

Greening Buildings for Healthier People

Optimizing Climate Mitigation, Resilience,
and Health Co-Benefits in Real Estate

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About This Report

Greening Buildings for Healthier People identifies building-scale opportunities to simultaneously and cost-effectively accelerate action on climate change and health, maximize their co-benefits, and manage any tensions between them. This report

- Explicitly makes the links between climate change and health strategies for a real estate audience;
- Compiles opportunities for health-promoting investments in climate mitigation and resilience in one accessible document; and
- Demonstrates the case for taking an integrated approach to health and climate strategies, including the many benefits for tenants, communities, and real estate.

Opportunities for health and sustainability exist throughout the development life cycle and include both tactical design choices and strategic real estate decisions. By acting efficiently and holistically, real estate professionals can overcome barriers to implementing climate mitigation, resilience, and health measures at the same time, so that tenants and communities, the industry, and the planet can thrive well into the future.

Key Takeaways

Building-scale strategies can enhance health while contributing to climate mitigation and resilience, maximizing the impact of a single investment.

1. **These strategies have many benefits for tenants, communities, and real estate.**

This report demonstrates the business case for real estate and describes how even one building can have an outsized impact for tenants and communities.

2. **Sustainability and health goals are often compatible.**

Although tension can exist between these goals in some instances, this report demonstrates the many ways in which climate and health do not have to compete and can even complement each other.

3. **Combining strategies can accelerate progress toward multiple goals at the same time.**

The COVID-19 pandemic resulted in a quick mobilization to improve indoor air quality and other health measures in buildings. Using this momentum to simultaneously work on health and climate solutions can help accelerate progress on both fronts.

4. **Flexibility is essential.**

Whether designing spaces that accommodate different ideal temperatures, ventilating office zones based on occupancy, or creating community rooms that can also serve as resilience hubs, flexibility is key to developing and managing buildings that can accomplish multiple goals at once.

5. **Equity must be at the core.**

The public health benefits of mitigating climate change affect everyone, but they have a disproportionate benefit for populations that are made vulnerable to climate impacts through their location, income, or existing health conditions. Equitable development practices can help ensure that new buildings extend their health and climate benefits to the whole community.

Introduction

In the years before the COVID-19 pandemic, many leading real estate companies were recognizing the value of health-promoting features in their buildings. Whether seeking certifications, providing high-quality amenities, or aiming to gain a competitive edge, early adopters of health and wellness strategies found themselves well positioned to adapt to 2020's urgent focus on respiratory disease.



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Owners that had previously upgraded their ventilation systems could more easily make the transition to higher-efficiency air filters. Previously “nice-to-have” outdoor spaces, such as courtyards, were now marketed to potential tenants as a sought-after feature. Building managers who were monitoring indoor air quality had the technology and data to continue ensuring a safe environment as offices began to reopen. Although these companies had not been expecting a health emergency, their early investments enabled them to adapt to new challenges quickly and to be more responsive to changing tenant needs.

COVID-19 is not the last crisis real estate will face. Developers, owners, and operators will have to confront climate impacts, the rise of chronic disease, and the long-term effects

of the pandemic, including its mental health impacts and an enhanced focus on wellness. Buildings, which are responsible for 40 percent of carbon dioxide emissions worldwide, will not only need to adapt to climate change but also play a critical role in mitigating the worst of its effects. (See the feature [“Why Focus on Buildings?”](#) to learn more.)

At the same time, the demand for climate-ready and healthy buildings will keep growing. Because buildings developed today will last for decades—the average life span of a commercial building is 60 years—integrating health and climate considerations can help ensure buildings’ ongoing relevance and usability as the real estate market and regulatory landscape continue to evolve.

More and more, real estate sustainability directors view health and the environment not only as important priorities but also as two sides of the same coin, recognizing that green buildings are often healthier. In fact, a 2017 [study](#) in *Building and Environment* compared health outcomes in high-performing buildings with and without green certifications. Workers in the certified buildings had 30 percent fewer sick building symptoms than those in noncertified buildings, which the study authors believe may be partially explained by the actions taken to achieve indoor environmental quality credits included in green building rating systems.

In addition, during the pandemic, many sustainability directors were tasked with their companies' COVID-19 responses, making their organizational structures further reflect a holistic view of health and sustainability.

Furthermore, the benefits of integrated strategies for climate mitigation, resilience, and health are widespread, extending to individuals, communities, and the real estate industry itself. By recognizing how impactful building electrification can be for air quality, how healthy building materials can also reduce embodied carbon, or any other “win-win,” developers, owners, and property managers can not only improve their building performance now but also foster more resilient places well into the future.¹

¹Throughout this report, *resilience* refers to physical climate resilience—making buildings more resilient to the physical risks climate change brings, such as extreme weather.

Real estate professionals can make strategic investments that address climate change and health together, and tackling one often has co-benefits for the other. This report identifies opportunities to simultaneously and cost-effectively accelerate action on both, optimize their co-benefits, and manage any tensions between them. By acting efficiently, real estate professionals can overcome barriers to implementing health and climate measures together—putting healthier, more sustainable, and more resilient buildings within reach.

“With more people now thinking about how buildings impact their health, industry leaders must leverage this opportunity to introduce additional health-promoting strategies like access to daylight and active design, and encourage consideration of other relevant health issues like climate change and equity. It’s on us as professionals to ensure a holistic conversation that doesn’t stay myopically focused on COVID-19.”

—Kelly Worden, Director, Health Research, U.S. Green Building Council²

²All quotes come from research interviews conducted for this report.



(tostphoto/Shutterstock)

Report Overview

This report showcases strategies that address climate mitigation, resilience, and health for real estate practitioners, and the benefits of taking an integrated approach to these issues. The audience includes developers, owners, and operators, but tenants can also use this report to learn about these strategies and advocate for them in their buildings, and architects can make the case for healthy green buildings to their building owner and developer clients. This report

- Explicitly makes the links between climate change and health strategies for a real estate audience;
- Compiles opportunities for health-promoting investments in climate mitigation and resilience in one accessible report; and
- Demonstrates the case for integrating health and climate strategies, including the many benefits for tenants, communities, and real estate.

Whether creating a sustainability plan for an entire portfolio or trying to get the most out of a building upgrade, real estate professionals can take a more integrated approach to energy efficiency measures, health-related improvements, and increasing resilience to extreme weather events. The strategies highlighted in this report are used in building certification systems like WELL, Fitwel, LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment's Environmental Assessment Method), RELi, and other sources known for their evidence-driven recommendations. Many of the strategies in this report align with the World Green Building Council's [Health and Wellbeing Framework](#).

When considering options, operators should prioritize evidence-based strategies for sustainability and health. During the pandemic, some companies installed experimental technology to make tenants feel more comfortable returning, but a sense of urgency should not outweigh the need for proven technologies.

Although the report focuses on synergies between strategies tackling climate change and health, it also notes instances of tension. For example, increasing the percentage of outdoor air may improve air quality, but it also requires more fan power and may increase energy consumption. However, it is often possible to manage these tensions in ways that optimize their co-benefits.

Designed to be a high-level overview, this report is not a comprehensive overview of climate change and health in real estate. Instead, it focuses on identifying building-scale strategies that address both health and climate mitigation or resilience (excluding certain common green building features, such as waste management, that are less relevant to building emissions). Where possible, each section directs the reader to more technical resources on implementation, benchmarking, and financing through links in the text and additional resources.

Finally, this report categorizes the opportunities to maximize the co-benefits of health and climate action—which exist across multifamily, office, and mixed-use developments—into tactical design choices and strategic real estate decisions. Within those, each opportunity discusses specific strategies for climate mitigation and resilience, and their impacts on health. For example, implementing active design measures like prominent staircases is a concrete strategy within the larger opportunity of new building and site design.

In total, this report describes eight building-scale opportunities that include a total of 48 specific strategies. (See the table [“Summary of Report Opportunities and Strategies for Climate and Health”](#) for a selection of these strategies.)

For more on how building strategies to reduce COVID-19 transmission intersect with climate change and advance health equity, read [“‘Co-Benefits’ as a Lens through Which COVID-19 Building Upgrades Can Advance Environmental Sustainability, Climate Mitigation and Adaptation, and Social Equity.”](#) This article provides an overview of strategies that address climate mitigation; extreme heat; air quality, droughts, and wildfire; storms and flooding; and vector-borne disease.

Summary of Report Opportunities and Strategies for Climate and Health

Category	Opportunity	Selected strategies for climate mitigation and health	Selected strategies for climate resilience and health
Tactical design choices	Site selection	<ul style="list-style-type: none"> • Transit-oriented development • Infill development 	<ul style="list-style-type: none"> • Evaluating the suitability of the site for development
	New building and site design	<ul style="list-style-type: none"> • Active design (e.g., prominent staircases) • Daylighting 	<ul style="list-style-type: none"> • Green stormwater infrastructure • Resilience hubs
	Electrification and decarbonization	<ul style="list-style-type: none"> • All-electric systems • Upgrading appliances to electric versions 	<ul style="list-style-type: none"> • On-site solar (also has significant benefits for climate mitigation)
	Energy efficiency	<ul style="list-style-type: none"> • Passive design 	<ul style="list-style-type: none"> • Cool and green roofs • Weatherization for passive survivability
	Building materials	<ul style="list-style-type: none"> • Using healthy and less carbon-intensive materials, and/or using fewer materials where possible 	<ul style="list-style-type: none"> • Using materials that can better withstand natural disasters, are nonflammable, and are mold-resistant
Strategic real estate decisions	Acquisition and disposition	<ul style="list-style-type: none"> • Integrating sustainability and health factors into due diligence and property condition assessments 	<ul style="list-style-type: none"> • Capture and communicate to buyers the value of resilience and its health co-benefits
	Leasing	<ul style="list-style-type: none"> • Green leases that include health considerations 	<ul style="list-style-type: none"> • Socially responsible practices
	Property management, operations, and tenant improvements	<ul style="list-style-type: none"> • Tenant engagement and communication • Optimized operations setpoints for tenant comfort 	<ul style="list-style-type: none"> • Promoting social cohesion through programming

History of Healthy Buildings

Although the evidence base for buildings' health and financial benefits is continuing to grow, these ideas are not new. In the late 19th century and early 20th century, architects aimed to create buildings that improved health outcomes. At the time, infectious disease was especially deadly without effective medications or vaccines: the flu pandemic of 1918 killed tens of millions of people, cholera epidemics routinely affected cities, and tuberculosis was one of the main causes of death.



(Jamesteohart/Shutterstock)

In response, the sanatorium movement in Europe and the United States used enhanced hygiene, exposure to sunlight (which helped kill tuberculosis bacteria), and fresh air to treat tuberculosis patients. In architecture, these practices led to an emphasis on hygiene-promoting surfaces, including bare white walls, floors without carpeting, and metal fixtures; minimalist design that removed dust-collecting fabric like drapes; large windows to let in sunlight and air; and generous balconies and outdoor courtyards.

However, these design strategies did not translate into better living or working conditions for everyone. The healthy building movement recognizes the need to ensure all people have equitable access to the core ingredients of a healthy life, including stable and healthy housing.

Over time, the focus of healthy buildings has expanded from preventing infectious disease to mitigating chemical exposures to life safety protections (e.g., sprinkler systems and egress stairs) to understanding the many ways in which buildings can influence chronic conditions. The U.S. Environmental Protection Agency (EPA) now officially defines “sick building syndrome” as situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified. This is distinct from “building-related illness,” which is used when symptoms of diagnosable illness are identified and can be attributed directly to airborne building contaminants.

In recent years, there has been a shift toward understanding and maximizing the potential for buildings to actively promote health and well-being. Yet according to the 2020 ULI report [Health and Social Equity in Real Estate: State of the Market](#), only 29 percent of survey respondents (all real estate professionals) were regular adopters of health-promoting practices, with cost being the most commonly cited barrier.

A 2021 [survey](#) of leading real estate investors, conducted by BentallGreenOak, found that 92 percent of respondents expect demand for healthy buildings to grow in the next three years. COVID-19 has increased the impetus to use buildings as a key strategy for reducing viral transmission once again, but recognizing the full extent of buildings’ impact on physical and mental health remains necessary.

Why Focus on Buildings?

This report focuses on buildings because of the cross-cutting opportunities to contribute to climate mitigation, resilience, and health that they provide, as outlined below.

Although the report focuses on new buildings, many of the strategies discussed can also be applied to existing buildings. Additional information on retrofits can be found in the section on property management, operations, and tenant improvements.

Climate Mitigation

- Buildings generate [nearly 40 percent](#) of global carbon emissions. Building materials and construction contribute 11 percent of global carbon emissions annually.
- Buildings in the United States use about [40 percent of the country's energy](#) for lighting, heating, cooling, and appliance operation. Just three materials—concrete, steel, and aluminum—are responsible for [23 percent](#) of total global emissions (most of this used in the built environment).
- About [59 percent](#) of buildings in the United States were built [before the onset of energy codes](#).

Climate Resilience

- [More than half](#) of U.S. buildings are in disaster hotspots, and about 1.5 million buildings are in hotspots for at least two environmental hazards. Between 2005 and 2018, sea-level rise flooding [cost \\$14.1 billion](#) in home values across eight states' coastal areas. Further, the wildlife-urban interface—the area where the built environment meets the natural environment where wildfire risk is heightened—represents about [\\$1.3 trillion](#) of property value in the United States.
- In a [global assessment](#) of real estate's exposure to physical risks, Four Twenty Seven (now Moody's ESG) and GeoPhy found that, across more than 73,000 properties owned by 350 listed real estate investment trusts, 35 percent of properties had a high probability of experiencing medium- to high-impact events.

Health

- Americans spend, on average, [90 percent](#) of their time inside buildings.
- According to the Institute for Market Transformation, the net avoidable costs associated with indoor air pollution are more than \$100 billion annually, and an average of 10 percent of productivity loss in office buildings could be attributed to [health issues related to poor indoor air quality](#).
- A [study published in 2017](#) found that high-performing, green-certified buildings not only result in fewer health symptoms but also increased thermal comfort and 6.4 percent higher sleep quality scores that are associated with 26.4 percent higher cognitive scores (relative to high-performing buildings without green certifications).



(Roschetzky Photography/Shutterstock)

Tactical Design Choices

Decision points throughout the site planning, design, and construction phases provide opportunities to use climate mitigation and resilience strategies while promoting health. Each of the following sections highlights these strategies and suggests resources for further reading.

Site Selection

The location of a new project not only exposes or shields the development from climate risks but also affects the extent to which building users are able to reduce emissions. For example, transit-oriented development creates an enabling environment for building users to drive less and therefore lower their carbon footprint.

Selected Strategies for Climate Mitigation and Health

- Developers can promote and implement **transit-oriented development** and encourage **multimodal transportation**. Transit-oriented developers promote climate mitigation by encouraging fewer vehicle miles traveled and more walking, biking, and use of public transit. Whether a multifamily, office, or other development, choosing sites near transit and providing amenities like bike sharing and locker rooms not only promotes alternative modes but also can come with density bonuses and other city incentives for developers. Transit-oriented development also has health benefits for tenants and the community by improving air quality (through reduced car exhaust) and encouraging physical activity. Mobility amenities and accessibility also tie into climate resilience, giving people more transportation options during a disaster when roads are blocked.



(Uyanik/Shutterstock)

- Developers can also promote **infill development**. Infill development can enhance density, walkability, and access to transit. It helps prevent urban sprawl and encourages denser, more walkable communities, which reduce the carbon-intensive need to drive. Although infill development has the potential to reduce outdoor green space and contribute to the urban heat island effect, there are many ways to mitigate these issues, such as by using cool roofs.



(Roschetzky Photography/Shutterstock)

Selected Strategies for Resilience and Health

- As climate change increasingly causes flooding, wildfire, and other disasters, developers should **evaluate the suitability** of the development for the surrounding context. Ensuring that the site is suitable for development for the service life of the building protects health and safety and lowers the chances of needing to do expensive relocations and rebuilding. The ULI reports [Climate Risk and Real Estate Investment Decision-Making](#) and [Climate Risk and Real Estate: Emerging Practices for Market Assessment](#) discuss how real estate investors are approaching these risks and vulnerabilities at the asset and market scales.
- Properties should **avoid locating near polluting sites**. In case of a disaster, the property would be vulnerable to increased exposure to the pollution, posing health and resilience challenges.
- In areas at risk of wildfires, **implementing a defensible space** around the development can reduce the ability of a fire to reach the building.

ADDITIONAL RESOURCES

- [Ten Principles for Building Resilience](#) (ULI)
- [Firebreak: Wildfire Resilience Strategies for Real Estate](#) (ULI)
- [Wildfire Risk to Communities](#) (USDA Forest Service)
- [Climate Risk and Real Estate Investment Decision-Making](#) (ULI)
- [Climate Risk and Real Estate: Emerging Practices for Market Assessment](#) (ULI)

New Building and Site Design

Spaces and amenities designed for climate mitigation and resilience can simultaneously promote health by encouraging physical activity, community building, and mental well-being. Many of these design strategies also improve energy efficiency (see the [“Energy Efficiency”](#) section for additional, nondesign strategies).

Selected Strategies for Climate Mitigation and Health

- **Passive design** includes strategic building orientation, shape, massing, and more as outlined in the table [“Overview of Mitigation and Adaptation Strategies: Buildings and Sites”](#) on the next page. These strategies not only reduce a building’s carbon footprint but also enhance the following: natural light (and LED lighting as necessary), which affects mental health and productivity; ventilation, which can help minimize the spread of air-borne disease; and south-facing skylights, operable and high-performance windows, and fans to deliver increased thermal comfort. (See the feature [“Certifications, Crosswalks, and Tools”](#) to learn more about Passive House certification.)
- The [World Green Building Council](#) recommends incorporating the following strategies:
 - **Passive heating and cooling (thermal massing).** Construct buildings using materials with a higher thermal mass, which take longer to change ambient temperature conditions. These materials act as a natural heat store during the day and a slow release at night, giving tenants a high level of thermal comfort without excessive heating and cooling.
 - **Air tightness and ventilation.** An airtight envelope helps manage the building’s air exchanges with the outdoor environment, leading to better control of the indoor temperature and humidity. However, natural and mechanical ventilation are still necessary to avoid stagnant air.
 - **Building shape, its orientation, number and size of windows, and reflective surfaces.** Various aspects of the building envelope can help control how much heat from the sun (solar gain) affects the building. It also enables tenants to have views and sufficient daylight, which impacts mood and circadian rhythms.
 - **Insulation.** Insulating the building envelope and using thermally efficient glazing reduces heat loss in winter and conduction heat gains in summer.

ULI Resource

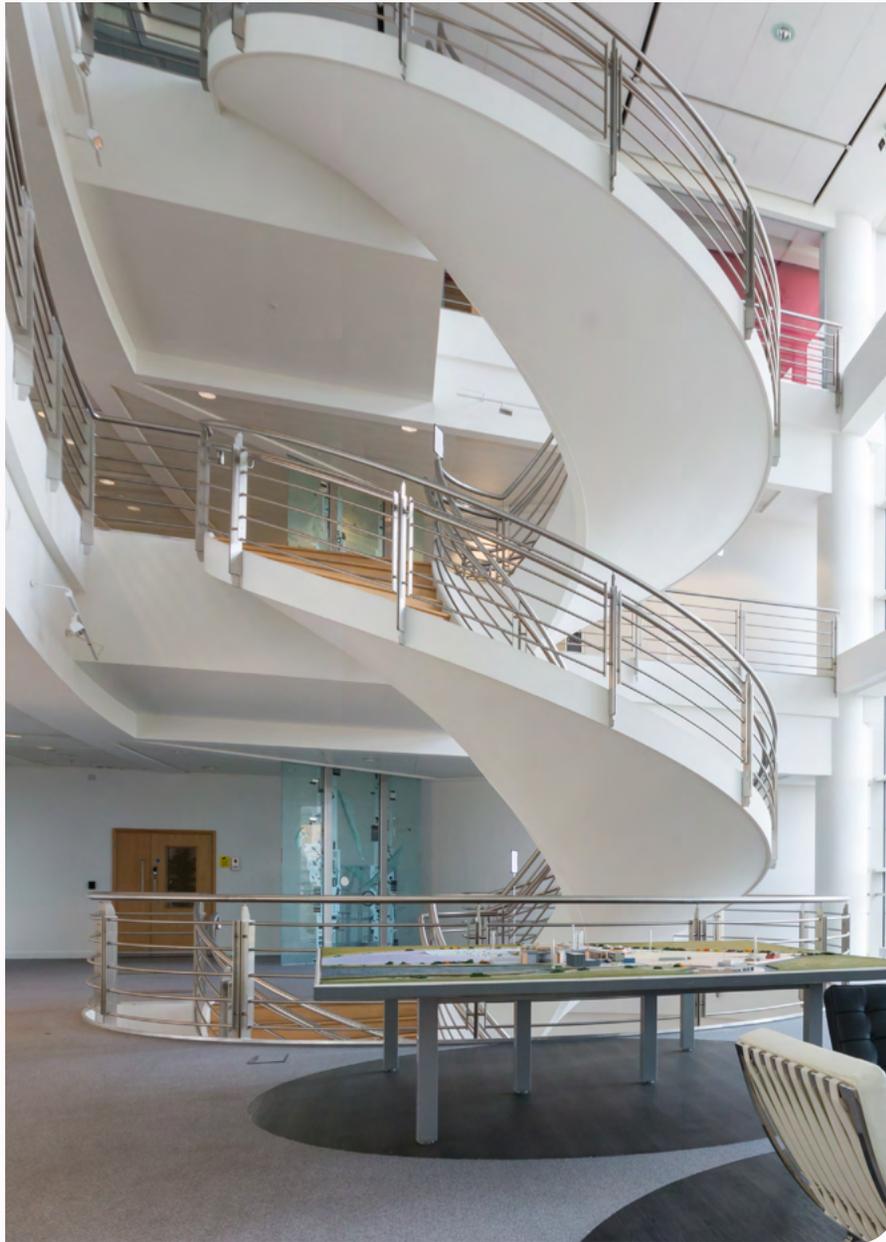
Overview of Mitigation and Adaption Strategies: Buildings and Sites

These passive design strategies contribute to both climate change mitigation and health promotion. For more information, see the 2019 ULI report [Scorched: Extreme Heat and Real Estate](#).

STRATEGY	DESCRIPTION
BUILDING DESIGN	
Orientation	The strategic orientation of a building, doors, and windows helps minimize solar heat gain and optimize ventilation. Typically, buildings are oriented north–south to reduce sun exposure, and windows are oriented toward the prevailing winds to maximize cross breezes. ³³
Shape	A building's shape can provide shade—and thus cooling—to other parts of the structure and to surrounding pedestrian environments. A courtyard design with buildings oriented around a small central plaza is a typical hot-climate strategy that minimizes outside heat gain by creating an internal shaded area.
Massing	Heavy, dense materials with high thermal mass (the ability of a material to store and release heat) can keep a building cool and modulate temperature swings. Materials such as concrete, tiles, brick, and stone absorb daytime heat and release it slowly at night if and when the temperature drops. ³⁴
BUILDING MATERIALS AND ENGINEERING	
Building envelopes	Building envelopes, the physical barrier between the internal and external environments providing structural support, moisture management, air flow, and temperature regulation, are one of the most important and challenging aspects of heat mitigation through building design. ³⁵ High-quality insulation and certain materials can prevent solar heat gain into and encourage the efficient heat dissipation out of buildings. ³⁶ Windows, if they are operable, glazed, or shaded, are a key component; windows leverage natural airflow to increase human comfort and decrease HVAC load.
Shading structures	A variety of impactful, often cost-effective structures, either permanent or temporary, can be installed on a building or as part of landscape design. Examples include awnings or umbrellas over windows or streets and structures covered with shading vegetation.
Waste heat reduction	Waste heat management is generally accomplished by reducing building cooling load (i.e., the waste heat generated by electrical equipment, lights, and people) and creating alternative outlets for rejecting heat rather than venting it directly on the street. Electric and ground-source heat pumps or heat recovery chillers can be used to move waste heat from a location where it is not wanted (such as an office space) to a location where it is needed (such as heating of domestic hot water) or stored for use during the winter months. Recycling heat in this way improves the efficiency of the cooling system and results in less heat rejection to the urban environment.
HVAC	Efficient HVAC systems safeguard human well-being by regulating indoor temperatures, keeping energy demand and costs low, and minimizing environmental impact. Industry standard equipment includes the Consortium for Energy Efficiency, Energy Star, and FEMP-designated certifications. Solar thermal water heaters are especially useful in extreme environments because they avoid the need for a boiler.
Lighting	Inefficient lighting adds to a building's heat load. Switching to LEDs and using strategies such as daylight dimming and occupancy-based lighting reduce the building's energy use and heating load.
Sensors and smart buildings	Sensors (temperature, occupancy, daylighting, motion, and carbon dioxide) enable automatic monitoring and adjustments, thus increasing energy efficiency.

(Urban Land Institute)

STRATEGY	DESCRIPTION
LIGHT-COLORED AND REFLECTIVE SURFACES	
Cool roofs	By reflecting more sunlight and absorbing less heat, cool roofs are typically 50° to 60°F cooler than standard roofs during peak summer heat and, on average, produce energy savings of 20 percent. ³⁷ Cool roofs are made of highly reflective paints, sheet coverings, or reflective shingles/tiles. Traditionally bright white, products can now meet demand for other colors without sacrificing cooling.
Cool walls	Cool walls use an exterior wall surface that stays cool by reflecting sunlight and emitting heat. They are not a widespread technology in the United States but have considerable potential because cool walls effectively cool building interiors and surrounding temperature.
Cool pavements	Cool pavements are light colored, reflective, or porous and work respectively via increased reflectance and/or heat-dissipating evaporation. There are many types, including light-colored and/or permeable coatings, aggregates, cement, and block pavement filled with materials such as soil, vegetation, or gravel. An emerging technology, life-cycle analysis of reflective paving has demonstrated energy, carbon, and cost concerns. ³⁸ Additionally, reflective pavement may reflect heat onto pedestrians and nearby buildings. Many ongoing reflective paving pilot projects and material development research initiatives exist. ³⁹
<p>We did over 100,000 energy building simulations across the U.S. and found that the energy savings from cool walls are generally equal to or greater than that of cool roofs.</p> <p>RONNEN LEVINSON, Director, Heat Research Group of Lawrence Berkeley National Laboratory</p>	
GREEN INFRASTRUCTURE	
Green roofs	A "green" or "living," "vegetated," or "eco" roof is one that is wholly or partially covered by vegetation planted over a waterproof membrane. There are three main categories: extensive, intensive (the most effective for heat mitigation), and semi-intensive. Green roofs are a high-impact temperature reduction strategy with multiple co-benefits and often local government incentives. However, their success depends on local conditions, and they may not be appropriate for arid locations due to water constraints.
Green walls	"Green" walls or "vertical landscaping" is composed of plants grown in vertical systems along interior or exterior walls. Green walls can be extensive ("green facades") or intensive ("living walls"). Green walls are an attractive amenity, reduce building energy use, and decrease building envelope surface temperatures as well as surrounding microclimate temperatures. Similar to other vegetative strategies, "the cooling effect of green walls is highly dependent on their orientation, plant density and water content." ⁴⁰
OPERATIONAL CHANGES	
Thermostat control	Strategically setting and/or adjusting thermostats maximizes energy efficiency and can contribute to reduced energy grid demand. Some New York City public offices, for example, decrease air conditioning use on high-demand days to lesson peak demand and schedule demonstration days without air conditioning.
Schedule modifications	Adjusting working or school hours to minimize people's exposure to heat (i.e., time outdoors in extreme conditions or in places without air conditioning) is a common strategy for the approximately 50 percent of U.S. classrooms without any or adequate air conditioning. ⁴¹



(John Sainsbury/Shutterstock)

- **Active design**, such as prominent staircases, encourages tenants to walk while reducing their energy-intensive elevator use. Similarly, providing bike storage, showers, and a locker room make biking to work more feasible for commuters.
- **Acoustic comfort** reduces stress and prolonged exposure to noise, which can lead to elevated blood pressure, cognitive impairment, mental health issues, and sleep disturbances. To control for reverberation noise, carpets and thick curtains can absorb sound. Insulation, in addition to supporting an energy efficient building envelope, can help in reducing exposure to outdoor noise.
- **Operable windows** enable building users to get fresh air and change the indoor temperature without energy-intensive air conditioning. However, this strategy can increase energy use when the building is set to maintain a different temperature (e.g., residents who open their windows in the cold winter because the radiators are too hot), or when it overlaps with existing ventilation systems. It is also not feasible when the outdoor air quality is unhealthy. (See the section on [energy efficiency](#) for related strategies and caveats.) Similarly, window screens and ceiling fans can help promote the use of windows for fresh air.

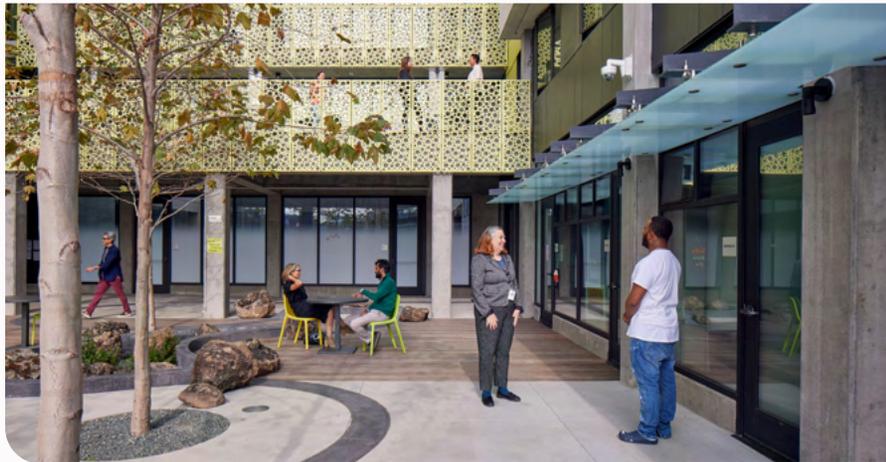


(Jason Finn/Shutterstock)

- **Daylighting** saves energy by reducing the need to excessively turn on lights, and it has been shown to promote mental health and well-being. Access to views can further enhance these benefits. Daylighting is also beneficial in [industrial](#) settings, where it contributes to employee sight and can enhance safety.
- **Window shades and other glare control strategies**, such as smart windows that auto-tint and smart blinds that adjust based on lighting sensors, can complement lighting strategies by ensuring that glare reduction measures do not increase the need for artificial lighting.

Selected Strategies for Resilience and Health

- Community spaces can serve as **resilience hubs** that are open to the surrounding neighborhood. Powered by an emergency generator (on the roof in case of flooding) or by on-site solar, the room can provide air conditioning, heating, a place to charge phones, and other necessary services during power outages. The spaces can also be stocked with water, provide refrigeration for medication, and connect people with health resources and social services. Outside of a disaster, these spaces continue to be important for health by building a sense of social cohesion for tenants.
- **Green stormwater infrastructure (GSI)** mitigates flooding, for both the building and the surrounding area. GSI should be designed to avoid having standing water, which can act as a breeding ground for mosquitoes and pose a risk of spreading vector-borne diseases.



The courtyard at Casa Adelante at 2060 Folsom helps address stormwater issues on the flood-prone site. (Bruce Damonte)

GSI and other greenery can also address extreme heat by lowering outdoor temperatures in the immediate area, providing shade opportunities, and reducing the need for excessive air conditioning in the building, which would then create more waste heat. Outdoor green spaces can also enhance the public realm, provide a place to recharge, and enable people to enjoy the mental health benefits of nature. When these spaces are publicly accessible, they can also contribute to a sense of social cohesion in the broader community, which helps to build social resilience. However, vegetation would not be appropriate in some circumstances, such as when creating defensible space for wildfires.



Outdoor green space at Mithun's affordable housing project Casa Adelante at 2060 Folsom in San Francisco. (Bruce Damonte)



The Green Cities Company's multifamily property Bower in Boston is LEED Gold certified and a 2021 Fitwel Best in Building Health award winner. (ESstock/Shutterstock)

- Access to nature also has health benefits inside buildings. When buildings use a **biophilic design**—such as having living walls, water features, and outdoor views—the plants can improve air quality and the natural elements can reduce stress and improve cognitive functioning. The ULI Greenprint Center for Building Performance's [State of Green: Greenprint Performance Report, Volume 12](#), highlights biophilic design strategies used in the Green Cities Company's multifamily property Bower, which is LEED Gold certified and a 2021 Fitwel Best in Building Health award winner:
 - Interior architecture, architectural finishes artwork, and furniture reference and/or mimic patterns found in nature.
 - An indoor atrium connects residents to the outdoors.
 - Live and healthy plants flourish indoors and out.
 - View Smart Windows control glare and thermal comfort while providing occupants a constant connection to the outdoors and natural light.
 - Spacious amenity rooms with tall ceilings provide a relief from indoor limitations.
 - Artwork and skylights offer opportunities to experience wonder.

- Hosting **bees** on site can enhance climate resilience by supporting local biodiversity. According to [The ULI Blueprint for Green Real Estate](#), “Biodiversity provides ecosystem services that are vital for the real estate industry, including stormwater management, microclimate regulation, air quality improvement, greenhouse gas sequestration, plant pollination, and recreation. In urban areas, biodiversity has decreased because of building on top of green space, population increases, and global warming.” This can also be part of a community garden, which improves access to healthy foods.
- Another strategy to mitigate flooding is to **reduce the impermeable spaces on site**, such as minimizing parking lots or designing them with permeable pavement. This can also help reduce stormwater runoff and opens up more space for bike storage or a community room. For when a flood does occur, resilience strategies include **elevating mechanical systems above the design flood elevation**; wet floodproofing the ground floor for uses such as parking and **moving up other uses**; and using construction techniques that **minimize potential sewer backup**.
- Some cities are increasingly experiencing chronic heat, posing a deadly threat even outside of heat waves. Regional strategies to mitigate the urban heat island effect are important, but city residents’ experiences of heat are more complex and variable than what is portrayed on a heat map alone. The strategic design of a building’s **thermal mass** can reduce heat for people on site, creating a cooler area. However, heat mitigation strategies do have tradeoffs and must balance regional and localized impacts. For example, Los Angeles’s cool pavement pilot

program used reflective pavements that successfully helped with the regional effect but actually raised temperatures for pedestrians on the pavement.

- Adaptive features should enable buildings to withstand future climate impacts. Redevelopment can be used as a chance to implement structural physical improvements that make the building healthier and more resilient in line with current projections of future risks.

ADDITIONAL RESOURCES

- [Scorched: Extreme Heat and Real Estate](#). (Urban Land Institute)
- [14 Patterns of Biophilic Design](#) (Terrapin)
- [“Biophilic Design: Bringing the Outside In”](#) (ULI)
- [Harvesting the Value of Water: Stormwater, Green Infrastructure, and Real Estate](#) (ULI)

Project Profiles

Enhancing Climate Resilience

Finch Cambridge, Massachusetts,
and Highpoint, Seattle

ULI's [Developing Urban Resilience](#) site features development projects that use resilient design to address climate shocks and stressors. The project profiles cover site-level responses to and preparation for extreme heat, wildfires, storm surges, heavy rain, earthquakes, and more.

Many of these projects have co-benefits for health and climate mitigation. For example, [Finch Cambridge](#), a 98-unit, mixed-income building in Cambridge, Massachusetts, has achieved Passive House certification through building design and energy efficiency measures—such as triple-glazed windows and shades on the southern face of the building—that provide a reliably comfortable environment for residents, even as winters remain cold and summers become hotter and more humid.

The owner, Homeowner's Rehab Inc., estimates that these measures will also enable residents to stay in their unit for several days during a heat wave if the power goes out. The owner also created a community space linked to a generator for air conditioning as an alternative place to shelter.



Finch Cambridge. (Jordan Guadalupe)



Finch Cambridge. (Jordan Guadalupe)

Project Profiles (continued)



High Point. (Juan-Hernandez)

Another mixed-income development, the 2007 ULI Global Award for Excellence winner [High Point](#) in Seattle, has 1,529 homes, of which 48 percent are affordable to low-income families to buy or rent. Aiming to innovatively manage stormwater, the development team (composed of the Seattle Housing Authority, Nakano Associates, Mithun, and SvR Design Company) created a natural drainage system that infiltrates 75 to 80 percent of stormwater runoff, whereas the site had previously been 65 percent impervious.

While designing a new street grid that included vegetated bioswales, porous sidewalks, and a recreational trail, the team also made the streets more pedestrian-friendly with traffic-calming measures. These features not only contributed to faster-than-anticipated sales and lease-up rates but also improved physical, mental, and environmental health for residents, as documented by several National Institutes of Health studies.

Learn more and see additional project profiles at ULI's [Developing Urban Resilience](#) site.

Electrification and Decarbonization

Decarbonization is key to tackling climate change. Electrification allows buildings to switch their power sources from fossil fuels to cleaner forms of energy, serving as a powerful enabler of decarbonization that comes with related health benefits.

Selected Strategies for Climate Mitigation and Health

- Installing or upgrading **appliances** to electric versions, such as switching a gas stove for an electric induction cooktop, has clear benefits for tenant health. Gas stoves can emit indoor nitrogen dioxide levels [exceeding](#) indoor air quality guidelines and carbon dioxide levels [exceeding](#) even outdoor ambient air standards. In multifamily buildings (particularly those without sufficient ventilation), this poses increased health risks to children, especially for childhood asthma, and to people with existing health conditions. In commercial assets, people working with gas stoves or in boiler rooms have an increased exposure to indoor air pollutants. Electric appliances directly result in better indoor air quality and health outcomes.
- **Heat pumps** and **all-electric systems** also have the potential to improve indoor air quality, among other benefits for tenants. High-performance electric HVAC systems enhance thermal comfort, enabling tenants to control their own settings, have a quieter airflow, and know that the air is more effectively filtered. However, electrification can also pose equity issues, such as raising utility costs for residents in multifamily buildings as electricity use increases—especially when owners have been paying the gas meter—and these considerations are important to address for the building’s affordability and tenant retention.
- **On-site electrical charging** for electric cars and micro mobility can help promote modes of transportation that are less polluting.



Rendering of a building with healthy and sustainable features. (Gensler)

Selected Strategies for Resilience and Health

- **Renewable energy** can aid buildings in decarbonizing while increasing energy resilience during power outages. When tenants have reliable power sources, they can store refrigerated medications and benefit from improved business continuity, and have more dependable communications infrastructure, which is important for disaster response and recovery. However, when installing on-site solar, it is important to note that solar panels can be damaged (or [become debris](#)) during high-wind events if not mounted properly.
- **All-electric systems** also reduce risk from natural gas infrastructure during disasters. For example, aging infrastructure and ruptures from earthquakes have caused fires and explosions, posing a dangerous health threat.

ADDITIONAL RESOURCES

- [Electrify: The Movement to All-Electric Real Estate](#) (ULI)
- [Equitable Building Electrification: A Framework for Powering Resilient Communities](#) (Greenlining Institute)
- [All-Electric Homes: A Health Professional's Guide](#) (Rocky Mountain Institute)

A Closer Look at Air Quality during Adverse Events

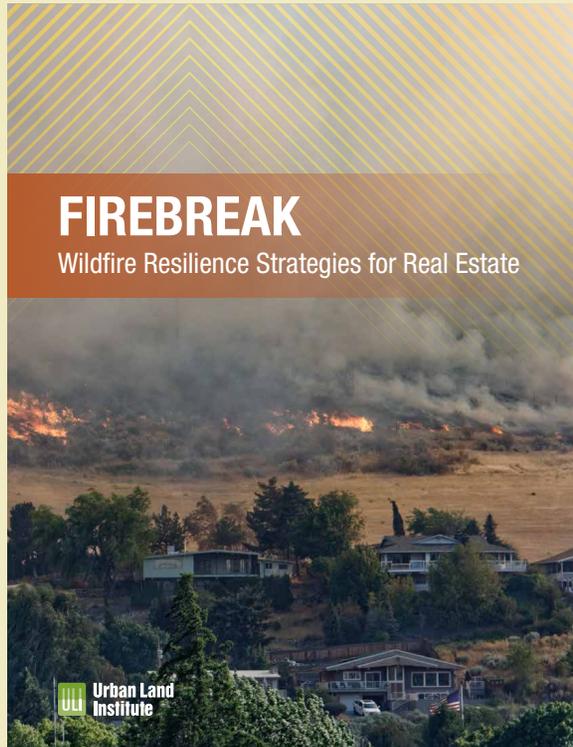
Air quality—both indoor and outdoor—is a significant factor in health outcomes, and air pollution kills an estimated 7 million people globally every year. In addition to its health effects, air quality influences cognitive performance and childhood development.

Many of the strategies listed in this report are designed to improve indoor air quality while reducing carbon emissions, such as by using energy-efficient ventilation systems, installing electric appliances, and using low-carbon materials with low volatile organic compounds (low VOC). Yet indoor air quality also reflects the outdoor environment, with 65 percent of exposure to outdoor air pollution occurring indoors.

For airborne pathogens like COVID-19, building managers can use ventilation systems to increase the flow of outdoor air or they can simply open a window. However, this poses a different set of risks during times of unhealthy air quality outside, such as during wildfires or as heat waves increase the amount of ozone in the air.



(hkalkan/Shutterstock)



2020 ULI report [Firebreak](#).

According to the 2020 ULI report [Firebreak](#), strategies to maintain indoor air quality when wildfire smoke is a concern include those listed below.

(Those also discussed in this report are marked with an asterisk.)

Engineering and Design Solutions

- Install high-performance air filters such as MERV 13 (or higher) systems.*
- Size ventilation systems to accommodate those high-performance air filters and to ensure there is no air bypass around filter banks.
- Consider a central ventilation system, with a reduced number of filter banks to maintain.
- Consider passive house design principles to reduce the infiltration of unfiltered air.*
- Consider constructing a “resilience hub” with backup power to support HVAC and high-quality filtration. This hub could be a large space for office, multifamily, or essential-service buildings or a designated room in single-family residences.*

Operations and Maintenance Solutions

- Ensure ventilation and HVAC systems are well maintained and functional.*
- Install gauges to indicate when air filters need replacing.
- Install carbon dioxide and particulate matter (PM) 2.5 sensors in critical spaces to provide real-time feedback on air quality.*
- Run certified air cleaners and purifiers during periods of poor outside air quality.
- Limit outside air intake by keeping windows and doors shut.
- Educate occupants about the proper use of natural and mechanical ventilation systems, and how they can be used to respond to different hazards (i.e., infectious aerosols versus PM from wildfire smoke).*

Energy Efficiency

One important component of energy efficiency in buildings is passive strategies, such as insulation, the buildings' orientation, and green roofs. These directly contribute to passive survivability during power outages, promote thermal comfort, and reduce the burden on heating, cooling, and lighting systems (as described in the [“New Building and Site Design”](#) section).

Active measures can help reduce the energy being used to operate the building. Advanced sensing and building controls can help optimize when and where the energy is directed. During the pandemic, many unoccupied buildings were not able to significantly reduce their energy use, and having these flexible systems in place would have enabled building managers to use less excessive energy during times of low occupancy. Buildings go through a recommissioning process if fully shut down to avoid health impacts like Legionnaires' disease, and optimizing energy use can help buildings use less energy without shutting down and ensure that some tenants can continue using the building when necessary.

Active management also enables asset managers to use power in strategic ways, which promotes resilience as well. For example, if all residents need to gather in one room during an emergency while an infectious disease is spreading and the grid is about to fail, buildings can reduce their energy use by only ventilating that room, thereby conserving power while keeping residents safe. And in times of utility grid instability, buildings can shed their energy load to reduce stress on the grid, thereby reducing the chance of a brown or black out. Rather than turning off whole systems, energy use can be reduced and channeled into specific zones that flexibly meet the building users' needs under different emergency conditions.

These strategies not only have health benefits for tenants but can also reduce costs. Cost-effective options for retrofits include HVAC equipment tune-ups, LED lighting retrofits with controls, and sophisticated building automation system upgrades. Of course, many of these strategies do require significant investment. High-performance windows and better building insulation have a larger impact and enable HVAC systems to later be downsized even more, but they also have a larger capital expense.

Energy efficiency improvements can also lower utility bills for residents, which is particularly important in affordable housing. If energy poverty is lessened, residents do not have to choose between paying high energy bills and buying medication, food, or health care, and the increased economic stability bolsters resilience to both climate and health emergencies.



(zhu difeng/Shutterstock)

Selected Strategies for Climate Mitigation and Health

- **Weatherization**—protecting buildings from outdoor elements while reducing energy consumption and improving energy efficiency, such as installing insulation and sealing leaks—is a useful strategy for existing buildings, but it is important to be aware of how it interacts with air pollution, especially during wildfires (see feature [“A Closer Look at Air Quality during Adverse Events”](#)). Weatherization can also be a useful time to perform integrated pest management and eliminate allergens, to the extent possible, from the building.
- **Humidity control** in energy efficient building design or renovation can reduce the risk of mold build-up, prevent damp or moist indoor environments, and help reduce viral transmission.
- Installing **high-efficiency HVAC equipment** improves energy efficiency while facilitating tenant comfort.
- **Programmable thermostats** allow buildings to reduce heating or cooling based on occupancy patterns. Similarly, **energy automation** reduces energy use while improving tenant comfort by automatically optimizing HVAC set points and other equipment.
- Energy-efficient ways of ventilating indoor spaces include **displacement ventilation**, which [pushes](#) cool, fresh air into a space at floor level to make the warmer “waste” air rise, where it is removed either passively or via low-energy powered ventilation near the ceiling.

Resource

The Building Innovation Hub, a project of the Institute for Market Transformation, has created the resource [“Health and Wellness Meet Energy Performance,”](#) which provides a matrix that can help guide these decisions.

The portion on enhanced filtration shows impact on health, cost, and performance:

	Feasibility of Implementation	Health Impact	Cost Impact			Performance Impact	
	Retrofit Application	Efficacy for Viral Mitigation	First Cost Retrofit	First Cost New Construction	Operational Cost	Energy Use	Water Use
Mechanical system design strategies							
Humidification	X	O	3	3	3	3	3
Reviewing air-distribution patterns	X	O	3	2	0	-1	N/A
Differential room pressurization	O	O	3	2	2	0	N/A
Exhaust Fans	O	O	2	1	1	1	N/A
Mechanical system controls strategies							
Demand Control Ventilation	O	X	2	1	0	-1	N/A
Extended Hours of Operation	✓	O	0	0	2	3	N/A
Mechanical system monitoring strategies							
One-time IAQ Testing	✓	X	1	1	0	0	N/A
Permanent or Continual IAQ Testing	O	X	3	2	1	0	N/A
IAQ Reporting Policy	O	X	3	2	1	0	N/A

<p>Feasibility of Implementation Key</p> <ul style="list-style-type: none"> ✓ EASY: Implementing into the design will likely have minimal to no impacts for redesign. The product or suggestion is readily available in the market. O MEDIUM: The suggestion may be feasible with moderate modifications to HVAC system and/or architectural layout or ceilings. X DIFFICULT: The suggestion is unusual in the commercial market, would likely require significant modifications to HVAC system and/or architectural layout or ceilings. 	<p>Health Impact Key</p> <ul style="list-style-type: none"> ✓ HIGH: Strongly recommended by ASHRAE/CDC: High level of evidence. O MEDIUM: Recommended by ASHRAE/CDC: At least fair level of evidence. X N/A: Data Not Available- Strategy has implications for wellness but little to no level of evidence for reducing spread of Covid-19. 	<p>Cost and Performance Impact Key</p> <ul style="list-style-type: none"> -1 DECREASE 0 NO CHANGE 1 LOW INCREASE 2 MODERATE INCREASE 3 HIGH INCREASE N/A NOT APPLICABLE
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(Building Innovation Hub)

Selected Strategies for Resilience and Health

- **Cool and green roofs** make buildings more resilient to extreme heat, and when used as accessible outdoor spaces, the vegetation can help with flooding while creating natural spaces that reduce stress and have positive mental-health impacts. Additional climate mitigation benefits arise from the co-benefit of a more insulated roof as well.
- Reducing the energy burden of providing and cleaning water, such as through **rain collection and filtration**, can help ensure access to potable [water](#) even in times of drought.
- Weatherization and energy efficiency help maintain indoor temperatures, which contributes to **passive survivability** and to keeping spaces cool—especially during heat waves—without ramping up energy use. Some currently temperate cities will start needing to retrofit buildings to address rising instances of extreme heat. For example, **high-performance windows** can use a type of glass that separates heat from light, making the building perform better during times of extreme heat.

Externally, energy-efficient buildings can ultimately lower the amount of **waste heat** they generate, which then has broader climate resilience and health implications for the community.



(Sunflowerey/Shutterstock)

ADDITIONAL RESOURCES

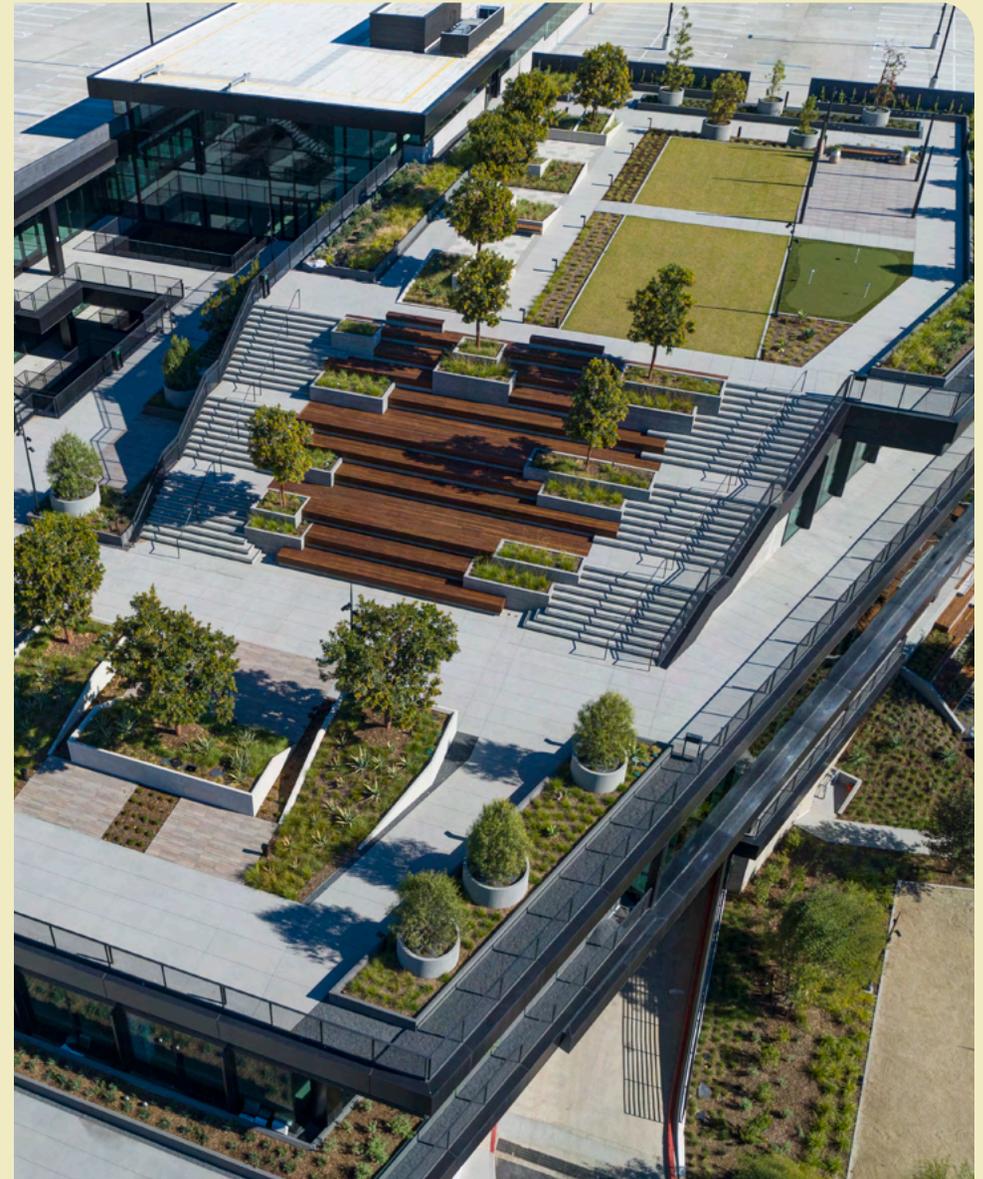
- [The ULI Blueprint for Green Real Estate](#) (ULI)
- [Unlocking Hidden Value in Class B/C Office Buildings](#) (ULI/RMI/BOMA)
- [Climate Change, the Indoor Environment, and Health, Chapter Eight: Building Ventilation, Weatherization, and Energy Use](#) (National Academies of Sciences, Engineering, and Medicine)
- [Healthy Buildings Toolkit](#) (U.S. Department of Energy)
- [Health and Wellness Meet Energy Performance](#) (Building Innovation Hub)

Optimizing Health and Energy Efficiency

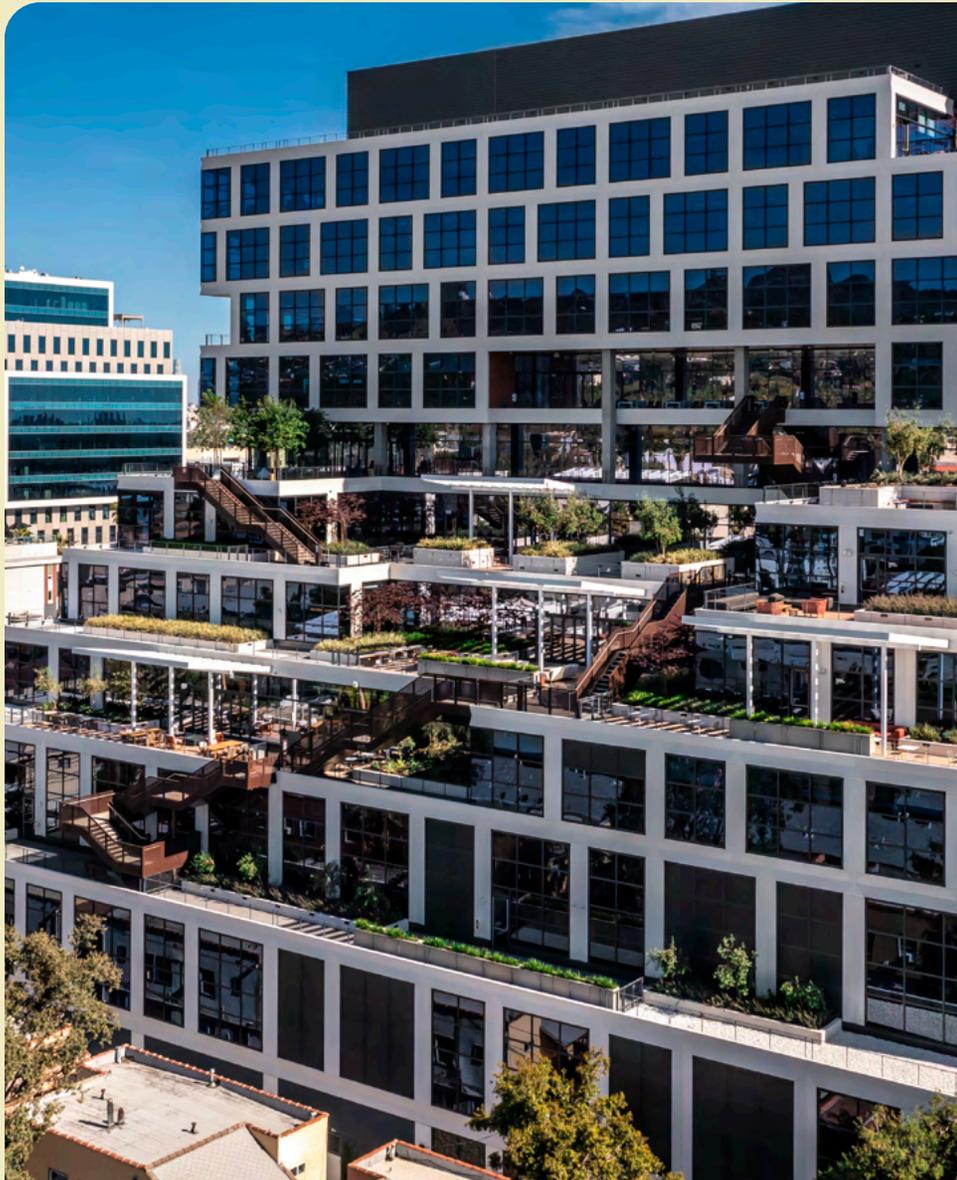
Some of the most commonly cited tensions between health promotion and climate mitigation refer to energy efficiency measures. A few examples follow:

- Weatherization can result in mold and moisture if water leaks occur after sealing the building (a sealed roof deck can help with this). In areas that will see shifts in everyday temperatures—not just extremes—the risk of moisture in a building could also increase simply because of the placement of the vapor barrier.
- Increasing the percentage of outdoor air or upgrading to a higher-efficiency MERV filter to improve ventilation can require more fan power, thereby increasing energy consumption.
- Some energy efficiency measures have unintended consequences for health, such as airtight construction with insufficient ventilation leading to stagnant air, overheating, and an increase in indoor air pollutants.
- A tighter building envelope often has smaller windows, which is more energy efficient but brings in less daylight.

Even in these cases, real estate professionals can find—and have found—creative ways to optimize the benefits of both health and energy efficiency.



Hudson Pacific's office campus One Westside in Los Angeles uses a robust indoor air quality strategy for human health, productivity, and the environment. (Meryl Press Vissel)



Developed by Hudson Pacific Properties in Los Angeles, EPIC has 280,000 square feet of office space, 18,400 square feet of retail space, and 27,000 square feet of outdoor space. *(Meryl Press Vissel)*

DECARBONIZATION AND ADDRESSING INEFFICIENCIES

Hudson Pacific Properties, a West Coast real estate company with expertise in development, redevelopment, leasing, and operations, accelerated its decarbonization strategy and went carbon-neutral five years ahead of schedule when the pandemic began. This way, when energy use increased during the COVID-19 pandemic because of enhanced ventilation, carbon emissions would not increase as well. “Tenants are coming back and wanting to optimize safety,” says Natalie Tear of Hudson Pacific Properties, “and we can never compromise that.”

When fully decarbonizing is not immediately possible, energy management systems can uncover hidden inefficiencies with energy performance, such as simultaneous heating and cooling. Improving energy efficiency can enable buildings to upgrade air filters without increasing energy use. Similarly, making these decisions may become less of a balancing act as new technologies reduce the tradeoffs between health and energy efficiency, such as higher-speed fans that save on energy.

Notably, a project profile of the 1776 G Street building in Northwest Washington, D.C., by WashREIT—a real estate investment trust that owns and operates properties in the D.C. region and U.S. Southeast—found that after the building implemented the recommendations of an energy audit on equipment and operations, the building experienced a 252,000 kilowatt-hour reduction in energy use, \$41,000 in annual electricity cost savings, and a 50 percent decrease in tenant comfort complaints. The building’s Energy Star score also rose by seven points.

PRIORITIZATION

Still, priorities often need to be balanced, and when faced with multiple options that lead to different health and sustainability outcomes, having clear goals can make this decision-making process more practicable. When it comes to health, having a specific standard of air quality and other health-related indicators can help narrow the set of choices to ones that adequately protect tenant health.

Using those health standards as a starting point, real estate professionals can assess how each one would fare under different climate scenarios and pick the option that best reduces tenant vulnerability. After that, energy modelling can help asset managers understand a building's energy needs and how users might interact with it, using this information to choose the most useful approach to energy efficiency out of the remaining options.

Although this type of hierarchy can help real estate professionals make difficult decisions while staying true to their priorities, it should also be adaptable to unexpected situations. For example, owners and asset managers may want to continue ventilating buildings at a high level to encourage tenants to come back to the office post-pandemic, even if they are exceeding their own standards.

Prioritizing items in green building and healthy building certification frameworks is also a way to select options for an asset, and the FLEXREADY framework has nine standards that make buildings healthier and more energy efficient while preparing to be safe and resilient during emergencies.



One Westside uses a robust indoor air quality strategy for human health, productivity, and the environment. *(Meryl Press Vissel)*

For example, Kilroy Realty, a West Coast real estate investment trust, recognized that its buildings had only a 13 percent decrease in energy use from 2019 to 2020 despite COVID-19 building closures. The primary explanation was increased ventilation for longer periods, and upgrading the MERV filters often required additional ventilation as well. These immediate improvements were necessary for viral safety, but Kilroy is now piloting an artificial HVAC software program and indoor air quality and occupancy sensors. Using this technology is expected to help address these issues and provide a smarter way of operating buildings while maintaining healthy and safe indoor air quality.

LAYERING STRATEGIES

Buildings can use multiple strategies to create a holistic, layered approach to energy efficiency. Rather than relying on energy-intensive ventilation alone, building managers can use proven and safe technologies to filter and clean the indoor air while maintaining the proper rate of outdoor air. By complementing ventilation with air filtration and cleaning, building managers can continue to provide safe levels of indoor air quality without using excessive energy on airflows. And, to provide more tenant comfort, ceiling fans in office buildings can complement normal HVAC systems.

Stacey Olson, Global Practice Area Design resilience leader at Gensler, described a recent research project that evaluated whether operable windows could decrease the energy demand of a project in an area where open windows are not possible year-round while increasing access to fresh air and maintaining occupant comfort: “Through data-driven design and analysis, we were able to quantify a 50 percent reduction in energy costs while providing acceptable levels of indoor temperatures,” she says. “This essentially increased the shoulder season by more than 25 percent.”

At the beginning of the pandemic, the ASHRAE recommendations for ventilation conservatively estimated high levels of outdoor air needed to protect against COVID-19. However, as more information and data emerged, ASHRAE updated the guidance in early 2021 to achieve similar levels of protection with lower cost and energy impact based on the concept that ventilation, filtration, and air cleaners can be combined flexibly.

Some of the highest return on investment use cases for these layered strategies are during HVAC replacements or upgrades, downsizing new HVAC systems in new construction, retrofit application to existing HVAC systems, hot and humid or cold climate zones that require energy use, and high-utility-rate markets with rebates.

Airflow is not the only example of layering strategies. Retrofitting lighting with LEDs reduces the HVAC load on the building. Old lightbulbs emit heat, and converting them to LED enables the building to reduce its cooling needs.

FLEXIBILITY

Finally, flexibility is key. Allowing employees to choose the zones where they work based on comfort levels—such as sitting by a window to cool down—can enable companies to reduce excessive heating and cooling. This approach also accommodates different comfort levels, which vary based on age, gender, neurodiversity, and other factors. When buildings are designed to have different zones, they have the flexibility to reduce energy consumption without needing to turn on or shut off entire systems.

New technologies can take this further and help asset managers optimize how energy is being used. By learning occupancy trends, sensors can give asset managers the information they need to modulate the airflow appropriately. By aligning air flow with occupancy patterns, energy is less likely to be used for ventilating empty spaces, which is especially important as remote work remains common and buildings may not run at full occupancy as often.

Navigating the Pandemic with PropTech

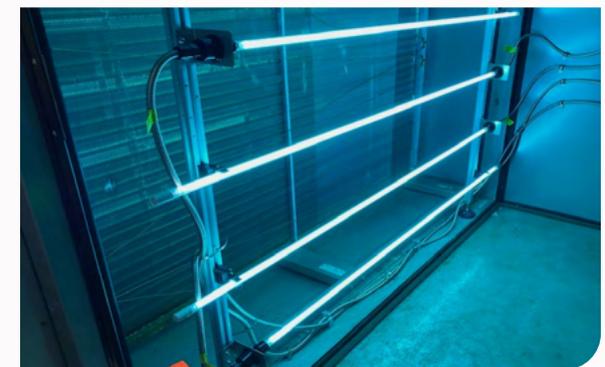
The Tower Companies
Washington, D.C.

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Data and technology can help unlock the health benefits of energy-saving programs. The Tower Companies—which develops, owns, and manages commercial, retail, and multifamily residential properties in the Washington, D.C., metro area—collects real-time data on both energy efficiency and indoor air quality. Tower then uses these data points to actively manage its buildings to accomplish multiple goals at once.

During the pandemic, Tower developed a comprehensive program to facilitate healthy buildings using both old and new technology centered on four layers of protection: ventilate, filter, sanitize, and monitor. This program was able to build on a history of prioritizing health at Tower; even before the pandemic, the company had started installing ultraviolet (UV) lights in its air-handling units. While implementing these UV lights, which existed portfolio-wide by summer 2021, Tower also upgraded to MERV 15 filters across its commercial portfolio to maximize the indoor air quality.

Tower took its interest and knowledge in UV lighting even further and became the first landlord in the country to use HEALTHE, a type of UV-C technology that uses UV-C 222 wavelengths to sanitize air in specific areas. Unlike some other UV wavelengths, this technology is able to kill bacteria and viruses without harming the eyes and skin of humans. Tower installed this technology in elevators and bathrooms, recognizing that HEALTHE can provide an important additional layer of protection in tightly occupied areas and help assure tenants that Tower is supporting a safe return to the office. “We have a responsibility as a landlord to give our tenants the tools they need to make their employees feel comfortable coming back,” says Katie Rothenberg, vice president of sustainability at the Tower Companies.



HEALTHE bar in an elevator and UV lights in an air-handling unit. *(The Tower Companies)*

Project Profiles (continued)

Tower is also the first landlord in the United States to use POPPY, a sensor technology that detects over one thousand pathogens, including SARS-CoV-2. Tower receives trends on pathogen load in the buildings, and the results inform operational adjustments (e.g., additional flush-outs or increased outside air). Because the testing is weekly, it does not give real-time information about infectious diseases in the building. However, POPPY helps validate the overall health and safety strategy, demonstrating that Tower's layers of protection are working.

This health data complements Tower's data on energy use. For example, Tower now also uses real-time indoor air quality monitors in its commercial portfolio, providing operators visibility into key data points such as carbon dioxide levels to ensure that they are providing adequate ventilation balanced with energy consumption. When buildings are only lightly occupied, they can make adjustments to their energy use that are easily reversible if CO₂ levels begin to rise.

However, one challenge during the pandemic has been getting normalized data on energy use. Because most people have been working remotely, it has been more difficult to track the push-pull of energy use and indoor air quality. However, as the United States transitions to a "new normal," proptech will continue supporting Tower's vision that "envisions a world where buildings inspire and enrich the lives of their occupants and create positive social change. In this world, people seek out buildings that improve their health and well-being, connect them to thriving communities, and help sustain the environment."

As tenants become savvier and place more value on health and safety measures, Tower hopes its investment in creating healthy indoor environments will further differentiate its assets. The company anticipates tenants wanting to see data points for themselves going forward, and Tower believes that these investments will serve as compelling proof that its buildings help promote occupant health. To begin providing this type

of information to new and existing tenants, Tower has launched www.towerbuildinghealth.com, which includes building-specific information on health and sustainability attributes.

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"Landlords have an incredible impact on the health of their building occupants. SARS-CoV-2 moved this fact out of the shadows and placed it front and center. Tower will continue to lead in this space by leveraging both old and new technology. There will be successes and failures—but we believe that is how you make impactful change."

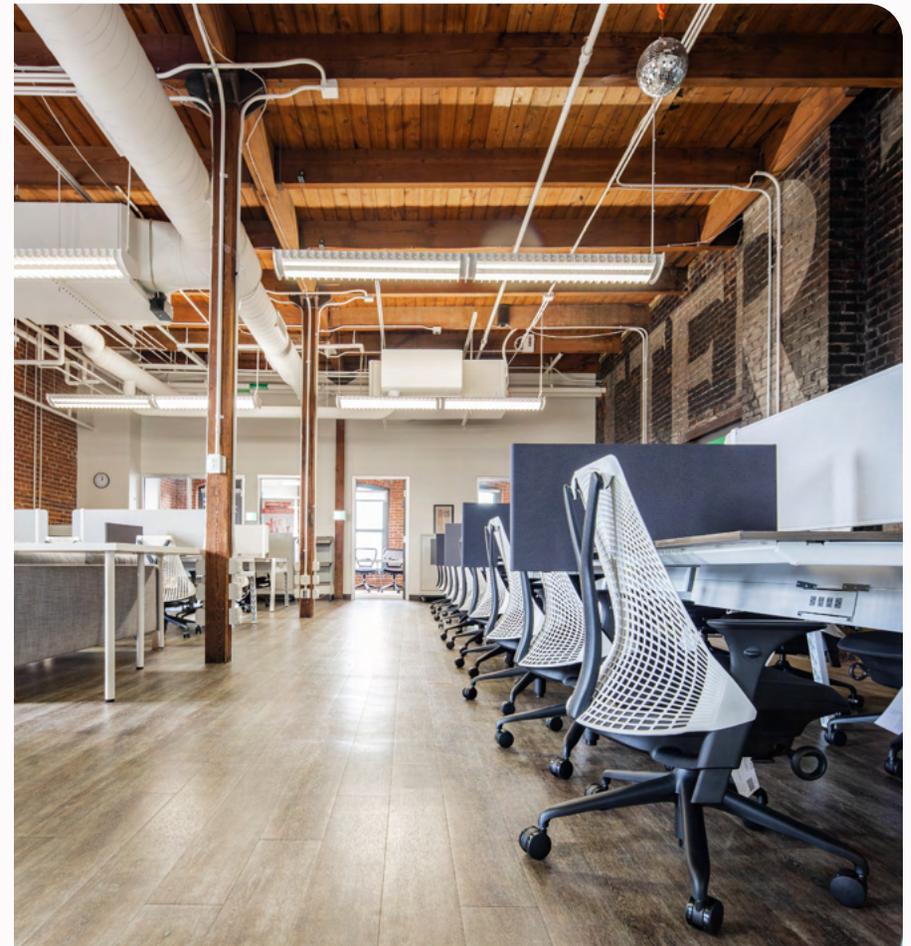
—Katie Rothenberg, Vice President of Sustainability, The Tower Companies

Building Materials

Taking a life-cycle view of buildings, carbon emissions come from not only operations but also the processes used to create and transport building materials. Developers can reduce this embodied carbon by using fewer materials, by repurposing used materials as much as possible, and by selecting low-carbon materials, such as structural materials or lower-carbon carpeting.

Selected Strategies for Climate Mitigation and Health

- Some materials can act as **natural elements** in a space, such as timber beams that are left exposed as part of a biophilic design that also sequester carbon through their lifetime.
- **Using fewer materials** can improve health and reduce carbon by lowering the presence of volatile organic compounds (VOCs) and can help maintain a healthy level of indoor air quality, while also reducing total embodied carbon of the development.
- When seeking materials that are **less carbon-intensive**, developers can choose building materials that are also healthy. These include low-formaldehyde products and low-VOC-emission paints, sealants, adhesives, fixtures, fit-outs, and flooring.
- Developers can conduct a construction material **life-cycle assessment** to consider the sustainability and health ramifications of the material, including its procurement and disposal.



(Karen Culp/Shutterstock)

- Developers can request Environmental Product Declarations and Health Product Declarations, which transparently disclose information about whether a material meets environmental and health criteria, to understand their options. The International Living Future Institute (ILFI) [Materials Petal and Red List](#) also has specific guidance on responsible material selection, such as eliminating all asbestos and having at least 20 percent of the materials construction budget come from within 500 kilometers of the construction site.

Selected Strategies for Resilience and Health

- Using **materials that can withstand natural disasters, are nonflammable, and are mold-resistant** minimizes the damage of extreme weather events and other natural disasters. In the event of natural disaster, products and materials should not off-gas or leak hazardous substances (e.g., cooling systems that would not leak highly polluting refrigerants when broken). Using nontoxic materials also minimizes the health risks for the community in case of debris.
- **Cross-laminated timber (CLT)** not only offers biophilic design benefits and reduces embodied carbon but also performs better [seismically](#) than traditional building materials, can maintain [structural integrity](#) during a fire, and can be designed for [wind resistance](#).

ADDITIONAL RESOURCES

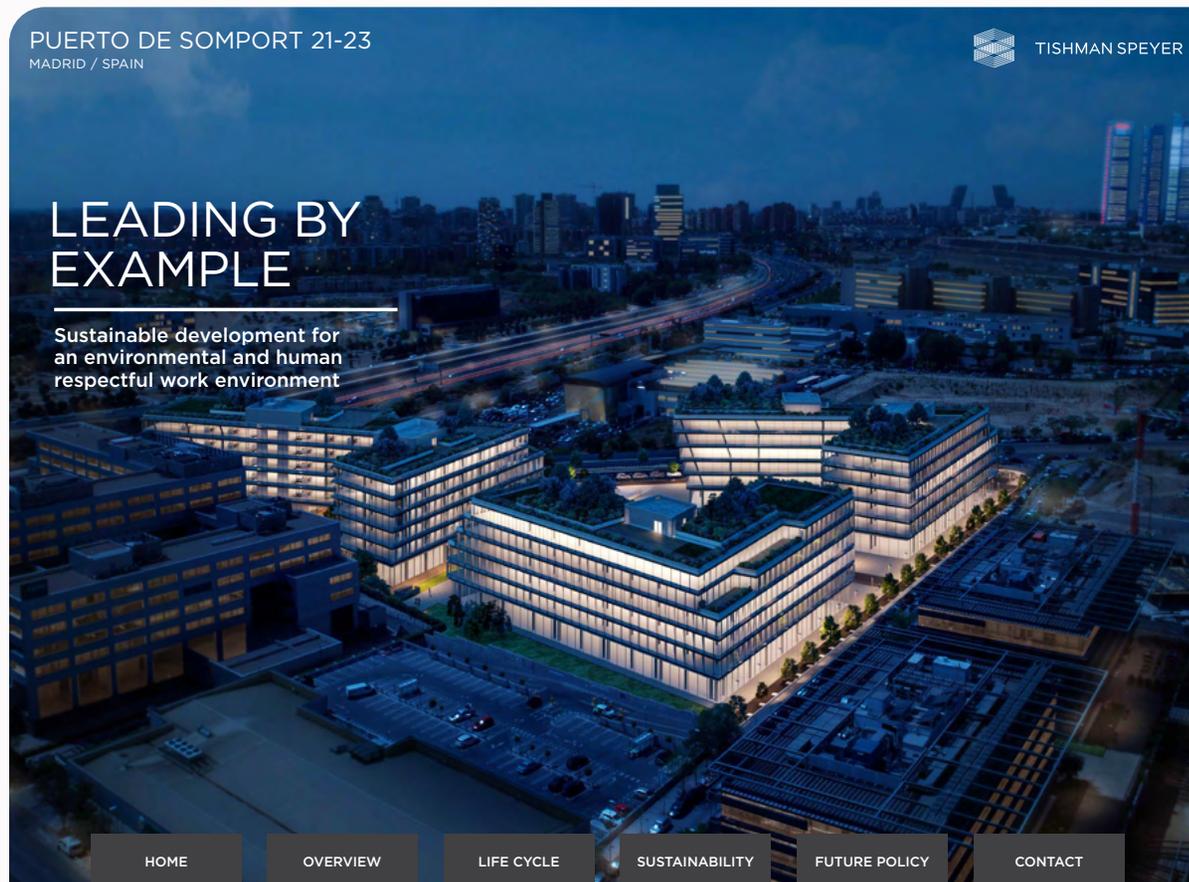
- [Embodied Carbon in Building Materials for Real Estate](#) (ULI)
- [Global Goals: A Primer on the U.N. Sustainable Development Goals for Real Estate](#) (ULI)
- [Mindful Materials Library](#)
- [ILFI Materials Petal and Red List](#)

Building Toward the Sustainable Development Goals

Tishman Speyer

Puerto de Somport, Madrid, Spain

The United Nations' Sustainable Development Goals (SDGs) provide one framework for working toward environmental, social, and health targets that can help inform development decisions.



Puerto de Somport case study.

In a joint venture with Metrovacesa, the integrated real estate platform Tishman Speyer developed the office building [Puerto de Somport 21–23](#) in Madrid, completing the first stage of three that will result in a 646,000-square-foot complex. Not only is the site next to Madrid Nuevo Norte, an urban regeneration project designed to deliver on Madrid's Sustainable Development Goals goals, but the complex itself aligns with Tishman Speyer's own goals for the United Nations 2030 Agenda.

Designed by KPF and BOD, the design process included a life-cycle assessment (LCA) for the entire building—including structural elements, facade, roof, internal walls, floors, and ceilings—and the materials were selected to minimize their embodied carbon and toxicity. The LCA reviewed the production, transportation, and construction stages, use and maintenance stage, and end of life and disposal.

Project Profiles (continued)

Using aluminum and steel with a high recycled content resulted in a more than 10 percent reduction in carbon impact and a 6 percent reduction in ozone depletion. In addition to conscientiously reducing the toxicity of the material, policies ensure that no toxic substances are used in cleaning and maintenance. Moreover, the building is well positioned to achieve certification for LEED BD+D v4 Platinum, WELL v2 Gold, and Global Safe Site.

Materials selection was just one of the many integrated climate-health strategies that Puerto de Somport 21–23 features. Others include the following:

- Access to natural light and views;
- Flexible and differentiated thermal and acoustic zones;
- Increased ventilation rates and enhanced filters;

- Outdoor green spaces, such as exterior green areas, terraces, open rooftop spaces, and a community park; and
- Flexible mobility solutions provided by the landlord, which will include e-bikes, e-scooters, a car-sharing service, and a shuttle bus connecting with the city center.

The LCA and materials selection were part of a larger strategy to respond to global, regional, and local goals, such as the European Green Deal and the SDGs—both of which take a holistic, people-centered approach to sustainability. For example, embodied carbon is one of the European Union’s main focus areas for reaching carbon neutrality.

Tishman Speyer is also dedicated to supporting the SDGs, which is becoming a more common approach to sustainability in the real estate industry. The company’s *Sustainability Report 5.5*, which documents its 2019 performance, connects company goals to the SDGs relevant to its business operations and tracks progress. “SDGs have been really helpful for collecting our thoughts and efforts in a common framework so that that people can see the value in these as related to sustainability,” says JP Flaherty. “This helps people to zoom out and see how they can drive outcomes.”

Community Engagement at the Core

Throughout the development life cycle, community engagement is a critical part of identifying climate and health risks, implementing community-driven strategies to mitigate them, and enhancing communication and transparency.

- **Community-driven strategies.** Development plans should not only be responsive to communities but should also include community members as decision-makers. Social equity should be central to these strategies from the start, including plans to both mitigate any negative effects of the development such as displacement and maximize other benefits like job creation. This holistic understanding of the project's benefits and burdens can help inform conversations with the community.
- **Risk identification.** Communities already know the climate and health risks that affect them, from increased flooding to low air quality to the urban heat island effect. In frontline communities, residents can often point to a long history of environmental hazards that have a cumulative effect on community health (learn more in the

ULI report [Environmental Justice and Real Estate: Perspectives from Leading Community-Based and Advocacy Organizations](#)). When co-creating a development strategy and conducting health impact assessments, real estate professionals should value the community's expertise.

- **Communication and transparency.** Respectfully share information about the development with the community so that they can fully participate in decision-making. This can include trainings, such as a workshop on brownfield remediation or an info session on weatherization programs for home efficiency, and ongoing information-sharing. Community members can also use community benefits agreements to hold developers accountable for ensuring that the development does not cause environmental health issues in the future.

The [NAACP Guidelines for Equitable Community Involvement in Building and Development Projects and Policies](#) provide insights and guidance on working toward community ownership in the development process.

.....
"Thorough community and client engagement at the start of any project is fundamental to realizing climate, resilience, health and sustainability goals. Dedicating time to collaboratively workshop the opportunities, identify outcome-based targets, and explore value-alignments leads to ESG design elements becoming core to the project's purpose, and therefore less likely to be value engineered."

—Hilary Noll, Sustainability Integration Leader and Associate Principal, Mithun



(Papuchalka – kaelaimages/Shutterstock)

Strategic Real Estate Decisions

When making strategic real estate decisions—on acquisition and disposition; leasing; and property management, operations, and tenant improvements—property managers and owners can strategically integrate climate and health considerations.

Acquisition and Disposition

When communicating how energy efficiency upgrades have added value, lowered operating costs, and increased net operating income, the narrative can include the value created by climate mitigation, resilience, and health measures. Noting the many co-benefits of one upgrade can help buyers and sellers better assess the deal and more accurately portray the building's value.

Selected Strategies for Climate Mitigation and Health

- Real estate professionals can proactively integrate sustainability and health factors into **due diligence and property condition assessments**.
- Developers can give brokers a one-page summary of the building's energy cost savings and increases in occupant productivity for **marketing**.
- **Capturing the value** gained for the sales team and assessors is key. A ULI [fact sheet](#) on embedding sustainability in real estate transactions gives the example of a 70,000-square-foot office building in Seattle that replaced its windows with smart glass. This reduced the building's energy consumption by 18 percent (\$0.40 per square foot), and with the improved thermal comfort, the owner renewed existing tenants and leased two empty floors for an additional \$5.00 per square foot.

Selected Strategies for Resilience and Health

- Underwriting investments in building resilience can drive higher returns, and when accounting for the health co-benefits, this value can be **captured and communicated** to buyers and sellers. According to ULI's [Returns on Resilience: The Business Case](#), the business case for resilience includes greater marketing, sales, and leasing success by offering assurance about the integrity of the project and its ability to continue to function through or recover quickly from severe weather; better financing options; more competitive insurance rates; greater long-term savings on maintenance; and higher overall value compared to more vulnerable properties.

ADDITIONAL RESOURCES

- [Embedding Sustainability in Real Estate Transactions](#) (ULI)
- [Guide: Best Practices for Achieving Zero Over Time for Building Portfolios](#) (Rocky Mountain Institute and ULI)
- [Returns on Resilience: The Business Case](#) (ULI)

Leasing

When leasing a property, featuring sustainability, resilience, and health amenities can attract tenants at a premium and also help lease up a building faster and with higher rates of retention. Tenant demand for certifications is growing, and these can help communicate the impact of such features. Many large corporate tenants also have sustainability mandates that inform their office space needs.

This demand applies to both residents in multifamily apartments and tenants in commercial spaces: JLL found that the green real estate certification rental premium is 5.4 percent for commercial buildings and 8.2 percent for residential buildings, and the sales premium is 11.5 percent for commercial and 5.5 for residential.

A 2020 survey by AMLI Residential, a leading developer of sustainable, multifamily properties, found that 83 percent of residents believe living in a green apartment is beneficial to their health, 71 percent place an increased value on the healthy building features in their apartment communities, and residents in LEED-certified communities agreed that the green features at their community affected their decision to lease with AMLI 11 percent more than residents at non-LEED communities.

Selected Strategies for Climate Mitigation and Health

- Owners can incorporate health- and efficiency-promoting strategies into green leases. Green leases help landlords and tenants identify and finance opportunities to make the building more sustainable throughout the lease term, helping retain sustainability-minded tenants while setting standards related to both sustainability and health, such as green cleaning, low-VOC materials, and indoor air quality testing.

Selected Strategies for Resilience and Health

- Socially responsible practices related to leasing, including housing affordability and leasing to small businesses in mixed-use developments, help foster community resilience, which is an important component of climate resilience and community health.

ADDITIONAL RESOURCES

- [The ULI Blueprint for Green Real Estate](#) (ULI)
- [Green Lease Library](#) (IMT/DOE)

Property Management, Operations, and Tenant Improvements

The opportunities to integrate health and climate strategies do not stop after a building has been designed, developed, and leased. Ongoing tenant engagement and maintenance can help ensure that these strategies are functioning as intended, and renovations, retrofit, and tenant buildouts all provide a chance to further raise the bar. Without funding and staff for “soft infrastructure”—such as support services or an active living coordinator in residential buildings—spaces designed for health may not reach their full potential.

Selected Strategies for Climate Mitigation and Health

- Tenant engagement and communication can promote behaviors that are both healthy and save energy, such as taking the stairs.
 - Having policies that allow building users to meet their varying comfort needs, such as allowing tenants to control the thermostat in their area, prevents users from wasting energy (e.g., by opening windows and doors when their spaces overheat or by bringing in a space heater if their office is cold). Giving occupants five degrees of local temperature control can result in 2.7 to 7 percent increases in productivity.
 - Building managers can ensure the maintenance and cleaning of filtration and ventilation systems. This not only keeps them effective but also reduces the potential growth of mold and bacteria.
 - When evaluating retrofits, companies can use a life-cycle assessment rather than a simple payback analysis to understand the full value, including reduced operating expenses, reduced repair costs, increased tenant satisfaction, and the many environmental and health benefits.
- Tenant fit-outs provide an opportunity to incorporate sustainability and health features into tenant space design and construction more efficiently and with higher returns than after a tenant has moved into the space.



(Mark Forbes)



The courtyard at Casa Adelante at 2060 Folsom provides an outdoor gathering space to connect and enjoy nature. *(Bruce Damonte)*

Selected Strategies for Resilience and Health

- Maintenance and audit plans can help buildings remain prepared for climate impacts and responsive to them. For example, quick measures for flooding response can help prevent mold and the spread of infectious diseases. (Passive design features, described in the site and building design section, can also reduce the maintenance cost burden on owners and tenants, especially as environmental conditions change.)
- Disaster education and engagement programs can help tenants stay involved in emergency preparedness strategies that could ultimately keep them safe.
- Promoting social resilience, such as with social events and shared spaces, can be positive for residents' mental health while fostering the social cohesion that improves climate resilience.

ADDITIONAL RESOURCES

- [The ULI Blueprint for Green Real Estate](#) (ULI)
- [Tenant Energy Optimization Program](#) (ULI)

Project Profile

Looking beyond the Building with a Triple-Bottom-Line Approach

Jamestown LP

Ponce City Market, Atlanta, Georgia

Even a single building can have an outsized impact on the surrounding community. Developers can harness this potential to build community resilience, repair environmental injustices, and amplify their impact.



The exterior of Ponce City Market. (Jamestown)

For example, in its Atlanta Ponce City Market development, the design-focused real estate investment and management company Jamestown subsidizes an on-site farmers market, which is managed by Community Farmers Markets (CFM). CFM is a nonprofit that operates multiple farmers markets across Atlanta, allowing farmers to increase their sales and supporting access to fresh, local produce by doubling SNAP dollars. At the same time, CFM farmers and vendors receive valuable support and continuing education to not only improve access to healthy, affordable food, but also strengthen the fabric of the local food community. This type of community-building fosters social health and economic resilience, both of which ultimately enhance climate resilience.

Project Profile (continued)

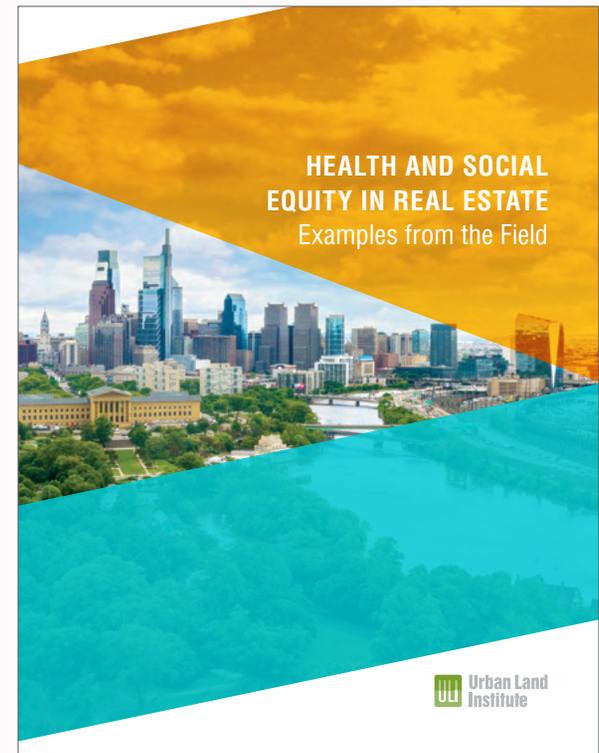
This is just one of many approaches to looking beyond the building. “You have to do this in a way that is authentic to you and your development,” says Jamestown director of ESG Becca Rushin. “There are no cookie-cutter solutions, and to be successful, they need to reflect the community and character of the asset.”

To understand the impact of these different strategies, real estate professionals can use a triple-bottom-line approach. Jamestown used a triple-bottom-line framework to assess its Ponce City Market development, evaluating the benefits of both sustainable and healthy building design elements such as energy-efficient technologies, ventilation, thermal comfort, a green roof, and bicycle facilities. Jamestown also looked at greenhouse gas emissions and reductions in air pollution as part of understanding its broader impact.

Understanding this broader impact is critical because development decisions and building operations affect more than the immediate community. For example, increasing ventilation to prevent COVID-19 transmission can spur additional energy use, which often comes from power plants that create air quality issues in the communities where they are located. The resulting low air quality contributes to health issues and puts citizens at a greater risk for COVID-19—the same virus that the ventilation choices were designed to protect against.

Although it can be difficult to zoom out and make these connections, buildings affect whole systems. Jamestown is continuing to evaluate different tools for quantifying its impact holistically, both on tenants and in the community.

Read more about Ponce City Market in the ULI report [*Health and Social Equity: Examples from the Field*](#).



The 2020 ULI report [*Health and Social Equity: Examples from the Field*](#).

Certifications, Crosswalks, and Tools

Several certification programs, crosswalks, and tools have evidence-based criteria for implementing the strategies listed throughout this report, many of which make the connections between green and healthy buildings.

Examples of Building/Property Certifications and Rating Systems

- **BREEAM** is a sustainability assessment method for master-planning projects, infrastructure, and buildings. It recognizes and reflects the value in higher-performing assets across the built environment life cycle, from new construction to in use and refurbishment.
- **Energy Star**—certified buildings save energy, save money, and help protect the environment by generating fewer greenhouse gas emissions than typical buildings. To be certified as Energy Star, a building must meet strict energy performance standards set by the U.S. EPA.
- The **Fitwel** Standard provides tailored scorecards for existing and new buildings and sites to optimize the unique opportunities for every project—whether it is a single-floor buildout or a large-scale development. The **Fitwel Viral Response** module provides annual certification of policies and practices to mitigate the spread of infectious respiratory diseases within buildings.
- **FORTIFIED** is a voluntary construction and reroofing program and certification designed to strengthen homes and commercial buildings against specific types of severe weather, such as high winds, hail, hurricanes, and tornados.
- **LEED** (Leadership in Energy and Environmental Design) is the most widely used green building rating system in the world. Available for virtually all building types, LEED provides a framework for healthy, highly efficient, and cost-saving green buildings. The **LEED Integrative Process for Health Promotion** pilot credit creates a process for prioritizing health within LEED. As of April 2020, [over 60 percent](#) of each LEED v4 rating system is associated with occupant health.
- The **Living Building Challenge** is a proven performance standard for buildings using a regenerative design framework to create spaces that give more than they take.
- The **PHIUS+ (Passive House Institute US) Certification Program** is the leading passive building certification program in North America. It is the only passive building certification that combines a thorough Passive House design verification protocol with a stringent quality assurance/quality control (QA/QC) program.
- **RELi** is a rating system and leadership standard that takes a holistic approach to resilient design, helping assess and plan for all of the acute hazards that buildings and communities can face during unplanned events, prepare to mitigate against these hazards and design, and construct buildings to maintain critical life-saving services in the event of extended loss of power, heating fuel, or water.

Feature (continued)

- **RESET Air** is a sensor-based and performance-driven indoor air quality standard and certification program that aims to make indoor environmental health measurable, deliverable, and accessible.
- **SITES** is a comprehensive system for creating sustainable and resilient land development projects. SITES certification is for development projects located on sites with or without buildings—ranging from national parks to corporate campuses, street-scapes to homes, and more.
- The **U.S. Resiliency Council (USRC)** rating system assesses a building's resilience to earthquakes along the dimensions of safety, damage, and recovery.
- The **WELL Building Standard** is a vehicle for buildings and organizations to deliver more thoughtful and intentional spaces that enhance human health and well-being. Backed by the latest scientific research, WELL includes strategies that aim to advance health by setting per-

formance standards for design interventions, operational protocols and policies and a commitment to fostering a culture of health and well-being. The **WELL Health-Safety Rating for Facility Operations and Management** includes strategies to address people's health, safety, and well-being during and beyond COVID-19.

Examples of Crosswalks

- The **LEED/WELL Crosswalk** provides guidance on which strategies can be used for both LEED and WELL certification, making it easier for companies to efficiently work toward achieving both.
- The U.S. General Services Administration **Sustainable Facilities Tool Health & Wellness Guidance Crosswalk** shows how the *Guiding Principles for Sustainable Federal Buildings* relate to health and wellness standards, guidelines, and building rating systems.

Examples of Benchmarking/Standards

- **ASHRAE** (the American Society of Heating, Refrigerating and Air-Conditioning Engineers) provides a variety of standards, including for indoor air quality and energy performance.
- The **GRESB Real Estate Assessment** is a global standard for environmental, social, and governance (ESG) benchmarking and reporting framework, which includes modules for energy, resilience, and health.
- The **Resilience-based Earthquake Design Initiative (REDi)** Rating System from Arup provides a framework for resilience-based earthquake design.



(Vladiri/Shutterstock)

Why Integrate Climate and Health Strategies?

Maximizing the health co-benefits of climate mitigation and resilience strategies can help real estate professionals overcome barriers to investing in health promotion. Despite a growing evidence base, some real estate professionals remain skeptical of the effectiveness and value of strategies such as biophilic design.

Although new research quantifies the effect of indoor air quality on productivity, many health benefits remain intangible or difficult to measure. And with limited time and money, companies need to prioritize which actions they take, with health sometimes seen as secondary to other commitments. By capitalizing on the health co-benefits of planned investments in climate mitigation or resilience, real estate professionals can begin to address these limitations.

According to the World Green Building Council's 2016 report [*Building the Business Case: Health, Wellbeing and Productivity in Green Offices*](#), eight primary features make offices healthier and greener: indoor air quality and ventilation; thermal comfort; daylighting and lighting; noise and acoustics; interior layout and active design; biophilia and views; look and feel; and location and access to amenities.

LEED [recognizes](#) the wide variety of health benefits that can be obtained through the green building rating system. For example, in the LEED v4 BD+C rating system, 65 percent of prerequisites and credits contain strategies that protect or promote health and well-being of site users. The strategies are related to indoor air quality, thermal comfort, daylight and views, acoustics and noise, materials, and open spaces.

Moreover, it is often more cost-effective to incorporate these strategies into building upgrades rather than address them separately with multiple different interventions over the course of years. By strategically planning and timing these upgrades, real estate professionals can cost-effectively implement them while maximizing their co-benefits.

In addition to these business considerations, reducing carbon emissions, making buildings more resilient to climate impacts, and enhancing health all have benefits for tenants and communities. Many of these benefits are related: for example, tenant satisfaction can lead to better employee and tenant retention (with financial benefits for owners), and resilient communities create a stronger real estate environment. The following sections provide an overview of these many benefits and help demonstrate why real estate professionals should take an integrated approach to the health and climate strategies outlined in the first part of the report.

“The majority of projects working on achieving the Health Safety rating realized that it’s the first step on the WELL journey, and it’s in their best interest to take that journey. We live in a risk-averse time, so if you know there’s something you could be doing to create a healthy and sustainable building, then you need to do it—or have a good reason not to.”

—Dr. Whitney Austin Gray, Senior Vice President, Research,
International WELL Building Institute

Benefits for Real Estate Professionals

Both health and climate features have a strong business case for owners that includes creating value, lowering costs, meeting tenant demand and retaining tenants, generating marketing opportunities, and future-proofing buildings. For example, health-promoting features can ensure that buildings meet post-pandemic tenant expectations for healthy buildings, and resilient buildings can lower costs by reducing their instances of tenant relocation or loss of business continuity.

Moreover, the MIT Real Estate Innovation Lab's report [The Financial Impact of Healthy Buildings](#) finds that, in commercial office space, health-certified buildings transact between 4.4 and 7 percent more per square foot than their nearest noncertified neighboring peers—independent of all other factors, such as LEED certification, building age, renovation, lease duration, and submarket. The report also highlights other research that finds economic value in daylighting, greenery, and ventilation specifically.

By maximizing the co-benefits of green and healthy features, real estate professionals can boost this business case even more. Often, the substantial health co-benefits of sustainability investments go overlooked. Taking into account reduced absenteeism, increased productivity, and lower health costs can reveal a higher return on investment.

For example, high-performance buildings—which are designed to enhance productivity, comfort, and health while reducing energy use and environmental impact—can lead to substantial financial savings. According to “The Financial Case for High-Performance Buildings” from Stok, high-performance buildings’ impact on productivity, retention, and

wellness results in an additional \$3,395 per employee in annual profit, or \$18.56 per square foot in annual profit, for owner-occupants and tenants.

The total value is even higher when accounting for utility and maintenance savings, but the bulk of the value comes from improved occupant experiences: 43 percent from enhanced employee productivity, 41 percent from increased employee retention, 7 percent from improved employee wellness, 7 percent from utility savings, and 2 percent from maintenance savings. According to the U.S. Green Building Council (USGBC), client demands and healthier buildings are the top two triggers for green building in the United States, and this generates additional operating cost savings, shorter payback periods, and increased asset value.

Over time, investments in high-performance building design can be more effective and less expensive in commercial buildings than employee health and wellness programs. This long-term view is especially compelling given the rising demand for high-performance buildings and the risks of unhealthy buildings: declining value, lower tenant retention over time, and the potential need for costly upgrades in response to regulations and tenant demand.

It also reflects the reality of demographic changes. Millennials are reaching their peak earning phase and are gaining power in the workplace, and their demand for physical health, mental health, and sustainability will continue to drive changes—especially in an employee-driven market. Gen Z has the potential for a large impact as they continue entering the workforce as well.

Investors are also increasingly looking for sustainability, health, and social equity features in their investments to meet their own ESG commitments. Investors are actively seeking out “green” real estate funds, so firms who are already sustainability leaders have a competitive advantage. The International WELL Building Institute [describes](#) some of the many ways in which investors are prioritizing ESG considerations, and particularly health, as follows:

- Of CFOs in the Fortune 1000, 73 percent feel pressure to act on climate change and social justice.
- ESG funds captured \$51.1 billion of net new money from investors in 2020, a record and more than double the previous year.
- Standard-setting agencies, such as the SASB (Sustainability Accounting Standards Board) and IIRC (International Integrated Reporting Council), are expanding human capital metrics to include worker well-being.
- Of companies that took concrete actions on health, 80 percent saw an improvement to their earnings and shareholder returns.

These strategies have the potential to not only create value but also reduce costs. For example, building owners can reduce the number of expensive fixes related to climate impacts and the ensuing tenant health risks, such as mold from flooding. Without resilient features, heat waves can cause tangible property damage, affect the health and safety of tenants, increase energy and water use, increase the maintenance needed for landscaping, and slow economic vitality—all of which are costly for owners, tenants, and the community.

Importantly, when health or climate investments are already being planned, finding ways to intentionally integrate the other can help to maximize these co-benefits at a lower additional cost than waiting to implement them later.

ULI Resource

The ULI report [Scorched: Extreme Heat and Real Estate](#) describes the benefits of heat resilience for real estate development. Many of these benefits apply to climate resilience in general, as discussed throughout this report.

BENEFITS OF HEAT RESILIENCE IN REAL ESTATE DEVELOPMENT

PROJECT DEVELOPMENT	PROJECT MARKETING	PROJECT COMPLETION	PROJECT OPERATIONS
<ul style="list-style-type: none">• Reduced construction costs and reduced likelihood of construction delays caused by extreme heat• Faster permitting and increased buy-in from influential stakeholders, including investors, public officials, and community groups• Reduced stress on public infrastructure, potentially helping sustain long-term economic vibrancy and climate resilience in the local area	<ul style="list-style-type: none">• Enhance project branding or boost a firm's reputation through high-quality, resilient design• Capture market demand for "green" building with extreme heat resilience as a differentiator• Public recognition through awards or iconic features	<ul style="list-style-type: none">• Increased occupant comfort, site visitation, and/or retail sales when property is available as a cool place of refuge during normal hot-weather months and extreme heat events• Enhanced asset value, higher rent premiums, lower vacancy rates, or faster lease-up because of increased occupant comfort and/or likely increased productivity of building occupants	<ul style="list-style-type: none">• Sustained value from avoidance of additional costs replacing heat-damaged materials, upgrading per regulatory requirements, and/or adding additional amenities per consumer demand• Long-term utility cost savings because of decreased cooling load and energy use, supporting an improved net operating income• Higher chance of sustained operations (business continuity) and occupant health during extreme heat events

(Urban Land Institute)

The Role of Regulatory Frameworks

Real estate decisions for climate-resilient, sustainable, and healthy buildings take place within a larger context of city regulations and evolving building performance standards. Integrating climate and health strategies can help efficiently future-proof new buildings and get the most value out of required upgrades.

For example, Berkeley (and many other cities across California and the United States) has prohibited natural gas lines in new construction. This not only promotes all-electric systems—which can be switched over to clean energy sources—but also reduces indoor air pollutants from gas stoves and other appliances. As other cities consider similar regulations, developers can ensure that their buildings are set up to meet these requirements while protecting tenant health.

Similarly, cities are beginning to experiment with heat regulation. Although there is a misconception that heat does not affect properties as much as other climate risks, it can be damaging to both infrastructure and health. Heat leads to materials drying out, excessive expansion or contraction that can compromise connections and water tightness, delamination, the softening of materials, reduced



(Aarti Kalyani/Shutterstock)

thermal storage capacity, melting, and more rapid weathering. Enhancing buildings' resilience to heat serves both to anticipate regulations and to protect properties.

To address low air quality from wildfire smoke, California recently modified its energy code to require air filtration systems designed to meet ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) standards—no longer accepting operable windows for ventilation—in high-rise residential and low-rise residential projects. ASHRAE standards are often mentioned in city and state building codes, and the Occupational Safety and Health Administration also provides standards for ventilation and for some air contaminants. A policy brief from the Institute for Market Transformation and International WELL Building Institute also recommends indoor air quality building performance standards.

Moreover, substantial improvements to properties often must comply with the latest set of local regulations. Planning to comply with—or even exceed—municipal requirements can be an opportunity to prioritize improvements, conduct risk assessments, and incorporate health and climate mitigation and resilience strategies that add long-term value.

Although one effective way to accelerate action is through economic drivers, there is an equally important long-term need for building standards and codes. The class A market can reward exceptional new buildings, but regulation can bring the floor up so that all buildings are healthier and more sustainable—even if not to the same degree. For example, Massachusetts is now requiring all publicly funded buildings to assess and address their hazard and climate risk. In addition to regulation, government incentives for green buildings can include expedited review or permitting processes, density and height bonuses, tax credits, and fee reductions or waivers.

However, if improvements are not required by codes, then only some asset managers will improve their buildings, which leads to inequities, explains Clay Nesler, senior fellow for buildings and energy in the WRI Ross Center for Sustainable Cities: “Buildings are about people, and people need to benefit equally from healthy building practices and solutions.”



(Aarti Kalyani/Shutterstock)

Benefits for Tenants

The [9 Foundations of a Healthy Building](#), created by the Harvard T.H. Chan School of Public Health, categorizes what health promotion looks like in buildings: ventilation, air quality, thermal health, moisture, dust and pests, safety and security, water quality, noise, and lighting and views. By supporting tenant health, these features—many of which can be implemented in ways that lower energy use—can also help reduce long-term employee turnover, lost productivity caused by illness, and absenteeism. These tenant benefits are potentially valuable: the real estate industry typically has a 3-30-300 rule in which \$3 per square foot of a tenant's costs go to utility bills, \$30 per square foot to rent, and \$300 per square foot to employees; thus reduced employee costs can be significant.

Moreover, green and healthy buildings have also been shown to improve cognitive function. The [COGfx Buildingomics Study](#) found that high-performing, green-certified buildings reported higher cognitive function scores, fewer health symptoms, and better perceptions of the indoor environment compared with similarly high-performing buildings that were not green-certified. In addition to supporting employee health, these buildings can enhance productivity.

The 2014 ULI report [Housing in America](#) notes that energy efficiency is correlated with improved occupant health, citing a 2013 study conducted by the National Center for Healthy Housing and Tohn Environmental Strategies that found improved health outcomes following energy-efficient retrofits in both single-family and multifamily housing in Boston, Chicago, and New York City. And a [USGBC](#) survey found that almost a third of respondents have had personal experience with indoor environments leading to worse health outcomes, and that respondents viewed clean air and water and less exposure to toxins as the main benefits of green buildings that resonated the most.

In addition, climate resilience strategies improve business continuity—another important benefit for tenants that can make a development more attractive. Resilient features like outdoor green spaces also allow tenants to recharge, reap the mental health benefits of connecting with nature, and mitigate stormwater flooding and extreme heat.

These tenant benefits can lead to a premium for green and healthy buildings, higher tenant retention, and compelling marketing. Although developers can build in these benefits on the base building side, tenants also need to be educated on these benefits when designing their own spaces. Because tenants are sometimes responsible for the costs of their own buildouts, they may create less expensive spaces without these benefits (although indoor air quality may remain a priority, no matter the cost). Tenant engagement can help tenants take a long-term view and design spaces for their future needs.

“Well-being has evolved from a nice-to-have to an absolute need-to-have. It’s a criteri[on] that people are relying on to be able to get back to the office. It extends beyond biophilic design to creating workplaces for connection, making people feel safe and comfortable, creating active environments with high air, water, lighting, and acoustic quality while having amenities like food availability/production, and hydration stations on site. The other aspect of well-being is understanding that space impacts each individual differently and designing for inclusivity, including neurodiversity. If you design spaces to be equitable and inclusive—ones that provide a diverse variety of space types to choose from—it benefits everyone.”

—Komal Kotwal, Sustainable Design Leader for Health, Well-Being and Equity, HOK

Benefits for Communities

Individual properties can also have broader impacts at the neighborhood scale. For example, opening privately owned green spaces to the public can raise the quantity—and potentially quality—of parks accessible to the community. Buildings can also use existing spaces like community rooms as resilience hubs, providing resources for the neighborhood before, during, and after disasters.

Properties can also contribute to community resilience by minimizing the impact of disasters. Nature-based features can help prevent localized flooding and reduce the urban heat island effect, and using nontoxic materials in construction improves community-wide safety in case of a fire or any other emergency that creates debris.

Strategies that reduce the air pollution associated with burning fossil fuels directly affect community health as well. For example, a small increase in long-term exposure to PM2.5 (a type of particulate matter that impacts respiratory health) leads to about an 8 percent increase in the COVID-19 death rate. By lowering emissions, developments can contribute to the health of their neighborhoods.

These considerations are especially important as ESG strategies increasingly account for community impact. Providing climate mitigation, resilience, and health benefits for the area surrounding the building is not just a good thing to do; safer and more resilient neighborhoods are also better real estate environments, and emphasizing the “S” in ESG can help companies meet their institutional commitments.



(sandsun/Shutterstock)

Project Profile

Harnessing Development for Community Co-Benefits

Bridging the Gap Development, Fifth and Dinwiddie
Pittsburgh, Pennsylvania

A new mixed-use, mixed-income redevelopment is underway in Pittsburgh's Uptown EcoInnovation District. Led by Bridging the Gap Development and GBBN, the 190,000-square-foot project is expected to cost about \$66 million and will add 171 units of housing, 20 percent of which will be affordable.



(GBBN Architects)

Fifth and Dinwiddie will both renovate an existing public works building and add a new building. On track for RESET, Fitwel, and Passive House certifications, the project aims to support the health, sustainability, and resilience of both tenants and the neighborhood.

By optimizing the building's shape and orientation, the design captures light and heat, and the airtight exterior envelope prevents the temperature from significantly fluctuating. This has the potential to reduce both the operating costs and tenants' utility costs, which is especially important in affordable housing. This also means that the building can retain its indoor environment for hours after losing power, making it more resilient during heat waves and winter storms.

Project Profile (continued)

Passive houses are more comfortable for residents because the internal temperature remains more consistent, there are fewer drafts, and outdoor noise is minimized. At the same time, energy use in a passive house is typically one-fifth that of the average U.S. household. Fifth and Dinwiddie uses a heat recovery ventilation system, which promotes indoor air quality without using excessive energy.

The passive house features are not the only sources of climate and health benefits. Located next to a bus rapid transit station, the building acts as a transportation hub, reducing the need for cars. One of the buildings is even being developed on top of a former parking lot.

All of these climate mitigation, resilience, and health benefits are good for the developer as well. These holistic goals helped facilitate buy-in from the client, design team, and construction team. Although, like all green building certifications, achieving Passive House

certification has associated expenses, it can still be cost-effective because of lower operating costs and government incentives, and as it becomes more common in the United States.

With 12,000 square feet of retail space, a civic plaza designed for community use, public art celebrating the neighborhood's history, and co-working spaces available to the community at reduced rates, the development also serves the community. One space will provide clean energy job training to expand local economic opportunities and ensure the community can partake in the benefits of a transition away from the fossil fuels that have historically defined Pittsburgh.

The building itself uses an integrated approach to climate mitigation and health, but it does not stop there and extends these benefits to the community as a whole. "This project represents the best of the best in equitable community development. Although we did not see faster approvals on this

project, we believe we are certainly raising the bar and will help shape how our communities are developed which will ultimately impact everything." In turn, this strengthens community resilience, creates a more attractive real estate environment, and helps to build a healthier neighborhood.

Sources

- [Less Carbon, More Connection](#) (GBBN)
- [Passive House Design: A Key to Sustainable Community Building](#) (GBBN)
- [Fifth and Dinwiddie – East](#) (GBBN and the Department of City Planning, Planning Commission)
- [\\$66 million Uptown development will become a model of sustainability](#) (NEXT Pittsburgh)

Conclusion

Buildings are powerful. They shape our health, our environmental impact, and our resilience to climate risks. Buildings also play a critical role in addressing climate change and actively preventing the worst of its impacts—not just dealing with its fallout. Failing to invest in climate mitigation, resilience, or health has financial and physical repercussions, but significant opportunities to contribute to a healthier environment and to a healthier population also exist.



(Olga Kashubin/Shutterstock)

The risks and vulnerabilities that the COVID-19 pandemic surfaced go beyond health and reveal the need for systems thinking, now more than ever. Increasingly, real estate practitioners are recognizing that it is ultimately in their interest to tackle these issues now and much more efficient to tackle them together.

Many of the strategies to do so, as outlined in this report, are not too different from typical best practices. The key is to recognize opportunities to intentionally optimize co-benefits and make the most of every choice.

By taking a strategic, integrated approach to climate mitigation, resilience, and health, real estate professionals can not only reap the benefits now but also enhance the future of their buildings—and the futures of the people that they serve.

Glossary and Abbreviations

Adaptation: The process of adjusting to new (climate) conditions in order to reduce risks to valued assets. ([U.S. Climate Resilience Toolkit](#))

Biophilic design: The practice of connecting people and nature within our built environments and communities. ([International Living Future Institute](#))

Environmental justice: The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. This goal will be achieved when everyone enjoys the same degree of protection from environmental and health hazards, and equal access to the decision-making process to have a healthy environment in which to live, learn, and work. ([U.S. Environmental Protection Agency](#))

ESG: Abbreviation for environmental, social, and governance.

Green building: A holistic concept that starts with the understanding that the built environment can have profound effects, both positive and negative, on the natural environment, as well as the people who inhabit buildings every day. Green building is an effort to amplify the positive and mitigate the negative of these effects throughout the entire life cycle of a building. Although green building has many different definitions, it is generally accepted as the planning, design, construction, and operations of buildings with several central, foremost considerations: energy use, water use, indoor environmental quality, material selection, and the building's effects on its site. ([U.S. Green Building Council](#))

Green stormwater infrastructure (GSI): A nature-based solution to water-quality issues that urban stormwater runoff causes. GSI comprises soil-water-plant systems that intercept stormwater, infiltrate a portion of it into the ground, evaporate a portion of it into the air, and in some cases release a portion of it slowly back into the sewer system. (Adapted from [PennFuture](#))

High-performance building: A building that exceeds the performance of conventional buildings in important areas, typically including energy conservation, durability, comfort, safety, and indoor air quality. Some definitions include additional criteria such as accessibility and enhanced occupant productivity. ([Building Science Corporation](#))

Indoor air quality (IAQ): The air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants. ([U.S. Environmental Protection Agency](#))

Indoor environmental quality (IEQ): The quality of a building's environment in relation to the health and well-being of those who occupy space in it. IEQ is determined by many factors, including lighting, air quality, and damp conditions. ([U.S. Centers for Disease Control and Prevention](#))

Life-cycle assessment (LCA): A process that aims to quantify the impacts that arise from material inputs and outputs, such as energy use or air emissions, over a product's entire life cycle to assist consumers in making decisions that will benefit the environment. LCA is typically a "cradle-to-grave" approach, which begins with the gathering of raw materials from the earth to create the product and ends at the point when all materials are returned to the earth. (Adapted from the [Sustainable Facilities Tool](#))

Minimum Efficiency Reporting Values (MERV) rating: Reports a filter's ability to capture larger particles between 0.3 and 10 microns. This value is helpful in comparing the performance of different filters. The rating is derived from a test method developed by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE). The higher the MERV rating, the better the filter is at trapping specific types of particles. ([U.S. Environmental Protection Agency](#))

[Climate] Mitigation: Processes that can reduce the amount and speed of future climate change by reducing emissions of heat-trapping gases or removing them from the atmosphere. ([U.S. Climate Resilience Toolkit](#))

Passive survivability: The ability of buildings to maintain habitable conditions in the event of a heating/cooling system loss. ([Better Buildings](#))

Resilience: The capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption. ([U.S. Climate Resilience Toolkit](#))

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