2018

IMPACT by DESIGN

RESILIENCE STRATEGIES SHAPING THE FUTURE OF CITIES

Gensler RESEARCH INSTITUTE

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Impact by Design 2018 is Gensler's third annual publication assessing the resilience and sustainability of our work. Through our work with clients and communities around the world to design and shape the future of cities, we have an unparalleled opportunity to improve our impact on the built environment. We also have a responsibility to lead our industry, clients, and peers in the development and adoption of smarter strategies.

We continue to make strides. **Gensler's estimated 1.25 billion square feet of project work from calendar year 2017 is designed to keep 11 million metric tons of C02 from entering the atmosphere on an annual basis.** And that only counts savings based on improved energy performance—the effect of a broad resilience strategy including a focus on embodied energy, materials re-use, water, and intelligent systems is even greater.

We purposefully use the term "resilience" here instead of sustainability. While the term "sustainability" originally referred to ensuring quality of life within earth's means, for many it has come to connote resource conservation alone. The concept of resilience recognizes the need to not just conserve resources, but also adjust our approaches and solutions to the effects of climate change.

At Gensler, we embrace the broader focus of resilience discussions and its alignment with our mission to leverage the power of design to create a better world. This report presents a transparent look at the successful progress we've made toward achieving this goal. We hope it serves as a reminder of the unique ability of the design industry to create real value in people's lives by adapting to a changing environment.

Diane Hoskins FAIA, IIDA, LEED AP, Co-CEO
Andy Cohen FAIA, IIDA, Co-CEO

DESIGNING FOR IMPACT

"To design is to devise courses of action aimed at changing existing situations into preferred ones."

When Nobel economist Herbert Simon wrote these words 50 years ago, the world's population was less than half what it is now. Most people lived in rural areas. Levels of carbon in the atmosphere were much lower, and global tree cover was much higher. It's a different world today.

Our world is dramatically more urban than it used to be. By mid-century, our urban areas will account for over three-quarters of the world's population. This urbanization will come with a huge amount of new building; it is estimated that 2.5 trillion square feet of new space will be built in the next 40 years. As a result of increased urbanization, and as the planet continues to reckon with the reality of climate change, our understanding of "preferred situations" is shifting dramatically.

In many ways, this is good news. Compared to rural and suburban communities, cities are far more efficient with resources, and their residents are happier, healthier, and more socially active. The ecological footprint and obesity rates for American city-dwellers are less than half the national averages. Cities are also the driving force behind the global economy, delivering not only resource and health benefits, but also improved opportunity and prosperity.

As the world continues to cluster into urban areas, we have an opportunity to rethink the built environment with an eye toward resilience and preservation. In fact, rethinking the built environment and finding ways to better integrate our buildings and cities with the natural world is the single smartest way to address today's most urgent challenges.

Because the building industry is responsible for such a significant portion of the world's emissions, dramatically reducing our reliance on fossil fuels is imperative. Adapting buildings and upgrading our existing building stock is essential; reusing an existing building can be twice as efficient with resources as building new. Technology is also changing how we use and operate buildings; making our buildings more intelligent is increasingly part of resilience strategies.

The greatest potential impact comes from design itself, however. From early concept design—when decisions like a building's location, orientation, and form are made—we have the opportunity to dramatically reduce a building's environmental impact.

In *Impact by Design 2018*, we illustrate that solving urgent challenges can create places that are inspiring and joyful as well as environmentally respectful. Design is a force for positive change. As the world's largest design firm we believe we have a unique obligation and opportunity to create a better world—environmentally, socially, and economically—creating a built environment that delivers not only great performance but also elevates the human experience.

ENVIRONMENTAL IMPACT

Nearly half of greenhouse gas emissions come from the built environment. We cannot address climate change without putting the built environment at the center of the conversation.

SOCIAL IMPACT

People spend more than 90 percent of their time indoors. The design of buildings and how we use them has wide-ranging health effects, from influencing our levels of physical activity, to how much natural light we receive and the quality of our air.

ECONOMIC IMPACT

According to the McKinsey Global Institute, the 600 largest cities generate 60 percent of global GDP every year. Almost 40 percent of GDP comes out of the built environment alone.

THE FUTURE OF SUSTAINABLE POLICY

The business case for sustainable design has never been clearer, even though the specifics of how to achieve higher levels of sustainability are evolving. State and city governments are driving many of these changes. Taking cues from progressive design firms and non-profit organizations, states and municipalities are implementing increasingly stringent building codes. These shifts will be the basis on which performance is judged in the future.

Vancouver (2020)
All new buildings carbon neutral, 33 percent reduction in fossil fuel use and ecological footprint, 50 percent reduction in solid waste. (Greenest City Action Plan)

Vancouver (2050)
100 percent of energy use derived from renewable sources, 80 percent reduction in carbon pollution (Renewable City Action Plan)

Cambridge, MA (2040)
All buildings net zero energy, goal of 70 percent overall emissions reductions through energy efficiency and increased renewables. (Net Zero Action Plan)

Sweden (2045)
Net carbon emissions cut to zero country-wide (Climate Act)

European Commission (2018/2020)
Twenty-one countries* planning for nearly zero for all new public buildings by 2018, all new buildings by 2020 (Energy Performance of Building's Directive)

C40 Coalition (2030/2050)
Nineteen city leaders** commit to all new buildings operating with a carbon neutral footprint by 2030, all buildings by 2050 (Net Zero Buildings Declaration)

United States (2025)
Reduce energy intensity by 2.5 percent and potable water intensity by 2 percent annually through 2025 (Executive Order 13693)

United States (2030)
All new federal buildings zero net energy (Executive Order 13415)

New York, NY (2030/2050)
City-owned buildings must get half their power from green energy by 2030; all by 2050. (Local Law 107)

Japan (2020)
All public buildings net zero energy (Basic Energy Plan)

Germany (2050)
Commitment to "fully renewable" economy with 80-95 percent reductions in GHG emissions (Klimaschutz 2050 Plan)

Japan (2030)
All commercial buildings net zero energy (Basic Energy Plan)

Oregon (2022/2023)
All new government buildings carbon neutral by 2022, new residential buildings by 2023 (Executive Order 17-20)

California (2020)
Single-family residential buildings and 50 percent of new government buildings net zero energy (Executive Order B-18-12)

California (2030)
All government and commercial buildings net zero energy (Executive Order B-18-12)

Costa Rica (2021)
Aims to become the first carbon-neutral country

Oregon (2030)
All government and commercial buildings net zero energy (Oregon Zero Energy Buildings Commission)

California (2025)
All new government buildings and 50 percent of existing facilities net zero energy (Executive Order B-18-12)

California (2045)
100 percent of energy state-wide from zero-emissions sources and state-wide carbon neutrality (SB-100, Executive Order B-55-18)

*Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom
**Copenhagen, Johannesburg, London, Los Angeles, Montreal, New York City, Newburyport, Paris, Portland, San Francisco, San Jose, Santa Monica, Stockholm, Sydney, Tokyo, Toronto, Tshwane, Vancouver and Washington, DC

Our 1.25 billion square feet of work in 2017 is designed to save 11 million metric tons of CO2 from being emitted each year.

STRATEGIES FOR POSITIVE IMPACT

Truly resilient places today—whether interior retail or workplace environments, new or renovated buildings, neighborhoods, or city districts—represent the culmination of design strategies and technologies that work in concert to maximize both performance and the human experience. They embody a mix of traditional and cutting-edge methods to achieve success, from a continued focus on optimizing mechanical systems and minimizing energy use, to the optimization of building form and the integration of new technologies that make our spaces intelligent, responsive, and adaptive.

In this section, we highlight six topics identified by our resilience leaders that we believe have the greatest potential for positive impact in the coming years. Each area identifies specific strategies and their real-world applications, helping to connect concept with implementation. Our goals are to expand the discussion of resilience beyond just energy efficiency and demystify complex concepts to encourage broader adoption of resilient methods.

FORM

The most direct way designers can affect performance is through design itself—from decisions on location and orientation to questions of size, proportion, and light.

MATERIALS

More energy is expended during the production of materials than at any other point during a project's lifecycle. Focusing on materials with a lower carbon impact, and re-using or recycling materials whenever possible, is imperative.

ADAPTATION

In many cases, the single greatest decision to minimize environmental impact is to re-use buildings, spaces, and materials that already exist—adapting them to meet new needs instead of building new.

ENERGY

Minimizing energy usage, and therefore operational carbon impacts, continues to be a major focus of resilience discussions. Comprehensive strategies focus not just on minimizing energy usage, but on offsetting energy needs with renewable sources.

WATER

Many of the world's largest, and most economically productive, cities are located in areas prone to flooding and sea level rise. Design strategies that mitigate water risks are required for a long-term perspective.

INTELLIGENCE

Our spaces, buildings, and cities are becoming increasingly "smart" as technology continues to permeate our lives and spaces. Intelligent spaces leverage real-time data to dynamically optimize both performance and experience.

Johnson Controls Headquarters, Asia Pacific | Shanghai, China

FORM

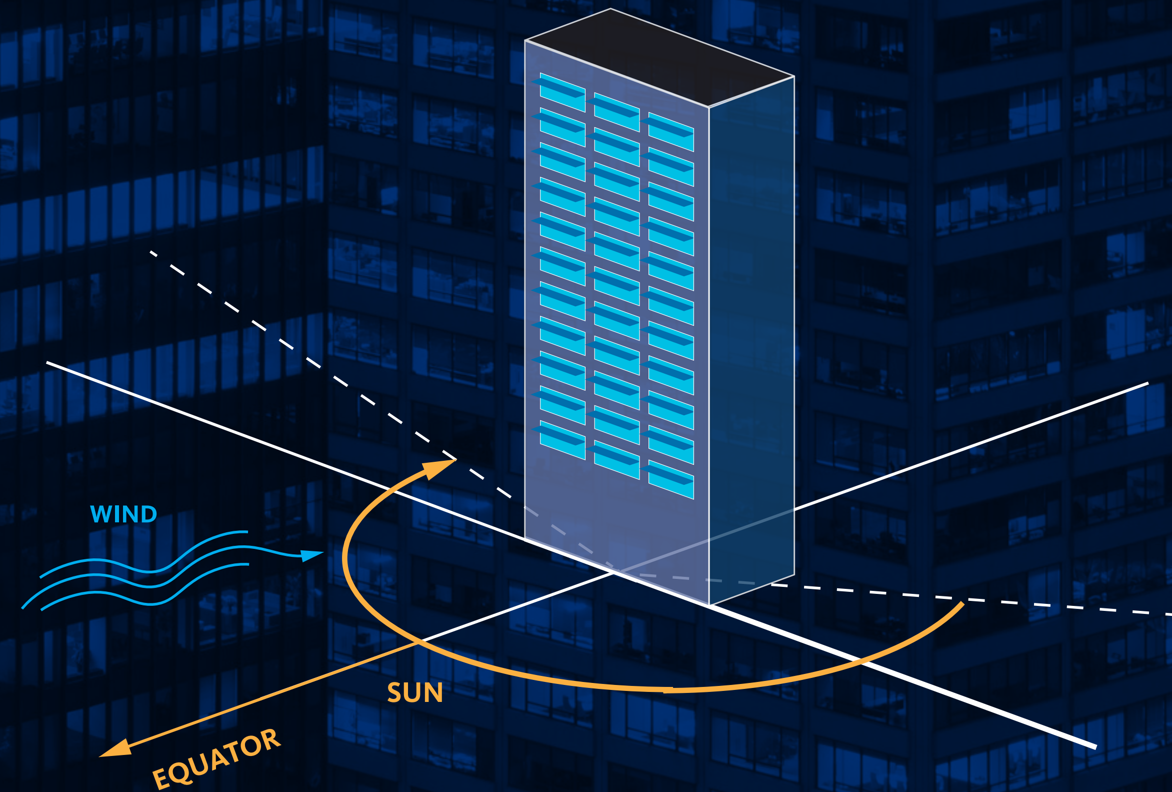
As designers, the greatest impact we can have on a building's overall performance comes via the design of the building itself. At every step of the design and decision-making process—from the location of a building, to its orientation on site and its shape, size, and ability to respond to its environment—the decisions we make are crucial to creating high-performance buildings that maximize experience with minimal environmental impact. Achieving this requires an openness to both new building forms and aesthetics, as well as pushing experimentation and performance testing earlier in the design process.

Our buildings and cities will also have to experiment with new forms, in many cases requiring dramatic shifts to achieve true resilience. The influence of urban form is crucial—street layouts determine building's solar orientation, wind exposure, and other environmental factors. At both scales, early intervention is important: if formal decisions aren't made with performance in mind, a significant amount of opportunity is already lost.

Advances in computational design are helping to push these discussions forward. It's possible today to create and test a wide range of building locations, orientations, and forms at the early stages of a design process to identify the most efficient solutions related to usage, materials and structures, or user accessibility and interaction.

Formal explorations should also take direction from the buildings that haven proven most amenable to adaptation and re-use in the past. Whenever possible, we should design our buildings for a future in which their use is potentially unknown. Human behavior, technology, and the ways in which we use and inhabit physical space will continue to evolve. Whether designing buildings in a way that they can be easily deconstructed and reconstructed with reusable or re-used materials, or creating flexible and reconfigurable spaces that easily adapt to new needs, this approach to an unknown future should increasingly be part of the resilience narrative.

HOW FORM AFFECTS PERFORMANCE



1. LOCATION
Understanding, and designing for, a building's context—local climate, availability of renewable energy, transportation options, urban amenities

2. PROPORTION
Exploring different building configurations to optimize surface to volume ratios in relation to local environmental conditions as well as experiential requirements

3. ORIENTATION
The way a building is situated in relation to the sun, wind, and other adjacent buildings, with implications for natural light, structural requirements, etc

4. FENESTRATION
The size, shape, location, and amount of windows or exterior openings—often a balance between optimizing views and natural light against solar performance

5. AUGMENTATION
Formal additions to the building that maximize performance, from sun shades and overhangs to other strategies that combine ornament and efficiency

ZHUHAI HUACE PLAZA
Guangdong, China
1,200,000 SF

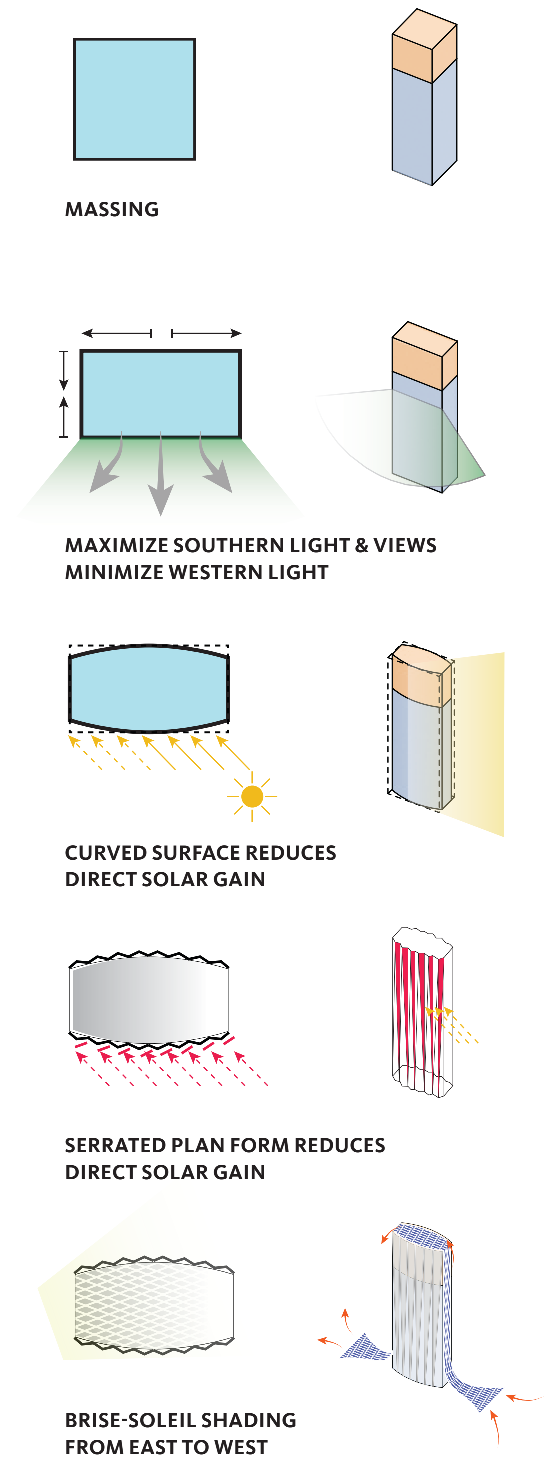
Twin towers create a vertical ecology leveraging passive and natural ventilation strategies.

Gensler's design proposal for the new Huace Plaza merges two towers into a single expression focused on sustainable performance, community connectivity, and the integration of nature. A vertical atrium system embeds vegetation at all levels of the building while creating a breathing envelope that brings vertical draft winds into the building. Performance is optimized via intelligent building controls.

CCCC HAIKOU HEADQUARTERS
Shenzhen, China
1,400,000 SF

Efficient form maximizes views while minimizing solar gain.

With a goal of marrying efficiency and experience while creating an iconic tower, the proposed design situates the building to provide ample southern light and river views while managing heat gain in a tropical climate. The curved façade and serrated plan reduce direct solar gain. Brise-soleil shading wraps the building east to west, growing denser on upper levels to shade sun and encourage use of outdoor space. The building's efficient structure is also designed to withstand tropical force winds and seismic waves.



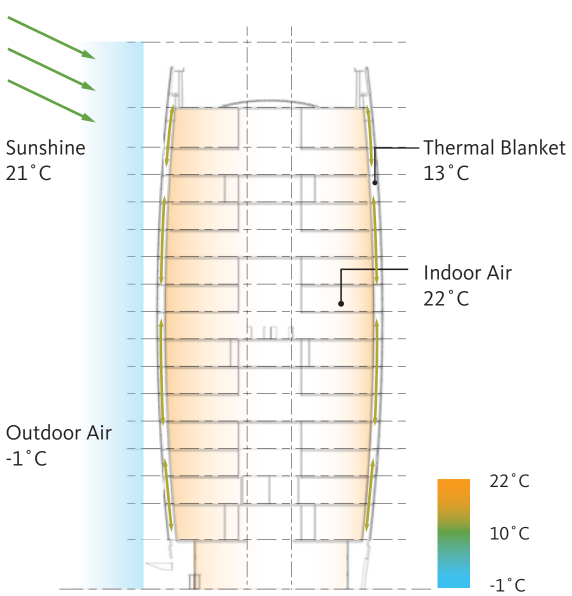
HEYU REAL ESTATE SANYUAN BRIDGE
Beijing,China
430,000 SF

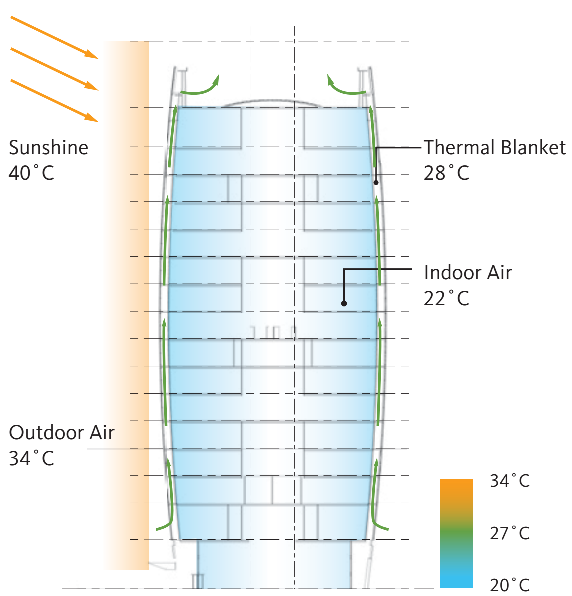
Double-glazed façade with automated shading minimizes cooling, heat loads.

Harbin Bank's new Beijing Headquarters uses a double-glazed, high-performance façade system to reduce the building's cooling load by over 50 percent in the summer and minimize heating loads by up to 40 percent in the winter. This system is supplemented with automatic blinds that facilitate access to daylight whenever possible while providing sufficient solar shading and mitigating glare. Additionally, a chilled-beam HVAC system minimizes energy use while also maximizing floor-to-ceiling heights in the building.

50% reduced cooling load in the summer

11% less mechanical equipment

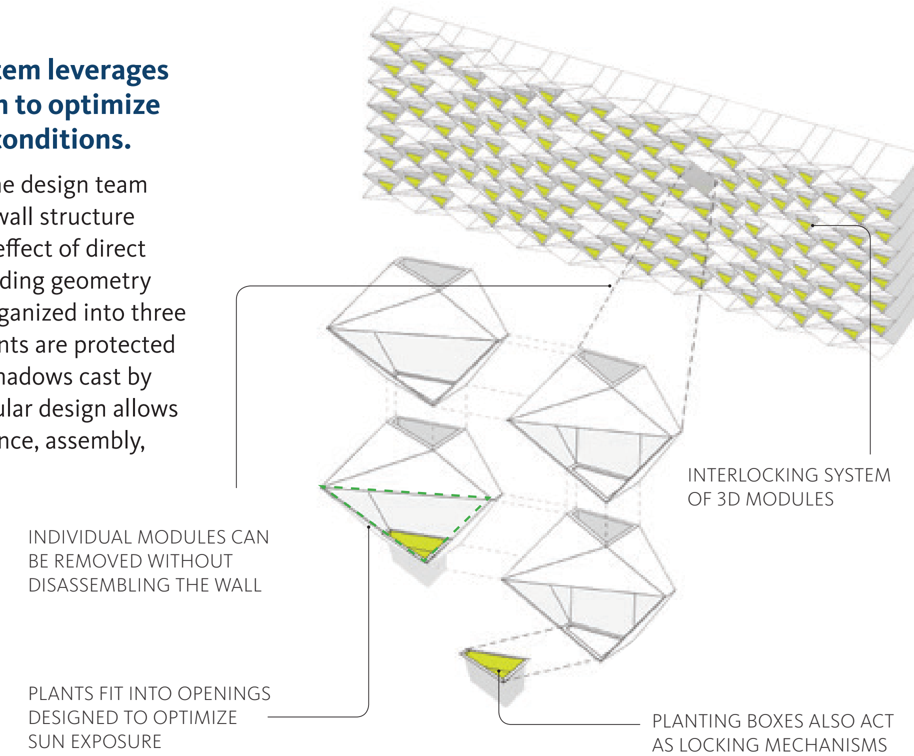




GREEN WALL AVENUES
Kuwait City, Kuwait

Vertical planting system leverages computational design to optimize for extreme climate conditions.

Using parametric tools, the design team created a modular green wall structure designed to mitigate the effect of direct southern sunlight. The folding geometry uses diamond patterns organized into three dimensional modules; plants are protected from the hot sun by the shadows cast by the forms, while the modular design allows for easy access, maintenance, assembly, and disassembly.



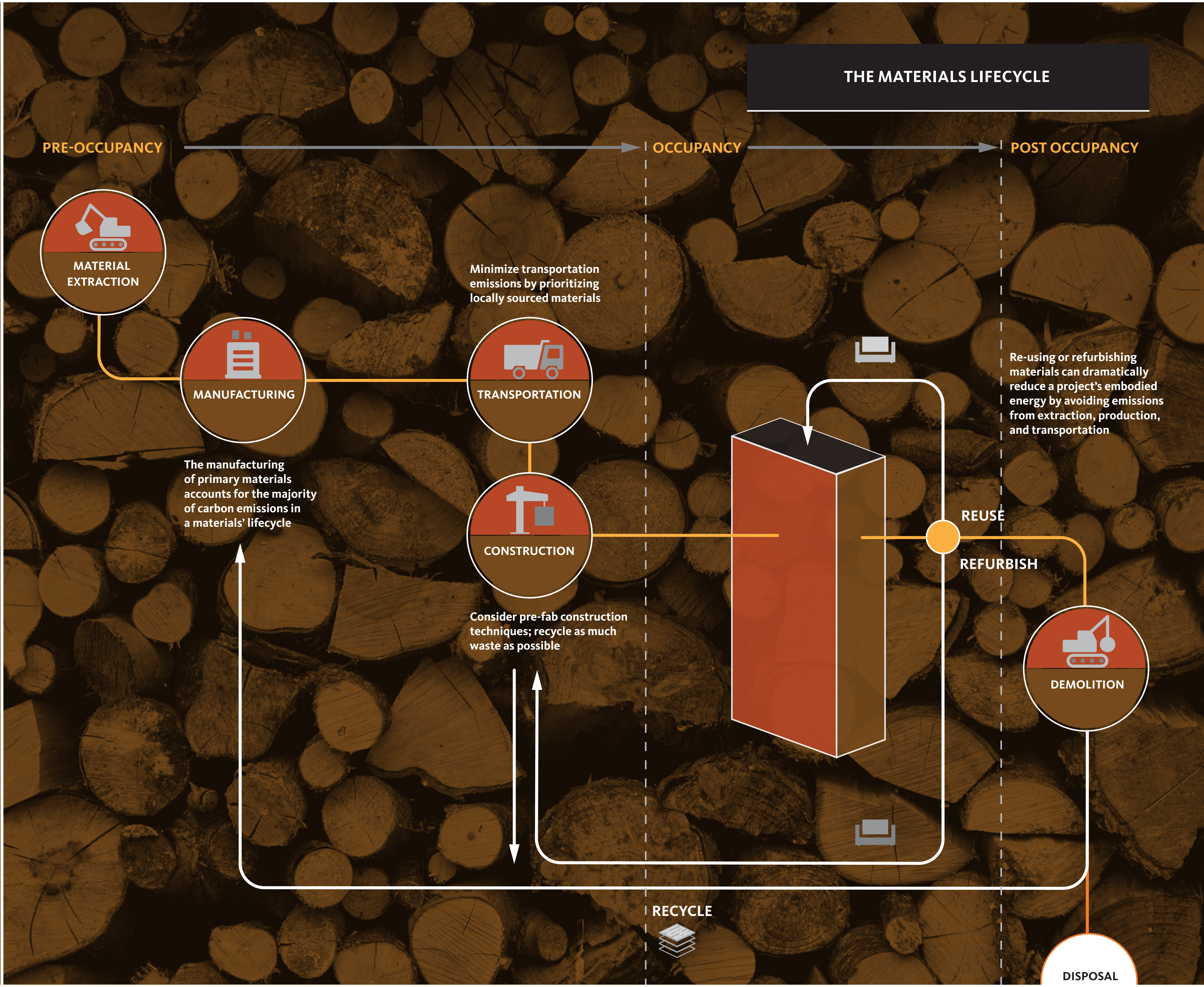
MATERIALS

More energy is expended from the production of building materials than at any other point during a building's lifecycle. For this reason, minimizing embodied carbon—defined as the amount of carbon dioxide emitted during the manufacture, delivery, and assembly of materials, plus end of life emissions—has become a point of emphasis within our portfolio.

Minimizing embodied carbon starts with selecting low-impact materials for a building's architecture and interiors. From a macro perspective, this entails raising awareness of the benefits of alternative building materials like wood, which stores absorbed carbon and requires less energy to transport. Designers can also choose concrete mixes that emit lower levels of carbon dioxide during manufacturing. From a micro perspective, emphasizing external and internal materials with minimal carbon impact—taking into account extraction, production, and transportation emissions—while also paying attention to durability and resilience will ensure the final building has as long a lifespan as possible.

Overall, we must prioritize lifecycle thinking for every design we create and every material, furniture, and fixture we specify. It is important to understand not only the energy and carbon expended in the creation of an object or place, but the expenditure at the end of that lifecycle. This means planning for re-use of materials and buildings whenever possible—whether via refurbishment, recycling, or adaptive reuse—and having a careful approach to waste management when materials do need to be discarded.

Ultimately, if we specify materials that minimize carbon production, select locally sourced materials that don't require much energy to transport, use resilient materials with longer lifespans, and consider each material's life beyond present use, then we significantly lessen the environmental impact our buildings have before occupancy even begins.

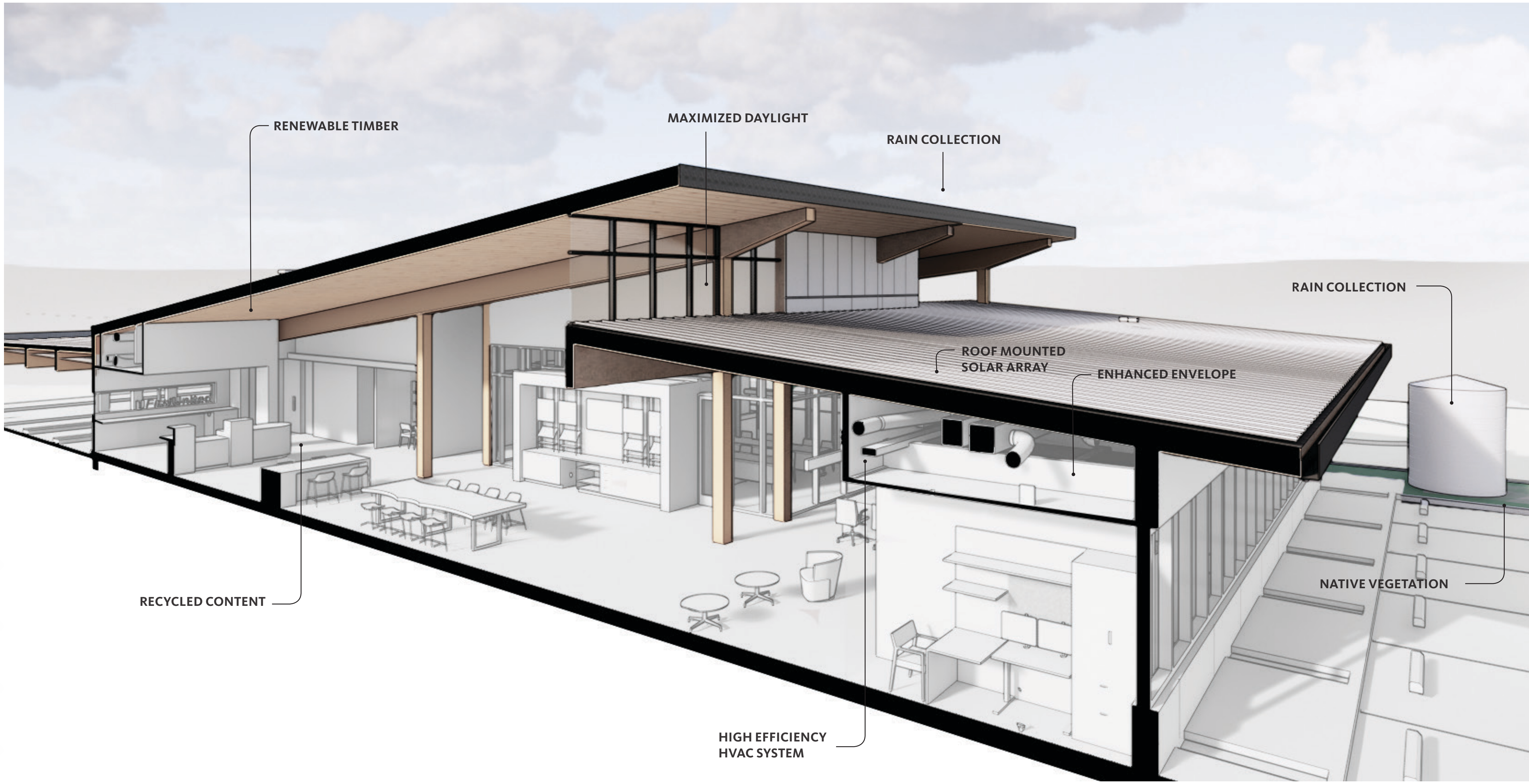


FIRST UNITED BANKS
Fredericksburg, TX; Shawnee, OK; Sherman, TX
8,500 SF

Renewable timber structure offers significant carbon and energy savings.

Too often buildings today are designed as short term solutions—the design for the new First United bank bucks that trend, focused on long-term impact from both an environmental and a community standpoint. The cross-laminated timber structure reflects the community while providing significant embodied energy savings compared to a concrete structure. Its comprehensive sustainability strategy combines high-efficiency systems, on-site renewables, rain collection, and daylight harvesting to achieve net zero energy.

250	million gallons of rainwater harvested from the roof yearly
190	tons of CO2 offset by using sustainably harvested timber
42%	more energy efficient than code requirements

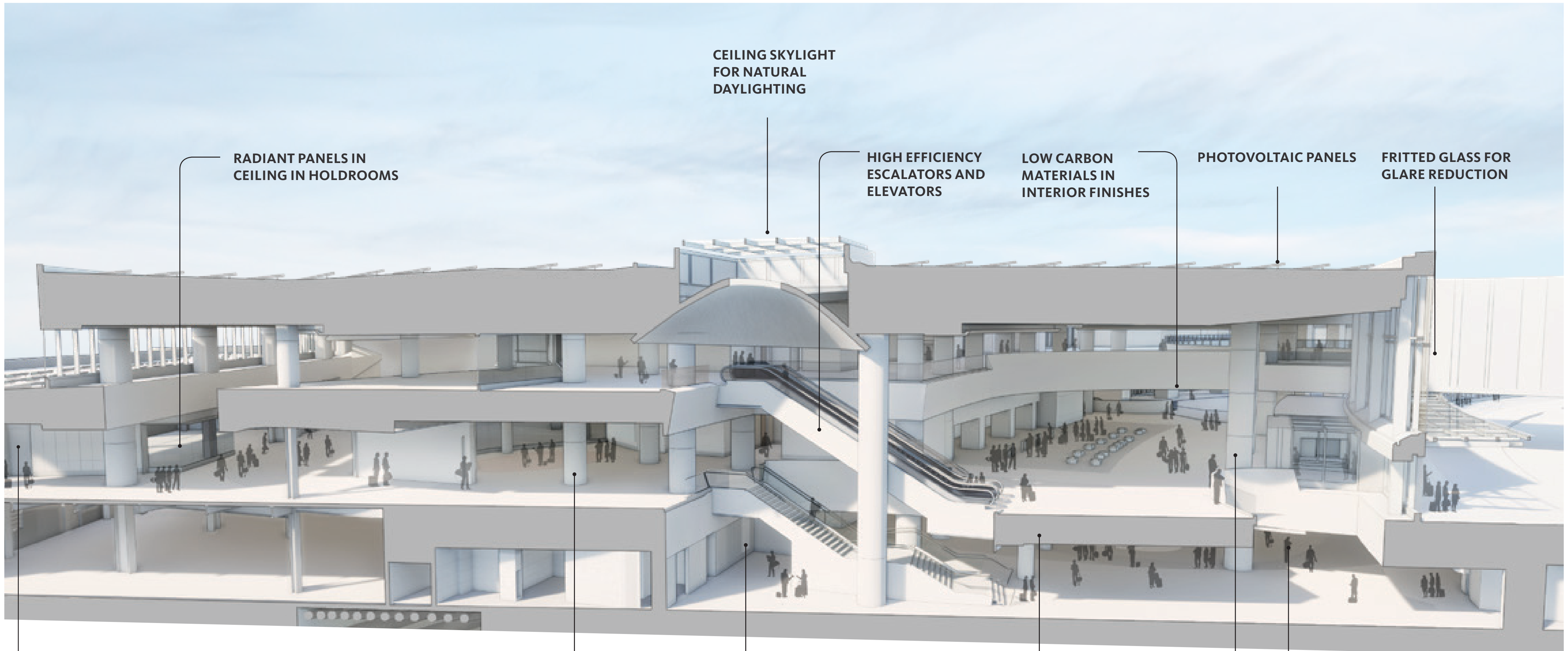


SFO T1 MODERNIZATION
San Francisco, California
770,000 SF

CERTIFICATION
LEED v4 Gold Required
LEED v4 Platinum Target

Long-term partnership reimagines airports as sustainable structures.

Gensler's relationship with San Francisco International Airport (SFO) began in the mid-1970s when airport officials asked the firm to reimagine the passenger experience. Since then, Gensler and SFO have partnered on numerous projects with an emphasis on how sustainable design can enhance the passenger experience while transforming SFO into a leading example of stewardship. The T1 modernization project currently underway represents the most ambitious, integrated sustainability strategy for the airport yet as they continue to push for near net zero energy usage alongside significantly reduced material/carbon impacts.



593	lbs CO2/sf (50 yr operating and embodied carbon), baseline
124	lbs CO2/sf (50 yr operating and embodied carbon), as designed
79%	total carbon footprint reduction

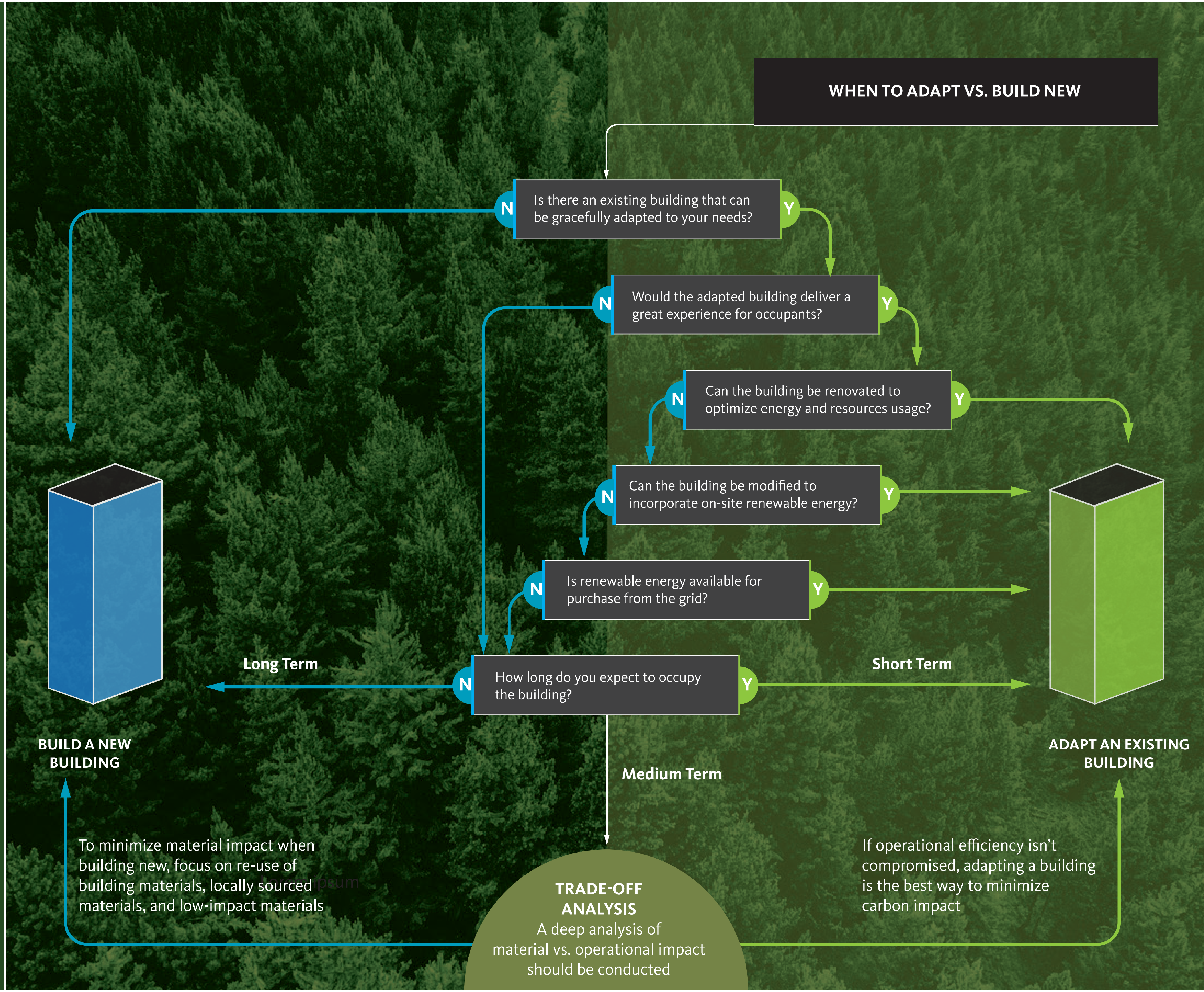
ADAPTATION

Building a new building, neighborhood, or city is one challenge—working with what already exists is a very different one. If treated correctly, adapting existing buildings produces a significantly more positive impact than focusing solely on new buildings. Why? Because optimizing the performance and operational impact of a building is just one component of its overall carbon and climate impact.

It is imperative that we develop strategies to improve the performance of our existing buildings without tearing them down. This is particularly true in cities within highly urbanized countries—for example, over 80 percent of the US population already lives in metropolitan areas. A rough rule of thumb: it takes approximately 20–30 years of a typical building's operations to equate the same amount of energy usage required to create the building from a materials and construction perspective, and upwards of 80 years for the additional energy of an average LEED building to make up for the impact of having built it in the first place.

That means for it to be worth tearing down and building a new building, at a minimum you have to expect the new building to offer significantly better energy performance than the existing one—and to be in use for quite a long time. Keeping existing building materials/forms while optimizing systems is almost always the ideal solution.

This doesn't just mean historic preservation—the majority of our existing buildings are not historic, and many may not even seem worth saving from an aesthetic perspective. But significant design interventions can present a whole new character or experience for users without starting over. These "hacked" buildings can be the best of both worlds—preserving materials to reduce environmental impact while adjusting the building's form to accommodate new use cases or operational realities.



ONE POST OFFICE SQUARE
Boston, Massachusetts
980,000 SF

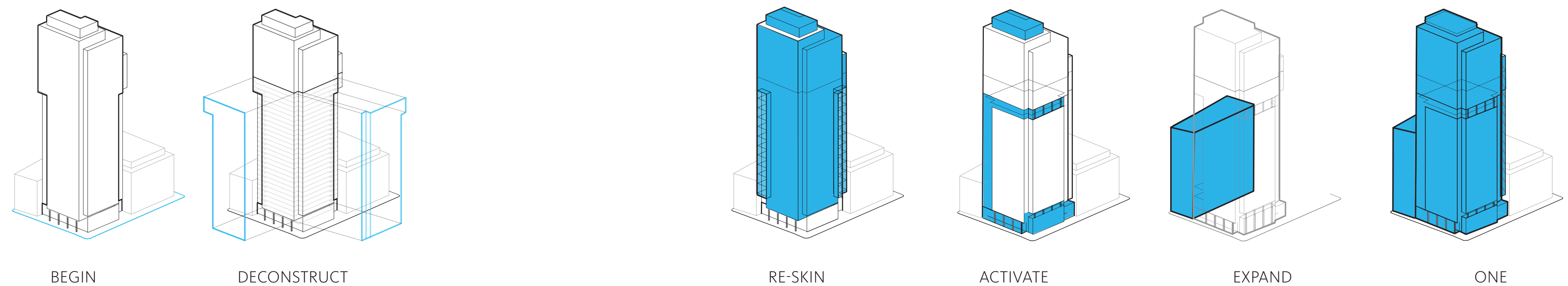
CERTIFICATION
LEED v4 Gold Expected

A dramatic shift delivers a new experience, better performance, with minimal material impact.

In cities across the world, single-use commercial office buildings are being transformed into mixed-use destinations that reflect today's everything/everywhere culture. This classic tower is being updated to accommodate a modern programmatic mix while creating new public spaces on the ground and in the sky. Sustainable strategies include achieving significant energy use reductions through lighting and mechanical retrofits, IoT enabled building management systems, and re-use of over 50 percent of the original building materials.

32% energy reduction over Boston code

50% of material carbon footprint avoided via reuse of envelope, foundation, structure



UPCYCLE
Austin, TX
81,000 SF

Repositioned warehouse re-uses 95 percent of building materials to create vibrant, creative workspace.

UPCycle, a multi-tenant creative office space, seeks to preserve a piece of East Austin history while also providing an updated, modern, and collaborative working environment in what is essentially a new office building. The design reuses 95 percent of the existing structure, even the building skin, which is turned inside out to reveal its natural finish. Even old elements such as exhaust fans were reused as decorative design features.

UPCycle

ONE SOHO SQUARE
New York, NY
768,000 SF

Two existing buildings merge to create an integrated structure while maintaining original character.

A narrow sliver element fills in an un-used open space between two existing buildings, creating a new structural component with updated elevators, equipment, and egress. The addition also created three new floors of penthouse office space and a garden terrace, resulting in a 250 percent rent increase. A careful planing strategy allowed both buildings to remain operational during renovations.

“The scale of impact we can have by improving the performance of our existing buildings is immense, much greater than if we only focus on new buildings.”

Rives Taylor, FAIA, LEED AP, Principal, Gensler

BRITISH RESEARCH ESTABLISHMENT: THE CHALLENGE AND OPPORTUNITY OF EXISTING BUILDINGS

The British Research Establishment (BRE) is a world leading, multi-disciplinary, building science center with a mission to improve buildings and infrastructure through research and knowledge generation. BRE uses its cadre of PhD researchers to develop a range of products, services, standards and qualifications that are used around the world to bring about positive change in the built environment.

The built environment is a massive contributor to global energy use and CO2 emissions. Figures from the International Energy Association (IEA) indicate that the global buildings sector is responsible for 30 percent of final energy consumption and more than 55 percent of global electricity demand, which equates to 25 percent of energy-related CO2 emissions. While there has been considerable effort to optimize the energy performance of new buildings through tighter energy requirements/codes and environmental certification programs such as LEED and BREEAM, refurbishing existing buildings carries the greatest potential for improvement.

Globally, there is a large stock of older buildings built under codes with lesser performance requirements, and the current retrofit rate in both the domestic and commercial building sectors is low. For example, in the US only 2.2 billion ft² (200 million m²) or 2 percent of floor area is refurbished each year. The situation is similar in the European Union (EU), where between 0.5 percent and 2.5 percent of residential buildings are renovated each year with a typical figure of 1 percent (equating to 250 million m²). The opportunity is particularly great as renovating existing buildings delivers positive environmental, economic, and social outcomes.

Environmental benefits are the most direct and immediate result of building refurbishment, and are the primary focus of this paper. These come via energy savings and reductions in CO2 from more efficient systems; the preservation of existing materials; and the use of retrofit opportunities to also improve building resilience against climate change impacts such as overheating, increased rainfall and flooding.

Economic benefits include increased construction activity (the construction sector is responsible for 7 percent of EU GDP and employs 11 million people), particularly as specialized construction activities that include renovation work and energy retrofits account for two-thirds of employment in the sector while avoiding the heavier energy/emissions costs of building new. More energy efficient buildings come with reduced running costs, and may deliver productivity benefits. Renovation also has a positive impact on property values; in the UK it’s estimated that efficiency improvements could improve domestic property values by 14 percent on average. Increased renovation activity would also trigger innovation in the building-related small and medium sized enterprises (SME) sector, as well as providing greater energy security and self-sufficiency.

Social benefits include improved health outcomes in addition to job creation. Poorly insulated homes are a significant problem in the EU; in 2012, 11 percent of the European population was unable to keep their homes warm in winter. Reducing the energy demand of housing helps to alleviate fuel poverty, and often has the added benefit of improving interior air quality. The value of such co-benefits has been found to range from 50 to 300 percent of household energy savings. The link between poor housing and health in England has been investigated by the Building Research Establishment (BRE), which estimates that leaving vulnerable people living in the poorest 15 percent of England's housing is costing the National Health Service (NHS) some £1.4 billion ($1.8 billion) per annum in first-year treatment costs.

Ultimately, the goal is reducing the energy impact of our buildings to zero. The US Department of Energy defines a zero energy building (ZEB) as "an energy-efficient building, where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy." The EU uses a similar approach but has introduced the concept of a nearly zero energy building (nZEB) which is defined as a "building that has a very high energy performance. The nearly zero or very low amount of energy required should to a very significant extent be covered by energy from renewable sources, including renewable energy produced on-site or nearby." In the US, the term Ultra-Low Energy Buildings (ULEBs) has also been introduced and is applied to energy-efficient homes and commercial buildings that, with the application of a renewable energy solution, can become ZEBs.

These new terms acknowledge the practical (often economic) difficulty in achieving a ZEB while promoting a continued focus on extreme energy usage reductions. As energy grids around the world incorporate more renewables, the terminology is also evolving to acknowledge the positive impact of procuring renewables from the grid (vs. generating on-site), even if this does not meet strict ZEB definitions. This lack of clarity in terms has been criticized for not supporting a more coherent approach by national governments, but also acknowledges the increasing number of paths to minimizing energy impact.

Currently, the number of ZEBs is small. There are only an estimated 200 new commercial buildings and 6,000 new homes in the US operating as ZEBs; for existing buildings the numbers are much lower: 100-150 homes and 65-70 commercial buildings. The position is comparable in the EU where the available data indicates that nZEB retrofit projects only amount to 0.05 to 0.5 percent of the building stock that is renovated each year. These data highlight the necessity of steep changes in retrofit activity. Figure 2 highlights the challenge in terms of delivering the energy performance required for ULEBs in the US.

Worldwide there are, however, promising initiatives to increase the level and depth of retrofit in the future. A number of countries and cities have announced milestones or initiatives to shift toward low-carbon economies and zero energy buildings. Certification programs such as the Passive House EnerPHit standard recognize the energy performance levels that refurbished existing buildings can achieve. Sustainable building certification tools such as BREEAM International Refurbishment and Fit Out and LEED can be tailored to reward a wide range of retrofit projects including those that achieve ZEB. And innovative programs like the Dutch Energiesprong ('Energyleap'), which uses pre-fabricated façades, insulated roof systems and advanced heating and cooling systems to deliver ZEB retrofits, have shown success and are now working internationally.

–*Richard Hartless, BRE Academy*

Figure 1

Barriers to energy refurbishment of buildings and policy options

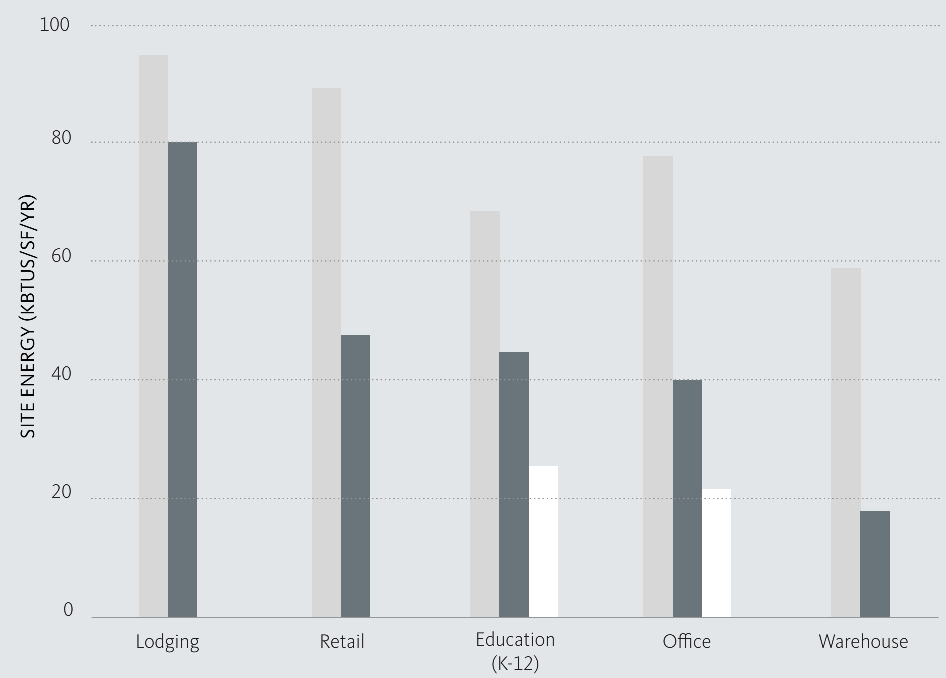
Adapted from Artole et al (2016)

Barrier
Policy instrument

Figure 2

Existing building stock EUI compared to building codes and standards

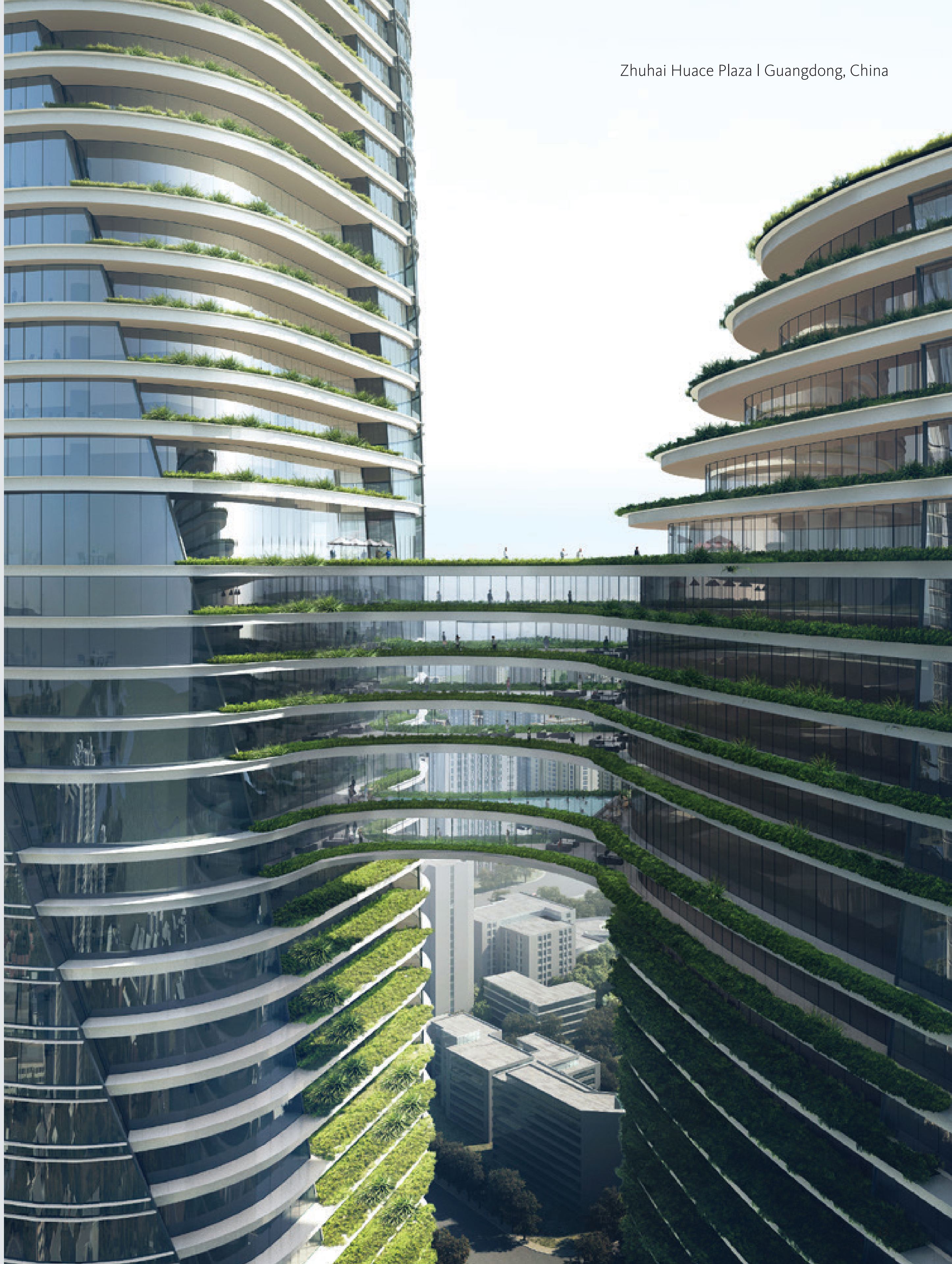
Adapted from Amann (2017)



Existing building stock
2013 Average Performance (ASHRAE 90.1-2013)
Ultra low energy

“Re-using buildings doesn’t mean sacrificing efficiency improvements. The best case scenario is often optimizing a building’s mechanical systems while maintaining its existing structure.”

Kirsten Ritchie, PE, LEED AP, Principal, Gensler


Zhuhai Huace Plaza | Guangdong, China

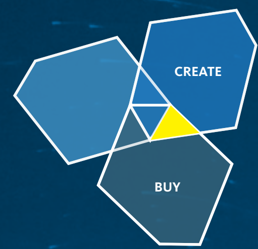
ENERGY

Reducing energy and achieving “net zero” has long been a clarion call of the green building movement. The path to net zero often focuses on two key strategies: energy reduction and energy creation. Recently, energy procurement from renewable sources is also becoming a major part of these discussions.

Energy reduction strategies push buildings to take advantage of locations and forms that minimize material usage and optimize performance. This tactic, when paired with sustainable technologies like high performance facades and efficient systems, significantly reduces operational energy usage. Minimizing the energy a building needs is a key first step—and the place where design often has the greatest potential for impact. In a traditional net zero approach, the amount of energy a building needs is then created on-site via renewable energy sources-from photovoltaic panels to geothermal or wind energy. This two-pronged approach to net zero is an accessible path for buildings located in environments where renewable technologies yield significant amounts of energy production and offer a high return on investment.

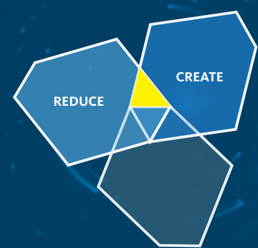
The conversation around net zero is quickly shifting, however, to include the procurement of renewable energy from utilities in markets where buyers can specify their energy source. This strategy becomes increasingly viable as energy grids begin to accommodate and offer more renewable options. The added approach of procuring energy that can’t be minimized or generated is a crucial strategy for minimizing impact when on-site renewables can’t meet energy demand.

While this option is only available in select markets today, an increase in market demand for renewables from the grid can incentivize greater future investment. Such demand can also foster a larger dialogue around the role utilities and smart energy grids can play in minimizing the impact of the built environment.



ENERGY RETROFIT

Leaving a building’s design and systems as-is while achieving zero carbon impact via on-site renewables and renewable energy procurement



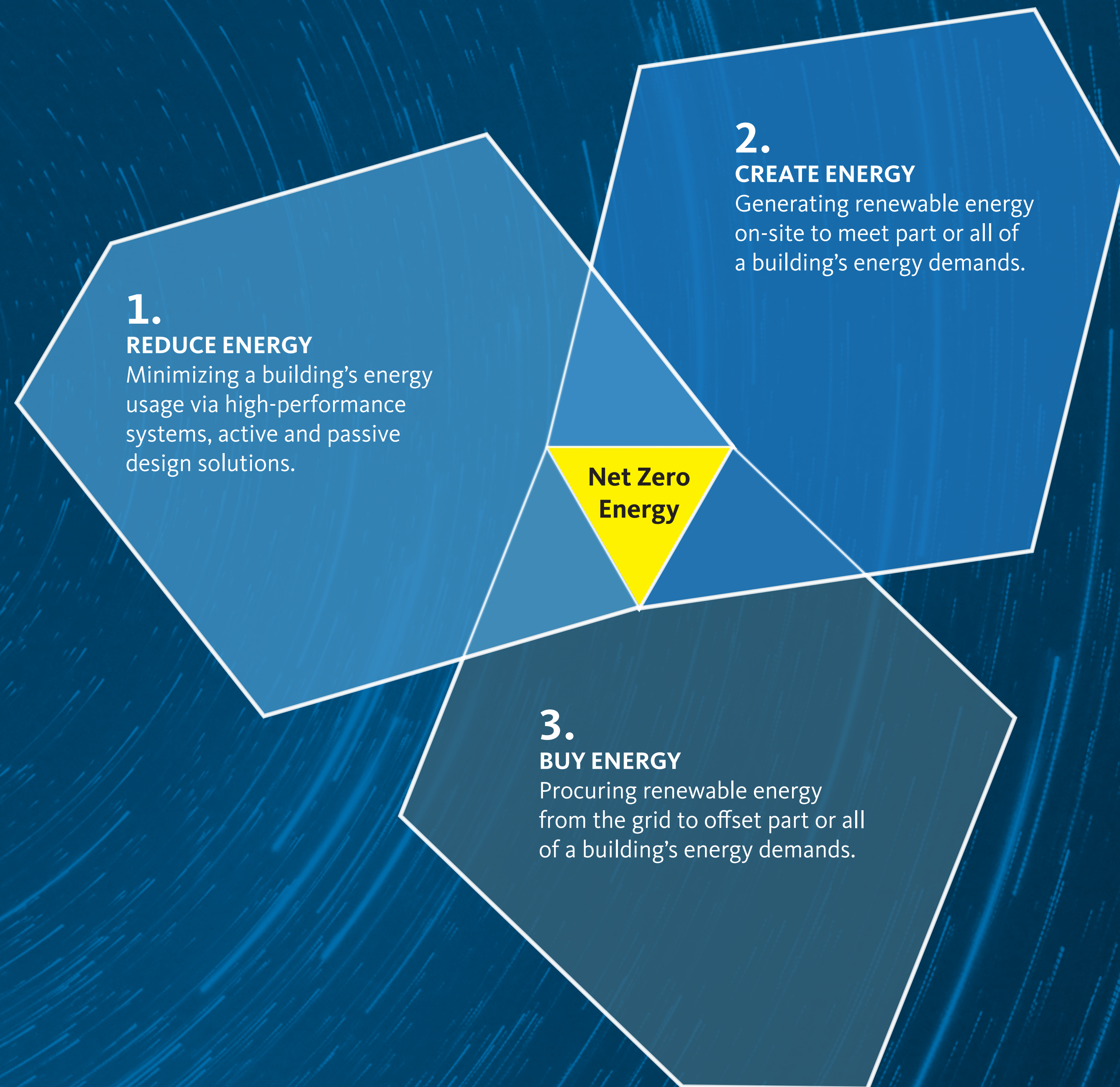
OFF-GRID RESILIENCE

Achieving true “net zero” via optimizing building design and performance and generating energy on-site to meet or exceed building demand

REDUCE + OFFSET

Improving building performance via systems and design upgrades, and offsetting remaining energy use via renewable energy purchased from the grid

MULTIPLE PATHS TO NET ZERO ENERGY

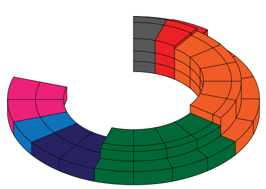


ENERGY

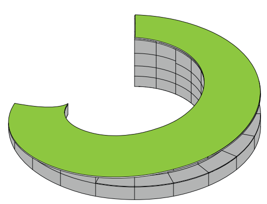
ELECTRIC VEHICLE ENCLAVE
Confidential Location
130,000 SF

A net zero approach to community planning prioritizes on-site energy generation and active house principles.

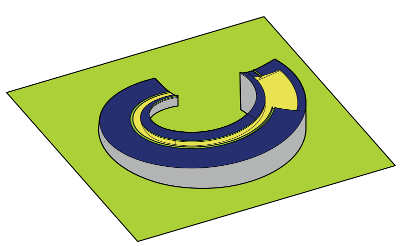
For s2e Technologies, Gensler created a master plan and concept design* called the Electric Vehicle Enclave (EVE). EVE, designed with the future ubiquity of autonomous vehicles in mind, is a new housing model that can be implemented on multiple sites in Canada and the United States. Comprising 52 townhomes capable of achieving net zero energy consumption, EVE reimagines the row house paradigm for a suburban landscape by proposing a "homestead" model that supports community building through common courtyards. It incorporates an autonomous vehicle network on the premise and includes a hydroponic farm for yearlong produce harvesting.



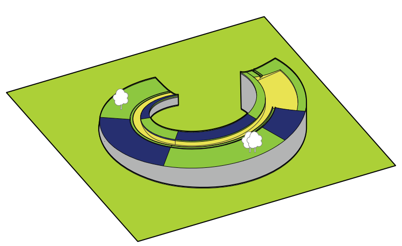
BEND
Massing is bent around a curve to create a new form



OPTIMIZE
Continuous roof creates room for natural ventilation and mechanical equipment

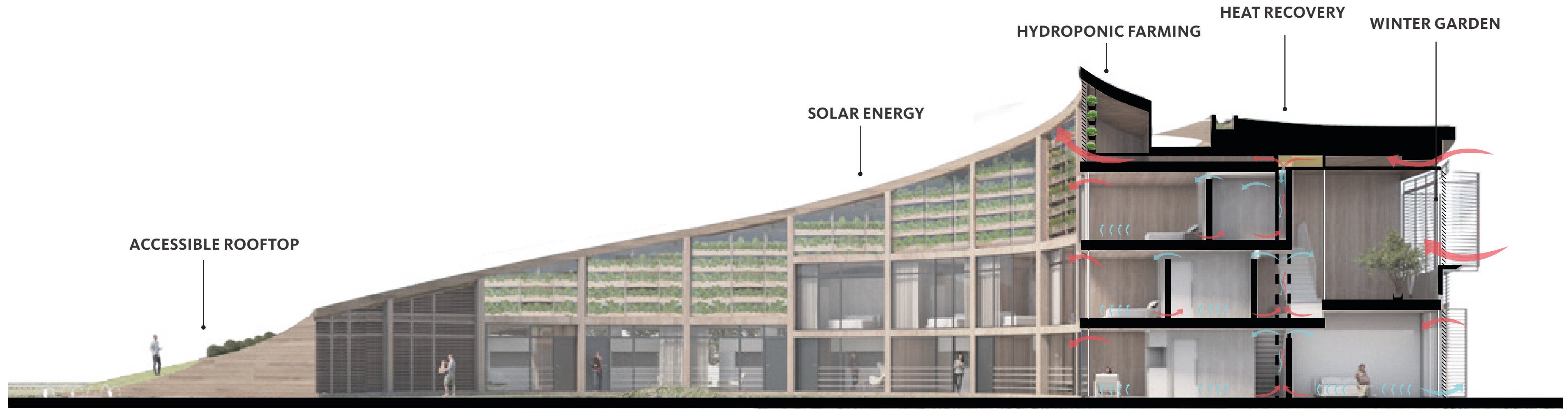


GENERATE
Large roof is also an opportunity to incorporate photovoltaic panels



COMBINE
Photovoltaic panels are integrated with rooftop gardens

*Designed in collaboration with Studio Dror



CSUN SUSTAINABILITY CENTER
Northridge, CA
8,000 SF

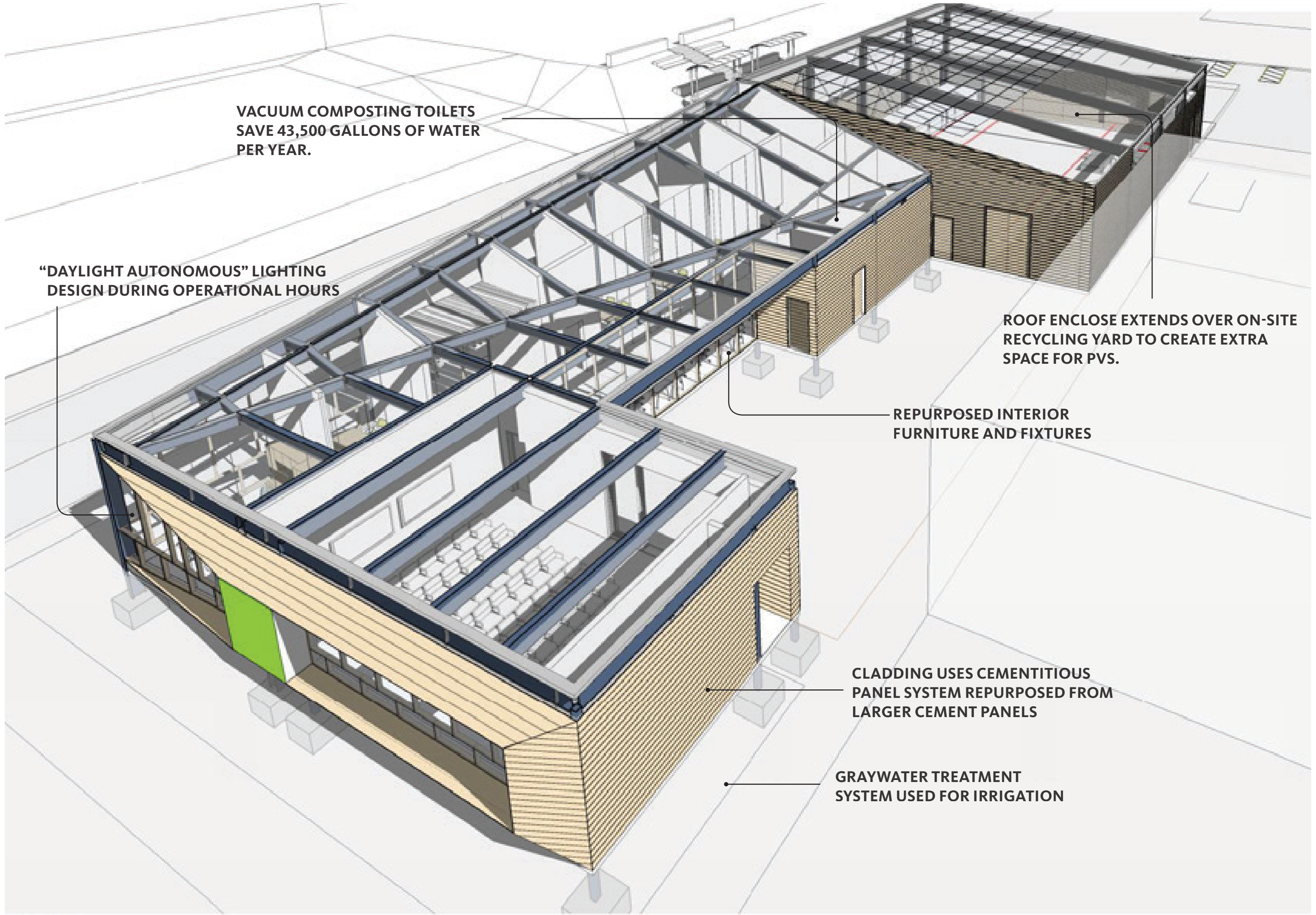
CERTIFICATION
LEED Platinum Certified

Sustainability and recycling center sets a new benchmark for campus net zero projects.

California State University, Northridge's (CSUN) new Sustainability Center leverages a range of sustainable strategies to raise the bar for sustainable design in higher education. The first completed Zero Net Energy building in the CSU system, the Center uses its large rooftop (which covers both conditioned and unconditioned space to maximize roof area) and a 25kw rooftop photovoltaic system coupled with a glazed overhead window to offset the building's entire energy needs. This eliminates the need for artificial light in the building during daylight hours and offsets the energy required to support administrative functions.

100% of hot water needs met by solar thermal and hybrid hot-water heat pump

43 thousand gallons of water saved per year



HOUSTON ADVANCED RESEARCH CENTER
Houston, Texas
18,000 SF

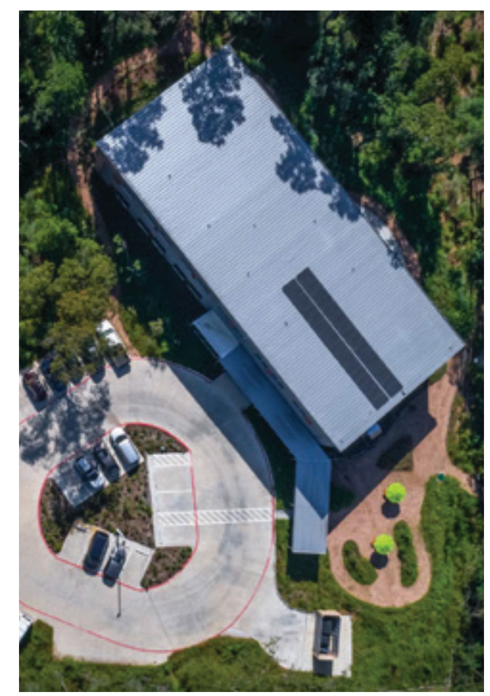
CERTIFCATION
LEED Platinum Certified

A holistic approach to minimal impact addresses energy, water, and embodied carbon.

The new Houston Advanced Research Center (HARC) is designed for extreme operational efficiency, operating at 60 percent less energy than a baseline project while also employing innovative strategies to reduce its material carbon footprint and water usage. On-site renewables including geothermal energy and photovoltaic rooftop panels help the project achieve better than net zero energy performance.

$21 thousand per year saved in energy costs

72% less energy used than baseline project of this size



WATER

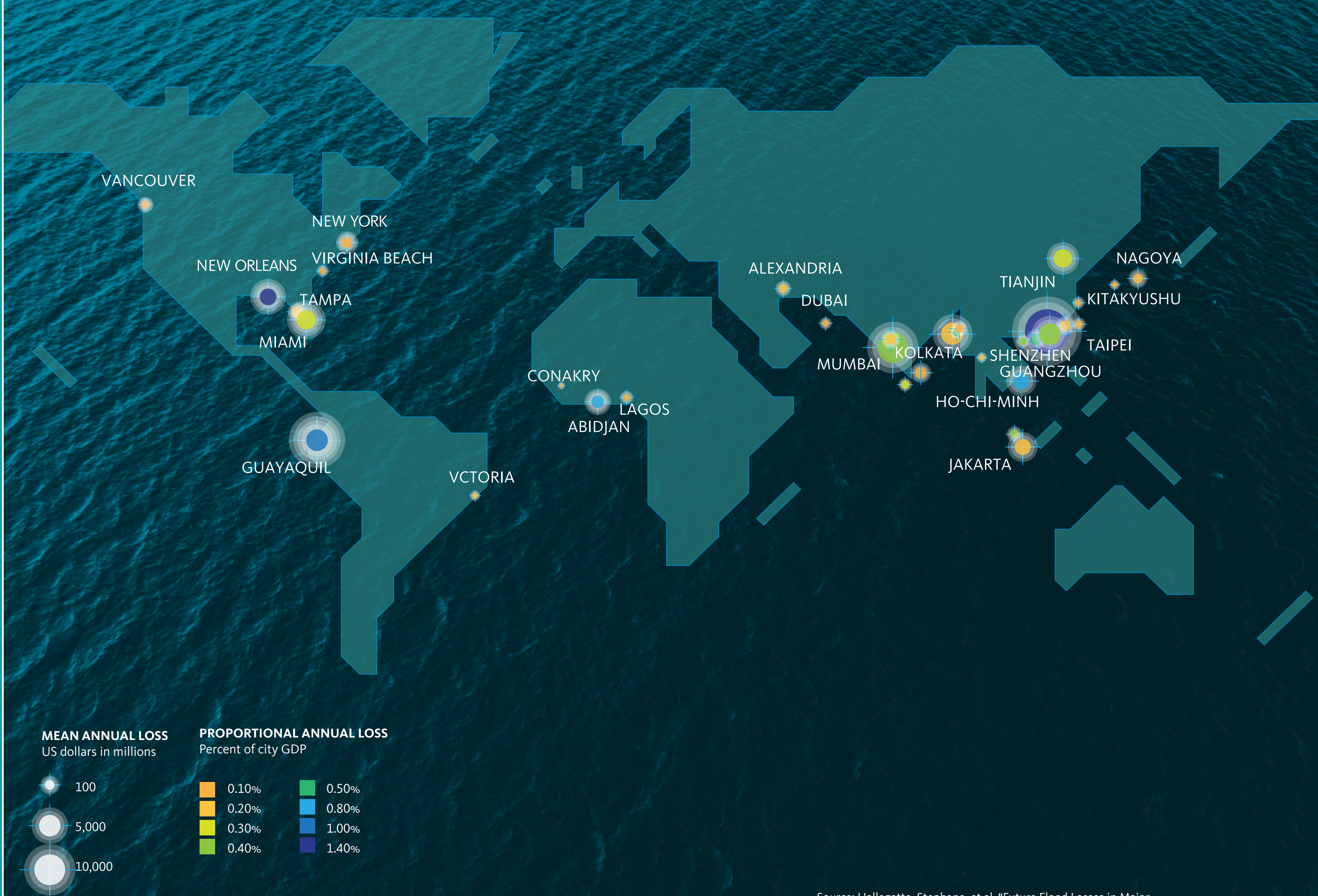
As coastal cities continue to come under siege from rising sea levels and increasingly frequent storms, the long and short-term returns on investment for design strategies that effectively manager water will grow in value and visibility. Cities are the economic engines driving growth in the 21st century—and a vast number of the world's major cities are in locations vulnerable to flooding. Cities that adopt progressive strategies toward designing with water in mind will possess a distinct competitive advantage and put themselves in a better position to attract new residents and businesses both now and in the future.

Resilient design strategies for coastal cities can be broken down into three scales: the regional scale, the city scale, and the building scale. At the regional scale, it is important to develop an understanding of each city's distinct ecological infrastructure and assess the risks threatening that infrastructure. Every coastal city faces unique hazards, from receding coastlines that displace residents to the contamination of potable water supplies. Once an understanding of these risks has been established, the adoption of proactive zoning codes acts as the first stage in developing a comprehensive resilience strategy.

Cities are in a prime position to consider strategies specifically designed to combat sudden or gradual influxes of sea water. Possible solutions include cut/fill canals that channel water away from the built environment to flood-proofed sites, and also constructing coastal dunes and dedicated wetlands that inhibit flooding and appropriately store both flood and fresh water.

The design of individual buildings must then be considered. The designers, owners, and operators of the built environment must determine the strategies that best suit their location. These could include raising ground floors to flood-proofing existing structures or using durable materials capable of withstanding the sudden incursion of floodwater or increases in humidity.

CITIES WITH GREATEST COASTAL FLOODING RISK

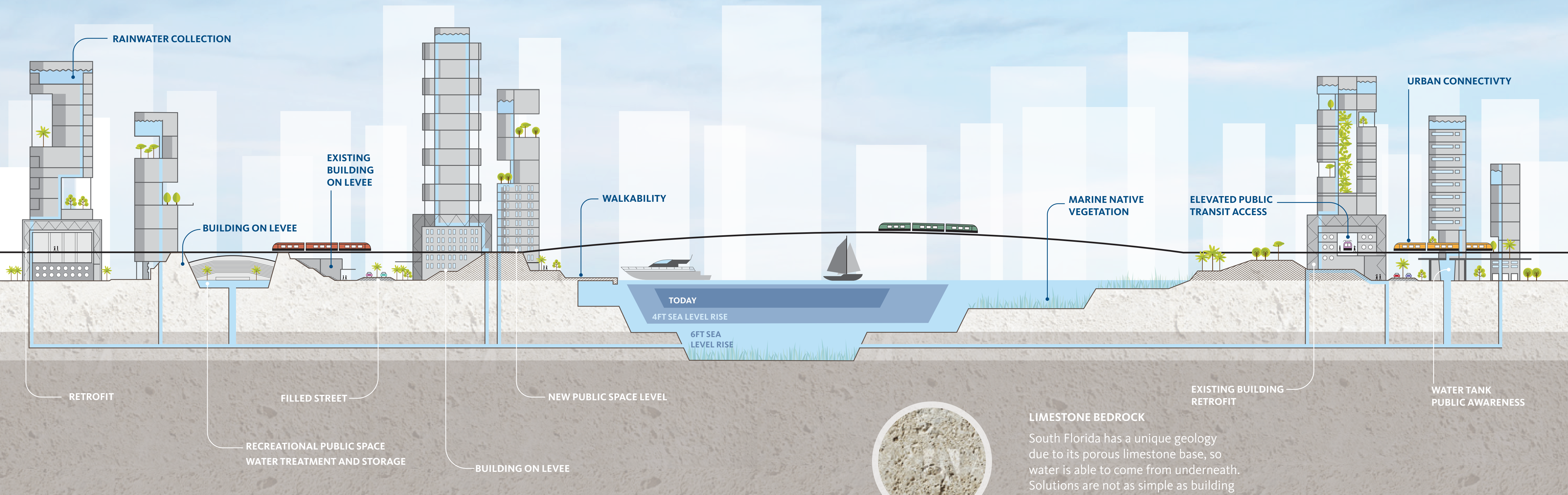


Source: Hallegatte, Stephane, et al. "Future Flood Losses in Major Coastal Cities." Nature Climate Change, vol. 3, no. 9, 2013, pp. 802–806., doi:10.1038/nclimate1979.

CONCEPT PROPOSAL, MIAMI WATERWAYS
Miami, FL

Ambitious plan for Miami creates parks, wetlands, and new circulation routes in areas prone to flooding.

Miami is among the most vulnerable cities to coastal flooding worldwide; innovative, dramatic approaches to rehsaping the urban environment will be required to keep the city viable as sea levels rise. A research project led by Gensler Miami* explores how zoning codes and development policies could require existing communities at higher elevation points to acquire increased levels of residential and commercial density, thus creating heavily populated, commercially stable areas that are insulated from flooding. Low lying areas would be zoned as parks and wetlands, effectively acting as buffer zones that protect the surrounding areas from water fluctuations. A man-made delta capable of integrating higher water levels into the urban fabric without threat to residents or businesses, including the transformation of streets into canals, would result in a transportation network that can serve the needs of a denser city while reducing individual vehicle usage.



*The first phase of this research was led by Ana Benatuil; it is now being continued via a grant from the Gensler Research Institute

WATER

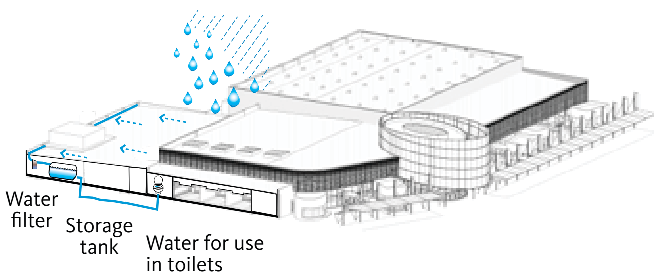
COSTA RICA CONVENTION CENTER
Heredia, Costa Rica
160,000 SF

CERTIFCATION
LEED CI Expected

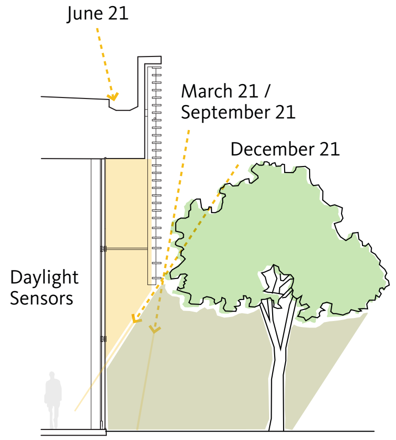
Bandera Azul Ecológica" (Blue Flag Ecology Program), Five Stars

Convention center models country-wide commitment to sustainability.

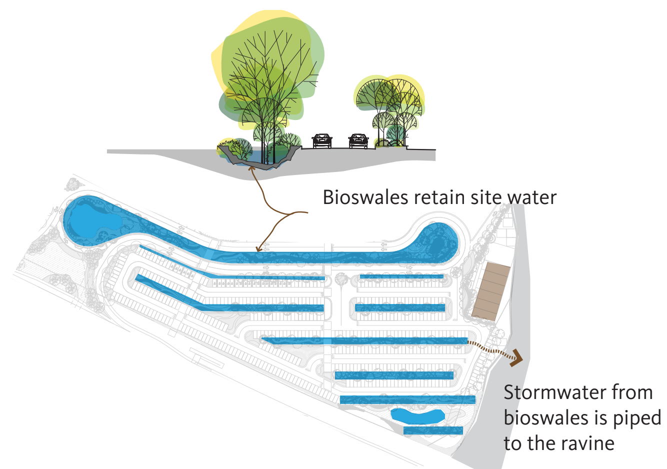
The newly opened Costa Rica Convention Center is a remarkable milestone in sustainable design for a country that helped pioneer eco-tourism and remains committed to a forward-looking green ethos. Sitting in a former brownfield, the center manages rain water—a critical consideration for site design in any tropical environment—with an extensive system of bioswales and endemic tropical planting. Reforestation of the surrounding area epitomizes Costa Rica's ongoing commitment to offset carbon production through the protection of naturally occurring vegetation.



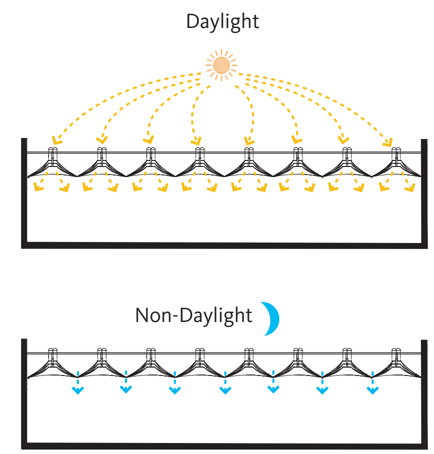
RAINWATER HARVESTING



SUNSHADING



BIOSWALES



HARVESTING DAYLIGHT

INTELLIGENCE

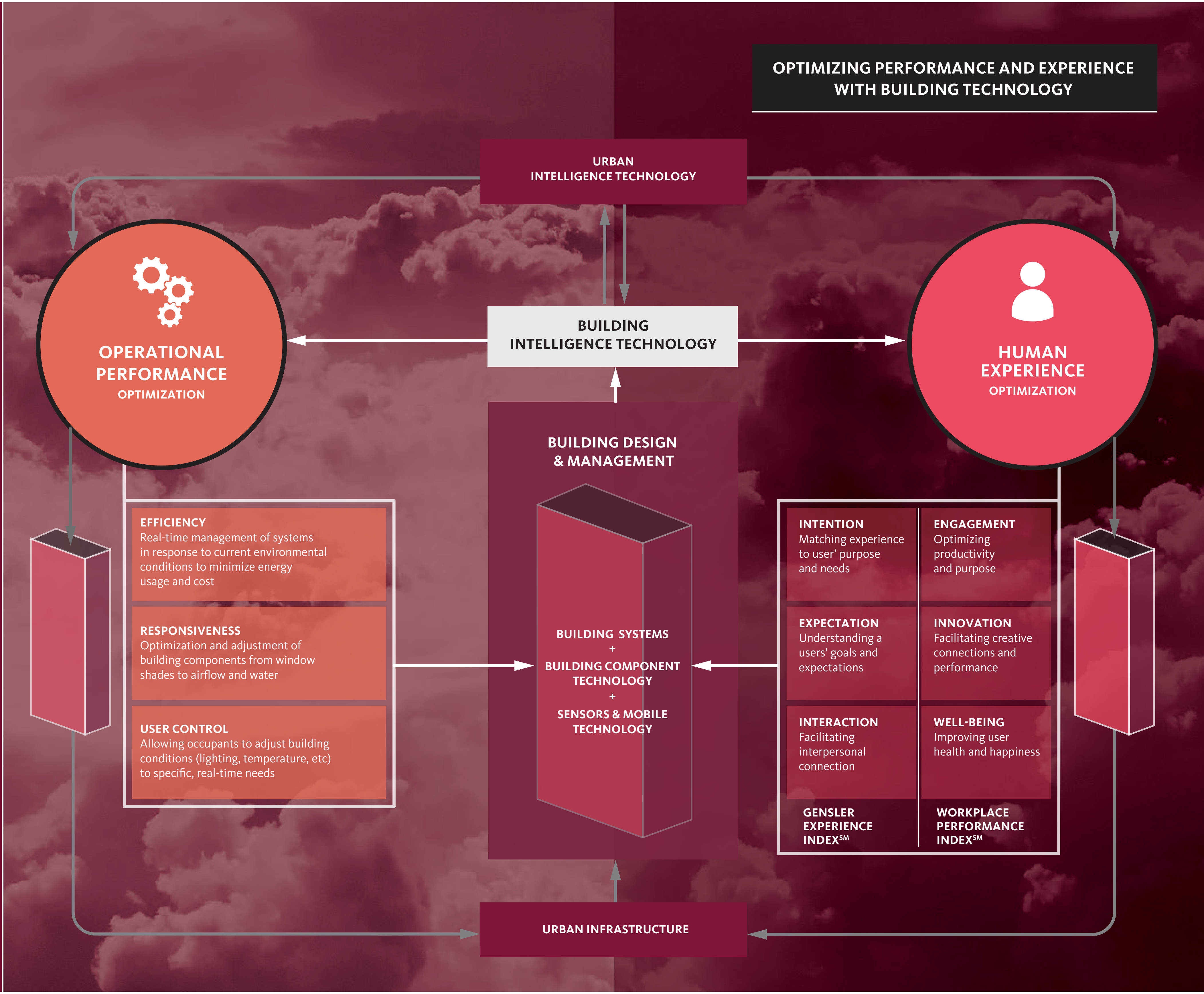
New sensor and network technologies continue to permeate our world. Our spaces, buildings, and cities will learn to leverage real-time data concerning occupant behavior and air quality/temperature to dynamically optimize space performance and experience. This responsiveness will significantly reduce the amount of energy required to operate the built environment.

Today, these strategies include leveraging market available technologies like breathable facades, automatically dimming windows or shades, and demand-dimming lights that adjust based on natural light levels—to name a few. More and more these systems are then connected together into sophisticated Building Energy Management Systems (BEMS) or other orchestration technologies, which operate as a central building CPU.

Systems are then dynamically managed in response to real-time conditions, either by building staff, automated algorithms (AI, machine learning), or a combination of the two. This is an important point to stress—most smart buildings still don't run themselves, so having a plan for how you'll operate a smart building is imperative before deciding to create one.

The next iteration of smart buildings will leverage advances in sensor technology alongside an increased number of IoT-enabled devices. This will allow building occupants to have a more direct relationship to their building—both in feeding it additional data to support optimization algorithms and having more direct control of their immediate surroundings. These buildings empower occupants to do everything from dim the lights at their workstations to adjust the climate of a specific room.

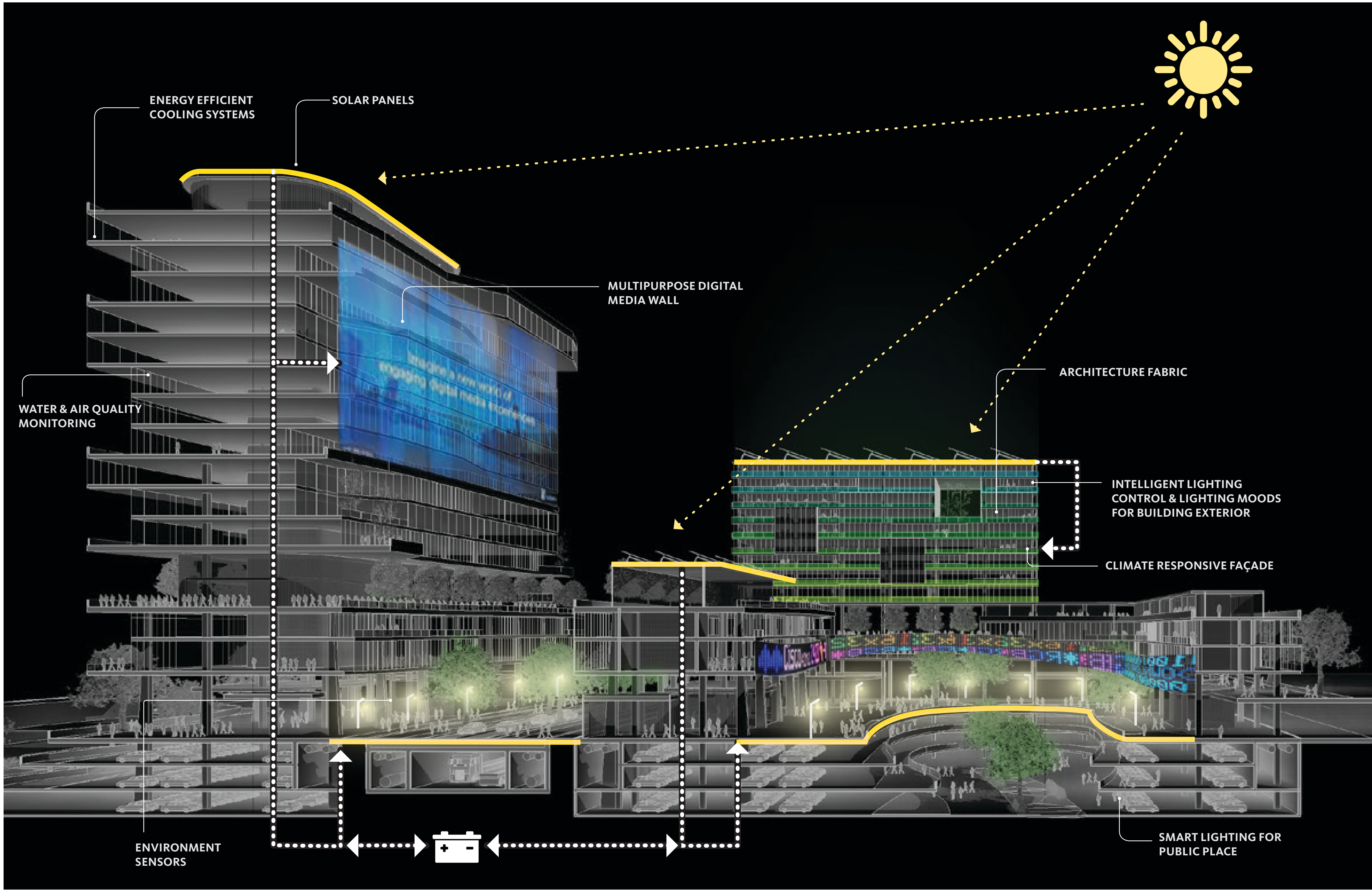
Importantly, this means that systems focused on the separate areas of optimizing performance and optimizing human experience will gradually merge. These combined, intelligent systems will also connect to other urban systems and infrastructure.



CISCO (GUANGZHOU) SMART CITY
Guangzhou, China

Smart city master plan promotes sustainability, mobility, connectivity, and flexibility.

Integrated technology across all scales of the built environment, from buildings to infrastructure, creates a connected environment that optimizes energy, water, and light efficiency based on real-time conditions. Systems also monitor temperature, pollution, and waste management. The same technological infrastructure also enables the creation of a hyper-connected community with secure, accessible mobility; support for autonomous vehicles; and intelligent traffic and parking optimization. A flexible planning strategy also prioritizes the ability to adapt over time as technologies, and behaviors, change.



JOHNSON CONTROLS HEADQUARTERS, ASIA PACIFIC
Shanghai, China
376,000 SF

CERTIFICATIONS

LEED Platinum Certified

China Green Building Design Label Three Star Certification

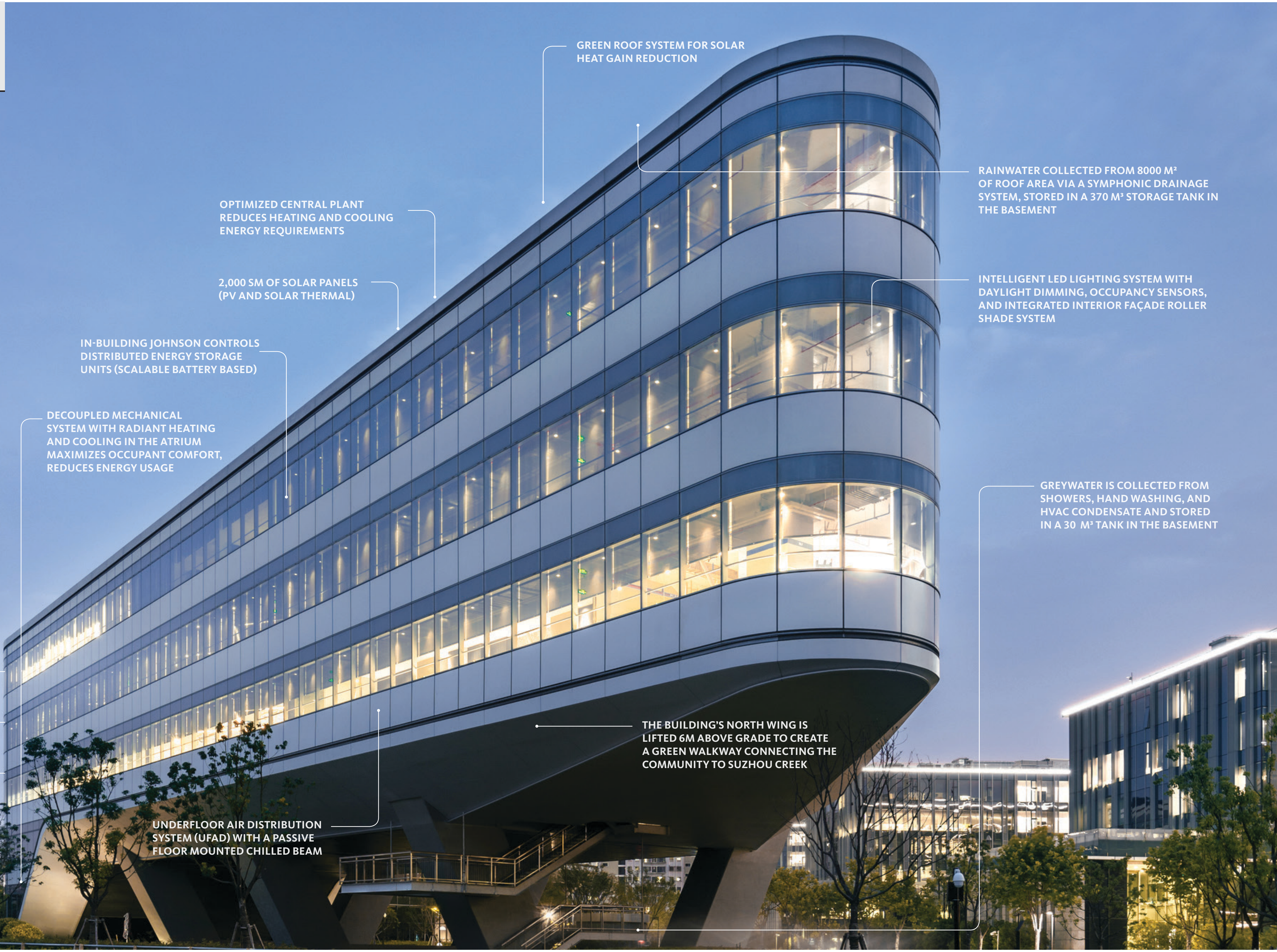
IFC EDGE Certification

Smart building management system generates significant energy, water savings.

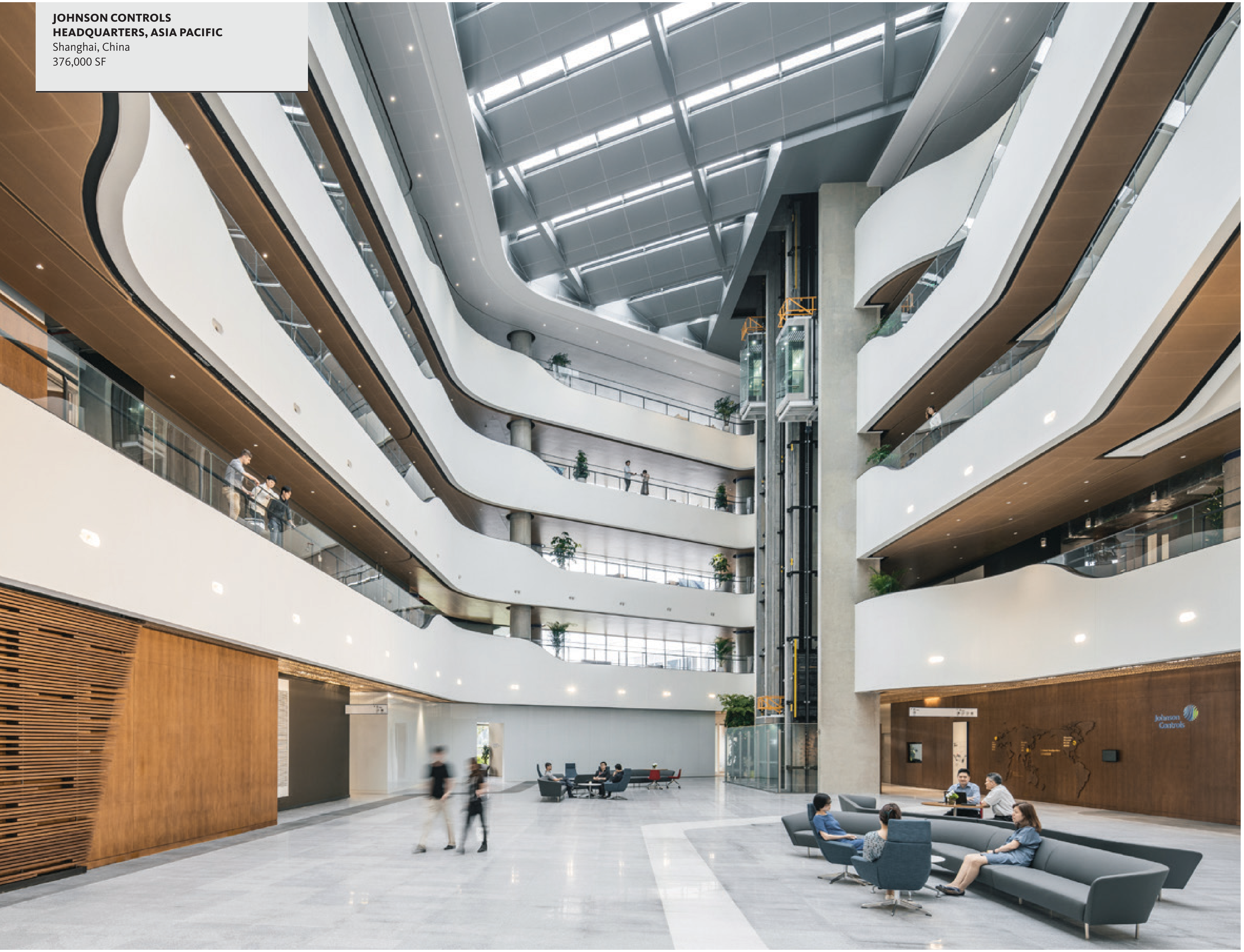
Johnson Controls' new triple-certified Asia headquarters employs a full range of smart building solutions including a Metasys® Building Automation System, a Central Plant, intelligent lighting, and other advanced technologies. The building is expected to generate 45 percent savings in overall energy consumption compared to the local market standard, reduce water usage by 42 percent via its greywater recycling and storm water recapture facilities, and reduce embodied energy in materials by 21 percent through the use of FSC (Forest Stewardship Council) certified wood-based building materials and the sourcing of locally supplied products. The headquarters is also equipped with hybrid and electric vehicle charging stations which enable employees to commute with a smaller carbon footprint.

42% reduced water usage

45% reduced energy consumption



JOHNSON CONTROLS HEADQUARTERS, ASIA PACIFIC
Shanghai, China
376,000 SF



DELOS
New York, NY
12,000 SF

CERTIFCATIONS
WELL New Interiors Silver Certified

Technology-rich environment tracks sustainability and well-being in real-time.

Delos, the creator of the WELL Building Standard focusing exclusively on human health and wellness, engaged Gensler to design its headquarters and a branded digital experience that illustrates its mission to employees and clients. The installations are expressed in real-time visual renderings as they educate and interact with guests and employees. Sensors in the space provide real-time data related to wellness. The goal is to make the space more efficient and more appealing for the people who inhabit it.

"Whether pursuing Net Zero or Zero Carbon, the ultimate goal is the same: create buildings with the smallest environmental impact."

Anthony Brower, AIA, LEED AP, Senior Associate, Gensler

OUR PERFORMANCE

In today's economy and climate, things seem to be moving and changing faster than ever—as a firm and an industry, we need to move just as quickly. Ambitious targets set by the Architecture 2030 challenge and 2015 Paris Agreement are on the horizon, with the first goal of an 80 percent reduction in building energy use by 2020 only two years away. And while we have made significant strides in recent years, there's still work to be done.

The first step to creating a better future is developing a deeper understanding of the past. In this section, we highlight a detailed analysis of our from 2017 design portfolio to understand the impact our work is having on the environment and world, and how we are tracking as a firm against the industry's broader goals for improvement.

PERFORMANCE OF OUR 2017 PORTFOLIO

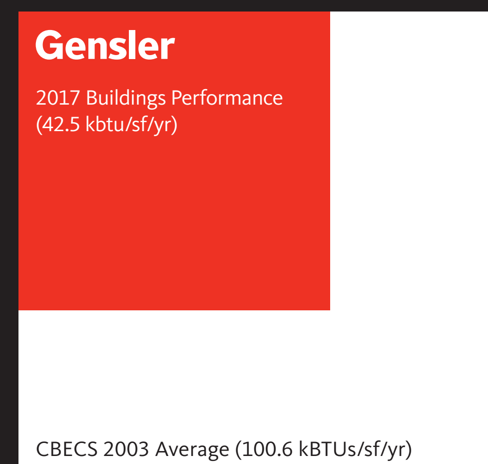
As part of our commitment to the Architecture 2030 challenge, we are focused on measuring and reporting the performance of our portfolio on a yearly basis to understand our progress toward a goal of designing only carbon neutral buildings by 2030. In 2017 alone Gensler professionals worked on nearly 7,000 different projects representing well over a billion square feet of space, ranging from new commercial office buildings and workplace interiors to schools, retail stores, data centers, and hotels.

To remain consistent with the standards established by this industry-wide research initiative, we measure the aggregate sustainable impact of our 2017 design work against the US Energy Information Agency's 2003 Commercial Buildings Energy Consumption Survey (CBECS 2003) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE 90.1-2007). It's the stated goal of the Architecture 2030 challenge to reduce average building EUI by 80 percent by 2020 via a mix of energy efficiency and renewable energy strategies, and to reduce average LPD by 25 percent on a similar timeline. For every project we design, we gather a predicted Energy Use Intensity (EUI) or predicted Lighting Power Density (LPD) metrics in order to track performance.

Analysis of our 2017 portfolio shows we are well on our way to these benchmarks as a firm—but there's still work to do. Our 800+ million square feet of buildings work has an averaged predicted EUI (pEUI) of 42.5 kBTUs/sf/year, a 58 percent improvement over our calculated CBECS 2003 equivalent of 100.6 kBTUs/sf/year. Our 400+ million square feet of interiors work has an average predicted LPD of 0.81 watts/sf, a 29 percent improvement over our calculated ASHRAE 90.1 2007 equivalent of 1.1 watts/sf. Taken together, our 2017 work is set to eliminate 11 million metric tons of CO_2 from being emitted into the atmosphere compared to average building performance—the equivalent of taking 2.7 coal-fired power plants offline for an entire year, or the power needed for 1.2 million homes for a year.

Our 2017 portfolio is designed to save 11 million metric tons of CO2 from being emitted each year.

Buildings performance (EUI)



58% better

than average buildings of the same type

Interiors performance (LPD)

29% better

than average interiors of the same type

EUI EXPLAINED

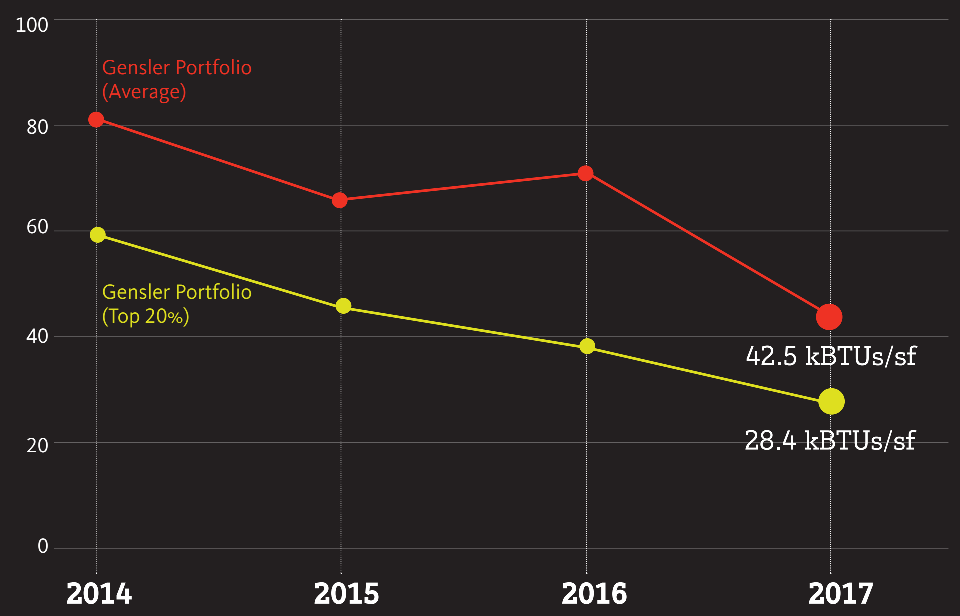
EUI is a measure of energy use. Typically, and as used in this publication, EUI represents an estimated number based on a building's design and energy model. It is measured in kBTUs per square foot per year.

LPD EXPLAINED

LPD is a calculation of the installed lighting power of an interior environment, and is measured in watts per square foot. An LPD score is generated through adding all of the lighting in a floorplan and dividing the total wattage generated by these lights by the floorplan's total square footage.

Our 2017 building projects are designed to keep over 10 million metric tons of CO2 from being emitted yearly.

The predicted Energy Use Intensity (EUI) average for our 2017 portfolio represents a 58 percent improvement over our calculated CBECS 2003 equivalent. At scale, the energy improvements compared to baseline represent a savings of approximately 14 billion kilowatt-hours of energy per year, or a reduction of CO2 emissions of approximately 10.5 million metric tons per year.



42%
EUI improvement from 2016 to 2017

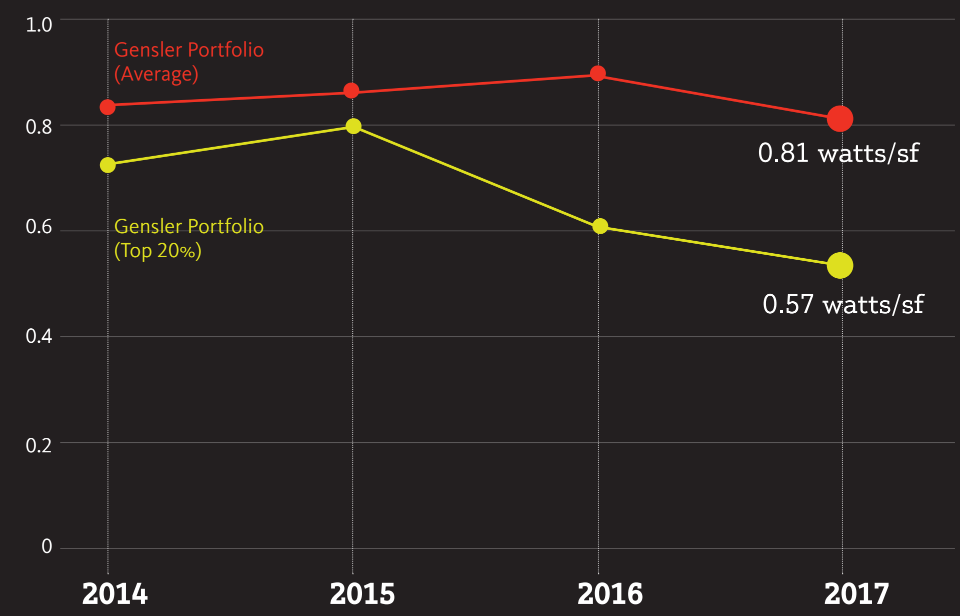
2 million
additional metric tons of CO2 could be offset each year if all our projects performed as well as our top 20 percent

Buildings performance (EUI)

Gensler's average predicted EUI from 2014-2017 as compared to average (CBECS 2003 equivalent) and the performance of the top 20 percent of our portfolio from each year.

Our 2017 interiors projects are designed to save 400+ million kilowatt-hours of electricity every year.

The predicted Lighting Power Density (LPD) average for our 2017 portfolio represents a 29 percent improvement over our calculated ASHRAE 90.1 2007 equivalent. At scale, the energy improvements compared to baseline represent a savings of approximately 434 million kilowatt-hours of energy per year, or a reduction of CO2 emissions of approximately 323,000 metric tons per year.



6%
LPD improvement from 2016 to 2017

400,000+
additional kilowatt hours of electricity could be saved each year if all our projects performed as well as our top 20 percent

Interiors performance (LPD)

Gensler's average predicted LPD from 2014-2017 as compared to average (ASHRAE 2007 equivalent) and the performance of the top 20 percent of our portfolio from each year.

“Truly intelligent buildings learn and adapt in real time—constantly optimizing not only energy performance but also the occupant experience.”

Richard Tyson, Connected Places Strategy Director, Gensler Research Institute

METHODOLOGY

1. Glossary of Terms

EUI (Energy Use Intensity): a measure of annual building energy use, expressed in kBtu/sf/yr.

PEUI (Predicted Energy Use Intensity): a measure of predicted building energy use, expressed in kBtu/sf/yr.

CBECS (Commercial Buildings Energy Consumption Survey): a national survey of various types, sizes, and occupancies of buildings in all regions of the US. This data is then normalized and cleaned to give an accurate estimate of commercial building energy use in the US. This is a measure of actual energy use and includes regulated (building system) loads and non-regulated (computers, coffee makers, portable equipment) loads.

National Baseline EUI: a constructed EUI for a particular project type and occupancy based on the CBECS data.

LPD (Lighting Power Density): a measure of the installed Watts due to lighting systems in a building, expressed in Watts/sf.

ASHRAE 90.1 2007: (Energy Standard for Buildings Except Low-Rise Residential Buildings) is an international standard that provides minimum requirements for energy efficient designs for buildings except for low-rise residential buildings.

PLPD (Predicted Lighting Power Density): a measure of predicted building energy use, expressed in kBtu/sf/yr.

PS: project size in square feet.

2. Portfolio size calculation methodology:

66% of Gensler's 2017 portfolio had reported square footage data. Therefore, 34% of the portfolio was estimated:

Missing project square footage was set to median value of the project's assigned Gensler Project Type

If median value of Gensler Project Type data was not available (77 projects), square footage was set to the median value of the assigned Practice Area's Project Category; for example, the square footage of a "Academic Campus, Library" was set to the median value of the Education Practice Area's Non-Residential Project Portfolio (57,000 SF)

Both the reported and estimated square feet totals were added to obtain the total portfolio size.

3. Portfolio performance analysis methodology

Analysis was conducted only on projects that had reported estimates of predicted performance for new buildings (PEUI) and buildings interiors (PLPD). Therefore, the data for projects with reported PEUI and PLPD was separated from all other data for all subsequent analysis. Gensler reported both PEUI and PLPD data for 300 projects in 2017.

Data clean up

The projects with PEUI and PLPD were separated from other projects.

Projects with a National Baseline EUI of over 1000 kBtu/sf/yr were excluded from analysis on new buildings.

Data Analysis

National Baseline (CBECS for new buildings, ASHRAE 90.1 2007 for buildings interiors), local code baseline (for both new buildings and building interiors) and the PEUI and PLPD were multiplied by the PS in square feet. Estimated PS was used in case of missing data.

Average national baseline on new buildings and buildings interiors were calculated for the whole portfolio using the following formulae:

(∑(National Baseline EUI * PS))/ ∑PS.

(∑(ASHRAE National Baseline 90.1 2007 * PS))/ ∑PS.

Average predicted portfolio performance on new buildings and buildings interiors were calculated for the whole portfolio using the following formulae:

(∑(PEUI * PS))/ ∑PS.

(∑(PLPD * PS))/ ∑PS.

Average portfolio percentage improvement over national baseline was calculated using the following formula for new buildings and buildings interiors.

New buildings: (¯X(National Baseline EUI*PS))-(¯X(PEUI*PS))/ (¯X(PEUI*PS))

Where:

National Baseline EUI – adjusted national baseline EUI expressed in kBtu/sf/yr

PS – project size expressed in sf

PEUI – predicted project EUI expressed in kBtu/sf/yr

Buildings Interiors: (¯(X)(ASHRAE 90.1 2007*PS))-(¯X(PLPD*PS))/ (¯X(PLPD*PS))

Where:

ASHRAE 90.1 2007- national baseline expressed as Watts/sf

PS – project size expressed in sf

PLPD – predicted project LPD expressed in Watts/sf

4. Methodology for energy saved and carbon emission reduction

New Buildings Analysis (EUI):

Metrics used in the analysis of energy saved and carbon reduction for new buildings:

New buildings portfolio size in square feet for 2017

The average National Baseline EUI for 2017

The average PEUI, building performance for 2017

Calculation of energy saved and conversion of EUI to kilowatt-hours:

The metrics were converted to energy saved in kilowatt-hours per year using the following formula by project type:

(∑((PS x National Baseline EUI) – (PS x PEUI)) x 0.293.

Note: 1 kBtu = .29307 kWh.

Building's Interiors Analysis (LPD):

Metrics used in the analysis of energy saved and carbon reduction for buildings interiors:

Buildings interiors portfolio size in square feet for 2017

The ASHRAE 90.1 2007 National Baseline LPD for 2017

The predicted LPD, building performance for 2017

Calculation of energy saved and conversion of LPD to kilowatt-hours:

Calculation of energy saved and conversion of LPD, to kilowatt-hours: The metrics were converted to energy saved in kilowatt-hours per year: using the following formula: (∑((PS x ASHRAE 90.1-2007 National Baseline LPD) – (PS x PLPD)))/1000

Actual energy consumption of the building was calculated by the following formula (PS*PLPD*3120) employing the same unit conversion to kilowatt-hours.

Carbon emission reduction calculation process:

All equivalencies were calculated through entering energy reduction stats into the U.S. EPA Greenhouse Gas Equivalencies Calculator (https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator)

ABOUT GENSLER

As architects, designers, planners, and consultants, we partner with our clients on some 3,000 projects every year. These projects can be as small as a wine label or as large as a new urban district. With more than 5,000 professionals networked across 48 locations, we serve our clients as trusted advisors, combining localized expertise with global perspective wherever new opportunities arise. Our work reflects an enduring commitment to sustainability and the belief that design is one of the most powerful strategic tools for securing lasting competitive advantage.

The Gensler Research Institute supports research investigations important to our firm, our clients, and to the ongoing learning and development of Gensler professionals. Research projects are practitioner-led with involvement across the globe. Our teams bring thought leadership to the table as we seek to solve our clients' and the world's most pressing challenges by creating high-performance solutions that embrace the business and world context in which we work, enhance the human experience, and deliver game-changing innovation.

LOCATIONS

Abu Dhabi	Dallas	Minneapolis	San Jose
Atlanta	Denver	Munich	San José, CR
Austin	Detroit	Morristown, NJ	San Antonio
Baltimore	Dubai	New York	São Paulo
Bangalore	Hong Kong	Newport Beach	Seattle
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