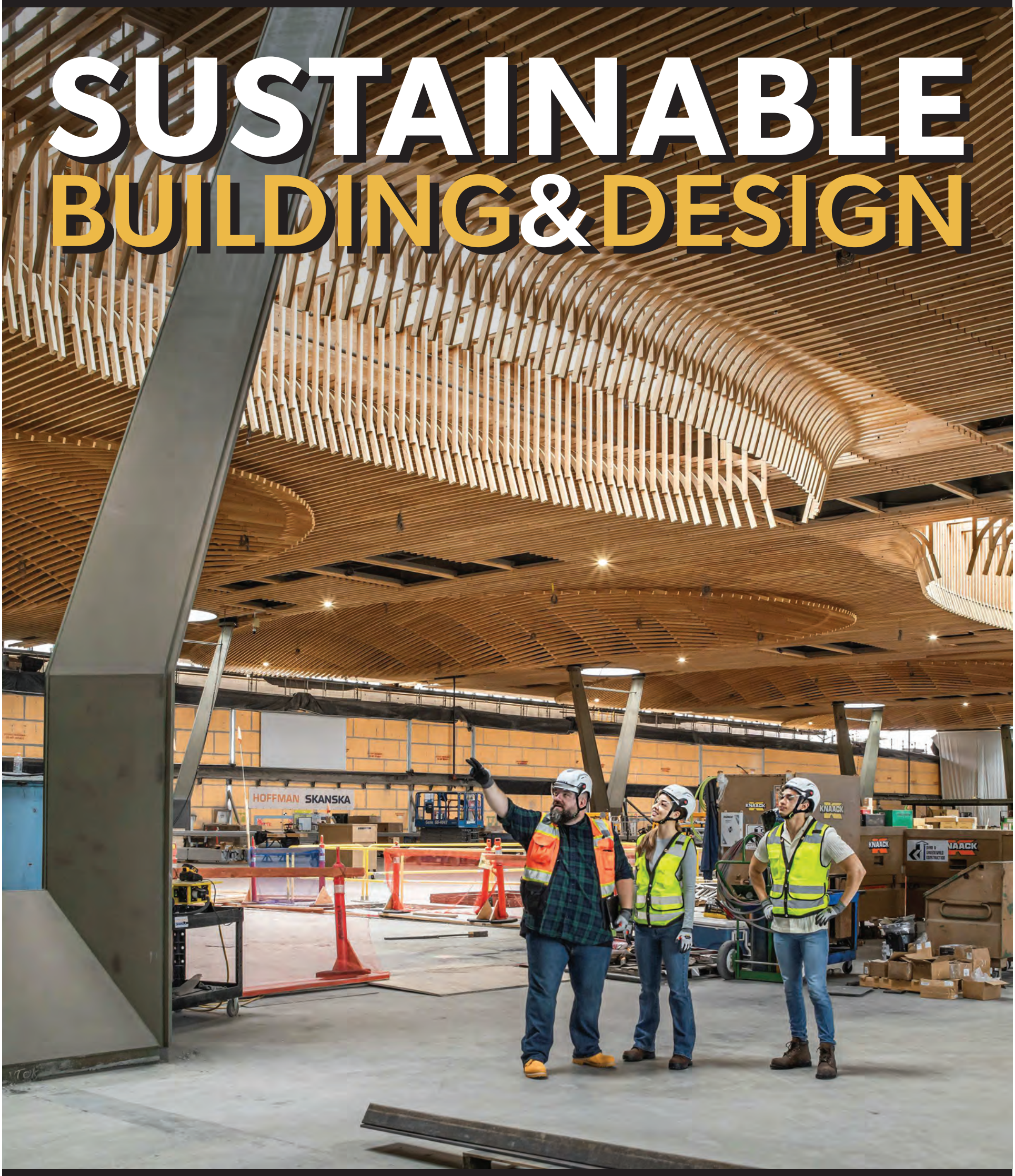
Seattle Daily Journal of Commerce

SUSTAINABLE BUILDING & DESIGN



April 25, 2024

IMPLEMENTING AGGRESSIVE WATER GOALS

Capturing and reusing rainwater onsite in new developments significantly reduces the increasing demand for our regional water supplies.

BY RACHAEL MEYER & MARK GREY
SPECIAL TO THE JOURNAL

Water is life. Essential to every living thing, yet it's often taken for granted in our urban environment. Thanks to locally-based scientific research, recent code changes, and new incentives from Seattle Public Utilities (SPU), Seattle is primed to start reversing the damage inflicted on our aquatic environment.

Private developments now have more code flexibility to collect roof water and reuse it, manage water across property lines, and expand the scope of infrastructure delivered by projects to benefit our region's health. Given the scale and complexity of water management and pollution issues, we must act to improve water infrastructure.

CLEANING ROADWAY RUNOFF

For years, researchers have studied the lethal effects of stormwater on salmon populations and sought solutions for cleaning the water before it reaches salmon habitats. One solution — passing polluted stormwater through layers of soil and rock — produced promising results. Bioswales alongside DATA 1, a LEED Gold, Salmon-Safe certified building nestled under Seattle's Aurora Bridge, applied this concept to cleaning stormwater from the bridge before it reached Lake Union.

When the swales were newly completed, the project team was tasked with collecting stormwater samples from two spots beneath the bridge. The first point collected water through a downspout directly off the bridge. This "before" sample revealed the most toxic levels researchers had seen coming off a roadway.

The second sample was collected after the bridge's runoff was slowed and cleaned through the swales' six stormwater retention cells. As stormwater moves through the soil, microorganisms, and bacteria latch onto the pollutants, breaking the chemicals down to their inert basic elements alongside plants that can absorb metals.

Each step cleaned 70% of the water's toxins, resulting in virtually clear, clean water. To the team's surprise, the effectiveness of the soil working as a sponge also meant that none of the polluted runoff reached Lake Union.

The bioretention cell cleans and slows stormwater redirected from the Aurora Bridge.

IMAGE BY BUILT WORK PHOTOGRAPHY

CONSERVING OUR REGIONAL WATER SUPPLY

The last three decades have seen great strides in water efficiency. Low-flow bathroom and kitchen fixtures are standard in new construction and water-saving practices are universally recognized as smart for both the planet and pocketbooks. In the Seattle region, we now use about the same amount of water we did in the 1950s despite the population doubling. But with drinking water supplies stressed nationally due to drought, climate change, and other factors, every drop counts.

Fremont's Watershed office building reduces potable water usage by 75 percent from a total baseline of approximately 800,000 gallons annually. With an 11,300-square-foot roof catchment area, Watershed had the potential to capture about 300,000 gallons of rainfall annually. Low-flow fixtures and automatic timers reduced Watershed's total water demand to about 400,000 gallons, with the remaining reduction achieved by using rainwater to flush toilets, a significant user of water in office buildings.

At 90 percent occupancy, Watershed's potable water usage has been measured at 105,000 gallons over a 12-month period, far below targets. In fact, despite expectations that some potable water would be needed to supplement the collected rainwater, the building has yet to use any potable water to flush toilets since its construction in 2020.

This reduction is attributed to higher-than-average rainfall, keeping the building's 20,000-gallon cistern full more of the year, and the impact of the new hybrid workplace. Even with these factors, the results demonstrate the potential. Capturing and reusing rainwater onsite in new developments significantly reduces the

WATER GOALS — PAGE 19

HARNESSING THE POTENTIAL OF MIXED-USE COMMUNITIES

Whether it's an office environment capable of absorbing housing or a space that can be shifted to hospitality if markets change, the most sustainable building is the one most flexible to last.

BY RYAN DIRAIMO
GRAPHITE DESIGN GROUP

Mixed-use communities are the future of urban centers like Seattle. The revitalization of Seattle's Denny Regrade neighborhood acts as a model of sustainable urban development as it was designed with the principles of resource conservation, transportation synergies, lifestyle benefits and long-term flexibility at the center.

Graphite designed 6 buildings within a 4-block area that serve the neighborhood and offer residential, commercial office, retail, and public amenities including childcare, dog parks, and public art.

DOING MORE WITH LESS

The revitalization of Seattle's Denny regrade neighborhood employed vertical density to increase overall site utilization and reduce the amount of area required to house these functions as compared to horizontal, single-use models where each program element may be in an individual building. Building mechanical elements are consolidated within the subterranean garages and rooftops, freeing up the ground plane for open space, circulation and active uses, while the towers above maintain high efficiency and program flexibility. The result is the ability to fit more value within a smaller container, doing more with less.

Experiential and lifestyle benefits accompany this community-driven sustainable approach. Buildings contain uses that activate the neighborhood throughout the day. While traditional single-use properties typically see peak intensity that cycles with their use—office during business hours, retail and residential in evenings and weekends, open space activity that varies with weather and season—the mixed-use Denny Triangle neighborhood blends these uses to provide engagement and activation on complimentary cycles. The same workers who occupy offices during the day may also live in one of the on-site residences and take advantage of the diverse retail and service offerings. This all contributes to a healthier, happier urban environment, promoting the goal of truly livable cities. By offering this diversity on site and convenient connections to adjacent uses, transportation demands are also reduced as there is less need to travel to attend to the needs of daily life.

Graphite designed six mixed-use buildings in the Denny Triangle including 1,100 apartments, 135 condos, 200 shelter beds, 2 million square feet of office space and 85,000 square feet of retail.

PHOTO BY BENJAMIN BENSCHNEIDER

DESIGNING FOR DENSITY AND VARIETY

Our core strength is being flexible in the design of buildings with density and variety. Varying from integrated uses, scale of development, or complexity of mixing housing, retail, offices, and amenity spaces, Graphite excels at problem-solving the fundamental challenges of making mixed-use projects successful.

The Denny Regrade features an abundance of housing and offices keeping activity around the clock, and supplements foot traffic with 85,000 square feet of retail. The retail is supported by this dense neighborhood and offers building occupants and residents retail needs in the form of home goods, food and beverages, fine dining, clothing, banking, grocery stores, bike shops and other general sales.

Occupants of mixed-use buildings reduce their energy and water use, and lower their carbon emissions by taking up less space and being centrally located. With access to transit and neighborhood businesses, these buildings become the economic engine for the city contributing to Denny Triangle's 24/7/365 activation.

Understanding the variety of mixed-use, it is essential to calibrate building layouts and infrastructure to support a wide range of uses. Whether it's an office environment capable of absorbing housing or shifting the space to hospitality in the event markets change, our core belief is that the most sustainable building is the one most flexible to last.

MAKING CRITICAL LAST-MILE CONNECTIONS

As it is located in downtown Seattle, the Denny Regrade neighborhood is inherently well-served by close proximity to regional transit networks, including protected bike lanes, the Rapid Ride bus system, the streetcar and future light rail expansion projects. This gives those who choose to live and work on site the opportunity to stay connected without the need for a car, reducing single-driver trips and their related emissions, as well as lessening demands on road infrastructure.

Additionally, numerous site-specific community transportation solutions have been integrated into the design of the properties themselves, helping address the critical "last mile" connection between broader networks and the places people live & work. These include:

- South Lake Union Streetcar line with stop at 2201 Westlake
- King County Metro stop on 7th Avenue
- Protected bike lane on 7th Avenue and Bell Street
- Expansive cycling facilities on site, with prominent entries designed to welcome bike commuters.

These transportation solutions are not merely a convenience to residents; they provide critical connectivity to schools, hospitals, grocery stores, parks, and other

MIXED-USE — PAGE 15

INSIDE

ON THE COVER

Hoffman Skanska team members inspect a portion of the nearly nine-acre mass timber roof under construction at PDX Airport.

PHOTO BY ECKERT AND ECKERT PHOTOGRAPHY

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TOWARD A PATH TO ZERO CARBON: BUILDING RENOVATIONS AND CIRCULAR ECONOMY PRINCIPLES

The embodied carbon footprint of an interior renovation can be drastically reduced by taking ownership of what already exists in a space, repurposing materials rather than sending them to a landfill and seeking out unused stock.

BY JENN CHEN & JUSTIN SCHWARTZHOFF
LMN ARCHITECTS

For the redesign of the Hines Seattle headquarters, a carbon accounting system was developed to account for the carbon benefit from materials reuse, incentivizing product reuse and helping to develop a hot list of priority materials for reuse.

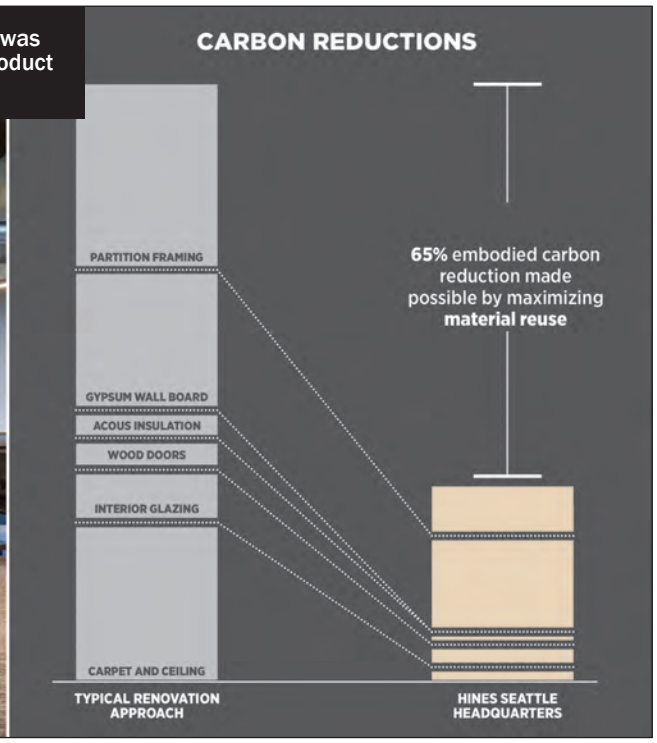


PHOTO BY BENJAMIN BENSCHNEIDER

How does the building industry align around radical, pragmatic decarbonization? Along with addressing climate pollution from energy use, we also must address the climate pollution that comes from manufacturing construction materials like concrete, steel, and even carpet and furniture. Known as embodied carbon, this pollution is around 20% of global greenhouse gases, and represents the next frontier in decarbonization. The solution toolkit includes building reuse and circular economy, sustainably-sourced mass timber, zero-carbon concrete and steel, structural materials efficiency, agricultural-waste biogenic materials and all-electric construction vehicles.

Since 2020, LMN Architects has led an industry-wide collaboration to uncover the challenges and consolidate solutions on carbon reduction through the Path To Zero Carbon series. With dozens of experts and peers involved, this provides the first comprehensive view of AEC carbon pollution and solutions.

CIRCULAR ECONOMY AS A KEY SOLUTION

Among solutions, transitioning to a circular economy is one of the most important. What is a circular economy? It means keeping materials, products and buildings in continual use instead of sending them to a landfill. From bricks and insulation to furniture and whole buildings, this means designing for timelessness, durability, and deconstruction, as well as salvaging from existing buildings, building a local refurbishment economy, and warehousing of refurbished products.

How does the circular economy impact carbon? In the case study below, buying best-in-class low carbon new products might have led to a 22% reduction in carbon, but by engaging the circular economy, the team realized a 65% embodied carbon reduction.

Materials also can have stories that contribute to design; from the old brick and reclaimed wood character we love in coffee shops to materials like ceiling tiles and workstations that can be refurbished to be indistinguishable from new. Circular economy platforms and products like Rheaply, Reseat, Davies Furniture, and Doors Unhinged already exist nationally in some product categories, and local options exist in most cities.

RETHINKING RENOVATIONS

Office renovations are often excluded by embodied carbon measurements, ratings and ESG accounting. Major certifications systems, such as LEED, allow interiors material to be excluded from embodied carbon calculations (also referred to as Life Cycle Analysis or LCA). A lack of carbon data (Environmental Product Declarations or EPDs) for interiors materials makes tracking emissions more difficult even if an owner wants to include them.

This is a huge potential oversight, as an early LMN study on interior renovations suggested that interior renovations could make up the largest percentage of embodied carbon over 60 years, larger even than building envelope and structure. Renovations have accelerated as well, and often require a restoration clause that requires tenants to remove everything from their space when their lease is up, even if carpet, walls, ceilings and furniture have a decade or two of useful life remaining.

Office furniture alone is estimated to account for over 8.5 million tons of waste per year. Worse, most office furniture is designed to function for 10-15 years, but with the short refresh cycle of seven years or less, much of this furniture is being sent to the landfill with years of useful life remaining. And with offices downsizing to accommodate a shift to hybrid work, this volume of furniture waste will likely increase over the next few years.

Can we rethink renovations? Starting with what exists already in a building and space, can existing materials and layouts remain in place as part of a thoughtful, new design instead of being removed? Can we capture the economic and carbon value of used materials instead of landfilling them?

PATH TO ZERO-CARBON INTERIORS

When Hines approached LMN for their Seattle HQ, one of the goals was to develop a repeatable system to get as close as possible to net zero carbon emissions for interior renovations. The LMN team understood that material reuse would result in the largest possible reductions, but how?

The team decided to take ownership over the existing material, first doing a walk through to identify material in good condition and with high reuse potential on and off site. A carbon accounting system was developed to account for the carbon benefit from materials reuse, incentivizing product reuse and helping to develop a hot list of priority materials for reuse. Material reuse options and carbon accounting were both consistently discussed at client design meetings.

Where removal was necessary, the team worked with the contractor to find reuse potential. For example, acoustical insulation removed from demolished interior walls was packaged up and sent to flood victims in a nearby community.

When new material was needed, the team reached out to suppliers to find unused stock; surprisingly, the team discovered that at least one supplier had a warehouse full of new, unused material that was destined for the landfill without ever being installed, which was able to supply a small area with carpet tile. For the feature wall behind the reception desk, the team worked with a local panelized wood supplier to obtain their off-cuts (destined for incineration) and repurposed them into an art installation that depicts the topography of Seattle and the region.

Overall, engaging in the circular economy resulted in a

ZERO CARBON — PAGE 10

OLD BUILDING, NEW TRICKS: DESIGNING ADAPTIVE REUSE FOR LONG-LASTING RELEVANCE

The most sustainable building is the one that is already built– but only if it is designed to live on.

BY MIKE JOBES & JIM HANFORD
MILLER HULL

In recent years, there has been a growing recognition of the sustainability benefits associated with repurposing existing structures rather than constructing new ones. The oft-heard mantra, "The most sustainable building is one that is already built," has gained significant traction. This is generally true – by avoiding building an entirely new structure, we can reduce the environmental impacts of constructing a building.

However, it may not be that simple. Our firm has evaluated the embodied carbon of our past design work to create an extensive database that we use when comparing strategies for new construction, adaptive reuse and tenant improvements. Overall, we've found that our renovation projects average about one-half of the embodied carbon footprint of comparable new construction, though within this data, the results vary according to project type. For example, the embodied carbon in light-frame building renovations is well below that of typical new construction, while the embodied carbon in larger building renovations that require significant structural upgrades is consistent with that of new construction.

Although our data does not explicitly say so, it certainly implies that there may be existing buildings that have such extensive needs, the benefits of their preservation are outweighed by the energy taken to save them. So, yes, the investment and resultant emissions of the structures we modify or construct are important factors to consider. Equally important, however, is the way we approach a building and consider it not only from the perspective of its current performance, but from one of long-term sustainability and success.

The following case studies demonstrate the criticality of the "how" when it comes to adaptive reuse, showing that, yes, the most sustainable building is the one that is already built— but only if it is designed to live on, continuing to accommodate whatever generation or expectation may come along.

EMBODYING THE FUTURE SPIRIT OF THE UW

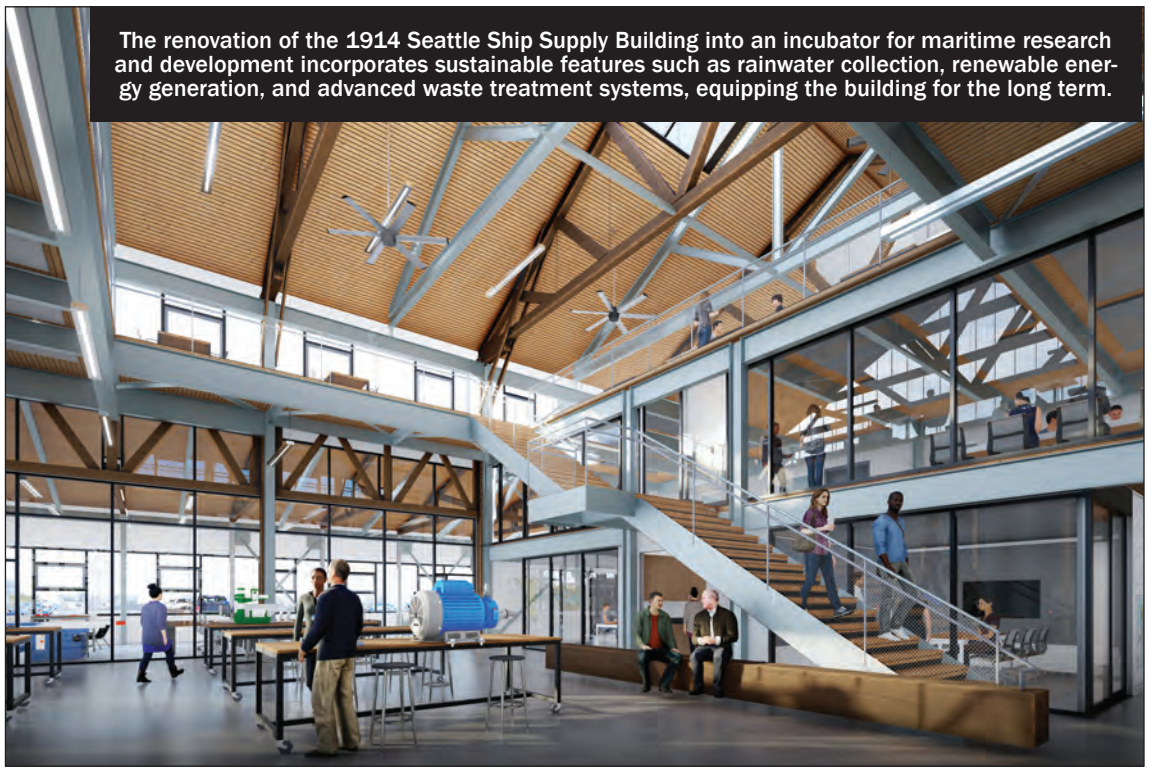
The transformative power of this approach is exemplified in projects like Tacoma Paper & Stationery — an adaptive reuse project that embodies the current and future spirit of the University of Washington, Tacoma (UWT). Originally built in 1904, this transformation connects past to present and brings new life and purpose to the last remaining undeveloped warehouse on the UWT campus. Through an innovative renovation, we reimagined the space as a cutting-edge learning environment while preserving its historical significance.

The LEED Gold certified building now provides classroom, studio and lab space for programs in urban studies, engineering and biomedical sciences, creating an active and vibrant connection to campus and the community. Our design maximizes flexibility to serve the evolving interdisciplinary programs, fosters student-centric learning and interaction, and creates a dynamic, transparent community space to connect the growing campus.

A post-occupancy evaluation of the project's energy use shows that ongoing performance is better than its design estimates, and even better than the campus 2030 Challenge targets, proving that high performance is readily achievable in adaptive reuse.

CONNECTIONS FOR FUTURE USES AT PIONEER SQUARE

In Pioneer Square, we are transforming the historic Westland Building — originally home to a steam pipe supply company — into a catalyst hotel and restaurant, uplifting the local community and paving the way for future developments.



The renovation of the 1914 Seattle Ship Supply Building into an incubator for maritime research and development incorporates sustainable features such as rainwater collection, renewable energy generation, and advanced waste treatment systems, equipping the building for the long term.

RENDERING BY MILLER HULL

The building was constructed with wide square floor plates, a configuration that didn't allow for either daylighting or egress windows for guest rooms in the middle of the building. In 1979, when the building was converted into offices, a narrow court was cut into the center of the structure to introduce daylight to the office floors.

Miller Hull's design widens and further expands the Sky Court into the void left by the relocated elevators and exit stairs to bring daylight and air into the interior guestrooms and all the way into the entry lobby and restaurant on the lower levels via a large skylight. By rotating the new vertical circulation core to the side of the Sky Court, a previously blocked axis from the main entry to the occupiable alley-side dining enclosure is opened up, reinforcing this valuable connection for all future uses to best exploit this key characteristic at street level.

To future-proof the functionality of the structure, significant seismic and mechanical upgrades have been made, including the addition of a newly permitted rooftop dining room and bar, ensuring the building remains structurally sound and economically viable without compromising its historic value. With these modernizations, the building stands to remain relevant and vital for decades to come.

PLANNING FOR LOW-IMPACT UPGRADES AT THE MInC

The Port of Seattle's Maritime Innovation Center (MInC) at Seattle's Fishermen's Terminal emerges from a Living Building Challenge-certified renovation of the circa 1914 Seattle Ship Supply Building, serving as an incubator for maritime research and development startups, and bolstering the Port's commitment to becoming the greenest port in North America.

The rehabilitation of the MInC exemplifies what is possible to support equitable sustainable development to address the climate crisis and the revitalization of blue-collar working communities. The design maintains and respects the form and mass of the more than 100-year-old building with sustainable features such as rainwater collection, renewable energy generation, and advanced waste treatment systems equipping the building for the long term future.

A new elevator and exit stair were required, which we located at the perimeters of the space in order to maximize the available floor area for future flexibility. With the vertical circulation placed to the side, a large operable skylight and upper-level floor penetration drives natural daylight deep into the structure, providing healthy workspaces at all levels. Mechanical systems are visually organized but left exposed to allow for low-impact upgrades over the future decades of use and technological advances.

Engaging the community and supporting economic opportunities for fishers, while promoting occupant health and well-being through indoor environmental quality initiatives, the project rehabilitates this historic maritime building to meet the world's strictest standard of green building certification, the Living

NEW TRICKS — PAGE 19

A PRIMER ON CAMPUS DECARBONIZATION IN WASHINGTON

Campus property owners must strategize solutions to plan, fund and successfully execute work that aligns with the common goal of decarbonizing across many project types such as new construction, existing buildings and utility infrastructure modernization.

Legacy fossil fuel steam boiler at the University of Washington.

PHOTO BY LYLE KECK

Campus property owners are currently faced with a confluence of codes and regulations, forcing them to think holistically about decarbonizing their buildings and campus infrastructure. "Decarbonization" is a broad term for reducing the greenhouse gas emissions (GHG) associated with operational energy use, goods and services used by an institution, and the embodied carbon of materials. This article will only focus on the energy side of decarbonization.

BY LYLE KECK
AFFILIATED ENGINEERS INC.

In Washington state, energy codes are restricting or banning the use of fossil fuels for space heating and domestic water heating and mandating renewable energy generation. The Washington Clean Buildings Performance Standard (CBPS) and the Seattle Building Emissions Performance Standard set mandatory energy use and GHG emission limits respectively for existing commercial buildings. Washington House Bill 1390 will mandate district energy system decarbonization under CBPS. New equipment that uses refrigerants with a global warming potential greater than 750 is now restricted for sale in Washington. Additionally, institutions may have their own set of public commitments to uphold related to carbon emissions reduction and environmental stewardship.

Campus property owners must strategize solutions to plan, fund and successfully execute work that aligns with the common goal of campus decarbonization while being coordinated across many project types such as new construction, existing buildings, and utility infrastructure modernization.

PROJECT VISION AND DELIVERY

Transitioning a campus away from fossil fuel energy sources is an enormous endeavor that begins with planning, followed by implementation, and finally by design and execution.

Planning stages commence with assessment of existing campus infrastructure and consider all potential solutions available given the site and building portfolio. Understanding campus load growth and leveraging deferred maintenance toward the unified goal of decarbonization are common. The outcome of the planning stage is a preferred path forward that considers how this new solution compares to business-as-usual levels of maintenance and reinvestment needed to maintain operations with existing infrastructure.

With a feasible concept of how to decarbonize the campus, the implementation phase furthers the planning effort with more detailed engineering and cost analysis, project scoping and phasing, delivery method assessment, and funding plan. Finally, the numerous phased projects are executed in strategic order with full design, construction, commissioning and verification.

Collaboration is crucial to developing and executing a campus decarbonization effort that may be decades in the making. Shared values and consensus building promote accountability among all stakeholders. Detailed documentation of decision-making enables the plan to be durable through changes in leadership and evolving constraints. Collaboration occurs on many levels, starting with the owner's internal groups such as capital planning, design and construction, facilities engineering and operations, and executive leadership. Additional opportunities are unlocked when an owner collaborates early and often with utility providers and other community partners. When executing the plan, designers and builders must also work together to deliver the entire project successfully.

TECHNICAL APPROACH

Campus decarbonization begins with efforts at the building level to minimize peak loads and annual energy consumption through demand reduction and passive design strategies. These projects improve building energy efficiency relative to compliance targets and reduce the cost of transitioning major infrastructure to support peak design heating, cooling, and electrical loads. Example strategies may include retro-commissioning, building envelope improvements, lighting retrofits, solar control and passive heating, occupant-scale comfort solutions, energy recovery, and intelligent controls for lighting, equipment, ventilation, and space conditioning.

Energy-efficient and low-carbon active systems are applied next to further reduce energy consumption and transition toward clean energy sources. This often boils down to a move away from fossil fuel combustion for space heating and domestic water heating toward heat pump–based technology powered by electricity sources that become renewable and more resilient over time. Consideration must also be given to specialty systems in buildings such as foodservice, domestic or laboratory water heating, humidification, sterilization, and other process needs that traditionally run on natural gas.

Many campus property owners have existing district energy systems (DES) that supply central heating, cooling, or heating and cooling through a distributed system to multiple buildings via steam, heating water, or cooling water. Often the DES heating provided to buildings comes from steam generated by natural gas boilers. These legacy systems are gravely inefficient and often produce most GHG emissions associated with operational energy in the campus environment. Transitioning steam DES to a lower-temperature hot water system allows a wide range of thermal energy sources to contribute to campus heating and significantly reduces energy loss inherent to lengthy steam and condensate return piping.

When approaching a steam-to-hot water transition, it's helpful to group the efforts into three main "buckets:" building conversion, distribution network, and central plant equipment.

BUILDING CONVERSION

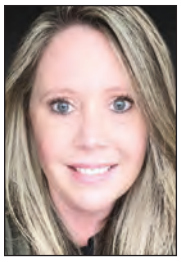
Building conversion takes building-level systems that currently operate on steam and/or high-temperature heating water and modernizes them to run on lower-temperature heating water. This may include legacy systems such as steam radiators, steam heating coils in air handlers, or a heating water system that is designed for 180°F. While its possible for steam or high-temperature heating water to be produced from low-carbon electricity, it may come with the tradeoff of poor energy efficiency, high operational cost and reliability concerns with unproven applications.

Building conversion work is often the most expensive

DECARBONIZATION — PAGE 19

REDUCING EMBODIED CARBON IN CONCRETE CONSTRUCTION

Mixing water-repelling pore blockers with concrete helps minimize a project's carbon footprint while maximizing the lifetime of new construction.



BY LINDSEY MONTGOMERY
HYCRETE

The construction industry's use of concrete accounts for a huge percentage of the carbon emissions we generate as a society. Mostly, that's due simply to the sheer amount of concrete we use. To put it into perspective, concrete is the second-most-consumed material in the world next only to water. As you can probably imagine, all of that material use comes with a whole lot of embodied carbon.

That's why some of the major challenges today's construction industry faces lie in finding new ways to make the building process more sustainable. How do we make construction cleaner, greener and more efficient? How do we make buildings that last longer and require less maintenance?

Obviously, any sustainability initiative has to include the raw materials being used – with concrete right at the top of the list. To that end, hydrophobic pore-blocking admixtures for concrete are one of the keys to minimizing the embodied carbon of the modern construction industry.

PUTTING EMBODIED CARBON INTO PERSPECTIVE

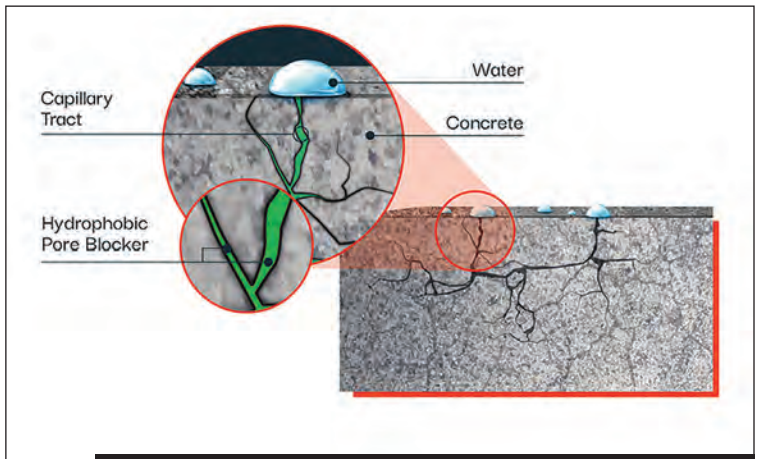
The built environment generates more than 40% of the annual carbon emissions in the United States. That places the construction industry (developers and builders of residential and commercial buildings, as well as infrastructure) amongst the highest producers of embodied carbon emissions by far.

As a whole, the construction sector is responsible for generating more embodied carbon than shipping, aviation or even electricity production. Which means on average, it will take 30 years before a building hits the same level of operational carbon emissions as the embodied carbon produced from constructing the building in the first place.

In the drive toward better sustainability across the industry, builders have employed a long list of strategies to minimize their carbon footprints while maximizing the lifetime of new construction. Hydrophobic admixtures are increasingly proving to be one of the best long-term solutions, as the first building material to achieve both Cradle to Cradle and NSF certification.

HOW HYDROPHOBIC PORE-BLOCKING TECHNOLOGY COMES INTO PLAY

Essentially, hydrophobic (water-repelling) liquid admixtures form a copolymer when mixed with concrete that fills in the material's natural capillary system. The result is concrete that's virtually non-porous, highly resistant to the transport of moisture vapor and liquid.



Concrete mixed with water-repelling pore blockers is highly resistant to the transport of moisture vapor and liquid.

IMAGE COURTESY OF HYCRETE

Hydrophobic admixture technology all but eliminates the common concrete damage caused by freeze/thaw cycles – including cracks, delamination, and spalling. Likewise, it protects the structure's internal steel reinforcement from long-term rust and corrosion.

WHAT ABOUT INSTALLED MEMBRANES?

Waterproof membranes which cover the exterior surfaces of below-grade concrete

EMBODIED CARBON — PAGE 17

CREATIVITY AND INNOVATION ARE HALLMARKS OF SUSTAINABILITY AT PDX AIRPORT

The carbon-conscious renovation and expansion at PDX includes a huge mass-timber roof sourced regionally, repurposed materials to avoid waste and cut carbon, and wells drilled under the airport to create a unique heating and cooling system.

BY JOE SCHNEIDER & STEVE CLEM
SKANSKA USA

When the Port of Portland began its transformative renovation and expansion of Portland International Airport (PDX) in 2020, it sought partners who could do the work and be willing to develop new methods, source in new ways, and not settle for business as usual. In short, they wanted partners who could do something groundbreaking while physically and literally breaking ground.

PDX selected the joint venture (JV) team of Hoffman Skanska as the general contractor/construction manager for the project. From the beginning, creative thinking and innovation have been the expectation of every member of the team, especially when it comes to driving sustainability.

As our work continues at PDX and while there is much to be proud of over the past four years, here are three pieces of creative thinking and innovation that stand out for their massive impact on the sustainability of this project:

REDUCING EMBODIED CARBON, REVITALIZING LOCAL TIMBER

The short version is we built a nearly nine-acre mass timber roof a mile away from its final destination, trucked it over in sections before assembling it, and the result was not only visually stunning but also an 18 percent reduction in carbon vs. a steel roof. But that doesn't begin to tell the full story.

The longer version is that the visual centerpiece of the remodeled airport is a gorgeous new 400,000 square foot mass timber roof made of 2.6 million board feet of timber from responsibly managed forests. That's nearly nine-acres made mostly of Douglas Fir from local forests – on public, private and Tribal lands – where the Port can say with confidence where all the wood came from. That's cutting-edge stuff.

To do that, the project team created new procurement processes to ensure the Port's sustainable wood requirements were being met and used third-party certification of environmental stewardship when full tracking of the timber wasn't an option. We worked with forest owners, Tribal members, loggers, mill workers and others throughout the sourcing process, creating a supply chain model that didn't originally exist. We even kept wood separate at the sawmill so that provenance could be tracked.

By sourcing the wood regionally, there were fewer vehicle miles traveled during transport and we were able to keep more budget dollars with local logging companies and other businesses. Local industry also helped with innovation in the form of a sheathing known as mass plywood, which we used on top of the roof. Developed in Oregon, the plywood is made from eighth inch thick veneers which were formed into 2.5-inch-thick plywood panels that were then cut and shaped to fit the curved surface of the roof.

This work helped create jobs and revitalize the logging town of Lyons, once again fueling pride in an industry that has played a large role in the Pacific Northwest for decades.

REUSING CONNECTOR SAVED WASTE, CARBON, TIME AND MONEY

To make room for all the construction happening at PDX, the Concourse Connector – a 700-foot-long, 18,000-ton elevated glass hallway that connected the north and south wings of the airport – was slated for demolition. But Hoffman Skanska had unique idea, to cut it in half and reuse it elsewhere, and the Port of Portland was fully supportive.

After moving the two halves into their new positions (a massive feat alone), each Concourse Connector piece found new life as a bypass to help people move safely around the construction zones within the main airport, easily separating pedestrian traffic from construction activity.

Furthermore, this circular approach to materials use eliminated waste, avoided unnecessary construction of tunnels or new walkways and the embodied carbon associated with it, and saved both time and money.

CUTTING ENERGY COSTS THROUGH UNIQUE HEATING AND COOLING

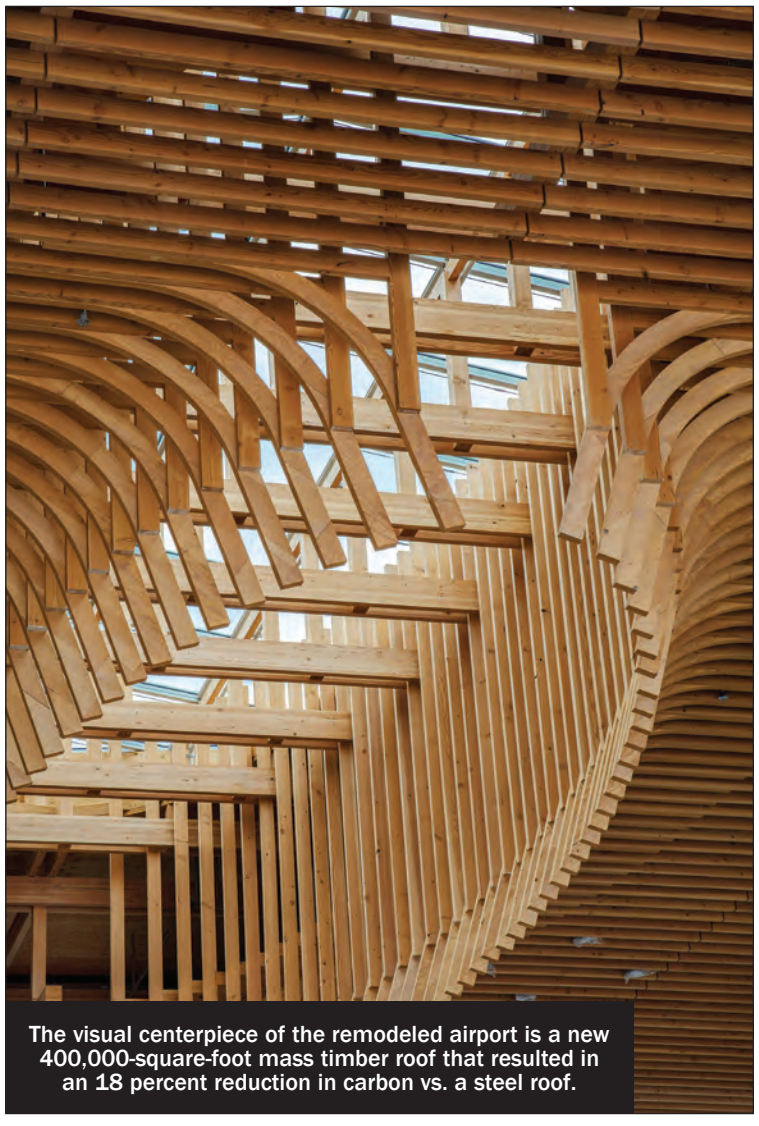
Another component of sustainability that's key to PDX's future operational efficiency is a unique ground-sourcing program designed to cut the airport's use of fossil fuels by 95 percent and total energy costs by 50 percent.

Hoffman Skanska is currently drilling wells deep into the Troutdale Sandstone Aquifer that lies about 500 feet below the airport. The water will then be turned into heating and cooling energy through a heat pump system designed by local engineering firm PAE. Once run through the heat exchangers, the water will be sent back down below the surface, completing this closed loop without contacting anything that could contaminate the aquifer.

Since the temperature of the ground water is cooler than the air temperature during warmer months and warmer than the air temperature during cooler months, the temperature differential can help heat and cool the airport without the need for oil and natural gas like the airport currently uses. This innovative approach will provide PDX with an ongoing, sustainable and cost-saving method of conditioning its buildings.

Portland International Airport is a world class airport, not just because of its aesthetics and amenities, which are second to none, but also because of how the Port of Portland and its partners like Hoffman Skanska work together to find creative and innovative solutions to the sustainability challenges of today and tomorrow.

Joe Schneider is senior vice president and account manager, and Steve Clem is senior vice president for project planning services & sustainability at Skanska USA.



The visual centerpiece of the remodeled airport is a new 400,000-square-foot mass timber roof that resulted in an 18 percent reduction in carbon vs. a steel roof.

PHOTO BY ECKERT AND ECKERT PHOTOGRAPHY

ZERO CARBON

CONTINUED FROM PAGE 4

reduction in embodied carbon around 65% from a typical renovation, three times the reduction possible if only new, low-carbon materials were used. While designing with the circular economy takes more design effort, it can reduce construction costs, supply chain issues, and embodied carbon. These strategies are captured in the Path To Zero Carbon series alongside many others, highlighting that there are already large levers for carbon reduction through clever design and strategic reuse.

Jenn Chen is a partner at LMN, helping to lead the firm's materials & health applied research team, and a co-creator of its Path to Zero Carbon series. Justin Schwartzhoff is an associate at LMN and leads its in-house research group on embodied carbon and mass timber.

HIDING IN PLAIN SIGHT: SUSTAINABILITY AND RESILIENCE BEYOND THE TERMINAL

PDX's new parking, rental car services and operations center additions are designed for environmental efficiency and traveler ease in the earthquake-prone region.

In the rush to and from an airport, travelers and those picking up or dropping off passengers likely don't pay much attention to the physical nature of the parking, ride share and rental car facilities they pass through. At Portland International Airport, as part of the transformative, multi-phase PDX Next project, relocation and upgrades of these service spaces were given elevated consideration by the Port of Portland (the Port).

BY TOM ROBBINS
INTEGRUS

The initial project brief grew to incorporate adding airport offices and an operations center built to withstand significant seismic events and maintain critical functions. This created unusual design and engineering challenges for the progressive design-build team selected. Referred to as PACR (Parking Additions and Consolidated Rental Car Facility), the $325 million building and structure with a cumbersome name presents a standard-setting example of advancing exceptional sustainable and resilient design where least expected. How many people walk by or utilize services each day — not realizing the underlying importance of this sleek presence?

DESIGNING FOR DISPARATE SERVICES

The Port strives to provide an exceptional passenger experience at PDX, consistently ranked 'the best airport in the U.S.. The unprecedented combination of long-term parking, rental car and critical airport operations adjacent to the terminal is a triumph in improving traveler ease and satisfaction, optimized for environmental efficiency with a backdrop of resilient infrastructure able to withstand natural disasters and meet future challenges. What does it take to design for a combination of disparate passenger services and critical airport functions, in an earthquake prone region, while keeping efficiency and traveler satisfaction in mind?

PUTTING PASSENGER EXPERIENCE FIRST

Improving passenger access and parking is a priority for most airports, and the Port saw PACR as an opportunity to take it further. Not only to expand its reputation for putting passenger experience and convenience first, but also to build in more sustainability and resilience in its operational facilities. Previously, several rental car facilities were offsite.

Major expansion of the on-site long-term parking and rental car facilities in the form of a multi-level parking structure a walkable (or moving walkway) distance through an underground tunnel makes it quick and easy for people to reach their cars or rental car services without exposure to the elements. The bright passageway is enlivened with art by regional artists. The 1.7 million square foot PACR complex includes six floors of parking with 2,200 long-term parking stalls, ADA parking spots and electric-vehicle charging stations.

The neighboring four-story building includes a first-floor rental car lobby encompassing 11 rental car partners. It atypically features an open and welcoming layout, with warm wood panels, natural lighting and artwork. Eliminating the need for shuttle buses to offsite parking and rental car locations in the airport corridor greatly streamlines overall airport campus circulation, both reducing the volume of cars and related Co2 emissions. It also removes a primary point of aggravation travelers face at an airport.

The project also simplified the parking and rental facility exit and fee payment process. Of note, the structure represents the first Portland-metro area use of carbon sequestering CarbonCure concrete. Given the large volume of concrete used, this significantly reduces the structure's overall carbon footprint and contributed to achieving LEED Gold certification.

Eliminating the need for shuttle buses to offsite parking and rental car locations streamlines overall airport campus circulation, reducing the volume of cars and related Co2 emissions.

PHOTO COURTESY OF INTEGRUS

RESILIENT DESIGN FOR CRITICAL AIRPORT FUNCTIONS

The upper floors of the 95,000 square feet of office space house critical airport functions. Located in an earthquake zone, the building necessarily incorporates resilient design strategies to ensure airport operations remain functional following a 9.0 Cascadian earthquake event. Accordingly, it is also designated as one of several statewide natural disaster emergency coordination stations.

Assembling the team of experts required to design a resilient essential services building was aided by the progressive design-build delivery model decision-making framework leveraging the experience and insights of all partners and stakeholders from the start. This was especially important as the Port wanted to deliver a design solution with minimal operational disruption. Project partners include JE Dunn, PAE, KPFF, Mayer/Reed, and numerous small businesses.

Regional realities unique to the airport's geographic location were considered in achieving this ambitious goal.

Portland International Airport is located in the Cascadia Subduction Zone, a 1,000 km megathrust fault line stretching from Canada to California, with subduction zones that have produced

IN PLAIN SIGHT — PAGE 19

PROMOTING RESIDENTIAL ADAPTIVE REUSE IN SEATTLE THROUGH POLICY

To meet Seattle's ambitious climate goals, we need to shift the conversation from reducing energy code requirements to quantifying and capitalizing on embodied carbon reductions.

BY DEVIN KLEINER, MYER HARRELL AND ELIZABETH GRACE
PERKINS&WILL

How can Seattle chart a course toward the city it aspires to become?

As we navigate our pressing urban challenges with opportunities for revitalizing our downtown core — re-purposing vacant office buildings and providing much-needed housing — we must also meet our city's ambitious climate goals. By 2030, the city of Seattle aims to reduce greenhouse gas emissions by 58%, with aspirations to reach net zero carbon by 2050. There is an opportunity to pair our city's operational carbon focused policy with equally ambitious policies targeting embodied carbon. In fact, embodied carbon must be a part of the equation to meet our 2050 commitments.

By acknowledging and incentivizing embodied carbon reduction in reuse projects, we can power housing solutions and bring wind back into our sails for downtown development.

A NEW POLICY PROPOSAL FOR OFFICE-TO-HOUSING CONVERSIONS

Following other jurisdictions such as New York City and Pittsburgh, Seattle has made a commitment to converting underutilized downtown office buildings to multifamily residential use through land-use exemptions and the elimination of onerous code requirements. The city recently proposed an ordinance that has cleared the State Environmental Policy Act and is moving forward to the city council for a vote.

The proposed ordinance arrived on the coattails of the Seattle Office of Planning & Community Development (OPCD)'s 2023 competition, Office-to-Residential Conversion Visions for Seattle Downtown. In the Call for Ideas, Perkins&Will partnered with Unico to convert the Smith Tower to a mix of market-rate residential units, an informative experience that shed light on the potential costs for conversion: without additional incentives or reduced costs, office-to-residential projects are rarely economically viable. Many of the submissions proposed

Perkins&Will created a concept design for an office-to-residential conversion of a 1929 historic tower at 100 McAllister in San Francisco. Revitalizing the Great Hall, which has been vacant for over two decades, is a unique draw for prospective buyers.

IMAGE COURTESY OF PERKINS&WILL

policy changes that would ease the burden of making adaptive reuse a reality, including grant money from the city, leniency in seismic requirements and reducing energy code requirements.

As a firm dedicated to building performance and Living Design, we'd like to shift the conversation from reducing energy code requirements to quantifying and capitalizing on embodied carbon reductions instead.

ADDING EMBODIED CARBON TO THE EQUATION

Embodied carbon, or greenhouse gas emissions caused by building materials, has not been as widely understood and measured as operational carbon, emissions resulting from running a building after construction is complete. Seattle has made commitments to reduce carbon emissions by a quickly approaching deadline, but the phrase "embodied carbon" is notably absent from the newly proposed ordinance. By adding embodied carbon savings to the equation, the city would not only bring our 2050 goals within reach but also benefit our frayed urban realm.

In recent years, Seattle has been quite active in reducing operational carbon emissions through strategy and policy. In addition to the city's 2018 Climate Action Strategy, an executive order, Driving Accelerated Climate Action, was passed in 2021, further amplifying Seattle's push toward net zero emission buildings. Then, last December, Mayor Bruce Harrell signed the Building Emissions Performance Standard (BEPS) into law, which requires existing buildings over 20,000 square feet to reduce greenhouse gas emissions to zero by 2050.

Over the next two decades, it will become easier to achieve operational carbon reductions. In 2019, Seattle passed the Clean Energy Transformation Act committing to a clean energy grid by 2045. Any building that transitions to all-electric systems will easily meet the operational carbon requirements. As operational carbon becomes less of a contributor to Seattle's total carbon emissions, the significance of embodied carbon grows in proportion. A critical way of reducing embodied carbon is leveraging what we've already built. Adaptive reuse – adequately incentivized to developers and investors – is essential to meeting the 2050 deadline, as it avoids emissions associated with new construction.

Perkins&Will has completed a full life-cycle analysis on a range of projects, combining them into a benchmark database of embodied carbon emissions. The trend is clear: adaptive reuse projects' average embodied carbon emissions are 42% less than new construction.

RESTORING VIBRANCY AND MAINTAINING CHARACTER

While not addressed in the proposed ordinance, Seattle's existing urban fabric is part of what defines the character of the city. Imagine Seattle without buildings like Smith Tower dotting our skyline and shaping the streetscape. Transforming vacant office buildings to high-demand residential uses supports our 2050 carbon goals and maintains and improves our urban realm.

Thriving neighborhood districts rely on an active pedestrian environment and a mix of uses fostering a diverse mix of people and activities. Increasing the downtown population with more residential units will draw new retail and services, support existing retail and improve safety with eyes on the street throughout the day and night.

CARBON REDUCTION LESSONS FROM WEST COAST PROJECTS

Narrowing our analysis from the broad benchmarking study to specific projects helps us better understand how to address embodied carbon and our historic urban fabric while not forgetting operational carbon. In downtown Seattle, the Federal Reserve Bank's concrete structure and stone façade were retained while a new high performance office building was added above. In addition to reducing the total embodied carbon by 39% (compared to tearing it down and building new), the global warming potential of the concrete alone was reduced from 76% to 36%.

In contrast, the office building at 400 Westlake in Seattle's South Lake Union neighborhood retained the façade of the old Firestone Tire building, while a new structure and high-performance enclosure were constructed.

This project focused on operational carbon benefits to achieve a net positive energy building generating 105% of the energy needed by the building and feeding the surplus to the grid. Solar panels were installed both on the roof and in northern Oregon where the electrical grid has more coal than Seattle. This resulted in an even greater operational carbon offset. Comparing these two Seattle examples, we see the value of tailoring design to a building's specific reuse opportunities and a client's carbon reduction goals.

A third example is the repurposing of a 1929 historic tower at 100 McAllister in San Francisco. This project demonstrates how other cities are successfully implementing office-to-residential conversions while enhancing the urban fabric and user experience. Revitalizing the Great Hall, which has been vacant for over two decades, is a unique draw for prospective buyers to the 257 Class A residential units. Such amenities are uncommon in new ground-up buildings. Capitalizing on the unique benefits of adaptive reuse, the Great Hall is a differentiator in the market and contributes to the unique character of the neighborhood and city.

TODAY'S DECISIONS HAVE CONSEQUENCES TOMORROW

Our city is facing unchartered challenges that require

ADAPTIVE REUSE — PAGE 17

MAKING OLD BUILDINGS NEW AGAIN: THE CASE FOR ADAPTIVE REUSE

Extending a structure's operational life helps maximize the built environment's embodied energy and sustain the spirit older buildings bring to their communities.

BY MICHAEL LEONARD
MLA ENGINEERING

We know that the world is undergoing the largest wave of urban growth in history. As the number of people living in cities increases, so does the need for building inventory —challenging existing infrastructure and available resources. But new construction is not the only solution. Finding a sustainable alternative is an exercise in recognizing an old building's potential for new life. Structural engineers are in the midst of this creative process, determining the durability and safety of existing buildings and feasibility of retrofits. By extending a structure's operational life, we are helping to maximize the built environment and its embodied energy through adaptive reuse projects.

Additionally, we want to highlight the role of adaptive reuse in sustaining the unique history and spirit that existing buildings bring to their communities. By giving outdated yet beloved structures new meaning and purpose, we are also strengthening the cultural roots of their environments. When we can preserve a building's architectural aesthetics while making it more functionally relevant, we are also contributing to a sense of place that endures.

CHALLENGING THE ONE-GENERATION BUILDING

The days of one-generation buildings are falling into the past. Structural engineers know good bones when we see them which, among other factors, is critical to making adaptive reuse economically feasible. Extending the life of a structure also plays into tight budgets and site availability.

A building still has a serviceable life when it meets the intended functional needs and can be operated within the typical annual maintenance costs. We also look for an economic, environmental, zoning, and historical benefit to keep significant portions of the building in place, with only minor repairs or upgrades required to meet its repurposed function.

The evaluation process is critical in the early stages of the project to estimate the building's remaining life. Depending on the environmental loads, this phase typically includes a seismic evaluation and materials testing to determine durability and the extent of deterioration. Discussions also include architectural modifications, updates to finishes, and MEP retrofit to assess the resulting construction cost.

SETTING THE COURSE FOR TRANSFORMATION

There are many items to consider when determining if adaptive re-use makes sense. Although the structural frame and foundation are fundamental to a cost-effective reuse, all disciplines need to be considered and coordinated during the project's feasibility phase. Structural engineers innovate as design opportunities present themselves and enjoy collaborating with project owners and designers to generate ideas and then evaluate the merits and costs of each one.

Diving deeper, our knowledge of load-bearing and seismic resilience issues combined with what goes on inside the walls is necessary to itemize potential costs that will impact the total project budget. We avoid retrofitting too much by identifying where we can leave costly features alone, which elements we recommend for further testing, and how we can give the client a reasonable range of options, costs, and benefits they can use for confident decision-making.

EXPLORING POTENTIAL

Sometimes, only a portion of an aging structure is selected for remodeling. This was the case when we were enlisted to help launch another iteration of Tacoma's Freight-house Square. The 1920s building, originally designed as a warehouse for materials being loaded onto freight trains, is a timber post and beam structure. Additions over the following 20 years expanded the building eastward. MLA's assessment and evaluation focused on the structural issues and extent of construction associated with reusing parts of the existing wood-framed superstructure and concrete foundations to reconfigure the building as an Amtrak station.

The first task was for us to identify seismic vulnerabilities and complete a concept plan for the required seismic upgrades. Based on our findings, we were able to explore the possibilities for development and make economic comparisons for preservation versus new construction. MLA's final role was to design the concrete platform, soldier pile retaining wall, MSE ramp wall, and steel canopy structures.

The interactive water feature engages children and families to learn and explore sea life with a "hands-on" experience.

PHOTO COURTESY OF MLA ENGINEERING

We found ourselves meeting many unique challenges that included coordinating with multiple transit agencies related to the adjacent Sound Transit construction project. Throughout the process, structural engineering insights on the pros and cons of different solutions helped our client determine the most effective and efficient approach to adaptive reuse.

RENEWING A COMMUNITY LANDMARK

Adaptive reuse projects can be impressively creative and even visionary to bring new life and meaning to a beloved community landmark. MLA provided structural engineering for the first aquarium in St. Louis, Mo. as part of a major renovation of the city's historic Union Station—the world's largest and busiest train station when it opened in 1892.

The project had its challenges, as it needed to be constructed inside the original train shed. While the two-story, 120,000-square-foot complex includes nearly one million gallons of new water exhibits, the aquarium had to be kept structurally independent from the existing building to avoid extensive retrofit of the historic superstructure. Due to the deep, unsuitable soils, the entire project was installed on approximately 80-foot-deep micro-piles that required coordination to support the new structure while avoiding existing wood piles and foundations. Using Revit to model all the structural, architectural, and life support system elements, in combination with several intense collaboration sessions, proved necessary and valuable to design a suitable foundation system within the limited space available.

FULFILLING A COMMUNITY NEED

As communities evolve, places constructed for a

particular use regularly lose their relevance. Vacant office buildings are a prime example. Recently, four such existing structures in Seattle, Kirkland, Renton, and Enumclaw were given new purpose by being converted into dialysis centers for Kidney Centers Northwest. More importantly, these projects demonstrate how adaptive reuse, as a cost effective model, is especially relevant for nonprofit budgets designed to fulfill essential public needs.

Known for being the world's first outpatient dialysis organization, Kidney Centers Northwest now treats thousand of citizens each year whose lives depend on visiting several times each week. With the objective to improve accessiblity by spreading as many facilities as possible throughout the region and keep treatments affordable, adaptive reuse became the obvious cost-effective strategy.

Our efforts in Enumclaw were the most notable, beginning with seismic evaluation of an an 8,765-square-foot structure that continued with strategic upgrades, including additional underfloor framing for increased floor loading, new openings in brick CMU walls, equipment bracing, and floor framing for scale depression. We also reviewed the existing roofing trusses and worked extensively with the mechanical engineer to limit the extra roof framing required for new mechanical units.

CHANGING A BUILDING'S FUNCTIONALITY

Inserting new activities into an existing building and updating systems to become code compliant takes place within a complex matrix of design factors. When visitors to KidsQuest Children's Museum far exceeded the capacity of its original mall space in Factoria, the decision was made to double in size by renovating a former doll museum in downtown Bellevue. Updating the project's original purpose for a new era required transforming the existing 13,500 square feet into nine interactive zones for learning through play.

MLA was responsible for the project's structural design, extensive renovation and seismic retrofit. Our efforts included removing or reconfiguring portions of bearing and shear walls, enlarging the north central portion of the main floor to create a small addition and to extend the on-grade space northward.

The significant area of renovations and modifications to the lateral resisting structure triggered substantial alteration provisions in the International Existing Building Code, with the most extensive of the requirements being for increased floor loading and seismic performance. New openings for doors and windows, upgrades to shear walls, and strengthening of floor elements were all essential to support the new exhibits and change in occupancy. Installation of the two-story climbing frame and a full-size semi-truck cab in particular required creative structural planning and coordination.

DEVISING NEW MATERIALS

Looking for space to house a new linear accelerator, Group Health in Seattle's Capitol Hill neighborhood turned to an existing basement room located underneath a parking and loading area for busses. With only two feet available overhead, the key was to provide adequate radiation shielding—typically provided by a three-foot thick concrete mass. The solution that best met the competing requirements was to remove and replace a portion of the existing drop-panel slab and replace it with a specialized high-density steel-aggregate concrete slab along with sheets of steel plate that provided the radiation shielding required. A high-strength concrete wall replaced one of the original columns that supports the slab.

SUPPORTING SUSTAINABLE COMMUNITIES

Among the various types of green building projects, adaptive reuse makes special sense from the standpoint of embodied energy. We typically understand this to mean the decades required for a new building to overcome the climate change impacts created by its construction. At the same time, embodied energy could be seen from the perspective of a structure's meaning to its community. Adaptive reuse has improved in creativity and ability to integrate a community's sense of identity and place with the renovated building. By redeveloping an existing building's functional relevance, we are also connecting its past with the future — incorporating the initial investment to strengthen and enrich its new purpose going forward.

Michael Leonard is the principal and owner of MLA Engineering.

MIXED-USE

CONTINUED FROM PAGE 3

regional destinations that support urban lifestyles for residents who live in the city but choose not to drive every day.

Functional elements of the buildings in the Denny Triangle have been designed to support density while minimizing resource use. Mechanical systems in all the buildings employ state-of-the art technology to condition spaces efficiently while providing dedicated fresh air to occupants and operable windows, increasing health and well-being, creating an eco-community.

Where programs are shared within one building, further efficiencies are attained. At 2201 Westlake/Enso, waste heat that is a byproduct from cooling the office space is captured and reused to heat domestic water for the condominium units. Broader neighborhood strategies are also key, as both Amazon Nitro and Frontier have been designed to tap into a hot water loop that circulates and stores excess heat energy from an adjacent high-rise data center to offset on-site heating and conditioning loads.

Mixed-use buildings reduce our building footprints, reduce our resource needs, and reduce our emissions. As populations continue to urbanize and downtowns begin to diversify, designers should equip themselves to deliver a sustainable solution though thoughtful mixed-use design.

Ryan DiRaimo, is the director of sustainability at Graphite Design Group, a member of the Northwest Design Review Board and contributor to the Aurora Reimagined Coalition.

CURBING CONSTRUCTION'S CARBON IMPACT FROM ALL ANGLES

Making new buildings more energy-efficient is a good start, but the biggest opportunity to decarbonize construction lies with reducing the embodied-carbon impact of concrete and optimizing our existing building stock.

BY JULIANNA PLANT
LEASE CRUTCHER LEWIS

By now, this staggering number will be familiar to many: 40 percent of the world's greenhouse gas (GHG) emissions come from buildings — constructing them, running them and retiring them. These are the places where we work, learn, heal, discover life-saving cures and govern. But they also play an outsized role in changing the climate.

In the past couple of decades, the A/E/C industry has made huge strides to curb the impacts and help new commercial buildings operate more efficiently. Net-zero energy and high-performance buildings have become commonplace. The result is that operational-carbon emissions linked to buildings across the U.S. have fallen by a third since 2005, even as the volume of buildings has grown.

But collectively, we can do much more to stem the tide and reduce the embodied carbon generated during the construction of new buildings or avoid generating as much by renovating existing buildings.

On both sides of the carbon ledger—whether it's reducing a project's operational carbon or embodied carbon—our industry has the potential to drive meaningful change toward a more sustainable built environment.

UNDERSTANDING CLEAN BUILDINGS STANDARDS

For existing commercial buildings, coming improvements related to operational carbon may not be voluntary.

The state of Washington has taken a leading role in enforcing new energy-efficiency standards that could influence how other states implement strategies for decarbonization.

In 2019, the state passed the Clean Buildings Act (CBA). The resulting Clean Building Performance Standards (CBPS) set by the Department of Commerce took effect in July 2021 with the goal of improving the operational efficiency of our existing commercial building stock. By 2026, buildings larger than 220,000 square feet must meet minimum energy performance (as measured by Energy Use Intensity, or EUI). The following year, buildings 90,000 square feet and above will fall under the same energy compliance requirements. A year later, the requirement will hit buildings 50,000 square feet and larger, and so on.

Owners who don't meet the requirements by the deadline will face fines until they retrofit their building to meet the target EUI.

While many owners are experts at navigating building codes, permits and other regulations that inform building alteration decisions and financing, the CBPS primarily impacts existing buildings — not buildings underway — and has a dictated timeline for improvements.

TAKING A FIRST STEP

The first step to assessing the impact of the CBPS is to understand your building's current state, energy use, operations and management and what base target EUI your building must meet by which deadline. If you don't already know your building's energy use, Energy Star Portfolio Manager can be a good place to start for collecting information. Some buildings are already tracked through the city of Seattle's Tune-Up program.

Either way, owners should hire or consult with an energy auditor or qualified professional to help them understand their building's target EUI and, if necessary, what they will need to modify to meet the energy performance metrics.

Once owners have a clear understanding of where their building ranks, they can begin making informed decisions regarding phased upgrades and operational changes.

Updates could be a simple switch to LED lighting paired with local rebates to offset the costs, installing submeters, or implementing education programs to influence user-behavior. For other buildings, it could require bigger steps, like building envelope modifications, or substantial MEP upgrades, which require lengthy permit processes and significant capital funding. There are local and federal funds available to offset some of the costs as well as C-Pace financing.

Other strategies might include upgrading electrical infrastructure or implementing renewable energy such as solar, micro wind, King County sewer recovery pilot program, while creating building resiliency.

While the timeline may seem far away, it's important to remember that compliance requires 12 months of energy tracking, so the deadline to be watching is June 1, 2025. Starting right away may allow for time to evaluate options, permitting, design and logistics.

ZEROING IN ON CONCRETE

In addition to delivering more efficient buildings for our clients, Lease Crutcher Lewis is working to minimize jobsite construction waste, exploring how we might phase out gas-powered trucks and equipment in favor of the all-electric kind, and making infrastructure improvements at our equipment yard to support those changes.

But we also recognize that our organization's greener business practices and jobsite operations are only part of the equation.

The biggest opportunity resides with reducing the embodied carbon impact of the structures we put in place. This covers emissions related to extracting, manufacturing, and transporting the building materials we ultimately use, as well as the impacts of construction and disposal.

The primary culprits in a building's embodied-carbon impact are structural elements like concrete, the most commonly-used substance in the world behind water. Production of cement, the key binding agent in concrete, is responsible for a whopping 8% of global CO2 emissions on its own.

Global-Warming Potential (GWP) limits for concrete are being imposed by a growing number of jurisdictions and owners. And the latest version of LEED, LEED v5, will emphasize reductions of projects' embodied carbon. This latest version debuts this spring for public comment and should be available for use in 2025.

Concrete mixes and their carbon impacts vary widely across markets based on the materials available, the manufacturing capabilities available, and how the material is transported. In the Puget Sound region, embodied carbon linked to concrete is lower than the national average in part due to access to waterways for transportation and the quality of local aggregates.

MAKING A NEW COMMITMENT FOR 2024

As a general contractor with self-perform concrete operations, we know we have the ability to influence not only our own projects, but the local market as a whole.

That's why our in-house sustainability council has analyzed historical internal data to measure our annual concrete usage and associated embodied carbon. While our standard concrete practices have consistently produced lower carbon than the local average, Lewis is encouraging owners and project partners to move the needle further. As an enterprise, we have committed to tracking ready-mix concrete placed on our projects and have set an internal goal in 2024 to reduce the embodied carbon of our concrete placements by 5% over last year's data.

For Hudson Pacific's 17-story office tower, Washington 1000 in downtown Seattle, early collaboration through preconstruction services helped set clear expectations and let multiple stakeholders work toward reducing embodied carbon.

PHOTO BY TIM RICE

We've met with major local concrete suppliers and structural engineering partners to discuss opportunities to use lower-carbon mixes that minimize the amount of cement with little-to-no increased costs.

We're also developing test cases for the use of cement replacements—or supplementary cementitious materials (SCMs)—including high volumes of typical industrial byproducts like fly ash and slag and new SCMs being added to the market. In addition, we are testing mixes with alternate materials like biochar that would otherwise release carbon and methane and which are now captured in concrete. We've received approval to use these non-standard mixes on active projects. We continue to test new low-carbon mixes to better understand their viability in standard construction applications.

Outside of what goes in the concrete, our project teams thoroughly evaluate schedule and sequencing requirements to refine the necessary finishing and cure times for the various mixes we use. In some cases, this reduces the amount of cement required, using time to our advantage to reach the design strength.

Buildings are a major contributor to global warming, and providing information about different building practices allows for more informed choices. The ultimate goal is to share our learnings and enable widespread use by the entire local industry.

Julianna Plant is a Seattle-based senior preconstruction manager at Lease Crutcher Lewis, leading the company's sustainability initiatives.

EMBODIED CARBON

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offer another way to protect against water incursion and corrosion. The problem is that the installation process is complicated and prone to inconsistency. Whether it's a sheet membrane or liquid-applied membrane, the long-term effectiveness largely depends on how well it was installed. In comparison, hydrophobic pore blockers are electronically dosed directly into the concrete mix at the ready-mix plant.

Membrane installation is also heavily dependent on optimal weather conditions. As everyone in the industry knows, waiting around for the weather is one of the biggest causes of construction project delays. Other issues are that installing membranes requires a lot of intensive labor and wasted materials. More importantly, they make the concrete non-recyclable at the end of the building's useful life – a huge cost in terms of overall carbon footprint.

Compared to waterproof membranes, hydrophobic admixtures make building weatherproof structures easier, more reliable, and more eco-friendly.

SEATTLE: LEADING THE CHARGE TOWARD BETTER SUSTAINABILITY

Seattle is one of the leading municipalities in the nation in terms of green initiatives that strive toward better sustainability. From the city's extensive Sustainable Buildings and Sites Policy to its Green Building Policy and Priority Green Expedited program, Seattle encourages new construction to be more environmentally sound and sustainable. Rising to that challenge, builders throughout the region are increasingly harnessing hydrophobic admixture technology for more and more projects.

These Puget Sound projects used hydrophobic concrete admixtures in place of membrane systems:

- Bullitt Center
- Amazon
- Google
- Expedia
- Gates Foundation
- Microsoft
- King 5 Building
- Amtrak
- Seattle Aquarium
- Seattle Great Wheel
- UW Medicine
- Sound Transit

At the University of Washington Medical Center, hydrophobic admixtures were used for below-grade foundational protection.

"If a membrane is used behind a wall or under a slab there is no way to repair it if it develops a leak. Water will continue to travel to find the nearest crack," said Jack Avery, director of construction for Sellen Construction "When there is a breach in waterproof concrete you know where the problem is and it can be addressed."

The Expedia Group campus in Seattle also used hydrophobic admixtures for below-grade concrete construction, allowing them to get their parking garage slab placed sooner and avoid weather delays.

Various Amgen Parking facilities in the Seattle region also use concrete admixtures as long-term protection against water damage and corrosion and to eliminate the need for a membrane.

Vulcan Real Estate continues to develop in the South Lake Union area, despite the difficult waterproofing challenges of designing and building in high-water table conditions.

"We have incorporated hydrophobic concrete admixtures into numerous projects in the Seattle area and have found that it is a very effective approach to waterproofing, leveraging its advanced waterproofing benefits," said Raymond Burdick, Director of Commercial Construction for Vulcan Real Estate. "Additionally, hydrophobic concrete admixtures contribute to LEED credits and significantly reduce the projects' embodied carbon emissions by eliminating the necessity for membrane systems."

The Google Lakefront Block projects with basements well below the level of Lake Union incorporated this approach.

Lindsey Montgomery leads business development for Hycrete's US division focusing on education and strengthening client relationships.

ADAPTIVE REUSE

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the public and private sector to work together.

It is clear that adaptive reuse is a key strategy for reducing embodied carbon emissions with the added benefit of maintaining the vitality and diversity of our downtown. The OPCD's Call for Ideas helped us realize that there are barriers to making adaptive reuse widespread in our city.

The proposed ordinance is a great first step, but by adding embodied carbon to the equation, we can further measure the city's progress toward climate action goals, leading to incentivized adaptive reuse, while helping building owners meet their carbon commitments. As we prepare to ride the waves of unknown future policies, such as potential carbon taxes, our embodied carbon reductions today might become even more valuable in the city we aspire to become.

Devin Kleiner is a director of regenerative design and associate principal at Perkins&Will, leading sustainability initiatives for the Seattle studio. Myer Harrell is a senior regenerative design advisor and senior project manager for the Seattle studio of Perkins&Will. Elizabeth Grace is a senior project designer for the Seattle studio of Perkins&Will.

A BLUEPRINT FOR ENVIRONMENTAL RESPONSIBILITY IN CONSTRUCTION

Focusing on waste diversion early in the process for the Symetra Center renovation in downtown Bellevue helped Turner reuse, repurpose and recycle more than 402 tons of construction materials.

A commitment to sustainability was a key factor for Sterling Realty Organization ("SRO"), a real estate corporation with assets in the Puget Sound and Salt Lake City markets, in selecting Turner Construction Company as general contractor for the 35,000-square-foot renovation of the lobby and plaza areas in the Symetra Center at 777 108th in downtown Bellevue.

BY LYDIA LIANG
TURNER

With deep roots in the Pacific Northwest, environmental stewardship is a high priority for SRO and one of its goals for the renovation was to focus on reusing, donating and recycling construction materials that would otherwise end up in a landfill. This vision perfectly aligned with Turner's desire to build greener for the future.

"As stewards of both the environment and the community, we believe that sustainable development isn't just a choice; it's our responsibility," said Whit Danz Hamlin, Chief Investment Officer for SRO "By prioritizing sustainability practices during the renovation of the Symetra Center and throughout our portfolio, we're not only helping to shape the future of real estate but also cultivating a legacy of enduring impact and meaningful progress."

CUTTING WASTE, MAXIMIZING RESOURCES

Turner's strategy on the project was early engagement, utilizing the time before mobilization to assess opportunities for waste diversion. The team identified initiatives and innovative practices to minimize waste and maximize resource efficiency.

From repurposing granite and glass to donating items to nonprofits, every effort was made to reduce environmental impact. This proactive approach allowed Turner to repeatedly engage its demolition company, securing credits for repurposed materials or items selected for take-back programs. This strategic practice demonstrated positive outcomes and underscored the financial benefits of sustainable practices.

DECONSTRUCTION, NOT DEMOLITION

Next, Turner engaged workers in the field to think differently and spearhead a deconstruction process in lieu of typical demolition. Upon arriving on-site, the team, from project managers to trade laborers, rallied to partake in the sustainability initiative.

The team's creative approach and wholehearted participation were nothing short of remarkable. In one standout example, an onsite carpenter repurposed eight glass front office panels, a sliding glass door with all its hardware, and a security desk into an environmentally friendly greenhouse, showcasing the transformative potential of upcycling in construction projects.

Additionally, Turner collaborated with local salvage and reuse companies to amplify its efforts. Earthwise Architectural Salvage and RE-USE Innovation Center, among others, played crucial roles in reclaiming materials for reuse. Office furniture, cabinets, and even ornamental fireplace features found new life through these partnerships, driving forward-thinking solutions to waste management.

DIVERTING MORE MATERIALS FROM LANDFILLS

Aside from reusing and repurposing materials on site, the project team also implemented strategies including manufacturer take-back programs with carpet and ceiling tile recycling. During demolition, Turner laborers stacked and palletized these materials neatly to be returned to the manufacturer. Additionally, trade partners contributed to salvage efforts, reclaiming items such as bank vault doors and vinyl tile. Even hard-to-recycle materials, such as exterior glass, were diverted from landfills and repurposed into paint, as the glazing had been chemically treated as tempered glass and could not be traditionally recycled.

Planned diversion efforts included donating clean drywall cutoffs (excess materials) to a local school district. Students in the high school program used the donated materials to learn basic construction processes such as unloading and stocking materials, and used the cutoffs to build mobile assemblies that mimic the construction of wall assemblies. This repurposing effort not only reduced waste on the project but also provided valuable educational resources for the next generation of tradespeople.

Additionally, 6,000 square feet of pavers were reclaimed by the RE-USE Innovation Center. Even the landscaping plants were reclaimed by building tenants and Turner. Another example was repurposing salvaged materials by local reuse centers, further minimizing waste and environmental impact.

The overall waste reduction quantities from the renovation include:

3,000 square feet of acoustic ceiling tile and 3,500 square feet of ceiling tile,

1,200 square feet of wooden wall paneling,

700 square feet of vinyl flooring,

4,050 square feet of carpet tile and 1,400 square feet of broad loom carpet,

57 linear feet of casework,

50 chairs, 20 glass tables, eight office front panels, one security table and six hollow metal doors,

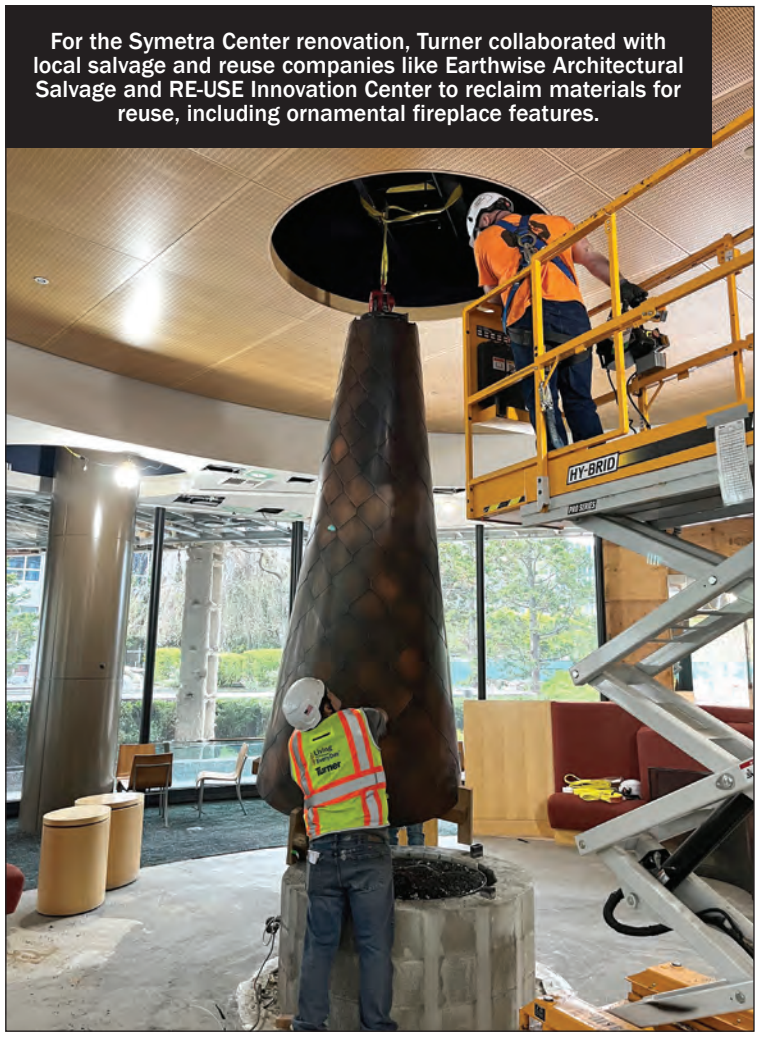
4,900 square feet of concrete pavers,

120 linear feet of stainless steel cladding,

two urinals, six sinks, six toilets, 30 restroom accessories, two linear feet of restroom countertops, 30 linear feet of toilet partitions,

24 linear feet of light fixtures,

1,200 square feet of granite, 33.5 tons of exterior glazing, one sliding glass door with hardware, one art installation and one largescale fire pit hood.



For the Symetra Center renovation, Turner collaborated with local salvage and reuse companies like Earthwise Architectural Salvage and RE-USE Innovation Center to reclaim materials for reuse, including ornamental fireplace features.

PHOTO BY MICHAEL MAXTED

All of this waste reduction resulted in 281.91 tons of construction materials recycled, and 120.25 tons reused-re/up cycled or salvaged, totaling 402.16 tons of construction material that was recycled, reused, up cycled, or salvaged.

As with all Turner projects, the waste from this renovation was tracked utilizing Turner Tracker, a proprietary waste tracking platform. Construction waste accounts for approximately 40% of the solid waste generated annually worldwide. For over 10 years, Turner has been committed to diverting half of construction and demolition waste from our project sites from landfills.

Turner has committed to improving this goal by diverting 80% of waste from landfills by 2025. Turner Tracker is a valuable resource in understanding construction and demolition waste generation, allowing teams to manage their waste streams and measure project waste diversion rates throughout construction.

Turner and SRO's unwavering commitment, collaborative spirit, and innovative approach to reuse and recycling serve as a model for promoting meaningful change. By prioritizing sustainability and fostering engagement across the entire team, they not only transformed a building but also shaped a greener, more sustainable future for the community and beyond.

Lydia Liang is the Regional Sustainability Manager for Turner Construction's Northwest Region and is a leading advocate for sustainable practices in the construction industry.

WATER GOALS

CONTINUED FROM PAGE 2

increasing demand for our regional water supplies.

MIMICKING NATURE

In Seattle, one of the biggest regional water issues is the environmental impacts of stormwater runoff. It is not enough for infrastructure to convey water into and away from buildings, it must clean and slow water and provide resilience for changing weather patterns. Our goal should be to match the attributes of the pre-existing, predominantly old-growth conifer forests, where surface runoff rarely occurred, and water moved slowly through soil before reaching streams and lakes.

Given Seattle's rainy reputation, the city has long been a leader in stormwater management (since 2016, the Seattle Stormwater Code has required management of all stormwater that falls within the boundaries of a proposed development). Rarely, though, does this requirement address the dirtiest water in our environment, that which runs off roadways and parking lots beyond the scope of most development projects.

'BEYOND CODE' PARTNERSHIPS

Near Fremont lies the newly constructed Northlake Commons, a lab-ready mass timber mixed-use office, retail and lumber warehouse. This project built on the aggressive storm water goals of DATA 1 and Watershed by constructing a regional swale on private property that treats stormwater that originates outside the project site and goes "beyond code" to manage roughly 2.6 million gallons annually, more than twice the required volume.

The project found potential in a nearby collector pipe that conveyed water from neighborhood roadways to Lake Union. The roads' steep grades allowed the project to divert and daylight runoff from the collector pipe onto the Northlake Commons site. The new infrastructure channels the water via gravity through settling vaults, catch basins, a runnel and ultimately an at-grade swale before returning the water to the downhill portion of the same collector pipe.

SPU provided design support and funding to help offset the cost of the additional treatment beyond what the code required, demonstrating a new kind of partnership between public agencies and private development.

Brian Mickelson, a project manager with SPU who acted as the city liaison for Northlake Commons' beyond code partnership, sees great potential.

"Over the last few years, SPU has been exploring partnerships as a way to complement, and build on, the strong foundation our stormwater code provides," he said. "The Northlake Commons partnership showed that it's possible to expand the envelope of a traditional developer project to treat several acres of stormwater from the larger neighborhood around the project site.

"The opportunity for private developers to implement and help maintain green infrastructure provides added environmental benefit at the point of redevelopment and leverages our shared investment for the public good. We hope Northlake Commons encourages more developers to come talk to us and explore the potential for 'beyond code' stormwater opportunities for their projects."

Rachael Meyer is director of sustainability and landscape architecture principal at Weber Thompson. Mark Grey is founder and president of Clean Lake Union, partner at HessCallahanGrey Group, and principal at Stephen C. Grey & Associates.

IN PLAIN SIGHT

CONTINUED FROM PAGE 11

the largest earthquakes on record. It isn't a matter of if, but when, the next large magnitude earthquake occurs here. The reality of highly liquefiable site area soil added technical complexity and dictated the need for resilience standards much higher than other geographies. PACR features a hybrid steel frame structure with composite concrete decking. Concrete is one of the largest producers of greenhouse gases contributing to global warming. The Port is progressive in its commitment to protecting the environment and promoting sustainability, in this case advancing the use of carbon sequestering CarbonCure concrete.

A FRAMEWORK FOR COLLABORATION

An endeavor of this magnitude with so many stakeholders could easily have devolved into competing agendas. The progressive design build process provided a strong framework for collaboration, facilitating the alignment of proposed solutions with desired outcomes. It also helped to dispel challenges presented by the pandemic, which included rising material costs and supply chain disruptions.

PACR demonstrates responsible management of public funds and support for the local business community. The Port offered women and minority-owned businesses as well as veteran owned businesses the opportunity to participate in a major undertaking of this scope and scale, providing more than $30 million in design and construction services on the project.

It has won several 'top project' awards, most recently the 'Prevention through Design' (PtD) award from the National Institute of Occupational Safety & Health (NIOSH), which recognizes steps taken to keep workers safe during construction and design considerations for safe operation and maintenance once built. The Port's high standards and PDX's favorable reputation were exceeded with PACR and has received praise on many fronts.

The innovative design and construction strategies behind PACR set new standards, demonstrating how the combination of delivery method, sustainable strategies and severe constraints for resilience can surpass expectations for infrastructure investments. Especially for project typologies not typically known for imaginative outcomes. Working with progressive clients like the Port that also prioritize enjoyable and safe experiences for people represent how support service buildings and structures can rise above the ordinary to elevate the experience of place, be environmentally responsible and endure.

(PACR was designed by Portland architecture firm YGH prior to a merger with Integrus in 2022).

Tom Robbins is a design principal at Integrus.

NEW TRICKS

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Building Challenge, while opening itself up to future possibilities.

DESIGNING BUILDINGS WORTHY OF FUTURE REUSE

Inspired by Stewart Brand's pivotal work, How Buildings Learn, we see a responsibility to transcend present-day needs to anticipate future upgrades and increase the likelihood that the building will be considered worthy of reuse.

With a commitment to longevity, Miller Hull designs all of our new and adaptive reuse projects for high performance, while remaining relevant for at least another century and beyond. We believe that if these structures are designed for efficiency and durability, they will possess an inherent flexibility that permits a wide range of alternative uses as societal needs evolve, goals we aim to apply in the design of all our buildings – both new and old.

Mike Jobes is a principal at Miller Hull, leading the firm's public WORK market-sector group, specializing in civic and community-based projects. Jim Hanford is a principal at Miller Hull, leading the firm's building performance and sustainability efforts.

DECARBONIZATION

CONTINUED FROM PAGE 7

element of decarbonizing a campus DES because the work is vast, uncertain, and detail driven. This high degree of risk impacts cost, schedule, and the need for unique solutions to be developed based on the particulars of each building's existing systems, space constraints, and operational needs.

THERMAL DISTRIBUTION NETWORK

The second bucket to consider is the thermal distribution network, which may include new heating, cooling, or condenser water distribution to buildings. Existing utility tunnels provide a conduit to buildings; however, it may not be possible to run new piping without first decommissioning existing steam and condensate piping (for which timing can become a challenge).

New utility tunnels provide long-term benefits with high first cost. Direct-bury options are attractive for many campus clients from a first cost standpoint, but require careful attention to material selection, routing, and accessibility at key intervals.

Distribution is often the second most expensive element for a campus DES decarbonization effort. It's important to plan and execute the work one time (avoiding disruption of the same location in short succession) and foster an agile team that responds to unforeseen field conditions efficiently. Additional win-win opportunities, such as campus pathway and ADA improvements, are a positive outcome of sitework.

CENTRAL PLANT EQUIPMENT

The final bucket includes modernization of centralized primary generation equipment. Potential sources of thermal energy on the campus are explored, including geothermal exchange, building waste heat, air-source heat pumps, solar thermal systems, and sewer water heat exchange. Thermal energy storage extends the duration of simultaneous heating and cooling production while providing benefits of peak load reduction, utility cost optimization, and improved resiliency.

The most reliable, practical and lifecycle cost-efficient solutions typically involve a mix of right-sized and right-applied technologies at the building or district scale. This often includes electric heat pumps, thermal energy storage and "peaking" equipment (such as electric or natural gas boilers) that handle infrequent peak loads in the most first-cost efficient and operationally reliable manner. A fossil fuel "backbone" system may be maintained to provide resiliency, peak heating and to serve process loads during the full transition. Lastly, early and open communication with electric utility providers is paramount with campus scale electrification.

Campus property owners are rising to the challenge of carbon emission reduction and strategically planning, funding and executing long-term campus decarbonization projects to move away from fossil fuels toward clean and renewable energy infrastructure.

Lyle Keck is building performance practice leader at Affiliated Engineers Inc.

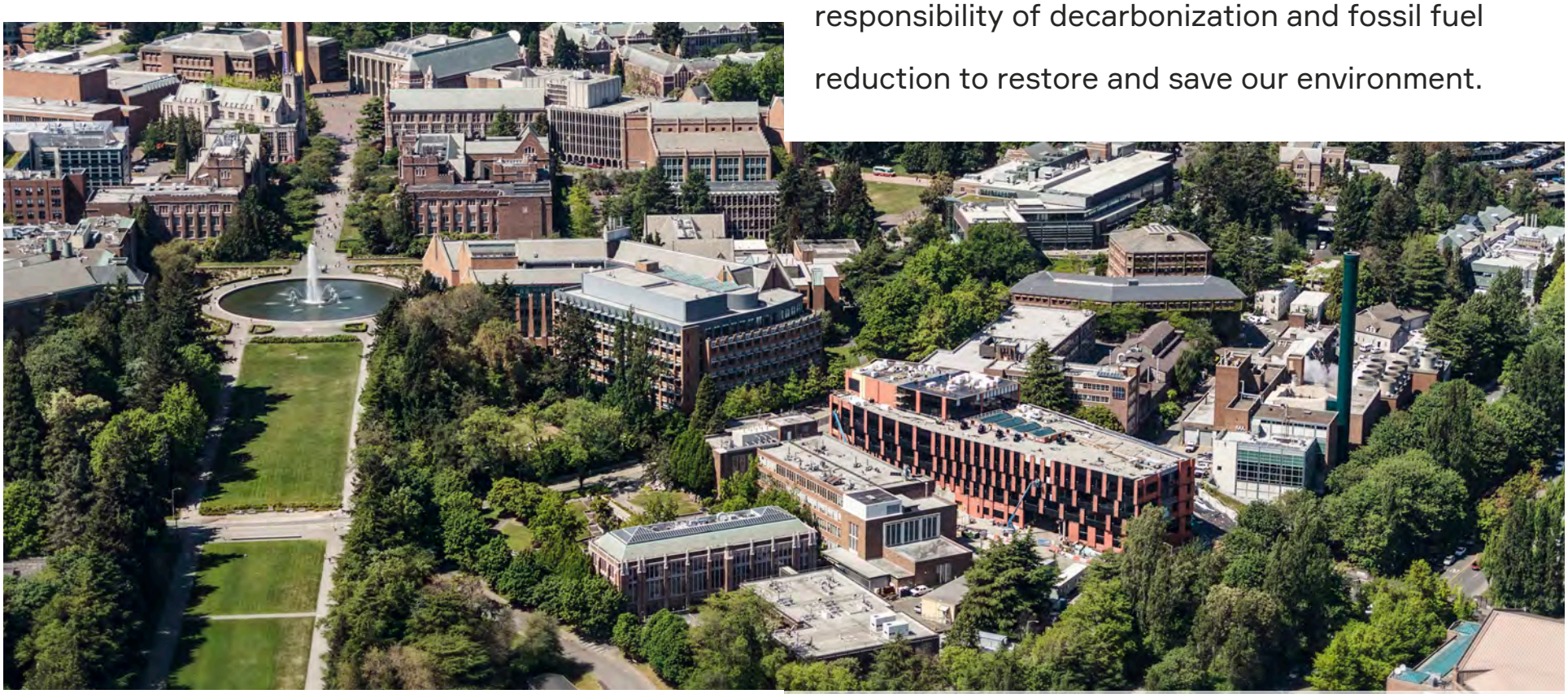
DECARBONIZATION
PLANNING AND IMPLEMENTATION

Working with clients and colleagues to improve the world.

100+
energy master plans

2.5+
million square feet
thermal utilities

With a dedicated group of 150+ engineers focusing on energy & utilities, building performance, and infrastructure optimization, AEI is committed to the shared global responsibility of decarbonization and fossil fuel reduction to restore and save our environment.



AEI is providing technical planning and consulting services for the University of Washington Energy Renewal Program

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