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Global Research

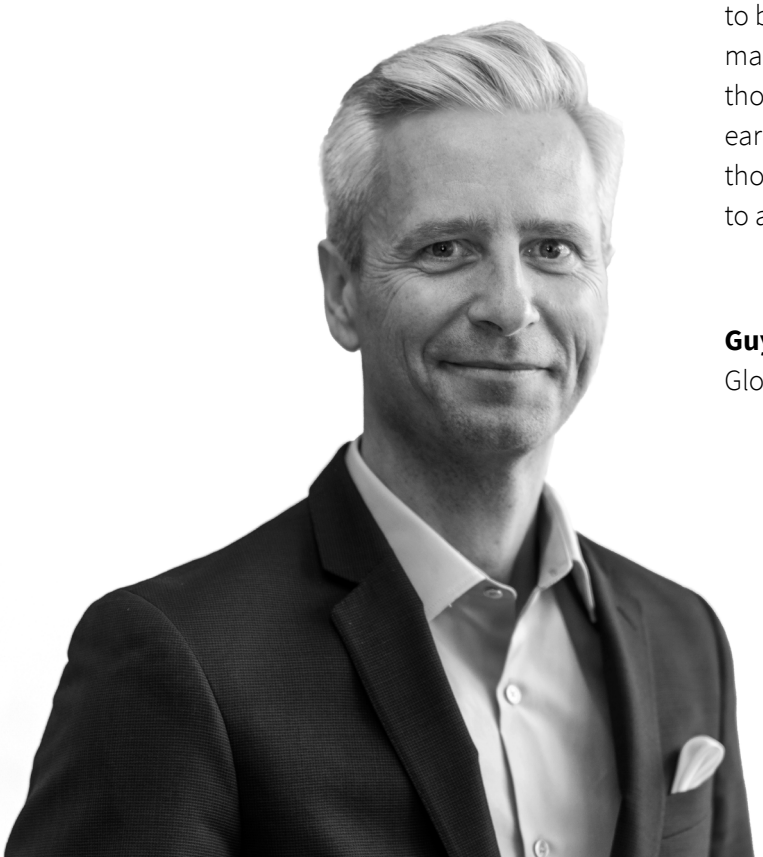
Decarbonizing Cities and Real Estate

Foreword
by Guy Grainger

Climate risk is the biggest disruptor to established cities. The urbanized Global North has a huge retrofit challenge. With a lack of funding or incentives from governments (both locally and nationally), it is likely that the policy mechanism of choice will be to put more controls in place – investors, developers and occupiers should be prepared for regulators to use 'sticks', not 'carrots'.

Given that more than 60% of carbon emissions within our cities typically comes from buildings, a growing number of city governments recognize that it's time for action. From New York City to Paris and Singapore, many cities now have a raft of targets and actions covering new and existing commercial and residential real estate.

While this momentum is to be applauded, it brings with it issues of its own; cities have different ways of measuring, reporting and regulating emissions. This makes for a very complex global landscape.



The aim of this report is to help you navigate the global landscape of real estate decarbonization through a review of the targets, regulations, reporting mechanisms, incentives, accelerators and collaborations across 32 global cities.

The science tells us that we are at a tipping point and, to deliver a net zero economy, city governments need to take real estate decarbonization as seriously as other sustainability initiatives. Partnerships will be crucial in driving progress; to pool resources and knowledge, to share or copy best practice, to educate, to help scale technology and to create the right balance between regulation, incentivization and advocacy.

By working together, all parties will be better able to bridge the gap between 'intent' and 'action' and make the best of this vital decade. Along the way, those cities with strong leadership to make tough early decisions will win in the medium term and those without the courage will fall behind in the race to a net zero economy.

Guy Grainger
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Key Messages and Real Estate Implications

1 **Policy and regulations are lagging the science.** City governments across the globe are setting bold commitments to move to a net zero economy. They are introducing a vast array of 'carrot and stick' policy instruments to decarbonize buildings. However, the science is telling us that we need to push harder and with real urgency.

If government policy fails to meet this moment, it puts a greater onus on the private sector to take the lead in tackling climate action. In the absence of public sector incentives, market forces are likely to be pushing harder than governments. Crucially, new forms of collaborative business models, involving both the public and private sectors, will be required to meet the challenge.

Building owners, investors and occupiers should not wait for regulations to kick in before taking action. Think beyond regulations to create a competitive advantage, while mitigating the risk of asset stranding. Expect mandatory regulations to be ramped up during the second half of the decade (2025-2030) as the climate emergency intensifies.

Monitor what the most progressive cities are doing and anticipate change. We call out New York, which has introduced a wide range of pioneering local laws; Boston for reporting and disclosure; Vancouver and Singapore, which have set out holistic approaches to greening their buildings; Paris, which is taking a lead in considering embodied carbon; London and Los Angeles, which are setting the pace on biodiversity; and Tokyo's cap-and-trade program, which incentivizes building owners to reduce emissions. Meanwhile, Hamburg is leaning on onsite renewables by mandating that photovoltaic (PV) systems are installed on all new buildings.

2 **Buildings are critical to the energy transition.** Decarbonizing and electrifying the built environment will be vital to delivering a sustainable net zero carbon (NZC) global economy. Across the 32 cities surveyed in this report, **buildings account for a sizeable 60% of overall emissions**, and for over 70% in some of the large business centers.[1] The retrofitting challenge in established cities is huge – where approximately 80% of the building stock that will be standing in 2050 has already been built.[2] To meet 2050 targets, **retrofitting rates will need to exceed 3% per year.**

The real estate industry needs to rebalance its efforts from new construction towards retrofitting, as city governments shift attention to the deep retrofitting of the existing stock. Retrofitting is a huge opportunity that will help plug the supply gap for NZC buildings.

Developers should consider the embodied carbon and circularity in new construction. Bringing in a whole life-cycle approach to development is critical to the solution. If new development is necessary, carbon-conscious construction along with regenerative and circular building principles can mitigate the impact of development.

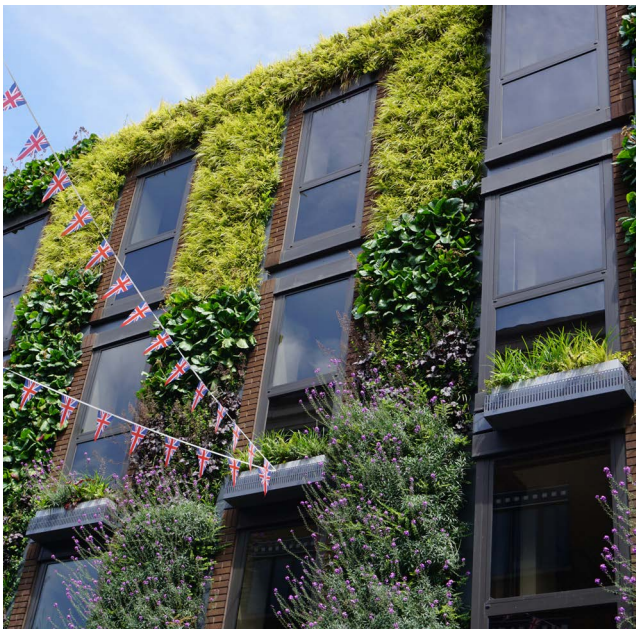
[1] The median value across 32 cities, based on government estimates
[2] WorldGBC, Bringing Embodied Carbon Upfront, Sept 2019

3 **Greening of energy grids is essential.** City governments have a pivotal role in greening local energy grids, over which the real estate industry has little direct control. Without decarbonizing the electricity grid, there are limits to what building owners can achieve in reducing their carbon emissions.

Building owners, investors and occupiers need to double down on energy efficiency initiatives and explore onsite and offsite renewables, given that many cities with brown grids will struggle to meet their clean energy targets.

4 **Think beyond carbon.** Beyond decarbonizing the built environment, cities must also think about regeneration, circularity and resilience. This study has highlighted an increasing number of targets around circularity, urban greening and biodiversity.

Real estate investors and occupiers can and must think beyond carbon as well. Seeking to create green, sustainable, healthy, regenerative and resilient spaces and places is a tall order, but a necessary one, nonetheless.



5 **Partnerships are the way forward.** It takes an ecosystem of partnerships to finance and enable the transition to a low-carbon, sustainable, equitable world with government, lenders, insurers, investors, occupiers, non-profits and innovators all deciding to prioritize sustainability in decision-making. Working together can and must drive greater harmonization and consistency in the approach towards these common goals.

Best practice in the most climate-progressive cities needs to be scaled globally and adopted in cities that are still early in their decarbonization journey.

The adoption of more collaborative business models will require a change in mindsets among city governments and the real estate industry. The most successful cities are likely to be those with broad stakeholder engagement that have a good balance between regulation, incentivization and advocacy.

Knowledge sharing and accelerator programs that create scale and plug gaps in know-how will be essential. Technology will be a key enabler in driving cities' transition to net zero.

1 Introduction

Cities, real estate and decarbonization

City governments across the globe are responding to the climate emergency by setting bold commitments to move to a net zero economy over the coming decades, often well ahead of national targets.

But, put simply, ambitious city environmental sustainability targets won't be achieved and will remain aspirational without a proactive program to significantly reduce emissions from buildings.

As city governments set more and more ambitious emissions targets, real estate landlords, investors, developers and occupiers will have a key role to play in delivering these targets.

It is a group effort

The real estate industry is under intense pressure to deliver a net zero built environment. Equally, expectations are high among real estate investors and occupiers about the role that city governments should be playing to drive the decarbonization agenda.

City governments need to create the infrastructure, frameworks, laws and incentives for all stakeholders to be successful. They have a pivotal role in the drive to 'green' local energy grids, over which the real estate industry has little direct control, and they need to look beyond carbon and balance decarbonization goals with social equity, affordability, biodiversity and climate adaptation.

This report looks at what 32 global cities are doing to create the optimum conditions to decarbonize buildings:

- What mix of instruments and initiatives are they adopting to deliver a decarbonized built environment?
- Which cities are ahead of the curve, where is best practice and what lessons can they offer to those cities that are just starting on the decarbonization journey?
- How should city governments and the real estate industry collaborate? No single stakeholder group, whether in the public or private sector, has the resources or capabilities to accomplish decarbonization on their own.

A raft of regulations and reporting frameworks are now being rolled out across the globe. As the pace and urgency to decarbonize buildings increases, this report aims to help you navigate an increasingly complex global landscape and to anticipate change, thus ensuring that portfolios are future fit for the decade ahead.

Introducing JLL's City Net Zero Carbon Tracker
A multi-year program

Program purpose

1 **To profile and benchmark** global cities on their commitments, actions, regulations and initiatives to deliver a decarbonized city and real estate market.

2 **To identify best practices** in delivering a decarbonized built environment.

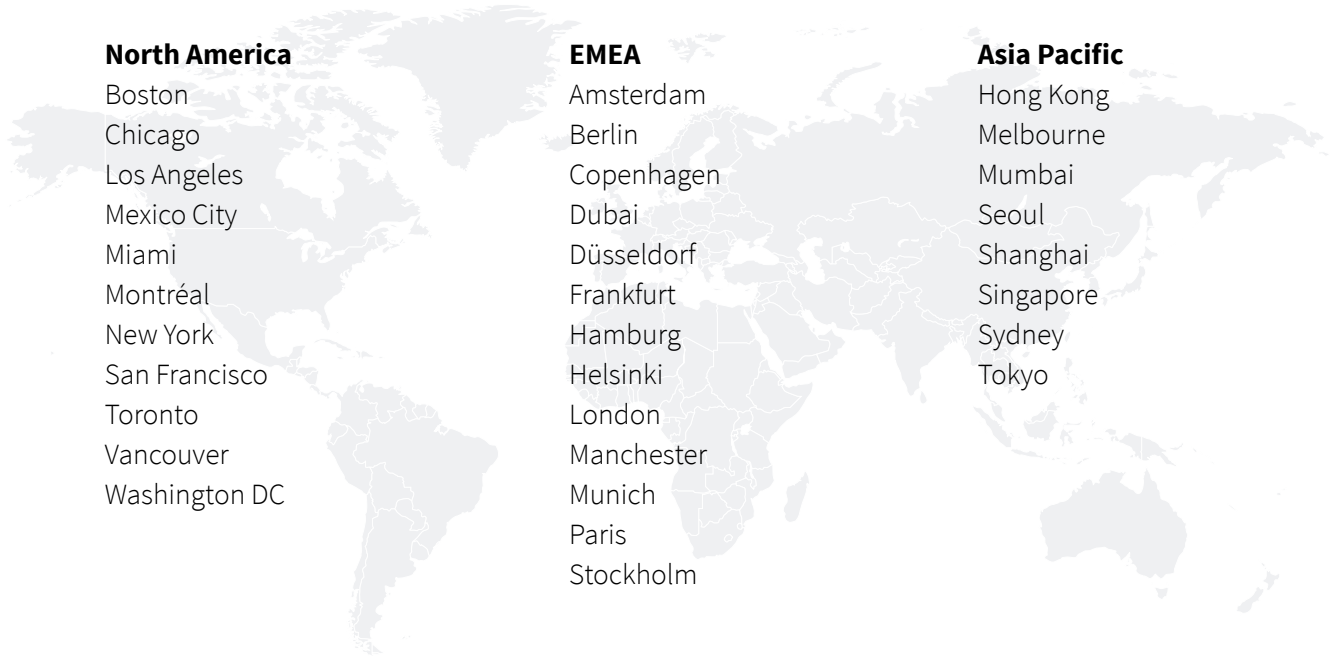
3 **To anticipate change** to ensure portfolios are future-proofed and to mitigate the risk of asset stranding.

What we are tracking

Cities
- Net Zero Carbon Targets, Commitments
- Carbon Emissions, Pricing, Tax
- Energy Use, Sources, Targets
- Sustainable Mobility
- Circular Economy
- Green Space and Biodiversity
- Resilience

Buildings
- Net Zero Carbon Buildings: Targets, Regulations, Incentives
- Building Energy Efficiency: Targets, Standards
- Retrofitting: Targets, Incentives
- Collaboration, Partnerships
- Land/Property Owner Commitments

Covering 32 cities worldwide



North America
Boston
Chicago
Los Angeles
Mexico City
Miami
Montréal
New York
San Francisco
Toronto
Vancouver
Washington DC

EMEA
Amsterdam
Berlin
Copenhagen
Dubai
Düsseldorf
Frankfurt
Hamburg
Helsinki
London
Manchester
Munich
Paris
Stockholm

Asia Pacific
Hong Kong
Melbourne
Mumbai
Seoul
Shanghai
Singapore
Sydney
Tokyo

The science says we need to act now

In April 2022 the International Panel on Climate Change (IPCC) released its latest assessment report, which reveals that emissions are at the highest level in human history.[3] Emissions rose 12% in 2019 when compared with 2010 and were 54% higher than in 1990.

The report stresses that the threats to human wellbeing and planetary health are "unequivocal." It urges expedient action, as the window to prevent global temperatures from rising by more than 1.5°C above the pre-industrial average rapidly closes. Global GHG emissions need to peak before 2025 and be reduced by 43% by the end of this decade to stay under that threshold.

Buildings, transport, industry and energy systems are critical to the energy transformation that is underway. There is added urgency in industries like commercial real estate, where capital planning, budgeting and development cycles can stretch over a decade. We are only one business cycle away from 2030.

Policy lags science

While governments across the globe are setting bold commitments to move to a net zero economy, the science is telling us that we need to push harder and with real urgency. This has deep implications for real estate in terms of energy efficiency, electrification and increased use of renewables.

[3] IPCC, 2022: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change

2 Buildings are Key to Meeting Net Zero Targets

Cities lead nations in setting ambitious NZC goals

Cities have increasingly ambitious NZC targets
City governments are committing to ever more ambitious net zero carbon targets. COP26 in November 2021 imbued a real sense of urgency to tackle the climate emergency, and city governments across the globe have been competing to bring forward their NZC targets, often well ahead of national targets. Last year for example, London, Sydney and San Francisco each revised their targets to 2030, 2035 and 2040 respectively, while Copenhagen is aiming to become the world's first carbon-neutral capital city by 2025.

Figure 1: The City Race to Net Zero – Commitments and Aspirations

	2025	2030	2035	2040	2045	2050	2060
Copenhagen	NET ZERO						
London		NET ZERO					
Helsinki		NET ZERO					
Sydney		70% reduction	NET ZERO				
Munich		50% reduction	NET ZERO				
Düsseldorf			NET ZERO				
Frankfurt			NET ZERO				
Melbourne		78% reduction		NET ZERO			
Toronto	45% reduction	65% reduction		NET ZERO			
Manchester	50% reduction			NET ZERO			
San Francisco		61% reduction		NET ZERO			
Hamburg		55% reduction		NET ZERO			
Stockholm				NET ZERO			
Berlin		70% reduction			NET ZERO		
Los Angeles	55% reduction		65% reduction			NET ZERO	
Mexico City	32% reduction	56% reduction		83% reduction		NET ZERO	
Amsterdam		55% reduction				NET ZERO	
Montréal		55% reduction				NET ZERO	
Vancouver		50% reduction				NET ZERO	
Boston		50% reduction				NET ZERO	
Tokyo		50% reduction				NET ZERO	
Miami			60% reduction			NET ZERO	
Washington DC			56% reduction			NET ZERO	
Chicago				60% reduction		NET ZERO	
New York City	30% reduction					NET ZERO	
Seoul	30% reduction					NET ZERO	
Paris		37% reduction				NET ZERO	
Singapore		36% reduction				NET ZERO	
Mumbai		30% reduction		44% reduction		NET ZERO	
Hong Kong		26%-36% reduction				NET ZERO	
Dubai		30% reduction				NET ZERO	
Shanghai		65% reduction					NET ZERO

Source: Miscellaneous government sources, JLL, 2022

Cities are at different places in their decarbonization journeys

While all 32 cities covered in this report have some form of climate action plan, not all plans demonstrate commitment through interim targets and detailed roadmaps, particularly in relation to the decarbonization of real estate. There is a wide spectrum of commitment and action from the 'Trailblazers' to those cities that are just 'Starting Out' on their route to decarbonization, to the Global South where they are still striving to improve living standards.

Figure 2: Cities and their Decarbonization Journeys

Starting Out	Climate Aware	Climate Progressive	The Trailblazers
Recently released their first climate action plans and NZC targets. More limited action. Tend to have higher climate vulnerabilities.	Climate action plans are aspirational, but lack joined-up specifics. Comparatively limited action to date.	Catching up fast with the Trailblazers. Mapping out comprehensive pathways to NZC. Leading on initiatives to decarbonize buildings.	Solid track record of planning for a sustainable future. Considerable momentum, experience and accumulated knowledge. Hitting the ground running in this important decade of action.
Dubai, Mumbai, Shanghai	**Chicago, Düsseldorf, Hong Kong, Mexico City, Miami, Seoul**	**Berlin, Boston, Frankfurt, Hamburg, London, Los Angeles, Manchester, Melbourne, Montréal, Munich, New York, Paris, San Francisco, Singapore, Sydney, Tokyo, Toronto, Washington DC**	**Amsterdam, Copenhagen, Helsinki, Stockholm, Vancouver**

Source: JLL, 2022

Even among the most progressive of cities, however, there is still much to achieve. Targets are one thing, but far more important is action. All cities need to set more specific goals to work towards that are measurable, so they can evaluate progress along the way; and governments need to recognize the pivotal role that real estate plays.

If government policy fails to meet this moment, it puts a greater onus on corporates and investors to take the lead in responding to the climate emergency. Given increasingly aggressive corporate ESG commitments, market forces are likely to be pushing harder than governments.

Figure 3: City Climate Action Plans

	Release Date	Key Documents
Boston	2019	Boston Climate Action Plan
Chicago	2022	Draft Climate Action Plan
Los Angeles	2019	Green New Deal: Sustainability City pLAn
Mexico City	2021	Mexico City Local Climate Action Strategy (ELAC) 2021-2050 & Climate Action Program (PACCM) 2021-2030
Miami	2021	Miami Forever Carbon Neutral
Montréal	2020	Montréal Climate Plan 2020-2030
New York	2019	OneNYC 2050
San Francisco	2021	San Francisco Climate Action Plan
Toronto	2021	TransformTO Net Zero Strategy
Vancouver	2020	Climate Emergency Action Plan, 2020-2025 (Vancouver Plan - due in late 2022)
Washington DC	2019	Sustainable DC 2.0 Plan
Amsterdam	2020	Amsterdam Climate Neutral Roadmap 2050
Berlin	2018	Berlin Energy and Climate Protection Program 2030 (BEK 2030)
Copenhagen	2017	CPH 2025 Climate Plan
Dubai	2022	UAE Net Zero by 2050
Düsseldorf	2017	Climate Adaptation Concept Düsseldorf (KAKDUS)
Frankfurt	2017	Masterplan 100% Climate Protection
Hamburg	2019	Climate Plan Hamburg
Helsinki	2018	The Carbon-neutral Helsinki 2035 Action Plan
London	2018	London Environment Strategy
Manchester	2020	Manchester Climate Change Framework 2020-25
Munich	2019	Integrated Action Program for Climate Protection in Munich (IHKM)
Paris	2018	Paris Climate Action Plan
Stockholm	2020	Climate Action Plan 2020–2023
Hong Kong	2021	Hong Kong Climate Action Plan 2050
Melbourne	2018	Climate Change Mitigation Strategy to 2050: Melbourne Together for 1.5°C
Mumbai	2022	Mumbai Climate Action Plan (MCAP)
Seoul	2022	Five-Year Climate Action Plan 2022–2026
Singapore	2021	Singapore Green Plan 2030
Shanghai	2021	Shanghai Ecological and Environmental Protection: The 14th Five-Year Plan
Sydney	2017	Sustainable Sydney 2030
Tokyo	2019	Zero Emission Tokyo Strategy

Note, for some cities such as Miami, Los Angeles, Vancouver, Melbourne and Sydney, state or regional-level climate action plans are equally relevant. Examples include Miami-Dade Climate Action Strategy (2021), Los Angeles County's Draft Climate Action Plan (2045 CAP), Victoria's Climate Change Strategy (2021), and NSW Net Zero Plan Stage 1: 2020-2030.

Source: Miscellaneous government sources, JLL, 2022

Buildings account for 60% of carbon emissions in cities

The imperative to decarbonize buildings

By and large, cities' climate action plans do not give sufficient attention to buildings – potentially leaving a massive gap, given their contribution to overall emissions.

Buildings are estimated (by the WorldGBC) to account for 40% of global carbon emissions, but in our cities this proportion is typically considerably higher. Based on audits across 32 global cities, the contribution of buildings to citywide carbon emissions has a median value of 60%.

And in the largest global business centers the contribution of buildings is even higher. For example, and according to their own government estimates, buildings account for 78% of emissions in London, 73% in Tokyo, 71% in Washington DC, 70% in Paris and 66% in New York.

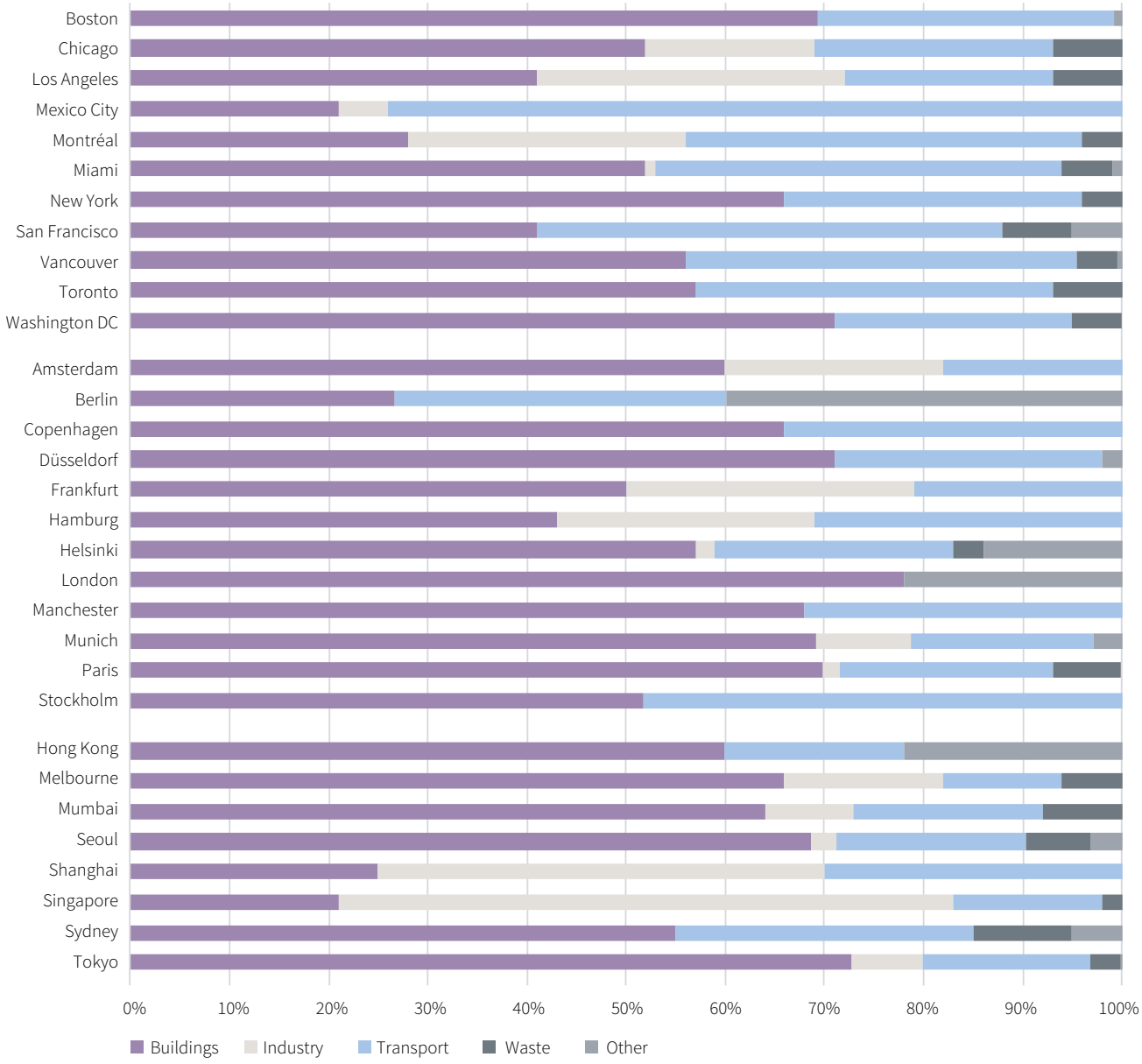
While some cities are creating the regulations, incentives or conditions that can accelerate the decarbonizing of the built environment, there is a sense that city administrations more broadly are not doing enough. JLL's Responsible Real Estate Survey 2021[4] revealed that only 29% of respondents strongly agree that top-tier cities are taking sufficiently bold action to mitigate climate risk.

City governments have the difficult task of having to focus on all sustainability issues like mobility, resilience, social equity and justice, not to mention tackling the wider energy transition that needs to take place beyond buildings (energy grid, transportation and industry for example).

While governments typically have a greater degree of control over public transport or energy grids, tackling buildings poses a more complex challenge given the fragmented, largely privately-owned building stock.

[4] JLL, Decarbonizing the Built Environment, June 2021

Figure 4: Share of Emissions by User Sector



Data not available for Dubai
Source: Miscellaneous government sources, JLL, 2022

The challenges of international comparisons
A note of caution in interpreting this chart. City government estimates are based on differing methodology, so there is a lack consistency for comparison purposes. Several city governments combine buildings with industry in their emissions estimates, or only report as stationary energy.

Some cities include emissions from aviation traffic, others exclude this source. The base year and year of reporting is also wide ranging. Geographic definitions also vary and will impact on figures. For example, buildings have been estimated to account for 76% of emissions in the City of Sydney, but 55% for Greater Sydney.

New build is too polluting – addressing the retrofitting challenge

New build is only part of the solution

In their initial efforts to 'green' buildings, city governments have focused their attention on new buildings. For good reason, city administrations can leverage the range of tools highlighted in this report (see Section 3) – such as the planning system, zoning laws, building codes and minimum energy efficiency standards – to influence and incentivize the construction of new, sustainable development. It is also easier sometimes to start with a 'clean slate' and take advantage of the latest processes and technologies. While work needs to be done to make 'net zero' and 'circularity' mainstream in the development process, it isn't entirely through new development that we will decarbonize the built environment.

While new construction will be central to strategies in developing economies, the developed cities surveyed in this report face a different challenge – that of aging building stock. In Europe, it's been estimated that up to 80% of buildings that will be in use in 2050 already exist today, and 97% of the building stock in the EU is not efficient enough to comply with future carbon reduction targets.[5]

The retrofitting challenge

Retrofitting a city's existing building stock to net zero carbon is central to decarbonizing a city's economy.

New buildings and construction alone will not get us to net zero. Consider these facts:

- Around 40% to 50% of the world's raw materials are consumed in the development of buildings.
- Of the almost 40% of global GHG emissions that stem from the built environment, 11% is embodied carbon from the construction process.[5]
- Construction and demolition waste (CDW) accounts for roughly one-third of total waste in the EU, and around 40% of solid waste in the United States.[6]

Knocking down an old building in order to build a new, albeit greener building is 'net net' more detrimental than retrofitting the existing stock. The greenest building is the one that's already built.

As C40 Cities advocates, cities should

"prioritize the better use, repurposing, and retrofit of existing building stock and infrastructure across the city to ensure their optimal use before new construction projects are considered."

[5] WorldGBC, Bringing Embodied Carbon Upfront, September 2019
[6] Sustainable Brands, Racing to Zero, Part 3: Reimagining Construction for Circularity, March 2022

Retrofitting rates will need to exceed 3% per year

The retrofitting challenge for cities is huge and the current pace of retrofitting needs to be accelerated. Most mature cities are seeing renovation rates of only 1%-2% per year and, even then, most are not renovated with net zero carbon or circularity in mind.[7] Retrofitting rates will need to exceed 3% per year to meet 2050 targets. San Francisco, for example, estimates that it will need to retrofit existing buildings at a rate of 3.5% per year between 2025-2050.[8] For those cities slow to implement strict standards on new builds, the retrofit rate may need to be even higher. The longer that cities delay in taking action, the more formidable the scale of the challenge in the future.

Cities are recognizing the scale of the retrofitting challenge

Boston: The Boston Climate Action Plan (2019) states that 85% of floorspace that will exist in 2050 has already been built, and to reach carbon neutrality, four out of five buildings in the city will need to implement deep energy retrofits and electrification by 2050.

Hong Kong: More than 85% of buildings in Hong Kong are over 10 years old. Even with a current rate of between 300 and 500 new buildings under construction each year, between 60% and 80% of buildings that will be in existence in 2050 are already standing.

London: London's Zero Carbon Pathway requires large-scale energy efficiency building retrofits. 100,000 homes and 15,000 workplaces need to be retrofitted per year to 2050, with energy efficiency improvements and renewable technologies. It estimates that 80% of existing buildings are likely to still be standing in 2050.

Manchester: The Greater Manchester Retrofit Task Force, established in July 2021, will undertake 61,000 domestic retrofits per year by 2030.

Paris: The city aims to retrofit all homes by 2050 at a rate of 40,000 private dwellings per year. It is calling for the establishment of new national renovation labels that include a carbon criterion.

Toronto: The TransformTO Climate Action Plan has a target to retrofit 100% of existing buildings to achieve an average 40% improvement in energy performance by 2050.

[7] World Economic Forum, A Framework for the Future of Real Estate, April 2021
[8] San Francisco Climate Action Plan 2021

Investors and developers are also seeing the potential from retrofitting

Encouragingly, JLL's Responsible Real Estate Survey found that there is an understanding among leading developers and investors of the tremendous potential in unlocking the retrofit challenge; and city governments need to be an integral part of this momentum. Retrofitting is a huge opportunity that will help plug the supply gap for NZC buildings.

Tackling embodied carbon

Building owners, investors and developers need to consider the embodied carbon and circularity in new construction.

If new development is necessary, carbon-conscious construction along with regenerative and circular building principles can mitigate the impact of development. Even renovations and repositionings offer ample opportunity to lower embodied carbon and to apply the same building principles to a project.

40% **WorldGBC** has called for a 40% reduction in embodied carbon in all new buildings, infrastructure and renovations by 2030 (and for all new buildings to be net zero operational carbon). By 2050 it calls for all new buildings, infrastructure and renovations to have net zero embodied carbon, and for all buildings to be net zero operational carbon.

Source: WorldGBC, Bringing Embodied Carbon Upfront, Sept 2019

Policy refocusing on whole life carbon

While the overall emphasis of city policy across the globe has been on operational emissions from buildings, some cities – such as Paris (see below) - are beginning to focus on reducing embodied carbon and considering whole life carbon, from design and construction to decommissioning and dismantling.

Paris is taking a lead in considering whole life carbon

Design for Reuse Principles –The City of Paris will be asking real estate developers to ensure that new buildings are designed with adaptability and versatility in mind. The aim is to enable a building to accommodate several functions (e.g., housing, hotels, offices, workshops), which can be changed over time without the need for renovations, major upgrading or demolition and rebuilding.

By 2030 the target will be for 30% of office space produced to be adaptable, rising to 50% by 2050. The Paris Climate Action Plan states that "all new urban projects launched from 2030 onwards will be carbon neutral throughout their entire life cycle".

RE2020 – This is a building performance regulation that goes beyond energy consumption to also consider the entire life-cycle carbon impact from a building's construction to its demolition. New elements have recently been introduced: fossil fuels are no longer allowed for new developments; energy needs must be lowered by 30%; carbon emissions will be calculated on the entire life cycle; and buildings must demonstrate the capacity to face extreme climate events such as heat waves.

Greening of the energy grid

Decarbonization cannot be achieved without the greening of the energy grid

Without decarbonizing the electricity grid, there are limits to what building owners can achieve in reducing their carbon emissions. Most major corporates now have aggressive targets to reduce emissions and become net zero, and they are relying on governments to deliver on their ambitious citywide targets to be powered 100% by renewable electricity.

Indeed, JLL's Responsible Real Estate survey found that investors and corporate occupiers would like to see national and city governments take bolder action on decarbonization, particularly in the greening of local energy grids, over which they have little direct control.

How green is the city grid?

Most major global cities now have ambitious targets to move to clean energy/renewable energy generation (as Figure 5 highlights). Leading the way is Munich, which aims to be powered 100% from renewable energy sources by 2025. This would make it the first major city in the world to achieve this target. Not far behind, the electricity grid in Montréal is now composed of 99% renewables (hydro, wind, solar), making it already largely decarbonized.

Figure 5: City Clean Energy Targets

Boston	100% clean energy by 2050
Chicago	100% renewable energy by 2035
Los Angeles	100% renewable energy by 2035
Mexico City	25% renewable energy by 2040
Miami	100% carbon-free electricity and energy by 2035
Montréal	100% renewable energy by 2040 (Electricity grid is already largely decarbonized)
New York	100% clean energy by 2040
San Francisco	100% renewable energy by 2040 (interim target of 100% renewable electricity by 2025)
Toronto	100% from renewable or low-carbon sources by 2050 (interim target of 50% renewable or low-carbon sources by 2030)
Vancouver	100% renewable energy by 2050 (interim target of 55% renewables by 2030)
Washington DC	100% of electricity generation from clean sources by 2032
Amsterdam	Natural gas-free by 2040
Berlin	55% energy from renewables by 2050
Copenhagen	100% carbon-neutral heating by 2025
Dubai	75% from clean sources by 2050 (interim target of 25% solar energy by 2030)
Düsseldorf	80% of power supply from renewable energy (Nordrhein-Westfalen state target)
Frankfurt	100% renewable energy by 2050
Hamburg	100% energy from renewable, local sources by 2035
Helsinki	Carbon-neutral energy by 2035
London	15% energy from renewable, local sources by 2050
Manchester	100% renewable energy by 2050
Munich	100% energy from renewable sources by 2025
Paris	100% renewable energy by 2050 (interim target of 45% renewable energy by 2030)
Stockholm	100% renewable energy by 2040
Hong Kong	Net zero electricity generation by 2050 (interim target of increasing share of zero-carbon energy to 60%-70% by 2035)
Melbourne	100% renewable energy by 2030
Mumbai	90% renewable energy by 2050 (interim target of 50% by 2030)
Seoul	30% renewable energy by 2030 (national target)
Shanghai	Renewables to account for 8% of energy mix by 2025
Singapore	Solar energy to account for around 3% of projected electricity demand in 2030
Sydney	50% of electricity demand met by renewable sources by 2030 (NSW government target)
Tokyo	100% renewable energy by 2050 (interim target of 50% by 2030)

Note: references to 'low-carbon', 'zero-carbon' or 'carbon-free' sources may include nuclear power.
Source: Miscellaneous government sources, JLL, 2022

There are limits to city-generated renewables

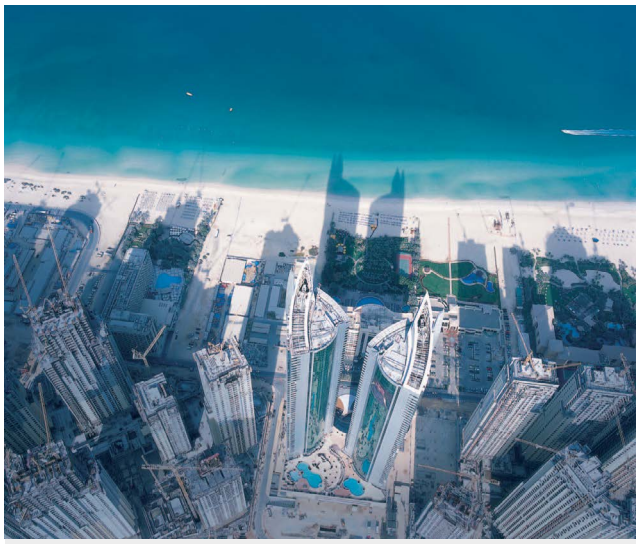
While grids have been decarbonizing in recent years (as the share of renewables has increased), the pace will need to accelerate significantly to meet ambitious targets. Yet, in most cases, city governments cannot achieve these targets independently, since decarbonizing the grid network – a massive infrastructure undertaking – typically requires action at a higher national level across a broader geography.

Moreover, within our dense, built-up cities, there are limits to the scale of renewable energy that can be generated inside city boundaries (in terms of hydro, wind and solar power). In Manchester, for example, only 1% of the city's electricity demand was met by local renewable generation in 2019[9], and so it is exploring plans to buy a site for a solar farm outside the city.

A regional approach to clean energy?

Some cities are looking at a regional approach and are working with neighboring local governments and state governments to plan where large-scale renewable energy and storage infrastructure projects will go.

Examples include Amsterdam (Regional Energy Strategy), Melbourne (Victoria Renewable Energy Zones) and Sydney (New South Wales' Renewable Energy Zones). The City of Sydney's council operations (e.g., streetlights, buildings) are now powered using 100% renewable electricity generated from wind and solar farms in regional New South Wales. Hamburg is leveraging wind energy from the Schleswig-Holstein coast (working together with neighboring Schleswig-Holstein Lander) to help it meet its citywide target of 100% electricity from renewable energy by 2035.



Dubai's renewable energy push

The Dubai Clean Energy Strategy 2050 aims to provide 75% of Dubai's total power output from clean energy by 2050 (with an interim target of 25% by 2030).

As the largest single-site solar park in the world, with a planned total production capacity of 5,000 megawatts (MW) by 2030, the **Mohammed bin Rashid Al Maktoum Solar Park** is a key project to help achieve this goal. The park, which also includes one of the world's largest concentrated solar power (CSP) projects, is expected to reduce significantly Dubai's carbon emissions once fully completed.

Source: Dubai Clean Energy Strategy, April 2021

[9] Manchester Climate Change Partnership, Manchester Climate Change Framework 2020-2025, February 2020

A look at offsite renewable energy

Given the challenges of scaling building-level onsite renewables, cities are looking to offsite renewables or shared district energy infrastructure to play a role.

A common method of procuring offsite renewable energy is through **Power Purchase Agreements (PPAs)**, such as the example from Melbourne (see below). By guaranteeing to purchase renewable energy into the future, PPAs fund the installation of renewable energy facilities, which requires significant upfront capital expenditure. However, among its challenges, PPAs tend to only make sense at scale, when parties have significant buying power (such as through the involvement of city governments).

Melbourne Renewable Energy Project (MREP) – collective renewable energy purchase

The MREP has accelerated the uptake of renewable energy through facilitating long-term power purchase agreements (PPAs):

- In MREP 1, the City of Melbourne partnered with other local governments, universities, cultural institutions and corporations to collectively purchase renewable energy. This commitment to purchase power from a renewable development enabled the construction of a new wind farm.
- The second wave of the project (MREP 2) has brought together more large energy users, including businesses and universities, to use corporate power purchase agreements to help support Melbourne's goal to be powered by 100% renewable energy.

The City of Melbourne claims that together, MREP 1 and 2 have reduced the equivalent of 5% of the city's emissions.

District energy infrastructure provides heating, cooling and power at a neighborhood scale. District energy systems (also known as district heating or district cooling) produce hot water and chilled water at a central plant and provide these to multiple buildings, usually via underground pipes.

Northern European cities such as Copenhagen, Stockholm, Helsinki and Amsterdam are leaders on district energy systems. For example, more than 80% of all buildings in the City of Stockholm are connected to the district heating system.[10] In cities with warmer climates, like Dubai and Hong Kong, the focus is more on cooling buildings.

While district energy systems can use both renewable energy sources or fossil fuels (e.g., natural gas), they aggregate the energy needs of multiple buildings, thereby creating economies of scale for low-carbon sources. In dense urban settings, these systems enable entire neighborhoods to utilize nearly 100% renewable energy sooner than would otherwise be possible.

District energy provides opportunities to reduce energy use, cost and carbon emissions when compared to individual building systems. However, as with any substantial infrastructure project, district energy systems do require proactive stakeholder management.

[10] City of Stockholm, Climate Action Plan 2020-2030, May 2020

The use of carbon offsets

On the pathway to net zero, there may be a moment when all possible reductions have been achieved, at which time the last part of the journey consists of **buying carbon offsets**. Carbon offsets are an action intended to compensate for carbon emissions due to industrial or human activity. The most mainstream form of offsetting is forestation.

The three main use-cases for carbon removal are:

- compensating for difficult or impossible-to-remove emissions resulting directly from activities.
- compensating to counteract emissions that are difficult to attribute to any specific entity.
- for those with high targets who desire to achieve net-negative emissions to address past emissions.

Within the city environment, for example, a building can have the highest energy efficiency rating, but if the city's energy comes from a brown grid, the builder owner would need to offset their energy supply carbons while exploring longer-term sustainable solutions.

Another example is when a company leases office space in a building where the landlord or lease does not allow for renewable energy investment. They can use offsets as a tool to help achieve shorter-term emissions goals, while still working to reduce or avoid future emissions.

The carbon offset industry is relatively young, and with that comes the risks of a fast-growing industry that aims to achieve a real purpose in moving to a net zero world while also juggling the desire to create profits from these transactions. The industry is full of for-profit brokers and unaccredited projects, so credibility concerns need to be considered.

Additionally, each carbon removal technique has different risks, such as:

- inflated baselines that occur when the carbon removal levels are stated to be higher than the actual removal levels.
- the risk of indirect carbon leakage if the chosen technique results in increased emissions elsewhere.
- the risk of physical reversal that occurs when the carbon storage timescale is relatively short-term.
- the cost of removal and availability varies widely by offsetting technique.

Source: World Economic Forum, Net-Zero to Negative Net-Zero, A Guide for Leaders on Carbon Removal, 2021

Scaling technology and innovation

Technologies at an urban scale

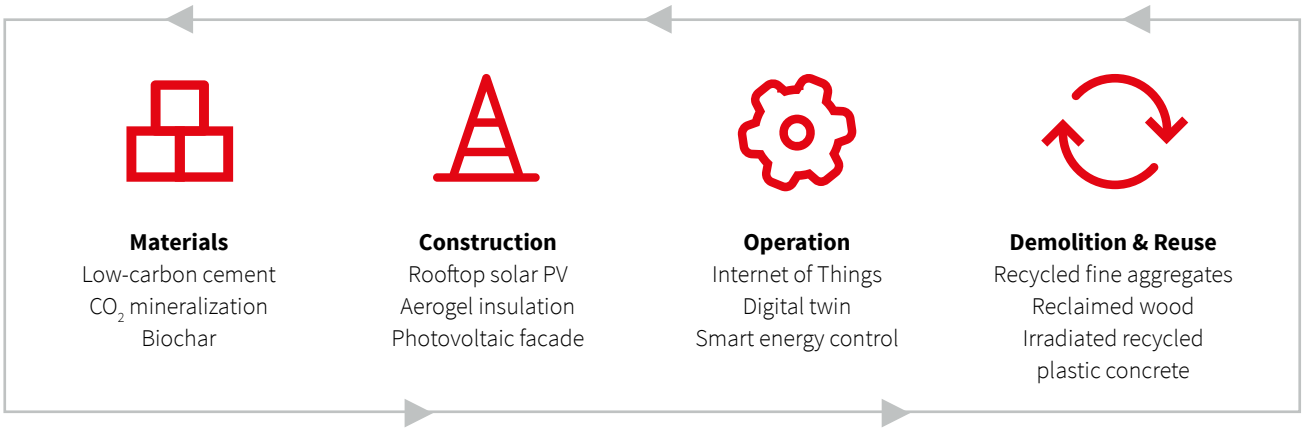
A key enabler in driving the transition to net zero is technology. At the urban scale, the available technologies focus primarily on infrastructure and public services, including green energy, smart energy grids and green mobility. Though infrastructure is mostly funded by the public sector, public-private partnerships are crucial to absorbing large upfront investments and increasing capacity. City governments also play a central role in motivating their citizens to use domestic decarbonizing technologies.

Technologies and the building life cycle

At a building level, technologies are used to tackle carbon emissions in every stage of a building's life cycle, from embodied carbon in the manufacturing, transportation and installation of green construction materials, to operational carbon in the energy use and maintenance of the building, and finally to demolition, recycling and reuse.

With the increasing number of technology tools being adopted, the issue of tech fragmentation is becoming a major challenge. Delivering fully integrated tech solutions at scale and throughout building life cycles still represents significant complexity. Building stronger industry consensus, standardizing data and application programming interfaces (API), and enabling transparent reporting are therefore important next steps. The commitment of the real estate industry is core in this process.

Figure 6: Technologies through the Building Life Cycle



Source: JLL, 2022

Nurturing a healthy technology ecosystem for continuous innovation

To ensure the continuous rollout of new green solutions, partnerships between governments, academia, the real estate industry and the technology sector are essential. For too long the real estate industry has primarily been the consumer of market-ready technologies. This is changing. With the rise of the building tech and proptech sectors, real estate-backed venture capital funds have become major investors in facilitating private R&D and the commercialization of technology products.

Compared to other applications, such as portfolio management, technologies for decarbonization, by nature, rely more heavily on scientific research that cuts across a variety of disciplines, including material science, architecture, civil engineering, mechanical engineering, thermodynamics, electrical engineering and computer science.

The basic research and prototyping are typically done by government agencies, universities and laboratories, which lay the groundwork for the further development of tech solutions. Establishing closer cooperation between city governments, real estate and academia could help direct resources to areas that would be most impactful in real-world use.

Essentially, technologies for net zero carbon require a streamlined approach, from research and development to commercialization, scaling and refinement.

Creating synergies with broader digital transformation

Decarbonization should not be a stand-alone fight. When it comes to deploying technologies, there is a range of ongoing digital transformation efforts in the real estate sector that could be synergized.

The Centre of Excellence for Sustainability (COES) in Real Estate in Montréal

JLL and Ivanhoé Cambridge are launching a Centre of Excellence for Sustainability (COES) in Montréal. The COES aims to build and animate a full technology pipeline across the various stages of the building life cycle. The Centre will be a place where innovators, academics, government, tenants and more can come together to explore technologies and processes, run pilot projects, develop partnerships and conduct collaborative research.

For example, the 'IoT workplace energy control system' is an important building block in reducing operational carbon. Concurrently, this technology serves as a critical component in other dedicated themes, including data-driven portfolio management, workplace health and wellness, and employee experience.

As cities and companies set aside budgets for these different initiatives, bridging the often-siloed conversations could help deliver a more powerful and holistic tech strategy. Some of the initiatives have higher direct economic returns, so pooling the investments could make tech adoption for decarbonization more financially feasible. By combining resources and sharing the benefits, it also makes a stronger case for higher upfront investments in the decision-making process.

3 Cities' Response to Facilitating the Energy Transition

Targets to decarbonize buildings

Most cities have set targets to decarbonize buildings

As virtually all of the 32 global cities evaluated have set their eyes on being at net zero carbon by 2050 at the latest, they have also set targets specific to their building stock. The majority now aim for all new construction to be operationally net zero by 2030, and for all buildings to be net zero by 2050. Few cities, however, have set out action plans to deliver on these targets.

Figure 7: Targets to deliver Net Zero Carbon Buildings

	New Buildings / Construction	All Buildings
Boston	Zero net carbon standard by 2030	Standards meet citywide target of carbon neutrality by 2050
Chicago	Net zero carbon by 2040	100% powered by renewable energy by 2035
Los Angeles	Operate at net zero carbon by 2030	Operate at net zero carbon by 2050
Mexico City	50% reduction in embodied emissions by 2030	Standards meet citywide target of carbon neutrality by 2050
Miami	Net zero emissions by 2030	Standards meet citywide target of carbon neutrality by 2050
Montréal	Zero-emissions standard from 2025	Net zero carbon by 2050
New York	100% net zero by 2030	Net zero carbon by 2050
San Francisco	Zero emissions by 2021	Zero emissions by 2040 (large commercial buildings by 2035)
Toronto	Built to produce near-zero GHG emissions by 2030	Emissions cut by 50% by 2030; 100% net zero by 2050
Vancouver	Net zero emissions by 2030	Zero emissions in construction and operation by 2050.
Washington DC	Operate at net zero carbon by 2030	Net zero carbon by 2050
Amsterdam	Almost Energy Neutral Building standard (BENG) from 2021	Carbon neutral by 2050
Berlin	Climate-neutral by 2030	Operate at net zero carbon by 2050
Copenhagen	Operate at net zero carbon by 2030	Operate at net zero carbon by 2050
Dubai	None	None
Düsseldorf	Climate-neutral by 2030	None
Frankfurt	Climate-neutral by 2030	Climate-neutral by 2035
Hamburg	Climate-neutral by 2030	Net zero carbon by 2050
Helsinki	Nearly zero-energy standard from 2021; Operate at net zero carbon by 2030	Operate at net zero carbon by 2050
London	Operate at net zero carbon by 2030	Operate at net zero carbon by 2050
Manchester	Major developments to be zero carbon from 2023	Net zero carbon by 2038
Munich	Climate-neutral by 2030	Climate-neutral 'in as many city districts as possible' by 2035
Paris	Operate at net zero carbon by 2030	Operate at net zero carbon by 2050
Stockholm	Operate at net zero carbon by 2030	Operate at net zero carbon by 2050
Hong Kong	None	None
Melbourne	Operate at net zero carbon by 2030	Operate at net zero carbon by 2050
Mumbai	None	None
Seoul	None	Zero energy buildings by 2050
Shanghai	Built to green building standard from Dec 2021	None
Singapore	80% (of new buildings) to be SLE (Super Low Energy) from 2030	80% (of all buildings) to be 'green' by 2030
Sydney	Operate at net zero carbon by 2030	Operate at net zero carbon by 2050
Tokyo	Operate at net zero carbon by 2030	Emissions cut by 50% by 2030; 100% net zero carbon by 2050

Source: Miscellaneous government sources, JLL, 2022

Decarbonizing the public building stock – influencing market transformation

Whether through retrofitting existing city-owned facilities or the construction of new schools, hospitals, administrative offices or social housing, city governments must lead the way and set an example by decarbonizing their public building stock.

City governments can help bring private-sector construction firms and contractors into the process, influence local supply chains through procurement, and introduce what are still relatively new and innovative concepts, such as net zero carbon buildings and whole life-cycle carbon and circular economy principles, to the private sector.

While city-owned buildings typically account for a small share of total building stock, decarbonization initiatives can help influence broader market transformation.

The ‘carrots’ and the ‘sticks’

Beyond setting targets, each of the 32 cities is adopting a wide variety of approaches to tackle the energy transition as it pertains to the built environment.

The spectrum of instruments is wide. Some cities merely ask building owners to voluntarily report on energy consumption or provide incentives, while others impose minimum building performance standards, carbon limits, fees or penalties. It is likely that the optimal combination of policies includes both ‘carrots’ and ‘sticks’. Building owners must navigate the complexity of various regulatory environments at the local level, but may also need to adhere to regional or national legislation as well. We anticipate further harmonization in these regulations over time.

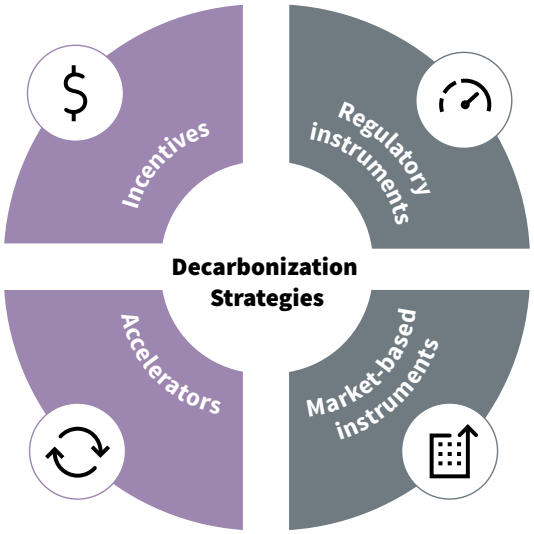
In the sections that follow we explore some of the instruments that are being used. While certainly not all-inclusive, they represent some of the primary ways that cities across the globe are trying to bring about the right behaviors and outcomes.

- **Regulatory instruments**
  - Reporting and benchmarking
  - Audits and retro-commissioning
  - Building codes and minimum building performance standards
- **Market-based instruments**
  - Carbon pricing (Carbon tax and trading)
- **Incentives**
- **Knowledge sharing and accelerators**

Figure 8: Cities are using an Array of Instruments to Decarbonize

Incentives
- Funding/subsidies
- Renewables demand guarantee
- Planning/zoning/permits
- Public recognition

Accelerators
- Resource hubs providing information and technical support
- Training and educational programs
- Net zero building technology incubators
- Demonstrator buildings
- Collaboration/partnerships



Regulatory instruments
- Reporting and energy benchmarking
- Building codes and design requirements
- Minimum energy efficiency standards/ regulations
- Emissions limits
- Audits and retro-commissioning
- Public disclosure (e.g., public display building labels)
- Penalties and fines

Market-based instruments
- Carbon pricing
- Carbon tax
- Emissions trading schemes (ETS)

Source: JLL, 2022

Regulatory and market-based instruments (the 'sticks')

Figure 9: Regulatory Instruments

	Reporting & Benchmarking	Minimum Building Performance Standards
Boston	Mandatory and also covers emissions. Building-specific data made publicly available online. Fines/penalties for non-compliance. Periodic energy audits required.	Mandatory, with minimum emissions standards to also come into effect from 2025. Building energy and emissions performance standards more stringent than state-level base code. Fines/penalties for failure to meet emissions limits.
Chicago	Mandatory. Building-specific data made publicly available online. Public display building labels required to be posted in a prominent location.	Mandatory for new buildings but comparatively basic standards (no more stringent than the state-level base code).
Los Angeles	Mandatory, with statewide emissions reporting under consideration for adoption in 2024. Building specific data made publicly available online. Fines/penalties for non-compliance, including public disclosure of non-compliance and fees. Periodic energy audits required.	Mandatory for new buildings and buildings undergoing extension or renovation. Requirements for 'cool roof' materials for new and re-roofing construction. Fines/penalties for non-compliance.
Mexico City	Voluntary (through the Efficient Buildings Challenge).	Mandatory energy efficiency standards for new buildings are comparatively basic and poorly enforced.
Miami	Voluntary, but mandatory regulation is being proposed to annually track, report and disclose energy and water use data.	Mandatory for new buildings and those undergoing major renovations, but standards are relatively basic (State of Florida prohibits cities from adopting codes that are more stringent than the state code).
Montréal	Mandatory energy use disclosure recently introduced. Carbon emissions reporting rolled out starting in 2022. Fines/penalties for non-compliance.	Mandatory for new buildings. Performance standards for existing buildings to be rolled out in the future, though no exact timeline confirmed.
New York	Mandatory, with carbon emissions reporting also adopted and will begin in 2024. Public display building labels required. Building specific data made publicly available online. Fines/penalties for non-compliance. Periodic energy audits required (every 10 years).	Mandatory for both new and existing buildings. Building energy and emissions performance standards are more stringent than state-level code. Carbon emissions limits and penalities are among the most ambitious in the world.
San Francisco	Mandatory, with statewide emissions reporting under consideration for adoption in 2024. Building specific data made publicly available online. Fines/penalties for non-compliance. Periodic energy audits required (every 5 years).	Mandatory for new buildings plus existing buildings undergoing extension or major retrofit. All new construction required to be all-electric. Fines/penalties for non-compliance.
Toronto	Mandatory and being expanded to smaller building sizes over time. Building specific data made publicly available online.	Mandatory for new buildings, with optional/voluntary enhanced standards.
Vancouver	Voluntary, but proposed mandatory system set to be rolled out from 2024.	Mandatory for new buildings and existing buildings that apply for rezoning (life cycle assessments required).
Washington DC	Mandatory and being expanded to smaller building sizes. Building-specific data made publicly available online. Fines/penalties for non-compliance. Audits and retrocommissioning actions to meet or exceed LEED standards are required for substantial improvements to privately-owned, non-residential buildings.	Mandatory for new and existing buildings. From 2026, all new buildings will be required to achieve net-zero energy use.

	Reporting & Benchmarking	Minimum Building Performance Standards
Amsterdam	Mandatory for sale/lease.	Mandatory energy neutral standard for all new builds. For existing office buildings, minimum standards (via EPC rating) to be enforced from 2023.
Berlin	Mandatory for sale/lease. Includes requirement for carbon emissions performance to be reported on the energy certificate. Fines/penalties for non-compliance.	Mandatory for new buildings, which need to be planned and constructed to be zero-energy (Niedrigstenergiegebäude). For existing buildings, it is mandatory that renovations/ retrofits do not make the building worse in terms of energy useage/performance.
Copenhagen	Mandatory for new construction, sale and public buildings. Building-specific data and labels publicly available online. Periodic energy audits required every 10 years.	Mandatory for new buildings. Requirements for existing residential buildings to meet minimum energy efficiency standards in order to raise rents.
Dubai	None.	Mandatory for new buildings and buildings undergoing extension or major retrofit.
Düsseldorf	Mandatory for sale/lease. Includes requirement for carbon emissions performance to be reported on the energy certificate. Fines/penalties for non-compliance.	Mandatory for new buildings, which need to be constructed to be zero-energy (Niedrigstenergiegebäude). For existing buildings, it is mandatory that renovations do not make the building worse in terms of energy useage/ performance.
Frankfurt	Mandatory for sale/lease. Includes requirement for carbon emissions performance to be reported on the energy certificate. Fines/penalties for non-compliance.	Mandatory for new buildings, which need to be constructed to be zero-energy (Niedrigstenergiegebäude). For existing buildings, it is mandatory that renovations do not make the building worse in terms of energy useage/ performance.
Hamburg	Mandatory for sale/lease. Includes requirement for carbon emissions performance to be reported on the energy certificate. Fines/penalties for non-compliance.	Mandatory for new buildings, which need to be constructed to be zero-energy (Niedrigstenergiegebäude). For existing buildings, it is mandatory that renovations do not make the building worse in terms of energy useage/ performance.
Helsinki	Mandatory for sale/lease.	Mandatory for new buildings plus existing buildings undergoing extension or major retrofit.
London	Mandatory for construction, sale and lease. Companies with 500+ employees and turnover of £500m+ need to disclose under TCFD aligned reporting requirements.	Mandatory for new buildings plus existing buildings for sale/ lease. Minimum standards likely to be strengthened from 2025.
Manchester	Mandatory for construction, sale and lease. Companies with 500+ employees and turnover of £500m+ need to disclose under TCFD aligned reporting requirements.	Mandatory for new buildings plus existing buildings for sale/ lease. Minimum standards likely to be strengthened from 2025.
Munich	Mandatory for sale/lease. Includes requirement for carbon emissions performance to be reported on the energy certificate. Fines/penalties for non-compliance.	Mandatory for new buildings, which need to be constructed to be zero-energy (Niedrigstenergiegebäude). For existing buildings, it is mandatory that renovations do not make the building worse in terms of energy useage/ performance.
Paris	Mandatory, with annual reporting. Energy consumption threshold targets to be met over time, with owners and occupiers held jointly responsible for meeting these thresholds.	Mandatory standards established in 1974, with standards updated over time.
Stockholm	Mandatory for sale/lease. Benchmarking valid for 10 years. Building specific data made publicly available online.	Mandatory for new buildings, plus existing buildings for sale/lease.
Hong Kong	Mandatory periodic energy audits required.	Mandatory for new buildings plus existing buildings undergoing extension or major retrofit.
Melbourne	Mandatory for sale/lease. Building specific data made publicly available online.	Mandatory for new buildings.
Mumbai	None, but intends to establish energy performance benchmarking from 2025.	Mandatory for new commercial buildings.
Seoul	None currently, but government to propose reporting & benchmarking guidelines (TBA)	Mandatory for public/government buildings. Currently optional for private buildings but scope to be expanded to private buildings in the future.
Shanghai	Mandatory for government office buildings and large buildings, including commercial, healthcare and education facilties. Periodic energy audits required.	Mandatory for new buildings, including residential and commercial buildings.
Singapore	Mandatory. Building-specific data made publicly available online.	Mandatory for new buildings plus existing buildings undergoing extension or major retrofit.
Sydney	Mandatory for sale/lease. Building specific data made publicly available online.	Mandatory for new buildings.
Tokyo	Mandatory reporting for small, mid and large-size commercial buildings.	Mandatory for new buildings plus existing buildings undergoing extension or major retrofit.

Source: Miscellaneous government sources, JLL, EDC Group (edc.dk), 2022

Reporting, benchmarking and auditing

Benchmarking

Benchmarking a building's annual energy and water use is an essential requirement for delivering more efficient buildings. After all, "you can't manage what you can't measure". Performance data is typically benchmarked using a scoring or rating system such as Energy Performance Certificate (EPC) ratings or ENERGY STAR Portfolio Manager, which allows a building owner to compare a property's energy performance against itself over time as well as against similar buildings.

Benchmarking is typically applied to all buildings, specific building types or buildings above a certain size threshold, though coverage has tended to expand over time to gradually capture a larger proportion of a city's building stock. Washington DC provides a good illustration.

Benchmarking can be an annual mandatory requirement for all properties (as in Paris and Singapore), or can be made mandatory for larger-sized properties or specific industries/user (as is the case in Boston, Chicago and Toronto).

Benchmarking might also be a voluntary system, like the Australian NABERS rating system applied in Sydney and Melbourne. However, Australian cities require disclosure of energy efficiency when a building is sold or leased. This is also the case in the UK, where all domestic and commercial buildings available to buy or rent must have an EPC.

The direction of travel is towards mandatory, annual reporting.

Washington DC
Benchmarking energy and water

Washington DC's Clean and Affordable Energy Act of 2008 (CAEA), which set out requirements for buildings to annually benchmark energy and water efficiency, initially only applied to buildings **over 50,000 square feet**.

The subsequent Clean Energy DC Omnibus Act of 2018 expanded coverage to buildings **over 25,000 square feet**.

From 2024, all buildings **over 10,000 square feet** will be covered.

Chicago
Reporting of building energy use

Chicago Energy Benchmarking Ordinance, adopted in 2013, required building owners or managers of properties of over 50,000 square feet to measure and report whole-building energy use once a year.

This was later updated with the introduction of the Chicago Energy Rating System (launched in 2019), which established a four-star scale rating system.

Properties that have not submitted required energy information will receive zero out of four stars.

U.S. cities are leading on data disclosure

Increasingly, benchmarking data collected on energy and water usage is being disclosed publicly. Cities in the U.S. are leaders, with Boston, New York, San Francisco and Washington DC all making building-specific data publicly available via open-data portals and interactive maps.

Cities can also require buildings to post their rating in a prominent location on the property, so it is visible to the public. This improves energy literacy among the wider public, encouraging greater awareness of differences in building energy efficiency. A more informed and educated public should increase tacit participation in the 'whole of society' citywide drive needed to tackle the climate crisis.

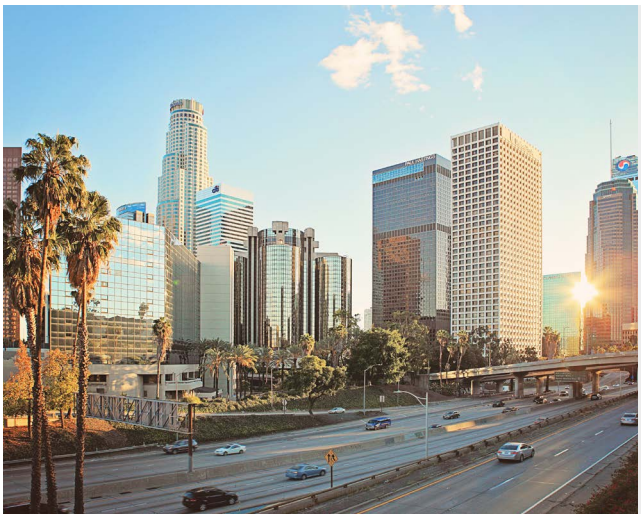
Some benchmarking systems include enforcement penalties, typically fines for non-compliance, such as failing to report on time or to meet minimum energy efficiency requirements.

Energy audits and retro-commissioning

Alongside reporting and benchmarking, cities can also require energy audits to be undertaken periodically or for priority building types.

Energy audits refers to requirements for buildings to engage a qualified professional to conduct whole-building performance evaluation to identify and prioritize improvements. Audits often also include a requirement to undertake retro-commissioning or retrofitting measures to improve energy efficiency.

Through undertaking energy audits and retro-commissioning, building owners and managers can ensure the building is running as efficiently as possible, thereby optimizing operational energy performance.



Los Angeles
Benchmarking and auditing

Los Angeles' Existing Buildings Energy and Water Efficiency (EBEWE) Ordinance consists of two parts:

- Benchmarking
- Audits and Retro-Commissioning

Buildings over 20,000 square feet are required to benchmark and report annual energy and water use and need to conduct audit and retro-commissioning actions every five years.

Benefits of benchmarking, audits and reporting systems

- Benchmarking and energy audits give building owners a more robust understanding of their buildings' performance and scope for improvement.
- If mandatory, they force building owners, managers and occupiers to care about their energy consumption and the energy efficiency of their building systems.
- They promote data-driven decision-making that ultimately leads to lower energy consumption and unlocks efficiencies ("you can't manage what you can't measure").
- They produce reduced operational costs. Financial savings outweigh the low costs of tracking energy use.
- They can be used to verify whether a 'performance gap' exists, where modelled building energy performance does not equate to actual in-use performance.
- They allow local governments to gather data to inform policies.
- Public disclosure of emissions improves transparency. This contributes to creating a more informed property market that influences behavior, with investors and occupiers likely to become more discriminating around buildings and their sustainability credentials.

Singapore's Green Building Masterplan

The Singapore Green Building Masterplan (SGBMP) is part of the Singapore Green Plan 2030. It was developed by the Building and Construction Authority (BCA) and the Singapore Green Building Council.

Dubbed "80-80-80 in 2030", the masterplan aims to deliver on three key targets:

1. 'Green' 80% of buildings by 2030. As of end 2021, 49% of Singapore's total building stock had achieved BCA Green Mark certification.

2. 80% of new buildings to be Super Low Energy (SLE) from 2030. The prerequisite for SLE is at least a 60% energy efficiency improvement over the 2005 building codes.

3. 80% energy efficiency improvement (from 2005 levels) for best-in-class green buildings by 2030. The BCA aims to achieve this target through the Green Buildings Innovation Cluster (GBIC) program, which supports the development and deployment of green building technologies and solutions.

To help achieve the targets, the BCA has:

- Raised the minimum energy performance requirements for new buildings (from end 2021) and for existing buildings which undergo major retrofitting (from 2022).

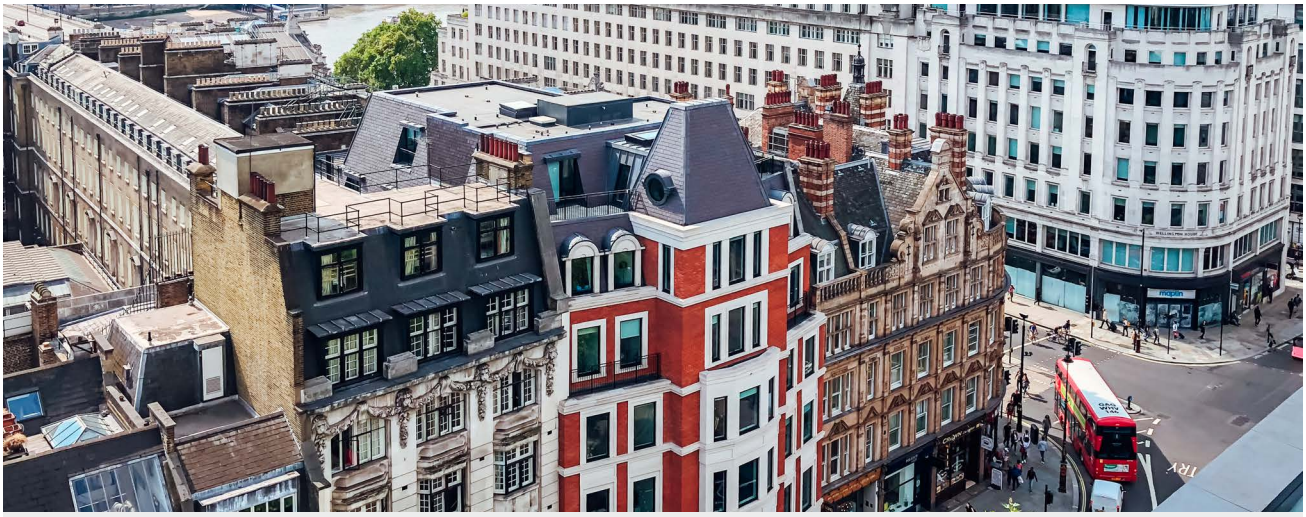
- Launched a revised BCA Green Mark 2021 green building certification to raise energy performance standards. The refreshed certification places greater emphasis on other sustainability outcomes such as whole life carbon, health and wellbeing, and climate resilience.

Building codes and minimum building performance standards

Minimum energy efficiency standards

Minimum energy efficiency standards or regulations are an important regulatory instrument, but as with reporting and energy benchmarking, cities are approaching this through different ways.

Minimum energy efficiency standards can be applied to new buildings, existing buildings or both, and are often linked to energy benchmarking systems like Energy Performance Certificates (EPCs). This is the case in Paris, where legislation ('Loi Climat et Résilience') means that from 2023, owners of houses with poor energy scores (based on DPE benchmarking grades) won't be allowed to increase rents if they don't make renovations, and from 2025 poorly insulated housing will be prohibited for rental.



London
Minimum energy efficiency standards

Minimum Energy Efficiency Standards (MEES) came into force in England and Wales in 2018 and apply to private rented residential and non-domestic property. The regulations make it unlawful for landlords to grant a new lease for properties with an Energy Performance Certificate (EPC) rating below an 'E' rating.

The national government has proposed lifting the minimum energy efficiency standard in relation to let non-domestic buildings to band 'B' by 2030 and has also recently consulted on raising the minimum EPC standard in all domestic rented properties to band 'C' by 2028.

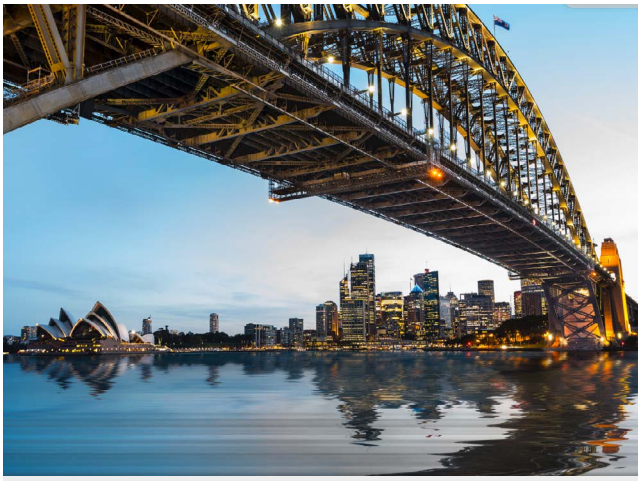
While current EPC ratings are design-based (and therefore a 'performance gap' can exist where modelled building energy performance does not equate to actual in-use performance), the expectation is to move to a performance-based scheme based upon buildings' actual energy use.

Major developments in London are currently expected to achieve at least a 35% onsite reduction in GHG emissions above and beyond the national government's standards.

London has adopted 'Be Seen' energy monitoring, with major developments now required to monitor and report on their actual operational energy performance for at least five years post-construction, with data verified and made publicly available. This policy will give London a better understanding of the actual operational energy performance of buildings and help it work towards bridging the 'performance gap' between design theory and actual energy use.

Building codes

For new buildings (or buildings undergoing major renovations or extensions), building codes are an important tool as they set minimum design standards and levels of energy efficiency that new construction must meet.



Sydney – Performance standards through the planning system

The City of Sydney plans to include energy targets in most development applications. It has produced performance standards for net zero buildings to be implemented through the planning system, with regulations that come into effect in 2023.

Development applications for office buildings, hotels, shopping centers and high-rise apartment blocks must comply with minimum energy ratings from 2023 and achieve net zero energy output from 2026.

San Francisco All-electric ordinance

San Francisco's All-Electric New Construction Ordinance, which came into effect in 2021, requires all-electric new construction and applies to every new building, both residential and non-residential. All heating, cooling, water heating, cooking and drying systems must be all-electric.

As the electricity grid continues to transition to renewables such as solar and wind power, all-electric buildings – whether a new building or electrifying an existing building – will increasingly become cleaner than using natural gas.

Given the direction of travel in regulations, fossil fuel systems in new construction will become liabilities for building owners.

Green building codes have typically been offered as a voluntary standard that developers can choose whether to adopt. Here again though, we are heading towards mandating compliance. This has been the experience in Toronto (see overleaf).

Toronto's Green Standard

The Toronto Green Standard (TGS) was first introduced in 2006 as a voluntary standard for new development. Since 2010 it has structured the city's sustainable design and performance requirements for new private and city-owned developments.

Version 3 came into effect in 2018 and included stepped performance targets and energy modelling guidelines to reduce emissions for all new buildings by 2030 and net zero emissions by 2040.

The TGS consists of performance tiers, with Tier 1 being mandatory and applied through the planning application and development approval process (Tier 1 mandates a 15% energy efficiency improvement on the Ontario Building Code). Tiers 2 to 4 are higher-level voluntary standards associated with financial incentives and are verified pre- and post-construction. Projects that demonstrate Tier 2 levels of performance or above may be eligible for a refund on development charges paid to the city.

Version 4 came into effect in May 2022 for new planning applications and includes three performance tiers that accelerate action on climate change.

Stretch codes or reach codes

It is not uncommon for major cities in North America to adopt a 'stretch code' that exceeds the requirements of the state's mandatory codes. A stretch code is an optional compliance path to the mandatory statewide minimum energy code. It 'reaches' beyond the state minimum requirements for energy use in buildings, resulting in buildings that achieve greater levels of energy efficiency.

Stretch codes provide some harmonization in that they allow those municipalities (from the same state) that wish to adopt more stringent requirements around building design and energy performance, to adopt a uniform standard, thus avoiding a patchwork of different local energy codes. This provides certainty and consistency for developers and the construction sector. Stretch codes also prime the construction industry for changes that could well be part of the next update to the state's baseline energy code.

New York City stretch codes

NYStretch Energy Code-2020 is a supplement to the 2020 Energy Conservation Construction Code of New York State (ECCCNYS). It is available for voluntary adoption by local governments as a more stringent local energy code (7% more energy efficient than the base code). It has been adopted by New York City, which has aligned its 2020 New York City Energy Conservation Code (NYCECC) with NYStretch-2020.

Onsite renewable energy

A number of cities are introducing building-specific requirements for renewable energy to be applied, in most cases to new buildings but also to existing buildings undergoing major renovations/retrofits.

Figure 10: Building Energy Self-Sufficiency Targets and Initiatives

Amsterdam	Target to install solar panels on 50% of suitable roof surfaces by 2030.
Berlin	At least 30% of the gross roof area of new buildings (and existing buildings undergoing roof renovations) must be installed with photovoltaic (PV) or solar thermal energy systems from 2023.
Hamburg	From 2023, photovoltaic systems (solar panels) must be installed on all new buildings. From 2025, existing buildings that require roof renovations must be equipped with a photovoltaic (PV) system.
Miami	From 2022, all new buildings (and existing buildings undergoing a major retrofit) are required to be "solar-ready" and "(battery) storage-ready".
New York	All new buildings and buildings undergoing major roof renovations are required to be covered with solar panels, green roofs, or some combination of the two.
Paris	20% of building rooftops to be equipped with solar power units by 2050.
Seoul	Mandatory installation of solar power on new buildings – from 2023, a mandatory amount of solar power (in proportion to the construction area) needs to be installed on large new buildings.
Shanghai	From 2022, new government buildings, schools, industrial plants and other specified buildings are required to install photovoltaic (PV) solar panels on at least 50% of the suitable rooftop area.

Source: Miscellaneous government sources, JLL, 2022

The benefits of onsite renewable energy:

- reduced emissions
- resilience - security of supply from a local, decentralized energy source
- financial benefits of being self-sufficient
- potential to sell excess energy to the grid. A ‘positive energy building’, also known as an ‘energy-plus building’, produces more energy from onsite renewable energy sources than it consumes. These buildings allow owners to turn excess energy into additional income.

Extending to carbon emissions

Having already established systems around benchmarking and minimum energy efficiency standards, some cities have now extended these requirements to emissions reporting and attendant emissions reduction limits.

Figure 11: Performance-based Carbon Emissions Limits

Boston	Minimum building emissions performance standards on large existing buildings, with limits to decrease over time until eventually all buildings achieve net zero emissions by 2050.
Helsinki	Finland's national carbon-neutral roadmap targets obligatory reporting and benchmark limits for emissions for all buildings by 2025.
New York	Buildings over 25,000 square feet required to meet GHG emissions limits by 2024, with stricter limits coming into effect in 2030.
Tokyo	Mandatory emissions reduction rate (27% for office buildings and 25% for factories) for large-scale facilities, with information on each building's emissions made publicly available.
Vancouver	From 2026, carbon intensity limits for existing large office and retail buildings over 10,000 square meters, with limits to be incrementally decreased to zero by 2040.

Source: Miscellaneous government sources, JLL, 2022

Vancouver's Zero Emissions Building Plan

- Vancouver's Zero Emissions Building Plan, approved in 2016, seeks to reduce the operational carbon emissions of new construction by 90% by 2025, and to zero by 2030. The plan establishes specific targets and actions to achieve zero emissions in all new buildings by 2030.
- In 2018, Vancouver City Council approved new 'catalyst tools', a range of measures available to advance zero emissions buildings at the rezoning and development permit stage. This includes additional floor area (up to 5%) that a developer may add to a proposed project by designing and building it to a zero emissions building performance level.
- The City of Vancouver claims that due to the Zero Emissions Building Plan, new buildings produce 70% less carbon pollution compared to 2007 levels.
- In 2020, the City Council approved a new Climate Emergency Action Plan which requires all new buildings to achieve a 40% reduction in embodied carbon from 2018 levels by 2030.
- Since 2017, developers seeking a rezoning application need to comply with stringent sustainability requirements, including the reporting of whole-building embodied carbon.
- One of the cornerstones of the city's Climate Emergency Action Plan is the Zero Emissions Buildings Retrofit Strategy (ZEB-R) and its objective to reduce carbon pollution in existing buildings by 50% by 2030, on the way to a 100% reduction by 2050.
- The ZEB-R outlines action areas including the development of incentives, the removal of barriers, support for capacity building, and collaboration with utilities on the provision of renewable energy.

Carbon pricing

Linked to emissions reporting, some governments have explored using carbon pricing – market-based instruments, chiefly carbon taxes and emissions trading schemes (ETS), to help drive emissions reduction.

Carbon pricing in Canada

Since 2019, all provinces in Canada have had carbon pricing in place. Provinces and territories can design a carbon pricing structure tailored to local needs or can choose to adhere to the federal pricing system.

The federal pricing system is comprised of a regulatory fossil fuel charge and a performance-based system for industries, known as the Output-Based Pricing System (OBPS). Facilities emitting 50,000 tonnes of carbon or more annually will be required to pay for their emissions based on industry standards.

Emissions trading schemes

Emissions trading schemes (ETS) is a method that incentivizes emissions reduction by setting an emissions target and allowing parties like building owners to sell or purchase credits based on their emission levels.

Essentially, a carbon trading program allows buildings with low-carbon emissions to sell credits to ones that exceed limits. This encourages building owners to invest in deeper emissions reductions sooner than they otherwise would have without a trading program in place.

A carbon trading program can be a very effective tool for spurring investment and action that ultimately accelerates progress on decarbonization.

Emissions trading programs have become commonplace around the globe, though most of them have tended to be targeted at large emitters/ industrial pollutants. To date, Tokyo is one of the only major cities to have implemented a carbon trading program for building emissions, but other cities are exploring its potential.

Tokyo
Building emissions reductions

Tokyo Cap & Trade Program – A mandatory emissions reduction program for large-scale facilities (mandatory reduction rate of 27% for office buildings and 25% for factories). Information on each building is made publicly available. It also includes an expansion of incentives to use renewable power.

Carbon Reduction Reporting Program – The Carbon Reduction Reporting for Small and Medium Entities (CRR) mandates the annual reporting of CO_2 emissions for owners of existing small and medium-sized commercial and industrial facilities consuming large amounts of energy in the Tokyo metropolitan area. In addition to the mandatory component, CRR has succeeded in attracting many voluntary submissions from facilities keen to monitor their annual emissions and to compare them to industry benchmarks.

New York
A raft of local laws to deliver decarbonized buildings

Energy Benchmarking

Local Law 84 requires buildings greater than 25,000 square feet to annually report and benchmark their energy and water consumption (using the United States Environmental Protection Agency's (EPA) online benchmarking/reporting tool, ENERGY STAR Portfolio Manager) and report for public disclosure through the NYC Open Data portal. The data has also been leveraged to create the NYC Energy & Water Performance Map, which was developed by New York University in partnership with the Mayor's Office of Sustainability.

Local Law 33 mandates that the energy efficiency score and grade that is obtained and assigned based on the benchmarking reporting (LL84) must be disclosed in the form of a Building Energy Efficiency Rating label. The label must be displayed in a conspicuous location near each public entrance to a building, so it is visible to the public.

Failure to comply with either LL84 or LL33 will result in financial penalties.

Energy Audit

Local Law 87 mandates that large buildings over 50,000 gross square feet undergo intensive yet periodic energy audit and retro-commissioning measures. Under LL87, large building owners must submit an Energy Efficiency Report (EER) every 10 years. In addition to benchmarking annual energy and water consumption (LL84), energy audits and retro-commissioning will give large building owners a much more robust understanding of their buildings' performance.

Carbon Emissions Reporting

Local Law 97 introduces the requirement for buildings to track and report GHG emissions. LL97 was included in the Climate Mobilization Act, passed by the City Council in April 2019 as part of the Mayor's New York City Green New Deal. It requires buildings over 25,000 square feet to meet energy efficiency and GHG emissions reduction targets by 2024, with stricter limits coming into effect in 2030.

Buildings must comply with the caps, or face fines for exceeding emissions limits. Building owners can also be fined for failure to file a report. LL97 applies a penalty of US$268 for every CO_2 above the limit, one of the most stringent regulations yet.

Building Codes

Local Law 85 requires that buildings undergoing renovations of any kind must meet the most current energy code. Prior to this, buildings were only required to upgrade to current code standards during renovations where more than half of the building's systems were being replaced – this despite that nearly all renovations in New York City affect less than 50% of the building, and as a result, these projects were not required to upgrade to the most up-to-date standards, therefore foregoing significant efficiency gains.

Local Law 32 mandates that New York City updates the NYC Energy Conservation Code (NYCECC) to align it with the latest version of the NYStretch Energy Code developed by the New York State Energy Research and Development Authority (NYSERDA).

Sustainable Roof Laws

Local Laws 92 and 94 – also part of the city's Climate Mobilization Act (2019) – require solar panels or green roofs on all new buildings as well as buildings undertaking major roof renovations. LL94 also increases the SRI (solar reflectance index) or roof reflectiveness of cool roofs as required by the NYC Building Code.

Incentives and accelerators (the ‘carrots’)

Incentives

While regulations are certainly needed, city governments need to find the right balance between regulation, incentivization and advocacy. On their own, mandatory regulations won’t generate the society-wide buy-in needed to create a significantly decarbonized built environment. Where successful cities will win out is in developing voluntary partnerships that are effective at generating multi-stakeholder buy-in and encouraging stakeholders to proactively contribute to sustainability goals.

Incentives, both in the construction of new buildings and retrofitting of existing stock, can help lower barriers to action. For example, building owners are often prevented from pursuing the installation of solar PV systems or deep retrofit projects that could result in long-lasting operational savings, due to the high upfront capex and longer payback period, so cities such as Paris have established innovative financing schemes to overcome this barrier:

Energies POSIT’IF, established in 2012 as a public-private partnership (société d’économie mixte or SEM) by the Île-de-France region, aims to be a pioneer in third-party financing (TPF) for the energy renovation of multifamily residential apartment buildings. Energies POSIT’IF advances the sum required by property owners to finance their renovation projects, with reimbursement of this sum facilitated by the savings made on energy bills. Incentives and effective ‘catalyst tools’ like this will support early private sector champions and drive voluntary leadership in the building sector. Incentives can also help build industry capacity and reduce costs through market transformation.

Some cities have sought to leverage the planning system as a tool to influence and incentivize the construction of new-build properties.

Figure 12: Incentives and Accelerators

	Incentives	Accelerator
Boston	Yes	Yes
Chicago	Yes	
Los Angeles	Yes	Yes
Mexico City	Yes	
Miami	Yes	
Montréal	Yes	
New York	Yes	Yes
San Francisco	Yes	
Toronto	Yes	Yes
Vancouver	Yes	Yes
Washington DC	Yes	Yes
Amsterdam		
Berlin	Yes	
Copenhagen		
Dubai	Yes	Yes
Düsseldorf	Yes	
Frankfurt		
Hamburg	Yes	
Helsinki		
London	Yes	
Manchester		
Munich	Yes	
Paris	Yes	Yes
Stockholm		
Hong Kong	Yes	Yes
Melbourne	Yes	Yes
Mumbai		Yes
Seoul	Yes	
Shanghai	Yes	Yes
Singapore	Yes	Yes
Sydney	Yes	
Tokyo	Yes	

Source: Miscellaneous government sources, JLL, 2022

Figure 13: Cities using the Planning System and Zoning to incentivize Developers

	Incentives
Chicago	The Green Permit Program streamlines the permit process for projects through expedited/priority review and reduction of permit fees.
Miami	Expedited priority review and permitting for green building/sustainable development applications, and density/zoning incentives for exceeding green building certification levels (developers offered greater floor area if minimum green building standards are met).
Montréal	The Sustainable Industrial Buildings Program offers a subsidy equivalent to the increase in the property tax for businesses that carry out construction or renovation work while adhering to sustainable development principles, and within specific areas of the city, building owners and tenants can apply for sustainable development and mobility subsidies if their building contributes to minimizing harmful impacts on Montréal's natural and built environment.
Seoul	The Seoul Metropolitan Government plans to incentivize green building construction through the implementation of a program for relaxing building permits and building size and floor area limitations.
Shanghai	Shanghai encourages the development and construction of ultra-low energy-saving buildings through plot ratio incentives.
Singapore	The Built Environment Transformation Gross Floor Area Incentive Scheme provides additional GFA for developers and building owners adopting enhanced Construction Industry Transformation Map (ITM) standards in areas of digitalization, productivity and sustainability in private sector developments.
Toronto	Potential to receive up to 20% of Development Charges refunded by implementing a minimum number of environmental design measures.
Vancouver	Zero-emissions buildings qualify for up to a 5% floor space ratio (FSR) increase (additional floor area that a builder or developer may add to a proposed multi-unit project by designing and building it to a zero-emissions building performance level).

Source: Miscellaneous government sources, JLL, 2022

Figure 14: Examples of Incentives Schemes to decarbonize Buildings

	Incentives
Berlin	The ENEO (Energieberatung für Effizienz und Optimierung) funding project supports property owners in the implementation of energy-efficient building renovations, including professional energy advice. Investment Bank Berlin (IBB), the development bank of Berlin, grants low-interest loans on the refurbishment of residential units (Energetische Gebäudesanierung).
Dubai	The Shams Dubai scheme incentivizes household and building owners to install photovoltaic (PV) panels to generate electricity and connect to the Dubai Electricity & Water Authority's (DEWA) electricity grid. Any surplus electricity that cannot be used immediately will be credited by DEWA.
Düsseldorf	The Klimafreundliches Wohnen in Düsseldorf funding program provides financial incentives for energy-saving building and refurbishment.
Hong Kong	The Feed-in Tariff (FiT) Scheme, an initiative following the Scheme of Control Agreements (SCAs) between the government and Hong Kong's two power companies, allows people and businesses who install solar photovoltaic (PV) or wind energy generation systems at their premises to sell renewable energy to the power companies at a rate higher than the normal electricity tariff rate.
Los Angeles	Through their Feed-in Tariff (FiT) Program, LADWP purchases energy generated from a customer's solar power system for a fixed price under a standard power purchase agreement, allowing property owners and developers to sell the output from onsite renewable energy.
New York	The Solar Panel Tax Abatement program offers property tax abatements to property owners that install solar electric-generating systems (photovoltaic solar panels) on their buildings.
Paris	The Éco-rénovons Paris program is dedicated to helping private residential buildings owned by individuals (co-ownership) to undertake energy efficient renovations.
Melbourne	The Victoria regional government, via its Solar Victoria programs, provides incentives for the installation of solar panels (PV) and battery systems through rebates.
Seoul	The Seoul Building Retrofit Program (BRP) loan support scheme lessens the financial burden of installation and replacement of energy-efficient material (e.g., insulation, LED lights, water-saving equipment). Loans cover 80%-100% of the construction fee and apply to commercial and residential buildings aged 10 years or older.
Singapore	The Building Retrofit Energy Efficiency Financing (BREEF) Scheme offers financing to pay the upfront costs (e.g., equipment, installation) of energy retrofits of existing buildings through an energy performance contract arrangement.
Sydney	The Small-scale Renewable Energy Scheme incentivizes individuals and small businesses to install small-scale renewable energy systems (e.g., solar panels, small-scale wind systems, solar water heaters and air source heat pumps) through the creation of tradable certificates, which wholesale purchasers of electricity are legally obliged to purchase.
Tokyo	Corporate tax exemptions for small and medium-sized enterprises purchasing energy-saving and renewable energy equipment. The Tokyo Zero Emission Housing Introduction Promotion Project subsidizes part of the expenses for construction of new-build zero emissions housing in Tokyo.

Source: Miscellaneous government sources, JLL, 2022

Knowledge sharing and accelerators

Accelerators

- Resource hubs providing information and technical support
- Training and educational programs
- Net zero building technology incubation
- Demonstrator buildings
- Collaboration/partnerships

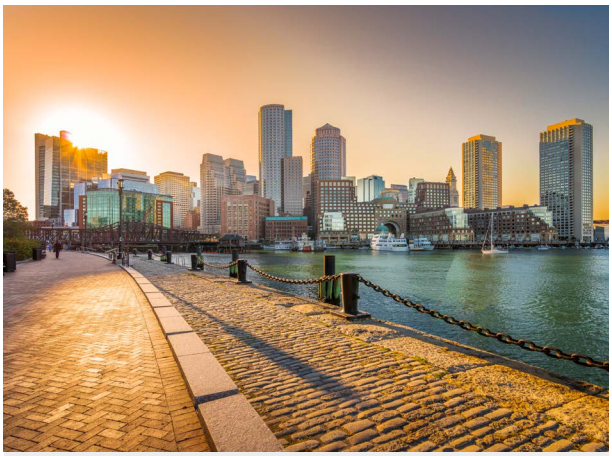
Long tail of small owners and occupiers

While cities can be confident that leading investors and developers will take action in constructing new NZC buildings or retrofitting prime CBD buildings, the greater challenge is how to incentivize the retrofits of low to mid-quality stock often owned by smaller operators. Most smaller companies are still at an early stage in their decarbonization journey and, while committed to the task at hand, often lack the resources and knowledge to take action. City governments are increasingly cognizant of the challenge posed by the significant long tail of small owners and occupiers that are not incentivized to decarbonize; where the financial burden for retrofitting or achieving green-building certification is proportionally higher, and where there is a knowledge gap that impedes progress.

City governments, in partnership with leading real estate investors and occupiers, universities and local green building councils, have an important role to play in educating and disseminating know-how, particularly to smaller companies and individual property owners.

Collaboration will be imperative to greatly accelerate the uptake of net zero buildings. There are already several good examples of cities (from Dubai to New York to Vancouver) establishing platforms and educational programs to share knowledge and resources on net zero building construction and deep energy retrofitting. Ultimately, the aim of such initiatives is to build industry capacity for net zero buildings.

Demonstrator Buildings: The ability to see and experience a local, successful example of a net zero building will also help increase the visibility and uptake of such buildings, including driving awareness and acceptance among the general public.



Boston typifies the challenge facing a lot of cities: its 2,200 largest buildings represent about 34% of the city's total floor area and account for close to half of total emissions. The remaining building emissions come from 84,000 buildings.

City of Boston, Climate Action Plan 2019 Update

Figure 15: Accelerators and Demonstrator Buildings

Boston	The Retrofit Resource Hub is a one-stop-shop information hub designed to make it easier for building owners, managers, tenants and contractors to access both technical and financial resources. The Boston Mass Timber Accelerator was launched in 2021 to help accelerate the use of mass timber. It provides technical support and funding grants for active development projects to integrate mass timber building practices.
Dubai	The Emirates Green Building Council launched the Net Zero Centre of Excellence in 2018 as a think tank and accelerator to advance net zero carbon buildings. The Council also runs a Building Retrofit Training (BRT) Program designed to teach the fundamentals of building retrofit and energy efficiency specific to the MENA region.
Hong Kong	In 2012, the Construction Industry Council (CIC) opened the CIC–Zero Carbon Park - home to Hong Kong's first zero carbon building - to showcase zero carbon building technologies and raise community awareness.
Los Angeles	In 2019, the U.S. Green Building Council-Los Angeles launched a Net Zero Building Technology Accelerator focused on the building technologies that will help make zero carbon, zero energy, zero water and zero waste buildings a reality. L.A. Energy & Water Efficiency Resource Center is funded by the L.A. Department of Water and Power and SoCalGas to provide comprehensive resources to help covered buildings comply with the Existing Buildings Energy and Water Efficiency (EBEWE) Ordinance.
Melbourne	A green roof at 1 Treasury Place has been constructed to act as a demonstration and research roof - part of Melbourne's Green Our Rooftop project in which the City of Melbourne, Victorian Government and Melbourne Water offered collaborative research grants and postgraduate scholarships to fund high-quality research to support the future growth of green roofs in Melbourne.
Mumbai	Mumbai's Climate Action Plan (MCAP) includes actions to undertake a demonstrative low/zero carbon buildings project to set an example in sustainable building and infrastructure design and operation, and to create a retrofit accelerator program on the lines of New York and London to identify the retrofit needs of existing buildings.
New York	The NYC Retrofit Accelerator helps building decision-makers comply with local laws (on building energy and emissions performance) by identifying energy and water saving retrofit opportunities and providing connections to financial and technical resources. It is administered through the New York City Mayor's Office of Sustainability.
Paris	The Territorial Energy Renovation Platform (Plateforme Territoriale de Rénovation Énergétique – PTRE) provides free, dedicated support (technical, financial, legal) to individuals in the residential market to inform and advise on renovation projects. The CSTB'Lab in Paris is an incubator/accelerator for start-ups in the sustainable building and construction sector, partly funded by Région Île-de-France.
Shanghai	Low-carbon pilot district/zone: New Town Low-Carbon Block Implementation Guidelines have been developed to regulate and guide the planning and construction of the pilot area.
Singapore	The Green Buildings Innovation Cluster (GBIC) was set up in 2014 as an integrated research, development and demonstration program to accelerate the development and deployment of promising building energy efficient technologies. GBIC initiatives include the Super Low Energy Building (SLEB) Smart Hub, a digital knowledge center for green buildings.
Toronto	Through the Better Buildings Partnership (BBP), the City of Toronto provides energy reporting and benchmarking, retrofit loans, and building support expertise to improve the energy efficiency of all building types. The BBP has supported over 2,600 projects resulting in 810,000 tonnes of CO_2 emissions reduction.
Vancouver	The City of Vancouver has established the Zero Emissions Building Centre of Excellence (ZEBx) to facilitate knowledge exchange, increase capacity and support the building industry through this transition. The Metro Vancouver Zero Emissions Innovation Centre's (ZEIC) mandate is to catalyze, accelerate and scale climate action innovation across Metro Vancouver.
Washington DC	The DC Sustainable Energy Utility (DCSEU), in partnership with the District Department of Energy & Environment (DOEE) and the DC Green Bank, has established the Affordable Housing Retrofit Accelerator to offer technical and financial assistance to owners and managers of qualifying affordable multifamily buildings that do not meet the District's Building Energy Performance Standards (BEPS).

Source: Miscellaneous government sources, JLL, 2022

New York City Accelerator

Administered through the New York City Mayor's Office of Sustainability, the **NYC Accelerator** offers free advisory services to help building decision-makers comply with local laws, such as LL84, by identifying energy and water saving retrofit opportunities and providing connections to financial and technical resources.

The NYC Accelerator uses the extensive datasets created by the city's building energy benchmarking and audit laws to proactively identify and prioritize building upgrades in privately-owned buildings.

Local Law 96 (of the Climate Mobilization Act, 2019) established long-term, low-interest PACE financing to fund upgrades to building energy and water efficiency (since traditional financing terms often do not match the longer payback period of clean energy or energy efficiency upgrades, preventing owners from pursuing projects that could result in long-lasting operational savings).

Financing the transition

There remains a funding gap

According to recent research by McKinsey, the investment needed to deliver on the global energy transition between 2021 and 2050 is estimated to be US$275 trillion, or US$9.2 trillion per year. The report indicates that this represents a funding gap of about US$3.5 trillion annually over current spending levels.

There are tailwinds and headwinds related to closing this funding gap.

Tailwinds around closing the financial gap

Momentum around a number of key funding sources continues to grow:

- Global sustainable debt issuance surpassed US$1.6 trillion in 2021, more than doubling 2020 volumes, according to BloombergNEF.

- Many private sector companies have joined alliances to commit to financing decarbonization, and the number is increasing. The assets under management represented by all 3,826 signatories to the Principles for Responsible Investment (PRI), a UN-supported network of investors who work to promote sustainable investment, increased from US$103 trillion in 2020 to US$121 trillion in 2021, a rise of 17%.

- In November 2021, at COP26, 450 organizations in the financial sector committed to the Glasgow Financial Alliance for Net Zero (GFANZ), pledging to move US$130 trillion of funds under their control into investments aligned with the 2015 Paris Agreement.

- Venture capital flowing into CleanTech and Climate Tech companies has increased too. Total deal volume was up 107% in 2021 according to PitchBook.

- The growth of carbon taxes could also help finance the energy transition by raising significant revenue. Roughly 40 countries and 20 municipalities, including 10 U.S. states, use either carbon taxes or carbon emissions trading covering 13% of annual global GHG emissions, according to the World Bank.

Headwinds around closing the financial gap

While financing sources are growing to support decarbonization, headwinds persist:

- Commercial banks and export credit agencies (EPAs) continue to provide financing for fossil fuel investments, according to the most recent Intergovernmental Panel on Climate Change Report (Working Group III), when this capital could be redirected towards the energy transition. For example, the world's 60 largest banks lent US$4.6 trillion to the fossil fuel industry in the six years after the 2015 Paris Agreement was signed, according to a March 2022 report by Rainforest Action Network and six other environmental groups.

- One more considerable headwind is that while carbon taxes help, they are seldom high enough. Carbon prices range from U$3-US$60 a ton according to the International Monetary Fund (IMF), but should be closer to US$100 to garner the results needed.

While the challenges are great, and the funding gap is considerable, there is enough capital on the planet to close it and the science reminds us that emissions need to be at a peak today.

Layering on national and international frameworks

While our report looks at 32 global cities and the regulatory instruments at play, we do recognize that investors, occupiers and city officials also need to contend with national and regional regulations and voluntary frameworks which, due to market forces, can feel like a requirement.

This can create complex systems, but we anticipate more harmonization, albeit slow, in requirements over time. A few signals are encouraging:

- The International Sustainability Standards Board (ISSB), established at COP26 to develop a comprehensive global baseline of sustainability disclosures for the capital markets, has released two proposed standards: One sets out general sustainability-related disclosure requirements and the other specifies climate-related disclosure requirements. They have given a 120-day comment period which is now open.

- In the U.S., the Securities and Exchange Commission released in March 2022 a proposed rule for emissions and climate risk reporting as well. They have given a 60-day comment period which is also now open.

- The European Financial Reporting Advisory Group (EFRAG) announced the release of its initial draft of European Sustainability Reporting Standards in May 2022, setting out the proposed rules and requirements for companies to report on sustainability-related impacts, opportunities and risks under the EU's upcoming Corporate Sustainable Reporting Directive (CSRD). This proposal extends existing reporting requirements to 50,000 firms, up from the current 12,000, as well as an expansion of reporting requirements.

These proposals along with regulations that are taking shape in the EU, the UK, Canada and other parts of the world should continue to provide standardization over time. The key is for regulations to not only impact reporting requirements, however, but to also incentivize action and impact.

4 Beyond Carbon

More than half the cities in the study have set targets in relation to biodiversity preservation or circularity. This is very encouraging as it is critical to creating resilient, sustainable cities.

Figure 16: Beyond Carbon

	Circular Economy		Biodiversity		Resilience / Climate Adaption
	Citywide Circular Economy/Zero Waste Strategy or Plan	Circular Economy / Zero Waste Targets	Citywide Biodiversity Strategy or Plan	Citywide Biodiversity Explicit Targets	Resilience / Climate Adaption Strategy or Plan
Boston	Yes	Yes	Yes		Yes
Chicago	Yes		Yes	Yes	Yes
Los Angeles	Yes	Yes		Yes	Yes
Mexico City		Yes	Yes	Yes	Yes
Miami		Yes		Yes	Yes
Montréal	Yes	Yes	Yes	Yes	Yes
New York	Yes	Yes			Yes
San Francisco		Yes	Yes	Yes	Yes
Toronto	Yes	Yes	Yes	Yes	Yes
Vancouver	Yes	Yes	Yes	Yes	Yes
Washington DC	Yes	Yes	Yes	Yes	Yes
Amsterdam	Yes	Yes	Yes	Yes	Yes
Berlin	Yes	Yes	Yes		Yes
Copenhagen	Yes	Yes	Yes		Yes
Dubai	Yes		Yes	Yes	
Düsseldorf			Yes		Yes
Frankfurt	Yes				Yes
Hamburg			Yes		Yes
Helsinki	Yes	Yes	Yes	Yes	Yes
London	Yes	Yes	Yes	Yes	Yes
Manchester	Yes		Yes	Yes	Yes
Munich	Yes		Yes	Yes	Yes
Paris	Yes	Yes	Yes	Yes	Yes
Stockholm		Yes	Yes		
Hong Kong		Yes			
Melbourne		Yes	Yes	Yes	Yes
Mumbai		Yes		Yes	
Seoul				Yes	
Shanghai		Yes		Yes	Yes
Singapore		Yes	Yes	Yes	Yes
Sydney		Yes	Yes	Yes	Yes
Tokyo	Yes	Yes	Yes	Yes	Yes

Source: Miscellaneous government sources, JLL, 2022

Embracing the circular economy

In tandem with the transition to a net zero carbon economy, many 'Trailblazer' and 'Climate Progressive' cities, including Munich, Helsinki and Los Angeles, have also set out ambitious goals to transition to 'zero waste' and 'circular economies'.

In a circular economy, the value of materials is preserved as much as possible throughout a product's life cycle, from design to disposal, with the goal to eliminate waste.

Figure 17: Circular Economy Targets

Amsterdam	Target to halve the use of new raw materials by 2030 and achieve a fully circular city by 2050.
Copenhagen	Target for 70% of municipal solid waste (household waste and light industrial and commercial waste) to be collected for recycling by 2024.
Hamburg	Hamburg has changed its building code to allow for timber to be used in larger construction projects (up to 22 meters in height).
Helsinki	Target to implement a carbon-neutral circular economy in land use and construction by 2035.
Hong Kong	Target to reduce per capita municipal solid waste disposal by 40%-45% and increase the recovery (recycling) rate to c.55%, with long-term goal of 'zero landfill'.
London	Target for zero waste to landfill by 2026.
Los Angeles	Target to become the largest city in America to achieve zero waste, a 90% landfill diversion rate, by 2025.
Melbourne	Target for 90% of waste to be diverted from landfill.
Mexico City	Target to triple the amount of recycled waste, including construction and demolition waste, and reduce waste going to landfill by 70%, by 2024.
Munich	Munich has established a dedicated Zero Waste Advisory Board, comprised of key stakeholders from all over the city, to assist the implementation of its zero waste strategy.
Paris	Aims to encourage all construction projects to adopt circular economy principles in order to attain the target of 50% zero landfilled-waste construction sites by 2030 and 100% by 2050.
Shanghai	Shanghai is the first city in China to implement a Municipal Solid Waste (MSW) sorting regulation, and is targeting a 45%+ recycling rate of domestic waste by 2025.
Singapore	Target to reduce amount of waste sent to landfill per capita per day by 30% by 2030 and achieve a 70% overall recycling rate by 2030; 70% adoption rate for Design for Manufacturing and Assembly (DfMA) in the built environment sector by 2025.
Tokyo	Signatory to the C40 Advancing Towards Zero Waste Declaration pledging to reduce amount of waste sent to landfill and incineration by 50%.
Toronto	Target for 70% diversion of waste by 2026. Toronto was co-convenor of the first Great Lakes Circular Economy Forum, an initiative to create a shared vision for a circular economy in the Great Lakes region.
Vancouver	Target for zero waste by 2040.
Washington DC	Medium-term target to reuse or recycle 50% of all commercial construction waste.

Source: Miscellaneous government sources, JLL, 2022

Adopting circularity in real estate

Cities' targets and policies around waste and the circular economy are highly relevant to the real estate sector, as they impact the entire building life cycle from design to dismantling.

As legislation on the adoption of circular practices is rolled out, real estate investors, developers and construction firms will increasingly need to concentrate on a 'whole life carbon' approach that encourages design for flexibility, adaptability and deconstruction to minimize end-of-life impacts and enable a 'circular economy' within the built environment.

Circular design places an increasing emphasis on modern methods of construction — focusing on standardization, mass production and factory-based, offsite construction. Although circular construction might mean higher construction costs, there is opportunity to spread higher initial costs of production across multiple, extended product life cycles.

New collaborative business models are required

'Whole life cycle' thinking requires deep collaboration across the entire value chain – including supply-side actors like architects, contractors, component manufacturers and materials suppliers. Demand-side actors within the value chain, including investors and developers, must work together with those on the supply side.

Public procurement from city governments, central purchasing bodies and other major public procurers/large buyers – particularly when working together and pooling their resources – can have significant market power and help to drive market demand for innovative and sustainable products and services.

London
Whole Life-Cycle Carbon Assessment

Life-Cycle Assessments, or LCAs, provide a standardized assessment of a material's embodied carbon from its initial extraction to its eventual end-of-use disposal. All referable planning applications in London are now required to calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon (WLC) Assessment and to demonstrate actions being taken to reduce life-cycle carbon emissions. While this requirement currently only applies to planning applications that are referred to the Mayor, WLC assessments are encouraged for all major applications.

Amsterdam
Leading in the circular economy

Amsterdam's Circular Strategy establishes a plan to make Amsterdam a 'circular city' by 2050, with an intermediate target of a 50% reduction in primary raw materials' consumption by 2030.

It also contains a buildings-specific goal that, by 2025, 50% of all refurbishment and maintenance operations should follow the principles of circular construction.

Amsterdam City Doughnut

The city's Circular Strategy is based on the Doughnut Economics Model. The model posits that nobody should be left in the hole in the middle of the doughnut, falling short on the essentials of life. At the same time, humanity must live within the outside circle of the doughnut, within ecological boundaries to preserve the Earth's resources. The doughnut shape left in-between those two circles is the sweet spot.

Park 20|20 – cradle-to-cradle inspired business park

- Park 20|20 is a 9-hectare business park scheme located near Amsterdam Schiphol Airport and is one of the first major circular economy real estate developments worldwide.
- It incorporates cradle-to-cradle certified materials and Madaster material passports for buildings. All materials used are logged on an external public platform – this serves as an inventory of resources and tracks the value of materials over time, facilitating reuse at the end of life.
- The buildings' structural frame is reusable. The scheme is designed for disassembly and repurposing, with shared amenities to provide more usable space.
- There is onsite water treatment and the development is run on renewable energy generation.
- Sustainability is woven into the building with solar PVs on the roof generating electricity that work in tandem with green roofs which provide shade and increase biodiversity, thereby leading to cooler surface temperatures and improved PV efficiency.

Timber

Timber is seen as part of the solution – in 2021, 32 municipalities across the Metropolitan Region of Amsterdam (MRA) signed the 'Green Deal Timber Construction' agreement, which contains a commitment for 20% of all new homes to be constructed using wood or other bio-based materials as the primary material from 2025.

Urban greening and biodiversity

Biodiversity is a key measure of the health of a city

Another route that cities are taking in decarbonization, and which is part of the wider environmental push, is in terms of encouraging green spaces and biodiversity.

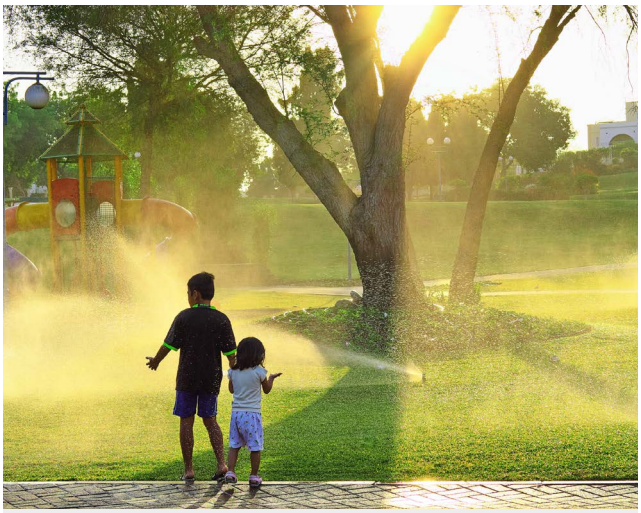
City governments are increasingly recognizing the role of biodiversity or natural capital as a fundamental element of sustainable, healthy and livable cities. Many cities have released broader plans or strategies to increase the size and health of their green spaces and tree canopy cover (see Figure 18). From Amsterdam to Los Angeles to Singapore, greening and biodiversity targets and initiatives are being rolled out.

The greening and biodiversity challenge

Data from the United Nations Environment Program shows that, per person, **the global stock of natural capital has declined nearly 40% since the early 1990s**. Natural capital refers to the planet's stock of renewable and non-renewable natural resources, like plants, soils and minerals.

By 2030, urban land cover is expected to triple from levels in 2000.

Source: WWF, Living Planet Report 2020 – Bending the curve of biodiversity loss, 2020



Urban Nature Declaration

In July 2021, mayors from 31 cities signed C40's Urban Nature Declaration committing to deliver the following by 2030:

- 30%-40% of the total built-up city surface area to consist of green or permeable spaces designed to absorb water and prevent flooding.
- 70% of the city population to have access to green or blue public spaces within a 15-minute walk or bike ride.

Signatories include **Berlin, Copenhagen, London, Los Angeles, Mumbai, Paris, San Francisco, Stockholm, Sydney, Tokyo** and **Toronto**.

Taskforce on Nature-related Financial Disclosures (TNFD)

The TNFD builds on the Task Force on Climate-related Financial Disclosures (TCFD) framework, but with a focus on nature and environmental risks such as the loss of biodiversity and degradation of ecosystems.

TNFD will deliver a risk management and disclosure framework for organizations to report and act on evolving nature-related risks, and aims to support a shift in global financial flows towards nature-positive outcomes.

The first prototype of the TNFD was released in March 2022, with a finalized framework set to be released in 2023.

Figure 18: City Greening and Biodiversity Targets and Initiatives

Hamburg	IFB Hamburg (Hamburg Investment and Development Bank) provides subsidies of up to €100,000 for green roofing measures for both residential and non-residential buildings.
Mexico City	Target of planting 10 million trees.
Miami	Million Trees Miami campaign to plant 1 million trees to achieve a 30% tree canopy cover.
London	Target for 50% of London to be physically green by 2050.
Los Angeles	Target to increase tree canopy in areas of greatest need by at least 50% by 2028. See Case Study on page 56.
New York	NYC Green Roof Property Tax Abatement Program (green roof/vegetation must cover at least 50% of eligible roof space).
Manchester	Target to plant 3 million trees by 2035 and a further 1-2 million by 2050.
Melbourne	Target to increase public realm canopy cover from 22% at present to 40% by 2040; Urban Forest Fund established to provide financial grants for new urban greening projects (e.g. green roofs).
Mumbai	Target to increase vegetation cover and permeable surface to 30%-40% of the city surface area by 2030 to tackle flood- and heat-related disaster risk.
Paris	Target for 100 hectares of green roofs and walls, one-third of which will be devoted to urban agriculture, by 2030; 40% of Paris to consist of permeable green space/vegetal covering by 2050.
Seoul	Target to create and maintain 31 million square meters of green spaces and parks by 2026.
Singapore	Target to add 1,000 hectares of green spaces by 2035. See Case Study on page 56.
Shanghai	Target for ecological land to account for at least 60% of total land area; increase forest coverage to 23% by 2035; park green space to increase to 13 square meters per capita by 2035.
Sydney	Target for every resident to live within a 3-minute walk (250 meters) of continuous green links that connect to the harbor foreshore, harbor parklands, or the Moore, Centennial or Sydney parks.
Tokyo	Plan to open 130 hectares of new metropolitan park land by 2030.
Toronto	Target to increase citywide canopy cover to 40%; Eco Roof Incentive Program (grants to support the installation of green roofs); Pollinator Protection Strategy (for bees, butterflies and other pollinators).
Vancouver	Target for every person to live within a 5-minute walk of a park, greenway, or other green space; increase the citywide canopy cover from current 22% to 30% by 2050.
Washington DC	Target to plant 10,500 new trees annually to reach 40% canopy cover by 2032 and provide access to the natural environment or quality green space within a 10-minute walk of all residents.

Source: Miscellaneous government sources, JLL, 2022

The value of biodiversity to cities

Resilience against urban heat island effect, flash flooding, storm surges, etc. Nature-based solutions to support resilience:

- Urban greening provides shade and cooling to reduce the heat island effect and moderate the impacts of heatwaves.
- Green roofs with vegetation absorb rainwater and combat the heat island effect.
- Natural drainage captures surface water run-off to help flood risk/storm water management.
- Retaining and restoring mangroves along coastlines can protect people and property by moderating the impacts from storm surges and coastal erosion.

Regenerative to air, water, soil, waste and health:

- Mitigating the impacts of climate change by sequestering and storing carbon.
- Green walls and roofs provide added insulation to buildings meaning a reduction in energy usage needed to heat and cool buildings.
- Green roofs and walls can also reduce the impact of external or internal noise.
- Providing habitats for birds and wildlife.
- Microclimate improvements such as air quality.

Recreational and tourism benefits:

- Providing amenity and recreational space (especially important in the most densely developed parts of cities where traditional green space is limited).
- Feeling connected to nature – access to green spaces enhances overall livability and wellbeing for the people who reside in cities (with positive outcomes for mental and physical health, and productivity).

Resourceful – water, food and pharmaceuticals:

- Sustainable drainage systems used to capture water for onsite use (circular economy).
- 'Blue roofs', for example, allow for the build-up of water (above a waterproof membrane), which may be reused to flush toilets, water plants or for other purposes.
- Food security – urban farms provide locally-sourced produce for city dwellers.
- Pharmaceuticals – biodiversity is a necessity for medicine discovery.

Singapore's urban greening

The Singapore Green Plan 2030 seeks to build upon the city's already strong reputation for urban greening, and contains several targets related to biodiversity and green space:

- One million more trees to be planted between 2020 and 2030
- By 2030, increase nature parks' land area by over 50% (around 200 hectares)
- By 2030, ensure every household will live within a 10-minute walk to a park
- By 2035, add 1,000 hectares of green spaces.

Launched in 2009, the city's Landscaping for Urban Spaces and High-Rises (LUSH) encourages the incorporation of greenery in the high-rise urban environment. It includes Landscape Replacement Areas guidelines to ensure that greenery lost on the ground is replaced vertically. New developments in some areas of Singapore are required to replace the greenery they have displaced in building their projects. This ensures that Singapore remains well landscaped with greenery, even as the environment becomes more built up. Urban farms can also be counted as part of the Landscape Replacement Areas.

To increase greenery provision in Singapore, the National Parks Board introduced the Skyrise Greenery Incentive Scheme (SGIS) to fund up to 50% of installation costs of rooftop greenery and vertical greenery.

Los Angeles' Green New Deal

Los Angeles' 'Green New Deal: Sustainable City pLAn' (2019) includes targets to:

- Achieve and maintain 'no-net loss' of native biodiversity by 2035
- Ensure the proportion of Angelenos living within 1/2 mile of an open space is at least 65% by 2025; 75% by 2035; and 100% by 2050
- Increase tree canopy by at least 50% by 2028 in areas with the least shade.

Planting street trees was one of the solutions employed by Los Angeles in its 'Cool Streets LA' program to combine several cooling strategies to help lower temperatures and add shade in the city's hottest and most vulnerable neighborhoods.

Google has piloted the Tree Canopy Lab in Los Angeles, which uses imagery data to estimate tree canopy coverage across the City of Los Angeles. The data is being used to determine new areas for tree planting efforts, which can reduce both the urban heat island effect and carbon emissions and improve air quality.

Real estate response to greening and biodiversity

The benefits of biodiversity have led developers more recently to enhance local ecology and even create strategies for net biodiversity gain.

Biodiversity is also now becoming part of the investor conversation.

Forward-thinking real estate developers see biodiversity/biophilic design/green infrastructure (including features such as living walls/green facades, indoor plants, green roofs and rain gardens) as an investment that enhances the attractiveness of their real estate assets. They also recognize the flexibility provided by open and green spaces that can be adapted for different uses and programing, e.g., outdoor meetings and events space, parks, farmers markets, etc.

The real estate industry is anticipating increased legislation related to biodiversity and buildings, and the UK in particular is leading the way:

- The Environment Act came into law in the UK in 2021, with long-term statutory targets to improve air quality, biodiversity, water and waste reduction and resource efficiency. It also includes a target to reverse the decline in species abundance by the end of 2030. The UK has committed to conserving 30% of land and water for nature by 2030.

- Biodiversity Net Gain legislation is likely to become law in England in 2023 and will require major developments to create a biodiversity net gain plan. 'Biodiversity net gain' is an approach to development that leaves biodiversity in a better state than before. This means that where biodiversity is lost as a result of a development, the compensation provided should be of an overall greater biodiversity value than that which is lost.

- The latest London Plan requires all major developments to include urban greening as a "fundamental element of site and building design", and also introduces the use of an Urban Greening Factor (UGF) tool to evaluate the amount and quality of urban greening provided by a development proposal.

Governments are progressively seeking to protect green spaces and, for example, are limiting 'soil sealing' in urban landscapes, which means that land available for real estate development, such as residential and logistics, could become scarce, particularly in Europe. Soil sealing is the covering of the soil surface with materials like concrete in new building and infrastructure works, thereby preventing natural soil and ecological functions.

The European Commission has announced a Soil Thematic Strategy with recommendations on best practices for limiting soil sealing for its 27 member states. For example:

- In Germany, the government has issued a decree to reduce the extent of newly-sealed land to below 30 hectares per day by 2030 and achieve a net zero strategy by 2050.

- In France, the 'Loi Climat et Résilience' law, which came into effect in 2021, intends to address soil sealing with a target for all local authorities to reduce the pace of soil sealing by 50% by the end of the decade, and of zero net soil sealing by 2050. The law already has immediate implications for real estate developers, with the development of any new shopping center on natural land prohibited.

A look at adaptation, resilience and physical climate risk

Cities have the responsibility of not only engaging in the energy transition and thinking about biodiversity but facing the reality that climate change is happening today. All over the globe, extreme weather is growing in intensity and frequency, and so resilience will be foundational to any long-term sustainability plan.

While all cities in this survey have an imperative to embed climate resilience into their sustainability plans, some cities are far more vulnerable than others to climate change and extreme weather events.

Risk Management Partners, a business unit of Munich Re, has provided data for 7 climate hazards – tropical cyclone, river flood, drought, fire weather, heat, precipitation and sea level rise – which were used to derive the scores for the 32 metropolitan areas – using the assumption of a 'business as usual' pathway (RCP 8.5).

The Asian cities of Shanghai, Hong Kong, Dubai and Mumbai stand out in terms of climate vulnerability and are under greatest pressure to take action to improve resilience against heat, drought, fire weather and precipitation. Yet, Northern American cities, most notably Miami, Washington DC and Los Angeles, are not so far behind. Northern European cities have the lowest hazard scores, with Helsinki, Stockholm and Manchester assessed to be in the least vulnerable position to climate stress.

Figure 19: Climate Hazards

Metro Area	Hazard Score*	Key Hazards
Shanghai	21.8	Precipitation, River Flood, Heat
Hong Kong	21.1	Precipitation, Heat
Dubai	20.9	Drought, Heat
Mumbai	20.6	Precipitation, Heat
Miami	20.6	Tropical Cyclone, Heat
Washington DC	18.5	Precipitation, Heat
Seoul	17.7	Precipitation
Los Angeles	17.7	Heat, Fire Weather
Tokyo	17.1	Precipitation
New York	17.1	Precipitation
Sydney	17.0	Precipitation, Heat
Melbourne	16.9	Drought
Boston	16.8	Precipitation
Mexico City	16.5	Drought
Singapore	15.7	Precipitation, Heat
Vancouver	15.6	Precipitation
Amsterdam	15.6	Sea Level Rise
San Francisco	15.5	
Chicago	15.3	
Frankfurt	14.8	
Berlin	14.6	
Paris	14.5	
Montréal	14.4	
Düsseldorf	14.4	
Hamburg	14.3	
Toronto	14.2	
Munich	13.5	
Copenhagen	13.0	
London	12.3	
Stockholm	11.7	
Manchester	11.3	
Helsinki	10.6	

* Based on 7 climate hazards – drought, fire weather, heat, precipitation, river flood, sea level rise and tropical cyclone

* Assumes an RCP 8.5 in 2050. RCP 8.5 refers to greenhouse gas emissions that result in additional 8.5 watts per square meter radiative forcing by 2100.

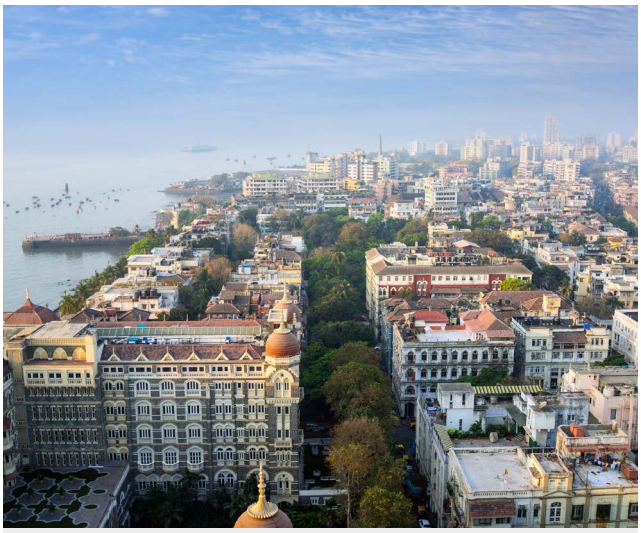
Source: Munich Re, May 2022

City resilience strategies

Some of the more forward-thinking city administrations – like Melbourne, Sydney, Amsterdam and Paris – have been pioneers in developing climate resilience strategies. Other prominent cities include New York, Singapore and London.

They have often been supported by the 100 Resilient Cities (100RC) project, started by the Rockefeller Foundation, which has provided:

- funding for the development of robust resilience strategies/plans and road maps;
- support for establishing a new position in city administration: a Chief Resilience Officer to lead the city's resilience efforts; and
- establishing a global network of member cities to learn from and help each other. This global network lives on through the 'Resilient Cities Network'.



Statistics from the Mumbai Climate Action Plan 2022

50% of Mumbai's residents live in informal settlements (made of temporary building materials that absorb and reflect heat onto streets) which are uninhabitable on extremely hot days. These are some of the world's largest slums and are almost 5-6°C degrees warmer than residential neighborhoods having trees and open spaces.

Mumbai's vegetation cover had reduced from 46% in 1988 to 27% in 2018, mostly in low-income areas. According to an IPCC report, the city is expected to experience high mean temperatures of up to 35°C for almost 117 days in a year by the end of the century and an increase in total rainfall of almost 32% by 2060.

Source: Mumbai Climate Action Plan 2022: Towards a Climate Resilient Mumbai, 2022

Figure 20: City Resilience Plans

Boston	Climate Ready Boston (2016); Resilient Boston Harbor
Chicago	Resilient Chicago (2019)
Los Angeles	Resilient Los Angeles (2018); Green New Deal: Sustainable City pLAn (2019), Chapter 11: Urban Ecosystems & Resilence
Mexico City	CDMX Resilience Strategy
Miami	Miami Forever Climate Ready (2020); Resilient305 Strategy (2019); Sea Level Rise Strategy
Montréal	Montréal's Resilient City Strategy (2018)
New York	OneNYC 2050 (2019), Vision 4: Our Resilient City
San Francisco	Hazards and Climate Resilience Plan (2020); Resilient San Francisco: Stronger Today, Stronger Tomorrow (2016)
Toronto	Toronto Resilience Strategy (2019)
Vancouver	Resilient Vancouver Strategy (2019)
Washington DC	Resilient DC: A Strategy to Thrive in the Face of Change Plan (2019)
Amsterdam	Strategie Klimaatadaptatie Amsterdam / Climate Adaptation Strategy (2020)
Berlin	Stadtentwicklungsplan Klima KONKRET (2016)
Copenhagen	Copenhagen Climate Adaptation Plan (2011)
Dubai	
Düsseldorf	Klimaanpassungskonzept (KAKDUS), 2017
Frankfurt	Frankfurter Anpassungsstrategien an den Klimawandel (2016)
Hamburg	Klimaplan Hamburg (2019)
Helsinki	Helsinki climate adaptation guidelines (approved by the Helsinki City Board in May 2019)
London	London City Resilience Strategy (2020)
Manchester	Greater Manchester Resilience Strategy 2020-2030
Munich	Konzept zur Anpassung an die Folgen des Klimawandels in der Landeshauptstadt München (2016)
Paris	Paris Resilience Strategy (2017)
Stockholm	
Hong Kong	
Melbourne	Resilient Melbourne (2016)
Mumbai	
Seoul	
Shanghai	Shanghai Sponge City Plan (2016-2035); Shanghai Emergency Management: The 14th Five-Year Plan
Singapore	A Resilient Singapore (2018)
Sydney	Resilient Sydney (2018)
Tokyo	Zero Emission Tokyo Strategy: Policy 9 (2019)

Source: Miscellaneous government sources, JLL, 2022

5 The Way Forward: An Ecosystem of Partnerships

Ecosystems of partnerships will be essential for progress

The magnitude of the climate change challenge and the urgency with which we need to create a significantly decarbonized built environment requires society-wide buy-in and mobilization of resources across multiple stakeholder groups. No single stakeholder group, whether in the public or private sector, has the resources or capabilities to accomplish decarbonization on their own. As we tackle the decarbonization challenge, an ecosystem of partnerships needs to emerge – from property owners, investors and corporate occupiers to national and city governments, academic institutions, employee groups and community organizations – that work together towards common sustainable targets.

The adoption of a more collaborative business model will require a change in mindsets among many city administrations who should see real estate owners, developers, investors and occupiers as long-term partners that can help achieve environmental goals which would otherwise be difficult to attain. There is strong potential to leverage the intelligence, skills, innovations and financial acumen of the real estate sector to reach these goals.

Greater collaboration with the real estate sector will help define the right balance between incentives, encouragement and advocacy as opposed to regulation, penalties and taxes. Where successful cities will win out is in developing voluntary partnerships that are effective at generating multi-stakeholder buy-in and encouraging stakeholders to proactively contribute to sustainability goals.

Likewise, as cities' environmental goals become more ambitious, the real estate industry should step up to partner with city governments to set achievable targets and define regulatory frameworks. Investors and occupiers will need to familiarize themselves with the environmental aspirations, actions and challenges of the cities in which they have existing assets, so they can contribute both directly and indirectly to making a city's environment goals attainable.

Copenhagen's 'Energy Leap'

The 'Energy Leap' (Energispring) initiative is part of the CPH 2025 Climate Plan, in which the City of Copenhagen has set a target to be the world's first carbon-neutral capital city by 2025.

The City is collaborating and forging voluntary agreements with the city's largest building owners to reduce energy consumption and implement active energy management.

The three-step approach involves:

- Tracking data on energy consumption
- Optimizing the operations of energy-consuming systems
- Retrofitting buildings to improve energy efficiency

The partnership represents 26% of Copenhagen's combined building stock.

Decarbonization and positive social outcomes

City stakeholders, in partnership, will need to ensure a fair and equitable transition to net zero. The best sustainability strategies embrace a holistic approach, in which the drive towards decarbonization and its implications are considered alongside social outcomes, or the 'S' in the ESG, and not treated as entirely separate agendas.

Decarbonization is increasingly playing a core role in city policy and how cities are being run, the implications for which are experienced by residents and workers, whether this is around expanding the amount of green space, introducing low-emissions traffic zones or requiring homes and workplaces to meet minimum energy efficiency standards.

Both environmental sustainability and ESG more broadly are being linked more and more to quality of life – for example, Amsterdam's embrace of the Doughnut Economics model, or the plan to transform Paris into a 15-minute city – with sustainability becoming an element of city competitiveness and a differentiator used to communicate a city's values and priorities. Cities with strong environmental credentials, or that are seen to be climate progressive, stand to benefit from an enhanced brand and attractiveness to companies and talent.

San Francisco's Zero Emissions Buildings Taskforce

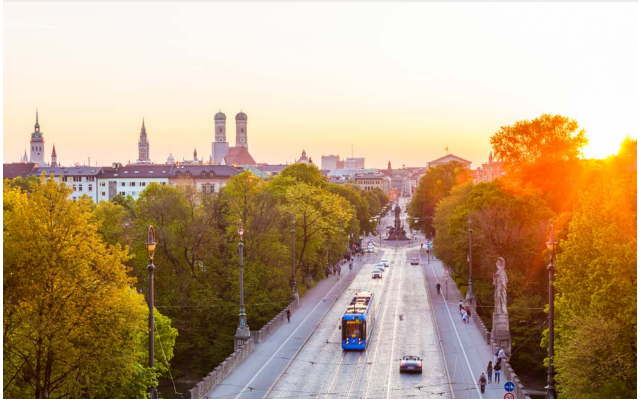
The Taskforce is a public-private collaboration of diverse key stakeholders that has collaborated on developing policy and program recommendations which have led to specific actions, including the All-Electric New Construction Ordinance requiring all new buildings to be all-electric, effective from 2021.

The Taskforce also helped inform building decarbonization strategies in San Francisco's Climate Action Plan, released in 2021.

Munich seeks climate-neutrality and livability

Munich has drafted the 'Stadtentwicklungsplan 2040' for a more sustainable and future-proof city. The plan focuses on mobility, open spaces, urban development, climate adaptation and climate protection.

On the one hand it provides measures and strategies so that Munich becomes climate-neutral by 2035; on the other hand, that Munich becomes a more livable and sustainable place. The focus is on green and open spaces, efficient and climate-neutral mobility, sustainable districts that are adapted to the climate and a climate-neutral energy supply. All of this is embedded in a dialogue with all stakeholders across the Munich region, from companies to residents.



The value of international collaboration

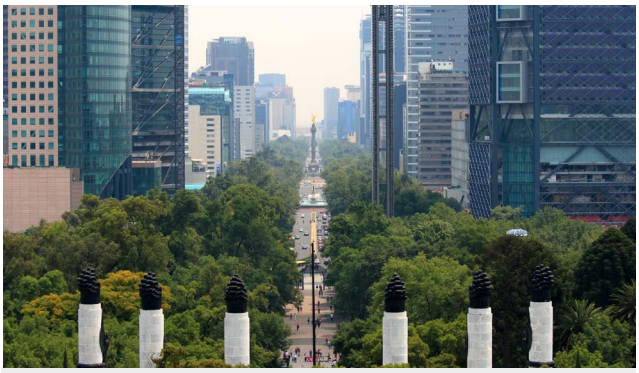
The decarbonization of the built environment is a global issue and as such demands a global response. Cross-border collaboration will be needed, especially to help support cities in the Global South (where much of the world's new building stock will be built over the next decades) kick-start their decarbonization journey. This message has been expressed by Mexico City, which in its Climate Action Plan (2021) stated that its lofty carbon emissions goal to be net zero by 2050 is contingent on large-scale international financing, collaboration and technology.

Harmonization and consistency of approach

Emissions reduction targets can only be achieved through collaborative action across different boundaries and levels of government.
This report highlights a patchwork of regulations and reporting structures being rolled out, and different metrics and definitions being adopted. We have reached a point where city governments and the real estate industry need to work towards greater harmonization and consistency of policy, regulation and reporting. The lack of consistency will have a negative overall effect on all. There is broad recognition, however, of the need for more international co-ordination to increase the pace of decarbonization. This realization is very encouraging.

Bridging the gap between 'intent' and 'action'

By leaning into the ecosystem of partnerships, all parties will be better able to bridge the gap between 'intent' and 'action' and make the best of this vital decade of action. Networks of government, owners, businesses, investors and communities will mean that we can more easily adopt and scale innovations in sharing and circular business models, promote sustainable mobility, regenerate urban infrastructures and, ultimately, reduce environmental footprints.



Mexico City's collaborative approach to net zero

Mexico City's 2021 Climate Action Plan commits to reducing emissions by 32% in 2024, 56% by 2030, 83% by 2040 (from 2016 levels) and achieving net zero by 2050.

But, without the necessary international funding, collaboration and technology sharing, it commits to less ambitious targets of a 10% reduction by 2024, 24% by 2030, 36% by 2040 and 43% by 2050.

A principal partner for Mexico City is the International Climate Initiative (IKI), a funding program led by the German Ministry for Economic Affairs and Climate Action. The strategic alliance with IKI played a key role in the City's climate action planning process, particularly for the development of the city's carbon budget and decarbonization strategies.

The C40 Cities Climate Leadership Group assisted the City in the development of its Climate Action Plan and has also played an essential role in various other projects including the City's Resilience Strategy as well as its Efficient Buildings Challenge; the latter is the most visible initiative targeting buildings in the City.

To find out how we can support your global real estate market strategy with research insights and strategic advice, please contact one of the members of the global research team.

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Regional Research

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