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Rethink, rebuild, reimagine

Laying the foundation for better buildings

UBS

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Joseph Bazalgette’s 19th Century London sewerage systems illustrate the tangible future benefits offered up by farsighted infrastructure planning. His super-sized, brick-lined tunnels are still in use to this day, as their size enabled them to accommodate the city's massive population growth. We need a similar, forward-looking approach today to lay the foundation for the buildings we need for the future.

This does not mean supersizing our buildings; instead, we should rethink our approach, where appropriate rebuilding and reimagining their structures to balance urban growth and sustainability. This starts with putting the needs of everyday residents on a par with bringing buildings into line with Net Zero targets. With buildings responsible for over a third of global real assets, getting this right is significant for wealth, health, and climate.

With hindsight, Bazalgette’s design choice seems obvious, but predicting society’s needs decades in advance is difficult. How does one design, build, and operate buildings today in a way that anticipates unknown future needs? A good place to start is with four megatrends prevalent today and likely acutely relevant for our future built environment: Urbanization, Demographic Change, The Fourth Industrial Revolution, and Climate Change.

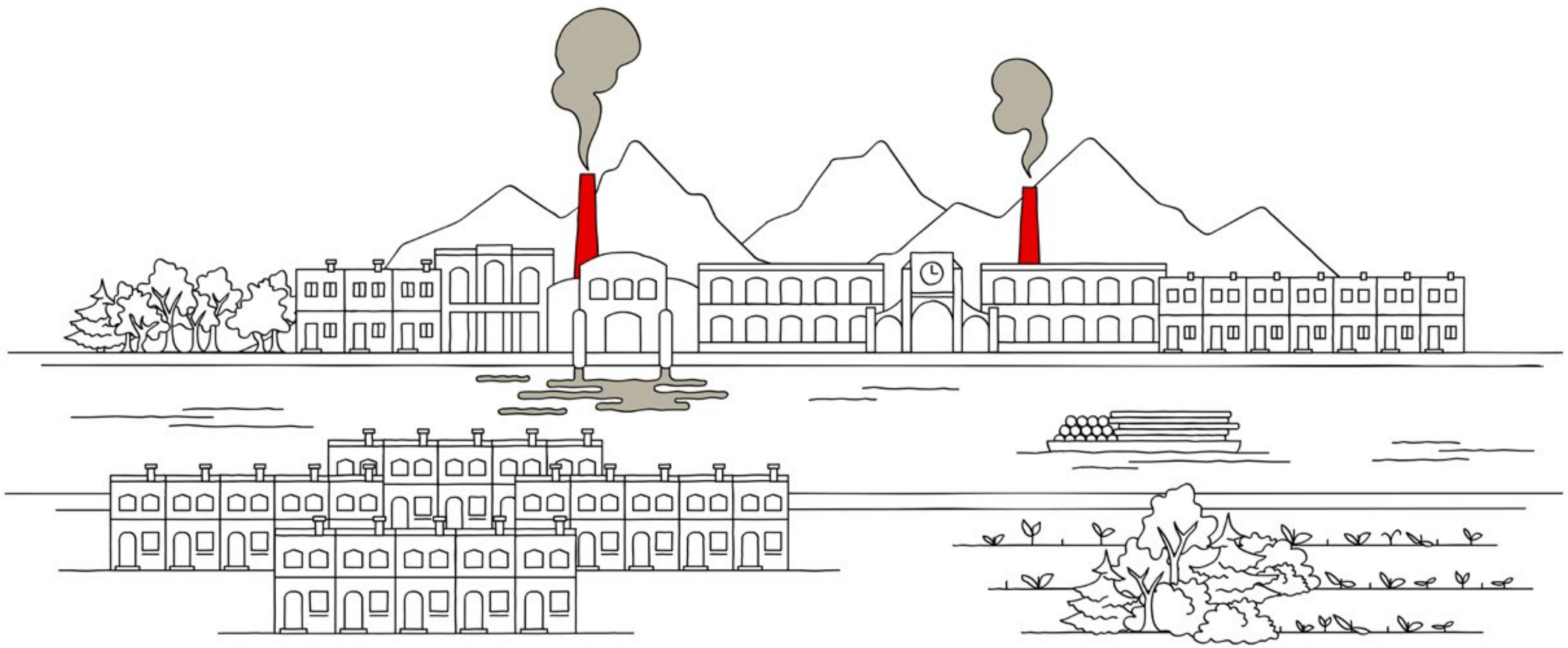
Failing to act is becoming increasingly untenable. Evolving regulatory standards are raising asset stranding risks. Energy-inefficient buildings could increasingly be unlawful to rent out or sell, potentially saddling their owners with massive capital losses versus today’s book values. Inefficient buildings will likely also weigh on investors’ climate balance sheets and may prove less attractive to tenants due to high energy bills and low sustainability ratings.

Solutions to decarbonize construction, like low-carbon steel and cement, still require innovation, but the technologies to achieve operationally net-zero buildings mostly exist today. The challenge lies in rolling them out.

This report presents examples of best practice and offers suggestions regarding how governments, investors, and other stakeholders can rebalance incentives and provide visionary leadership to propel the building industry toward the impact economy.

Executive summary

Throughout most of human history, disease, food, transportation, and resource constraints prevented cities from expanding much beyond easy walking distance. The Industrial Revolution changed that.



Where Ancient Rome took centuries to reach 1 million residents, London added 5.2 million in just 90 years (1811 – 1901). Since then, technology and structural changes like the shift from manufacturing in favor of services have continued to shape human settlements and the way buildings meet our needs for shelter, energy, and connection. Yet, priorities are constantly shifting.

Buildings account for around 37% of global emissions, 28% stemming from existing structures, either directly, e.g., from onsite fossil-fueled heating, or indirectly, from their energy use. Most of today's buildings will still be standing in 2050. Therefore, to reach the global Net Zero target, existing buildings' emissions need to be reduced significantly.

The much-needed retrofit revolution

In practice this means deep changes to energy-inefficient buildings: installing insulation, sealing building envelopes, optimizing ventilation, minimizing energy use, switching heat source to electric or geothermal, and, where possible, maximizing onsite energy generation.

None of this requires exotic new technology, so why are retrofitting rates languishing at 1% per year when they need to be more than triple that? The answer is a lack of sufficient scale and incentives. The retrofit industry remains under-developed. Well-publicized issues like a shortage of heat pump installers urgently need addressing.

Weakness on the demand side is a related and equally important problem. Building owners are typically not yet concerned enough about the difficulty they will have in renting out and selling an energy-inefficient building over the medium-to-long term. Nor are they confident enough in the reward they will receive for bringing one up to standard—the green building premium—to pull the trigger on retrofits.

Governments are likely part of the solution—by improving incentive structures, leveraging their balance sheets, and committing to large-scale retrofitting of publicly-owned buildings they can provide certainty and encouragement to new market entrants.

Building only what we must

From an environmental point of view, new construction is almost always more costly than retrofitting. Demolition and rebuild should be considered only where the economic and social benefits outweigh the environmental costs, and once retrofitting or repurposing has been judged inappropriate.

Growing and shifting populations will inevitably require new buildings. The IEA estimates global floor space will increase by 75% by 2050 in a Net Zero scenario. But new structures should avoid "carbon lock-in"—creating infrastructure today that perpetuates emissions in the future—through focusing on energy efficiency to minimize operational emissions and reduce embodied emissions by using mostly recycled elements or innovative low-carbon materials.

Anticipating our future needs

Anticipating our future needs decades in advance is difficult. One place to start is with today's megatrends. We believe there are four with acute relevance for the built environment:

- **Urbanization:** Growing urban populations contrast with declining rural ones;
- **Demographic change:** Many countries face aging populations and declining workforces;

- **The Fourth Industrial Revolution:** Fewer in-person interactions, more dispersed workforces, and the rise of AI may lead to smaller onsite workforces and lower demand for offices;

- **Climate change:** Buildings must decarbonize while adapting to changing weather patterns.

These ongoing changes mean that a static built environment is unlikely to be able to accommodate our future needs. As such our emphasis should be on building flexibility into designs, facilitating usage change, upgrades, extensions, and refurbishments, so that adapting the building stock to future demands does not require demolishing and starting again.

When retrofitting is not enough

We cannot be overly prescriptive, however. In some cases, an existing building will not be fit for use even with a substantial upgrade, or there will be opportunities to substantially upgrade a plot in terms of density or livability that will require a demolition. Increasingly too, as some populations decline and urbanization continues, the rationale for decommissioning some buildings and returning the land to nature is likely to increase. Some governments are fighting mostly losing battles to convince people to move to declining districts; at some point they may be better off helping people move to non-declining areas instead.

Rising physical risk is likely to be another major driver of decommissioning. Coastal erosion, rising sea levels, and rising temperatures can all threaten the viability of whole settlements in affected areas, either directly or indirectly, via un-insurability.

Governments will need to be sensitive to the risks of decommissioning—such as loss of heritage, social risks from moving people to places where they have fewer roots, the potential pollution from improperly decommissioned buildings—as well as the opportunities for more efficient resource allocation, recycling of materials, and moving people and infrastructure away from high-risk areas.

Making it happen

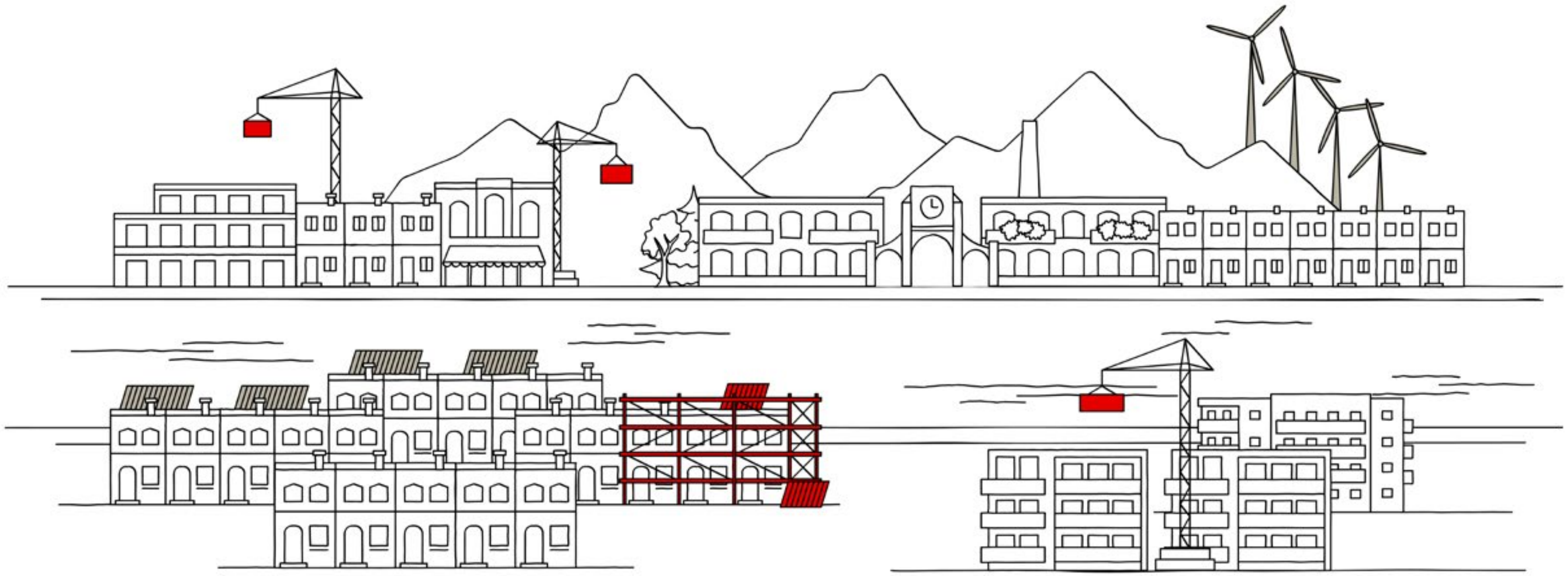
With over 90% of the world's GDP now covered by Net Zero commitments, governments have implicitly signed the building sector up for full decarbonization by 2050. Building owners, their tenants, contractors, and the sector's financial backers all have roles to play in making this a reality. But so far, reducing building emissions has proved fiendishly hard. Left unchecked, buildings' current emissions will double by 2050.

And yet while some solutions to decarbonize construction, like low-carbon steel and cement, require innovation, the barriers to reducing building emissions are less technological and more systemic. Information failures are preventing sustainability information from making its way up and down the buildings value chain. Misaligned incentives are undermining the investment case for low-carbon construction and for making improvements to existing buildings. Green buildings accrue insufficient rewards, while inefficient buildings incur insufficient penalties. Correcting this will require an improved mix of carrots and sticks.

The financial sector's role is nascent but developing. For instance, green real estate bonds and mortgage-backed securities make up only 1.5% of conventional bond issuance and new mortgage loans. The sector holds a unique, cross-value chain position, which enables it to promote best practices, facilitate public-private partnerships, and connect stakeholders. These steps are among the six that we outline which can help financial market participants move the needle, reducing market failures today.

Need for a retrofit revolution

Most of our existing building stock is inefficient, using far more energy than it should, and most of it will still be standing by 2050. Improving, renovating, and retrofitting the buildings we already have is therefore imperative. The challenge is achieving the scale required. Retrofits are being impeded by misaligned incentives, an underdeveloped supply chain, and high upfront costs.



Retrofitting: A climate imperative

Buildings account for around 37% of global emissions, with new construction accounting for about 9 percentage points of that.[1] The other 28% is from the existing building stock, which is often energy inefficient.[2] Retrofitting is thus imperative both to reduce emissions and to support the energy transition in the following ways:

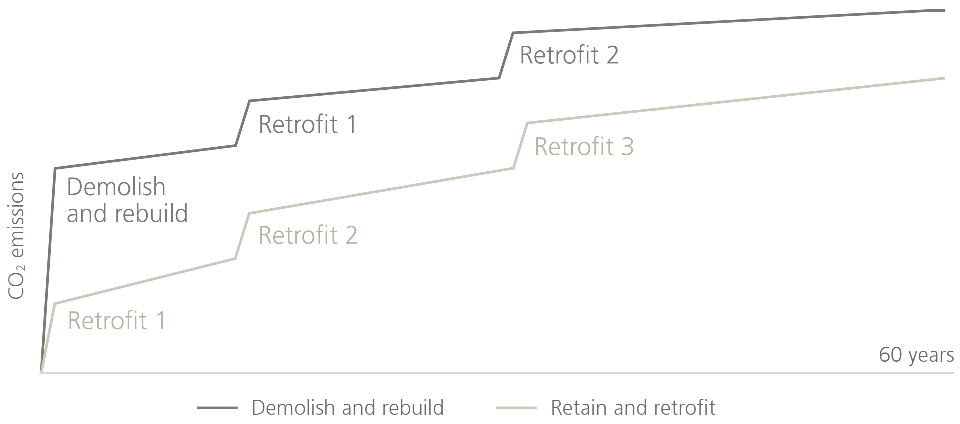
1. Extending the life of existing buildings, thereby reducing the amount of new construction required, leading to lower embodied emissions;
2. Decarbonizing the existing building stock, reducing both direct and indirect operational emissions;
3. Increasing building energy efficiency and onsite energy production, thereby reducing bills and the strain on the grid, a crucial offset as auto transport and heating are electrified (operational conservation).

Extending building lifetime

From a building owner and developer perspective, new buildings are typically easier to rent out or sell, and therefore command higher prices. So, demolition often makes better financial sense, particularly as the resulting extra carbon emissions are not priced according to their environmental cost—a classic economic "externality challenge." This needs to change, but waiting for carbon to be appropriately priced is not a viable solution. Building owners, developers, financiers, government planners, and regulators need to take immediate responsibility for recognizing the retrofit of existing buildings as the most sustainable option and the first choice.

Sometimes the higher energy efficiency of new constructions is invoked to justify a rebuild; this is misleading for two reasons. First, in many cases, high-quality retrofits can achieve similar reductions in energy demand.[3] Second, the embodied emissions given off by a new building's materials and construction are so high that they typically far outweigh any efficiency saving over the lifetime of the building (Figure 1). Larry Strain, board member of the Carbon Leadership Forum estimated that retrofitting an existing building can save 50–75% of the carbon that would be emitted by constructing a similar building.[4]

Figure 1: Demolish and rebuild is rarely better than retrofitting from a carbon perspective
Indicative life-cycle carbon emissions of demolition and rebuild versus retain and retrofit



Source: LETI, UBS

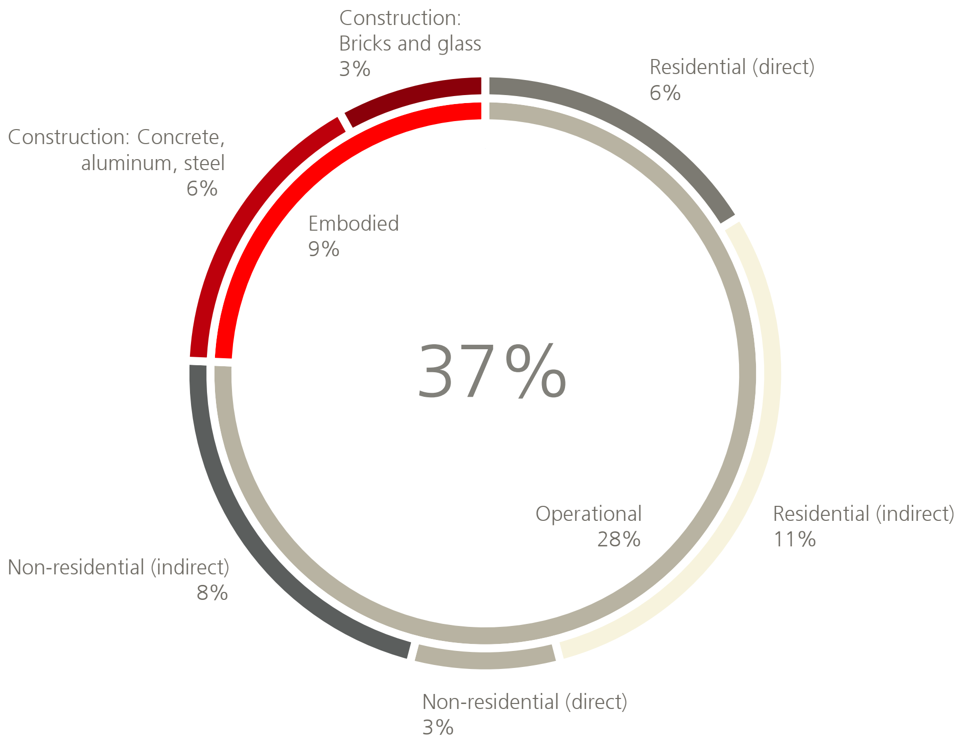
[1] UNEP (2022), 2022 Global status report for buildings and construction: Towards a zero-emission, efficient, resilient buildings and construction sector.
[2] According to the European Commission 75% of the existing European building stock is "'energy-inefficient"' (built before 1990); European Commission (2021), Making our homes and buildings fit for a greener future; Buildings Performance Institute Europe (2017), 97% of buildings in the EU needs to be upgraded.
[3] Passivhaus Trust, (2021), Passivhaus retrofit in the UK, P16.
[4] Strain, L., (2017). *Time Value of Carbon, Carbon Leadership Forum*, University of Washington, P6.

Decarbonizing the building stock requires a retrofit "revolution"
Retrofitting is also needed to bring the rest of the building stock into line with global climate ambitions. The International Energy Agency (IEA) projects that around 50% of the current global building stock will still be in use in 2050,[5] 99% of which is not aligned with Net Zero today.[6] In developed markets, the figure is much higher—the European Commission estimates that 85–95% of the EU's current building stock will still be in use by 2050.[7] Building operations currently account, directly and indirectly, for around 28% of global CO_2 emissions[8] (Figure 2). This means reaching Net Zero by 2050 will require most of the current building stock to be retrofitted (Box1).

> Current retrofit rates are far too slow to achieve Net Zero targets.

Current retrofit rates are far too slow to achieve Net Zero targets. At around 1% of the building stock each year, the current rate of global retrofits needs to at least triple,[9] which in turn requires an unprecedented ramp-up in the retrofit supply chain.

Figure 2: Emissions from existing buildings outweigh those from new construction by three to one
Breakdown of the 37% of global emissions stemming from buildings in 2021



Source: GlobalABC, UBS

[5] International Energy Agency (2021), *Net Zero by 2050: A Roadmap for the global energy sector*, P141
[6] Ibid, P66.
[7] European Commission (2020), *A Renovation Wave for Europe – Greening our buildings, creating jobs, improving lives.*
[8] UNEP; Global Alliance for Building and Construction (2022), *Global Status Report for Buildings and Construction*, P42.
[9] JLL, (2022), *Retrofitting Buildings to be Future Fit*, P2.

Box 1

What does a good retrofit look like?

Every building is unique in some way, be it by geography, design, function, age, materials, etc.
So, there is no one-size-fits-all approach. But a good retrofit should accomplish four goals:

1. Minimize heat loss during winter and heat gain during summer through improved insulation and optimized ventilation;
2. Minimize energy use, e.g., via smart light sensors, sophisticated building management systems, and by replacing inefficient appliances;
3. Minimize reliance on fossil fuels by replacing oil and gas boilers with electrified heat sources like heat pumps (there are exceptions, depending on the carbon factor of the local grid—in situations where local electricity generation is primarily from a dirty source like coal, a gas boiler may be preferable) or, where possible, geothermal;
4. Maximize onsite energy generation from renewables, such as rooftop solar.

The retrofit should also be conducted in a way that is cognizant of the following:

1. Minimizing the embodied carbon of the materials used in the retrofit;
2. Ensuring that the performance of the building post-retrofit can be measured, e.g., by installing smart sensors;
3. Prioritizing the health of the building and its occupants. Window replacement, for example, might improve insulation, but care should be taken that it does not adversely affect ventilation and cause damp and rot to develop.[10]

What is optimal for a one-family residential unit will be different than what works for a block of apartments or a large office building. For residential buildings, the Passivhaus method, a non-profit retrofit design approach and certification, is arguably the gold standard, claiming a potential 90% reduction in heating needs for "leaky" houses."[11] For commercial buildings, retrofits can achieve energy demand reductions of 15–40% not including the potential gains from onsite power generation).[12]

In summary, given modern insulation standards, climate-friendly heating and cooling systems, and onsite electricity generation, many buildings have the potential to become operationally carbon neutral today, producing as much (or even more) clean energy as they require.

[10] LETI (2021), Climate Emergency Retrofit Guide, P10.
[11] Passivhaus Trust, (2021), *Passivhaus Benefits,* P19.
[12] Srivastava R. and Mah J., (2022), *Moving the Needle on Comprehensive Commercial Retrofits,* ACEEE, P7.

The risk of "energy-inefficiency" discounts and asset stranding

Retrofitting is not just a climate imperative for society, it is also likely to become a financial imperative for building owners (Box 2). Energy-inefficient buildings, sometimes referred to as "brown" buildings, are exposed to significant regulatory and fiscal risks. Various countries and municipalities are in the process of introducing energy efficiency laws for existing buildings.

> Retrofitting is not just a climate imperative for society, it is also likely to become a financial imperative for building owners.

New York has passed Local Law 97 (LL97), which from 2024 will require buildings over 25,000 square feet to meet increasingly strict emissions caps—those falling short will face financial penalties. The UK recently introduced the Minimum Energy Efficiency Standard (MEES), which from 2023 requires buildings to attain a minimum Energy Performance Certificate (EPC) standard of E (on a scale from A (best) to G). Buildings falling short of this standard require retrofitting before they can be rented out or sold after the deadline. By 2030, if government consultations are a guide, the MEES could be tightened to a B-grade via a series of hard deadlines.

The scale of retrofits that could be required to avoid falling foul of these tightening standards is daunting. Going by the EPC registration data, as of June 2023, 88% of the UK's residential buildings and 86% of its non-residential buildings currently fall below the B-grade.[13]

Box 2

What are stranded assets?

The term was popularized by the Smith School's Stranded Assets Program in 2014. It refers to "assets that have suffered from unanticipated or premature write-downs, devaluations, or conversions to liabilities."[14] In the context of real estate, this might refer to non-energy-efficient buildings that become impossible to rent out and unsellable due to minimum energy efficiency regulations or alternatively become uneconomical to own due to financial penalties. It can also refer to buildings that become uninsurable due to rising physical climate risks, e.g., properties in areas prone to wildfires or flooding.

[13] Government database: Epc.opendatacommunities.org.
[14] Smith School of Enterprise and the Environment, (2014), Stranded Assets and Scenarios Discussion Paper, P2.

Scaling the retrofit industry remains a major challenge

In economic and emissions terms, upgrades like LED lighting and smart design insulation represent some of the highest returns on investment.[15] They are "no regrets" options, which will typically save more money on energy bills over their lifetime than they cost to implement. These are options which, in theory, every building should have, barring exceptional circumstances. So why don't they?

High capital outlay; not high enough confidence in benefits

The problem is that while retrofitting has one of the best cost-to-abatement ratios, it is also among the most capital intensive.[16] A deep retrofit (Box 3) typically involves significant upfront capital outlay and in the case of a large commercial structure, could pause the building's revenue generation for several years while it takes place. The incentive for the building owner is further diluted by the fact that their rewards—potentially higher rents and building value—are often deferred while the immediate benefits of the retrofit—lower bills, upgraded experience—accrue to the tenant. Retrofits almost always make climate sense, but without the confidence that they make financial sense, the building sector will struggle to meaningfully decarbonize.

This is an issue even in the big metropolises where potential rental value is high and building improvements are considered more likely to be rewarded by a green premium. However, it is likely to be a particular problem in less wealthy areas where the risk-reward calculation is more in doubt. Unlocking the capital and capacity required to scale retrofits at both the commercial and residential level is likely to require concerted efforts to improve this calculation. These include:

Retrofits almost always make climate sense, but without the confidence that they make financial sense, the building sector will struggle to meaningfully decarbonize.

[15] International Energy Agency, (2020), *GHG abatement costs for selected measures of the Sustainable Recovery Plan.*
[16] McKinsey & Co, (2009), *Pathways to a Low-Carbon Economy Version 2, P18.*

1. **Increasing the value of energy-efficient buildings relative to their non-efficient counterparts: The green building premium**
   The evidence suggests that per square foot, New York and London valuations and rents for green-certified office buildings are, on average, already above those of their non-certified counterparts by 17% (Figure 3). However, it can be difficult to untangle energy efficiency and the implied emissions from the other factors included in these certifications. Furthermore, the research into this area remains somewhat unsettled,[17] and our own conversations with industry participants suggest that in most locations it remains equivocal whether a retrofit that reduces a building's carbon footprint will in fact be rewarded by higher rents and/or resale valuations, or whether price differentials are caused by other factors. Here, government action can make a key difference, for example, through preferential tax treatment specifically targeted at green building characteristics, or by tightening regulations that include penalties for buildings falling below certain energy-efficiency thresholds (e.g., LL97).

2. **Improving the availability of concessional finance, particularly for buildings in less well-off areas**
   At the residential level, there are "just transition" concerns regarding the affordability of retrofits, with the potential for poorer households to be shut out of upgrades that would improve their living standards and lower costs. Government grants or tax relief measures could make a positive difference to the level of retrofitting in areas where affordability and retrofit cost-to-property value ratios are less favorable.

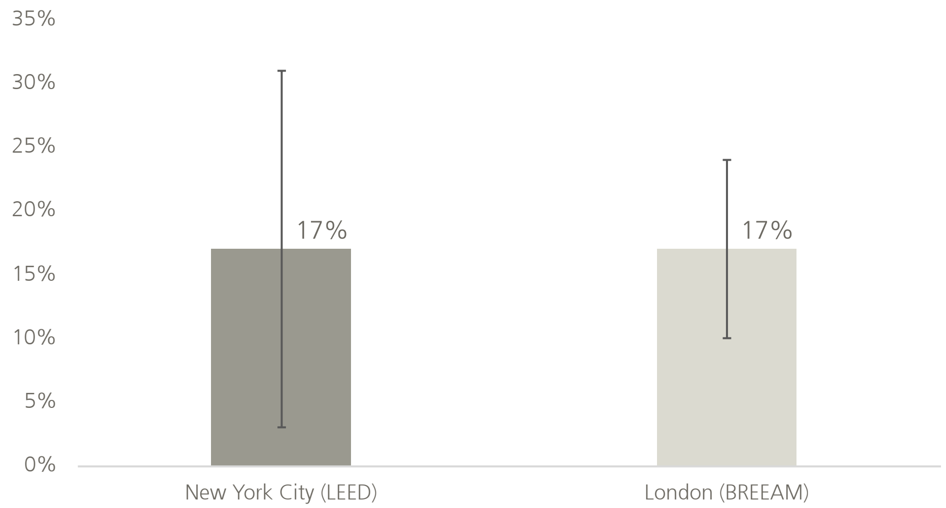
3. **Lowering retrofit costs by drawing more companies and personnel into the retrofit supply chain**
   Retrofit supply chains in most countries are not yet mature, with shortages of personnel, appliances, and materials keeping prices too high and impeding mass roll-out. This raises costs and prompts delays, further discouraging retrofit initiatives. One potential solution is for governments to commit to retrofitting government buildings and social housing at scale to encourage new market entrants. The New York City Housing Authority ran a successful competition to stimulate innovation in air source heat pumps to make them small enough for apartments, with the winner being awarded a contract to supply 30,000 to social housing units.[18]

4. **Educating building owners on the value of retrofitting**
   Payback periods for retrofitting improvements can often be surprisingly short, a few years in some cases, e.g., loft insulation. Rising energy costs are likely to have improved such metrics. Information campaigns to raise awareness of such benefits could help to increase retrofitting rates.

[17] CBRE, (2022), *Does it matter if we can't prove there's additional value in green building features?*
[18] NYC.gov, (2022), *Mayor Adams, Governor Hochul Announce $70 Million Initial Investment to Decarbonize NYCHA Buildings as Part of Clean Heat for All Challenge.*

Figure 3: Sizable green premium for office buildings in New York and London

UBS research looking at 1,843 transactions between 2010 and 2022 in New York and London found material green premiums of, on average 17%, all else being equal (location, age, renovation, occupancy). The bands show the 90% confidence interval



LEED refers to the Leadership in Energy and Environmental Design, the prevalent certification for sustainable buildings in the US, developed by the US Green Building Council.

BREEAM refers to the Building Research Establishment Assessment Method, the prevalent certification for sustainable buildings in the UK and used in over 70 other countries.

Source: RCA transactions, walkscore.com, USGBC LEED building data, BREEAM building data, UBS

Box 3

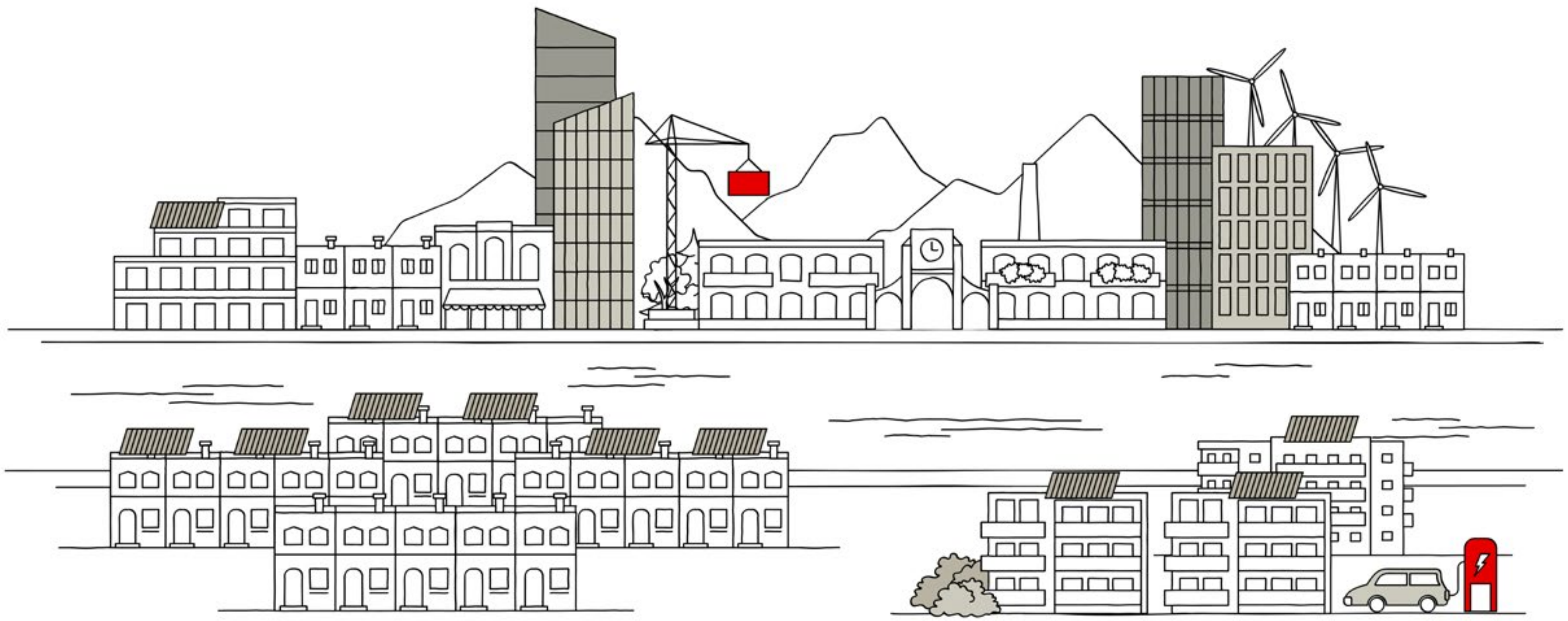
What is the difference between shallow and deep retrofitting?

A "shallow retrofit" might involve upgrading lighting, installing insulation, ventilation improvements, and can be expected to result in around a 30% reduction in heat energy demand. A "deep retrofit" includes all the above and in addition, improvement in most of the building's fabric, e.g., sealing the building envelope to avoid leaks, switching heat source, and upgrading the ventilation system. This might take place in phases or at the same time as a major renovation or extension and can typically be expected to achieve a 70% or more reduction in heat demand in a residential building.[19]

[19] LETI (2021), *Climate Emergency Retrofit Guide*, P200.

Build only what we must

Many new buildings will be needed to accommodate growing and shifting populations, but these will likely be unevenly distributed, with the developed world's 2050 building stock mostly built, and most of the developing world's in the pipeline. It will be critical to minimize the whole-life carbon emissions of these buildings through a range of technologies and techniques, some of which require innovation, but many of which exist today.



How much new construction and where?

Forecasting with precision the amount and location of buildings the world will need over the next several decades is not a goal of this report—different countries, cities, and even neighborhoods will follow disparate development paths, each with diverse building requirements. Despite limited visibility, we offer two broad comments about future global building needs:

- **Growth:** The global population is simultaneously growing, urbanizing, and aging. The UN projects the global population could reach 8.5 billion in 2030 and 9.7 billion in 2050.[20] The latest urbanization forecasts (calculated pre-COVID) suggest that two-thirds of the global population is likely to live in urban centers by 2050, a 10-percentage-point increase over 2018.[21] As a result, total building floor area is expected to increase 75% by 2050—the equivalent of adding the surface area of Paris every week.[22] At the same time, populations are getting older, with the proportion of people over 65 years expected to increase from 10% today to 16% by 2050.[23]

- **Divergence:** The Global South is expected to expand rapidly—over 80% of new building floor area between 2020 and 2050 will be in developing and emerging market economies, fueled by high rates of population and GDP growth. The Global North will expand its stock more slowly, with a greater focus on replacement and retrofitting, given the longevity of existing buildings and consequently long asset lives.[24]

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[20] United Nations Department of Economic and Social Affairs (2022), *World Population Prospects 2022: Summary of results*.
[21] United Nations Department of Economic and Social Affairs (2018), *2018 Revision of world urbanization prospects*.
[22] International Energy Agency (2021), *Net Zero by 2050: A Roadmap for the global energy sector*, P141.
[23] United Nations Department of Economic and Social Affairs (2022), *World Population Prospects 2022: Summary of results*.
[24] International Energy Agency (2021), *Net Zero by 2050: A Roadmap for the global energy sector*, P141.

What do we need from new buildings?

New buildings—regardless of their intended function—should adhere to one grounding sustainability principle: meeting today's needs while being flexible enough to accommodate those of tomorrow. Obsolescent structures are wasteful and typically lead to damaging or costly outcomes, leaving future generations with environmental, social, and economic burdens. If new buildings are constructed with flexibility in mind, over time, the obsolescent building debt will diminish.

> Obsolescent structures are wasteful and typically lead to damaging or costly outcomes, leaving future generations with environmental, social, and economic burdens.

Anticipating the unknown unknown

Demands of a building will naturally fluctuate as tastes change, people and businesses move around, and environmental pressures grow. However, at a fundamental level society's essential asks of buildings tend not to change over time; what changes is how buildings meet these needs.

How does one design, build, and operate new buildings today in a way that anticipates unknown future needs? There is no one perfect answer, but the best place to start is with today's megatrends:

- **Urbanization:** Urban populations will likely grow while rural ones decline, changing demands for living space;
- **Demographic Change:** Aging populations and, often, declining workforces are likely to intensify the need for habitable buildings close to healthcare and other amenities;
- **The Fourth Industrial Revolution:** Fewer in-person interactions, more dispersed workforces, and the rise of AI may lead to smaller onsite workforces and lower demand for offices;
- **Climate Change:** Accelerating climate change demands that we do more with less, decarbonizing buildings while adapting them for changing weather patterns.

In Table 1, we explore how these megatrends could change the way new buildings meet society's fundamental needs for shelter, power, and connection. For example, connection to the grid was once sufficient to meet our power needs, but increasingly, onsite power generation and storage is required to provide reliable supply, reduce emissions, and minimize excess demand on increasingly strained power grids.

Table 1: Four megatrends reshape buildings' fundamental services

Basic needs		Megatrends: Urbanization	Megatrends: Demographic Change	Megatrends: Fourth Industrial Revolution	Megatrends: Climate Change
	Macro View	**Urban population** 2022: 55% 2050: 68% **Floor area (m²)** 2020: 244bn 2050: 427bn	**Global population > 65** 2022: 10% 2050: 16%	**Manufacturing jobs displaced by industrial robots** 2000–16: ~1.6mn 2018–30: ~20mn	**Urban population exposed to extreme heat** 2023: 200mn 2050: 1.6bn
Shelter	*Impact of megatrend on basic need*	Growing demand for space, increasing pressure on essential urban services	Diverse accessibility requirements	Improves wide range of services	Resilience to withstand extreme weather events and to adapt to changing climate conditions
Shelter	*How buildings can meet basic need*	• Efficient and scalable building design • Pivot toward mixed-use development	• Design shift toward "age in place" • Inclusive building technologies, e.g., assistive communication	• Novel materials increase building longevity and durability • Technology improves privacy and security (e.g., biometric systems) • Atmosphere regulation technologies to automate heating/cooling	• Put adaptation at core of building design • Incorporate energy-efficient materials
Connect	*Impact of megatrend on basic need*	Rising competition between urban residents for connectivity infrastructure (digital, transport, social)	Buildings need to serve more diverse connectivity needs (e.g., local access to markets and services)	Diversified ways to connect	Extreme weather can disrupt communication and mobility infrastructure
Connect	*How buildings can meet basic need*	• Expand smart infrastructure, turning buildings into consumers and generators of public real-time data • Better served by transport networks • Design based around community spaces	• Multi-use development, reducing distance to markets and services • Multi-generational building design	• Virtual and augmented reality devices create "digital buildings" • Collaboration platforms tailored to needs of a building (e.g., shared space management and community networking apps)	• Robust connectivity infrastructure, including backup systems • Flexibility to repurpose buildings for use in emergencies
Power	*Impact of megatrend on basic need*	Increasing demand for power at a system level, higher costs for power infrastructure	Demographic transition changes how power is consumed	New energy technologies change how buildings power our lives	Disruption to centralized energy infrastructure
Power	*How buildings can meet basic need*	• Building-level energy generation and storage, plus a focus on efficiency	• Adapt to potential shifts in daily peak consumption • Changes in accessibility technology in building, e.g., better lighting and audio-assistive technologies	• Sophisticated energy management beyond consumption data, e.g., pricing information and automatic management • Buildings become "mini powerplants" and active participants in grids	• All buildings host energy generation and storage technologies, becoming less reliant on centralized models of energy

Source: United Nations Department of Economic and Social Affairs (2018), *2018 Revision of world urbanization prospects; International Energy Agency (2021), Net Zero by 2050: A Roadmap for the global energy sector, P141; United Nations Department of Economic and Social Affairs (2022), World Population Prospects 2022: Summary of results; Oxford Economics (2019), How robots change the world, P22; C40 Cities (2018), The future we don't want: How climate change could impact the world's greatest cities,* UBS

The need to minimize lifetime emissions

From a climate perspective, all buildings need to take roughly the same set of actions to reduce their emissions. Table 2 outlines these steps, highlighting two tracks along which emissions need to be reduced: operational emissions, created through the day-to-day use of buildings; and embodied emissions, i.e., the emissions created due to construction and "baked into" materials like cement.

Table 2: Reducing the lifetime emissions of new buildings
Most of a building's emissions are operational, but a sizable chunk is "embodied" in its structure

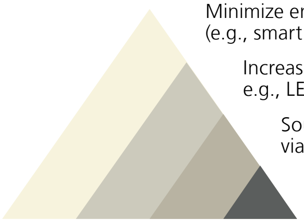
Operational emissions

What is it?
GHG emissions produced in the day-to-day operations of a building. Either direct, such as from burning fossil fuels in a boiler, or indirect (occurring away from the building) through consuming electricity to power lights.

Contribution to global emissions

Residential (direct)	Residential (indirect)	Non-residential (direct)	Non-residential (indirect)
6%	11%	3%	8%

Reduction hierarchy



- Minimize energy demand (e.g., smart metering, upgrading building envelope)
- Increase energy efficiency (improved efficiency of appliances, e.g., LEDs and heat pumps)
- Source green energy (e.g., onsite renewables or offsite renewables via power purchase agreements)
- Offset (any remaining emissions)

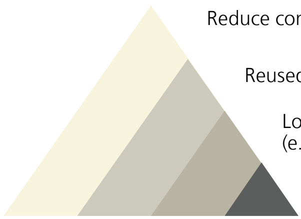
Embodied emissions

What is it?
GHG emissions created through building. Includes emissions created when producing and transporting materials (e.g., glass, steel, and concrete), during construction, and at the end of a building's useful asset life (e.g., demolition).

Contribution to global emissions

Concrete, aluminium and steel used in construction	Other materials (such as bricks and glass)
6%	3%

Reduction hierarchy



- Reduce construction and material use (build less, build light)
- Reused/recycled materials in construction
- Low-carbon alternative materials in construction (e.g., low carbon concrete, steel from electric arc furnaces)
- Increased prefabrication (cut build times, traffic, water and waste consumption)*

*While the technologies to produce low-carbon materials exist, significant uncertainty still surrounds their feasibility, cost, and therefore, production at scale. It is likely to be at least a decade before materials like low-carbon concrete and steel develop single-digit market shares; most forecasts predict they will begin entering the market from the early- to mid-2030s (e.g., IEA, 2020).

Source: UNEP (2022), *2022 Global status report for buildings and construction,* UBS

We have the technology

Technology is crucial but it is not what is holding us back from decarbonizing buildings. What we need is in the pipeline and likely to come to fruition in the late 2020s or early 2030s, or is market-ready today.[25] Rather, the challenge is political will, individual mindsets, and data availability:

- **Insufficient focus on whole lifecycle carbon emissions:** Today, efforts to decarbonize buildings focus mostly on operational emissions—better energy efficiency and widespread electrification—because these are the easiest to tackle. But there is widespread agreement in the market that to meet Net Zero targets, we need to consider the whole lifecycle carbon emissions of buildings, particularly embodied emissions, which constitute as much as 20–25% of lifetime emissions in a typical building.[26] Embodied emissions will grow in importance as buildings become more operationally efficient, making up 45–50% of lifetime emissions for an energy-efficient building and over 90% *"in extreme cases."*[27]

- **Data not yet fit for purpose:** Assessments of whole lifecycle carbon emissions are not sufficiently reliable or comparable. Like all model-based assessments, the results are dependent on the quality of the inputs. Currently, there is significant uncertainty as to the carbon content of materials used in a building. This uncertainty is built in at multiple steps in the value chain—emissions calculated depend on the assessor the contractor chooses; the calculation software the assessor chooses; the accuracy of the carbon coefficients used by the suppliers of each material, which are subjective and often not disclosed; and on the contractor being able to source the materials used in the original calculation, which is not always the case. In short, there is more than enough uncertainty to fuel disagreement over the numbers. An assessment of embodied emissions could miss the mark by 30–40%. This muddies the waters, incentivizing creative emissions accounting while undermining incentives to minimize carbon emissions. Government coordination of consensus building on material emission factors and better education for market participants could help streamline the data.

- **Costs are perceived as too high:** This thinking is down to a few reasons. First, the long lives of today's buildings make it difficult to manage budgets predicated on costs and cash flow that span multiple decades. Second, it is also a function of the sector's low margins,[28] which focus minds on suboptimal solutions that maximize returns today (by lowering upfront costs) at the expense of balancing costs and benefits over a building's lifetime (raising lifetime costs). Because those longer-term costs are not sufficiently reflected in the bottom lines of construction companies or building owners, the incentive to use, for example, higher-cost, lower-emission steel, is lacking.

Prioritizing the present over the future is a natural evolutionary tendency, but long-term thinking for the benefit of future generations is now imperative. There are signs of it working in other sectors: already more electric than conventional vehicles are sold in some countries, and investment in renewables now outpaces that of fossil fuels.[29]

The equivalent here—to ensure all new buildings are sustainable—is possible and affordable in the building sector today. It is mostly a question of mindset and the incentive structure provided by policymakers. As with property owners, this needs to shift from the current, outmoded short-termist mindset—seeing buildings only through the lens of the present—toward a long-term, anticipatory mindset, which evaluates buildings over their whole asset life.

[25] Technologies targeting operational emissions are market-ready today, while those targeting embodied emissions are in the pipeline and are likely to begin entering the market in small amounts in the later 2020s; For more information see Shell and Deloitte (2023), *Decarbonising construction: Building a low-carbon future*, P11.
[26] Rock, M, et al., (2020), *Embodied GHG emissions of buildings – The hidden challenge for effective climate change mitigation, Applied Energy.*
[27] Ibid
[28] Shell and Deloitte (2023), *Decarbonising construction: Building a low-carbon future*, P14.
[29] IEA (2023), *Global EV Outlook 2023;* IEA (2023), *World Energy Investment 2023.*

Box 4

Commitment to sustainability: The UBS experience with 5 Broadgate

Branded as one of the most sustainable office buildings of all time when it was completed in 2015, 5 Broadgate has been UBS's London office for around 6,500 staff since then. The building's design incorporates a range of sustainability factors:

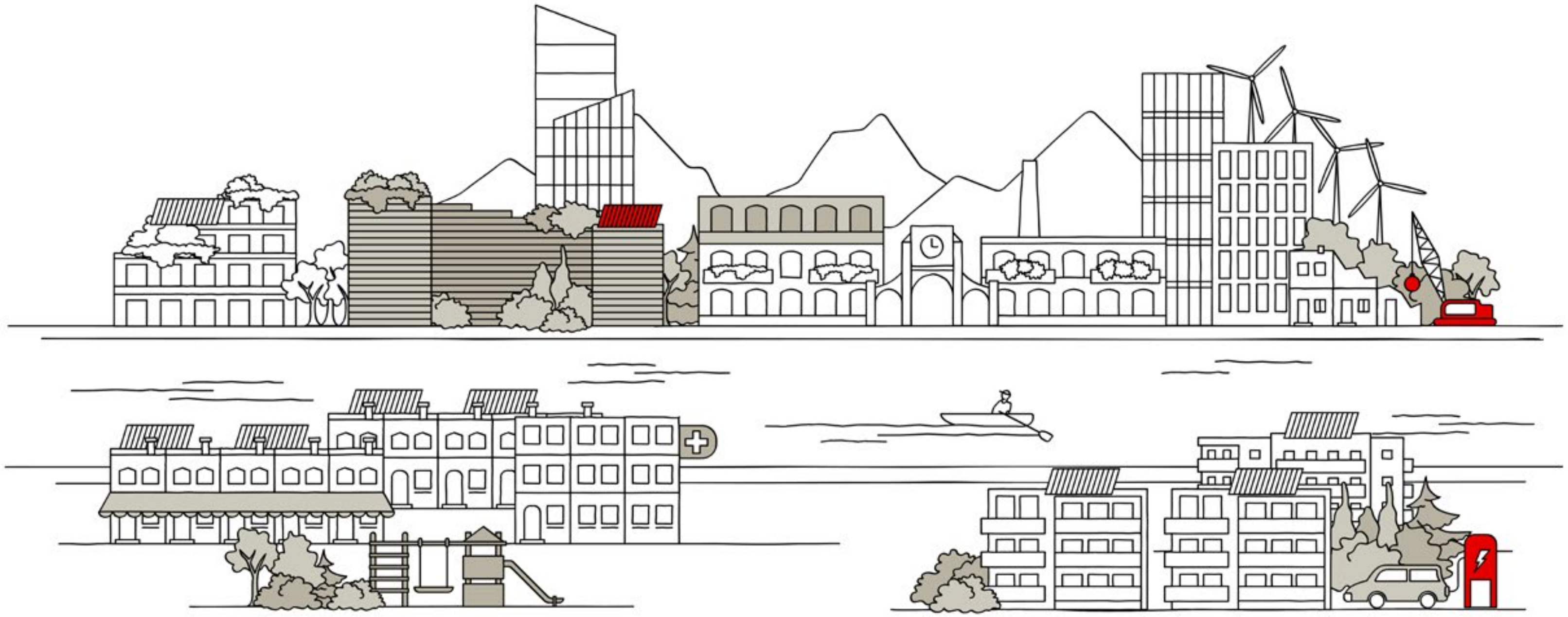
- **Reduced upfront footprint:** 99% of the construction waste was diverted from landfill.
- **Reduced ongoing footprint:** The building hosts the second largest solar photovoltaic and thermal panel area in London; 100% of its electricity is procured from renewable sources; rainwater harvesting cuts mains water use by 1.7 million liters per annum; and, the building has a waste heat from air conditioning recovery and redistribution system, which minimizes the need for heating.
- **Mobility:** 497 bike spaces promote active commuting, and while there are some car parking spaces, they are reserved for clients only, and one-third of them are dedicated to electric vehicles.
- **Flexibility:** Floors are arrayed so they can be easily redesigned to meet ongoing needs. The floor plate shape also has regular indents to provide more natural light, making the building more suitable for future non-office uses such as apartments.[30]

These attributes earned the building high marks under industry sustainability accreditations, including "Excellent" under BREEAM (whole building) and "Platinum" under LEED (interior).

[30] Gensler (2018), *Design parameters for urban office to residential conversion,* P3.

No longer fit for purpose

Demographic changes, urbanization, altered work practices, sustainability concerns, and rising physical risk are changing the optimal mix and location of building infrastructure. As a result, some buildings and even whole settlements may no longer be required in their current form and are likely to be better off being adapted and reused, demolished and rebuilt, or simply decommissioned altogether.



The conversion opportunity

As economic models and human behavior change, so too does the mix of buildings we require. This inevitably pushes some structures into redundancy, even with a deep retrofit, requiring unconventional ways to reimagine spaces (Figure 4, Box 5). For example, just as a structural shift from manufacturing to services can result in the conversion of factories and warehouses to apartments and offices, so the shifts to hybrid-working (Box 6) and online retail are bringing opportunities to redevelop a new generation of underutilized spaces.

> As economic models and human behavior change, so too does the mix of buildings we require.

Conversion options can be office- and retail-to-residential or even commercial-to-food production in the form of vertical farms. Full conversions, known as adaptive reuse, are likely to be combined with an increase in mixed-use properties (where office space is combined with living space in the same development, for example). More people "living above the shop," or close to it, has the added benefit of reducing commuting times and the associated vehicle miles travelled. The Intergovernmental Panel on Climate Change (IPCC) has stated that integrated spatial planning, including the "co-location of higher residential and job densities, mixed land use and transit-oriented development could reduce greenhouse gas emissions between 23% and 26% by 2050" versus a business-as-usual scenario.[31]

Figure 4: When retrofitting is not enough

Options for a building no longer fit for purpose in its current form, even with a deep retrofit

Adapt and reuse

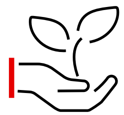
When?
A viable structure not at the end of its life that can be repurposed

What?
Building conversion e.g., office-to-residential, possibly with extension or other upgrades

Demolish and rebuild

When?
Prohibitive retrofit costs relative to value, safety concerns, or opportunity for major upgrade of plot with co-benefits like densification or social amenities

What?
Demolish the building and build a new, better structure



Decommission and re-wild

When?
A falling need for real estate infrastructure in that area

What?
Decommission the building; recycle the materials where possible; return the plot to nature

Source: UBS

[31] Lwasa, S., K.C. Seto et al., (2022) *Urban Systems and other Settlements* in IPCC: Climate Change 2022 Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, P864

Box 5

Battersea Power Station: From boom to bust and back again

Commissioned in 1929 but only completed in 1955, this coal-fired power station supplied one-fifth of London's power needs at its peak. It closed in 1983 due to its age and amid a general move away from coal, falling into disrepair in the ensuing decades as it struggled to find a use. Various schemes were proposed to revive it, one of the most colorful being a theme park. The site was eventually saved by the meteoric rise in London's luxury property market over the past two decades, which meant that it could be economically redeveloped into a mixed-use community development while maintaining its iconic aesthetic.[32] Crucially, its bone and substructure were retained, minimizing the embodied carbon spent versus a completely new development.

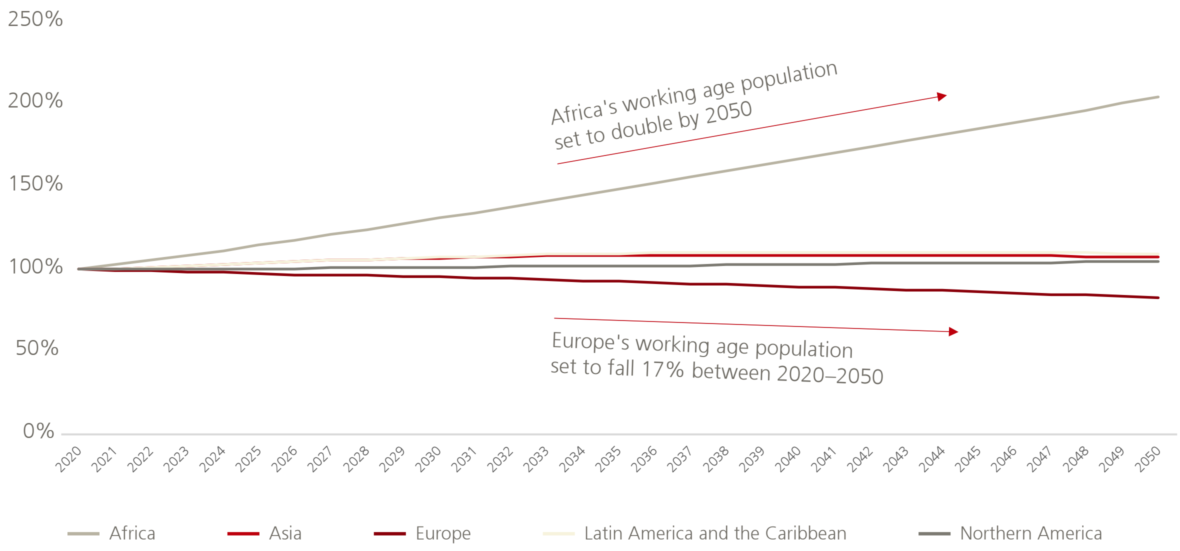
But the scale and feasibility of such opportunities is likely to differ markedly by geography. The need for residential space over offices is likely to be particularly acute in Europe, where the working age population is already falling and is forecast to fall a further 17% between 2020 and 2050.[33] By contrast in Africa, it is expected to double over the same period (Figure 5).

One caveat is that such conversions should be sensitive to the needs of potential residents—some office buildings with a large floor plan may be hard to convert to apartments without leaving some with no access to natural light. In some such cases, a demolition and rebuild may make more sense than a conversion, although innovative approaches to solve this problem are being used today, such as New York's 180 Water Street office-to-residential conversion, which in effect punched a hole in the middle of the 20-story building to create a courtyard.[34]

[32] Battersea Power Station (undated), *The history.*
[33] United Nations Department of Economic and Social Affairs (2022), World Population Prospects 2022: Summary of results.
[34] Bloomberg, (2023), *What it actually takes to turn an office building into apartments*

Figure 5: Working age populations set to decline in most continents except Africa

Projected percentage change in working age populations (15-65), base = 2020



Source: United Nations, UBS

Box 6

Is hybrid working a flash in the pan?

The jury is still out on hybrid working. It is not clear whether it has a positive or negative impact on worker productivity.[35] Some studies have suggested it could have a positive impact, mostly thanks to the time saved on commuting.[36] What is clearer is that workers like it—it may be valued to the tune of around a 10% pay increase.[37] It also reduces the overall need for office space and thus the office overhead for the firm. Yet, hybrid working is not an option for everyone, with only around 18% of the global workforce in occupations and locations with the right infrastructure to facilitate it.[38] The desirability from a business perspective is also less clear-cut, and there are a growing number of examples of companies calling their employees back to the office full time. Regardless, to some degree remote working looks likely to be here to stay.

[35] UK Parliament, (2022), *The Impact of Remote and Hybrid Working on Workers and Organizations*
[36] Barrero et al., (2021), *Why Working from Home will Stick, Becker Friedman Institute*, University of Chicago, P4
[37] SHRM (2022), Article: *Nearly Half of Workers Are 'Definitely Looking' to Work Remotely*
[38] Bonnet, F. et al (2020), *Working from home: Estimating worldwide potential,* VoxEU/CEPR; the ILO arrive at a similar number (17%) via survey evidence, see ILO (2021), *Policy brief: From potential to practice: Preliminary findings on the numbers of workers working from home during the COVID-19 pandemic.*

When rebuilding is better

Demolition and rebuild incurs a hefty, embodied carbon cost and should therefore be avoided where possible. However, dogmatism is unhelpful—not every existing building can or should be saved and "retrofit first" should not mean "retrofit only." The cases where a rebuild may be preferable include:

> "Retrofit first" should not mean "retrofit only."

- **When retrofitting is prohibitively expensive relative to the end value of the property:** Retrofitting a non-sustainable building may have such an unattractive cost-to-value ratio that rebuilding is the better option. Retrofitting costs are highest when a building and its systems are antiquated or the process itself is particularly difficult. These factors often converge with an otherwise undesirable, low-value building, which, even if made energy-efficient via a costly retrofit, would still be unattractive to potential tenants. In such cases a retrofit may represent poor value-for-money.

- **When building safety is an issue:** If a building is structurally unsound or there is uncertainty regarding the safety of the materials used in its construction, demolition may be the best choice. Similarly, if a very deep and costly retrofit is required but the "bones" of the building are not strong enough to withstand a space extension, the economics of the retrofit may not add up. However, it is worth noting that, if energy-inefficiency discounts and the green building premiums become large enough, then this problem may be solved. As regulations tighten, the difference in value between a stranded energy-inefficient building, which cannot be rented out and could even have negative value, and a high-efficiency green building, becomes increasingly likely to cover the cost of a retrofit, the higher the energy-inefficiency discount and green premium become.

- **When there are important co-benefits like densification:** In areas of high property demand which are currently underbuilt, new building plans enabling densification may be desirable (Box 7). In some cases, a new building plan can be transformative for a plot or area. For example, a joint venture by the UK charity St Mungos and a British company called Stories is in the process of demolishing a three-story 1960s hostel in London to replace it with a new 20-story apartment block and accompanying 8-story homeless shelter.[39] This could add significantly to the supply of housing in the area, while also improving the supply of social services.

With an eye on transparency, the above-mentioned economic and social factors should be quantified as far as possible and weighed against the carbon cost of a new development versus the option of retrofitting. There are both positive and negative externalities associated with the demolition of an existing building and its replacement with a new development, but too often these are subordinated to factors that have a market price. Government action to ensure that the environmental impact of redevelopment versus retrofitting is reflected on developer and building owner bottom lines is key. A carbon tax on embodied carbon, perhaps levied when a building is bought and sold, might be one place to start. Another would be carbon passporting of materials to ensure there is better transparency of the emissions in the construction value chain.

[39] Stories, *217 Harrow Road, W2.*

Box 7

Promoting "good" densification

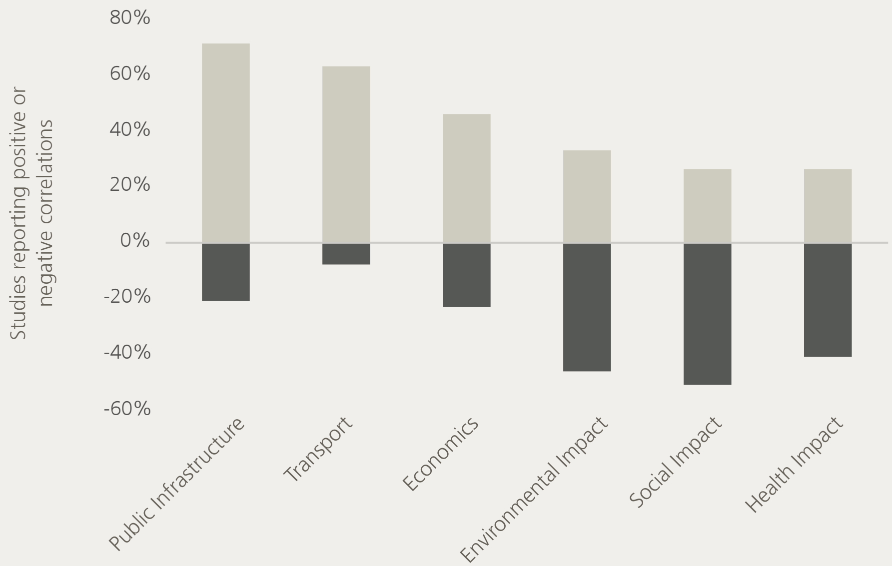
There are various forms of densification. One such initiative, Verdichtung, is the Swiss concept of demolishing houses with large gardens and building much higher density housing on the land. Its literal translation is, roughly, "compaction" and it is designed to avoid the need to enlarge towns beyond their existing borders, even as their population grows.

Some argue that all urban areas should aim for density, but at a macro level, densification presents trade-offs. A recent meta-review by Berghauser et al. (2021) found densification has a positive effect on things like transport (it is far cheaper per passenger when everyone is closer together), but on other criteria its effect is mixed (Figure 6).

What should we conclude from this? Density presents vital benefits for improving economies, infrastructure, and the climate, but done inadequately, it negatively impacts people's lives.[40] Culture plays a large role, with Western European cities tending to favor "gentle density" through five-story blocks with preserved historical facades, versus some US cities that favor "hard density" characterized by skyscrapers. These different forms can all work if well managed, because density is a means and not an end.

Figure 6: The mixed effects of densification

Proportion of studies reporting a positive or negative correlation between density and its impact. This chart hides the strength of each correlation, but it varies between cities, making aggregate views less meaningful



Source: Berghauser Pont, M. et al (2021), Systematic review and comparison of densification effects and planning motives, Buildings and Cities, UBS

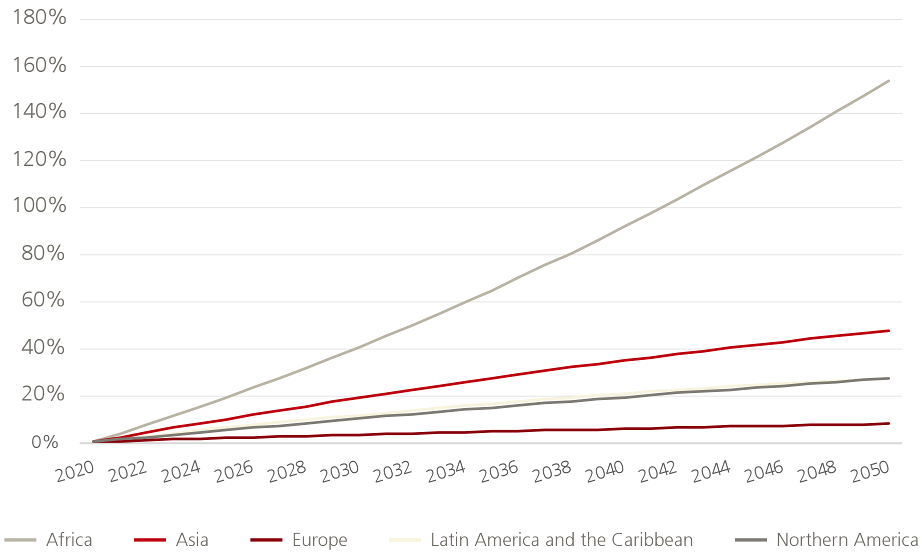
[40] Within environmental impacts, the authors include four components (macro climate, micro climate, biodiversity, and ecological condition), of which only macro climate has a net positive correlation with density.

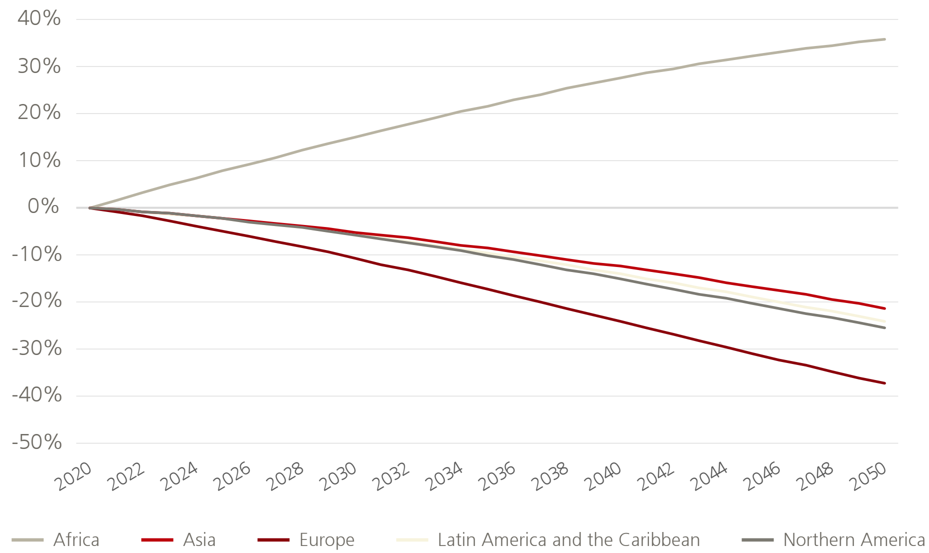
Giving up the ghost: When decommissioning is best

In some circumstances it makes sense to decommission entirely, with the space either given back to nature or used as a nature-based solution, e.g., for water management or heat reduction (Box 8). This might seem wasteful but could become increasingly desirable in certain areas as populations rise in age and fall in numbers, and climate change takes its course. Countries encompassing half of the world's GDP have a declining population; at the extreme, 80% of Japan's towns, cities, and villages are affected.[41] The continued trend toward urbanization is exacerbating population declines in rural areas. In Asia for example, where the overall population is projected to increase by 14% from 2020–50, the urban population is projected to grow by 47%, while the rural population is projected to decline by 21%[42] (Figure 7).

Figure 7: Urban populations are expected to grow while rural populations mostly shrink

Projected percentage changes in urban (left) and rural (right) populations by continent from 2020–50, base = 2020





Source: United Nations, UBS

[41] Nikkei Asia, (2021), *Not all Japanese towns are shrinking: 300 show how it's done.*
[42] United Nations Department of Economic and Social Affairs (2022), World Population Prospects 2022: Summary of results.

Box 8

Incorporating nature into buildings: Bloom or bust?

Including environmental features in developments provides benefits. Street trees for example reduce heat, can serve as natural "carbon sinks," and increase the "feel good" factor of seeing green in the concrete jungle. The benefits not only accrue to those using the building, but also to anyone who uses that street as well as the surrounding area.

These public benefits provide a case for buildings undergoing redevelopment—either through remodeling or rebuilding—to incorporate more nature, at least from a societal point of view. People and the environment benefit. Why then are cities (on average) becoming less green over time as they densify, with a 10% increase in density associated with a 3% fall in green canopy?[43]

There are a couple of drivers. Competition for space in cities is high, and installing green features means something else cannot go in that spot (the opportunity cost). Another is financial cost and familiarity: Natural solutions, absent other incentives, tend not to generate a financial return, and their benefits flow mostly to those not paying for them. Furthermore, based on our conversations, developers tend to prefer to stick with what they know—concrete, steel, and glass.

Remodeling or reconstructing buildings presents opportunities to design nature into developments from the outset. But due to the hurdles outlined above, the economics often do not stack up. If re-greening cities is a priority for society, it requires both incentives and penalties. One example is Chicago, which gives developments with green roofs an increase in permitted floor-to-area ratio, increasing the amount that can be built in a given space.[44]

Some governments are fighting mostly losing battles to convince people to move to declining districts. However, at some point they may be better off helping people move to non-declining areas as they can then empty already hollowed out settlements. Such an approach could reduce the need to finance old infrastructure in thinly populated areas where the cost of providing services is higher because economies of scale cannot be achieved. It is necessary to plan for what happens to the built infrastructure that is left behind, as simply abandoning it entails significant environmental and social risks (Box 9).

Growing physical risk is likely to be another major driver of decommissioning (Table 3). Coastal erosion, rising sea levels, and rising temperatures can all threaten the viability of whole settlements in affected areas, either directly or indirectly, via un-insurability. Adaptation measures can sometimes provide solutions, but in acute cases, which are likely to become increasingly common in the coming decades, decommissioning, and relocating may make the most sense.

[43] McDonald, R. et al. (2023), *Denser and greener cities: Green interventions to achieve both urban density and nature*, People and Nature.
[44] Berghauser Pont, M. et al (2021), *Systematic review and comparison of densification effects and planning motives,* Buildings and Cities.

Table 3: What could drive building decommissioning?

Growing physical risk and population declines driven by demographic changes and urbanization are likely to depopulate some areas

Rising physical risk

- +26% — Projected increase in US flood risk by 2050
- +30% — Projected increase in global wildfire risk by 2050

Depopulation to 2050

- 13 — Countries facing falling urban populations
- 133 — Countries facing falling rural populations

Decommissioning Risks

- Loss of historical heritage
- Moving people to where they have fewer social connections
- Pollution from improperly decommissioned buildings

Decommissioning Opportunities

- Re-allocation of resources away from underpopulated areas
- Relocation of individuals and infrastructure to lower risk areas
- Address social impacts of loneliness and disconnection
- Recycle materials

Source: United Nations, UN Environment Program, Nature Climate Change,[45] UBS

Box 9

The risks of not decommissioning unused buildings

Over time, neglected structures degrade when not maintained. This can cause building materials to decay into toxic substances that harm both the environment and local populations. One example of this is the "toxic plume" on Long Island from the decommissioned Northrop Grumman facility. By neglecting maintenance—and then refusing to address the risk—the plume expanded dramatically, seeping into the water table, and compromising drinking water for many local communities.[46] This was happening even while the facility was open and operating, but the closure of the facility allowed the plume to spread largely unchecked. The end result was not only the hefty environmental and social risks imposed upon the local community, but also the much higher costs required to remediate further toxic encroachment.

Neglected structures can also raise social risks, creating semi-lawless areas where crime rates rise, and residents feel unsafe.

[45] Wing, O. E. J., et al., (2022), *Inequitable Patterns of US Flood Risk in the Anthropocene, Nature Climate Change*.
[46] Newsday, (2020), *The Grumman Plume*.

Laying the foundation for better buildings

The direction of travel for buildings seems clear. With over 90% of GDP covered by Net Zero targets, governments have implicitly signed the sector up for full decarbonization by 2050. The required annual 3.6% reduction feels temptingly easy, but left unchecked the sector's emissions could double by 2050. Changing mindsets and new approaches to regulation and capital allocation will prove key.

Output economy barriers

The buildings sector remains in an output economy[47] mindset, characterized by producing more buildings that are not always aligned with society's needs: Buildings still emit large amounts of greenhouse gases, are sometimes built in places where people do not want to live, and can be constructed without enough heed to local infrastructure capacities. Construction activities need to become better aligned with society's changing needs, at the same time as we optimize the buildings we already have.

In a functioning impact economy, markets would deliver these shifts alone, pricing buildings in line with their positive and negative impacts on society and the planet (externalities). The economic balance would tilt away from energy-inefficient buildings, leaving them costing more in impact terms (with associated lower capital value) and generating lower returns (lower rents or occupancy retention). Owners would think twice about knocking down an existing building if they had to pay a price for its climate and environmental impact, making retrofits a better option for their wallet and the planet. Buildings represent over 30% of global real assets today[48], but those that cannot adapt to changing megatrends could find obsolescence creep in over time, leaving their owners out of pocket.

But this is not happening. Why? We believe there are three barriers:

1. **Information failure:** Sustainability information fails to make its way up and down the building value chain. As discussed in Section 2, building owners assess carbon impacts in divergent ways, such as drawing on dissimilar methodological assumptions, making the carbon footprint of two similar buildings hard to compare.[49] In other cases, information is not available anywhere in the chain. For instance, market-wide uncertainty over real estate's specific trajectory to net zero by 2050—the required emission reductions in different submarkets, how fast, where first—ensures decarbonization remains largely outside of market decisions.

2. **Insufficient rewards for better buildings (positive externalities):** The benefits of better structures tend to accrue to tenants, not owners. A good example is retrofitting: the energy efficiency benefits flow to tenants via lower bills. Owners shoulder the cost, while in some markets receiving too low an upside (versus energy-inefficient buildings) through either higher rents or a higher value for the whole building. In some areas evidence of a "green premium" for buildings with green certificates is growing, but it tends to go unacted upon by asset owners (it is challenging to underwrite or develop a business plan on location-specific evidence), or the premium remains too small to justify the investment. Current market attitudes maintain this status quo, ensuring the price uplift of green buildings remains too small to reflect their positive climate impact.

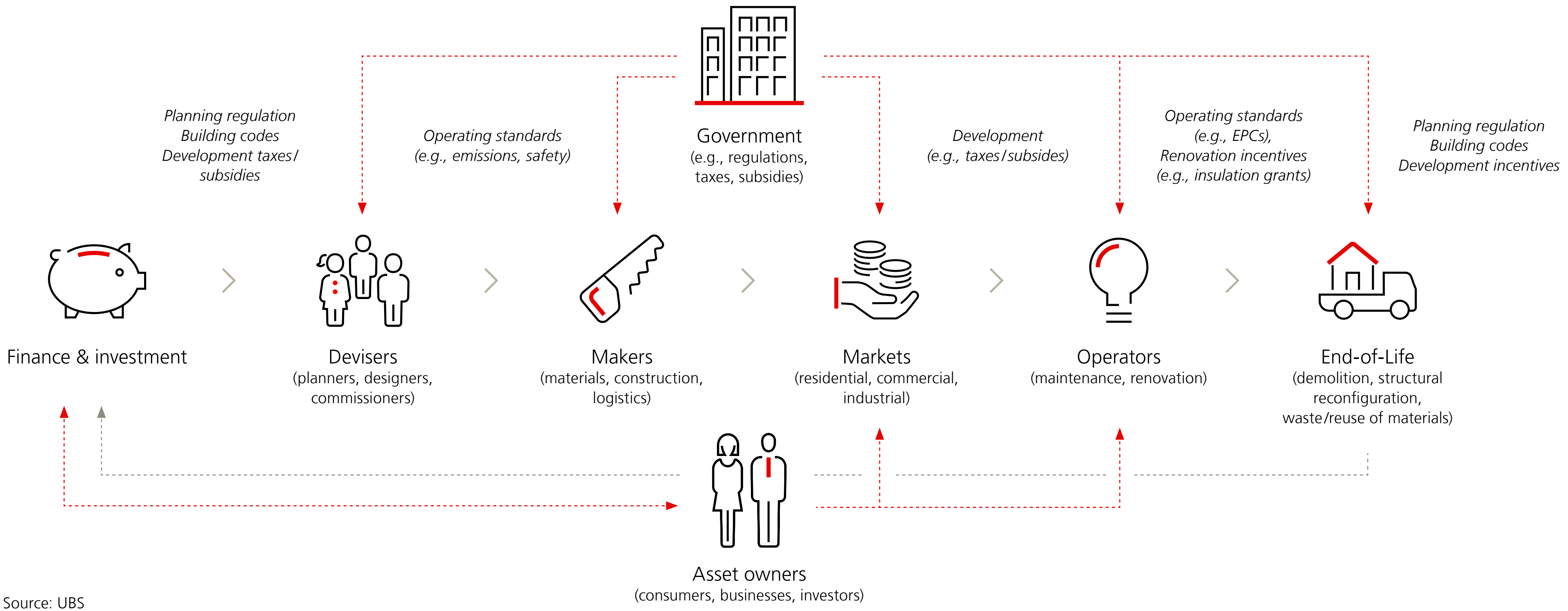
3. **Inadequate penalties for worse buildings (negative externalities):** In some markets, buildings that create negative environmental, economic, and social impacts remain broadly as valuable as those that avoid them. Factors like location, appearance, and size drive the value of buildings, while hidden costs remain out of the equation. For instance, data centers in the west of London were installed without regard for their impact on local electricity grids. Due to oversubscribed public infrastructure, applications for essential housing face a possible ban until 2035.[50] This is a classic characteristic of the output economy: Production ignoring the hidden cost (grid impact) of its output (data centers), storing up costs (housing shortages) for the future.

[47] UBS Sustainability and Impact Institute (2023), *The rise of the impact economy: Evolving to the next level.*
[48] McKinsey Global Institute (2021), *The rise and rise of the global balance sheet: How productively are we using our wealth?;* Dwellings and non-residential buildings were 31% of global real assets in 2020.
[49] Robati, M. et al (2019), *A method of uncertainty analysis for whole-life embodied carbon emissions (CO_2e) of building materials in a net-zero energy building in Australia, Journal of Cleaner Production.*
[50] Financial Times (2022), *West London faces new homes ban as electricity grid hits capacity.*

A sole market stakeholder or even a group of stakeholders cannot overcome these barriers alone (Figure 8). The issues are deeply entrenched in today's buildings market—sustainability information struggles to flow, while building values and rents do not reflect externalities—keeping us in output-economy-mode as building owners toe the market line.

Each link in the value chain can play a unique role to overcome the market's current teething problems (Table 4). Governments, asset owners, and the financial sector have leading roles given their cross-value chain position and the tools at their disposal. Other stakeholders remain crucial enablers of change, given addressing market-wide barriers requires a whole-value-chain approach.

Figure 8: Governments and asset owners plug in at multiple points of the value chain
Overcoming market barriers is only possible through a whole-value-chain approach



Source: UBS

Table 4: A whole-value-chain approach is required

Each link in the value chain can play a unique role to overcome current market barriers

Roles: Leader Enabler

Barrier themes	Details: *Description*	Details: *Example*	**Governments** *Regulations, taxes, subsidies*	**Devisers** *Planners, designers, commissioners*	**Makers** *Materials, construction, logistics*	**Operators** *Maintenance, renovation*	**End-of-Life** *Demolition, reconfiguration, waste/reuse*	**Finance and investment** *Banks, investors, insurance*	**Asset owners** *Commercial, residential, industrial*
Information failure	No common sustainability concepts, leading to stakeholders speaking past each other	Building owners assess carbon impacts in divergent ways, making the carbon impact of two similar buildings incomparable	Promote international disclosure & assessment standards Align regulatory tools with Paris emission pathways	Build downstream sustainability into designs		Ensure post-certification sustainable management of buildings Proactively collect and organize data on assets. Promote disclosure through asset owners	Articulate trade-offs of options–demolition vs. reuse or recycle	Promote uniformity in sustainability concepts along value chain (e.g., green bonds using same standards; portfolio allocation using standard metrics) Grow and align green real estate products Vocalize industry needs Connect the dots Form public-private partnerships Share best practices	Unite and disclose behind common sustainability concepts Obtain comparable building certifications, then operate assets in line with standards
Insufficient rewards for better buildings (positive externalities)	The benefits of building better structures tend to accrue to tenants, not owners. Where a green premium may exist, it may not be considered high enough to compensate	Energy efficiency benefits flow to tenants via lower bills. Owners shoulder the cost while receiving limited upside through either higher rent or seeing a higher value for the whole building	Use carrots and sticks to enhance green premium, such as: • Taxes: Linking property taxes to energy efficiency • Subsidies: Tax credits for better energy efficiency • Regulations: Favorable planning for greener buildings Minimize regressive impacts, particularly on residential	Maximize potential from carrots to make the economics work (e.g., subsidy stacking) Proactively design and make buildings to align with climate pathways, or at least anticipate transition risks that materialize over a building's asset life (e.g., rising minimum EPCs) Source and use green materials		Ensure buildings are operated in line with green certifications Articulate cost savings from greener buildings via data collection and publication	Maximize potential from carrots to make the economics work (e.g., subsidy stacking)	Grow and align green real estate products Adjust horizons Form public-private partnerships Share best practices	Maximize potential from carrots to make the economics work (e.g., subsidy stacking)
Inadequate penalties for worse buildings (negative externalities)	Buildings that create negative environmental, economic, and social impacts remain broadly as valuable as those which avoid them	Some types of buildings lead to too much demand on public infrastructure without paying the costs (e.g., data centres in West London) pressures on public infrastructure	Use carrots and sticks to deepen the discount on worse buildings, such as: • Taxes: Pricing energy based on grid constraint (promoting lower building in constrained areas, plus better building efficiency) • Subsidies: Subsidize insulation retrofitting • Regs: Levy decommissioning funds on buildings that store up future costs Minimize regressive impacts, particularly on residential	Design buildings with rising transition risks in mind (e.g., rising minimum EPCs; potential future infrastructure capacities)			Articulate trade-offs of options (i.e. demolition vs. reuse or recycle)	Perform transition risk assessments on portfolios of buildings Grow and align green real estate products Adjust horizons	Articulate issues caused by nearby problematic buildings (e.g., impact on local infrastructure capacity)

Source: UBS

Moving buildings toward the impact economy

In an ideal world, markets would allocate capital in way that achieves beneficial long-term outcomes. Given the conflicting interests and the speed of change required—left unchecked, buildings' current emissions will double by 2050[51]— the right incentive structures are crucial. Governments, therefore, have an indispensable role to play in putting buildings on a sustainable path, in keeping with a broader societal transition toward a more sustainable "impact economy"—as discussed in a recent UBS White Paper.[52] In a world with no silver bullets, governments can take a series of small but cumulative steps to create the conditions for markets to take over sustainable capital allocation. The tools exist today, with clear examples of governments putting them to work (Table 5).

Table 5: The tools to overcome most market barriers exist today

Barrier theme	Barrier examples	Sticks		Carrots	
		Tool	*Example today*	*Tool*	*Example today*
Information failure	Carbon metrics	Whole life carbon assessment standards	France and Netherlands—mandatory whole life carbon assessments for built environment	Preferential treatment in planning if application includes carbon assessment using common standard	London Plan 2021—calculate whole life carbon along "nationally recognized standard"
		Carbon disclosure obligations	SEC climate proposals		
	Uncertainty over the transition	Clear sector decarbonization pathway, with ratcheting standards	Rising minimum energy efficiency standards— many European countries	Additional planning incentives for retrofitting	Singapore 2nd Green Building Master Plan—up to 2% additional gross area for better energy efficiency
Insufficient rewards for better buildings (positive externalities)	Owners unable to capture upside from retrofitting	Link property tax rates to energy performance standards	EU considering expanding ETS to buildings	Tax credits for higher energy efficiency	US tax credit per square foot for buildings that meet ASHRAE[53] standard
	Incorporating more nature	Planning system targets for minimum green areas in development proposals	Urban Greening Factor—Malmo Biodiversity net gain	Subsidies for development greening streets	UK Green and Healthy Streets Fund
Inadequate penalties for worse buildings (negative externalities)	High impact on public electricity infrastructure	Higher energy prices where grid constraints are high	Australian local electricity pricing market	Subsidies for Active Buildings which adjust their grid demands to the needs of the system	
	Poor building materials raise safety risks	Regulate to ensure building owners set funds aside over time for "decommissioning" costs	UK regulation makes construction companies replace unsafe cladding	Preferential treatment for buildings that reduce urban heat island effect	Planning favors LEED certifications (and others) that reduce urban heat island–multiple countries
	Owners neglecting to retrofit	Tax penalty for non-efficient buildings	Local Law 97 (LL97) in New York: Buildings >25k sq ft below efficiency threshold incur penalties from 2024	Subsidies for retrofitting	LL97 in New York: Deductions planned for onsite renewable generation

Source: UBS

51 The Economist (2022), The construction industry remains horribly climate-unfriendly.
52 UBS Sustainability and Impact Institute (2023), *The rise of the impact economy: Evolving to the next level.*
53 ASHRAE stands for the American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Given no real estate market is decarbonizing at the required rate, we can safely say that no government has yet achieved the right balance between carrots and sticks. Some policies will work in one market but not another, making this more of an art than a science. And the task is becoming harder as the world finds itself in a trickier macroeconomic environment.

Focusing capital on impactful buildings

Private finance through its current toolbox (Box 10) can do most heavy financial lifting when it comes to decarbonizing the building stock. Total investment required to decarbonize the global building stock is a minor proportion of overall investment in buildings today—from a purely technological perspective, estimates suggest the annual investment required to make existing buildings zero-carbon by 2050 could be around USD 630 bn. This is 11% of the current annual investment in building construction and renovation, 90% of which could be met with private sector finance.[54]

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Absolute capital scarcity or lack of market enthusiasm for green financial products are not the main factors preventing the decarbonization of buildings today. The problem is current market barriers mean the economics of sustainable buildings do not stack up as they would under an impact economy.

Box 10

Green real estate financial markets

Real estate represented some 30% of the green debt finance proceeds in 2021, up from 22% in 2014. Debt instruments focused on greening buildings include:

- **Green bonds:** Debt securities designated to improve the built environment (typically through achieving green certifications), where debt is issued (typically by Real Estate Investment Trusts) and the proceeds allocated to specific green building projects;
- **Green loans:** Loans (typically issued by banks) for financing or refinancing where the proceeds go toward eligible green building projects;
- **Green asset-backed securities:** Typically mortgaged-backed securities focused on purchasing energy-efficient assets or improving the efficiency of existing ones.

[54] SystemIQ (2022), *Better Finance, Better Built Environment; The annual investment required to ensure 85% of commercial and residential properties are zero-carbon by 2050 could be around USD 630bn—11% of the sector's current investment in energy efficiency of USD 5.9trn.*

What can finance do today?
Finance alone cannot tackle the real estate market's current problems, but the sector can take steps to help move the needle. These fall into two buckets: changing finance itself *(better finance),* to improve how capital flows toward building; and improving the sector at large *(better value chain),* leveraging finance's cross-value chain position to promote best practices.

Better finance starts with three key actions:

- **Grow and align green real estate products:** The diverse and developing set of green real estate finance products remains a thin slice of the total market today. For instance, green real estate bonds and mortgage-backed securities account for only about 1.5% of conventional bond issuance and new mortgages.[55] Financial stakeholders can continue growing their green product portfolios and market share, and in the process promote more sustainable building. This could lead to a growing importance of products aligning behind common or at least comparable definitions of green (such as alignment with the Carbon Risk Real Estate Monitor (CRREM) pathways), ensuring green financial products promote sustainable building across highly localized submarkets.

- **Align information flows:** Financial practitioners do not have the information today to know where capital can support decarbonization of buildings. Simply put, real estate submarkets are not good at generating and sharing comparable data on carbon performance. This keeps financial practitioners in the dark regarding the relationship between building sustainability and portfolio risk and return—such as the underperformance of buildings with poor green credentials—maintaining a crucial hurdle to promoting confidence in a green premium. Financial practitioners can address these barriers by first aligning behind a framework for reporting consistent carbon data, perhaps using investor coalitions with large industry sway such as the Glasgow Financial Alliance for Net Zero (GFANZ). They can then work with real economy asset owners and developers to disclose data where it is not confidential—highlighting the good versus the not-so-good assets, eventually establishing a new risk-reward benchmark.

- **Adjust horizons:** Some approaches to real estate valuation are necessarily backward-looking. They tend to leverage recent transaction data to build estimates of a building's value today, because recent transactions give a good idea of how a dynamic market is pricing a building. But only looking backward can mask the creep of transition and physical risks. For instance, governments are increasingly imposing minimum energy efficiency standards on buildings that ratchet up over time. This means the most energy-inefficient buildings today are likely to require capital expenditures in the future to bring them up to the regulatory standard. Market appetite for more sustainable buildings could become the norm in the future, as regulations like the Sustainable Finance Disclosure Regulation (SFDR) and the EU taxonomy for sustainable activities clarify the minimum expectations of sustainable buildings. These risks are potentially material to some buildings, but the market barriers outlined earlier mean that the risks tend to go unrecognized in today's prices. Established approaches such as discounted cash flow models[56] offer methods to look forward in addition to backward.[57]

Optimizing for a better value chain requires three key actions:

- **Connect the dots:** The value chain of the building sector can be siloed. However, finance has a foot in every door, providing capital at various points in the chain. Connecting the dots between disparate stakeholders is an important and necessary role that finance can fill. This is already happening today, e.g., in Switzerland UBS

[55] OECD (2022), *Real estate and climate transition: Market practices, challenges and policy considerations,* P16.
[56] Le Goff, N. (2022), *Why now is the time for a better approach to valuation in the UK and Europe, AltusGroup.*
[57] Such as through Discounted Cash Flow approaches which are used in some markets and that take into account capex, including that related to (for instance) retrofitting assets to meeting future regulations covering minimum energy efficiency performance.

provides a renovation calculator in collaboration with an independent service provider, an example of connecting customers with products that can assist them with sizing renovation costs.[58]

- **Form public-private partnerships:** Finance can form public-private partnerships to promote efficient routes for green building projects to find capital alongside public funds. One such example is the city of Ljubljana, Slovenia, which funded the retrofit of 48 buildings, many of which belonged to the government, with 49% coming from the Ljubljana city budget and the remaining 51% from two companies, Petrol and Resalta, with repayment set for 15 years.[59]

- **Share best practices:** The local nature of the building sector results in fragmented practices across markets. As an example, divergent national green certification standards are an issue when comparing real estate green bonds issued in different countries.[60] The global nature of real estate capital markets means finance can bring global standards to local markets, or at least promote local standards' comparability with international ones. For instance, the initially EU-funded CRREM is a tool for assessing the alignment of buildings in different real estate submarkets against the goals of the Paris Agreement. Industry-facing tools with a global focus, like CRREM, help promote consistent best practices across borders while maintaining a submarket lens—in this case ensuring that global portfolios can assess the alignment of a building against the Paris Agreement.

These six steps can help financial market participants move the needle, reducing real estate market failures today (Table 6). Finance alone cannot shift the market from output to impact mode—this requires government action, as well as action from stakeholders along the building value chain.

Table 6: Actions can target existing market failures
Relation of market failures and the role of finance

Six steps finance can take today	The real estate market failures: **Information failure**	**Insufficient rewards for better buildings** (positive externalities)	**Inadequate penalties for worse buildings** (negative externalities)
Grow and align green real estate products	✓	✓	✓
Align information flows	✓	○	○
Adjust horizons	○	✓	✓
Connect the dots	✓	○	○
Form public-private partnerships	✓	✓	○
Share best practices	✓	✓	○

✓ Action relevant ○ Action not relevant

Source: UBS

[58] UBS (2023), *Renovation calculator.*
[59] Energy Cities (2020), *Public-private Partnership for a Large Scale Building Retrofit Program.*
[60] Climate Bonds Initiative (2022), *Sustainable debt: Global state of the market 2022*, P8.

Summing up

1. **Shift toward an anticipatory mindset:** The lifetime service of buildings needs to be considered from the outset, with the ability to adapt to evolving user needs and weather patterns built in—a whole asset life approach This needs to be combined with a change in the way we value buildings—incorporating exposure to future transition and physical risks, not just past market transactions.

2. **If it's broke, fix it:** The great majority of our existing buildings are less energy efficient than they need to be to meet emissions goals. Where viable, these buildings need to be retrofitted, not neglected or demolished and rebuilt, to minimize operational and embodied carbon emissions.

3. **More carrots, more sticks:** Governments have an indispensable role to play in creating and managing a system of incentives that encourages and rewards forward-looking behavior while disincentivizing short-termism. Penalizing underperforming buildings is reasonable to reinforce an energy-inefficiency discount, but the speed of transformation needed is more likely to be achieved if this is combined with carrots to catalyze private investment.

4. **No fundamental barriers to decarbonizing most building emissions:** The technologies are available today or are largely in the pipeline. The benefits, both public and private, also outweigh the costs. The problems are short-termist, backward-looking mindsets, poor and incomparable data, inadequate incentive structures, and the lack of a reliable (and accepted) green premium.

5. **Balance climate and people:** Buildings are primarily about people. A single-minded focus on environmental goals at the expense of social factors like livability and useability risks building in early obsolescence and undermining broader sustainability goals.

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