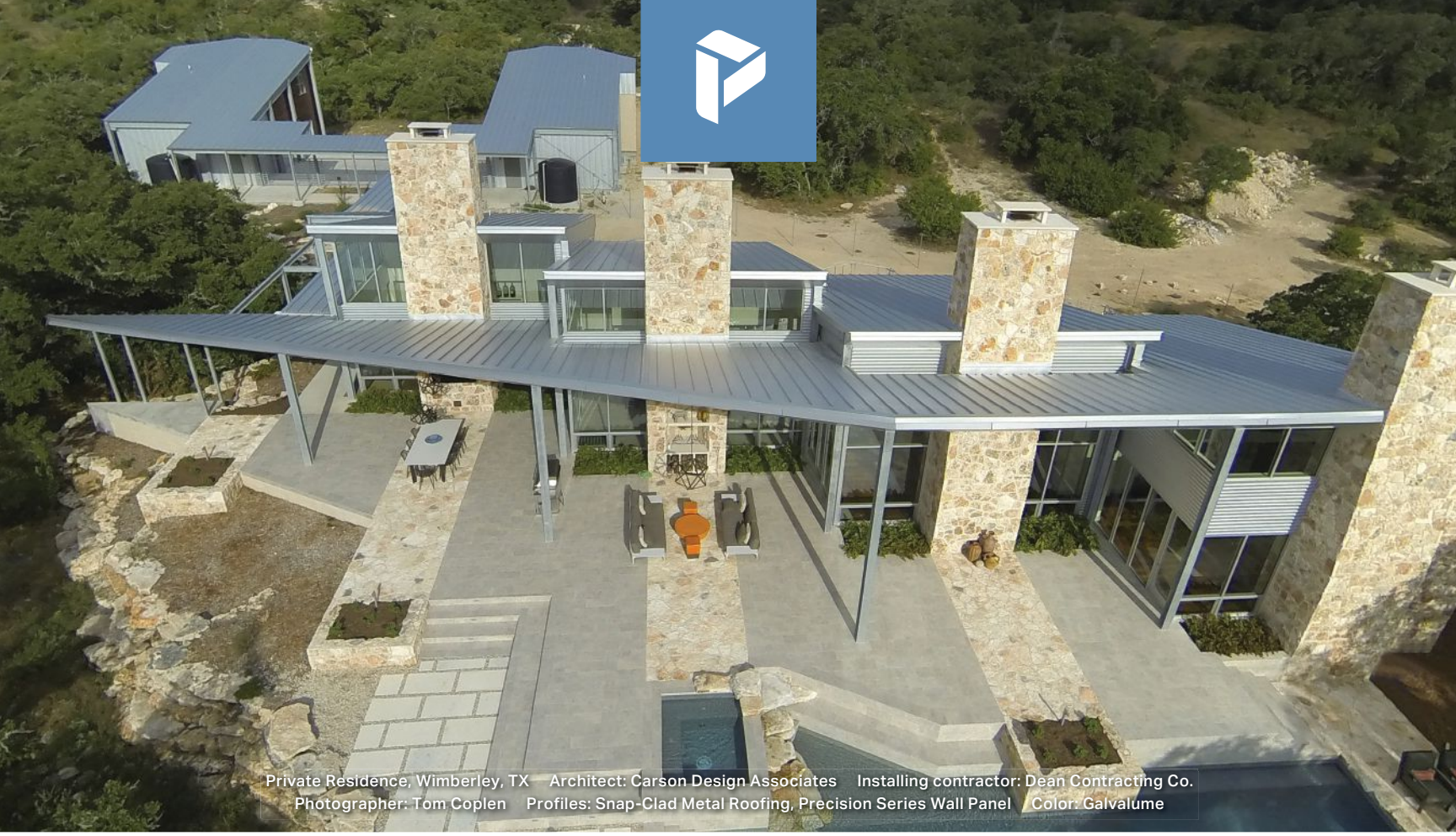
Now your hand dryer, soap dispenser and paper towel dispenser can be hidden.

ASI's exclusive Velare™ Behind the Mirror cabinet, Piatto™ washroom accessories and Alpaco™ partitions are the most revolutionary solutions in half a century. Everything you want to see, nothing you don't. It will change the way you design restrooms. See how at www.americanspecialties.com/vpa or call 914.476.9000.

ASI Group
Integrated Building Products

ARCHITECT

The Journal of The American Institute of Architects



Private Residence, Wimberley, TX Architect: Carson Design Associates Installing contractor: Dean Contracting Co.
Photographer: Tom Coplen Profiles: Snap-Clad Metal Roofing, Precision Series Wall Panel Color: Galvalume

Q. What roofing does an architect choose for his own home?

A. Metal roofing.

"We wanted our home to be as maintenance-free as possible. Metal is just a great option for residential construction."

-Jack Carson, President, Carson Design Associates

With a lifespan of more than 50 years, a PAC-CLAD metal roof can be the last roof you buy. More than 45 colors available, including Energy Star colors that can reduce heating and cooling costs.

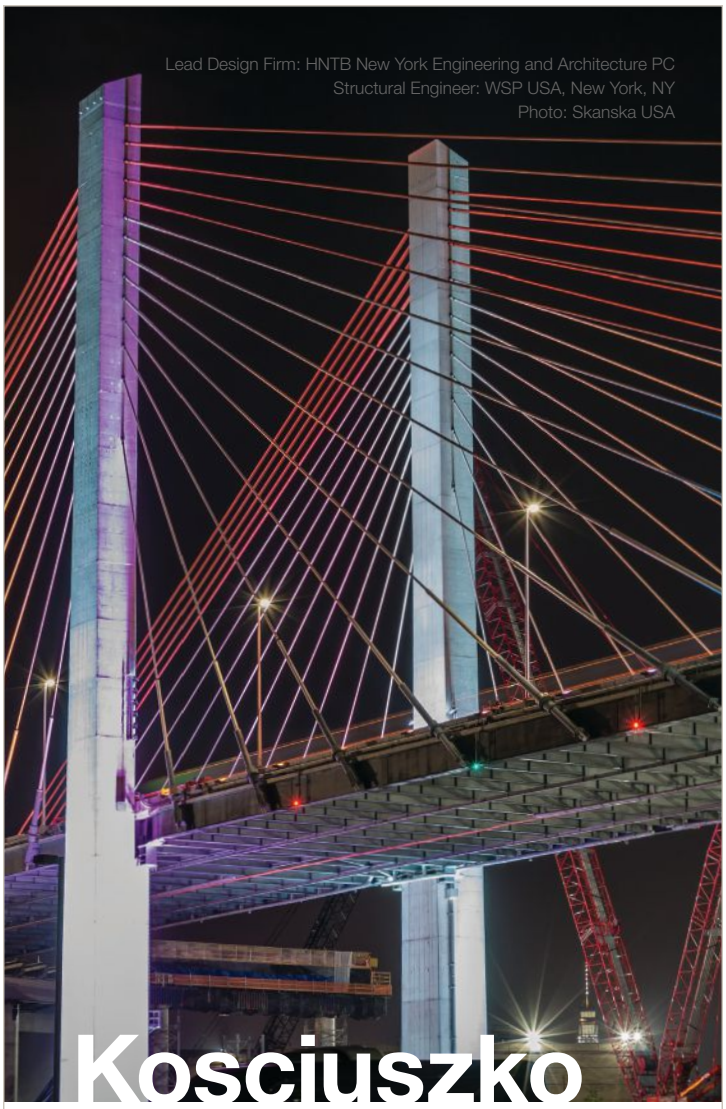
Case study at PAC-CLAD.COM/CARSON

PAC-CLAD.COM | INFO@PAC-CLAD.COM

IL: 800 PAC CLAD MD: 800 344 1400 TX: 800 441 8661
GA: 800 272 4482 MN: 877 571 2025 AZ: 833 750 1935

See us at the IBS – booth SU560

PAC-CLAD
PETERSEN
A CARLISLE COMPANY



Lead Design Firm: HNTB New York Engineering and Architecture PC
Structural Engineer: WSP USA, New York, NY
Photo: Skanska USA

Kosciuszko à Gogo

The design of urban infrastructure affects city life as much as the design of its buildings. That's why replacing the **Kosciuszko Bridge**—a notorious pinch point in traffic between Brooklyn and Queens—was a high priority for Governor Cuomo. With heavy lifting from **HNTB**, **WSP USA**, and **Skanska**, a striking cable-stayed span has risen where the outdated bridge once stood, ensuring New Yorkers may still have trouble saying its name, but they never have trouble getting home. Read more about it in **Metals in Construction** online.

Steel Institute of New York

WWW.SINY.ORG

ARCHITECT

The Journal of The American Institute of Architects

Hanley Wood Media
Chief Operating Officer
Andrew Reid

Senior Vice President, Digital and Residential Construction
Christie Bardo

Senior Director, SEO and Analytics
Jennifer Malkasian

Executive Vice President, Chief Content Officer
Jennifer Pearce

Vice Presidents, Editorial
Ned Cramer
John McManus

Vice President, Digital Strategy and Operations
Bridget Forbes

Executive Vice President, Executive Programs
Paul Tourbaf

Vice President, Audience Operations
Mari Skelnik

Design Director
Tina Tabibi

Hanley Wood
Chief Executive Officer
Jeff Meyers

Group Vice President, Talent Strategy
Kurt Nelson

Director of Sales, Emerging Accounts Group
Philip Hernandez

Chief Financial Officer
Melissa Billiter

Senior Managing Principal, Advisory Group
Tim Sullivan

Vice President, Finance
Ron Kraft

Chief Operating Officer
Andrew Reid

Executive Vice President, National Sales
Amy Dudley

The American Institute of Architects

2020 Board of Directors
L. Jane Frederick, FAIA, President
Peter J. Exley, FAIA, First Vice President
Jason C. Winters, AIA, Secretary
Evelyn M. Lee, AIA, Treasurer
Emily A. Grandstaff-Rice, FAIA, At-Large Director
Daniel S. Hart, FAIA, PE, At-Large Director
Timothy C. Hawk, FAIA, At-Large Director
Mark L. Levine, FAIA, At-Large Director
Britt Lindberg, AIA, LEED AP, At-Large Director
Jessica A. Sheridan, AIA, At-Large Director
Becky Magdaleno, 2020 CACE Director
Yiselle M. Santos Rivera, ASSOC. AIA, Associate Director
Sarah M. Curry, ASSOC. AIA, AIAS, Student Director
George B. Forsythe, PH.D., BG, US ARMY (RETIRED), Director
Vivian E. Loftness, FAIA, Director
Robert A. Ivy, FAIA, EVP/Chief Executive Officer

The AIA Architect section of this magazine is produced by the Institute as a benefit to its members in partnership with ARCHITECT's editorial and production teams. Please direct any questions or comments to Frank Scanlan, MD, Strategic Communications & Content for AIA.

MODERNFOLD®

INTRODUCING

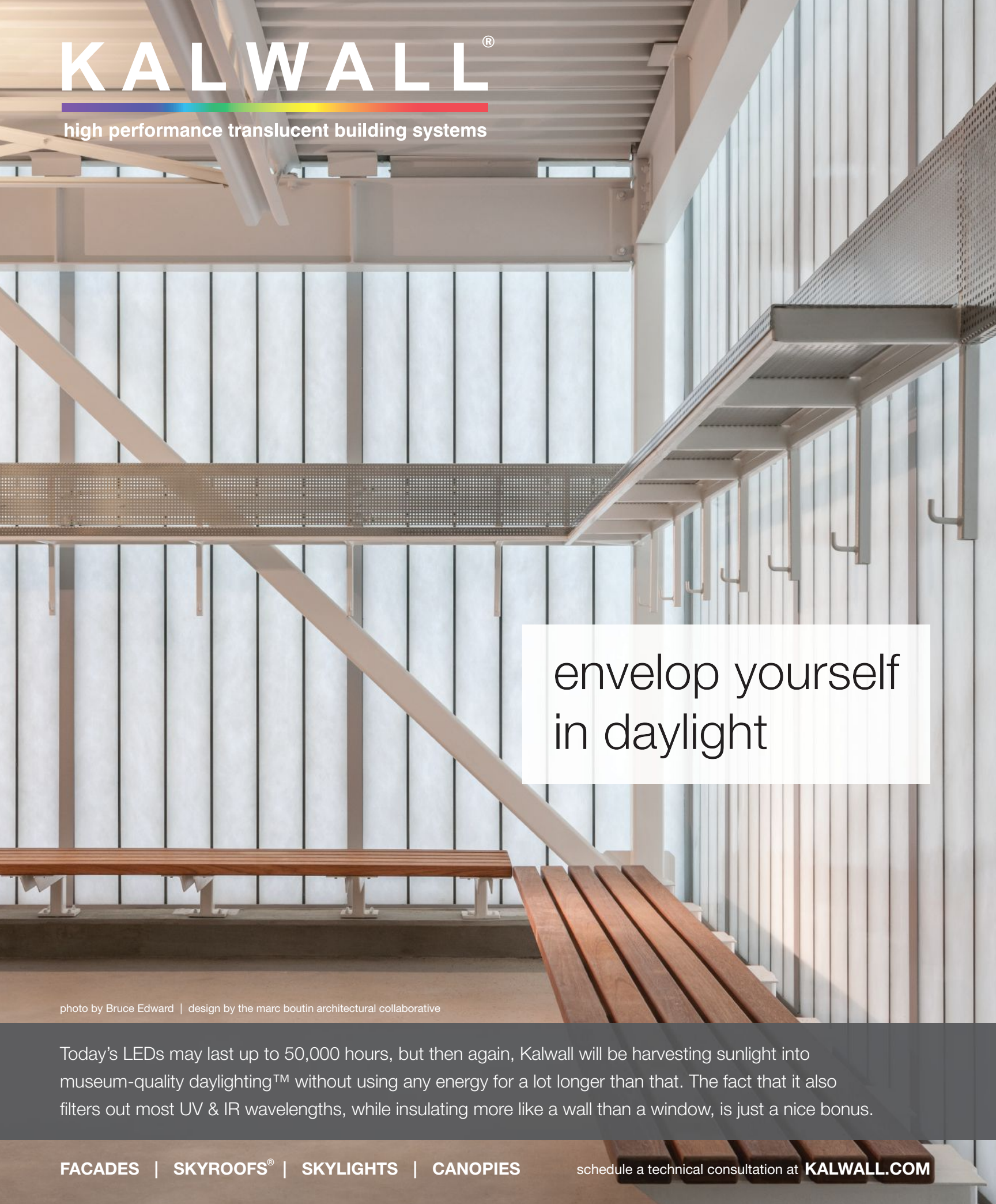
PUREVIEW®

MOVABLE GLASS WALL SYSTEM

Modernfold's new PureView® movable glass wall system provides the winning combination of high-quality glass partitions paired with easy and convenient operability for your ever-changing space division needs.

- Convertible panel for variable egress
- Concealed door closer in top rail
- Foot-operated floor bolts for security and convenience
- Custom RAL Powder Coating Options

Contact your local Modernfold, Inc. Distributor today to learn more about PureView® and the numerous other Modernfold space division products available by calling **800-869-9685** or visiting **www.modernfold.com**



KALWALL®

high performance translucent building systems

envelop yourself in daylight

photo by Bruce Edward | design by the marc boutin architectural collaborative

Today's LEDs may last up to 50,000 hours, but then again, Kalwall will be harvesting sunlight into museum-quality daylighting™ without using any energy for a lot longer than that. The fact that it also filters out most UV & IR wavelengths, while insulating more like a wall than a window, is just a nice bonus.

FACADES | SKYROOFS® | SKYLIGHTS | CANOPIES

schedule a technical consultation at **KALWALL.COM**

AIA Architect

AIAVoices

CREDIT: ASHER + OAK PHOTOGRAPHY

How to Survive a Downturn

During tough economic times, remember your value as a problem solver.

Carole Wedge, FAIA, is the winner of AIA's 2020 Edward C. Kemper Award, which honors significant service to the organization. She has been at Shepley Bullfinch since 1986, and has served as the firm's president since 2004. She's seen it all economically: booms and busts, downturns and expansive growth. Through it all, she's acquired a deep understanding of what a firm and its employees can do to thrive during the good times and survive through the bad ones. "When times get tough, remember that you're really valuable as a problem solver," she says, "and always stay in conversation with your clients about their needs."

As told to Steve Cimino

Everyone wishes their firm had a rainy day fund. For an architect, that fund would be part of their savings account. At any point, a client could call and put a project on hold. Then it gets tricky, because it becomes emotional and it involves people's livelihoods. In a downturn, some firms want to keep everyone employed and ride it out. But then a lot of times you see those firms—who didn't trim staff or make major course corrections—run out of capital before business picks back up.

Sometimes a crisis can let you change something that you wouldn't change before. It can prompt strategic conversations about how you're doing business, what you can do to be more efficient, and how to use technology in a more robust way. During the Great Recession, we focused on creating service offerings for our clients that were much more about operation and utilization. Even developers pivot; they might not invest in properties, but they're going to buy real estate. We can help them evaluate those purchases, even if they're not going to build for five years.

It's mostly about being savvy about the world around you and finding new opportunities. When we rode out 2009, we reduced staff and got brutally honest with everyone who was left. We asked them to help us find smaller projects and services that would get us over the hump. And people found lots of business that got us through a rocky financial time.

The best employees have a great attitude and will do whatever needs to be done. I love someone who asks, "What can I do to help?" It provides a sense that we're all in this together. Cutting vertically can also be an option to consider. Someone might say, "I'd love to take six months off, or I was thinking about retiring anyway."

There have been times where we've asked someone to learn new software or pick up a new task and they've said, "I'm not interested in that." Well, that's a shame because it has to get done. As much as everyone wants to set their own career path, pitching in and helping goes a long way. From leadership to administrative staff, we all need to be open and willing to entertain all sorts of ideas. AIA

A'20

Get ready for the architecture & design event of the year!

Registration opens January 22.

AIA Conference on Architecture 2020
May 14–16, Los Angeles

conferenceonarchitecture.com

AIANow

TIMBER! Building Tall With Wood

Using wood in a novel way may decrease embodied carbon in new buildings.

By Ben Schulman

When that apocryphal cow kicked over a lantern and burned Chicago down in 1871, it made manifest the dangers of a wooden city and allowed steel-frame construction to emerge as the predominant high-rise material. The thought of building tall with wood has been seen as outside the scope of architects since skyscrapers became a common typology, and IBC code compliance has ensured load-bearing structures made of wood are height-regulated.

But with environmental awareness rising, and environmental stressors being placed upon the industrial production process, many in the AEC industry see mass timber as a promising material to decrease embodied carbon in new construction buildings.

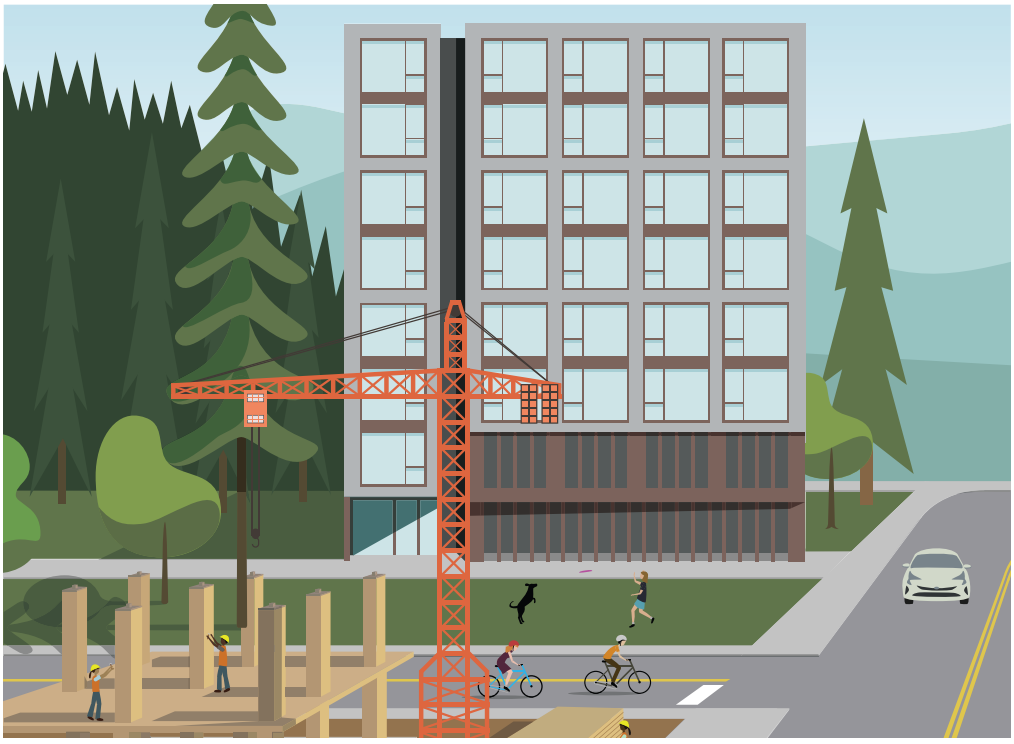
In recent years, wood has been elevated to a new status as a sustainable, economical, and, yes, noncombustible material in which to build up. Progressive designers—and market pressures—are pushing for code reforms (IBC is slated to change its height standards for mass timber construction in 2021) and are now employing mass timber to build up to new heights.

Carbon12, in Portland

Carbon12 is an eight-story, 14-unit condo building in Portland, Ore., designed and developed by Path Architecture and Kaiser Group. Its 85-foot presence hovers over the street corner in a sleek yet understatedly modern manner, signaling its luxury status like many projects designed for similar demographics in urban cores across America.

Yet dig deeper under the façade and Carbon12 is one of the more significant contemporary residential buildings to be constructed in the United States. It is essentially a high-rise treehouse, with a building frame made from cross-laminated timber (CLT). CLT is a tightly wound wood product made from gluing small beams of wood together at high pressures, producing boards that provide the same structural sturdiness as steel but at a fraction—nearly 20%—of the weight.

"It is the only renewable structural material that we have to work with at this scale, and it sequesters carbon along the way," says Kristin Slavin, AIA, architect with Path Architecture.



Carbon12, in Portland, designed and developed by Path Architecture and Kaiser Group, is built like a high-rise treehouse.

Slavin sees the project and the adoption of mass timber as an inflection point for consumers, the firm (which is engaged on additional mass timber projects already), and the building industry at large.

"We are at a point in the world where most people recognize the need for immediate climate action in all aspects of life, and this is one way that architects and developers can make a positive impact on our carbon emissions," she says.

Mjösa Tower, in Brumunddal

The Mjösa Tower (or Mjøstårnet) rises out of the lush valley of Brumunddal, a small, densely populated municipality that hugs Norway's largest lake. Mjösa Tower—a hotel, housing, and office development—opened in March 2019, and assumed the mantle of the "world's tallest wooden building."

Its 18 stories extend 278 feet into the sky, a looming beacon to sustainability that ups the ante on the heights that wooden buildings can attain. One reason for that increased stature is how architects Voll Arkitekter made use of glue-laminated timber, or glulam, to add volume to the building mass.

As opposed to CLT fabrication, in which the wooden boards are glued together with grains alternating at 90-degree angles, the glulam process layers laminates along the grain, producing longer lengths.

Mjösa Tower is situated in an area with a heavy forestry industry, and the building materials were all sourced from local Norwegian and Finnish vendors.

River Beech Tower, in Chicago

Perkins and Will's Todd Snapp, AIA, likes to view perceived difficulties as "challenges" to be figured out. That mindset led to the designs for River Beech Tower, a proposed 80-story building in Chicago that would far surpass the height of any existing mass timber building.

"We believe that reducing environmental impact is critical, thus it was important that we research and test feasible ways to use renewable materials," Snapp says. "Ultimately we sought to prove that a structurally sound tower could be both made of wood and safe enough for residential use."

River Beech Tower is, for now, still an academic exercise. Perkins and Will intends to "build a full-size modular residential unit using the nodes we've constructed and tested," Snapp says.

Conceived in collaboration with engineering firm Thornton Thomasetti and researchers at the University of Cambridge, the idea behind River Beech Tower is to create a building so impressive in its mass, its sustainability, and, ultimately, its performance, that it solidifies the case for mass timber construction to become the standard. AIA

Visit thinkwood.com for more information.

CREDIT: RACHEL KAPISAK JONES

AIAFeature

Planning for the Next Recession

For architecture firms, potential downturns are business challenges to be managed, not anxieties to be suppressed.

By Kermit Baker, HON. AIA

With a potential economic downturn on the minds of many firm leaders, it's a judicious time to stay focused on business conditions. And while it may not be possible to fully recession-proof your firm, an achievable goal is to develop a strategy for minimizing the negative effects of a slowdown. The U.S. economy frequently goes through recessions, and the way that architecture firms have dealt with previous downturns can provide useful lessons for coping with future economic adversity.

Many architecture firms are seeing healthy business conditions at present. Others are at least enjoying the continuation of an extended period of prosperity for the design professions and construction industry. Our economy is currently in the midst of a more than decade-long economic expansion, the longest ever recorded for the United States. With this longevity, however, comes increased anxiety. Some might wonder, aren't economic recessions inevitable? Are we on borrowed time in terms of the next downturn? While business cycles often come around and end in downturns, economic recessions are not inevitable. For example, it has been widely reported that Australia last had a recession in 1991, even though they have had a number of slowdowns in their economy over the ensuing almost three decades.

Economists like to say that economic expansions don't die of old age. Instead, recessions occur when there are fundamental imbalances in the economy: a housing price bubble prior to the 2008 recession; a technology investment (dot-com) bubble prior to the 2001 downturn; and an oil price surge that generated unsustainable energy costs and inflation throughout the economy from the mid-1970s through the early 1980s, and again in the early 1990s. These economic imbalances often are magnified by external "shocks" to the economy, such as the Iraqi invasion of Kuwait prior to the 1990 recession, or the 9/11 attacks on the U.S. prior to the 2001 recession.

Where are we now, economically speaking?

There are clear signs that the U.S. economy has been slowing in recent quarters. GDP probably grew a bit over 2% last year, compared to almost 3% in 2018. The growth in payroll employment nationally was about 1.6 million last year; a healthy figure, but below the 2.2 million in 2018. Yet, in spite of more than a decade of continuous growth, inflation remains surprisingly subdued and interest rates extremely low, conditions that would suggest a favorable economic outlook.

Still, there are signs of mounting headwinds. Businesses are increasingly concerned regarding the large amount of debt that they have built up in this low interest rate environment, and the impact that uncertain tariff and trade policies might have on the level of exports and the cost of imports. Consumers have benefited from the low-inflation environment and labor shortages that have helped to lift wages, but even they are beginning to grow nervous about future economic conditions. The Federal Reserve Board didn't raise interest rates much during the last expansion, so it has limited ability to lower them if needed this time around. And since the federal government ran a budget deficit of almost $1 trillion last fiscal year, and is projected to run similar deficits for the foreseeable future, there is limited interest in increasing the deficit even more for fiscal stimulus programs should the economy weaken more than expected. Some see these emerging economic headwinds pushing the economy into a recession. In fact, a recent survey of forecasters by the National Association of Business Economics put the probability of entering a recession by the end of the year at just under 50%, and by midyear 2021 at almost 70%.

However, the design and construction sector of the economy should fare relatively well regardless of whether the emerging slowdown in the economy results in a recession or the proverbial "soft landing" that economic policy makers strive for. Even with the relatively weak recovery coming out of the last recession, the economy has been able to absorb the new building activity that has resulted. New construction has been added to our stock of buildings at a rate of 1.3 billion

CREDIT: ANA GALVAN

AIA Feature

CONTINUED

square feet on average each year since 1980, according to Dodge Data and Analytics, but there hasn't been that level of construction activity in any year over the past decade. As a result, there isn't the typical oversupply of buildings that traditionally has exacerbated a construction downturn. Vacancy rates for office buildings and availability rates for rental space are below their average levels of the past 20 years, and occupancy rates at hotels are above their average of the past two decades. This suggests that the real estate sector, and therefore the construction industry, is better prepared to cope with an economic downturn should one emerge.

Monitoring Business Conditions

There are good reasons to believe that even if a recession were to emerge over the next 18 months, it will be relatively mild by historical standards, and that construction is not likely to be one of the sectors of our economy that will bear the brunt of a downturn. Still, there is every reason for architecture firm leaders to remain vigilant. On average, architecture firms currently have over six months of project backlogs, meaning that even if no new project work came in, the current staff would be fully covered for more than six months. This level is about as high as backlogs have been over the past decade, and theoretically should give firm leaders plenty of time to adjust in the event of a slowdown.

However, as many firms learned during the Great Recession, project backlogs can be an elusive indicator. A project that a firm has included in its estimate of backlogs could be significantly delayed or put on hold with little or no notice from the client. Other projects may be significantly redesigned or scaled back, while others may be canceled if development assumptions or business conditions were to change. A survey of architecture firms conducted this past October found that over half of them had at least one project that fell into one of these categories that year, with an average of more than 15% of their project revenue being impacted by these at-risk projects. Project backlogs can therefore evaporate very quickly.

When economic conditions become more volatile, it's useful to monitor measures of business conditions closely to try to anticipate unwelcome surprises. Indicators monitored should include several categories of potential disrupters:

- Indicators of national economic conditions, such as GDP, interest rates, stock market trends, employment trends and the unemployment rate, and consumer confidence scores will help gauge the general arc of the economy.
- Design and construction market indicators, such as AIA's Architecture Billings Index, construction spending levels, construction contract awards, the AIA Consensus Construction Forecast, backlogs at construction companies, vacancy rates and rents for key building types, building materials costs, and labor rates help monitor the general direction of the construction industry, as well as the health of different sectors.
- Conditions in market areas served by a firm, such as the health of industries in its service area, the performance of current or perspective clients, the outlook of contractors in markets served, and business conditions of other design firms in its area. These measures help to provide a broader perspective of the business ecosystem. For example, if the residential market is weakening in its area, that generally suggests that the commercial/industrial (and eventually the institutional sectors) will follow suit.
- Detailed indicators of business conditions of a firm may include staff chargeability rates; overhead rates; quality of new project leads; the potential for current projects to become stalled, significantly redesigned, or canceled; and the probability of project win rates, cash reserves and credit lines, and cash flow situation. While broader billings and backlog trends give a general sense of financial health at a firm, getting a feel for potential problems over the coming months and quarters helps to provide "an early warning of bigger issues on the horizon."

> New construction has been added to our stock of buildings at a rate of 1.3 billion square feet on average each year since 1980.

Developing a Plan

While there are numerous variations, there effectively are only two strategies for dealing with a business downturn: increasing revenue or reducing costs. Most effective business plans consist of a combination of the two. However, often the key to success is having sufficient business intelligence to pursue a strategy as soon as problems begin to emerge.

Revenue strategies can involve traditional diversification efforts to serve new construction sectors (e.g. diversifying into designing distribution centers) or new geographical areas. But it typically is extremely difficult for a firm to develop expertise in a new specialty on short notice. A more realistic approach is to expand firm offerings, particularly to existing clients. Longer-range facilities planning, sustainability and resiliency initiatives, and energy management strategies may be attractive services to clients, even if they have no current need for additional space. Also, developing strategic partnerships to supplement existing firm specialties may be beneficial for opening up new project opportunities when conditions become more competitive.

Managing expenditures is often viewed as an option of last resort, and therefore generally not planned in advance. However, having a series of possibilities in place to deal with a range of scenarios can save a lot of time and agony if cutting expenses is deemed necessary. Generally, it is useful to have a series of cost-cutting options planned out—for example, specific strategies to reduce firm expenditures by 10%, 15%, or 25%. Often, cost-cutting strategies are put off too long, with plans hastily hatched after more opportune choices are no longer viable.

Business cycles are a fact of life for architecture firms. On one hand, it is fortunate that it has been almost a decade since most architecture firms have seen a downturn of any magnitude, since these are typically extremely painful events. On the other hand, since it has been such a long time since firm managers have had to implement downturn policies, the "muscle memory" for dealing with them may be a bit hazy. Also, a large share of employees began their career after the last recession. Having never experienced a downturn in their professional life, they may be resistant to the sacrifices that are asked of them. That makes it all the more important that firm leaders monitor the situation closely, have the required information at their fingertips, and put strategies in place that can be implemented decisively should the need arise. AIA

Compensation for architecture positions nears record growth.

The AIA Compensation Report 2019 reveals the highest salary increase in over a decade. Firms are investing in better benefits, bonuses, and firm culture to attract and retain top talent.

See how your compensation compares!
aia.org/compensation

The American Institute of Architects

AIAFuture

Using Data to Create Tech Tools

Design firms are investing in customized computational applications that can benefit clients, themselves, and the field in general.

By Amanda Abrams

CREDIT: PAYETTE

Payette's Glazing and Winter Comfort Tool offers open source data on how window glazing design can affect temperature and heat.

Around a decade ago, KieranTimberlake principal Rod Bates worked on a project focusing on sustainability. But gathering accurate, granular numbers about the energy use of the building he was designing was highly labor-intensive. At the time, life cycle assessments were usually done only after a structure was complete, and there were no computational tools available to make the process easier.

"Calculating was really laborious: I actually had to weigh [materials]," says Bates, who is now in charge of software-commercialization at KieranTimberlake. "The data was all over the place. We said, 'This can't work.'"

That was the seed of development for Tally, a computer application that conducts a complete life cycle assessment on a building—not only its operation, but also its materials and manufacture—during the design and planning process. Created, produced, and sold by KieranTimberlake affiliate company KT Innovations, Tally is a prime example of the customized technology that architecture and design firms are increasingly creating in-house. Some, like Tally, are so useful and well-built that their creators make them commercially available to anyone in the field. Others remain proprietary, providing firms with creative solutions to internal and client-facing jobs.

The field is in its nascency and is still mostly the realm of larger architecture firms. But the work doesn't necessarily require full-time teams wholly focused on computational innovation. In many cases, the most useful products are fairly simple scripts connecting existing applications and libraries. And observers think there's much more yet to come.

Building on What's Already There

KieranTimberlake has been thinking about how to solve design problems with customized technology since 1999. These days, the firm's efforts range from applications that are solely created to improve internal processes to those that, like Tally, make it onto the market.

Creating anything new takes resources and staff time on the front end, and often requires training and maintenance later. So the firm tries to pick its projects wisely. KieranTimberlake has an internal, multidisciplinary group designed to examine tools and practices that can better serve clients. Together, the team asks three questions of a potential investment in new computational technology: Are there other tools out there that can solve this problem? Is it even possible to address the problem? And finally, is it practical? "We work mightily to make sure we're not reinventing the wheel," Bates says.

Some of the tools are relatively easy to create. Those that KieranTimberlake has designed for internal use, for example, help designers analyze elements like circulation or energy use, or create dashboards allowing users to better track in real time what they're managing.

Those programs might simply be plug-ins—a piece of code that functions within a conventional program. "We work in a lively ecosystem of existing tools," says Chris Connock, design computation director at KieranTimberlake. "Many that we make aren't operating on their own, but are tying into [Autodesk's] Revit or other software."

Applications designed for commercial use may also heavily utilize existing programs. Tally, for example, is a Revit plug-in that adds extra information about building materials that a structure will eventually contain. Sphera software provides the actual data for various components.

Another bespoke tool developed by KT Innovations is Roast, a survey application meant to be used by a building's inhabitants that went on the market this year. A series of questions about temperature, humidity, airflow, and other parameters allows architects and facility managers to assess whether the building is running optimally from the perspective of those inside.

Roast doesn't exist within another program, but it was created with the help of several open-source libraries and other collections of code. "So that allows us to get a scale and complexity in our application beyond what you think a small team can do," Connock says.

KieranTimberlake has seen some financial returns from its customized technologies. But Bates and Connock agree that the benefits of making these tools widely available would go far beyond dollars.

"It shows our clients that we know what we do and are good at it," Bates says. "We want to be in the position of driving the industry."

Plus, says Connock, the developers and designers who work on these projects

massively benefit: By creating the software or hardware, they gain a deep understanding of how it works. "We often fold back a lot of the lessons learned from large commercial software into our internal tools and daily projects."

Advancing the Field by Making Information Publicly Available

In making its custom-built software commercially available, KieranTimberlake is something of an outlier.

Creating bespoke technology for a commercial market is a challenge for most firms, says Charlie Williams, AIA, project delivery director for LPA Design Studios and chair of AIA's Technology in Practice knowledge community. Not only can it be expensive and use up precious staff hours for development and support; it also requires a nimble team that can quickly respond to evolving needs in the field and market the result accordingly.

"You have to move quickly to set market share," Williams explains. "You can't dawdle and think [your product] will organically evolve—more commonly, you need to put energy and resources into making it very popular."

As a result, he said, most design firms tend to focus their work on smaller-scale tools that can be used internally or shared with a client.

That's been the case with Boston-based Payette, but the company has put a spin on that practice. Some of its products do follow the traditional route: Payette's Space Strategies division, for example, has developed an interactive survey tool that allows clients to graphically discover use patterns and opinions among an institution's stakeholders. The firm makes the tool available only to its clients.

But two years ago, the firm's Building Science Group was aiming to understand how window glazing design could affect internal temperature and the need for perimeter heat, and decided to try something different. Initially, the team had created an Excel chart to examine the various variables involved, but it became an unwieldy file that few people could modify.

So instead, says Andrea Love, AIA, a principal at Payette and director of the Building Science Group, "We decided to make it open source and available on our site." After all, she says, "We were building on an existing open-source tool," so it made sense.

The Glazing and Winter Comfort Tool now gets about 650 hits per month, largely from professionals at other firms around the country. Because it's open source, those designers can modify it themselves and use it in other ways. "I know another firm has

CREDIT: MATTHEW MILLMAN PHOTOGRAPHY

Tally, a computer application developed by KieranTimberlake, was used on this student housing complex at the University of Washington.

AIAFuture

(CONTINUED)

mentioned that they used it for summer comfort," says Love, adding that Payette is considering doing a summer version itself as a result.

Making a proprietary computational tool open source seems counterintuitive, but Love says that Payette has historically aimed to share the results of its work—so it just made sense. "The mindset is if we all are doing research and sharing, we all advance as a field," she explains.

Using Data to Uncover the Patterns Beneath People's Use of Space

When architects start talking about companies making commercially available computer applications, Gensler invariably comes to mind. And indeed, the international company has created scripts and plug-ins that can be purchased by other firms.

But the firm's latest tech innovation is not for public consumption; rather, it's a tool designed specifically for clients to help them better understand how their space's layout affects their business. And it all starts with data.

"Client spaces are generating data all the time through sensors, IT info, badging data on the door, and so on," says James Wynn, a director of Gensler's Intelligent Places division. "To help our clients, we've developed a methodology that allows us to integrate multiple sources of data." Together, those data sources create a picture of how shoppers—in a retail environment, for example—utilize a space and spend money there. And that information, of course, can be extremely useful to that business.

Wynn thinks that the tool—which was only formally announced a couple of months ago—is unique in the design world. It combines human-centered research, computational design, BIM, and cutting-edge applications.

And it speeds up the pace of decision-making, he says. In the past, the feedback loop between an architecture decision and how it affects users has taken too long to be useful. With this tool, Wynn says, "what we're hopeful about is that [it] will give us the ability to understand in a more granular way how people respond to design decisions."

In the end, it's not only the client who will benefit. In analyzing the data, Gensler's designers will gradually gain a data-driven understanding of the patterns behind how people use space and how it affects their behavior. And for a design firm, that's valuable knowledge. AIA

AIAPerspective

Being What Happens

Solving the climate crisis is about using our specialized skills.

"Don't ask what will happen. Be what happens."

That's a climate call to action from writer, historian, and activist Rebecca Solnit, and I'm proud that architects are answering the call.

Architects have the specialized skills and perspective to help solve this unique challenge, and AIA's approval of a landmark sustainability initiative in 2019 positions us at the forefront of positive change. As AIA's 2020 president, I welcome the opportunity to advance the architecture profession's leadership on this, the most pivotal issue of the 21st century.

The previous year underlined, in stark terms, the urgency of action. July 2019 marked the hottest month in recorded history—part of a disturbing trend that has seen the past five years take their places, one by one, as the hottest years ever recorded. Hurricane Dorian, which devastated the Bahamas, was the fourth Category 5 storm in the Atlantic in as many years—the longest such streak we've ever seen. And the latest climate reports show accelerating rates of sea level rise: Scientists say just half a degree in additional warming could make the difference between whether flooding will impact up to 69 million people or as many as 80 million people by the year 2100.

But 2019 also marked accelerating recognition of the challenge, and accelerating progress toward solutions—both within and outside the architecture profession. Bold new policy proposals and bold young leaders have emerged, moving public sentiment to a tipping point in favor of action.

Building on decades of focused efforts—including the Framework for Design Excellence, launched in 1990, and the 2030 Commitment to net-zero emissions, established in 2009—AIA's 94,000 members are well-positioned to apply our expertise toward reducing emissions in the built environment.

The comprehensive Climate Action Plan set for release at the Grassroots Conference next month will expand on good work already underway. Through AIA's partnerships with the U.S. Conference of Mayors and Climate Mayors, we're making inroads to ensure sustainability and resilience are prioritized in cities throughout the nation. Our advocacy for building codes and climate policies at local, state, and federal levels is driving action. AIA's coordination with building product manufacturers and other industry stakeholders is highlighting the imperative of sustainable materials and practices through every aspect of the built environment. And it's all supported by programs that supply AIA members with the tools we need to lead and to serve as true citizen architects.

Does our focus on climate solutions mean other AIA priorities will take a back seat?

Absolutely not.

In fact, our values—equity, diversity, inclusion—are indispensable to our success. One of the architect's greatest assets is the ability to see the big picture. And our big picture vision is enhanced by a big tent culture that welcomes and nurtures a broad range of perspectives and experiences.

The architecture profession's progress toward greater equity and diversity has been immense, and it's one of the greatest strengths we can bring to bear as we work to achieve critical objectives like advancing social welfare, protecting public health, and elevating the human experience—all of which go hand in hand with tackling climate change.

Working together, in this next year and beyond, we can "be what happens," and do our part to fight climate change and build a more sustainable, resilient, equitable society.

Jane Frederick, FAIA, 2020 AIA President

CREDIT: J CARRIER

Give better hygiene a hand

The fastest energy efficient HEPA-filtered hand dryer[1]

Ergonomic design

Straight line configuration allows for simpler air flow paths, meaning less energy consumption. And efficient aerodynamics means the Dyson digital motor draws up to 87% less energy than a warm air hand dryer and lowers costs to just $19/year running in Eco mode.[3]

User friendly

Tested to withstand real washroom scenarios, the durable design uses 'time of flight' sensors that accurately detect hands in 0.25 seconds to activate air and reduce waiting time. It is also our quietest Airblade to date.[2]

HEPA filter

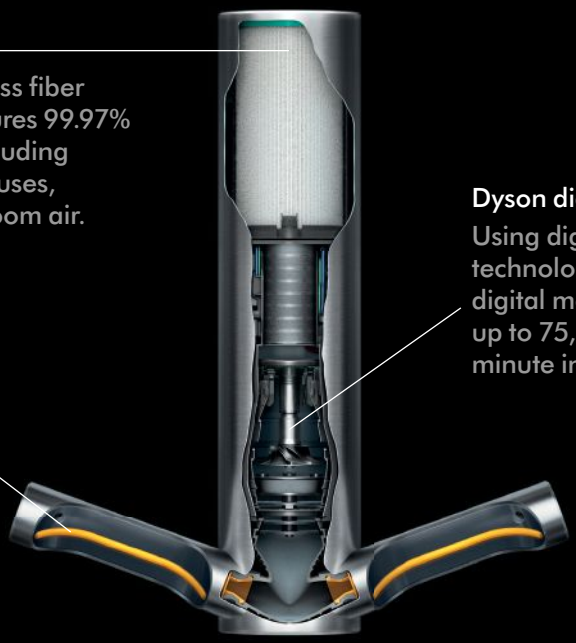
Fleece-lined glass fiber HEPA filter captures 99.97% of particles,[4] including bacteria and viruses, from the washroom air.

Dyson digital motor V4

Using digital pulse technology, the Dyson digital motor V4 spins up to 75,000 times a minute in Max mode.

10 second dry time[5]

Ergonomic drying angle and Curved Blade™ design follow the curves of your hands to remove water quickly, for fast, comfortable hand drying.



[1]Dry time and energy consumption calculated for Max mode. Dry time was determined using Dyson test method 769 based on NSF P335 to a measurement of 0.1g residual moisture.

[2]Average loudness (measured in sones) compared to Dyson Airblade™ hand dryers.

[3]Average electricity price $0.1/kWh as of May 2019. For calculations visit www.dyson.com/calcs.

[4]HEPA filter tested to IEST-RP-CC001.6, by an independent testing laboratory, under prescribed test conditions.

[5]Dry time determined for Max mode using Dyson test method 769 based on NSF P335 to a measurement of 0.1g residual moisture.

Experience it live
888-397-6622
airbladeinfo@dyson.com
www.dyson.com

dyson airblade 9kJ

Presented by:

SOUND ISOLATION AND NOISE CONTROL IN STEEL-FRAMED BUILDINGS

Structural steel framing for The Heights Building in Washington, D.C.
Photo Courtesy of Silman/Gilbane

LEARNING OBJECTIVES

1. Analyze the importance of acoustic comfort within a steel-framed building structure.
2. Explain the basic principles of how sound travels through a building.
3. Examine how to isolate sound and control noise in steel-framed buildings.
4. Explore best practices for specifying building assemblies that optimize the acoustical performance of a building.
5. Analyze a case study where noise was an issue, and sound attenuation practices were particularly important.

CONTINUING EDUCATION

AIA CREDIT: 1 LU HSW
COURSE NUMBER: AR012020-1

AIA Continuing Education Provider

Use the learning objectives above to focus your study as you read this article. To earn credit and obtain a certificate of completion, visit http://go.hw.net/AR012020-1 to view the entire CEU and complete the quiz. CEU courses are free of charge once you create a new learner account; returning users log in as usual.

INTRODUCTION

Modern buildings must be designed and constructed with sound control as a top priority, as acoustical comfort rates high on occupant needs, whether in work or living spaces. A common misconception is that the structural building type, whether steel, concrete, or wood, will have a significant effect on the acoustics of a building. The truth is, the framing system material does not have a significant impact on a building's acoustical performance; it is more dependent on how the individual building elements are designed, specified, and constructed.

HEARING

Before delving into building assemblies that can improve sound attenuation, we must first understand the science behind hearing and sound. Hearing is a very complex process of changing the sound waves in the air into electrical signals that are then carried to the brain via auditory nerves. The brain interprets this sound differently depending on the amount of background noise, the health of the ear, an individual's sex, and age.[1]

According to the Australian Academy of Science, "The human ear is extremely sensitive, and it never rests. So even when you sleep, your ears are working, picking up, and transmitting sounds that are filtered and interpreted by different parts of the brain. It's a permanently open auditory channel. So, although you may not be aware of it, background noises of traffic, aircraft, or music coming from a neighbor are still being processed, and your body is reacting to them in different ways via the nerves that travel to all parts of the body and the hormones released by the brain."[2]

Human ears are so sensitive that listeners can not only detect sound, but pick up on a minor change in frequency and noise level, or pinpoint a sound's source. This is important because there are often many sounds occurring at once that need to be filtered out to focus on a specific sound.[3]

According to the authors of *Auditory and Non-Auditory Effects of Noise on Health*, "Evolution has programmed human beings to be aware of sounds as possible sources of danger."[4] Our permanently alert ears are a vital part of the body's defense mechanism, as they are continually exploring the environment for potential threats while simultaneously blocking out irrelevant information.[5]

NOISE—UNWANTED SOUND

Most people have been annoyed by environmental noises at some point. It takes a great deal of mental energy for our brains to interpret sound continually, and it can become overwhelming if noise is too loud or in discord with other noises. A bird singing in the trees is soothing, but a flock of birds all screeching at the same time while cars are honking on a busy city street is stress-inducing. When we are not in control of our living environment, stress ensues, which can lead to adverse effects on health and wellbeing, including high blood pressure and cardiovascular

disease.[6] According to the National Institutes of Health (NIH), "Noise annoyance can result from noise interfering with daily activities, feelings, thoughts, sleep, or rest, and might be accompanied by negative responses, such as anger, displeasure, exhaustion, and by stress-related symptoms."[7]

Effects of Noise on Health

Studies on both humans and animals have looked into how long-term exposure to noise affects the cardiovascular system and can lead to cardiovascular diseases such as hypertension and arteriosclerosis, which result in heart attack and stroke. An article in the Encyclopedia of Environmental Health, "*Cardiovascular Effects of Noise*," states that "Acute exposure to different kinds of noise is associated with arousals of the autonomic nervous system and endocrine system. Investigators have repeatedly noted that noise exposure increases systolic and diastolic blood pressure, changes heart rate, and causes the release of stress hormones."[8]

Effects of Noise on Productivity, Learning, and Healing

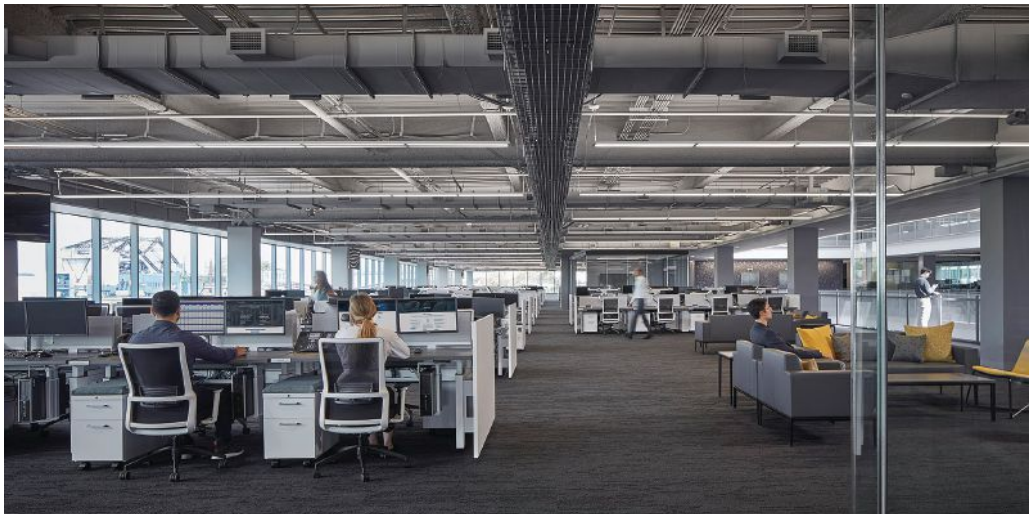
Distracting workplace noise can come from many sources, including the HVAC system, ringing phones, outdoor traffic, and construction. The problem compounds in noisy environments as people raise their voices to be heard (known as the Lombard effect). In addition, modern office design trends are shifting toward open floorplans without walls or finished ceilings and hard surfaces such as metal, glass, and concrete.[9] A study by the Center for the Built Environment (CBE) at the University of California Berkeley found "Occupants' self-rated job performance shows that over 60% of occupants in cubicles think that acoustics interfere with their ability to get their job done."[10]

Acoustic comfort is vitally important in schools as well, as environmental noise can affect cognition, communication, and attention, particularly for younger students who do not have well developed coping strategies to combat these learning hurdles.[11]

Acoustic comfort in healthcare facilities can actually aid in healing, but when left unaddressed noise can be detrimental to patient health and well-being. A study cited by the NIH called "*Influence of Intensive Coronary Care Acoustics on the Quality of Care and Physiological State of Patients*" found, "The sound environment in hospitals, especially in intensive care units, can be characterized by irregularly occurring noises from sources such as medical devices (e.g., alarms), telephones or pagers, conversations, door sounds, and nursing activities. Such noise worsens patient health outcomes through factors such as increased cardiovascular stress, longer healing times, increases in doses of pain-relief drugs, and increased patient readmission rates. Neonates, long-term patients, and elderly people are thought to be particularly at risk to the effects of noise. Sleep disruption is the most common noise-related patient complaint."[12]

Noise can also negatively affect healthcare staff, leading to burnout, lower performance, fatigue, and tension headaches. Even more importantly, a noisy medical environment can affect speech intelligibility, which may lead to medical errors.[13]

As long as buildings are occupied by humans that require building systems, furnishings, and technologies, we will not be able to completely remove all of the noise that has a negative



Steel framing maximizes open office design by providing long spans between columns as exhibited by the C.H. Robinson Midwest Headquarters in Chicago, IL.
Photo Courtesy of Skidmore, Owings & Merrill LLP

GLOSSARY

A-Weighted Decibels
The standard weighting for outdoor community noise measurements that are commonly used for noise measurements within architectural spaces and within vehicles.

Acoustical Comfort Measurement Unit (ACMU)
A way to measure the effects of sound on human productivity and well-being by measuring both speech privacy and comfort to ensure that creating privacy does not simultaneously create audible distractions that diminish comfort.

Amplitude
The loudness of a sound measured in Decibels (Db), which is a logarithmic scale, meaning that for every 10 dB increase in sound level, there is a 10-times increase in sound intensity.

Flanking Transmission
When structurally transmitted sound travels through adjacent structures such as ceilings, floors, walls, and windows.

Frequency
"High" or "low" pitch sounds measured in Hertz (Hz) defined as one cycle per second.

Impact Insulation Class (IIC)
A laboratory tested rating describing how much noise is created by footfalls or impact on a floor through a ceiling.

Lombard Effect
The involuntary tendency of speakers to increase their vocal effort when speaking amongst loud noise to enhance the audibility of their voice.

Noise Criterion (NC) Ratings
Ratings developed to characterize background sound in buildings caused by mechanical equipment and other building systems. The one-number rating system compares the background sound levels to a set of defined NC curves.

Sound Transmission Class (STC)
A single-number rating of a material's or an assembly's ability to resist airborne sound transfer at the frequencies 125-4000 Hz. In general, a higher STC rating blocks more noise from transmitting through a partition.

Transmission Loss (TL)
Measures a wall or floor assembly's ability to block sound at a given frequency, or how much of the incident sound is transmitted into the space on the opposite side of the assembly.

NYU Langone Health Helen L. and Martin S. Kimmel Pavilion is located in a dense urban environment with sound emanating from the street level, an adjacent freeway, nearby river traffic, and underground commuter train tunnels in New York, NY.
Photo Courtesy of LERA Consulting Structural Engineers/Fadi Asmar

impact on our lives. However, there are many options for mitigating the effects of noise in the spaces where we live, work, learn, and heal.

ACOUSTIC COMFORT

Architects and designers can give occupants more control over their environments by designing buildings with materials that minimize intrusive noise and contribute to acoustic comfort. Acoustic comfort in schools and offices improves concentration, productivity, and learning. Acoustic comfort in healthcare settings means patients can heal faster in a calm, private environment. Acoustic comfort in the home helps residents decompress from the outside world and sleep better at night.

According to a manufacturer of sound masking products, "Acoustical comfort is seen as equal to other environmental factors in evaluations of productivity and psychological well-being in the workplace, but the design industry has yet to adopt a standard of measure pertaining to this variable. While ASHRAE, OSHA, and ASTM standards exist for various environmental conditions, these guidelines measure sound itself rather than gauging its associated potential for distraction, loss of privacy, and the subsequent deterioration of comfort." In response, the manufacturer developed the Acoustical Comfort Measurement Unit (ACMU) as a way to measure the effects of sound on human productivity and well-being. The ACMU measures both speech privacy and comfort

Architects and designers can provide students a space of increased concentration and productivity through dynamic aesthetics and acoustic comfort. An example is the Mori Hosseini Student Union at Embry-Riddle Aeronautical University in Daytona Beach, FL, where the steel framing, interiors, and exterior illustrate the expression of movement, flight, and aerodynamics.
Photo Courtesy of ikon.5 architects/Brad Feinknopf

to ensure that creating privacy does not simultaneously create audible distractions that diminish comfort.[14]

QUALITIES OF SOUND

Sound is a range of vibrations that the human auditory system receives and interprets to the brain. There are three basic qualities of sound: frequency (pitch), amplitude (loudness), and power. Frequency is often discussed as "high" or "low" pitch sounds and is measured in Hertz (Hz) defined as one cycle per second. Amplitude is the loudness of a sound and is measured in Decibels (dB), which is a logarithmic scale, meaning that for every 10 dB increase in sound level, there is a 10-times increase in sound intensity. Another property of a sound source is power, which is equal to the total power emitted by that source in all directions. Power is measured in watts (W).[15]

Often we discuss the levels of sound as well because they tell us how loud varying sounds are in relation to each other and the range of human hearing.

When a sound wave strikes an object, like a building wall, that wave may be transmitted (travel through an object), reflected (bounce off an object), or absorbed (trapped by the object and converted to heat). Typically a combination of all three occurs. Low-frequency sounds are more likely to be transmitted, while high-frequency sounds generally are reflected or absorbed. Harder surfaces are more reflective than soft ones; thicker or denser objects tend to absorb better, while thinner, less dense ones transmit sound better.[16] For example, a ceiling with acoustical tiles will do an excellent job of absorbing sound but a poor job of stopping sound from transmitting through to the space above. The opposite is true for a concrete floor slab.

When a sound is reflected, it is scattered, therefore making it weaker than the source sound. When a sound is absorbed, it is converted to a different form of energy. The combination of scattering and absorption is the total sound attenuation, which is a reduction or loss of intensity of sound energy.[17]

HUMAN PERCEPTION OF SOUND

Humans with healthy hearing can perceive sound at frequencies from 20 Hz to 20,000 Hz; those with hearing loss have a hard time hearing sounds at the upper end of this range. According to the American Institute of Steel Construction's *Facts for Steel Buildings – Sound Isolation and Noise Control*, "The average speech spectrum peaks at mid-frequencies (500 to 1,000 Hz). These peaks for standard normal, raised, loud, and shouting speech amount to roughly 54 dB, 61 dB, 67 dB, and 75 dB, respectively, as measured 3 feet from the source (ASA, 2012). Large gatherings of people can, of course, produce much more noise than a single talker. The authors measured the sound pressure level (SPL) of cocktail parties ranging from 75 dBA to over 85 dBA. The level depends on crowd size and density, as well as room volume and the presence or absence of sound-absorbing finishes. The noise in lively restaurants (often playing background music) can exceed 85 dBA, and bars and nightclubs can exceed 100 dBA."[18]

A large gathering of people enjoying "Hide & Seek," a responsive and kinetic installation in New York, NY, that shifts occupants' perceptions of the space around them.
Photo Courtesy of Dream the Combine

IMPACT SOUND

When sound is unwanted, it becomes noise. Consistent sounds at a low level are often perceived as ambiance and are not disruptive to occupants. The same sounds can become annoying if they are excessively loud or consist of an impact sound. The most common source of impact sound is the footfall of people walking, which can be heard on the floor or from the ceiling above. A floor/ceiling assembly may effectively block voices, but it is more difficult to attenuate the sharp report of hard-soled shoes. Impact sound can also include rolling carts, weights dropping at fitness centers, and even rain.

Impact Insulation Class (IIC) is a laboratory tested rating describing how much noise is created by footfalls or impact on a floor through a ceiling. In a controlled acoustical environment, impact sound is generated by a standardized testing device that taps on the floor/ceiling surface. In the receiving room below, listening devices measure the resulting sound pressure level. They are measured in the same frequency bandwidths as those used in sound transmission loss measurements. Larger IIC values for a floor assembly equal better impact sound absorption.

This article continues on http://go.hw.net/AR012020-1. Go online to read the rest of the CEU course, complete the corresponding quiz for credit, and receive your certificate of completion.

QUIZ

1. According to the course, noise interference impacts human health and well-being in which of the following ways?
   a. Cardiovascular disease
   b. Release of stress hormones
   c. Ability to learn
   d. Loss of productivity
   e. All of the above

2. _____-frequency sounds are more likely to be transmitted, while _____-frequency sounds generally are reflected or absorbed.
   a. Mid, low
   b. High, low
   c. Low, high

3. Humans with healthy hearing can perceive sound at frequencies from ¬¬¬_____; those with hearing loss have a hard time hearing sounds at the upper end of this range.
   a. 5 Hz to 50,000 Hz
   b. 10 Hz to 10,000 Hz
   c. 15 Hz to 15,000 Hz
   d. 20 Hz to 20,000 Hz

4. Which of the following is a laboratory tested rating describing how much noise is created by footfalls on a floor through a ceiling?
   a. STC
   b. IIC
   c. OITC

5. Which of the following measures a wall or floor assembly's ability to block sound at a given frequency?
   a. Noise Criterion Ratings
   b. Transmission Loss
   c. Sound Transmission Class
   d. A-Weighted Decibels

6. Which of the following is a common floor/ceiling assembly in steel buildings?
   a. Precast planks
   b. Concrete over metal deck with a suspended ceiling
   c. Post-tensioned concrete slab
   d. Cross-laminated timber panels

7. Which of the following sound attenuation methods dissipates energy, reducing vibration and sound transmission?
   a. Increase mass
   b. Decrease stiffness
   c. Damping
   d. Mechanical Decoupling

8. Which sound attenuation method restricts sound's ability to pass from one side of a wall to the other side?
   a. Increase mass
   b. Decrease stiffness
   c. Damping
   d. Mechanical Decoupling

9. Under most building codes, multifamily dwellings must achieve an IIC _____ between dwelling units, but there is an expectation of higher performance in luxury properties where more stringent sound isolation criteria may apply.
   a. 30
   b. 40
   c. 50
   d. 60

10. Single-stud walls can achieve STC values in excess of STC _____ with two layers of gypsum board installed on resilient clips fastened to metal studs.
    a. 30
    b. 40
    c. 50
    d. 60

SPONSOR INFORMATION

The American Institute of Steel Construction (AISC), headquartered in Chicago, is a non-partisan, not-for-profit technical institute and trade association established in 1921 to serve the structural steel design community and construction industry in the United States.

Steel is the most resilient material—it's designed to last, whether it's exposed to fire, blast, or the ravages of time. And when a steel building reaches the end of its life, the steel is recycled and retains all of its fantastic physical characteristics. Today's beams and columns are nearly 40% stronger and offer greater constructability benefits than beams and columns produced just 30 years ago!

Steel is the most recycled material in the world. In fact, according to the American Iron and Steel Institute, more steel is recycled than all other materials combined. In the U.S. alone, domestic mills recycle more than 70 million tons of scrap each year. Currently, structural steel includes 93% recycled content!

Steel doesn't add to our waste problems. More than 98% of structural steel is recovered for reuse at the end of a structure's usable life.

Structural steel features an incredibly sustainable manufacturing process.

- The steel manufacturing industry has cut its carbon footprint by almost 40% since 1990.
- It takes a third less energy to make a ton of steel than it did in 1990.

Are you Earth-friendly?

aisc.org/earthfriendly

Structural steel has a low global warming potential. In fact, most of the greenhouse gas emissions associated with steel is from electricity use—and as power plants in the U.S switch to renewable energy sources, steel's global warming potential will continue to shrink! (Research is underway on new production processes with the goal of carbon-neutral steel.)

The steel industry features superior water resource management. The structural steel-making process boasts a 95% water recycling rate with no external discharges, resulting in a net consumption of only 70 gallons per ton!

The steel industry offers transparent reporting of environmental impacts. The American Institute of Steel Construction provides environmental product declarations (EPDs) for fabricated hot-rolled structural sections, fabricated steel plate, and fabricated hollow structural sections (HSS). These EPDs cover the product life cycle from cradle to fabricator gate. Simply visit **aisc.org/epd** to access the data!

Smarter. Stronger. Steel.

American Institute of Steel Construction
312.670.2400 | www.aisc.org

NEW CLAY ROOFING TRENDS

EMERGING DIRECTIONS & FUTURE APPLICATIONS

Presented by:

BORAL®

LEARNING OBJECTIVES

1. Identify the three segments of the existing clay market.
2. Evaluate the ways in which clay roofs are being paired with emerging and existing architectural trends, including but not limited to transitional, gabled modern, and contemporary styles.
3. List the color groups that are becoming more prominent in roofing trends.
4. Name the alternative application for clay roof tile that is ideal for progressive design projects.
5. Explain and evaluate architectural, cultural, and consumer changes that have the potential to impact the future of roofing.

CONTINUING EDUCATION

AIA CREDIT: 1 LU/ELECTIVE
AIA COURSE NUMBER: AR012020-2

AIA Continuing Education Provider

Use the learning objectives above to focus your study as you read this article. To earn credit and obtain a certificate of completion, visit http://go.hw.net/AR012020-2 to view the entire CEU and complete the quiz. CEU courses are free of charge once you create a new learner account; returning users log in as usual.

OVERVIEW OF SECTIONS

The research of this report is compiled into three unique sections:

1—The Existing or "traditional" clay market, which focuses on segmenting current clay products by design and development.

2—The Emerging (or currently up-trending market), that describes how clay roofing is utilized in the new era of contemporary architectural influence.

3—The Forthcoming tile market that identifies opportunities for creative applications in the forward contemporary design segment.

PATHWAYS: FROM GLOBAL INFLUENCES TO DESIGN TRENDS

To best understand all the topics ahead, it's important to first review the basic fundamentals of design trends, why they manifest when they do, and how trend researchers and forecasters are able to identify future directions.

Trend work begins by identifying, monitoring, and analyzing cause and effect relationships between macro influences, consumer desire and behaviors, and trends related to design. Quite simply, macro influences directly impact consumer desires and behavior, which in turn fuel shifts in product design. Of course, the reverse is also true; however, for the types of trends discussed within this study, the focus is solely on the former.

Macro Influences

Under the bucket of "macro" influences lies a number of significant categories—all representing variables in daily life that can and will impact how consumers see, feel about, and interact with the greater world. These influences include economic and political landscapes, environmental concerns, cultural events and norms, technological shifts, and more.

Consumer Desires and Behavior

Consumer desires are important to identify because they are the precursors to actual behavioral shifts and may precede noticeable shifts by anywhere from a few weeks to a few years, depending on the other factors at play. In today's world, social listening is the clearest way to begin pinpointing shifts in consumer desire.

Shifts in Product Design

Product design is a broad category that encompasses a wide variety of design assets. This could mean a type of footwear, a speed boat, a grocery delivery system, a packing or branding strategy, or—in the case of the architectural industry—it could reference a specific product or material or an entire environment.

The announcement of a second Amazon headquarters, for example, is a business development that represents an economic shift for the region where the headquarters will be located. That economic shift could directly impact the migration to/from the region as well as the cost of living within surrounding neighborhoods, which in turn may change consumer attitudes towards how attractive those neighborhoods are in which to live. For some, it may make those neighborhoods less desirable while others may quickly see those same neighborhoods as far more desirable than before. How the consumer population in a given region changes will directly impact the look and type of stores and restaurants as well as the style of renovations or architectural influences of the new construction of homes.

These are some of the macro topics trend researchers and forecasters explore before diving into design development by more niche segments such as exterior residential architecture or roofing design. Throughout this article, references to and descriptions of long term design trends that are a result of this and other studies will be highlighted.

Design Trends Supporting Authenticity and Innovation

Understanding the intricacies and nuances of consumer behavior is one of the trickiest components of trend forecasting, and in relation to exterior design choices, today's consumers most value authenticity and innovation, as well as environmental responsibility, from the brands they choose.

Successful products are often those that score high marks in one category or both, with few exceptions. Yet the characteristics of authenticity and innovation are not common partners. Rather, they are often found at opposite ends of a spectrum.

While the claim of authenticity has been, arguably, overused and overstated in many marketing and design industries for the past few years (to the point of causing some consumers to view such claims with increased skepticism), true authenticity nonetheless continues to appeal to consumers.

Understanding what true authenticity is can be different for each brand and each industry.

For the purpose of this study, "authentic" can be defined as of, or pertaining to, undisputed origins.

Authenticity can be a powerful driver when it comes to home design, and the demand for reclaimed clay tiles imported from European markets is one such example. The salvaged/reclaimed clay tile market provides a diverse array of aged, time-worn profiles that provide an authentic old-world aesthetic for the discerning home owner. With builders who focus on true-to-form Mediterranean-style architecture, the reclaimed roof can be seen as an essential finishing touch.

In today's world, innovation is often an equally powerful driver as authenticity—an attribute that often attracts the consumer who is drawn to contemporary solutions and forward styles. Innovation can be defined as the creative application of new and better solutions to meet unarticulated and evolving market needs. The introduction of the Apple iPod almost 20 years ago is one of the best modern examples of the power of innovation at work. The sleek device offered a sophisticatedly simple new look and

The contemporary marketplace for clay is not complete without new tiles that look precisely that—brand new. These products are ideal for new builds where both a sense of newness and a strong Mediterranean look are desired.

GLOSSARY

Applied Imperfections—may be machined or applied by hand as a post-process yet are intended to offer a crafted look that references authentic handmade tiles as well as the slight aging of a product that has been worn with time

Authentic—of, or pertaining to, undisputed origins

Innovation—the creative application of new and better solutions to meet unarticulated and evolving market needs

New Tile Product—brand new; ideal for and often found on new builds where both a sense of newness and a strong Mediterranean look are desired; exudes the feeling of a fresh purchase

Macro Influences—represent variables in daily life that can and will impact how consumers see, feel about, and interact with the greater world; these influences include economic and political landscapes, environmental concerns, cultural events and norms, technological shifts, and more

Manufactured Texture—both uniform and irregular raked effects are common, although the former is more suggestive of a handmade product

Product Design—broad category that encompasses a wide variety of design assets; this could mean a type of footwear, a speed boat, a grocery delivery system, a packing or branding strategy, or—in the case of the architectural industry—it could reference a specific product or material or an entire environment

Reclaimed-Look Tile—competes with the reclaimed market; comprised of newly produced tiles that have been designed and processed to simulate reclaimed/aged tiles; considered less authentic than reclaimed, yet still hold a fair degree of authenticity

Reclaimed Tile—focused on salvaging tiles from existing builds; typically older tiles, hand-made and most often procured from European markets; aged appearance; considered highly authentic

Whitening Effects—similar to efflorescence; when it comes to salvaged/reclaimed products the effect is seen as a positive attribute

digital functionality: a contemporary solution to the cumbersome disc-man audio devices of the day.

It is between these key aspects of true authenticity and forward innovation that the future directions for clay roofing lie. Research indicates that there is not one fixed point on this spectrum, but rather there are a series of points where clay tiles find resonance.

THE CURRENT CLAY MARKET: AN OVERVIEW

The existing clay roof market can be sorted into three core categories, determined by aesthetic and development process:

1. **The reclaimed category** is focused on salvaging tiles from existing builds. These are typically older tiles, hand-made and most often procured from European markets. No matter what the profile, they look quite aged. Reclaimed products are considered highly authentic.
2. **The reclaimed-look category** competes with the reclaimed market. This category is comprised of newly produced tiles that have been designed and processed to simulate reclaimed/aged tiles. Clay roof products that look reclaimed are considered less authentic than those that are truly reclaimed, yet they still hold a fair degree of authenticity (varies by quality of process).
3. **The new product category:** The contemporary marketplace for clay is not complete without new tiles that look precisely that—brand new. These products are ideal for and often found on new builds where both a sense of newness and a strong Mediterranean look are desired. Similar to the appeal of driving a new car off the dealer's lot, these tiles exude the feeling of a fresh, new purchase.

Reclaimed clay tile may be barrel, ridged, or flat, and the reclaimed clay roof tile market finds its favor with customers who love to tell a story about the history of their materials and construction of their beautiful home.

Reclaimed Clay Tile

Reclaimed clay tile may be barrel, ridged, or flat, and the reclaimed clay roof tile market finds its favor with customers who love to tell a story about the history of their materials and construction of their beautiful home. They are drawn to the allure of knowing their product was sourced from overseas (often in a location perceived as more culturally rich or exotic than their own) and of feeling that the product itself is like a piece of history they get to own.

After studying the reclaimed clay roof offerings across several websites, from Alibaba to 1st Dibs, and across many resellers, importers, and contractors, it became clear that the core characteristics that connect with consumers' desires for character and authenticity are as follows:

Whitened Effects—Although whitening effects generally have a negative association with production tiles, which some may see as similar to efflorescence, when it comes to salvaged/reclaimed products the effect is seen as a positive attribute.

Surface Texture—Mosses and molds have had the gift of many years to spread and create a rough surface texture to random areas of antique tiles.

Light Color Palettes—A survey of websites and resellers offering reclaimed tiles, primarily from France, Italy, and Spain, showed that many antique tiles feature much lighter hues—most notably yellows and whites—than production tiles made in the U.S. market.

Random Firing Patterns—Unlike most production clay tiles, the firing effects of antique handmade tiles display random, non-linear patterns.

Irregular Sizing—Subtle irregularity of sizing implies the products have been handmade, which in turn suggests there is an authenticity to the product.

Due to the expense associated with reclaimed tiles, they are primarily found on high-luxury, customized home builds that feature an extreme dedication to authentic Mediterranean styling and details. In most cases, the home buyer has specified the added expense in exchange for the increased authenticity.

Aged-Looking Clay Tile

The aged-look clay tile market includes a wide array of colors and surface effects designed to yield an aged and weathered look from new tile production. These products may be made by hand or die-cut. Imitating antique or reclaimed clay tile across the industry is done in a variety of ways, including the following:

Painterly Effects—spatter or brushed painterly effects imitate firing or whitened aged effects.

Manufactured Texture—both uniform and irregular raked effects are common, although the former is more suggestive of a handmade product.

Surface Pebbling—another form of manufactured texture, the surfaces of these tiles have a bumpy, pebbled look and feel.

Applied Imperfections—may be machined or applied by hand as a post-process yet are intended to offer a crafted look that references authentic handmade tiles as well as the slight aging of a product that has been worn with time.

Faux Lichen/Mold Growth—"faux" can mean more than one thing. It may be a painterly effect, used to mimic the desirable look of mold or lichen growth. Alternatively, it may be the result of a topical application, such as yogurt or beer mixtures, to result in actual lichen growth that otherwise would take years to achieve.

The contemporary clay tile market offers uniform, die-cut profiles with few surface effects save for controlled coloration changes or machined textures.

Contemporary Clay Tile

The contemporary clay tile market offers uniform, die-cut profiles with few surface effects save for controlled coloration changes or

machined textures. This product has historically been the clay tile of choice for homes, developments, and master plan communities at the luxury and mid-tier levels. As will be discussed in upcoming segments of this study, there are new opportunities emerging for such well-produced, clean-finish looks.

THE EMERGING CLAY MARKET: AN OVERVIEW OF A CONTEMPORARY SHIFT

The previous information on clay tile categories within the existing market may be quite familiar to some and is evident when conducting a full review of clay roof products in the market. Yet often, the emerging market for products and categories cannot be seen by focusing specifically on the products available. As with all design trends, as mentioned earlier, catalysts often come from external sources. Therefore, to get a better understanding of how the clay market can shift, the scope must be broadened and architectural styles must be looked at in relation to clay roof products and shifting roofing style trends.

It is here, within this expanded scope of architectural influences and shifts, that evidence of new directions can be seen. Specifically, there is evidence that the classic barrel clay profiles are becoming more linked to contemporary design; flat clay profiles have also expanded opportunity with trending and emerging home styles.

Over the last five years, Mediterranean homes in the U.S. have begun to take on greater austerity in exterior styling as well as more and more contemporary characteristics.

This article continues on http://go.hw.net/AR012020-2. Go online to read the rest of the CEU course, complete the corresponding quiz for credit, and receive your certificate of completion.

QUIZ

1. Which of the following is similar to efflorescence and can be viewed as a positive attribute when it comes to salvaged/reclaimed products?
   a. Painterly effects
   b. Whitened effects
   c. Manufactured texture
   d. Faux lichen/Mold growth

2. According to the information in the course, which of the following product categories is considered highly authentic?
   a. New Product Category
   b. Reclaimed-look Category
   c. Reclaimed Category
   d. None of the above

3. For customers looking for ultra clean exteriors, the terra-cotta colors of classic Mediterranean homes have been replaced by
   a. Clean whites or muted ash and tan hues
   b. Sand hues, greiges, grays, and blacks
   c. Gray-browned reds
   d. Green grays and charcoals

4. When reviewing classic products and contemporary architecture, the best place to begin is with _____ inspired architectural styles which tend to display pastel-toned and terra-cotta stucco exteriors, arched windows and doors, and clay tile roofs with a low, hipped, or gabled pitch.
   a. Gabled Modern
   b. Mediterranean
   c. Transitional
   d. Contemporary

5. _____ describes a macro trend that impacts residential exteriors. Its core attributes are reduced ornamentation, greater neutrality of color palettes, and the application of fewer colors and materials for all facades, including the roof.
   a. Mediterranean
   b. Traditional
   c. Transitional
   d. Sensorial Ease

6. _____ identifies a design direction in which traditional architectural elements are sourced for contemporary homes. Only certain traditional elements and details are selected, clay tiles being one such example.
   a. Traditional
   b. Traditional Leap
   c. Contemporary
   d. Mediterranean

7. A house with a minimal silhouette, simple gabled roof with medium to low pitch, a highly austere approach to exterior features and/or ornamentation, and limited color palettes and exterior faced materials is indicative of which trend:
   a. Traditional Leap
   b. Sensorial Ease
   c. Mediterranean
   d. Gabled Modern

8. An anticipated design shift affecting clay roofing is color. According to the course, which of the following warm neutrals that will be trending over the next five years include:
   a. Sandy tans
   b. Grayed tans
   c. Gray-browns/gray-browned reds
   d. All of the above

9. As mentioned in the course, for the first time, _____ is becoming associated with clean, contemporary, and modern architectural styles and is lingering at the far fringes of gabled and contemporary home trends.
   a. Traditional
   b. Transitional
   c. Shake Revival
   d. Mid-century Modern

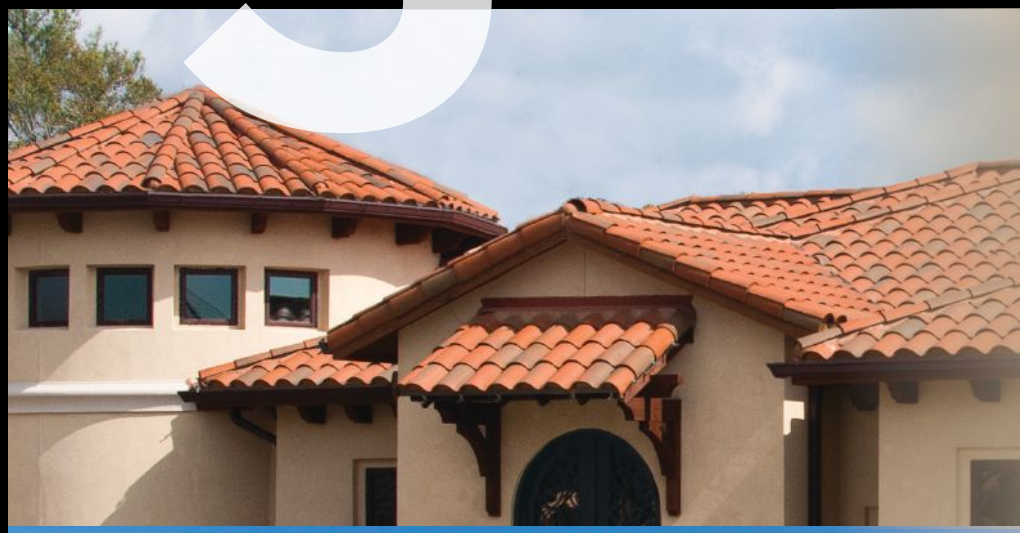
10. According to the course, Mediterranean-style homes were popular in the _____.
    a. Early 1900s
    b. Post-Great Recession era
    c. Mid-80s through the mid-90s
    d. 1970s

SPONSOR INFORMATION

BORAL®

Boral Roofing is the nation's largest manufacturer of sustainable, durable and affordable clay, concrete, stone-coated steel and composite slate roof tile products. Boral's brands include Boral Roofing, US Tile by Boral, Boral Steel, and Inspire by Boral roofing products. For more info call 800-699-8453 or visit BoralRoof.com.

3 STYLES



All Boral Roofing products easily harmonize with 3 dominant architectural styles.

TRADITIONAL

American adaptations of regional home styles from other time periods or areas of the world. Often mixed references.

COTTAGE
CRAFTSMAN
SPANISH COLONIAL
FOURSQUARE
NEW TRADITIONAL
FRENCH CHATEAU

TRANSITIONAL

Prefers the clean lines of contemporary architecture, but draws heavily on details and styles from traditional architecture.

RANCH
PRAIRIE
MISSION REVIVAL
CONTEMPORARY FARMHOUSE

CONTEMPORARY

Characterized by a preference for clean lines, open concepts, decoration, ample light sources, large windows, and lack of round forms.

MODERN
NEW BARNHOUSE
CONTEMPORARY
MID CENTURY MODERN

THE IMPACT OF WOOD USE ON NORTH AMERICAN FORESTS

Presented by: THINK WOOD®

LEARNING OBJECTIVES

1. Evaluate the use of wood as a construction material in the context of long-term forest sustainability as well as attributes such as low embodied energy and light carbon footprint.
2. Discuss forest sustainability measures such as biodiversity, soil and water quality, and harvest versus net growth.
3. Examine the concept that using wood in buildings provides an incentive to landowners to keep forested lands forested instead of converting them to uses such as urban development.
4. Compare the carbon benefits of an unmanaged forest versus a managed forest where timber is used for wood buildings.

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: AR012020-3
GBCI CREDIT: 1 CE
GBCI COURSE NUMBER: 0920020675

AIA Continuing Education Provider

GBCI

Use the learning objectives above to focus your study as you read this article. To earn credit and obtain a certificate of completion, visit http://go.hw.net/AR012020-3 to view the entire CEU and complete the quiz. CEU courses are free of charge once you create a new learner account; returning users log in as usual.

By Roxane Ward and Dave Patterson, RPF

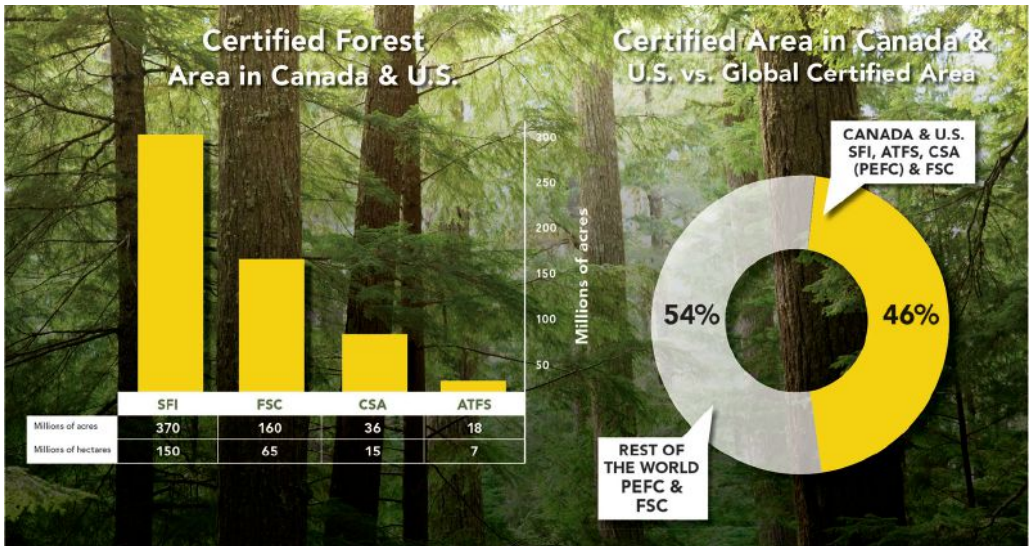
CAN SPECIFYING WOOD FOR BUILDINGS CONTRIBUTE TO FOREST SUSTAINABILITY?

As green building has evolved beyond its initial emphasis on energy efficiency, greater attention has been given to the choice of structural materials and the degree to which they influence a building's environmental footprint. Increasingly, wood from sustainably managed forests is viewed as a responsible choice—for a number of reasons. Wood grows naturally by harnessing energy from the sun, absorbing carbon dioxide and releasing oxygen. It is renewable and a carbon sink, and it outperforms other materials in terms of embodied energy, air and water pollution, and other impact indicators.[1]

However, what about the forest? The benefits above notwithstanding, how can building designers be sure that specifying wood does not negatively impact the North American forest resource?

As this course will demonstrate, the answer to that question has several elements. On one hand, North American forest practices are among the world's best, and the amount of forested land, in both the United States and Canada, has been stable for decades. On the other, there are threats—such as climate change, increased wildfire, insect infestation and disease, and deforestation due to urban development—which are broader than the forest industry and must be addressed at a societal level. Drawing from a wide range of research publications, the following pages will examine the current state of North American forests, modern forest practices, and criteria for sustainability, and consider some of the challenges that could profoundly impact the future of the forest resource. In this context, the course will also discuss why strong markets for wood products provide an incentive for landowners, not only to invest in forest management but also to keep forested land forested even though greater profit can often be made by converting it to other uses.

Deforestation is the permanent conversion of forest land to non-forest land uses. Around the world, it is a major issue and contributor to global warming. In the United States and Canada, the rate of deforestation has been virtually zero for decades; however, the value of forest land in agriculture and real estate maintains pressure to convert.



Shown is a second-growth working forest in Oregon.
Photo courtesy of Plum Creek/© Frank Rosenstein; Source: www.pefc.org and www.fsc.org as of March 2019

IS NORTH AMERICA RUNNING OUT OF FORESTS?

According to the National Report on Sustainable Forests–2010, "On the whole, no evidence suggests that we are using up our forests. In fact, the total area of forests has been stable and the volume of wood on them increasing."[2]

Until the early 1900s, settlers coming to North America cleared an average of 2.1 acres of forest per person to survive and grow food.[3] Since then, the establishment of industrial agriculture and other changes in land use have mitigated the need for forest clearing, and forest acreage has been stable for close to a century.

The United States reported an annual increase in forest area of 0.12 percent in the 1990s and 0.05 percent from 2000 to 2005, while Canada had no change, and twice as much wood is being grown each year as is harvested.[4] In both countries, responsible forest management has resulted in more than 50 consecutive years of net forest growth that exceeds annual forest harvests.

United States

The United States has approximately 765 million acres of forest area, which is about one-third of the country's total land area.[5] According to the National Report on Sustainable Forests–2010, "This stability is in spite of a nearly three-fold increase in population over the same period and is in marked contrast with many countries where wide-scale deforestation remains a pressing concern."

Forty-two percent of U.S. forests are owned by entities such as national, state, and local governments; the rest are owned by private landowners, including more than 22 million family forest owners.[6] The fact that net forest growth has outpaced the amount of wood harvested for decades supports the idea that landowners who depend economically on the resource have a strong incentive for their sustainable management for the long term. This aligns with global forest data, which indicates that forest products and industrial roundwood demands provide the revenue and policy incentives to support sustainable forest management.[7]

However, with urban development and other uses increasingly vying for land, an issue going forward will be making sure that landowners continue to have reasons to keep forested lands forested.

Canada

Canada has 857 million acres of forestland, which is about 90 percent of the forested area it had before European settlement.[8,9] Ninety-four percent of the forest is publicly owned and managed by provincial, federal, and territorial governments. The remaining 6 percent is on private property belonging to more than 450,000 private landowners.

Wood supply is the term used to describe the estimated volume of timber that can be harvested from an area while meeting environmental, economic, and social objectives. Governments regulate harvest levels on public lands by specifying an annual allowable cut.

TOOLS FOR ACCOUNTABILITY

Although types of ownership vary, forest management in the United States and Canada operates under layers of federal, state/provincial, and local regulations and guidelines that foresters and harvesting professionals must follow to protect water quality, wildlife habitat, soil, and other resources. Laws addressing safety and workers' rights also govern forestry activities. Training, continuing education, and certification for loggers and foresters support continuous improvement as well as the use of forestry best management practices (BMPs). Government agencies monitor forest management activities for compliance with regulations.

Forest Certification

While sustainable forest management is defined by the regulations and guidelines that consider environmental, economic, and social values for that particular area and ownership, sustainably managed land does not have to be certified. Forest companies can turn to voluntary forest certification to have their practices independently assessed against sustainability standards to provide additional assurance to customers, backing up their claims that their wood products come from legal, responsible sources.

Wood is the only building material that has third-party certification programs in place to demonstrate that products being sold have come from a responsibly managed resource. As of March 2019, more than 584 million acres of forest in the United States and Canada were certified under one of the four internationally recognized programs used in North America: the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), Canadian Standards Association's Sustainable Forest Management Standards (CSA), and American Tree Farm System (ATFS). This represents almost half of the world's certified forests.[10]

According to the National Association of State Foresters, "Credible forest certification programs include the following fundamental elements: independent governance, multi-stakeholder standard, independent certification, complaints/appeals process, open participation, and transparency. While in different manners, the ATFS, FSC, and SFI systems include the fundamental elements of credibility and make positive contributions to forest sustainability."[11] Similarly, the World Business Council on

Certification bodies conduct forest management audits as part of the third-party certification process.
Photo courtesy of www.naturallywood.com

GLOSSARY

Biological diversity, or biodiversity—refers to the variety of species and ecosystems on earth and their ecological systems

Clearcutting—used when the young trees of a species need an abundance of sunlight to germinate and to compete successfully with grasses and other plants

Deforestation—the permanent conversion of forest land to non-forest land uses

Environmental Product Declaration (EPDs)—a standardized, third-party-verified label that communicates the environmental performance of a product

Forestry—the art and science of creating, using, and conserving forests

Life-cycle Assessment (LCA)—a tool that can be used to evaluate the potential environmental impacts of a product, material, process, or activity

Silviculture—the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society such as wildlife habitat, timber, water resources, restoration, and recreation on a sustainable basis (as defined by the USDA)

Soil—made up of a complex mixture of minerals, organic matter, gases, liquids, and microorganisms; held together by the root structures of trees and plants

Sustainable Forest Management—the stewardship and use of forests and forest lands in a way and at a rate that maintains their biological diversity, productivity, regeneration capacity, vitality, and potential to fulfill, now and in the future, relevant ecological economic and social functions at local, national, and global levels, and that does not cause damage on other ecosystems (as defined by the FAO)

Wood Supply—the term used to describe the estimated volume of timber that can be harvested from an area while meeting environmental, economic, and social objectives

Sustainable Development released a statement supporting an inclusive approach that recognizes these programs as well as CSA (and others).[12]

The FSC, SFI, CSA, and ATFS programs all depend on third-party audits, where independent auditors measure the planning, procedures, systems, and performance of on-the-ground forest operations against the predetermined standard. The audits, performed by experienced, independent foresters, biologists, socio-economists, or other professionals, are conducted by certification bodies accredited to award certificates under each of the programs. A certificate is issued if a forest operation is found to be in conformance with the specified forest certification standard.[13]

EPDs and Forest Certification

The wood industry has been a leader in the development of environmental product declarations (EPDs). An EPD is a standardized, third-party-verified label that communicates the environmental performance of a product, is based on life-cycle assessment (LCA), and applicable worldwide.

An EPD includes information about both product attributes and production impacts. This document provides consistent and comparable information to industrial customers and end-use consumers regarding environmental impacts. The nature of EPDs also allows summation of environmental impacts along a product's supply chain—a powerful feature that greatly enhances the utility of LCA-based information.

In the case of wood products, sustainable forest management certification complements the information in an EPD, providing a more complete picture by encompassing parameters not covered in an LCA—such as biodiversity conservation, soil and water quality, and the protection of wildlife habitat.

THE ART AND SCIENCE OF FOREST MANAGEMENT

There is a good reason forestry is often described as a blending of art and science. Foresters must follow the laws, regulations, and best practices of forestry and apply forest science and the results of ongoing research. They must also nurture the art of recognizing the unique features of a specific forest and site while developing a management design that will meet diverse environmental, economic, and social interests, including the needs and objectives of the landowner.

The blending of art and science that occurs in forest management is similar to what occurs in a building project. Like the multidisciplinary team that designs and constructs buildings, sustainable forest management involves a team that includes foresters, engineers, biologists, hydrologists, surveyors, and loggers that plan and care for the forest. In both cases, members of the team must address the technical requirements and obligations of their profession while taking into consideration the tastes and desires of the project partners and owners. In

DEFINING FOREST SUSTAINABILITY

Forest sustainability was first described in the book Sylvicultura oeconomica by German author Hans Carl von Carlowitz, published in 1713—and, while our understanding of what constitutes sustainability has evolved significantly in 300 years, it has long been a cornerstone of forest management.[14]

Von Carlowitz's work planted the seed for what we now know as sustainable development, defined in the landmark 1987 report of the World Commission on Environment and Development (the 'Brundtland Report') as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

The Food and Agriculture Organization of the United Nations (FAO) defines sustainable forest management as, "the stewardship and use of forests and forest lands in a way and at a rate that maintains their biological diversity, productivity, regeneration capacity, vitality, and potential to fulfill, now and in the future, relevant ecological economic and social functions at local, national, and global levels, and that does not cause damage on other ecosystems."

In the United States and Canada, forest sustainability is measured against criteria and indicators that represent the full range of forest values, including biodiversity, ecosystem condition and productivity, soil and water, global ecological cycles, economic and social benefits, and social responsibility. Sustainability criteria and indicators form the basis of individual country regulations as well as third-party sustainable forest certification programs.

Shown is a Douglas fir working forest in Tillamook County, Oregon. Photo courtesy of the Oregon Forest Resources Institute

the case of forestry, this includes caring for the forest while meeting the needs of landowners, the environment, and their community.

PLANNING FORESTS OF THE FUTURE

Although approaches differ, effective multi-decade planning is a fundamental part of forest sustainability.

On national forests in the United States, for example, conformance with the National Forest Management Act (NFMA) requires the development of a comprehensive plan, utilizing substantial public involvement and sound science to guide management decisions.

In Canada, where most forests are publicly owned, integrated land-use planning seeks to balance the economic, social, and cultural opportunities in a forested area while maintaining the well-being of the forest. The public gets a say in decisions about how the land and its resources are managed; forest companies must solicit public input on their forest management plans, which must be approved by government agencies.

QUIZ

1. In the United States and Canada, responsible forest management has resulted in more than _____ years of net forest growth that has exceeded annual forest harvests.
   a. 110 b. 95
   c. 50 d. 85

2. The concept of forest sustainability was first described in:
   a. In 1713, in the book *Sylvicultura oeconomica*
   b. In the 1800s, when settlers coming to North America cleared an average of 2.1 acres of forest per person
   c. In 1987, by the World Commission on Environment and Development
   d. In 1992, as part of the United Nations Conference on Environment and Development

3. The term used to describe the estimated volume of timber that can be harvested from an area while meeting environmental, economic, and social objectives is:
   a. Ecosystem condition b. Biodiversity
   c. Mass timber construction d. Wood supply

4. Clearcutting is considered an appropriate silvicultural tool:
   a. When young trees of a species need an abundance of sunlight to germinate and compete successfully with other plants and species
   b. On private lands only
   c. When woody debris in the forest builds up and increases the risk of wildfire
   d. When the forest company is in a hurry to finish harvesting before winter

5. In the United States, commercial and government use of herbicides in the forestry sector accounts for what percent versus the percentages used in home and garden and agriculture?
   a. 30 percent forest/10 percent home and garden/60 percent agriculture
   b. 43 percent forest/12 percent home and garden/45 percent agriculture
   c. 4 percent forest/5 percent home and garden/91 percent agriculture
   d. 18 percent forest/28 percent home and garden/54 percent agriculture

6. All of the following contribute to biodiversity EXCEPT:
   a. Planning forest management to maintain habitat patterns
   b. Managing forests so they resemble forests established by natural disturbance (such as fire or wind)
   c. Creating parks and protected areas
   d. Adding diversion ditches and water bars to forest roads

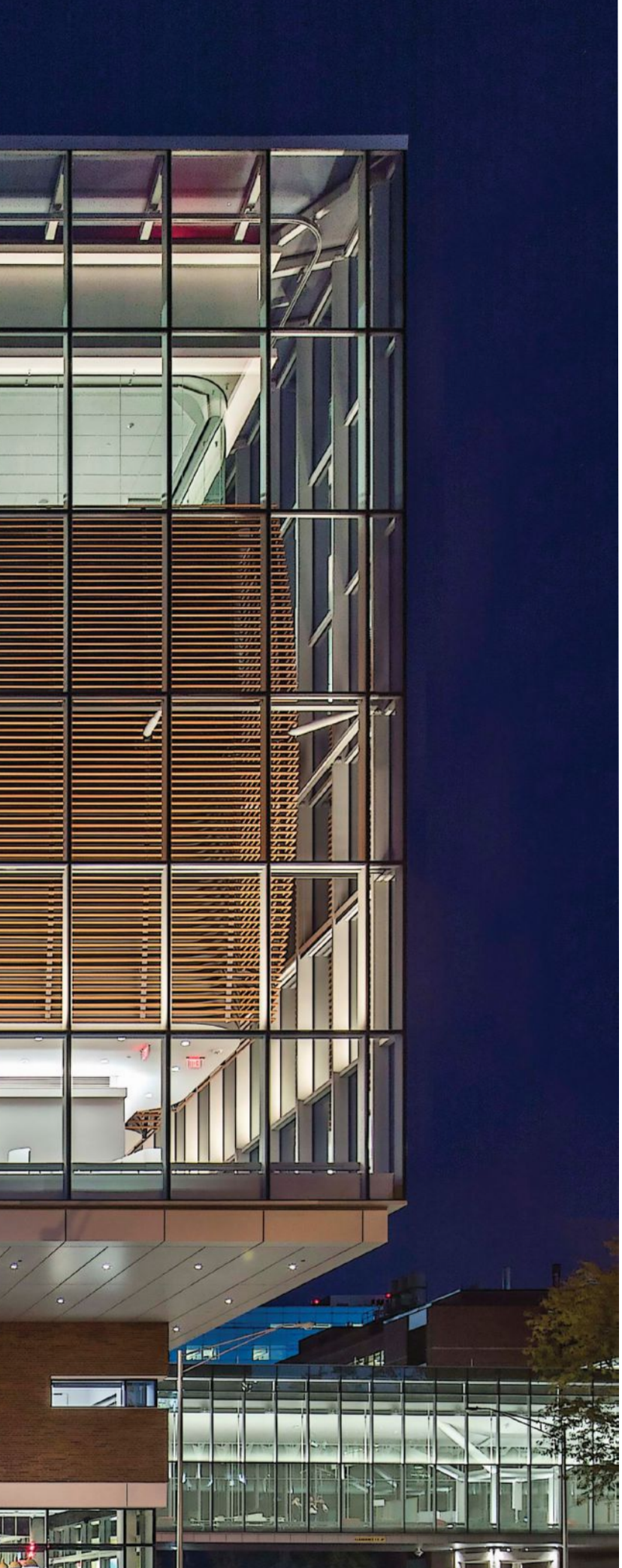
7. Deforestation is defined as:
   a. Areas impacted by insects or wildfire prior to regeneration
   b. Harvested areas prior to regeneration
   c. Forested lands that have been permanently converted to other uses
   d. Areas that need additional treatments when the regenerating forests are young

8. According to the course, _____ is an important indicator of forest sustainability as it enables organisms and ecosystems to respond and adapt to environmental change.
   a. Biological diversity (biodiversity) b. Carbon
   c. Biomass energy d. Biohabitat

9. The latest forest inventory systems use light detection and ranging technology to do which of the following?
   a. Identify habitat and sensitive areas b. Build more environmentally sound road systems
   c. Identify popular areas for backwoods camping d. A and C only

10. Threats to forest sustainability include:
    a. Forest fragmentation b. Urban development
    c. Increased wildfire and insect infestation d. All of the above

This article continues on http://go.hw.net/AR012020-3. Go online to read the rest of the CEU course, complete the corresponding quiz for credit, and receive your certificate of completion.



Less green.
For less green.

Find affordable clarity in the *Solarban*® *Acuity*™ low-e glass series.

Introducing *Acuity*™ low-iron glass — which is 60 percent less green than ordinary clear glass. The new *Solarban*® *Acuity*™ series by Vitro Architectural Glass provides the truly clear look you want with the outstanding performance of the full range of *Solarban*® solar control low-e coatings.

Upgrading a low-e coated clear insulated glass unit to *Solarban*® *Acuity*™ glass will typically increase the total installed curtainwall cost by only $1–2 per square foot.

Give a little, get it all.
Request your samples at vitroglazings.com/acuity

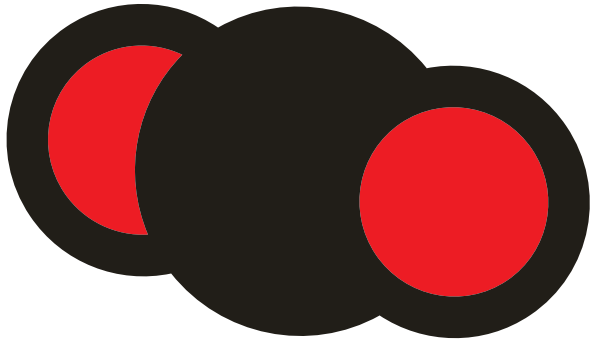
SOLARBAN® *Acuity*™ Series
Low-E Low-Iron Glass

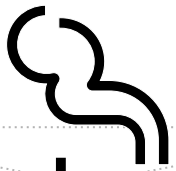
University of Kansas Medical Center
Health Education Building | Kansas City, Kansas
Helix Architecture + Design and CO Architects

Shown: *Solarban*® 72 *Starphire*® glass*

*Like *Solarban*® *Starphire*® glass, *Solarban*® *Acuity*™ glass delivers a distinctive, highly transparent low-iron aesthetic.

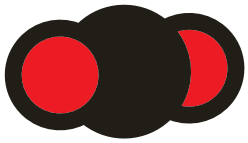
Vitro® Architectural Glass

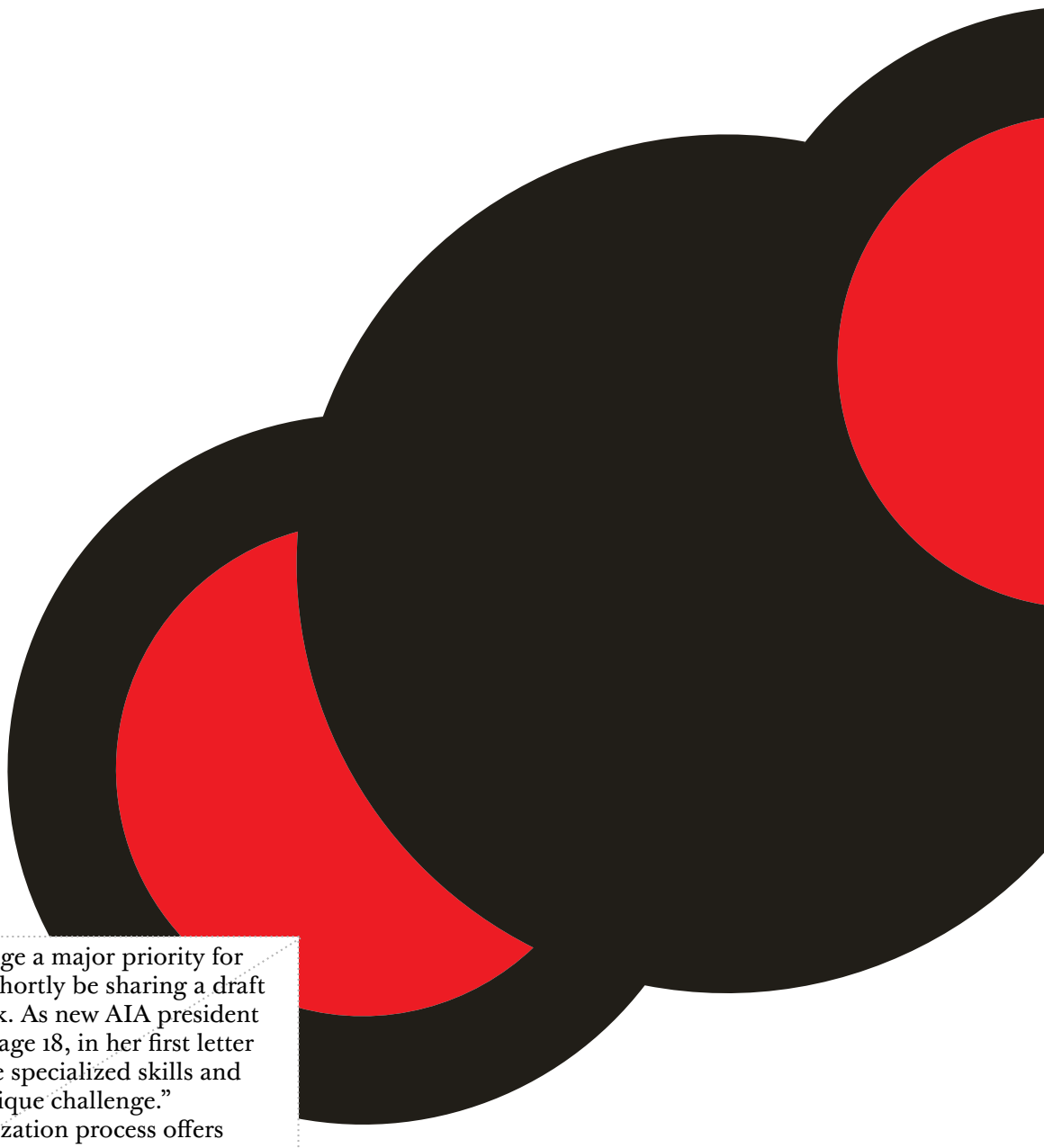




The Carbon Issue

Architecture must quickly kick its carbon habit and minimize the threat of climate change. The profession has already made great progress toward eliminating CO_2 emissions from new buildings' operations. But energy efficiency is just the first step. The next is to shift to renewables and eliminate emissions from building materials, also known as **embodied carbon**.





AIA is making climate change a major priority for the foreseeable future, and will shortly be sharing a draft action plan for member feedback. As new AIA president Jane Frederick, FAIA, writes on page 18, in her first letter to members, "Architects have the specialized skills and perspective to help solve this unique challenge."

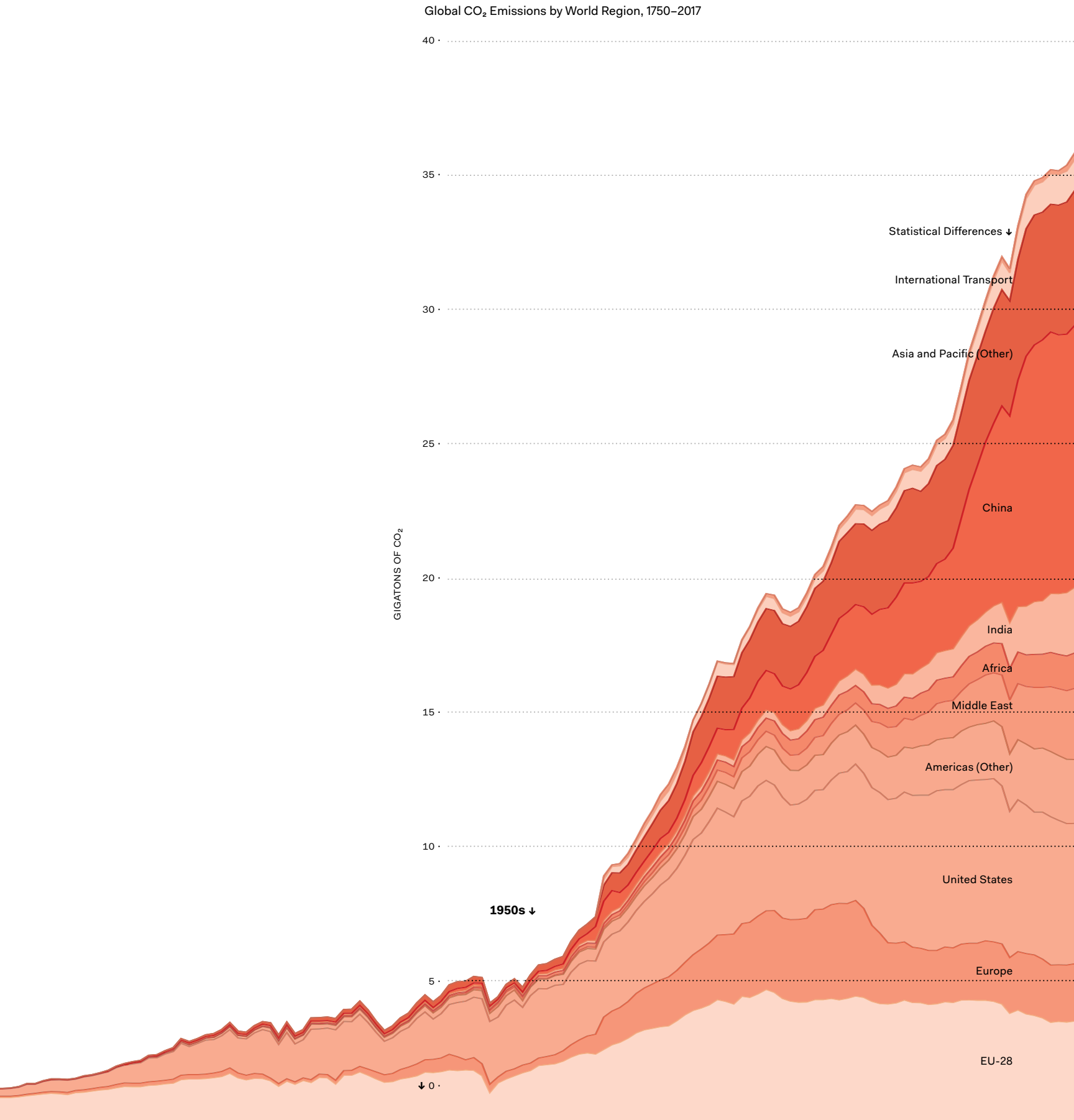
What's more, the decarbonization process offers architects an epochal opportunity to reinvent how and what they design. This special issue of ARCHITECT, edited in partnership with the nonprofit Architecture 2030 and its founder and CEO, Edward Mazria, FAIA, is meant to help architects get CO_2 out of their systems, for the health, safety, and welfare of us all.

Embodied Carbon
The CO_2 emitted during the extraction, manufacture, and transport of building materials and products, and the construction of buildings and infrastructure.

Humanity has been on a carbon binge since the 1950s.

Burning fossil fuels for energy releases CO_2 into the atmosphere, trapping heat, raising the temperature of the planet, and causing massive changes to the climate and ecosystems. The process began with industrialization in Europe, and increased profoundly after World War II.

ADAPTED FROM THE OPENING AND CLOSING KEYNOTES GIVEN BY EDWARD MAZRIA, FAIA, AT THE CARBONPOSITIVE'19 SUMMIT IN CHICAGO


Global CO_2 Emissions by World Region, 1750–2017
GIGATONS OF CO_2
40
35
30
25
20
15
10
5
0
Statistical Differences
International Transport
Asia and Pacific (Other)
China
India
Africa
Middle East
Americas (Other)
United States
Europe
EU-28
1950s

We now exert a dominant influence on the climate and environment. If we don't quit burning fossil fuels, the effects will be catastrophic.

"Climate-related natural disasters are becoming more frequent, more deadly, more destructive, with growing human and financial costs," U.N. Secretary General António Guterres said last month. The 2015 Paris Agreement's long-term temperature goal is to keep the global average increase well below 2 degrees C above preindustrial levels, and to pursue 1.5 C, as this would substantially reduce the risks and impacts of climate change. We can only release about another 340 gigatons of CO_2 into the atmosphere—that's the limit of our "carbon budget"—and still have a 67% chance of limiting warming to 1.5 C.

What Warming May Bring

+8° The world's current grain-producing regions are no longer able to produce food efficiently.

+7° In the tropics, exposure to the outdoors becomes deadly as heat dissipation becomes impossible.

+6° The oceans emit poisonous hydrogen sulphide gas.

+5° The World Meteorological Organization's outer projection for global average temperature by 2100. Global grain prices double.

+4° Sea level rise submerges land currently home to 470–760 million people globally.

+3.7° Economic damages from climate change total $551 trillion—twice as much wealth as exists in the world today.

+3° The Amazon rainforest turns into savanna. Hundreds of millions of refugees flee deadly heat waves and drought in equatorial regions.

+2° The Paris Agreement upper limit goal. The Mediterranean basin experiences widespread desertification, coral reefs mostly disappear, and the ice sheets begin to collapse.

+1.5° The Paris Agreement lower limit goal. Flood damage increases by 160%–240%. Up to 350 million more city dwellers than today are vulnerable to extreme drought.

+1° We are here. Half of the world's coral reefs and vertebrate animals have died in the past few decades due to a combination of local factors and global warming.

0° Preindustrial average global temperature, circa 1750.

SOURCES (TOP TO BOTTOM): D. Battisti & R. Naylor, "Historical Warnings of Future Food Insecurity with Unprecedented Seasonal Heat," *Science*, 2009; S. Sherwood & M. Huber, "An Adaptability Limit to Climate Change Due to Heat Stress," *PNAS*, 2010; J.-F. Lamarque, J.T. Kiehl & J.J. Orlando, "Role of Hydrogen Sulfide in a Permian-Triassic Boundary Ozone Collapse," *Geophysical Research Letters*, 2007; "Without Action, WMO Chief Sees Temperatures Rising 3–5C This Century," Reuters, Nov. 26, 2019; "Climate Stabilization Targets: Emissions, Concentrations, and Impacts Over Decades to Millennia," National Research Council, 2010; "Mapping Choices: Carbon, Climate, and Rising Seas—Our Global Legacy," *Climate Central*, 2015; "Risks Associated With Global Warming of 1.5 or 2C," Tyndall Centre for Climate Change Research, 2018; H. Fischer et al., "Palaeoclimate Constraints on the Impact of 2°C Anthropogenic Warming and Beyond," *Nature Geoscience*, 2018; E. Byers et al., "Global Exposure and Vulnerability to Multi-Sector Development and Climate Change Hotspots," *Environmental Research Letters*, 2018; C. Giannakopoulos et al., "Climate Change Impacts in the Mediterranean Resulting From a 2°C Global Temperature Rise," WWF, 2005; "Global Warming of 1.5°C," IPCC, 2018; G.R Grant & T. Naish, "Here's Why Scientists Are Working So Hard to Keep Warming Below 2 Degrees Celsius," *ScienceAlert*, Oct. 5, 2019; F. Dottori et al., "Increased Human and Economic Losses From River Flooding With Anthropogenic Warming," *Nature Climate Change*, 2018; "Global Warming of 1.5°C," IPCC, 2018; "Climate Change Threatens the Survival of Coral Reefs: Only 12 years to Avoid the Worst Damage," International Society for Reef Studies, 2018; "Living Planet Report 2018," World Wildlife Fund, 2018.

PREVIOUS PAGE, SOURCE: CARBON DIOXIDE INFORMATION ANALYSIS CENTER (CDIAC); GLOBAL CARBON PROJECT (GCP).
NOTE: "STATISTICAL DIFFERENCES" NOTES THE DISCREPANCY BETWEEN ESTIMATED GLOBAL EMISSIONS AND THE SUM OF ALL NATIONAL AND INTERNATIONAL EMISSIONS

B-635 Klutch
Mobile Device Holder

SMART PHONE, SMART HOME.

Studies suggest as many as 75 percent of Americans use their phones in the restroom. Bobrick's new, patented **B-635 Klutch Mobile Device Holder** keeps phones and mobile devices safe and secure. Featuring sleek design that complements any décor, Klutch's unique functionality provides modern convenience—easily installed in toilet cubicles or anywhere in the restroom hygienic storage is needed.

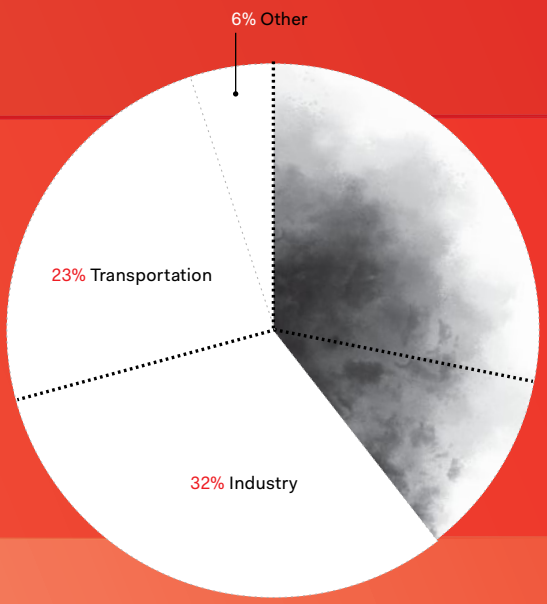
Specify Smarter

BOBRICK

Watch the product video at bobrick.com/klutch

Buildings are responsible for about 40% of global CO_2 emissions.

Global CO_2 Emissions by Sector

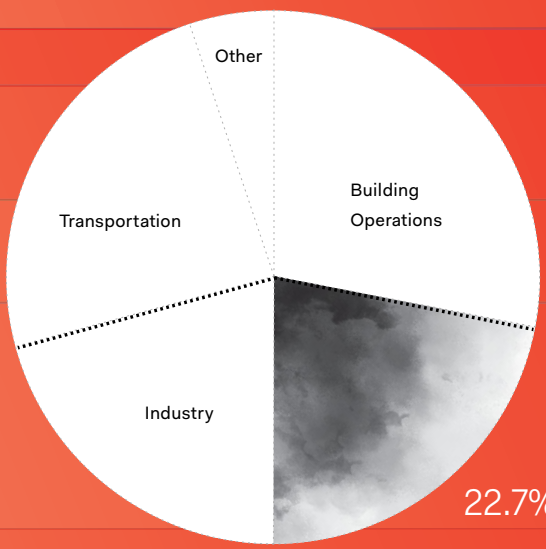


28% Building Operations

11% Building Materials and Construction

(Core and Shell)

Just three materials, mostly used in buildings and infrastructure, are responsible for over half of industrial CO_2 emissions.



22.7% Concrete (11.1%), Steel (10.1%), and Aluminum (1.5%)

(Including Buildings and Infrastructure)

SOURCE: 2018 GLOBAL ABC REPORT; IEA

Envista®

Roof and Floor Deck Ceiling Systems

Envista FA Timberlok® provides the structural support and fire resistance of steel roof deck panels while providing the warm appearance of natural wood. Envista offers four wood grain finish options, superior acoustic properties, and long spans up to 30´.

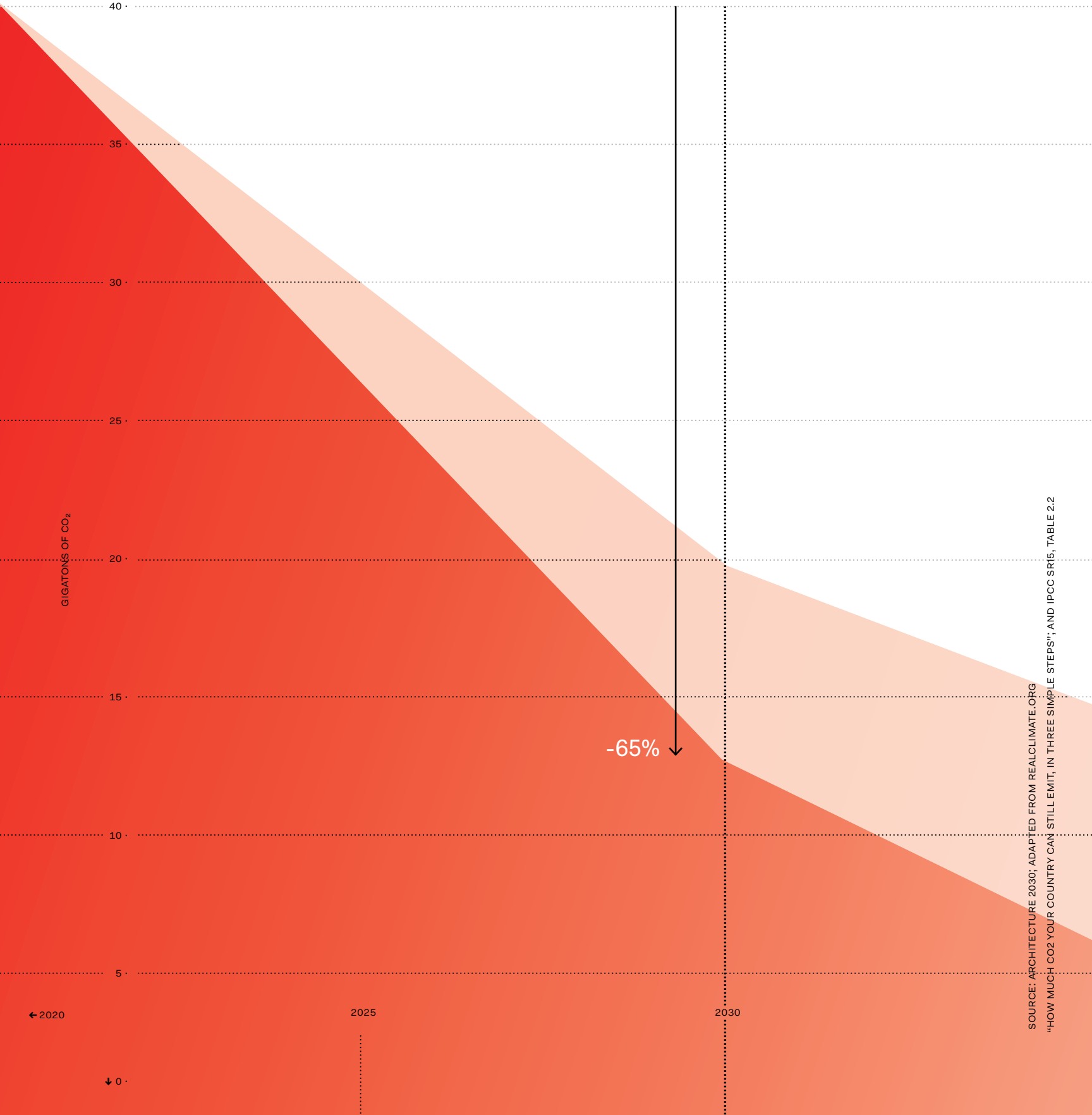
EPIC METALS®

877-696-3742 epicmetals.com

Products: Envista® F7.5A, Timberlok® Dark Cherry

West Texas A&M University, AG Science Building Canyon, Texas Products: Architect: Kirksey Architecture – Houston, Texas

Optimal Projected Global CO_2 Emissions, 2020–2050



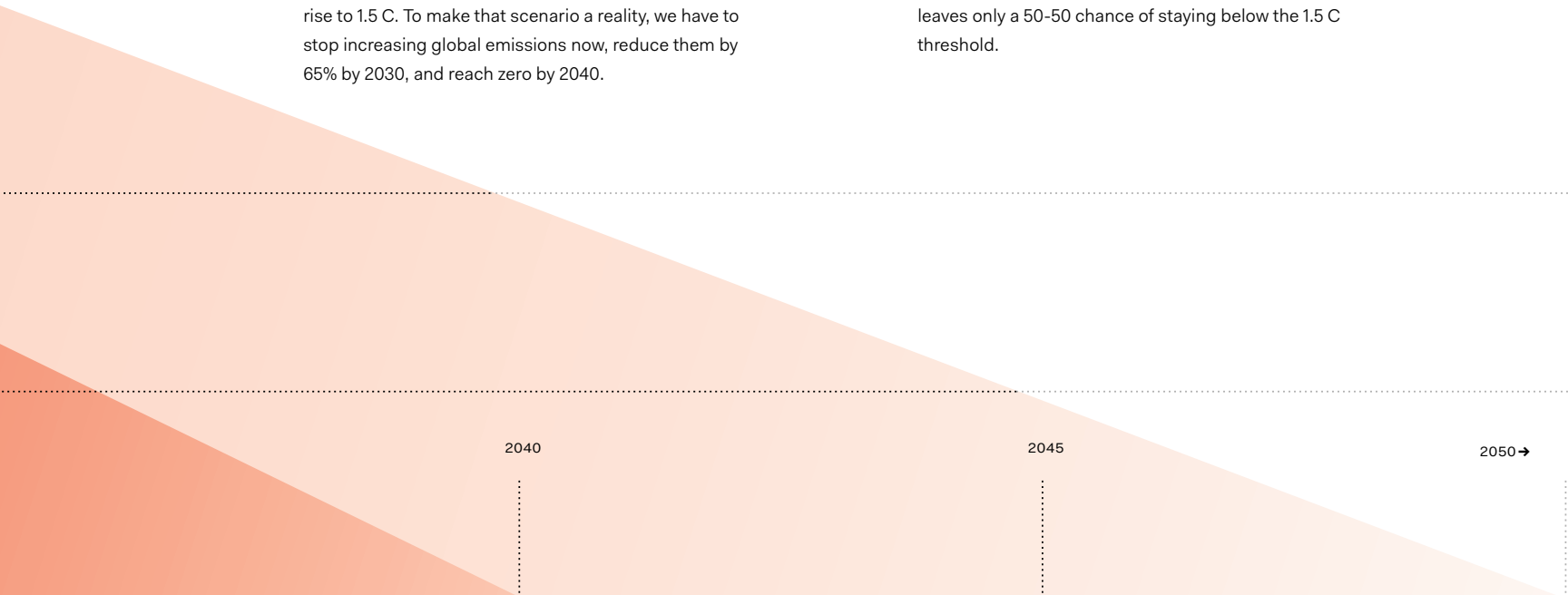
To stave off a climate catastrophe, we must act quickly—peak CO_2 emissions now, reduce them by 65% in the next ten years, and reach zero emissions by 2040.

■ ≈340 $GtCO_2$
(1.5 C, 67% Chance)

Capping total future emissions at ≈340 $GtCO_2$ will give humanity a 67% chance (a "high probability," as the scientific literature says) of keeping global temperature rise to 1.5 C. To make that scenario a reality, we have to stop increasing global emissions now, reduce them by 65% by 2030, and reach zero by 2040.

■ 500 $GtCO_2$
(1.5 C, 50% Chance)

Reaching zero in 2050 is only slightly less ambitious than the 2040 goal. But taking the extra decade means total global emissions will rise to 500 $GtCO_2$, which leaves only a 50-50 chance of staying below the 1.5 C threshold.

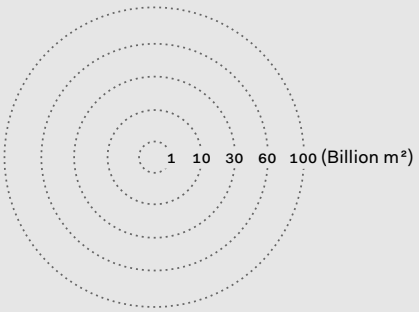


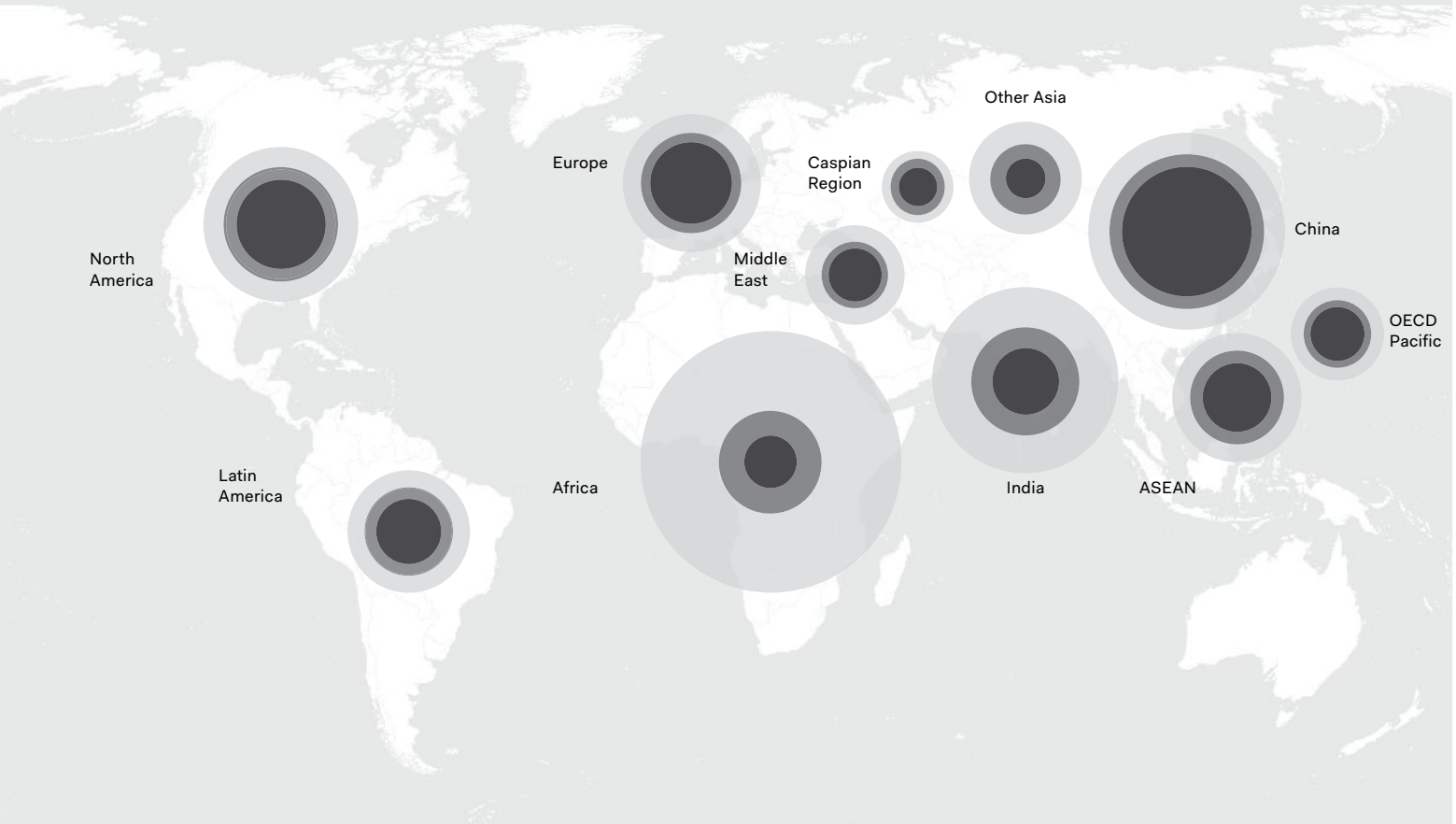
Meanwhile, global building stock is projected to double between now and 2060. This is a huge design, planning, and construction opportunity!

Population growth and economic development will drive demand for new urban construction, particularly in the emerging markets of India and Africa.

Building Floor Area Additions to 2060 (Billions m²)

	2030	2040	2060
Africa	3.5	13.5	88.2
China	22.4	32.4	50.0
India	5.7	21.5	45.0
North America	11.0	17.8	32.9
Europe	8.9	13.0	24.0
ASEAN	6.0	11.2	22.8
Latin America	5.7	10.0	19.8
Other Asia	1.9	6.1	16.1
Middle East	3.6	5.8	12.7
OECD Pacific	3.7	5.7	11.0
Caspian Region	2.1	4.0	6.5





SOURCE: ARCHITECTURE 2030; GLOBAL ABC, GLOBAL STATUS REPORT 2017 (AREAS ARE APPROXIMATE)

So here's what needs to happen:

Immediately, we must ...

- Ban the construction of new fossil-fuel power plants, and transition to renewable energy.
- Ban on-site fossil fuel use in new buildings
- Adopt a ZERO Code—all new buildings designed zero-net-carbon
- Begin electrifying existing buildings and reducing the embodied carbon of steel, concrete, and other building materials

By 2030, we must ...

- Phase out all coal power plants.
- Reduce the embodied carbon of steel and concrete to zero.
- Electrify 50% of existing buildings.

By 2040, we must ...

- Phase out all remaining fossil fuel power plants.
- Phase out the embodied carbon of all construction and building materials.
- Electrify all remaining existing buildings.

YOUR TENSION, PLEASE

Relax. Feeney delivers the highest-quality products to surpass the highest expectations. All backed by the promise of making it easy. From quoting to installation, Feeney steps up so there's less stress for you.

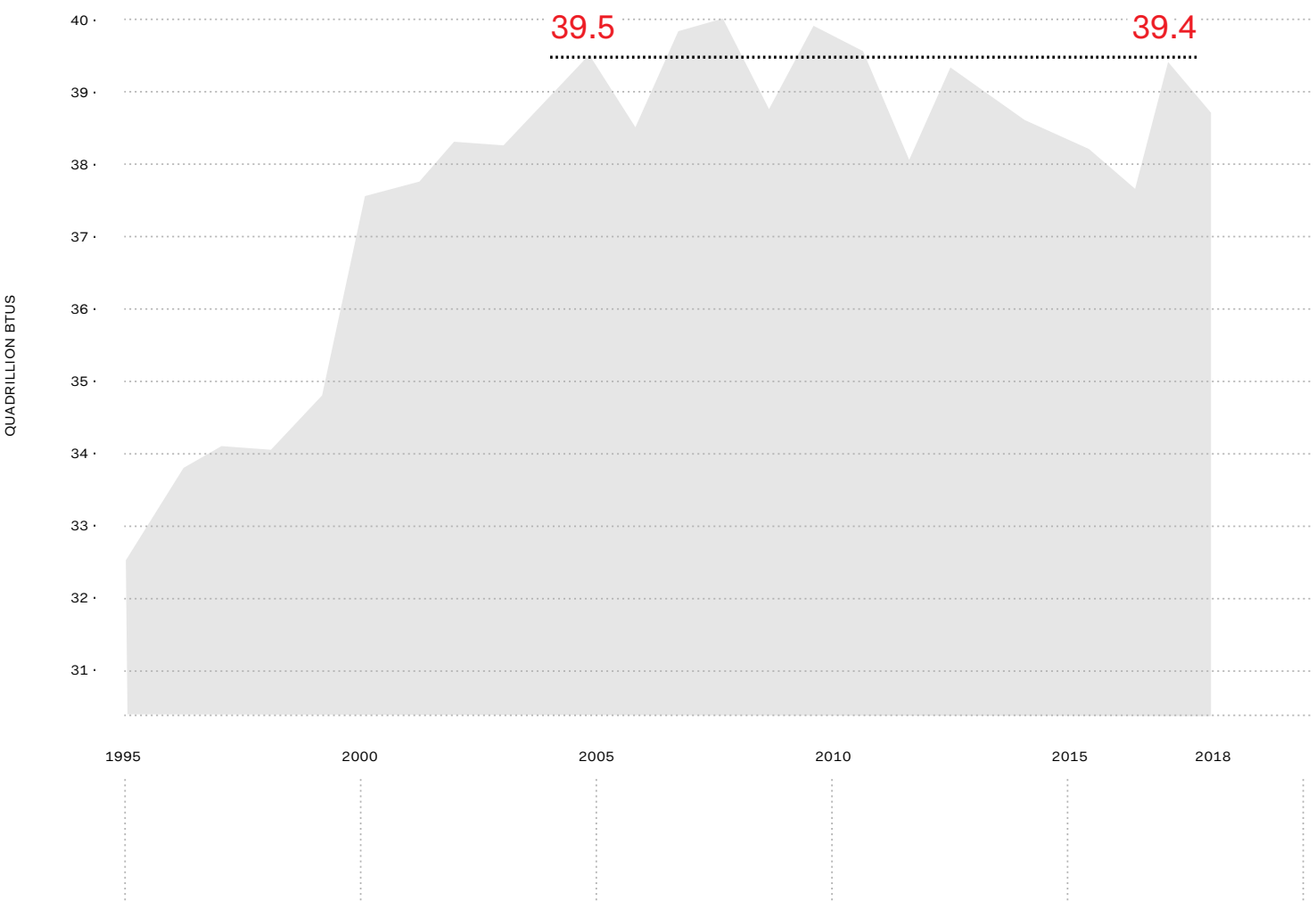
Lose the tension at **Feeneyinc.com.**

Feeney Makes it Easy.

feeney®

The U.S. building sector has made great strides in energy efficiency and the reduction of emissions from day-to-day building operations, even while adding over 30 billion square feet of building stock since 2005.

U.S. Building Sector Operations Energy Consumption



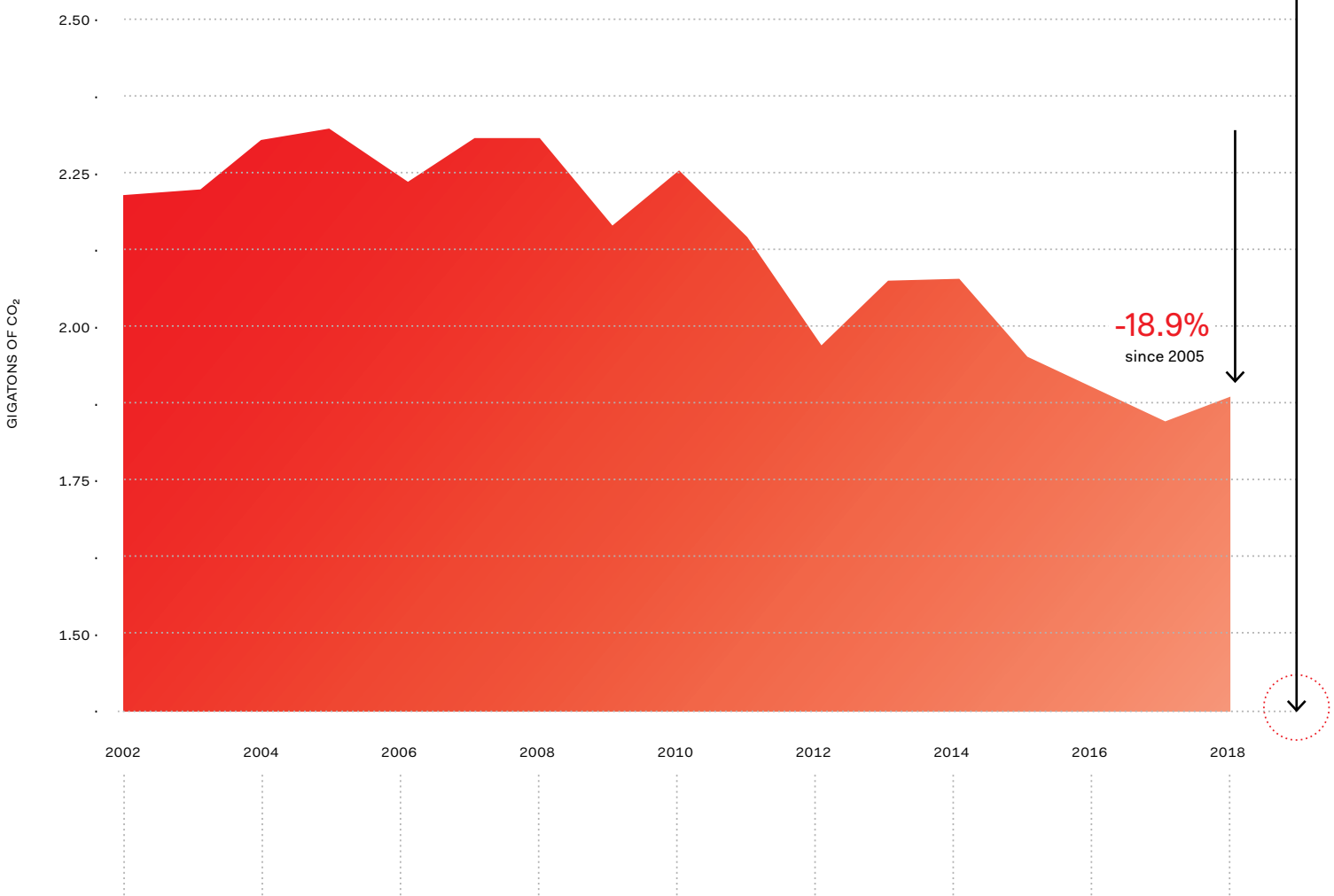
SOURCE: ARCHITECTURE 2030, U.S. ENERGY INFORMATION ADMINISTRATION, ANNUAL ENERGY OUTLOOK 2018

It's now possible for every new building to have zero-net-carbon operations.

To ensure zero-net-carbon new construction, Architecture 2030 developed the ZERO Code, a national and international standard for commercial, institutional, and mid- to high-rise residential buildings that pairs existing energy efficiency codes with electrification and on-site and/or off-site renewable energy.

> *Visit* zero-code.org *for more information.*

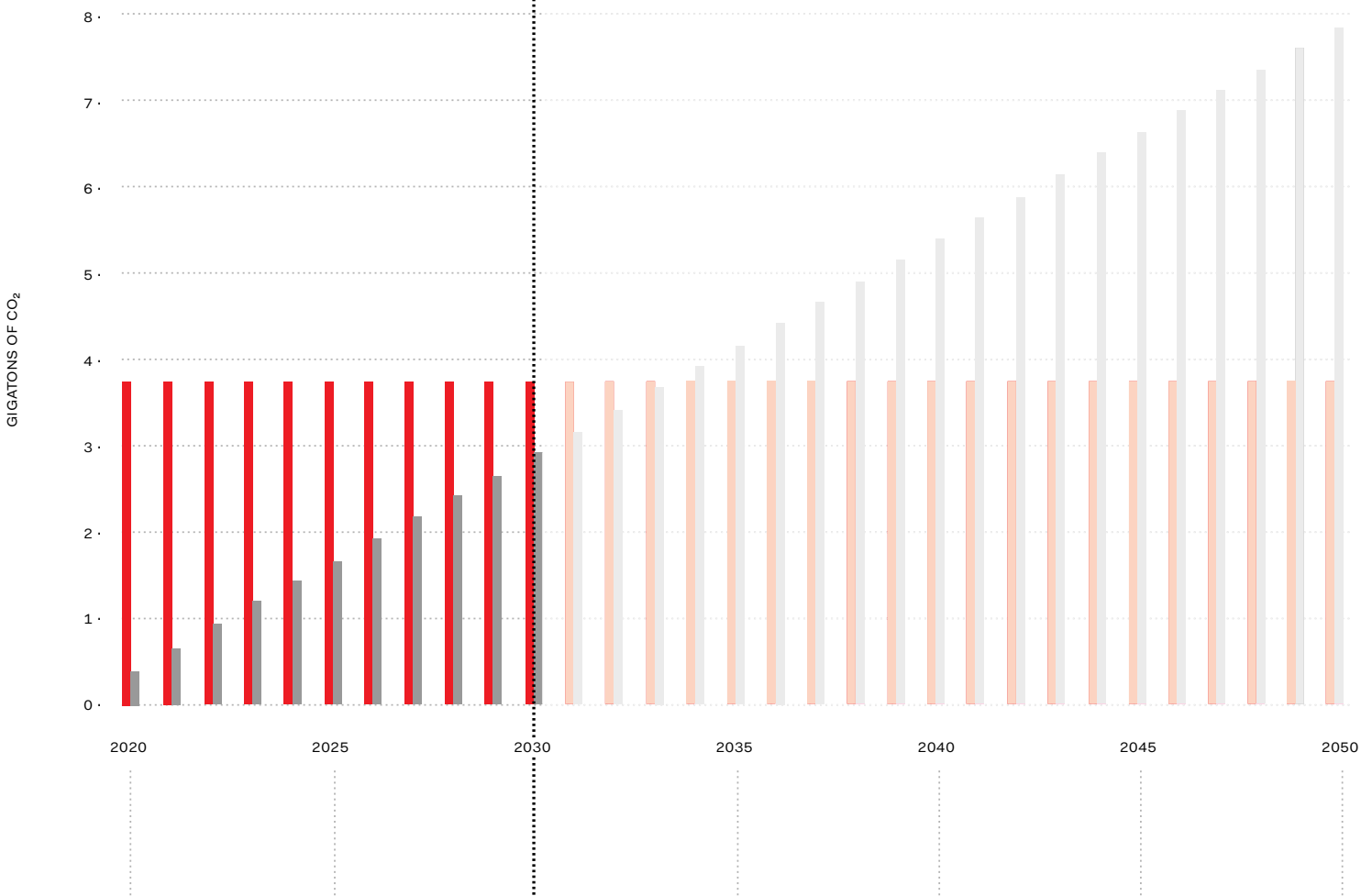
U.S. Building Sector Operations CO_2 Emissions



We must also dramatically reduce embodied carbon in infrastructure, buildings, and materials—in the next 10 years.

Quickly reducing the embodied carbon in building materials and construction over the next 10 years is critical. For all of the buildings built between now and 2030, ■ **embodied carbon** will be responsible for 72% of their CO_2 emissions and ■ **operational carbon** 28%.

The Time Value of Carbon



BUSINESS AS USUAL, GLOBAL SCENARIO; SOURCE: ©2019 2030, INC. / ARCHITECTURE 2030. ALL RIGHTS RESERVED. DATA SOURCES: UN ENVIRONMENT GLOBAL STATUS REPORT 2017; EIA INTERNATIONAL ENERGY OUTLOOK 2017 | SOURCE: ARCHITECTURE 2030; ADAPTED FROM EIA AEO 2017 AND GLOBAL ABC; GLOBAL STATUS REPORT 2017

It's not an impossible task: Modern architecture changed the world in just 27 years—from the Bauhaus to Lever House—and without the materials, equipment, and design and communication tools available today.

J. ALEX LANGLEY / ESTO

Materials

Building Products With Low Embodied Carbon

It may sound obvious, but a building's overall embodied carbon is inextricably linked to the composition of the products from which it is built. Moreover, the manufacture of materials like steel, concrete, aluminum, and glass for use in building construction accounts for 11% of global carbon dioxide emissions, according to the 2018 Global Alliance for Buildings and Construction report coordinated by the U.N. Environment Program. The following products feature admirably carbon smart formulations—and they are largely available for architects to start specifying today.

TEXT BY BLAINE BROWNELL, AIA

CalPlant I, CalPlant
After harvest, rice growers flood their fields to decompose the remaining straw byproduct. This winter, Willows, Calif.–based CalPlant will offer MDF panels made from rice straw collected from farms within a 25-mile radius of its plant, reducing the need for the water-intensive practice by utilizing a naturally carbon-sequestering material that otherwise would be considered waste. According to the company, the **biomaterial** performs similarly to, if not better than, wood-fiber based products. CalPlant's MDF will be available in 2mm to 30mm thicknesses. *calplant1.com*

EcoSmart Wallboard Panels Firecode X, USG
Utilizing special additives that purportedly reduce water usage during manufacturing by 25% as compared with conventional gypsum wallboard, USG maintains that its EcoSmart Sheetrock panels are less energy- and resource-intensive than traditional drywall. The product weighs 22% less than typical wallboard and therefore consumes up to 20% less transportation energy. EcoSmart contains no Red List chemicals and is Greenguard Gold–certified. Measuring ⅝" in thickness, the panels can be ordered by the square foot. *usg.com*

Recycled Plastic Cladding, Kedel
Lancashire, U.K.–based Kedel offers exterior cladding made from recycled high-density polystyrene otherwise destined for a landfill. The repurposed, durable material is allegedly easy to maintain and is manufactured without the high-energy input that virgin plastic or cement cladding production requires. The cladding is available in five finishes and 79" to 142" lengths. *kedel.co.uk*

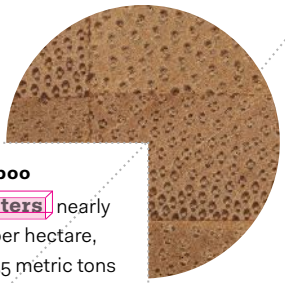
Bio-Based Material or Biomaterial
A product that consists of a substance (or substances) derived from living matter (biomass).

Carbon Smart Material
A material that is low carbon or carbon sequestering.

> *To learn about more materials and systems with low embodied carbon, visit bit.ly/Arch2030Products.*

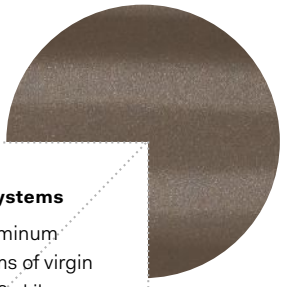
JEFF ELKINS

Carbon Sequestration
The process of capturing and storing atmospheric carbon dioxide that would otherwise be emitted or remain in the atmosphere.



Lamboo Structure, Lamboo

Mature bamboo sequesters nearly 80 metric tons of carbon per hectare, compared with less than 55 metric tons per hectare for fast-growing evergreen species. The Lamboo Structure series by its namesake Litchfield, Ill.–based producer includes engineered bamboo beams, posts, trusses, and other framing components that reportedly have tensile strengths 30% to 50% stronger than commonly used tree species. Available in four finishes or unfinished. *lamboo.us*



Rustic Shingle,
Classic Metal Roofing Systems

A kilogram of recycled aluminum displaces only 3.5 kilograms of virgin material compared to the 85 kilograms required for virgin aluminum. Piqua, Ohio–based Classic Metal Roofing Systems offers aluminum roof shingles made of up to 99% recycled content, sourced from post-consumer waste. According to the company, every 100 square feet of roof contains 1,815 discarded aluminum cans. *classicmetalroofingsystems.com*

Gutex Multitherm,
Gutex Rustic Shingle

German manufacturer Gutex produces exterior thermal insulation systems made from wood fiber, which requires less energy to process than conventional extruded polystyrene or closed-cell spray foam options. As a result, the tongue-and-groove style Gutex Multitherm insulation board resists moisture and wind while sequestering carbon. Gutex is available in 70"-by-24" sheets in 1.5" to 8" thicknesses. *gutex.de*

JEFF ELKINS

JUST AS YOU IMAGINED

Eldorado Stone produces premium stone products that empower visionaries and creators with inspiration to create more meaningful environments and experiences.

ELDORADO STONE®

A BORAL® Brand

eldoradostone.com

Visit Us at
IBS 2020 Booth #C4519

The Challenge of Structural Materials

TEXT BY GIDEON FINK SHAPIRO

In the U.S. commercial building market, steel and concrete predominate as structural materials, while engineered wood—specifically mass timber—is garnering attention for its potential embodied carbon savings and sequestration ability. Which of the three materials is actually the most environmentally responsible?

To promote his designs for lightweight structures, Buckminster Fuller famously asked, "How much does your building weigh?" Today, as architects realize that both structural efficiency and carbon efficiency are necessary, the question has become, "How much carbon does your building embody?"

Many architects are pushing for the reduction or elimination of embodied carbon emissions, as is already happening with **operational energy**. Beginning in 2020, for example, global architecture and engineering firm HOK plans to conduct a **life cycle assessment** on the structures of all of its new whole-building projects, and to "look for opportunities to optimize our specifications," says Anica Landreneau, ASSOC. AIA, director of sustainable design.

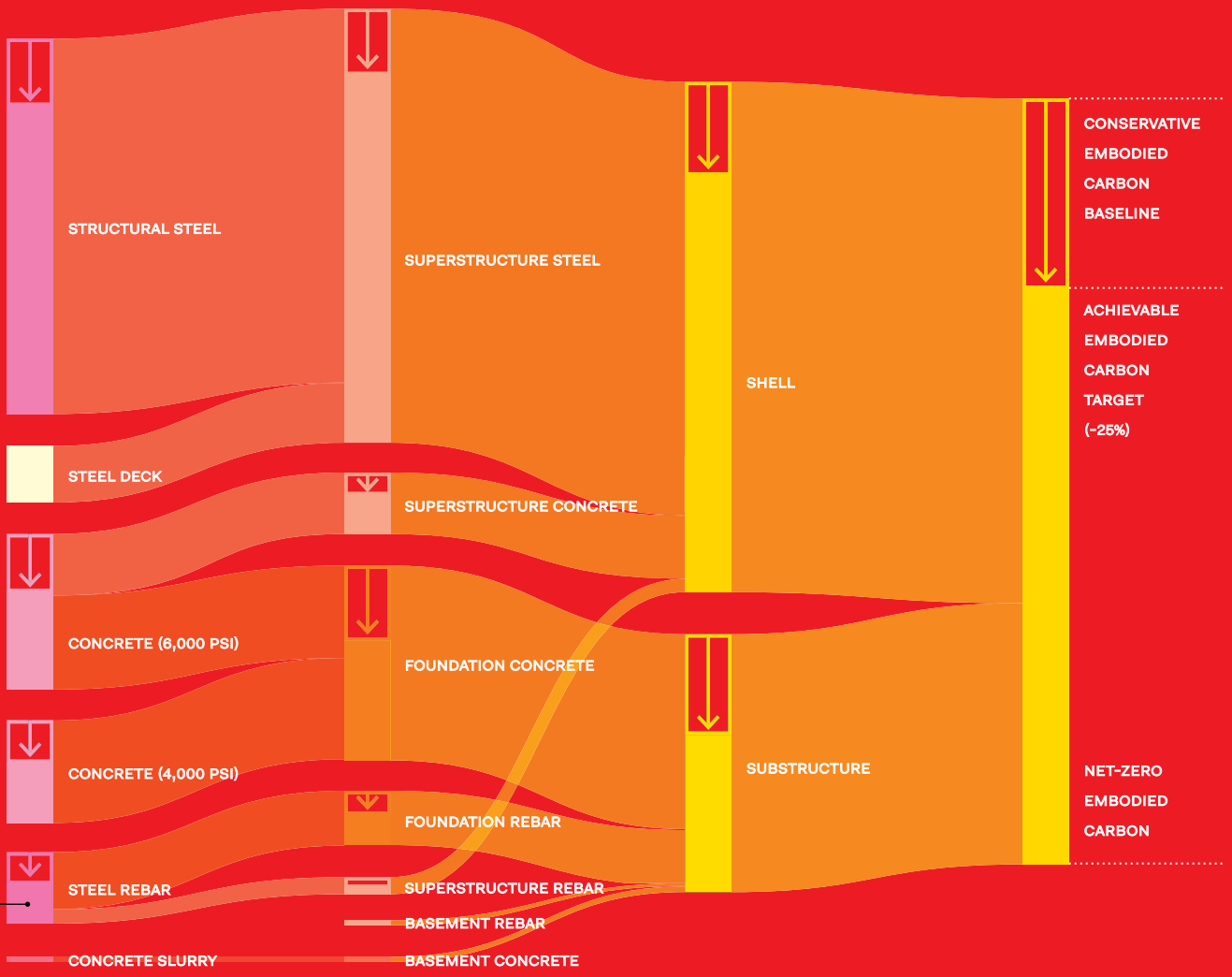
Indeed, the building structure and sub-structure are good places to hunt because, together, they constitute more than half of a commercial building's embodied carbon footprint. Moreover, architects and developers should look for opportunities to reuse and renew existing structures, so as not to waste the energy already expended (and carbon dioxide already emitted) to create them. Architecture 2030's Carbon Smart Materials Palette and the Embodied Carbon in Construction Calculator, or EC3, a tool developed by the Carbon Leadership Forum, C Change Labs, and Skanska, are great places to investigate the impact of material selection for both retrofit and new construction projects.

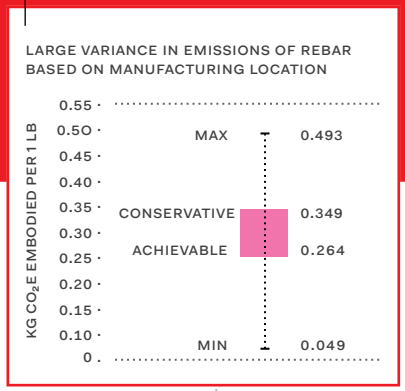
In weighing the options of steel, concrete, or wood, factors to consider include project location, scale, expected service life, reuse potential, and even the material metrics being compared (see "Making Sense of the Metrics," opposite). As awareness of embodied carbon increases, industries are angling to make their products more appealing. Architects alone can't reduce the embodied carbon of their projects, but they are the party most likely to have the client's ear, and can affect the supply chain through their specifications. Before finalizing material decisions, leverage the increasingly user-friendly comparison tools and bring builders and suppliers into the conversation—the earlier, the better.

Life Cycle Assessment (LCA)
A standardized, data-driven method of tracking and reporting the environmental impacts of a product or process throughout its full life cycle.

Operational Energy
The amount of energy that a building consumes for heating, cooling, ventilation, lighting, equipment, and appliances.

An example Sankey diagram of available reductions based on current supply chain, drawn from the Embodied Carbon in Construction Calculator





Making Sense of the Metrics

Measuring embodied carbon is complicated. It requires tracking materials through fantastically elaborate manufacturing supply chains. With so many variables, "the precision of a great deal of ecodata is low," writes British materials scientist Michael Ashby in his book *Materials and the Environment* (Butterworth-Heinemann, 2009).

The good news is that more manufacturers and industry groups are publishing environmental impact data on their products, often with third-party verification. Even better, new digital tools make it possible to compare life cycle analyses (LCAs) and Environmental Product Declarations (EPDs) during the course of project development. Examples include KieranTimberlake's Tally; Bionova's One Click LCA; and the Carbon Leadership Forum's EC3 tool, which compares all available EPD data.

The change is welcome. EPDs to date have proven woefully incomparable. Though all EPDs conform to the same ISO standard, each one defines its own product category rules and presents its data in a different format. Many EPDs even come with a disclaimer renouncing their comparability. For example, you may be able to search for products with the lowest global warming potential, but the underlying data may reflect only a portion a product's life cycle: the pre-construction phase (known as "cradle to gate"); a limited portion of the manufacturing phase ("gate to gate"); or the entire life cycle ("cradle to grave"), including maintenance and end of life.

The most useful EPDs are not only verified by a third party, such as UL, but also include data on specific manufacturers and factories. Industry-average data may conceal wide swings in the carbon footprints of different manufacturers and regional supply chains.

The takeaway? Always ask for cradle to grave EPDs from manufacturers and leverage tools that allow for comparability.

COURTESY CARBON LEADERSHIP FORUM

Steel

The global steel sector has a massive carbon footprint, contributing upwards of 10% of global carbon dioxide emissions. "The major steel companies are very well aware of the demands of society to reduce emissions, and they are looking for ways to respond to that," says Matthew Wenban-Smith, executive director of ResponsibleSteel, an international, not-for-profit organization based in Wollongong, New South Wales, Australia.

Manufacturing virgin steel from iron ore is energy intensive. Basic oxygen furnaces (BOFs), the norm in much of the developing world, require coke—a purified version of coal—to extract the iron from the ore and alloy it with carbon. The result, pig iron, is then refined into mild steel, which incorporates about 25% recycled iron and steel scrap. Manufacturers are experimenting with ways to replace coal and coke with non-fossil agents like hydrogen and electrolysis in BOF mills.

The American Institute of Steel Construction estimates that 98% of structural steel from demolished buildings is recovered and recycled into new steel products. As such, domestically produced structural steel, which comes from electric arc furnace (EAF) mills, boasts a recycled content of 93%, according to a UL-verified **Environmental Product Declaration** (EPD) authored by the AISC in 2016. "A car door, a steel beam, a shipping container, or an old refrigerator could be sold as scrap and turned into a steel wide-flange beam that goes into a new skyscraper," says AISC adviser Luke Johnson.

Because EAF mills run on electricity, they largely are as green as their power source. Last September, a 19th-century Colorado steel mill owned by Russian conglomerate Evraz reached a deal with the local power utility to build an adjacent 240-megawatt solar array, which will supply a significant portion of the mill's energy. Steelmaker Nucor is building a $250 million mill in Missouri that will be entirely powered by wind. Other, similar projects are in the works.

ResponsibleSteel recently published the first version of its eponymous standard, a voluntary, international benchmark designed to support "the responsible sourcing and production of steel" and developed through a multi-stakeholder process involving manufacturers, like ArcelorMittal, and environmental advocacy groups, like Mighty Earth. Certification is based upon third-party auditing and independent panel approval.

Wenban-Smith, who helped draft sustainability standards in forestry prior to focusing on steel, wants to make steel one of the world's cleanest materials: "When the energy footprint for EAF becomes neutral, we can think of steel in a fully circular economy," he says. Realizing that dream, if possible, would likely occur first in developed nations, where large quantities of scrap are available for recycling.

Concrete

People love to hate concrete almost as much as they love using it. As the world's most ubiquitous construction material, it contributes 6% to 11% of global carbon dioxide emissions. Most of those emissions come from the production of its binder, portland cement, which comprises about 10% of the concrete mix by weight, on average. Producing aggregate—sand and crushed rock, which may constitute 70% to 80% of the mix, on average—also requires energy, but much less so. Sand mining can damage river and coastal ecosystems.

Nearly half of cement's carbon dioxide emissions results from the burning of fossil fuel to heat cement kilns to about 2,500 F. Advances in clean energy production can help reduce these emissions: Solar-powered cement plant prototypes in California and France by Heliogen and Solpart, respectively, have successfully heated kilns to around 1,800 F using enormous mirror arrays. However, the majority of carbon dioxide emissions come from chemical reactions that are inherent to cement's production: In a process called calcination, limestone breaks down into carbon dioxide—which escapes into the atmosphere—and quicklime, an ingredient of cement.

Some companies have sequestered carbon dioxide into concrete, including Dartmouth, Canada–based CarbonCure and Los Gatos, Calif.–based Blue Planet. These processes remain the exception and, to date, do not fully offset the carbon emissions of concrete production.

Currently, the most straightforward way to reduce concrete's carbon footprint is to use less cement, as the Carbon Smart Materials Palette makes clear. So-called blended cements use uncalcined limestone and other supplementary cementitious materials (SCMs) in place of a portion of clinker—the hard, kiln-formed pellets that are ground and mixed with other ingredients—in the manufacture of cement. Encompassing natural pozzolans, such as rice husk ash, and industrial byproducts, such as fly ash, blast-furnace slag, and silica fume, SCMs can improve the structural performance of concrete as well as lower its embodied carbon.

North America lags behind Europe in adopting blended cements, says Julie Buffenbarger, senior scientist and sustainability principal at Mendota Heights, Minn.–based Beton Consulting Engineers. Specifications are a good way to make concrete construction more efficient, she notes, but being too prescriptive can be counterproductive. Rather than dictate the ingredient proportions in a concrete mix, she suggests design teams specify performance criteria in terms of measurable plastic and hardened properties, "so the producer can provide options within the constraints." Keep in mind that SCMs may extend the times needed to reach the required strength benchmarks.

Environmental Product Declaration
An internationally accepted, verified, and published report that communicates transparent information about the environmental impacts of a product throughout its life cycle.

BUILD SMART

BUILD EFFICIENT

Whatever your profession, whatever your goals, Cultured Stone is determined to equip you with the products and resources necessary to achieve your vision.

Visit Us at **IBS 2020 Booth #C4519**

culturedstone.com

CULTURED STONE®

A **BORAL**® Brand

Timber

Innovations in **mass timber**, notably the domestic production of engineered products such as cross-, glue-, nail-, and dowel-laminated timber, have fueled hopes of making carbon-neutral building attainable on a large scale. According to industry-backed analyses, the trees felled—and replaced—to produce mass timber can sequester more carbon during their growth than what's emitted to manufacture, transport, and construct with it. Increased demand for sustainably sourced timber could incentivize reforestation. "We have to re-cover parts of this planet with forests," HOK's Landreneau says. "We can impact that by specifying wood construction where possible."

Engineered wood panels can replace steel decking and concrete floor slabs in commercial structures, and glulam columns can take the load of mid-rise and high-rise structures from their steel and concrete counterparts. These timber products can also be fire-resistant and quick to assemble. "The day they're installed and connected to the structural frame, they're able to carry their full design load," says Kenneth Bland, a vice president at the American Wood Council.

But does mass timber live up to its billing as environmentally sustainable?

According to the U.S. Department of Agriculture, the total volume of trees growing in U.S. forests has increased 60% since 1953. As demand for engineered wood products ramps up, forests that produce mass timber will have to be managed sustainably, with trees replanted after harvesting. Differences in forest management practices translate into wide variations in the amount of carbon sequestered, so knowing where and how your timber products were made is important.

More research is needed on the carbon emissions of the logging, processing, and transport of wood products. New industry-average EPDs for wood and timber products are expected in the first quarter of 2020, but declarations from specific wood manufacturers would be even more useful. Beyond the carbon embodied in the wood itself are emissions from soil and forest impacts, and from the manufacture of the resins and glues that bind mass timber layers.

Finally, mass timber's carbon storage advantage only holds true if the beams and panels remain in service or are prevented from decomposing, which would release carbon back into the atmosphere. To be durable, wood structures must be protected from water, insect, or fungal infiltration potentially through the use of sealants combined with the sound design and detailing of the building envelope. To be reusable, timber members should be joined by removable fasteners.

Mass Timber
A type of structural system that utilizes large solid or engineered wood panels and framing members.

What to Ask When Specifying ...

Steel

- Is steel available from an electric arc furnace mill, and, in particular, one that is powered by renewable energy?
- Can the structure use braced frames instead of moment-resisting frames to reduce the mass of steel required?
- Can you source ResponsibleSteel-certified steel?

Concrete

- Can the amount of cement be reduced in the concrete mix?
- Can the overall mass of concrete in the project be reduced?
- What is the least energy-intensive cement kiln that is locally available?
- What carbon-sequestering aggregate or mix techniques can be included?

Wood

- Is your wood product reclaimed? If not, does it come from a sustainably managed forest?
- Can the structure be assembled with removable fasteners to allow for potential reuse of the members?
- Does the project use efficient framing techniques that minimize the mass of the timber required?

> *Find more tips and design guidance at Carbon Smart Materials Palette* (materialspalette.org).

BUILDINGENVELOPESYST FORMSHADOWLINETEXTURE
EMAIR**SPECWRITING**THER SPACEGESTUREMOTIFINSPIR
MAL**CONSULTATION**SCIEN ATIONCOLORLIGHTSTYLEDE
CE**ENGINEERING**MOISTU SIGNFREEDOMAESTHETICS
RE**INSTALLATION**OPTIONS SCALE**CREATIVITY**FUNCTION

Achieving a high-performance building envelope can be a complex, time consuming, often risky proposition. Not so with CENTRIA on your team. That's because we take an entirely different approach as expressed in our four guiding principles. **INTEGRATION** A building envelope is made from various components that must function in unison for high-level and longterm performance. Every element comprising a CENTRIA building envelope is engineered for precision integration in order to maintain critical air, water, thermal, and vapor controls, and to enhance aesthetics. **SIMPLICITY** With CENTRIA, a complex multi-component wall composed of 5 or 6 major elements - from as many manufacturers and requiring intensive training and skill of numerous trades to build - is reduced to a single component, from a single manufacturer, installed by a single well-trained and experienced specialist. **BUILDING SCIENCE** CENTRIA building envelope systems perform at the industry's highest levels in thermal; air, water, and vapor control; fire resistance; and resiliency categories and come with an industry-exclusive single-source performance warranty. **CREATIVE FREEDOM** CENTRIA gives architects the widest possible latitude in design - in materials, form, color, and texture - so that virtually any unique vision can be fully realized. Partner with CENTRIA on your next project and remove risk, eliminate burdens of engineering and detailing, achieve single-source responsibility, secure a building envelope performance warranty, and experience newfound freedom to focus

(This is where you come in.)

FIND NEW FREEDOM TO CREATE.

Partner with CENTRIA today and find new freedom to create remarkable buildings of tomorrow.

Visit CENTRIA.com/Freedom

CENTRIA

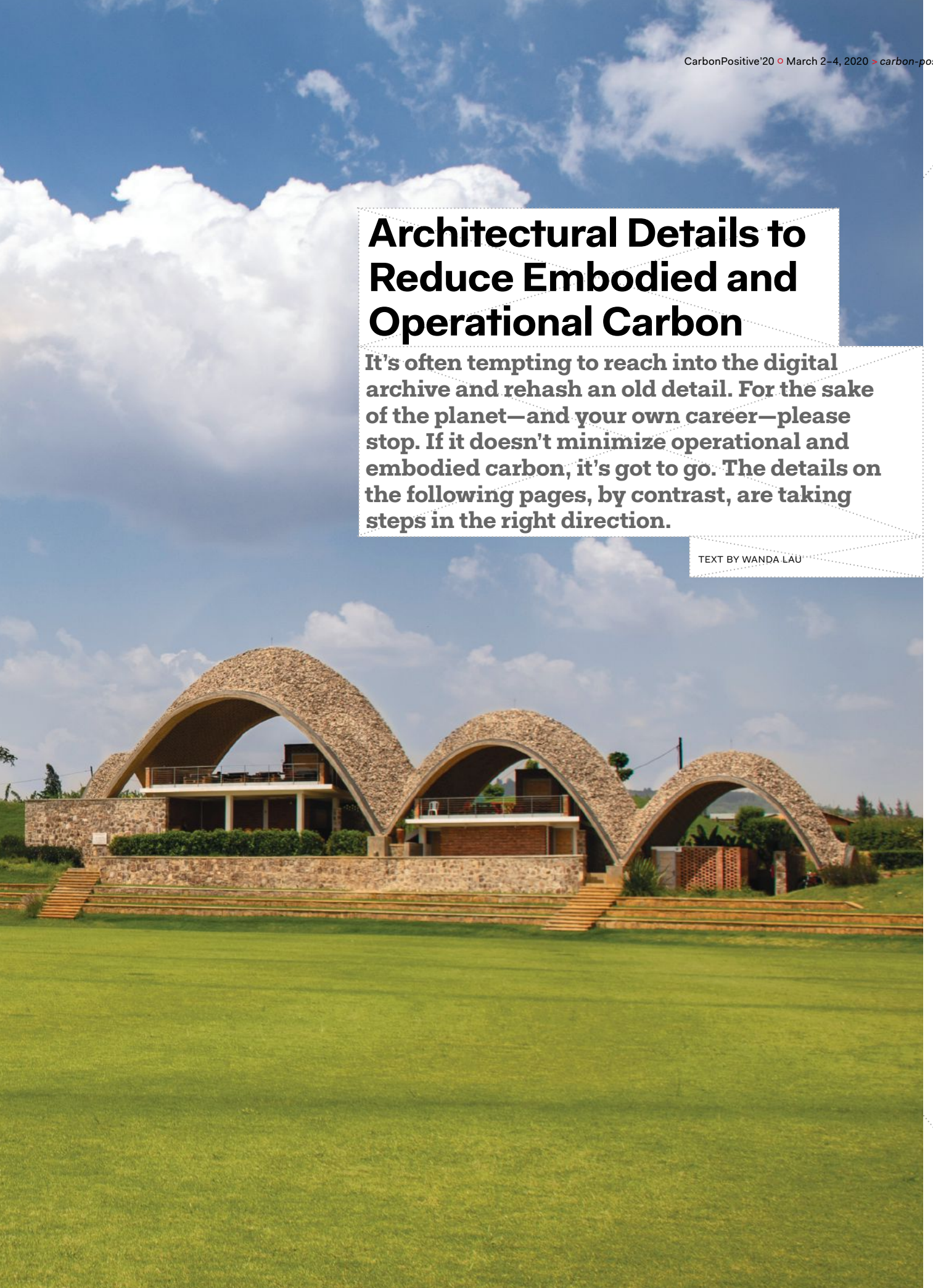
Design

COURTESY LIGHT EARTH DESIGNS

Architectural Details to Reduce Embodied and Operational Carbon

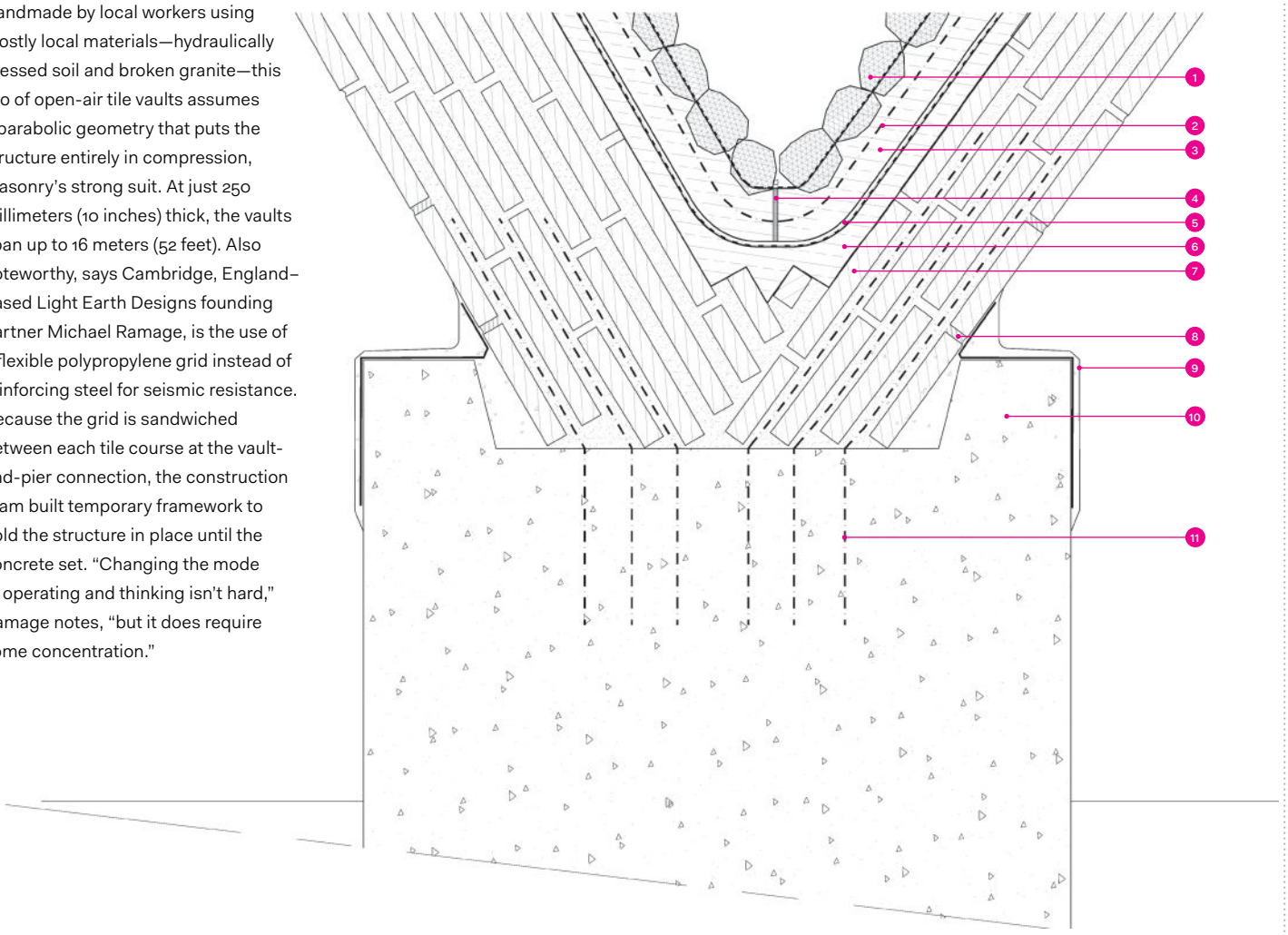
It's often tempting to reach into the digital archive and rehash an old detail. For the sake of the planet—and your own career—please stop. If it doesn't minimize operational and embodied carbon, it's got to go. The details on the following pages, by contrast, are taking steps in the right direction.

TEXT BY WANDA LAU



Rwanda Cricket Stadium
Kigali, Rwanda
Light Earth Designs

Handmade by local workers using mostly local materials—hydraulically pressed soil and broken granite—this trio of open-air tile vaults assumes a parabolic geometry that puts the structure entirely in compression, masonry's strong suit. At just 250 millimeters (10 inches) thick, the vaults span up to 16 meters (52 feet). Also noteworthy, says Cambridge, England–based Light Earth Designs founding partner Michael Ramage, is the use of a flexible polypropylene grid instead of reinforcing steel for seismic resistance. Because the grid is sandwiched between each tile course at the vault-and-pier connection, the construction team built temporary framework to hold the structure in place until the concrete set. "Changing the mode of operating and thinking isn't hard," Ramage notes, "but it does require some concentration."



"Two people with a van can carry a 300-square-meter roll of geogrid, further reducing its embodied energy from that of steel mesh. Overall, the tile vaults have approximately 75% less embodied carbon than if they were built using reinforced concrete."

—Michael Ramage, founding partner, Light Earth Designs

1. Ø50mm (approximate) broken granite
2. Tensar Triax Geogrid (typ.)
3. Floating sand/lime cement reinforced-screed
4. Movement joint
5. APP (atactic polypropylene) modified bitumen membrane finished with paint and weather shield
6. 25mm bonded sand and cement lime screed
7. Alternating 290mm × 150mm × 20mm soil-cement tiles in 20mm mortar bed
8. Gypsum Crystacal
9. Cemflex in sand-cement plaster
10. Reinforced concrete pad
11. Tension Triax Geogrid connection to reinforced concrete pad

Embodied Energy
The energy consumed during the extraction, manufacture, and transport of building materials and products, and the construction of buildings and infrastructure.

ORIGINAL DETAIL DESIGNED BY MICHAEL RAMAGE WITH REFINEMENTS BY LIGHT EARTH DESIGNS PARTNERS RAMAGE, TIMOTHY HALL, AND ANA GATÓO. DRAWN BY GATÓO.

UNIFY YOUR TOTAL RESTROOM VISION

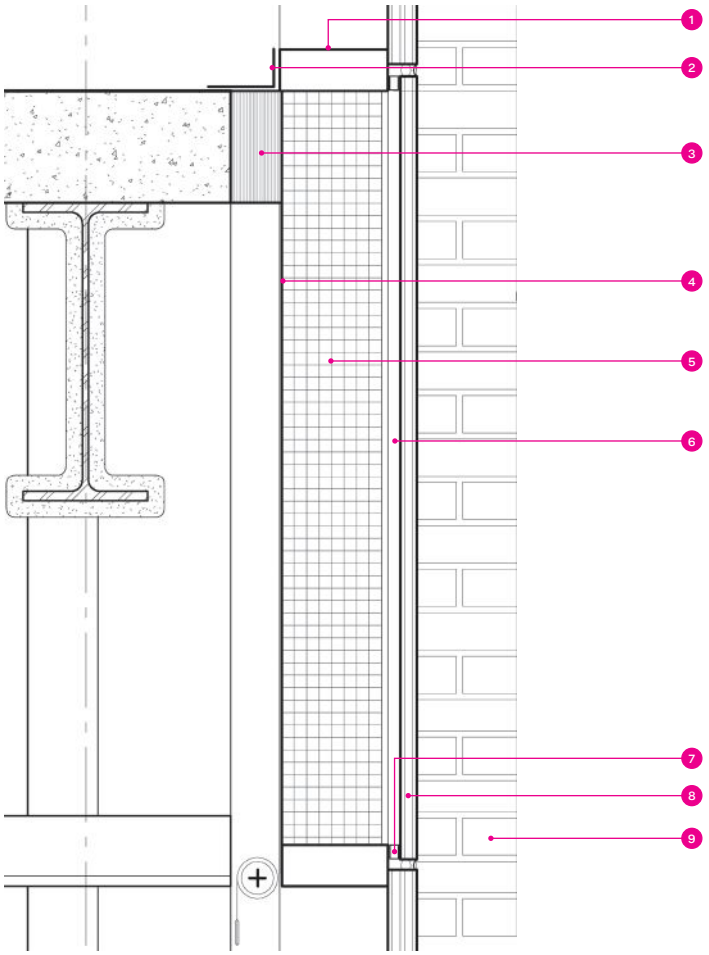
Our wide range of resources and elegant products is improving your ability to design, evaluate and specify your ideal restroom. As a single source partner, Sloan is elevating your aesthetic with products designed to unify the commercial restroom experience.

Unify your restroom at sloan.com/unify

SLOAN®
Water Connects Us®

Tufts University Science and Engineering Complex
Medford, Mass.
Payette

Full-height glazed curtain walls abound in all climate zones, desired for their ability to let in daylight and visually connect the indoors and outdoors. At Tufts University, Boston-based Payette strategically inserted a glass box between two historical red brick buildings—one of which the institution had proposed demolishing or relocating. The result is a singular interdisciplinary research hub that Tufts plans to own and operate for the next 100 years or more. "You want the insulation as close to the glass as possible," says Payette principal and building science director Andrea Love, AIA, without creating a large temperature differential between components or building up heat behind the wall. The detail uses mineral wool insulation, which has a lower embodied carbon than extruded polystyrene (XPS) and polyisocyanurate, though options with even lower embodied carbon could be potentially specified.



1. Curtain wall frame
2. Closure metal to match curtain wall frame
3. Perimeter fire-stopping
4. Galvanized sheet metal backpan at non-exposed locations; painted aluminum where exposed
5. 5" minimum mineral wool insulation
6. 1" air space
7. PVC insulated spacer (substitute phenolic wood pulp to reduce embodied carbon)
8. Insulating spandrel glass with stainless steel spacer
9. Masonry brick beyond

"As built, this detail achieved an R-value of 15.6, about 160% higher than a traditional spandrel panel."

—Andrea Love, AIA, principal and director of building science, Payette

PAYETTE

HEAD TO NEW YORK CITY AND JOIN US FOR TWO FULL DAYS OF NON-STOP LIGHTING ACTION!

With an exhibition expansion of over 400 exhibitors of architectural lighting, controls and related technologies, a historical LED Museum, and a Saint Patrick's Day Light It Up Reception, this is a year you don't want to miss!

Attendees will also have an exclusive opportunity to earn continuing education credits through a variety of dynamic seminars. From codes and technical issues to design topics and more, attendees can learn all aspects of solid-state lighting.

DLFNY thanks ARCHITECT and AL for their support as Media Sponsors of LEDucation 2020

ARCHITECT A·L ARCHITECTURAL LIGHTING

400+ EXHIBITS ACCREDITED SEMINARS "LIGHT IT UP" RECEPTION NETWORKING OPPORTUNITIES

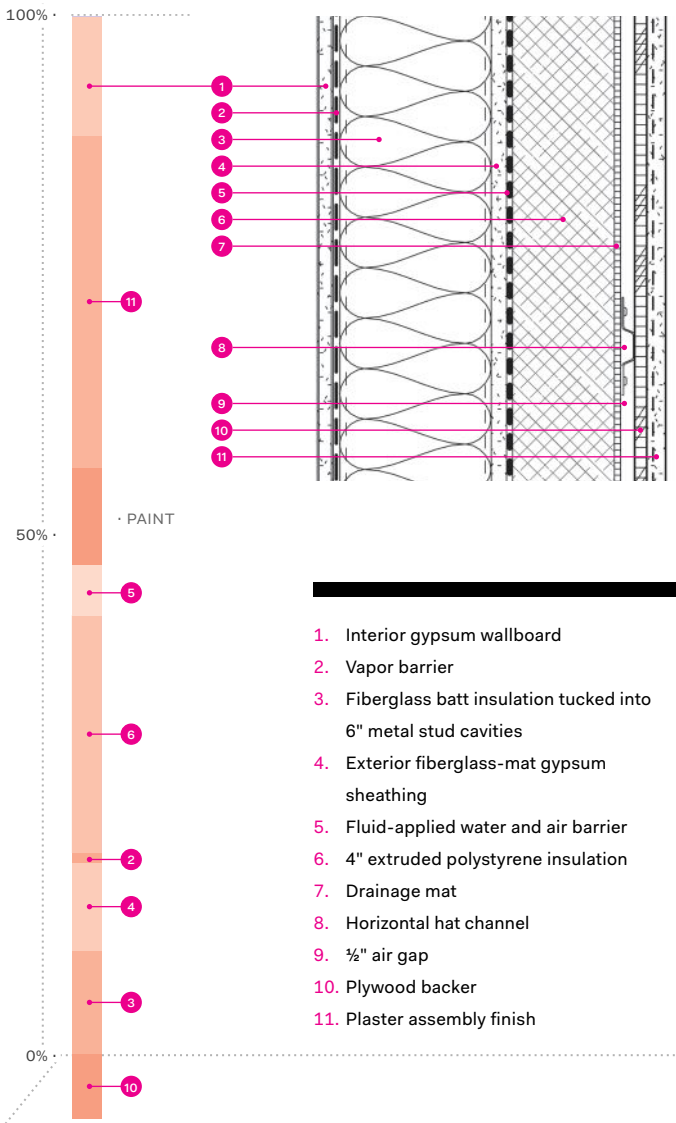
Project Name Withheld
East Coast, United States
McLennan Design

For this zero-net-energy project, Bainbridge Island, Wash.–based McLennan Design is putting its ongoing research of sustainable materials into practice. "Having an innate understanding of where embodied carbon comes from more fully allows you to come up with custom details for specific projects and locations," says designer Brad Benke, AIA. By undertaking these studies, he adds, architects can pinpoint missing industry data, encourage more manufacturers to publish Environmental Product Declarations, and "drive market change for lower carbon solutions." In these details, the firm discovered that switching the insulation material provided the greatest reduction in embodied carbon, while the plaster finish had the highest individual contribution. "We are now investigating ways to reduce the cement/lime content of the plaster while still maintaining performance," Benke says.

The optimized wall assembly reduces embodied carbon by 22% without compromising thermal performance. "Almost any cladding material could be used" with this wall assembly to achieve similar results.

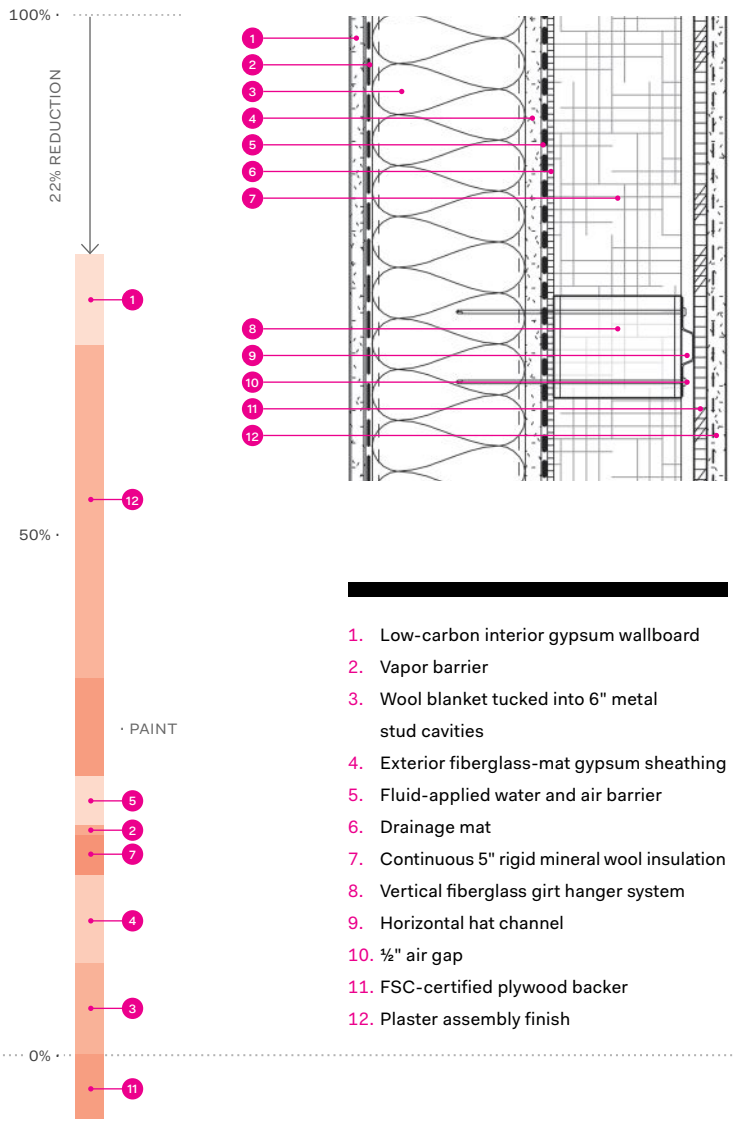
—Brad Benke, AIA, designer, McLennan Design

Conventional Plaster over Metal-Stud Rainscreen



1. Interior gypsum wallboard
2. Vapor barrier
3. Fiberglass batt insulation tucked into 6" metal stud cavities
4. Exterior fiberglass-mat gypsum sheathing
5. Fluid-applied water and air barrier
6. 4" extruded polystyrene insulation
7. Drainage mat
8. Horizontal hat channel
9. ½" air gap
10. Plywood backer
11. Plaster assembly finish

Optimized Plaster over Metal-Stud Rainscreen

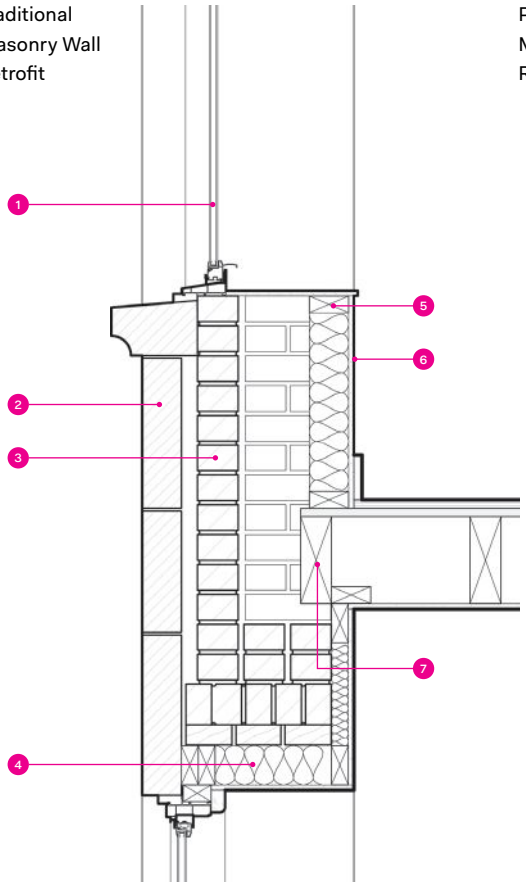


1. Low-carbon interior gypsum wallboard
2. Vapor barrier
3. Wool blanket tucked into 6" metal stud cavities
4. Exterior fiberglass-mat gypsum sheathing
5. Fluid-applied water and air barrier
6. Drainage mat
7. Continuous 5" rigid mineral wool insulation
8. Vertical fiberglass girt hanger system
9. Horizontal hat channel
10. ½" air gap
11. FSC-certified plywood backer
12. Plaster assembly finish

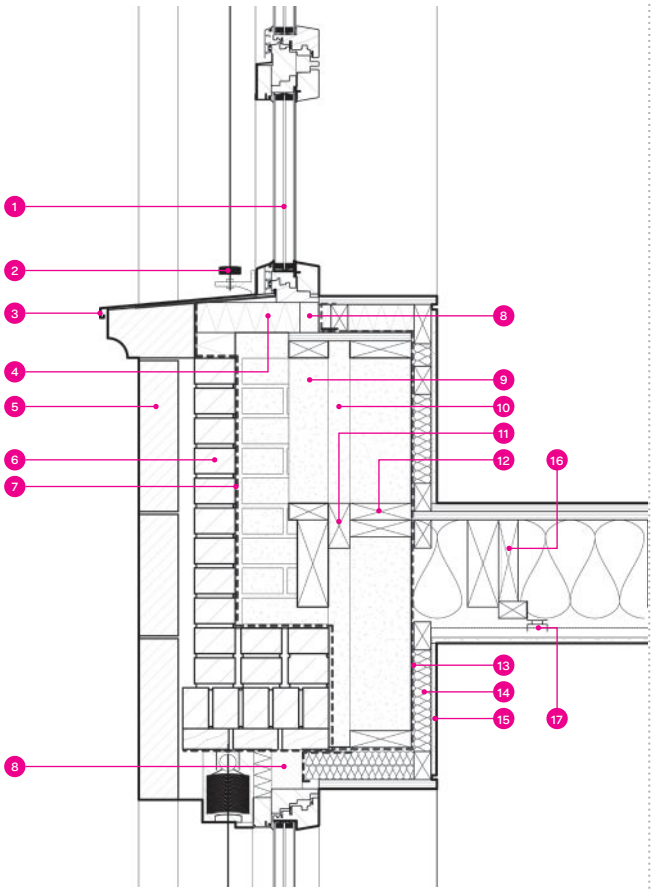
Bed-Stuy Passive House
Brooklyn, N.Y.
Co Adaptive Architecture

For the renovation of their own brownstone, Co Adaptive principals Bobby Johnston, AIA, and Ruth Mandl, AIA, used no fewer than four insulation types. At an equivalent R-value, mineral wool has a lower embodied carbon impact than XPS, expanded polystyrene, polyisocyanurate, and spray foam, while cellulose is considered to have a negative embodied carbon impact. Wood fiberboard can be substituted for XPS, but Johnston has yet to find a non-foam structural insulation. The effective R-value of the Passive House wall assembly is 33.7, nearly 70% higher than the code minimum.

Traditional
Masonry Wall
Retrofit



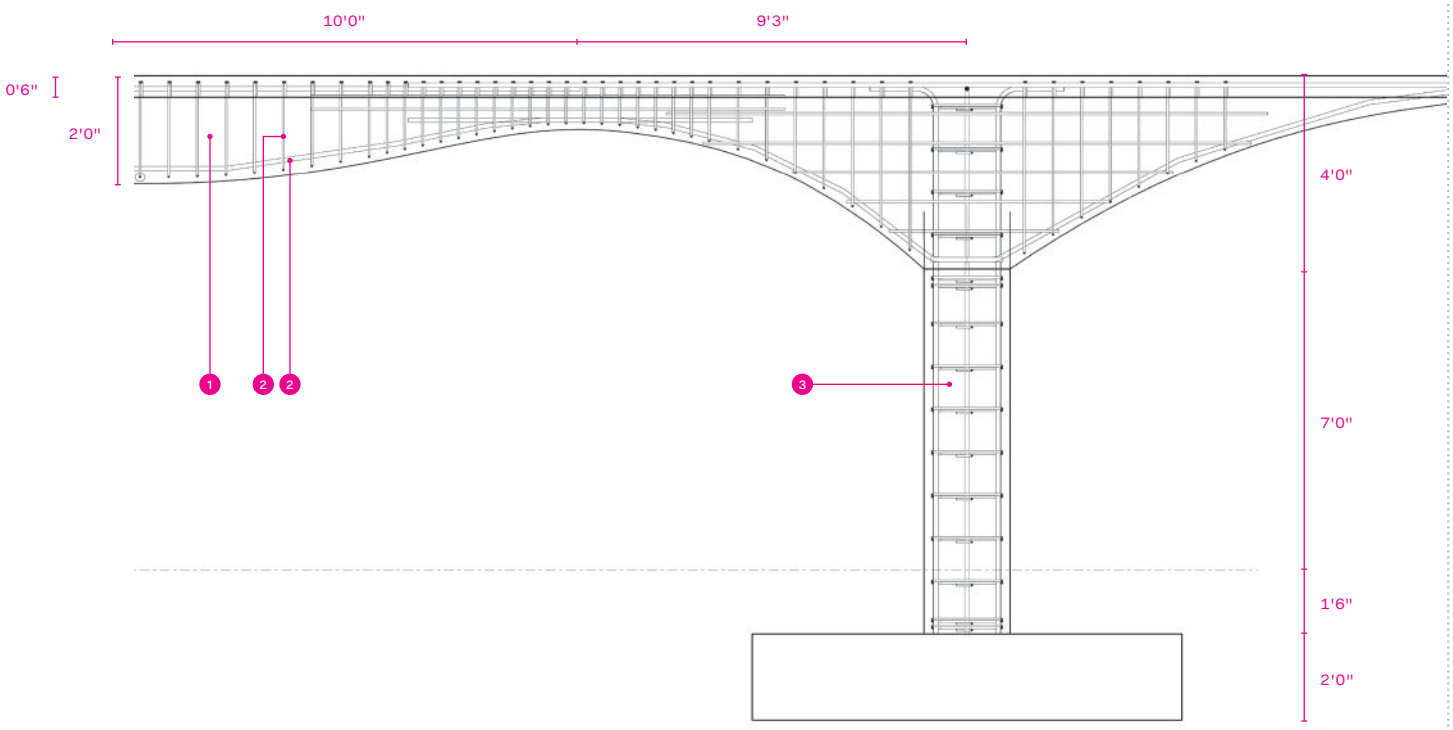
Passive House
Masonry Wall
Retrofit



1. Vinyl frame double-hung window
2. Existing brownstone façade
3. Existing three-wythe masonry backup
4. Fiberglass insulation
5. Wood blocking
6. ½" gypsum wallboard
7. Wood joist

1. Passive House Institute–certified tilt-and-turn over fixed window
2. Exterior motorized solar shading blinds
3. Prefabricated aluminum sill
4. Extruded polystyrene insulation (substitute wood fiberboard insulation to reduce embodied carbon)
5. Existing brownstone façade
6. Existing three-wythe masonry backup
7. Outboard, continuous air and moisture control membrane
8. Structural rigid foam insulation at window mounting points
9. 2×4 cripple stud
10. Dense-pack cellulose insulation
11. 8"-long wood blocking (36" o.c. horizontally)
12. 2×6 wood framing
13. Inboard, continuous air and moisture control system membrane
14. Service cavity with R-7 mineral wool insulation
15. ⅝" gypsum wallboard
16. Laminated veneer lumber sister joist
17. ⅞" hat channel with resilient clips

Stereoform Slab
Chicago
Skidmore, Owings & Merrill



At the 2019 Chicago Architecture Biennial, the local office of SOM revealed its latest iteration of a more efficient concrete slab—"the most common element in contemporary construction," according to the firm's press release. The optimized arched geometry was created with reusable polystyrene molds fabricated with robotics, a faster process than erecting conventional wood formwork. "The built form," says structural engineering director Benton Johnson, "is fluid in appearance and can be used in open-ceiling applications where additional cost and carbon footprint savings can be achieved." Specifying low-carbon rebar and carbon-sequestering aggregate in the concrete could further reduce the project's embodied carbon.

> "This detail reduces concrete materials by 20% and steel reinforcing quantities by 10%, while increasing the span length of conventional flat-plate structures."
>
> —Benton Johnson, director of structural engineering, SOM

1. Concrete
2. Reinforcing steel (various sizes)
3. 24"-square reinforced concrete column

SKIDMORE, OWINGS & MERRILL

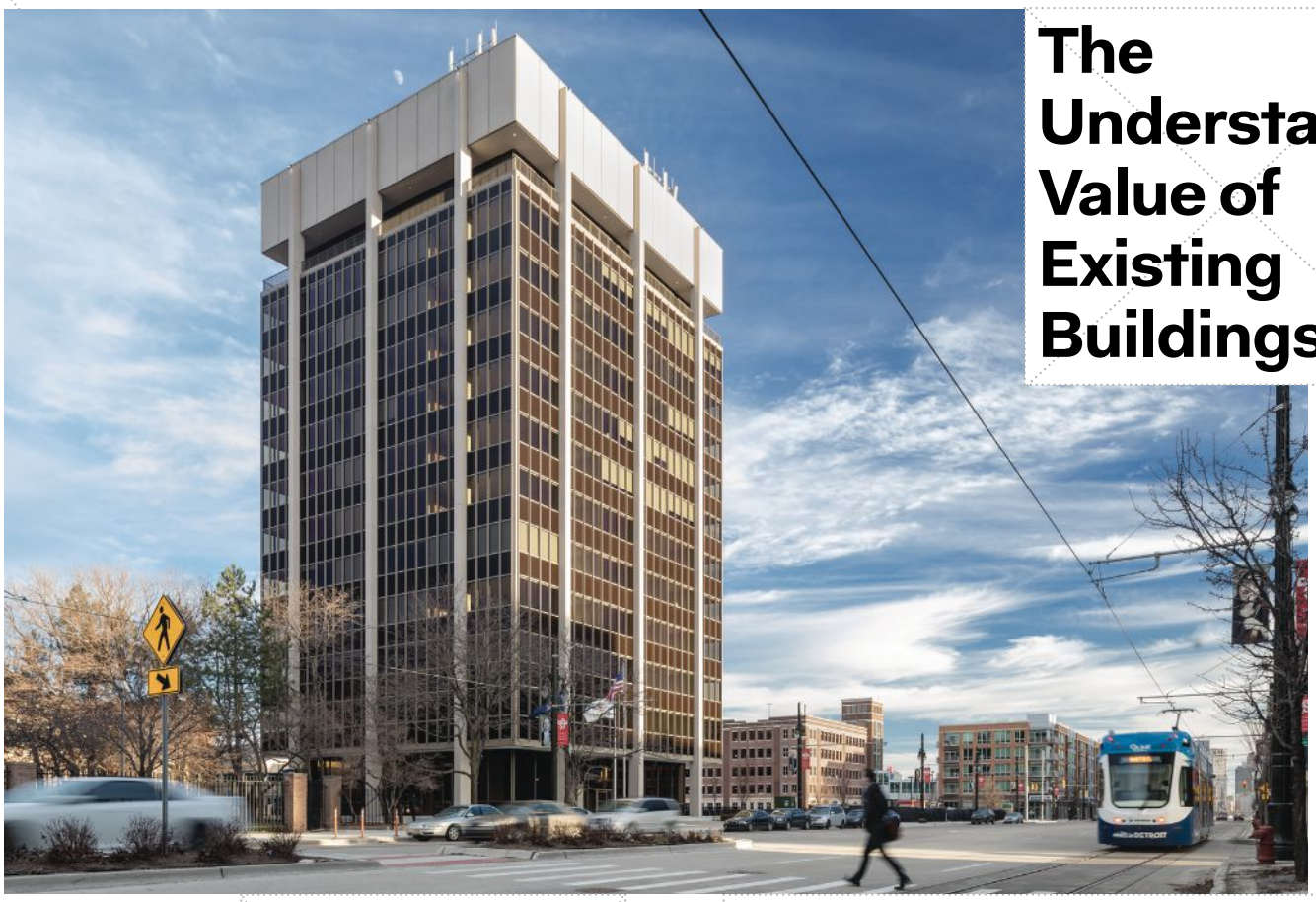
THROUGH THICK AND THIN.

Trust Endicott to help you create uninterrupted design. The same beautiful colors, bold textures and assorted sizes—available in both face and thin brick—so you can build spaces that move.

ENDICOTT™

Endicott's keyback thin brick is manufactured to meet the requirements of ASTM C1088, Exterior Grade, Type TBX, and the more stringent size tolerances of +0" -1/16 required for precast applications.

Endicott Clay Products Company | Endicott Thin Brick & Tile, LLC
402-729-3315 | endicott.com



The Understated Value of Existing Buildings

It's not enough to design super-efficient new buildings. To reach zero-net carbon, architects have to improve performance in existing buildings, and make the most of the embodied carbon we've already spent on them.

INTERVIEW BY KATIE GERFEN

Given that we're on target to double the current square footage of building stock globally by 2060, it would be criminal to ignore existing building inventory as an opportunity for reuse. Quinn Evans principal emeritus and 2018 AIA president Carl Elefante, FAIA, and senior associate Richard JP Renaud, AIA, explain why renovation and adaptive reuse—staples for their firm—are critical to achieving the necessary carbon benchmarks.

You have said that "the greenest building is the one that is already built." Why are the renovation and adaptive reuse of existing buildings so important to achieving zero net?

Carl Elefante, FAIA: We have a carbon burden that already exists in the built environment. As designers, we're thinking about the future, we're thinking about new buildings. The challenge is to not increase the current carbon burden, which means new buildings have to be much, much more energy-efficient, contributing much less carbon, ultimately contributing zero. But that does nothing to reduce the existing carbon burden. We're not going to get to zero without drawing down from where we are today. To do that, we have to address the performance of existing buildings.

How should architects and developers approach the existing building stock that they should be considering for renovation?

Elefante: "The mountains and the carpet" is Ed Mazria's description—the "mountain" of modern, tall, dense

JUSTIN MACHONOCHIE

buildings surrounded by a "carpet" of midcentury and earlier low-density buildings—and it describes an important duality that exists when you start to look at the carbon needs. The types of policies and programs needed to address getting to zero carbon with the large downtown buildings is very different from the challenge of the dispersed buildings in the carpet.

What are some of the challenges?

Elefante: The concentration of dense, large buildings downtown has a relative handful of owners. To get at their **carbon footprint**, you're dealing with a few stakeholders. The projects are large enough to potentially fund all of the analytical work of energy modeling and life cycle assessment that needs to be done to reach performance goals. In the carpet, you have many thousands more owners, down to the ones with a single property. The scale is so small that it's very hard to say to an individual homeowner, "Spend money doing modeling, life cycle assessments, and optimizing alternative design scenarios." It tends to require a more prescriptive approach: "Here are things that you can do to adapt your residence or small-scale commercial building: Insulate your roof and walls, upgrade your mechanical systems to all electric, etc."

In large-scale renovation or reuse projects, where are the opportunities with embodied carbon?

Richard Renaud, AIA: With the mountain buildings, the envelope is a good target. Many of the curtain walls in early modern buildings had very little concern for thermal performance—keeping the view and light was their primary objective. Operationally, how can we improve the curtain wall? And when is it too far gone to be able to be improved? This all comes back to improving performance and minimizing the future use of carbon. The curtain wall was made out of aluminum and glass, two materials that use a lot of carbon to make them. What can we do to save that carbon? Not replacing it becomes very important.

The Professional Plaza Building [shown opposite, in Detroit, which Quinn Evans renovated] was a nice midcentury building that actually had a thermally insulated curtain wall. The owner came to us and said: "From a monetary basis, I want to retain this curtain wall. What can we do to improve its performance?" In his eyes, it's money; in our eyes, it's carbon. The owner wanted to save money, he wanted to make the building more efficient. He wanted to reuse as many materials as possible in its redevelopment, which inherently is what we intend to do, too.

Are there ways for architects to get owners thinking more about carbon?

Renaud: The mountain is actually a lot easier, because the owners are going to come to architects. The problem, as Carl said, is with the "carpet." You have thousands of owners, and most are not going to hire an architect.

Do we write off the carpet too quickly as not worth saving?

Renaud: Yes. If you come in [to a carpet building] and you have four walls and a roof, even in poor condition, if you can save anything, it's a plus. We've got to stop looking at it only as saving money, and start saying: "How much carbon do we have here, and how is reuse going to save it?"

Elefante: We can't do this without systemic change. I constantly find myself reminded of the founding of AIA 160 years ago. What was happening then was the adoption of what we now call Building and Life Safety Codes. What we're faced with today is really similar. Back then, the systemic change was recognizing that it was more important to have all buildings fireproof so that we didn't have a disaster every time somebody dropped a candle. We need systemic change here as well, and the basis for the change is there. City after city is beginning to develop plans for carbon reduction. There is no way to get to the reductions that are needed without addressing carbon in the building stock—both operational and embodied carbon. Even if you find no value in an existing building other than to keep its basic structure, that saves so much embodied carbon. How do we really start to think about our buildings as carbon sinks, as ways to sequester carbon?

Is sequestering the carbon that is already in the built environment critical to achieving zero?

Elefante: Yes. We just can't throw these buildings out. We've got to work with the buildings that we have and continue to make them valuable. If we're looking for quick reductions in carbon, the place that we have to look first is embodied carbon. If you start with scenarios like renovating existing buildings, then you are instantly saving carbon. This market change is happening very quickly. From my own perspective of being an official old guy and having been around for the rise of sustainability and green building, there's an awful lot of people around that say, "Architects really missed the boat on the green building switch, so others took it on." This is going to happen even more quickly, and it's imperative that architects wake up and make this transition from being carbon polluters to being carbon sequester-ers. It will be either the saving or the demise of our profession.

Carbon Footprint
The total amount of greenhouse gas, particularly carbon dioxide, emitted as the result of a specific activity.

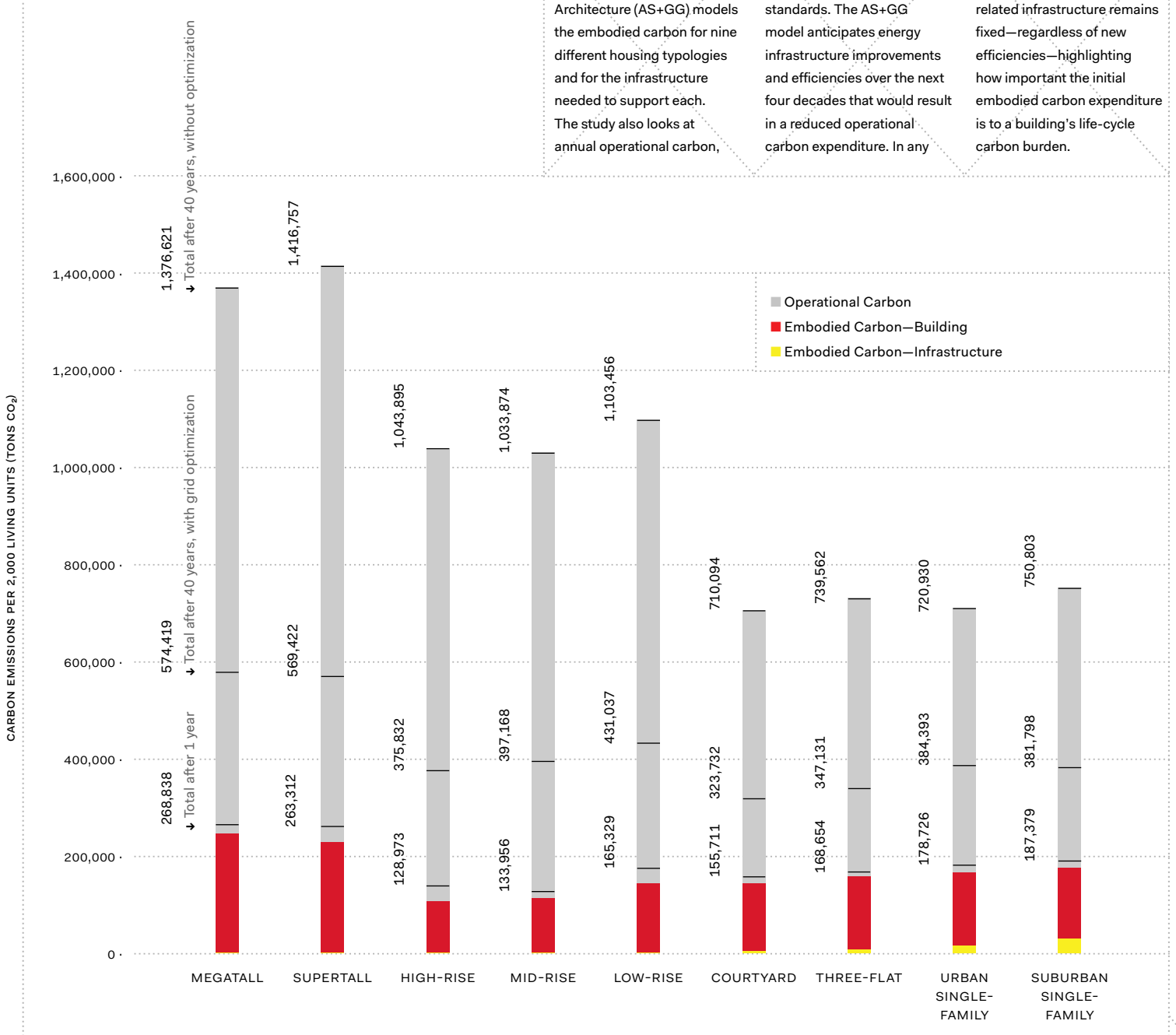
Adaptive Reuse
Reusing an existing building for a new purpose. As an alternative to new construction, adaptive reuse can allow a project to significantly reduce its embodied carbon impact and participate in a circular economy.

With Housing's Carbon Footprint, Density Matters

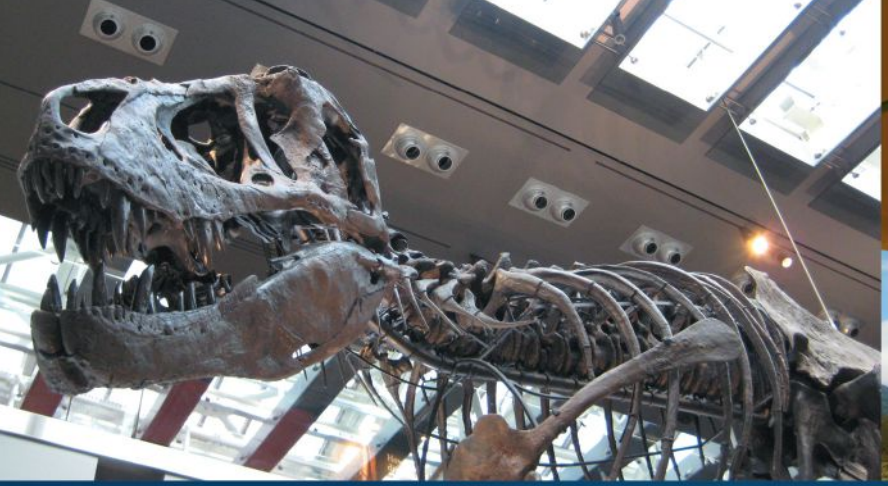
In the e-book *Residensity: A Carbon Analysis of Residential Typologies*, Chicago-based Adrian Smith + Gordon Gill Architecture analyzes the embodied carbon and other attributes of nine housing types to uncover ideal residential densities—those that improve quality of life while minimizing their environmental impact.

In *Residensity*, the team at Adrian Smith + Gordon Gill Architecture (AS+GG) models the embodied carbon for nine different housing typologies and for the infrastructure needed to support each. The study also looks at annual operational carbon, and extrapolates 40 years of building use at current standards. The AS+GG model anticipates energy infrastructure improvements and efficiencies over the next four decades that would result in a reduced operational carbon expenditure. In any case, the embodied carbon cost of the buildings and related infrastructure remains fixed—regardless of new efficiencies—highlighting how important the initial embodied carbon expenditure is to a building's life-cycle carbon burden.

Carbon Emissions by Housing Type



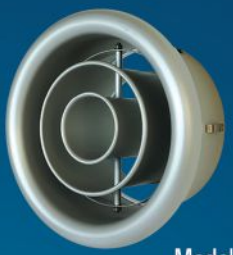
SOURCE: *RESIDENSITY*



SUPPLY DIFFUSERS

Model:**PK**
3"- 20" Aluminum

Model:**PK-K**
6"- 20" Aluminum



Model:**NT**
4"- 24" Aluminum

Model:**RHV**
6"- 24" Aluminum

DRYER VENTS

Model:**SFB-P**
4"& 6" Aluminum

Model:**SB-P**
4"& 6" Aluminum

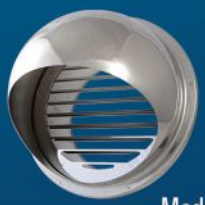
Model:**SFZC**
4"& 6" Aluminum

Model:**RCC-S**
4"& 6" Stainless Steel

VENT CAPS

Model:**SX**
3"- 8" Aluminum

Model:**KX**
3"- 6" Aluminum



Model:**SFX-S**
4"& 6" Stainless Steel

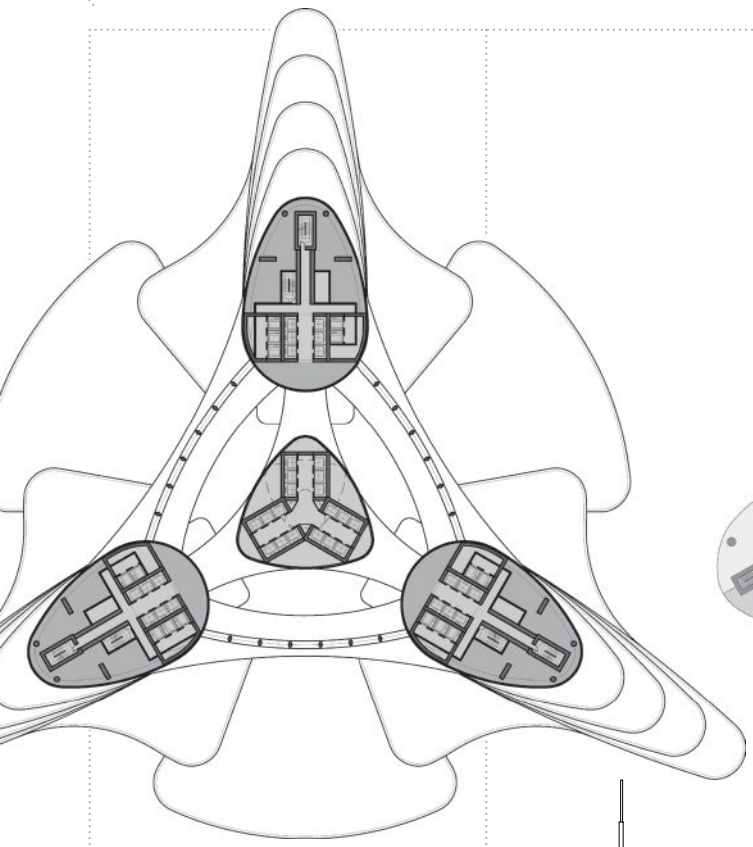
Model:**SXL**
10"- 16" Aluminum

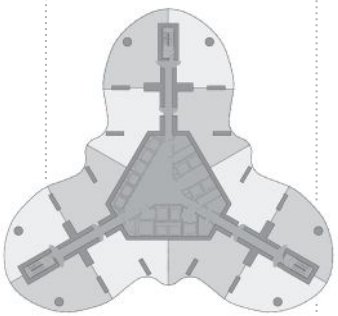
▶If you are interested in becoming an authorized international distributor, please contact us. (Except the United States/Canada/Mexico/Japan)

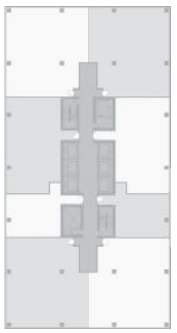
SEIHO® | seiho.com

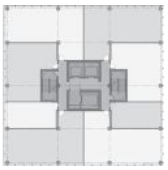
We Ship Worldwide

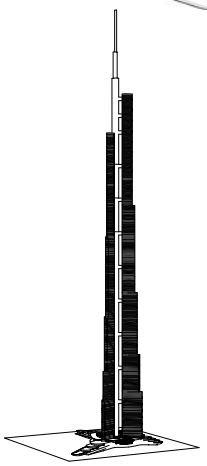
Seiho International,Inc. 120 W.Colorado Blvd. Pasadena, CA 91105 Tel: (626) 395-7299 Fax:(626)395-7290 info@seiho.com seiho_international

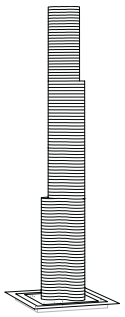


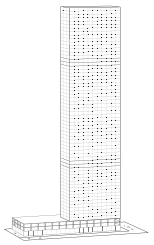


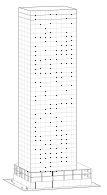






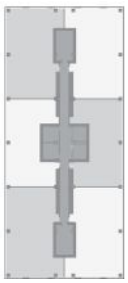
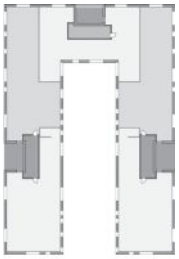


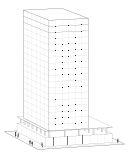
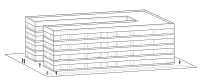




	Megatall	Supertall	High-Rise	Mid-Rise
Number of Buildings	1	2	4	10
Number of Units per Building	2,000	1,000	500	200
Number of Stories (Above Grade)	213	121	65	38
Building Height (M)	766	435	229	134.5
Building Floor Area (M²)	495,880	231,869	110,184	42,896
Building Embodied Carbon (Tons CO_2)	238,971	110,597	26,048	10,904
Embodied Carbon per Unit (Tons CO_2)	119	111	52	55
Infrastructure Embodied Carbon (Tons CO_2)	1,462	1,762	1,322	1,844
Total Embodied Carbon (Tons CO_2)	240,433	222,957	105,513	110,882
Structure (%)	93%	93%	85%	84%
Window/Wall Ratio (%)	40%	40%	40%	40%

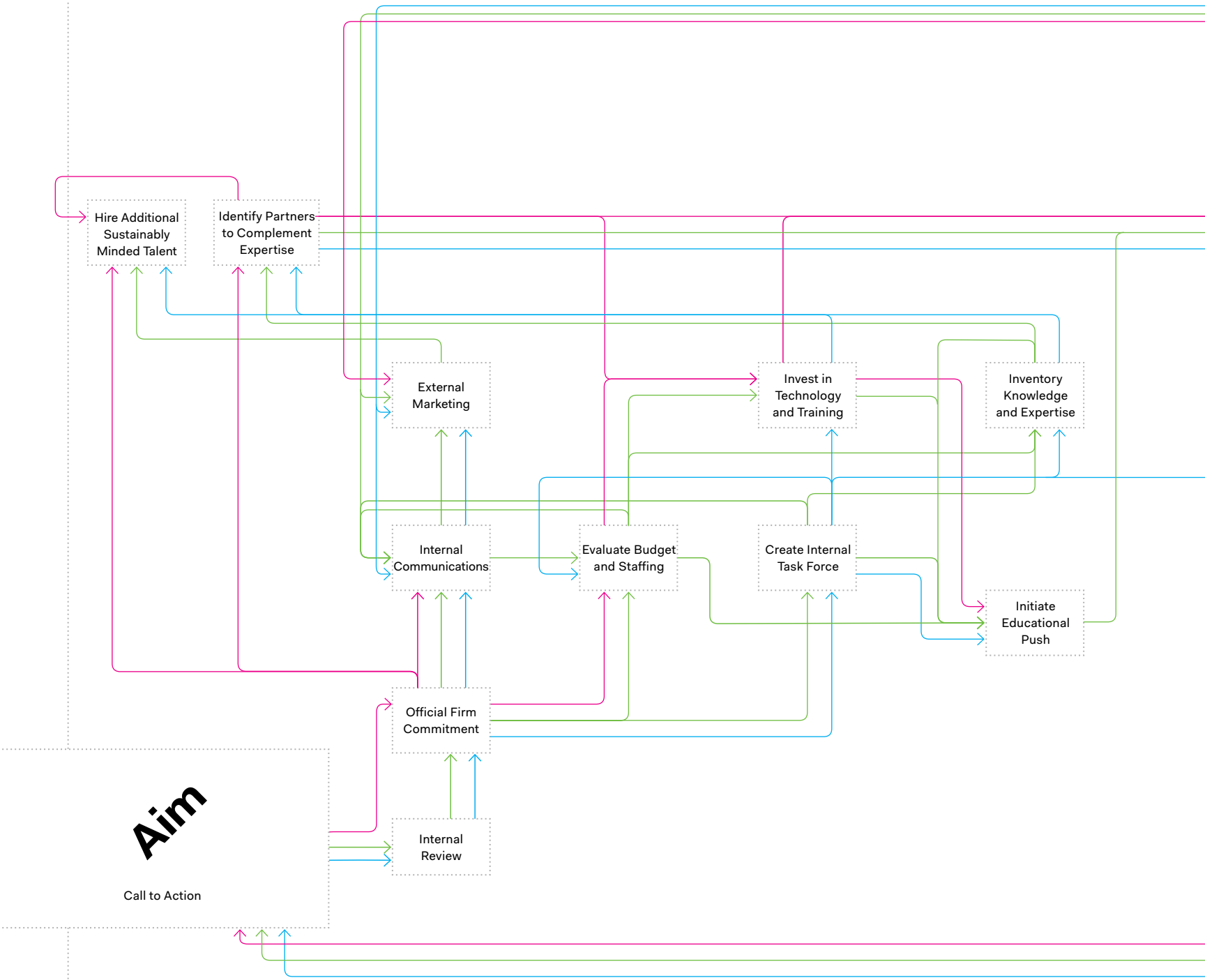
SOURCE: *RESIDENSITY*

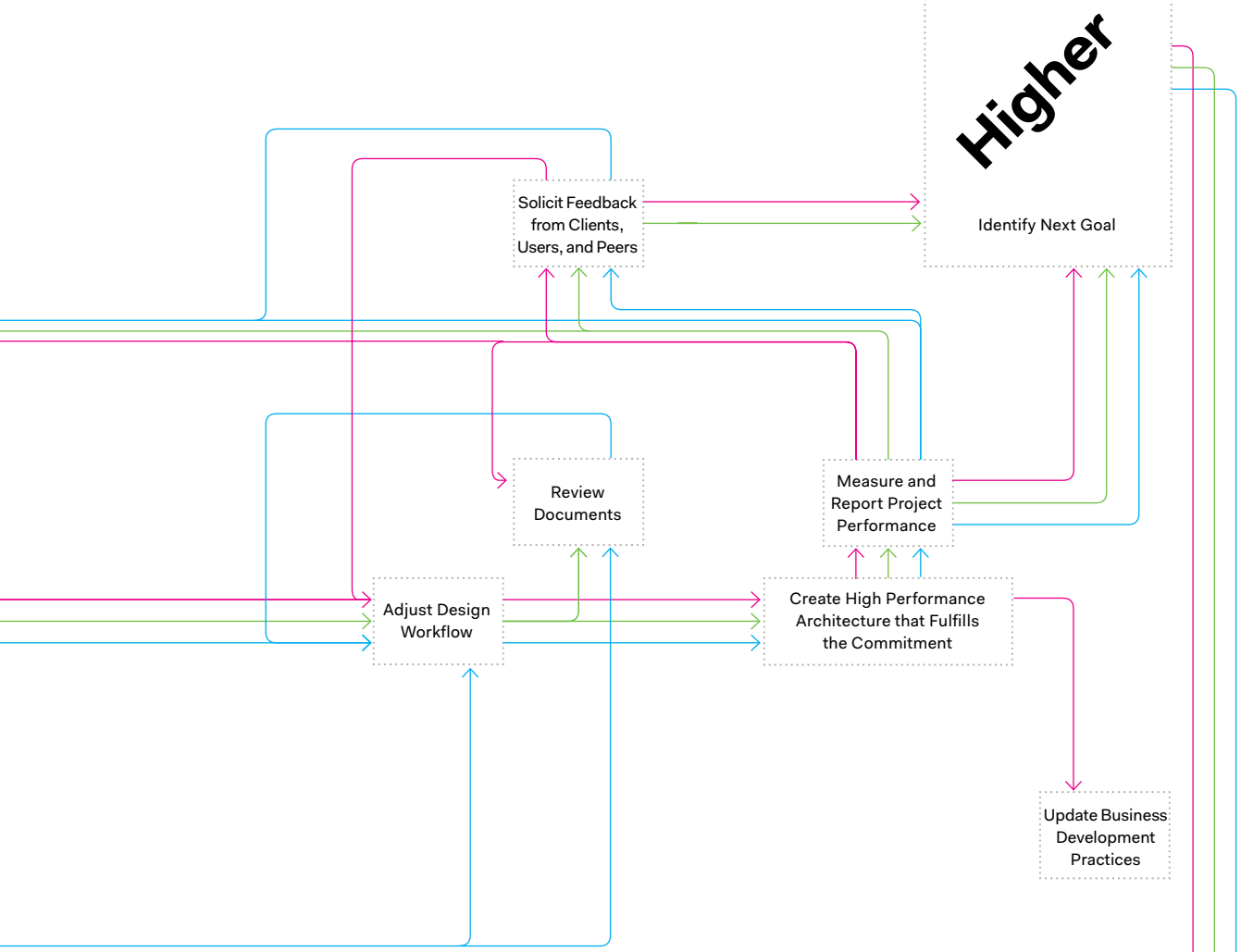




Low-Rise	**Courtyard**	**Three-Flat**	**Urban Single-Family**	**Suburban Single-Family**
20	100	667	2,000	2,000
100	20	3	1	1
20	4	3	2	2
71.5	14	10.5	5.6	8.6
24,300	3,756	554	216	233
6,945	1,360	218	74	71
69	68	73	74	71
2,383	5,562	8,742	16,023	30,529
141,274	141,496	154,016	164,823	172,932
90%	73%	78%	47%	53%
40%	14.6%	9.6%	8.9%	10.9%

Practice


Hire Additional Sustainably Minded Talent
Identify Partners to Complement Expertise
External Marketing
Invest in Technology and Training
Inventory Knowledge and Expertise
Internal Communications
Evaluate Budget and Staffing
Create Internal Task Force
Initiate Educational Push
Official Firm Commitment
Internal Review
Aim
Call to Action



TEXT BY WANDA LAU

How does a firm commit to zero-net-carbon design? Here, three very different practices—Studio Ma, BWBR, and Gensler—share their ongoing journeys.

- Studio Ma (10–20 employees)
- BWBR (100–200 employees)
- Gensler (6,000-plus employees)

Aim Higher

Studio Ma

Location: Phoenix
Staff size: 14
Projects per year: 3 to 5
Call to Action: In 2008, local utilities company Salt River Project asked Studio Ma to design a demonstration project that went beyond LEED Platinum standards. Intrigued, Studio Ma began poring over the National Institute of Building Sciences' *Whole Building Design Guide* (*WBDG*), which includes ideas for achieving zero-net energy and water. "Once the lightbulb goes on, you really can't turn it off," says founding principal Christiana Moss, AIA.

Commitment: Studio Ma wants to create "regenerative," or net-positive, architecture as soon as possible, Moss says. "The question is: How do we try to advocate for this with our clients?" In 2010, the firm signed the AIA 2030 Commitment and has largely met the progressive energy reduction targets. The goal of regenerative architecture became woven into the culture of the firm organically, no formal vote or announcement needed. **Identify Partners:** To help crunch the numbers, Studio Ma teams with engineering firms and universities. **Education:** Interested employees can pursue professional accreditation, such as LEED or Living Future. Associated fees are reimbursed upon successful accreditation. **Technology and Training:** To estimate embodied carbon, Studio Ma uses the Athena Sustainable Materials Institute's EcoCalculator. For energy modeling, the firm uses Sefaira and Climate Consultant; it is also a beta tester for DIVA and ClimateStudio, developed by Cambridge, Mass.–based Solemma. To manage the cost of software, the firm assigns licenses to specific workstations for shared use. The firm invests between $25,000 and $75,000 on software and staff training, depending on project needs. **Design Workflow:** Studio Ma conducts an energy-analysis study on each project to examine issues such as site orientation, daylight control strategies, and photovoltaic energy potential. Working with its engineers and contractors, it also uses life-cycle cost analysis methods as prescribed by the *WBDG*. "Design has become extremely front-loaded, so the number of decisions that you're making earlier in the process has increased exponentially," Moss says. **High-Performance Architecture:** The firm's bioclimatic philosophy "is not only part of the design process, but it actually is a driver of the design process," Moss says. "While abstract concepts or other ideas have driven form-making in architecture, this is what drives form and design in our studio." **Business Development:** Studio Ma communicates its design philosophy to potential clients by focusing on passive strategies and locally sourced and carbon-sequestering materials. **Reporting:** Since 2010, the firm has reported its projects' energy performance as part of the AIA 2030 Commitment. **Review Documents:** The firm hires legal counsel when applying for the federal R&D tax credit for its study of net-positive buildings. **Marketing:** The firm publishes projected and actual energy use intensities and water reduction numbers. It is currently revisiting its branding and website, in part to highlight its regenerative design approach. **Up Next:** Through its brand refresh and outreach, Studio Ma hopes to attract private clients with its approach. It is also in the planning stages of projects utilizing a timber structure.

BWBR

Locations: St. Paul, Minn.; Madison, Wis.; Omaha, Neb.
Staff size: 162
Projects per year: 300-plus
Call to Action: In 2001, BWBR formed its Performance Design Group (PDG) of about 10 people who integrate energy efficiency and other sustainability initiatives into every project. In 2007, then-CEO Steve Patrick was inspired by a presentation on the 2030 Challenge at the AIA Large Firm Round Table.

Commitment: BWBR signed on to the 2030 Challenge in 2007 and the AIA 2030 Commitment in 2014, though its annual portfolio average has not yet met the required targets. It is evaluating its design practices to set a performance baseline exceeding code requirements for its projects. **Task Force:** In early 2019, a subcommittee of the PDG began researching ways to meet the AIA 2030 targets. It presented ideas to BWBR's board of directors, which approved continued study. **Assess Knowledge and Expertise:** A PDG subcommittee has reached out to nearly a dozen engineers, contractors, and clients in BWBR's network to assess the impact of designing to a higher performance baseline on project costs and firm competitiveness. **Education:** Since 2014, the firm has made a push for training in sustainable design, says project manager and PDG co-chair Jesse Turck, AIA. About a quarter of the firm is LEED accredited. The firm has also stretched Earth Day into a weeklong event, complete with talks by non-AEC business leaders to help show that zero-net-carbon "can be a market-driven initiative, and not just an altruistic initiative," says communications manager James Lockwood. **Technology and Training:** BWBR uses the Athena EcoCalculator to estimate embodied carbon but is currently evaluating the Carbon Leadership Forum's EC3 tool. For energy analysis, BWBR uses Autodesk Insight, a Revit plug-in. The firm has come to realize that software training on an as-needed basis is more effective in terms of knowledge retention. BWBR spends 0.5% to 1% of its net revenue on staff training (not all related to sustainability). **Design Workflow:** BWBR piloted a performance design–mentorship program for each active project. It is looking into integrating life cycle analysis studies more regularly into its workflow to reduce the embodied carbon of its designs. The firm also wants to reach more clients during initial planning, before project budgets are set, in order to advocate for a long-term view beyond first cost. **Review Documents:** BWBR continually updates its specifications to include more sustainability information. **Reporting:** In addition to the reporting required by the AIA 2030 Commitment, the firm also conducts benchmarking comparisons as part of Minnesota's Buildings, Benchmarks & Beyond program, which requires projects receiving state funding to meet 2030 energy targets and conduct post-occupancy evaluations. **Marketing:** BWBR publishes accomplishments in a magazine, a website blog, a biannual e-newsletter, and industry presentations. **Up Next:** BWBR plans to evaluate its sustainable design practices, set project energy performance targets, update its materials library, and complete a zero-net-carbon project.

Locations: 48 offices on five continents
Staff size: 6,000-plus
Projects per year: 8,000
Call to Action: The firm has a history of spearheading performance-driven design. Founder Art Gensler, FAIA, chaired the U.S. Green Building Council's LEED for Commercial Interiors committee and helped develop LEED for Core and Shell. Between 1998 and 2018, the firm designed 1,500 LEED projects.

Aim Higher

Gensler

Commitment: Gensler signed the AIA 2030 Commitment in 2009 and the Paris Pledge for Action on Climate Change in 2015. Last September, co-CEO Diane Hoskins, FAIA, announced the Gensler Cities Climate Challenge (GC3) at the U.N. Climate Action Summit to make the firm's annual portfolio carbon neutral—both in embodied and operational carbon, as well as in other aspects—by 2030. "The new commitment is basically our moon shot," says principal and design director Lance Hosey, FAIA, who is also the firmwide co-leader of design resilience along with Rives Taylor, FAIA. Each of the firm's 11 regions has two additional design resilience co-leaders, and individual offices may also have a leader. **Decision Process:** These commitments have come from the co-CEOs, with input from the firm's board of directors and management committee. **Task Force:** Gensler has many in-house committees tackling different aspects of design resilience. For the nascent GC3 initiative, the firm is organizing a group to specifically study climate-positive design. **Assess Knowledge and Expertise:** Though the firm has no shortage of experts on design resilience, Hosey says it may consider forming strategic partnerships with institutions or think tanks to broaden its outreach. **Hire Talent:** About 15 years ago, Hosey says, the firm made a push to recruit people with technical expertise in sustainability, including Taylor. More recently, the firm has brought in experts outside the traditional building arena, such as a cultural anthropologist. **Education:** About a quarter of the firm is LEED accredited. Additional resources include Gensler University—which is an internal repository of 3,500-plus training programs on topics such as leadership and design training—and studies by the Gensler Research Institute (GRI). Hosey says the amount of time people spend in formal training varies by individual and role; similarly, spending on education related to design resilience varies by region and office. **Technology and Training:** Gensler uses "virtually every tool in the market," Hosey says, but is also working with specific developers to customize programs for the firm. **Review Documents:** Specifications are continually updated to "reflect current standard of practice," Hosey says, though no recent changes have resulted from the climate action initiatives—yet. **Reporting:** After signing the Paris Agreement, the firm began publishing an annual Impact by Design report on its portfolio's performance. Its 2018 portfolio is estimated to be 46% more energy efficient than baseline. In 2017, the GRI debuted the Gensler Experience Index, documenting good and bad design qualities based on interviews and surveys. **Up Next:** Gensler is actively working to determine how it will realize its GC3 initiative.

Lighting is just one part of your project.

Light All handles the details so you can manage the big picture.

Light All is a suite of expert services and custom solutionsfrom TCP, longtime designers and manufacturers of top-awarded LED lighting and fixtures.

Light All guides you through sourcing, installation, energy-efficiency and aesthetic solutions. **Light All** experts can even secure lighting rebates.

Now – Light All clients qualify for TCP Pro pricing through approved electrical distributors.*

Learn More

TCPI.com/LightAll

Complete commercial lighting from layout to luminaires

Light All

TCP

TCP reserves the right to change, modify or cancel these programs at any time with or without notice. All pricing is valid in the US only through December 31, 2019 at a TCP certified electrical distributor. Please contact TCP for full details.

Eight Questions You'll Hear When Proposing Carbon Positive Design

Change is tough. The slightest tweaks in design approach, philosophy, or workflow can raise concerns from clients or supervisors, and even cause you to doubt yourself. Fortunately, several environmentally oriented designers and firms are eager to help you manage the pushback: Stephanie Carlisle, principal at Philadelphia-based KieranTimberlake; Tenna Florian, AIA, associate partner at San Antonio, Texas–based Lake|Flato Architects; and San Francisco–based firm Leddy Maytum Stacy, which is led by principals William Leddy, FAIA, Marsha Maytum, FAIA, and Richard Stacy, FAIA.

EDITED BY WANDA LAU AND KATHARINE KEANE

Question for Yourself

1

I'm interested in reducing the embodied energy of my projects, but I don't have access to materials data, analysis tools, or information on how to conduct a whole building life cycle analysis (LCA). Where can I start?

Leddy Maytum Stacy: Embodied carbon can be a hypertechnical, complex topic, but it doesn't have to be. Making smart decisions early—such as reusing a building and designing an efficient structure—can provide the biggest "bang for the buck" related to embodied carbon. High volume materials, such as concrete and steel, can account for between 50% and 75% of embodied emissions in a typical ground-up design. When possible, use carbon-sequestering materials such as wood from well-managed forests. Focus on reducing or substituting nonstructural yet high-impact materials, like aluminum or foam. And look at free educational resources, such as the Architecture 2030 Carbon Smart Materials Palette, AIA Framework for Design Excellence, COTE Top Ten Toolkit, and webinars available at the Embodied Carbon Network website.

Stephanie Carlisle: The Carbon Leadership Forum recently published an LCA Practice Guide that covers the basics of life cycle concepts, modeling practice, and available tools and databases. The free resource also walks through the steps of creating a whole building LCA model. Tools such as Tally [developed by Carlisle and her firm, KieranTimberlake] and Athena Sustainable Materials Institute's Impact Estimator have online demos and videos that will also take you through the steps of creating your first model and provide pointers for beginners.

Questions From the Top

2 **What does "carbon positive" mean? I thought we wanted to be carbon negative.**

Tenna Florian: Both terms have been used to refer to buildings that go beyond zero-net-carbon emissions by removing additional carbon dioxide from the atmosphere. When speaking about embodied carbon, we're talking about construction impacts and using building materials—such as wood that is locally sourced from responsibly managed forests—that sequester more carbon than is used by all the other materials for that building. When speaking about operational carbon, we're talking about generating more electricity from renewable sources than needed to run the building.

3 **Of course we care about climate change, but our clients and/or their tenants don't value or understand it. We can't be selective in choosing our clients.**

TF: We shouldn't assume our clients don't value or understand climate change. Start by listening to what is important to your clients. Understanding their values informs how you approach the topic of climate change and discuss the benefits of high-performing buildings.

LMS: Most clients care about their return on investment. In providing information about the business case of high-performance design, ongoing operational cost reduction, health benefits to occupants, reduction of absenteeism, and overall user satisfaction, we can help clients see that the benefits of effective design are also better for the environment.

SC: As architecture firms increase their own carbon literacy and become more confident with low-carbon strategies, they will be in a far better position to do the slow work of raising awareness and influencing clients. We already do this for topics that we feel are essential, like accessibility or health and safety. Keep in mind, design professionals make many decisions for which we don't ask permission and for which we feel obligated to confidently express our opinions. For example, we don't rely solely on our clients' opinions about code, aesthetics, or user experience.

4 **This project is tight on time and budget. We do not have the resources to conduct additional analyses or to reinvent the wheel here.**

TF: We aren't reinventing the wheel. The tools exist to standardize embodied and operational carbon analysis for every project. The cost of time spent conducting the analysis is minimal compared to the value it brings.

SC: Start by making use of the excellent and accessible resources that exist for designers new to this topic such as the Carbon Smart Materials Palette, case studies published by other firms, or trade resources like BuildingGreen. Many simple strategies, such as revising your standard concrete specifications and exploring bio-based materials, can add value to all of your projects.

Additionally, consider ways to build capacity and expertise within your firm that can be used on every project. You might need to invest in training in LCA and low-carbon construction strategies for one project, but those skills should be applicable to all of your future work. Find projects where you can innovate and expand your knowledge base; for the others, be sure to make good use of existing resources and reach out to free forums like the Embodied Carbon Network. The carbon community in architecture is growing, passionate, and collaborative. Ultimately, we need to view embodied carbon as an integral part of good design, similar to how seriously we take code review or lighting analysis.

Questions From Clients

5 Having high-performing buildings is not a part of our organization's mission, so why should we make the investment?

TF: High-performing buildings can affect an organization at many scales—from individual health and wellness to community. Nearly every organization's mission touches on at least one of those issues; finding points of overlap is key to starting the conversation about the value of performance. If a client feels like they are being listened to rather than told what they should do, they are more likely to trust you to create a building that broadens the impact of their organization's mission.

6 I want to reduce my building's embodied and operational energy, but I can't afford a zero-net-carbon design. What's the next best thing? What's the low-hanging fruit?

LMS: Achieving site net-zero energy can be daunting, but focusing on energy fundamentals such as passive strategies, reducing heating and cooling loads, and moving toward an all-electric design alone can have an outsize effect on operational energy and carbon. It might be easier to get to zero carbon than you think, especially as renewable electricity options become more prevalent. The "bang for your buck" happens when you reuse existing buildings or design an efficient, low-impact structure. If you have concrete in your design, focus on cement replacement with fly ash and slag. If you'd prefer to start by eliminating just one thing, consider swapping out foam insulation from your specifications for a lower carbon impact product.

7 What is the cost premium to reduce my project's embodied carbon or improve building performance? These strategies sound expensive.

SC: There is no clear indication that low-carbon construction costs more, just as good and thoughtful design has no inherent cost premium. The most powerful thing you can do is make low-carbon strategies normative, standard, and required. Presenting carbon-reduction strategies as a separate design option or as an alternate only communicates that they are optional, superfluous, and external to design. Who would pay extra in that case?

Architectural Adventures

Expert-led travel for architecture enthusiasts

Earn AIA LUs!

Rhine River Cruise

Jul 12 - 20 | **18 LUs**

Journey through the picturesque towns and historical landmarks of Germany, France and the Netherlands.

Along the Danube

Aug 29 - Sep 12 | **22 LUs**

Experience Roman ruins, cathedrals, synagogues, mosques, and fortresses while on a cruise through eight European countries.

©Richard Mortel

Baltic Capitals

Sep 1 - 14 | **18 LUs**

Discover a world transformed with a fascinating journey through the rich architectural heritage of Lithuania, Latvia, Estonia and Russia.

Japan

Sep 5 - 17 | **23 LUs**

Explore this fascinating land of dizzying modernity and rich traditions from Tokyo to Kyoto.

Sign up for email updates at **architecturaladventures.org/architectmag**.

Ready to book? Call 1.800.293.5725

Architectural Adventures is the official travel program of the American Institute of Architects.

TF: Understanding first-cost and long-term savings is critical to the success of this project, and for quantifying the value these strategies bring to the project. That said, clients have the opportunity to move the industry—especially with embodied carbon—to understand the value beyond cost.

LMS: The short answer is, "It depends." Cost is contingent on a variety of factors, such as project type and construction region, as well as the strategies and goals of a specific project. Obviously, this is considering first cost only. Studies show the savings attributed to high-performance buildings, such as operational energy costs, increased tenant satisfaction and retention, and higher rental rates in some certified green buildings.

As this question relates to embodied carbon, there can certainly be first-cost savings. If a client agrees to reuse an existing building, there is immediate savings on structure and enclosure costs, though there may be life safety or other code requirements required that will have an impact on scope.

For new construction, an efficient structural design can provide first-cost savings by reducing material use or the weight of the overall structure, which subsequently can reduce the foundation depth. Some of our structural engineers have made the case that cement replacement—with a higher percentage of ternary concrete mixtures—can actually provide cost savings in our Bay Area economy.

Finally, reducing finishes is a straightforward way of reducing embodied carbon: Using structure as an exposed finish, such as a concrete floor or mass-timber ceiling, can both reduce embodied carbon and save money.

8 Is straying from conventional energy sources and systems a good idea given the unreliability and volatility of the electrical grid and utility providers?

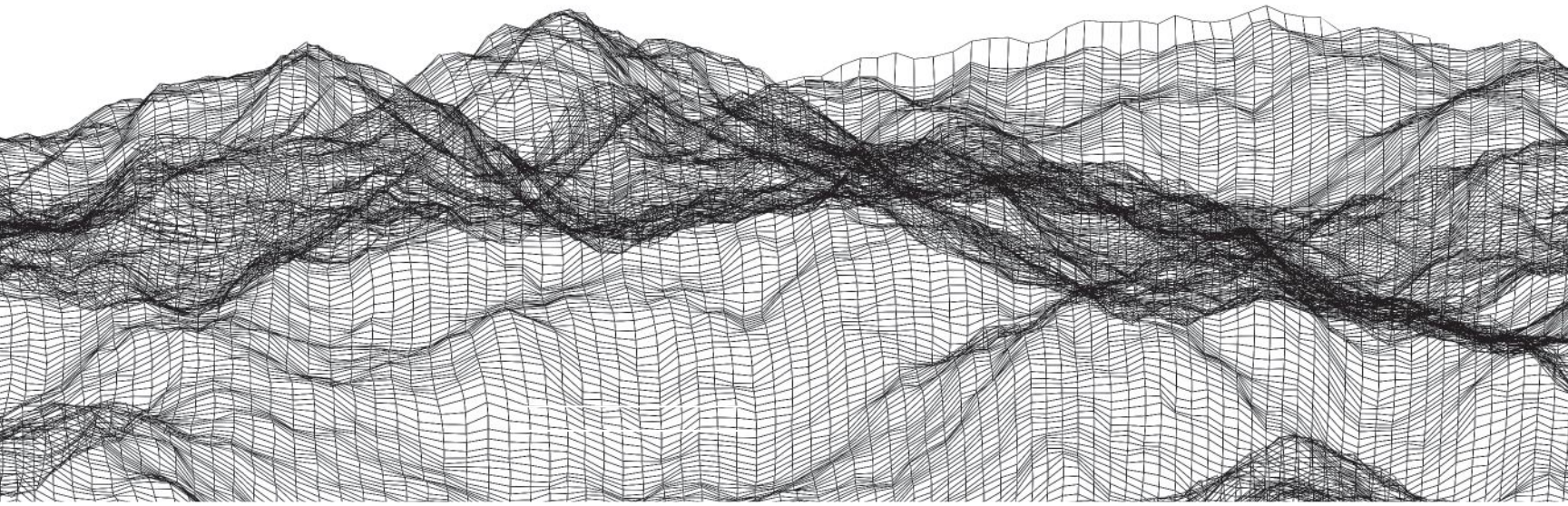
LMS: In Northern California, where our studio is located, many cities have taken steps to phase out fossil-fuel combustion in buildings. Simultaneously, we have witnessed utility companies cutting off power to thousands of customers to reduce wildfire risk—a reaction that seems at odds with an all-electric movement. However, an all-electric infrastructure is the only way to achieve our climate goals. For a clean energy future to work, we will need to invest in a robust electrical distribution system, as well as in microgrids, and shift to green energy generation and localized energy storage. Our policies and infrastructure are moving toward clean, renewable energy. As a result, we have begun advocating all-electric designs to owners.

The **ARCHITECT** Podcast Network

Where we talk with the innovators working at the cutting edge of design, technology, and practice in architecture.

Come join us.

> ***bit.ly/ArchitectPodcasts***

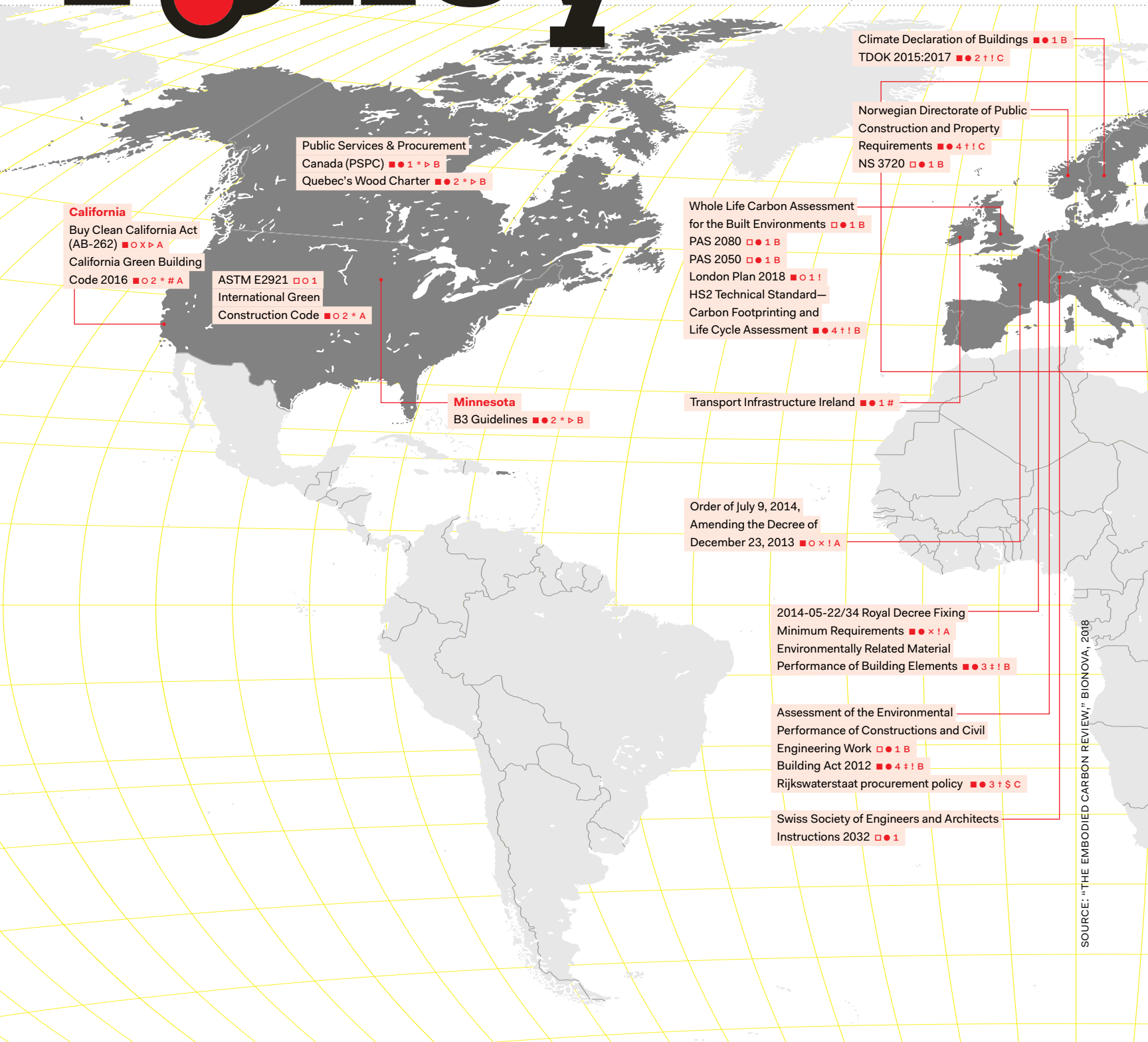


Now available on

iTunes SOUNDCLOUD

Policy

Embodied Carbon Regulations and Standards Worldwide



SOURCE: "THE EMBODIED CARBON REVIEW," BIONOVA, 2018

Operational carbon requirements are being adopted globally, but embodied carbon policies are just starting to catch up. Here are 34 regulations and standards that are setting the bar.

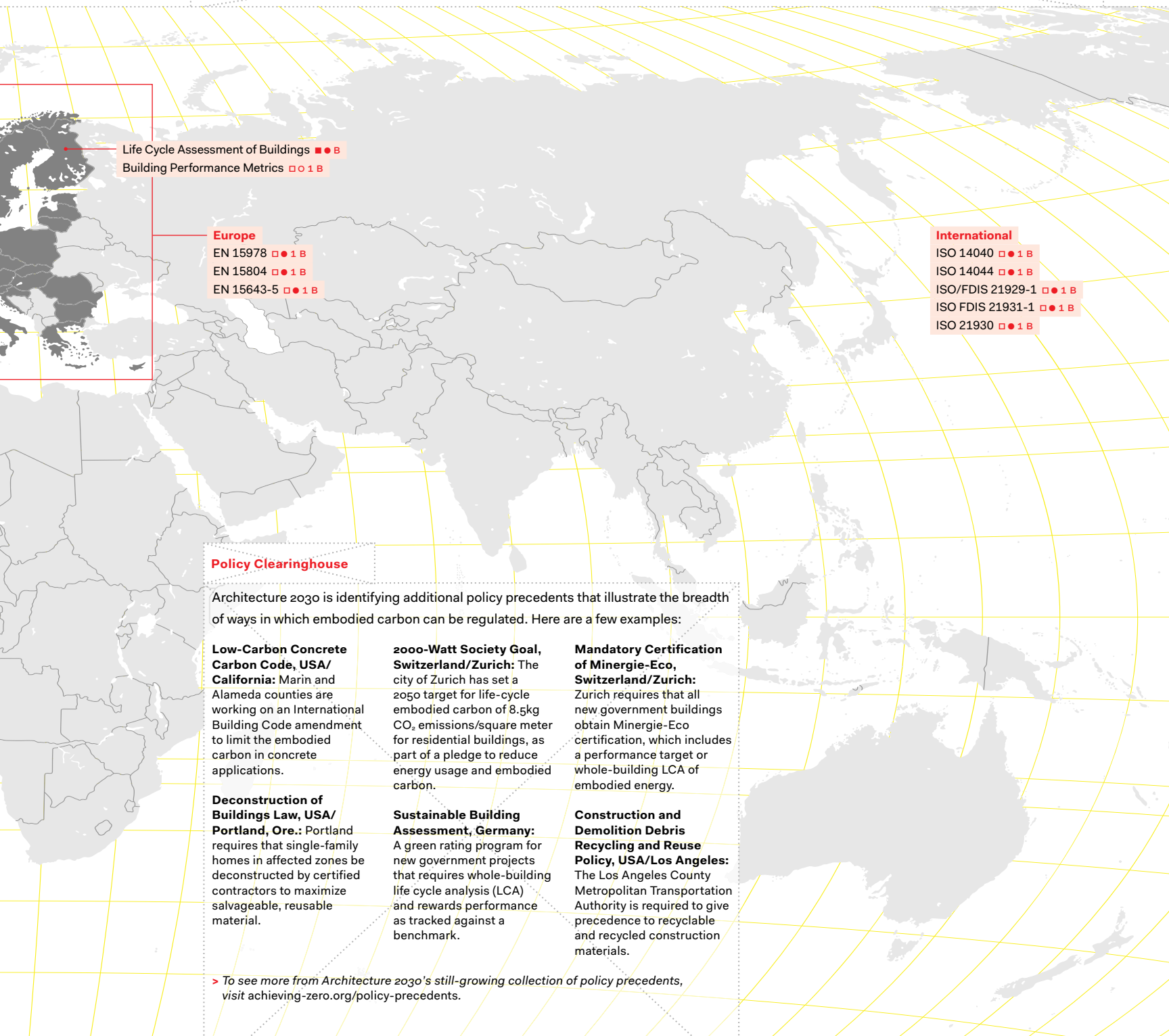
■ Regulation
□ Standard
● Embodied Carbon Consideration Required
○ Embodied Carbon Consideration Optional

Carbon Reduction
1 Carbon Reporting
2 Carbon Comparison
3 Carbon Rating
4 Carbon Cap
× Simplified method

Cap/Rating Type
* Self-declared
† Methodology
‡ Fixed scale
? Not determined

Carbon Incentive
Rating points
▹ Funding criteria
$ Cash impact
! Mandatory

Product EPD Use
A Documentation
B Use in life cycle analysis
C Buy low-carbon



Policy Clearinghouse

Architecture 2030 is identifying additional policy precedents that illustrate the breadth of ways in which embodied carbon can be regulated. Here are a few examples:

Low-Carbon Concrete Carbon Code, USA/California: Marin and Alameda counties are working on an International Building Code amendment to limit the embodied carbon in concrete applications.

Deconstruction of Buildings Law, USA/Portland, Ore.: Portland requires that single-family homes in affected zones be deconstructed by certified contractors to maximize salvageable, reusable material.

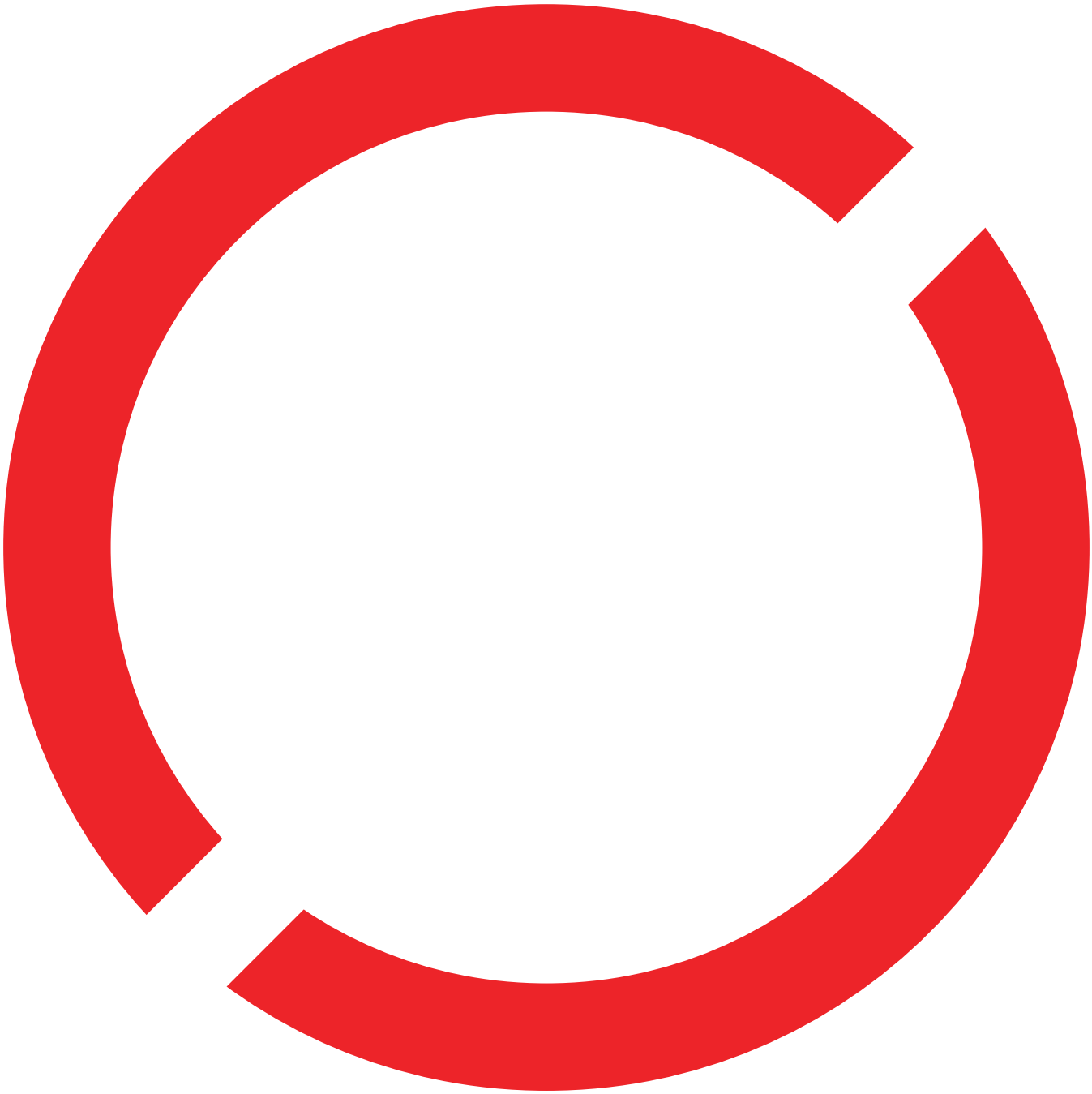
2000-Watt Society Goal, Switzerland/Zurich: The city of Zurich has set a 2050 target for life-cycle embodied carbon of 8.5kg CO_2 emissions/square meter for residential buildings, as part of a pledge to reduce energy usage and embodied carbon.

Sustainable Building Assessment, Germany: A green rating program for new government projects that requires whole-building life cycle analysis (LCA) and rewards performance as tracked against a benchmark.

Mandatory Certification of Minergie-Eco, Switzerland/Zurich: Zurich requires that all new government buildings obtain Minergie-Eco certification, which includes a performance target or whole-building LCA of embodied energy.

Construction and Demolition Debris Recycling and Reuse Policy, USA/Los Angeles: The Los Angeles County Metropolitan Transportation Authority is required to give precedence to recyclable and recycled construction materials.

> *To see more from Architecture 2030's still-growing collection of policy precedents, visit* achieving-zero.org/policy-precedents.



Achieving Zero

Policy Framework for Eliminating Emissions From the Building Sector.

TEXT BY VINCENT MARTINEZ AND NATASHA BALWIT
(PROJECT TEAM: VINCENT MARTINEZ, NATASHA BALWIT, LINDSAY RASMUSSEN, AND ERIN MCDADE)

The global population is growing at a staggering rate, requiring an equally staggering amount of new construction worldwide. Most of the growth is occurring in cities, which are responsible for more than 66% of total global energy consumption and more than 70% of energy-related CO_2 emissions—and counting. The steps that architects, developers, planners, and the construction industry take in the next few years will determine whether the international community can meet demand for growth and still achieve the targets set out in the Paris Agreement to reduce global greenhouse gas emissions and limit warming to 1.5 C above preindustrial levels. Architecture 2030's Achieving Zero framework provides a unified vision for building sector policies that drive climate action.

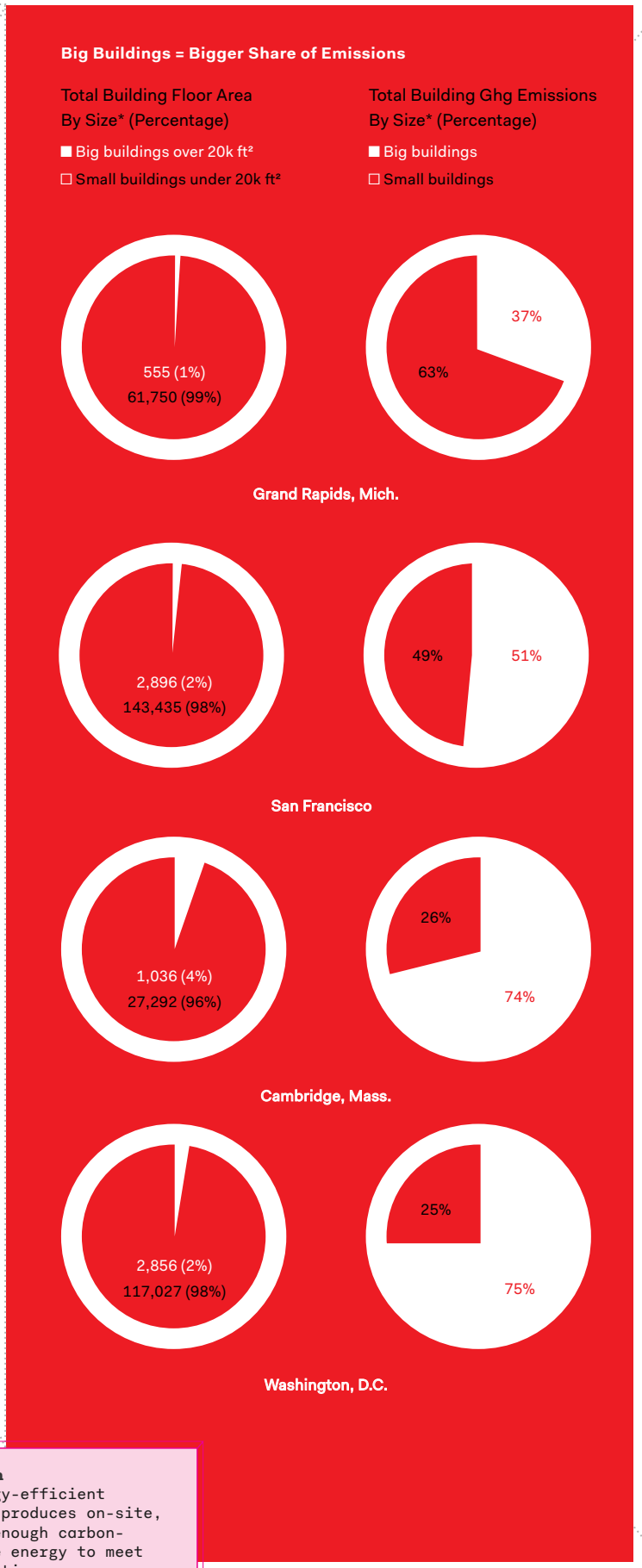
Rapid urbanization presents an extraordinary opportunity. Cities generate over 80% of global gross domestic product, serving as hubs of economic growth and innovation. Municipal governments have demonstrated the ability to act more rapidly than national governments in confronting environmental issues, embracing resilience strategies in the face of a changing climate, and working with communities to increase equity and protect those who are at the greatest risk.

Achieving Zero focuses on cities and subnational governments because of their direct impact on emissions and their position as leaders in climate action. By applying the Achieving Zero framework—through building codes, zoning, and other measures—mayors, city councils, and other leaders can phase out greenhouse gas emissions in their jurisdictions by 2040. Achieving Zero offers strategies in three key areas:

1. Energy upgrades for existing buildings, tailored differently for large and small buildings, and mandated to coincide with market-driven points of intervention such as changes in ownership and occupancy.

2. **Zero-net-carbon** operations for new construction, with no on-site fossil fuel use. To that end, Architecture 2030 developed the ZERO Code, which is currently available and detailed on page 102.

3. Building materials with low or zero embodied carbon emissions, and consideration of embodied carbon at all levels of design and planning, including infrastructure and building reuse, site selection and landscape, and interior fittings and finishes.



*MODEL RESULTS BASED ON PUBLICLY AVAILABLE DATA — MAY DIFFER FROM ACTUAL EMISSIONS. DOES NOT ACCOUNT FOR FUGITIVE EMISSIONS OF NATURAL GAS INFRASTRUCTURE AND DISTRIBUTION.
*20K FT IS USED AS THE BIG BUILDINGS/SMALL BUILDINGS THRESHOLD FOR PURPOSES OF COMPARISON. THIS THRESHOLD CAN BE ADJUSTED AS APPROPRIATE TO RESPOND TO LOCAL CONDITIONS.

Zero-Net-Carbon
A highly energy-efficient building that produces on-site, or procures, enough carbon-free renewable energy to meet building operations energy consumption annually.

Existing Buildings

Attaining zero emissions from the existing building stock will require new policies that accelerate the rate of energy upgrades by leveraging building intervention points.

Building energy upgrades include:

- Improvements in the energy efficiency of building operations
- A shift to electric or district heating systems powered by carbon-free renewable energy sources
- The generation or procurement of carbon-free renewable energy

Building intervention points include:

- Point of lease
- Point of sale
- Major renovations
- Systems, materials, and equipment replacements
- Capital improvement cycles
- Zoning or use changes
- Life-safety and resiliency upgrades (as for seismic, flooding, fire prevention, and power disruption)

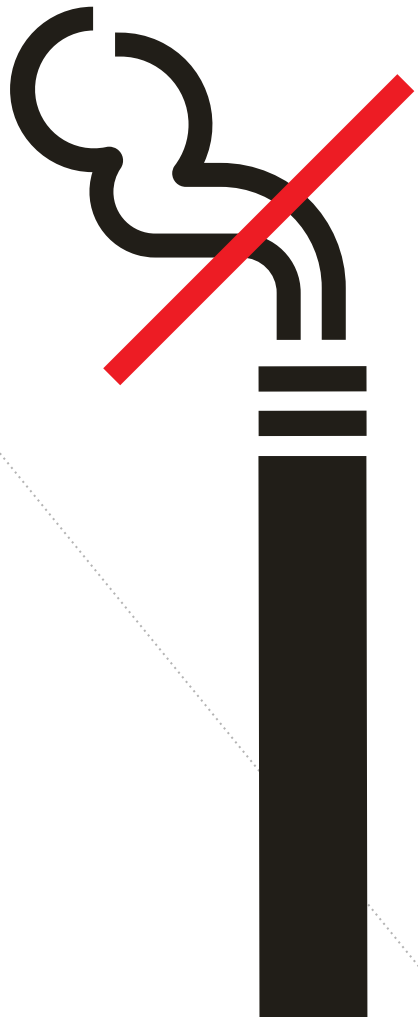
Policies that align upgrades with market-driven intervention points will help mitigate the cost barriers and disruption associated with building renovation work. Such policies will also expand the market for building renovations, building systems and equipment, and carbon-free renewable energy, which in turn will create new local jobs, market growth, and tax revenue.

The Achieving Zero framework is tailored to two broad categories—big buildings such as multifamily residential, commercial, and institutional, and small buildings such as single-family residential and retail—recognizing that the timing, requirements, and implementation are different for these two categories.

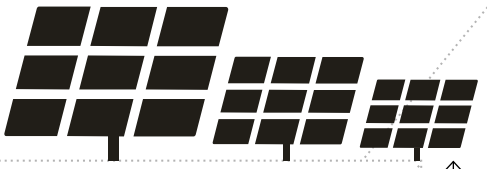
Big buildings, such as high-rises and large offices and apartments, in a downtown core make up only 2%–5% of the total number of buildings in most cities, but they account for about half of total building emissions. Big buildings are sold infrequently, and are renovated periodically during capital improvement cycles. Decarbonization policies for big buildings should be applied consistently and over a suitable period of time, so that the market learns to act accordingly.

Small buildings, meanwhile, make up the vast majority of buildings in the city by number, and altogether account for the other half of total building emissions. Small buildings are sold more frequently, and don't have traditional capital improvement cycles—instead, renovations typically occur after the failure of equipment, upon change of occupancy, or at the point of rental or sale. Decarbonization policies applied to small buildings should be equitable, simple, and prescriptive, in order to make implementation and compliance easy.

Decarbonization policies for big and small buildings are most efficient when they account for the differences between the two categories. Policies that reflect the timing and financial concerns of building owners and occupants are not only easier to pass into legislation, they are easier to implement, enforce, and build upon.



New Construction

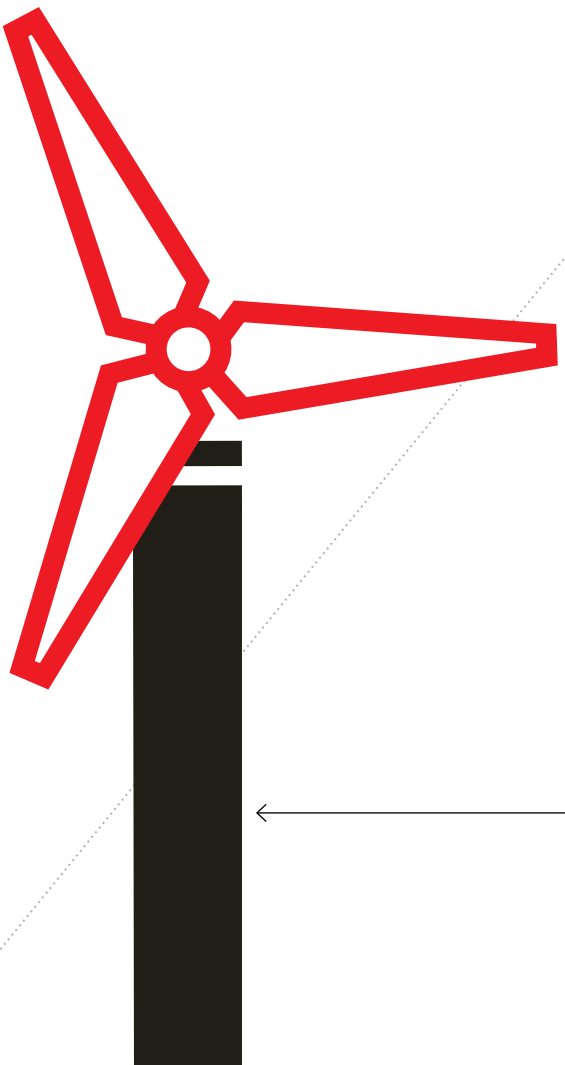


By 2060, the world is projected to add 2.5 trillion square feet of buildings—an area equal to the entire current global building stock. This is the equivalent of adding a new New York City to the planet every 34 days for the next 40 years. While improvements in the energy efficiency of buildings and growth in the generating capacity of renewable energy have both helped, it has not been nearly enough to offset the increase in emissions from new construction.

Only by eliminating CO_2 emissions completely from new building operations will we begin to reduce building sector emissions overall. Achieving zero-net emissions from new construction will require the complete elimination of fossil fuel consumption, such as natural gas for space and water heating or kitchen use. Instead, buildings must draw their power solely from carbon-free, **renewable sources** located either on- or off-site.

New construction must also rely on energy-efficient systems to ensure that total building energy use is minimal, enabling the carbon-free, renewable energy sources to easily meet demand.

Architecture 2030's ZERO Code, a national and international commercial building energy standard for new building design and construction, integrates cost-effective energy efficiency standards with on-site and off-site renewable energy, resulting in zero-net-carbon buildings. The code applies to all new buildings and major renovations and includes guidelines for its incorporation. The code includes prescriptive and performance paths for building energy efficiency compliance, based on current standards that are widely used by municipalities and building professionals worldwide.



How ZERO Code Works

After designing a building that meets an energy efficiency code standard such as ASHRAE 90.1 or the International Energy Efficiency code, which include ...

- Efficient building envelope
- Daylighting
- Passive heating
- Cooling
- Ventilation
- Efficient systems
- Equipment
- Controls

Then meet the building's main energy needs with on-site renewable energy ...

And/or with off-site renewable energy from ...

- Wind
- Solar
- Hydro
- Other non-CO_2-emitting sources

(Project Team: Architecture 2030 and Charles Eley)

Embodied Carbon

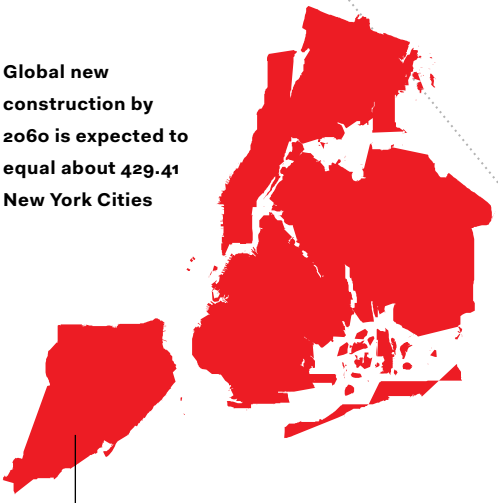
Managing embodied carbon begins with understanding the critical choices in the early phases of construction and development, as well as their impacts downstream: the choice to adapt and reuse an existing building, rather than raze it and erect a new structure; choices around location, size, and site design that require more or less material and infrastructure; and choices in the design of the building, ranging from material selection to designing for later adaptive reuse or for deconstruction and material reuse or recycling.

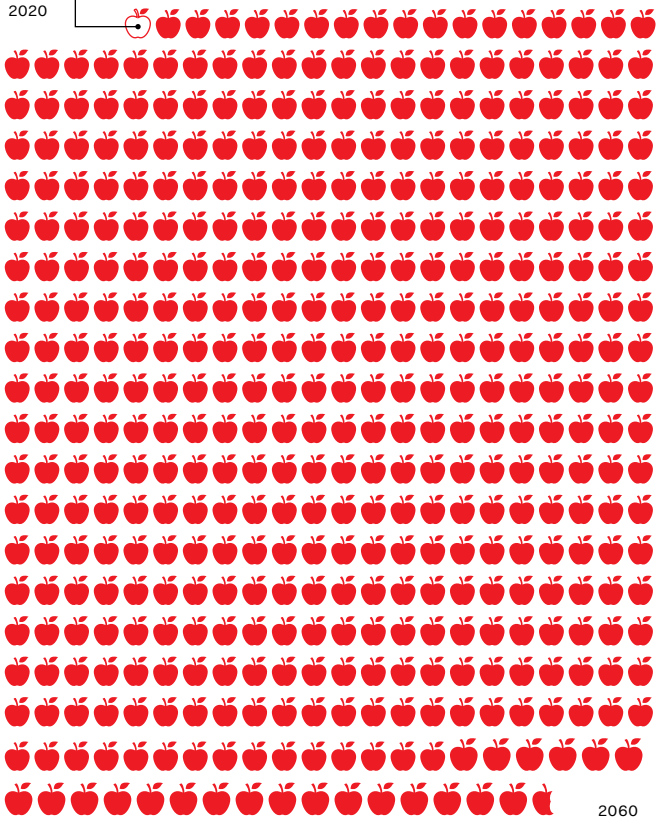
The embodied carbon of materials for the structures, enclosures, and construction of buildings represents 11% of total annual global greenhouse gas emissions. When interior walls, finishes, and fixtures; equipment; mechanical, plumbing, and electrical systems; and site infrastructure are taken into account, the percentage of global greenhouse gas emissions from embodied carbon is even greater.

Educating policymakers about building and infrastructure design and material specifications can help support them in the development of realistic, market-sensitive policies for low-carbon to **carbon positive** buildings. Policies that change the way architects and developers choose and use building materials can help manufacturing and industry to shift away from products and processes with heavy emissions. Architecture 2030 created the Carbon Smart Materials Palette as a resource for architects, engineers, and builders to identify high-impact building materials and the attributes that contribute to their carbon footprint, as well as provide strategies for reducing their emissions.

Cities can leverage their legal, regulatory, and financial powers to tackle embodied carbon through zoning and land use policies, administrative and financial incentives, and mandates for infrastructure, buildings, and products. Architecture 2030 is now in the process of developing a policy toolkit that will guide cities in implementing policies to reduce building sector embodied carbon through these mechanisms.

Global new construction by 2060 is expected to equal about 429.41 New York Cities





Renewable Procurement
The attainment or acquisition of renewable energy not generated on-site, by purchase of renewable energy credits, shares in community solar, or other means.

Carbon Positive
A city, development, building or product that goes beyond carbon neutral to create an environmental benefit, intentionally removing carbon dioxide from the atmosphere and turning it into useful forms.

Looking Ahead

To maintain even a 67% chance of limiting warming to 1.5 C above preindustrial levels, humanity has to limit its total emissions to a "carbon budget" of about 340 gigatons of CO_2 starting in 2020. The numbers may be abstract, but the implications are firm: a 65% reduction in greenhouse gas emissions by 2030, and full decarbonization by 2040. In the face of these urgent demands, it is crucial that a comprehensive and unified framework of decarbonization policies reaches all segments of the building sector.

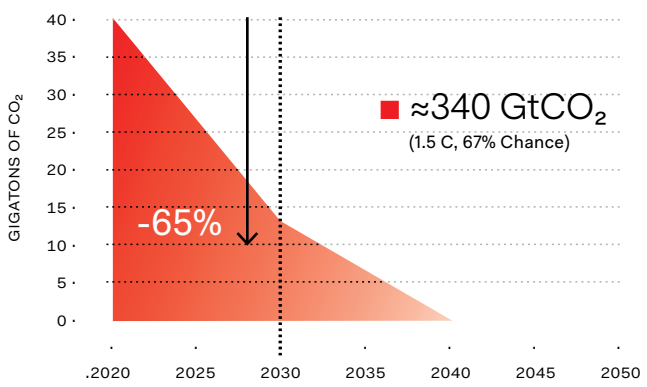
Even moderate change in the building sector can create powerful ripples that can become waves. Widespread **electrification** of existing buildings (eliminating natural gas) in tandem with grid decarbonization will remove operational emissions of existing buildings from the equation; zero-net-carbon new construction, with its demand for carbon-free renewable energy, will create a steady and predictable market for renewables and support the necessary advances in renewable energy storage and other technologies. A paradigm shift in building design and material selection will push manufacturing industries to catch up and reduce the embodied carbon of their products. Policies that reduce embodied carbon at the level of the neighborhood, city, and region have the potential to reshape patterns of consumption and waste. Such policies are being developed, adopted, and implemented in many cities across the world.

Active participation of the design, planning, and construction community in the creation and implementation of these policies can help ensure their success. The transformation of cities from contributors to greenhouse gas emissions and climate change to sites of carbon sequestration and hubs of activity for **circular economies** has the power to transform the world.

Electrification
The replacement of fossil fuel–based building systems (e.g. natural gas space and water heaters) with electric systems, which can be fossil fuel free if powered by on- or off-site renewable energy or a carbon-free electric grid.

Circular Economy
An alternative to the linear economy model (which is premised on extraction, production, and disposal) based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems.

Optimal Projected Global CO_2 Emissions, 2020–2040



SOURCE: ARCHITECTURE 2030; ADAPTED FROM REALCLIMATE.ORG "HOW MUCH CO2 YOUR COUNTRY CAN STILL EMIT, IN THREE SIMPLE STEPS"; AND IPCC SR15, TABLE 2.2


What's Next?
Let's Quit together!
March 2–4, 2020
Intercontinental
Los Angeles Downtown
CarbonPositive'20
CONFERENCE AND EXPO
HOW TO PLAN, DESIGN, BUILD, AND MANUFACTURE A CARBON POSITIVE FUTURE
Visit > carbon-positive.org
to learn more and register
A three-day gathering of the committed and the curious,
on how to kick the CO_2 addiction

Presented by

Architecture 2030 & ARCHITECT

CarbonPositive'20 CONFERENCE AND EXPO

March 2–4, 2020 | Intercontinental Los Angeles Downtown

DON'T GO IT ALONE.

Join

FRANCIS KÉRÉ, Principal and Founder, Kéré Architecture

EDWARD MAZRIA, Founder and CEO, Architecture 2030

KATE SIMONEN, AIA, SE, Founding Director, Carbon Leadership Forum

PRASHANT KAPOOR, Chief Industry Specialist at the World Bank Group (IFC)

FARHANA YAMIN, Founder and CEO, Track 0

CARL ELEFANTE, Principal Emeritus, Quinn Evans Architects

GORDON GILL, Founding Partner, Adrian Smith + Gordon Gill Architecture

And many others!

HOW TO PLAN, DESIGN, BUILD, AND MANUFACTURE A CARBON POSITIVE FUTURE

This first-of-its-kind event will show how to dramatically and rapidly reduce the embodied and operational carbon emissions that will stem from unprecedented global construction and urbanization over the next four decades.

This is an interdisciplinary, practice-focused event for architects, planners, engineers, builders, developers, and policymakers.

Visit carbon-positive.org to learn more and register

Join the conversation

#CarbonPositive | #CarbonPositive20

materialsCAN Carbon Action Network

Interface · Gensler · SKANSKA · Armstrong · CertainTeed · USG · Kingspan

AIA Large Firm Roundtable

AUTODESK. Make anything.

INVISIBLE STRUCTURES Pioneering Stormwater Solutions

Oldcastle BuildingEnvelope A CRH COMPANY

JESSE H. NEAL AWARDS

Est. 1955

CONGRATULATIONS

TO HANLEY WOOD'S JESSE H. NEAL AWARD WINNERS

Hanley Wood is committed to publishing quality content that serves the information needs of construction industry professionals. Our editors have once again been honored by the most prestigious editorial awards program. Join us in congratulating them.

2019 WINNERS

ARCHITECT
Best Use of Social Media

AFFORDABLE HOUSING FINANCE
Best Single Article

2019 FINALISTS

ARCHITECT

AFFORDABLE HOUSING FINANCE

MULTIFAMILY EXECUTIVE

The following Hanley Wood brands have been recognized over 100 times for editorial achievement.

AFFORDABLE HOUSING FINANCE
APARTMENT FINANCE TODAY
AQUATICS INTERNATIONAL
ARCHITECT
ARCHITECTURAL LIGHTING
BUILDER
CUSTOM HOME
MULTIFAMILY EXECUTIVE
POOL AND SPA NEWS
PROSALES
REMODELING
REPLACEMENT CONTRACTOR
THE JOURNAL OF LIGHT CONSTRUCTION
TOOLS OF THE TRADE

hanleywood

Advertiser	Page	Website	Phone
American Institute of Architects	10	www.conferenceonarchitecture.com	
American Institute of Architects	15	www.aia.org/compensation	
American Institute of Architects	93	www.architecturaladventures.org/architectmag	800.293.5725
American Institute of Steel Construction	20-25	www.aisc.org/earthfriendly, www.aisc.org	312.670.2400
ARCAT	C3	www.arcat.com	
Architect Online	110	www.architectmagazine.com	
Architect Podcast Network	95	www.bit.ly/ArchitectPodcasts	
Architecture 2030	105-106	www.architecture2030.org	
ASI Group	3	www.americanspecialties.com/vpa	914.476.9000
Bobrick Washroom	43	www.bobrick.com/klutch	
Boral Roofing	26-31	www.BoralRoof.com	800.669.8453
Centria	65	www.CENTRIA.com/Freedom	
Cultured Stone	63	www.culturedstone.com	
DeepStream Designs	91	www.DeepStreamDesign.com	305.857.0466
Doug Mockett & Co., Inc.	89	www.mockett.com	800.523.1269
Dyson	19	www.dyson.com	888.397.6622
Eldorado Stone	59	www.eldoradostone.com	
Endicott Clay Products	75	www.endicott.com	402.729.3315
Epic Metals	45	www.epicmetals.com	877.696.3742
Feeney, Inc.	51	www.Feeneyinc.com	
Formica	49	www.formica.com/lookbook	
Hanover Architectural Products	92	www.hanoverpavers.com	
IAPMO	90	www.IAPMORT.org	909.472.4100
Jesse H. Neal Awards	109	-	
Kalwall	8	www.kalwall.com	
LEDucation	71	www.LEDucation.org	
Legrand	C2-1	www.legrand.us/shades	
Messe Frankfurt	89	-	770.984.8016
Modernfold	7	www.modernfold.com	800.869.9685
ModularArts	94	www.modulararts.com	206.788.4210
Ornamental Metal Institute of New York	4	www.metalsinconstruction.org	
Petersen Aluminum	5	www.PAC-CLAD.com	800.PAC.CLAD
SAFTI FIRST	C4	www.safti.com/sc45	
Seiho International	79	www.seiho.com	626.395.7299
Sloan	69	www.sloan.com/unify	
Steel Institute of New York	6	www.SINY.org	
TCP Lighting	87	www.TCPI.com/LightAll	
Think Wood	32-35	www.ThinkWood.com/ceus	
Uline	89	www.uline.com	800.295.5510
Vitro Architectural Glass (formerly PPG Glass)	36-37	www.vitroglazings.com/acuity	

Publisher not liable for errors or omissions.

Editorial: The Great Deceleration

One scientific theory uses the term The Great Acceleration to describe the explosive pace of global development since World War II. From 1950 to today, the population of the planet has more than tripled, from 2.5 billion to 7.7 billion, and real GDP worldwide has increased 15-fold, from $5.5 trillion to more than $85 trillion. A billion or more people have been lifted out of poverty in the process. But our current coal- and gas-powered path to prosperity takes an unacceptable toll. As you know, burning fossil fuel releases gases into the atmosphere that trap outgoing infrared radiation and overheat the planet, jeopardizing ecosystems; economic, social, and geopolitical stability; and the well-being of every individual on Earth.

Because the building sector is a major culprit, emitting unconscionably large amounts of CO_2, architects need to lead the way toward a carbon positive future. This special issue of ARCHITECT is designed to help. One outcome of a partnership with the nonprofit Architecture 2030 and its founder and CEO Edward Mazria, FAIA, it explores architecture's unhealthy relationship with CO_2 and the ways that quitting will affect materials, design, practice, and policy. Already, the profession has taken important steps to minimize the amount of energy that new buildings use. As that work continues, the profession must turn to renewable energy to meet the remaining demand, **upgrade** existing stock, and eliminate the other major source of building-related emissions: the "embodied carbon" of materials and products.

The pursuit of greater efficiency is making architects rethink old habits; minimizing embodied carbon will push them even further. Anyone with a particular interest should attend the CarbonPositive'20 conference (March 2–4 in Los Angeles), produced by ARCHITECT and Architecture 2030 in partnership with AIA, AIA Large Firm Roundtable, and AIA California. Speakers include the World Bank's Prashant Kapoor, City of Los Angeles Chief Design Officer Christopher Hawthorne, the Carbon Leadership Forum's Kate Simonen, 2018 AIA president Carl Elefante, FAIA, Francis Kéré, HON. FAIA, and many others.

AIA's recent Resolution for Urgent and Sustained Climate Action mandates that "until zero-net-carbon practice is the accepted standard of its members, AIA prioritize and support urgent climate action as a health, safety, and welfare issue." To that end, AIA is now crafting its Climate Action Plan—one of many related initiatives, as Jane Frederick, FAIA, explains in her first letter to the profession as AIA president (on page 18). "Bold new policy proposals and bold young leaders have emerged," she writes, "moving public sentiment to a tipping point in favor of action." It is indeed time.

Frightening reports and our increasingly common lived experiences of natural disasters make it clear that we have to rapidly slow down consumption and eliminate CO_2 emissions—and do so while serving a growing and vulnerable population. Paradoxically, deceleration of our carbon economy will necessitate a rush of investment and cooperative effort, like the heroic U.S. mobilization for World War II, but on a global scale. Architects should prepare for changes as momentous as the advent of modern architecture. The path of decarbonization and resilience needn't be a burden, if we approach it as an adventure.

STEPHEN VOSS

Energy Upgrade
Improving the energy efficiency of building operations and shifting to electric systems powered by the procurement or on-site generation of renewable energy.

Just a click away.

ARCAT.com has been designed to get you the building product information you need fast and easy, the first time. Whether you are looking for a BIM object for a window, or a catalog from a paint company, we have the information you crave. Even our content like CAD, BIM and specs come in multiple formats to suit your project needs. Also, ARCAT does not lead you down a path and surprise you with registration to download content. You're free to search, find and download as you please. No sales calls after you download that spec, so ***enjoy the freedom!***

CAD • BIM • LONG FORM SPECS • SHORT FORM SPECS • OUTLINE SPECS
SPECWIZARD® • PRODUCT CATALOGS • MANUFACTURER PROFILES
VIDEOS • GREEN DATA • ARCATECT NEWSLETTER • CHARRETTE

ARCAT®
www.arcat.com

OLD TECHNOLOGY FIRE RATED GLASS

NEW TECHNOLOGY FIRE RATED GLASS

TINTED

Laminated Ceramic

$$$

CLEAR

SuperClear® 45-HS-LI

(HS Hose Stream - LI Low-Iron)

$

Request a sample of SuperClear® 45-HS-LI today!

Patent Pending

SAFTIFIRST

Visit www.safti.com/sc45 to request your sample

GLASS MAGAZINE 2019 AWARD WINNER

VOTED
"PRODUCT OF THE YEAR"
BY GLASS MAGAZINE

Intertek · CLASSIFIED UL US · USA-MADE

SAFTIFIRST® FIRE RATED GLAZING SOLUTIONS