



**CCAG**

Climate Crisis  
Advisory Group



**Risk &**

**Resilience**

**The role of cities in tackling the climate crisis**

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## CCAG's 4R Planet Strategy

### The 4R Planet Strategy

CCAG will act to move policymakers, government officials and business leaders to address the key problems at the heart of the crisis, focusing on action in four key areas:



#### REDUCTION

Current targets are not enough. We need to increase emissions reduction rapidly to limit the earth's warming.



#### REMOVAL

We need critical investment to develop, research and scale techniques to remove greenhouse gases from the atmosphere.



#### REPAIR

We must find solutions that could help repair parts of our damaged climate systems in a safe and manageable way.



#### RESILIENCE

We must strengthen our capacity to deal with the climate crisis.

In this CCAG report, the focus is on:



#### REDUCTION

How can cities insist on construction that moves to net-zero emissions?



#### RESILIENCE

How can cities strengthen their liveability in the face of extreme weather events, protecting their populations and improving the quality of their lives?



# Foreword

CCAG is once again dedicating a complete report to the interaction and dynamics of the climate crisis in cities.

Informal settlements in rapidly growing megacities of the developing world grow bigger as rural-to-urban migration continues to accelerate. Many migrants are in fact leaving their rural homes because farming and subsistence become more challenging in the face of the effects of climate change, and they know that things will only get worse. Vulnerable people end up living on the margins of cities where they are most harmed by extreme climate events.

Despite a high level of technical knowledge and options in the construction industry, carbon-intensive, climate-unfit construction continues at ever faster rates in almost every city of the world. Investors are happy to go ahead in the current system: property values are usually unrelated to the carbon footprint of a building, or even its energy efficiency in use. Why would an investor spend more on construction for no return on investment? Why would a tenant pay more rent because the world needs better buildings?

This CCAG report investigates how some of these fractures can be repaired within cities. Whether strengthening social resilience, modernising building regulations to meet the needs of a climate crisis, or adopting strategies for reducing life-threatening 'urban heat island' effects, whole systems need to be considered and changed.

In all parts of the world we need cities that are resilient, keeping their people safe; we need cities and construction to be fit-for-purpose in a net-zero emissions world. This report shows the great range of approaches that can and must be taken to secure safe and prosperous cities for their citizens.



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# A home for humanity

**Cities can do more than any other single human-designed system to alter the course of the climate crisis. As key contributors to climate change, yet acutely vulnerable to its impacts, cities present a vital opportunity to reduce global emissions while enhancing our capacity for adaptation and resilience.**

This report examines the twin challenges of building resilient cities and funding improvements to the built environment, with a key focus on private sector investment. We look at the potential contribution of buildings in accelerating emissions reduction, the current contribution of the building industry to global emissions, and the need to regulate for low emissions in both the use of buildings and in the embodied carbon arising from building practices. All of this must be managed while designing-in resilience to the extreme climate events that will affect every region of the world for centuries to come.

Globally, 56% of the population (4.4 billion people) live in cities<sup>1</sup>. By 2030, it is estimated that urban areas will house 60% of all people<sup>2</sup>, and by 2050 this figure will be nearly 70%<sup>3</sup>. Cities also continue to attract waves of vulnerable people fleeing conflict and natural disaster, with 50% of forcibly displaced persons living in urban areas<sup>4</sup>. Whether through choice or necessity, cities have become the primary home for humanity.

Urbanisation can be a force for good, driving productivity, growth and job creation: cities account for 80% of global GDP. But rapid urban development puts immense pressure on the environment, exacerbates global climate change, and often puts vulnerable people directly in harm's way.

Despite occupying less than 2% of the Earth's surface, cities represent two-thirds of global energy consumption and account for 70% of all waste and greenhouse gas emissions<sup>5</sup>. Rapid and unplanned urban growth disproportionately increases emissions, leads to failures in the management of waste, clean water and flood risk, and produces urban settlements unfit for present or future purposes.

Cities are clearly a key battleground for emissions reduction. If we can achieve net zero<sup>i</sup> in our cities – by decarbonising transport systems and energy supply, improving energy efficiency and managing waste – we can shift the global emissions trajectory and avert worst-case scenario temperature rises.

<sup>i</sup>There are different definitions of 'net zero' in current use. The C40 Cities' definition focuses on net-zero emissions from a city on a sector-by sector analysis, with claims of carbon neutrality to be continuously achieved by demonstrating net-zero greenhouse gas emissions on an annual basis. C40 (2019) 'Defining Carbon Neutrality for Cities and Managing Residual Emissions' [https://www.c40knowledgehub.org/s/article/Defining-carbon-neutrality-for-cities-and-managing-residual-emissions-Cities-perspective-and-guidance?language=en\\_US](https://www.c40knowledgehub.org/s/article/Defining-carbon-neutrality-for-cities-and-managing-residual-emissions-Cities-perspective-and-guidance?language=en_US)

Cities are also the human spaces most exposed to climate risk, where investment and innovation are urgently needed to build climate resilience.

From New York to Shanghai, Dhaka to Jakarta, the cities of the world face a dizzying range of climate risks: storm surges, wildfires, floods, landslips, typhoons, droughts, water shortages and heat stress. These risks threaten human lives and disrupt livelihoods. They cause lasting social, economic and environmental damage. With a new El Niño arriving, plus a likely bump into 1.5 degrees Celsius of global warming before 2030, the frequency and scale of extreme climate events will increase.

By building resilience, cities prepare for the coming storm; they equip themselves to withstand future impacts, protecting their inhabitants and their assets, while unlocking improved quality of life for residents. For older cities, this means rethinking and reinventing, shoring up defences and modernising ageing buildings. For new and expanding cities, it means designing-in resilience across all urban development. In this way, cities can begin to manage and mitigate climate risk. They can create places of safety and sanctuary in which, far from being trapped and exposed to the impacts of climate change, people can live healthy, fulfilling lives.

How we create liveable cities in this time of climate extremes is the critical question facing urban planners and authorities, particularly in the Global South where urbanisation is still unfolding at pace. Funding and capital investment will play a huge role in helping cities transition from risk to resilience, while progressing towards net-zero targets. Yet the current gap in climate finance – thought to be in the region of US\$630bn per year – is a major barrier to progress, particularly among the most rapidly urbanising areas of the developing world.

To transform the investment landscape, we need to create compelling propositions for investors and insurers; and we need to provide positive incentives to drive the shift towards sustainable cities. Funding for urban development comes from a range of sources. There are specific Green Climate Fund payments available for poorer countries to help build resilience and reduce emissions. But for the most part, the actual buildings in cities anywhere in the world will be built as private or public-private projects, regulated by local and national laws, and relying on private investment funds.

The challenges ahead are significant, but bridging the finance gap to deliver the solutions required to make cities more sustainable and resilient, will certainly help shape a brighter future for our planet.

**By building resilience, cities equip themselves to withstand the challenges they face, protecting their inhabitants and assets.**

**If we can bridge the finance gap to deliver the solutions required to make cities more sustainable and resilient, we can shape a brighter future for our planet.**

# 1. CITIES & CLIMATE RISK

Cities are where much of human culture emerged and evolved. Often located in coastal areas and on the great rivers of the world, cities have always been centres of trade, communication, exchange and cultural dynamism. Many cities have seen continuous human settlements for over two thousand years, during which time sea levels changed very little.

But today we live in a changing world, and our cities are increasingly exposed to climate risks and impacts. Without adaptation and investment, many will not survive for long.

Horizons for managing current climate risks are often expressed in terms of decades. But great ambition is needed to secure the foundations of cultural human life for centuries, if not millennia. These are not unreasonable aspirations; they provide a context in which the vulnerability of humanity – as people and as culture – is placed into the trusteeship of today's societies and institutions.

In 2018, of the 1,146 largest cities in the world, 679 (59%) were at high risk to at least one of six types of natural disaster. Of the six, four are caused or exacerbated by weather events: cyclones, floods, droughts and landslides. Only volcanic eruptions and earthquakes are relatively independent of climate change. These cities each housed at least 500,000 individuals, and together were home to 1.4 billion people.<sup>6</sup>

2018\* Data



Global temperature rises also bring an upward trend in heat stress in urban populations. In central Europe, heatwaves killed 70,000 people in 2003 and 60,000 in 2022<sup>7</sup>. In July 2023, the world officially experienced the hottest month ever recorded<sup>8</sup>, with extreme heat and wildfires across Europe, the US and Asia. Meanwhile air pollution, caused largely by vehicle emissions and exacerbated by wildfires and forest burning, continues to kill seven million people each year<sup>9</sup>.



## Rising seas and coastal flooding

Flood risk is perhaps the greatest climate challenge facing cities around the world. Projections vary according to different emissions scenarios, but experts predict sea-level rise, linked to ice sheet melt, of between 70cm and a metre by 2100. After that, rises will continue.

If deep and rapid emissions reductions are not achieved, coupled with mass removal of excess GHG's from the world's atmosphere by the end of this century, hundreds of years of sea-level rise will be locked in. The process is slow but inexorable. Cities need to contain short-term climate impacts while planning for the ever-increasing challenges in the decades and centuries ahead.

Globally, most of the human population, and most major cities, are concentrated in low-elevation coastal zones or on tidal rivers. This increases the exposure of people and infrastructure to inundation, storm surges, flooding, erosion and salt water intrusion<sup>10</sup>.

According to C40 Cities, 600 million people live in coastal areas less than 10 metres above average sea level, while more than half of the world's megacities are located in these at-risk areas<sup>11</sup>.

Building and city expansion continues into the most vulnerable locations. Since 1985, about 76,400km<sup>2</sup> of newly urbanised land has been built upon in places with flood depths of over 0.5 metres during severe events. And globally, an astonishing one in four people (1.81 billion) live in high-risk flood zones<sup>12</sup>. Exposure is especially high in developing countries, on densely populated, rapidly urbanising river plains and coastlines, which are home to 89% of the world's flood-exposed people<sup>13</sup>.

Worryingly, UN data may even underestimate cities' exposure to global sea-level rise. According to Kulp & Strauss (2021), "new elevation data triples estimates of global vulnerability to... coastal flooding". This revised analysis shows that 190 million people currently occupy land below projected annual flood levels for 2100, up 80 million on previous predictions. The new research also estimates that 1 billion people occupy land less than 10 metres above current high tide lines<sup>14</sup>.

If these adjusted predictions are correct, sea-level rise and coastal flooding now pose an even greater existential threat to cities the world over. No coastal or riverside city can plan for a future without planning for flood prevention and management. Hoping for the best is not an option.

Recent research suggests that UN data has underestimated our exposure to sea-level rise. If these adjusted predictions are correct, coastal flooding now poses an even greater existential threat to cities the world over.

## Turning the tide on climate risk

With flood risk and severe weather events set to increase, systems that keep cities moving – public services, sanitation, transportation – risk being overwhelmed, even by mid-century. Today's citizens will feel their quality of life affected, often disastrously.

Crucially, the largest cities in the world are still growing, and many of their projected 21<sup>st</sup> century buildings do not yet exist. The identified need for many more buildings as the century unfolds presents a massive opportunity. Expanding cities can think about how and where to grow so as to create habitation that not only survives, but thrives, for the next 100 years and more. These new developments can be havens from the pressures of climate change and safer places for humanity. To achieve this ideal outcome, of course, a lot will have to change – and very quickly.



## Cities in focus

**While 'old' cities and 'new' cities face similar climate risks, their preoccupations and concerns are likely to be different**

Every city faces challenges specific to its local context. Building resilience will depend on local weather, proximity to rivers or the sea, demographic trends and the surrounding policy framework. However, differences in emphasis are discernible in the priorities of cities depending on their age and developmental trajectory.

In old cities, often in Europe or North America, populations are relatively stable and urbanisation is complete. In these established metropolises, flood defences and other systems aim to protect what is already there, with economic loss and damage to mature assets the primary concern.

In the new, rapidly expanding cities, populations are growing and much of the required infrastructure is yet to be built. The challenges are more dynamic, more fluid, more difficult to navigate. These cities are often located on low-lying land, increasing their exposure to sea-level rise. Many people live in informal settlements and floodwater brings the immediate threat of loss of life and livelihood. There are also continuous threats, such as waterborne disease, linked to poor infrastructure.

Cities that exemplify these differences clearly are New York and Shanghai on the one hand, and Jakarta and Dhaka on the other. These four cities are all exposed to increasing flood risk, but are grappling with starkly contrasting concerns and concepts of loss. They are also devising very different responses to the climate challenges they face.

## A tale of two cities part 1

### New York and Shanghai

Financially, global annual losses from disasters affecting the urban built environment now exceed US\$250 billion, and will increase by another 25% by 2030<sup>15</sup>.

New York and Shanghai are two well-established, wealthy cities with stable populations and much to lose economically if their defences are breached by storm surges and rising sea levels.

### New York: embankments, bunds and barriers

As demonstrated during Hurricane Sandy in 2012, New York is highly vulnerable to the impacts of extreme storm events. To protect against future losses, a report was commissioned, called the 'New York-New Jersey Harbor and Tributaries Study' (NYNJHATS), to consider how to protect the city from future extreme weather events.

Due to funding complexities, the feasibility study for this phase of the programme was commissioned from the US Army Corp of Engineers (USACE) – a highly regarded, federal-funded organisation. USACE examined various options and argued for the adoption of its favoured proposal. This comprises a 50-mile stretch of seawall and other structures, 12 to 20 feet high, around and close to New York's central business district (with sections of on-land barriers in Manhattan, Brooklyn and Queens)<sup>16</sup>. The scheme is presented at a high level, so the detail of how each component might be integrated into local landscapes and community functions is lacking.

The Chief Climate Officer in the NYC Mayor's Office of Climate and Environmental Justice noted:

**"[...] the specific details at the local scale will make the difference between acceptable and unacceptable projects"<sup>17</sup>.**

Coming in at a cost of US\$52.6 billion, the USACE scheme has met with a number of objections during public consultation, including:

- Potential loss of amenity in the city
- Ecological impact in the waters around New York
- Reduced flow of surface water, requiring mass rebuilding of drainage infrastructure
- 40% of exposed neighbourhoods, home to the most vulnerable populations, remaining unprotected
- Loss of vistas and public access, with potential impacts on quality of life and tourism

An alternative vision to such reliance on sea-wall structures might incorporate integrated flood defences using folding flood barriers, elevated roads and natural features. This approach promotes both resilience and access. Only through more nuanced and inclusive interventions like this, it is argued, would New York balance the protection of its high-value assets with the interests of its people and green space<sup>18</sup>.

Examples of this approach can be seen in a separate scheme to protect Battery Park, which is just getting underway, and the first phase of the East Side Coastal Resiliency Project, which is now complete. The development of the East Side Project, using integrated protection approaches, was led by City representatives and prioritised community concerns and the protection of the vulnerable.

Every one of these projects or proposals causes divergence of opinions about which priorities should prevail. Cost, amenity, security and economic benefits all need to be balanced. In the words of New York City's Deputy Mayor of Operations, Meera Joshi, commenting on the East Side Project:

**“Preserving and enhancing public spaces with waterfront views must be an objective for all coastal resiliency projects<sup>19</sup>”.**

The USACE-favoured flood defence proposals would not seem to adhere to this principle, although the Battery Park scheme and East Side Coastal Resiliency Project clearly value these priorities. Critics of the USACE programme say the proposed seawalls would obscure iconic views of the Hudson Greenway, dominate greenspace in Brooklyn and Queens, and carve through other public areas.

Carrie Grassi, Deputy Director for Climate Ready Infrastructure, NYC Mayor's Office of Climate and Environmental Justice, commented for this report:

**“We want to make this partnership with USACE work – to provide the safety measures New York City needs and deserves. USACE has a particular way of working, with a focus on strong engineering solutions. They have not usually been asked to consider multiple purposes such as aesthetic, community or social needs. The current USACE proposals would not fit comfortably in the densely populated local urban context.**

**Our own experience in the city has taught us the importance of innovative and integrated approaches that serve more than one purpose and address more than one climate risk. The more we recognise that this is an unprecedented large-scale infrastructure project, the more we understand the importance of its being fully integrated into the fabric of our communities.”**

The New York case for this phase of its flood protection development shows unintended impacts emerging from funding realities in a specific location. The process of shifting the development of solutions from the City Offices, with concern for all aspects of urban wellbeing, to an engineering-focussed organisation has created a technically robust but socially problematic outcome.

With so much at stake, any decisions on future flood defence in a city like New York will always be controversial. While the consequences of flooding are dire, the 'one-shot bund solution', which excludes the vulnerable and blights the waterfront, seems severe. As such, it is unlikely to be accepted by City officers.



## Shanghai: 'no regrets' integrated flood defence system

Shanghai is China's richest and most developed city. But for the last 100 years and more, it has been slowly sinking. Between 1921 and 2007, Shanghai experienced major land subsidence, which occurred at an average rate of 22.94 mm/year<sup>20</sup>. Compounded by rising sea levels, this scenario means that by 2100 half of the city could be under 1.2 metres of floodwater.

In response to this threat, Shanghai is developing a sophisticated 'no regrets' flood defence system. The 'no regrets' approach leans into the uncertainty of climate impacts and outcomes. Put simply, the city's authorities can't know exactly how bad future storm surges, floods or other extreme weather events will be or when they will occur. They have therefore identified precautionary adaptation and resilience solutions they can implement now without being certain of the changes that lie ahead; solutions whose benefits will continue to be felt even if the impact of future events are not as severe as currently predicted.

Taken from economic theory, the 'no regrets' approach involves applying uncertainty analyses to concrete engineering interventions. As explained in an article in *Nature*, this means



**“...Provid[ing] a theory-backed robust and practical approach for developing a long-term flood defence strategy on the Huangpu River, taking account of the need to design resilient engineering works with fixed thresholds and levels. [It enables the city] to consider large future changes as implied by the non-stationary dynamics of sea level rising and extreme climate events...and to show the long-term implications of a flood barrier on the flood defence system, including the future need to raise upriver defences with the barrier in place<sup>21</sup>.”**

As a result, Shanghai has developed sequential, dynamic and adaptive engineering pathways, providing different options that can be applied over time. These options include:

- Raising the standards of existing defences along the length of the Huangpu River
- Constructing a tidal flood barrier near the mouth of the river
- Combining elements of the first two options<sup>21</sup>

A viable alternative to the one-shot fixed solution, this integrated model enables Shanghai to establish plausible worst-case scenarios; design interventions for future thresholds; and monitor change to determine if and when these interventions are needed<sup>22</sup>. Its flexible, adaptive nature means the city's defences can evolve in response to future changes, while providing benefits in the present to minimise regrets and impacts.



## A tale of two cities part 2

### Jakarta and Dhaka

Jakarta and Dhaka, the capitals of Indonesia and Bangladesh respectively, are both rapidly expanding megacities under extreme climate stress. In response to acute flood risk, the two cities have conceived contrasting survival strategies.

#### Jakarta: organised retreat

Overcrowded, polluted and lacking in adequate national joined-up climate policies, Jakarta<sup>ii</sup> is sinking at an alarming rate. Rising sea levels, land saturation and subsidence (linked to the over-extraction of groundwater) mean that some 50% of Jakarta is already at or below regional water level<sup>iii</sup>. 90% of North Jakarta is expected to be underwater by 2030 without intervention<sup>iv</sup>.

In 2020, as part of a planned retreat to relieve these pressures, the Indonesian parliament approved a bill to relocate its capital city to East Kalimantan on the island of Borneo. Borneo is a globally important biodiversity hotspot, with ancient rainforests among the oldest in the world. It is home to charismatic and critically endangered orangutans and clouded leopards, with environmentally valuable peat swampforests along its entire coastline.



<sup>ii</sup>Indonesia is in the lowest 'Credibility' category when evaluating individual nations' commitment to net zero targets. Indonesia has no published plan to meet its promise to achieve net zero by 2060 or before, and there is no nationally legally binding dimension to the promise. There has been no reduction in emissions (or reduction in emissions growth-rate) in line with the net zero promise. Rogelj et al (2023) 'Credibility gap in net-zero climate targets leaves world at high risk' <https://www.science.org/doi/10.1126/science.adg6248>, summarised in Carbon Brief Rogelj (2023) 'What 'credible' climate pledges mean for future global warming: Guest Post' [https://www.carbonbrief.org/guest-post-what-credible-climate-pledges-mean-for-future-global-warming/?utm\\_content=buffer1cebc&utm\\_medium=social&utm\\_source=twitter.com&utm\\_campaign=buffer](https://www.carbonbrief.org/guest-post-what-credible-climate-pledges-mean-for-future-global-warming/?utm_content=buffer1cebc&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer)

<sup>iii</sup>See, for example, the report on the National Research and Innovation Agency of Indonesia, summarised in 'The Conversation', saying that 25% of Jakarta will be submerged by 2050, with that area potentially doubling in the face of climate change: Aldrian (2021) 'Indonesia's Capital Jakarta is sinking. Here's how to stop this' <https://theconversation.com/indonesias-capital-jakarta-is-sinking-heres-how-to-stop-tis-170269>

<sup>iv</sup>The Jakarta Post is one of several outlets to have reported this projection from the Bandung Institute of Technology, geodesy division: Aqil (2018) 'Jakarta sinking fast: Experts'

## Jakarta life

Daffa Praditya lives in Jakarta, where he combines his studies with a job in the city centre. Here, he reflects on life in a sinking city on the frontline of the climate crisis.

We face a lot of climate crisis challenges in Jakarta. The most visible is the sinking. The sea-level rise is really clear to see in the north, which is not far from the coastal area. Houses there are already under water, so people are leaving. You can't imagine that people will be living here in 20 years. It's one of the most vulnerable cities on the planet. Even Joe Biden mentioned it in a speech last year.

The situation is so serious the government is now moving the capital to Kalimantan. But what about the people here? Those who can afford to move will move, but those who can't will be left behind. Will they live here and suffer in desperation? About 70% of people in Jakarta live in poverty; they cannot afford to buy a house or rent or relocate. They understand about climate change, but there's nothing they can do about it. Their focus is just to get food each day and survive.

I think it's really unfair that the government is planning to move the capital rather than overcoming the problems here in Jakarta. And moving to Kalimantan is only going to cause more environmental damage, because Borneo is home to tropical rainforests and rare natural habitats. It will just be creating another problem on another island.

No one can deny that Jakarta is sinking. It's a fact. It's real. I see it with my eyes every day. People here are losing hope. As long as they are not sinking yet, they try to survive as long as they can. But this is the reality. I will be an Indonesian citizen for the rest of my life, but to get economic security I will have to move to another country to work. I have a responsibility to look after my parents and to get my younger brother through school and university. It's sad, but I will probably have to leave.



## Dhaka: Secondary city development

Dhaka is a low-elevation city with a tropical monsoon climate. Located on the Ganges-Brahmaputra delta, it has a long history of urban flooding and is among the top 10% of global ranking cities at risk from climate change<sup>23</sup>.

With these pressures intensified by a constant influx of climate migrants and rural poor, Dhaka is taking coordinated actions to curb expansion and build resilience in the city.





## Working in Dhaka

Sarder Shafiqul Allam, is Coordinator for the Urban Climate Change Programme and Country Coordinator for ACCRN-ICCAD (International Centre for Climate Change and Development) in Bangladesh. Here, he reports on the city's efforts to navigate climate challenges through enlightened policies and planning.

Dhaka has always faced multiple climate risks. Firstly, it's a floodplain city. We're currently protected by a flood protection barrier, but during torrential rains the water authority has to pump water into the floodplain. I can see this is not a long-term solution, especially if sea levels rise further. We also have rural-to-urban population pressures, with many people migrating to the city in search of a new life.

Since 2014, I've been looking at approaches to urban climate change adaptation and resilience in Bangladesh. And I've been investigating how to make coastal cities as climate resilient as possible. Following a series of urban climate conferences held in our country between 2016 and 2019, we developed a new concept. We saw there is a need to build secondary cities and towns away from megacities like Dhaka. These secondary cities will be climate resilient, with good schools, housing and health services. They will attract rural migrants – especially young people – and divert them from the capital, relieving its population pressures and halting expansion.

The plan is to develop at least 12 new secondary cities and towns in Bangladesh. We're currently piloting this concept with the support of a national NGO called BRAC. We also have the backing of the government. In fact, the national government and city authorities are working hard to build resilience in Dhaka itself, and in other cities. The government wants to help one million people find jobs in new economic zones in the Cities and municipalities. We also have a new deep mass transportation service in Dhaka, like a Metro, plus an elevated expressway. The aim is to reduce urban traffic and increase mobility via public transport, which will help to improve people's lives.

In the past I have used the idea of the 'carrying capacity' of our city. Just like every boat, every city has a carrying capacity. And if there is an overload, we could capsize. The risks are building, but hopefully, through these measures, we will keep our city and our heads above water.

## Tipping Points

When it comes to climate projections, tipping points present a whole new level of risk potential. 'Tipping points' refer to irreversible shifts in the planet's biophysical systems that become self-perpetuating, accelerating further change. Examples of tipping points include:

- **The melting of the Greenland Ice Sheet**

Global temperature rise linked to greenhouse gas emissions may start to thaw the Greenland Ice Sheet (GIS). At a certain point, the height of the ice sheet will be reduced, exposing its surface to warmer air, which will lead to accelerated and self-perpetuating melting. At this point, the cessation of global warming would not save the GIS and the rate of sea-level rise would increase.

**“Crossing [the GIS] tipping point would irreversibly commit all future generations to a seven-metre sea-level rise.”**

Professor Johan Rockström, Director of the Potsdam Institute for Climate Impact Research

- **The death of the Amazon Rainforest**

Due to pressures caused by drought, reduced rainfall and deforestation, the Amazon Rainforest now emits more carbon dioxide (CO<sub>2</sub>) than it absorbs. If this trend continues, the Amazon will tip into self-drying self-perpetuation. Thereafter, the rainforest will lose its ability to regenerate and will gradually become savannah.

Tropical rainforests such as the Amazon are the 'lungs of the planet', as they absorb carbon dioxide and exhale oxygen. The death of the Amazon would therefore have consequences way beyond its immediate impact on local communities and species. It would cause enormous amounts of CO<sub>2</sub> to be released into the atmosphere, further accelerating global temperature rise.

**“The Brazilian part of the Amazon has already tipped over from carbon sink to carbon source<sup>24</sup>. Push deforestation and global warming just a bit further, and we risk crossing a tipping point which would mean an irreversible loss of rainforest.”**

Professor Johan Rockström

For people in cities, tipping points may seem remote. The Arctic, Antarctic, distant forests and deep oceans – these are the places where the critical shifts will happen. But the impacts will hit urban centres harder and faster than any other area of human habitation.

It is not too late to influence these tipping points, but the window of opportunity is closing fast. Only through massive efforts to reduce emissions can we avert these outcomes. And only cities have the critical mass of people, activities, processes and environments that can make a difference.

In order to drive change, city officials, developers and investors need to look beyond short-term horizons to solutions that are built to last. The rise in global temperatures and sea levels will happen slowly over hundreds of years. Systems designed to address these changes therefore need to endure long into the future.



## 2. CITIES &

# CLIMATE RESILIENCE

### The three strands of climate resilience



PEOPLE



ECONOMY



GLOBAL

**Climate resilience refers to the ability of systems – social, economic and environmental – to withstand the impacts of climate change. It is achieved through adaptation, encompassing all activities undertaken to adjust to, manage and mitigate climate impacts. Examples include reinforcing flood barriers and urban infrastructure, retrofitting old buildings, creating stormwater storage, improving housing and investing in greenspace.**

In the context of cities, climate resilience is defined by a city's ability a) to absorb shocks and b) to bounce back from the initial impact. A climate-resilient city is able to protect its people and assets and pivot to address new emerging risks. It also has the resources and preparedness to cope with extreme events in the future. Overall, it suffers less and recovers faster.

CCAG identifies three strands of resilience. These reflect the most urgent climate risks facing cities today, and the key resilience focus areas for local and national governments:





## People & livelihoods

The coastal locations of cities, climate migration and increasing urban populations in the poorest countries have increased the exposure of vulnerable people. Protecting people and livelihoods therefore has to be a major priority in city resilience strategies.

Measures to increase resilience must engage with local communities to ensure local relevance and acceptability. In Rio de Janeiro, for example, a well-organised alarm system involving text messages and sirens ensures people move to higher ground before being overtaken by flood water<sup>v</sup>. In France, better connections between formal public health and social services ensures people are less likely to die alone in un-cooled living spaces.

The top 5 cities ranked in 2007 in terms of population exposure to coastal flooding are Kolkata and Mumbai in India, Dhaka in Bangladesh, Guangzhou in China and Ho Chi Minh City in Vietnam<sup>vi</sup>.



## Economy & cost

In 2021, the importance of economic resilience to the world was a major theme and focus of the G7 talks. Coastal cities in wealthier nations may be well defended, but any event that circumvents existing flood defences causes massive economic loss. When existing structures and measures – such as the Thames barrier in London – become overwhelmed, the economic losses will be beyond anything experienced so far. Increasing resilience to prevent such losses is a guiding principle in all urban planning and development in wealthier cities.

The top 5 cities, ranked in 2007 in terms of economic asset exposure to coastal flooding are Miami and New York-Newark in the USA, Guangzhou and Shanghai in China and Kolkata in India.



## Global supply chains

As the world experienced during the covid pandemic, and following Russia's invasion of Ukraine, global supply chains are fragile. Food, goods and livelihoods are heavily interconnected around the world.

When exports from Ukraine are interrupted, the global price of wheat goes up raising food prices around the world. Farmers in Africa struggle to access grain, and farmers in South America lose access to fertilisers as established trading patterns are broken.

Supply chain resilience in the face of multiple, widely distributed, extreme weather events is critical to prevent price rises and shortages from cascading round the world.

<sup>v</sup>This is an example of best practice described in the C40 Implementation Guide 'How to Reduce Flood Risk in your City' [https://www.c40knowledgehub.org/s/article/How-to-reduce-flood-risk-in-your-city?language=en\\_US](https://www.c40knowledgehub.org/s/article/How-to-reduce-flood-risk-in-your-city?language=en_US)

<sup>vi</sup> In an OECD report – Nicholls et al (2007) 'Ranking of the World's Cities Most Exposed to Coastal Flooding Today and in the Future' - a multi-disciplinary and international team of experts examined the exposure of global port cities to coastal flooding in 2007, and also in 2070. The report's Executive Summary contains two tables capturing the ranking of cities' exposure by population affected, and by economic damage exposure. <https://climate-adapt.eea.europa.eu/en/metadata/publications/ranking-of-the-worlds-cities-to-coastal-flooding/11240357>

## The power of social and infrastructure resilience

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Europe is warming twice as fast as the global average, with linked events increasing in frequency and magnitude as a result<sup>25</sup>. But due to social and infrastructure resilience, the misery caused by these events is less pronounced in Europe than on other continents.

For example, if a person collapses with heat exhaustion in Paris or Vienna, an ambulance will usually come. That person will receive rehydration treatment and be transported to a cool location. In Copenhagen or Bologna, flash floods may cause massive temporary disruption, damage and loss of personal property. Yet families will seldom need to permanently remove their children from school, and the long-term economic impacts will be managed.

Fires in, or close to, cities can pose a threat to health and property, but in Europe fewer people die in these fires than ever before. Firefighters have good equipment, high 'rapid response' capability and sufficient capacity to tackle conflagrations. Notably, during the record-breaking fires in Greece in the summer of 2023, in which thousands of homes were damaged or destroyed, 18 out of the 21 recorded deaths were suffered by a group of vulnerable migrants trying to enter Greece from Turkey after, no doubt, hazardous travel from their original starting point<sup>26</sup>. In any context the most vulnerable pay the highest price.

In this way, European cities can depend on the resilience of their infrastructure and systems when extreme events occur. In well-built, well-run urban environments, the loss and damage to humans and human activity is more easily kept within manageable bounds.

**In well-built, well-run urban environments, the loss and damage to humans and human activity is more easily kept within manageable bounds.**

## The fragility of low-resilience cities

**In sharp contrast to the Paris example, poorer cities, often in developing countries, experience far greater misery and damage.**

On the streets of New Delhi in India, Ouagadougou in Burkina Faso, or Bamako in Mali, a person suffering from heat exhaustion is more likely to die, as it is unlikely an ambulance will come to the rescue.

When floods hit informal settlements in rapidly growing cities of the poorest countries, thousands of homes can be lost, with buildings washed clean away. Massive floods across a third of districts in Pakistan in 2022 created problems that will endure for a generation or more. As well as intensifying economic problems in the fifth largest country of the world by population, these floods have left children malnourished or stunted<sup>vii</sup>, while millions are still out of education indefinitely. The damage to infrastructure and other economic loss is estimated at US\$30 billion<sup>27</sup>. Meantime, agricultural and commercial productivity has also dropped off<sup>28</sup>. On an individual, family and community level, the loss experienced as a result of such events can be profound.

The climate crisis therefore underscores and exacerbates existing global inequalities. Developed countries are better prepared and protected, meaning they avert some of the worst human and economic consequences. Meanwhile poorer countries suffer significant losses and reversals of progress, as Professor Johan Rockström observes:

**“We have very different social resilience in wealthy countries and these countries are good at adaptation. The cities in the Global South don’t have that shock-absorbing capacity and they suffer. So we need to demand and deliver change, because currently we’re failing on the socioeconomics.”**

<sup>vii</sup>In a small survey of 156 children affected by flooding, Islamic Relief found that 40% were 'stunted', meaning more than two size categories below the WHO Child Growth Standards median. Islamic Relief (2023) 'Towards a Resilient Pakistan – Moving from rhetoric to reality' page 27 <https://www.islamic-relief.org.uk/wp-content/uploads/2023/08/Towards-a-Resilient-Pakistan-Islamic-Relief.pdf>

## Heat stress in Europe

**Just because things are ‘less bad’ in European or North American cities in the face of extreme weather events, these cities still experience devastating – if less visible – losses.**

During the extreme summer heat of 2022, Paris avoided a repeat of the mass fatalities it experienced in 2003. Having learnt from this experience, Paris implemented core systemic and structural interventions. These included:

- Knowing where vulnerable people live so that they can be contacted and offered help during a heatwave
- Providing cool spaces around the city as refuges
- Ensuring that health providers and local authorities coordinated their support
- Implementing a programme for retrofitting housing stock to improve both summer and winter liveability

But across Europe as a whole, in 2022 over 60,000 people perished through heat exposure. This demonstrates that while coping mechanisms may improve, the human cost and fallout from worsening heat waves will continue to be severe.



## Greening the city

**While cities at different stages of development require different climate solutions, some interventions are of universal value.**

In cities old and new, rich and poor, the 'urban heat island' effect amplifies the discomfort and danger-to-life linked to rising temperatures. The heat island effect also pushes up energy demand for cooling systems, generating further heat outside buildings and increasing GHG emissions from built-up urban areas.

The effect occurs where solid materials such as concrete, metal, stone and brick are exposed to the sun, absorbing and storing solar heat. This heat, released as the day fades, raises the ambient temperature and reduces nighttime cooling. Urban heat islands increase the vulnerability of city inhabitants to heat exhaustion, respiratory problems, headaches and heat stroke – with potentially fatal consequences<sup>viii</sup>.

As confirmed by the Intergovernmental Panel on Climate Change (IPCC), the planting of trees and creation of greenspace alleviates the urban heat island effect. Through shade provision, trees and vegetation reduce the direct exposure of hard surfaces and prevent heat transmission into the built environment. They also help to cool the air through transpiration and improve ventilation. According to Trees for Cities, a single mature tree provides a cooling effect that is on average equal to 10 air conditioning units running for 20 hours in a day<sup>29</sup>.

As well as generating oxygen, trees create vital carbon sinks, absorbing CO<sub>2</sub> along with other pollutants. In London it is thought that 2,367,000 tonnes of carbon is stored in the city's trees, at a value of £147 million to the UK economy<sup>30</sup>. Trees reduce soil erosion and help to prevent flash flooding, while proximity to nature is shown to improve mental health and wellbeing. Trees and greenspace are vital components of resilient cities.

<sup>viii</sup> A 2021 study published in The Lancet Planetary Health focussed on nighttime excess temperatures, rather than daytime temperatures, and found a strong link between hotter nights and excess deaths across 28 cities between 1981 and 2010. <https://www.sciencedirect.com/science/article/pii/S2542519622001395>

## A breath of fresh air

Around the world, individuals and organisations are trying to make their cities more liveable, sustainable and resilient. Climate resilience programmes look towards future impacts, but can also create immediate improvements in people's lives.

In London, the Ultra Low Emission Zone (ULEZ) aims to improve air quality by reducing the number of older polluting vehicles in the capital.

Since the scheme was introduced in central London in 2017, the percentage of vehicles that meet emissions standards within the ULEZ zone has risen from 39% to 94%<sup>31</sup>. This brings a 46% reduction in harmful nitrogen dioxide pollution in central London<sup>32</sup>, enabling many of the city's inhabitants to breathe cleaner air, reducing the risk of death. It is predicted ULEZ, which has now expanded across all London boroughs, will avert over 1 million hospital admissions by 2050<sup>33</sup>.

## Retrofitting resilience

Old cities can adapt to new challenges. In the rapidly expanding and urbanising cities of Africa and Southeast Asia, resilience can be designed-in as new infrastructure is developed and populations grow. But in cities in developed parts of the world, energy efficiency and resilience need to be retrofitted into legacy building stock. Retrofitting enhances existing buildings through:

- Structural repairs and reinforcement
- Flood-resilient design and materials
- Building envelope upgrades (for improved thermal performance)
- Waste heat recovery, air filtration and ventilation
- Relocation of essential services
- Improved drainage
- Insulation and draft-proofing
- Passive cooling and heating
- Solar panels and heat pumps
- Low-solar-heat-gain windows
- Shading strategies
- Improved Indoor Environmental Quality (IEQ)

Retrofitting and adaptive re-use are far more sustainable options than the 'demolish and rebuild' model: before it was called off in 2022, the planned demolition of the M&S flagship store in central London was set to release 40,000 tonnes of CO<sub>2</sub> into the air. By avoiding embodied carbon emissions and the environmental footprint of new construction, retrofitting presents a win-win solution for urban development. Indeed, as well as reducing a building's environmental impact, retrofits have demonstrated operational cost savings of 10%<sup>36</sup>.

## Supporting Green and Thriving Neighbourhoods

In July 2023 the C40 'Green and Thriving Neighbourhoods' programme was launched to promote a model of urban renewal that puts nature and people at the heart of all planning decisions<sup>34</sup>. The model is based on the '15-minute city', currently being adapted in a variety of urban contexts. By putting amenities within easy reach, the 15-minute city enables a more socially vibrant, pleasant, connected and healthy form of urban life. According to the IPCC, it could also help to cut urban emissions by 25%.

Green and Thriving Neighbourhoods supports cities as they seek to turn the 15-minute concept into reality. Specifically, there are 22 pilot projects in cities across the globe, and the programme is also building a network of city practitioners to share best practice and knowledge.

Helping cities to become part of the solution to the climate crisis, not part of the problem, the Green and Thriving Neighbourhoods programme promotes development of inclusive, walkable, liveable and resilient urban communities.

Project examples include:

- Jernbanebyen, central Copenhagen: a 365,000m<sup>2</sup> former railyard is being transformed into a thriving and sustainable neighbourhood, comprising 25% social housing, car-free zones and 11 acres of greenspace
- Dakar, Senegal: the city is expanding public greenspaces, promoting micro-gardening and building pedestrian cycle paths to connect public and commercial infrastructure. An integrated solar energy production system is also being set up to improve household waste management.

**"Projects like these serve as a reminder that cities are climate leaders and incubators for the kind of innovations that will help us meet global climate targets"**

Mark Watts, Executive Director, C40 Cities



### 3. THE DRIVERS OF CHANGE

To build resilience and deliver effective climate action, cities and national leaders must draw on all available levers of change. Through effective planning, coordination and funding, cities can address the key issues of how buildings are built and who pays for them. They can work to ensure signals align to enable cross-sector partnerships and progress.

As cities are the largest place-based source of greenhouse gas emissions, they have a key role to play in driving the net-zero transition. Some local governments have control of over 52% of emissions that occur within their municipalities<sup>36</sup>. This gives them agency and ownership over reduction strategies.

If cities increase their focus on tackling emissions at source by insisting upon low-carbon footprint buildings and construction processes, they can lower their contribution to global climate change, reduce the climate-related challenges they face, and improve quality of life for their citizens. As discussed in this report, embracing climate resilience as a guiding principle across all urban development is a game-changer. It reduces social, economic and environmental stress, significantly enhancing a city's ability to survive and thrive in the future. It also reduces emissions, accelerating the move towards net zero. Indeed, net zero and resilience can go hand in hand.



## Urban emissions and buildings

A big proportion of urban emissions arises from a city's buildings. Existing buildings have variable levels of emissions while in use, according to their energy efficiency. The construction of new buildings also creates variable levels of emissions according to the materials used, the transportation of those materials, and the design principles adopted. Then, at the end of their life cycle, buildings emit vast quantities of GHGs if they are demolished, further contributing to a city's carbon footprint.

The technical knowledge to create low-carbon buildings is already largely available, but the market gives little credit for being climate smart. Broadly speaking, cheaper, faster, uneconomical buildings are just as valuable in an investment portfolio as buildings built to climate-aware specifications. As explained in this section, Denmark has made a stand to challenge and change this model.



## Planning, coordination and funding

The major drivers of the changes required to secure low-emissions practices in a resilient city include:

### Planning

The conditions for making cities safer, more liveable and more resilient do not appear haphazardly. Planning is fundamental. Well-planned cities are built as safely as possible, without spilling into flood plains. They are dense and do not sprawl. Neighbourhoods contain all amenities for a decent life, including access to services and economic opportunities. Buildings are fit for their intended use, minimising 'urban heat island' effects and contributing to a liveable, resilient city on track for a net-zero emissions future.

Formal urban construction standards dictate how buildings are made. A focus on safety through strength and stability, for example, currently tends to favour high-emissions concrete constructions. Another focus may be aesthetics, which might include regulating the colour of finishes or aligning facades and maximum heights. Carbon emissions have not, historically, been taken into account.

The challenges for urban planning – especially on coasts and tidal rivers – are profound. Getting planning right, as the global climate changes, means putting climate resilience and emissions mitigation at the heart of planning frameworks and decisions. The success of planning strategies should be assessed by their benefit to the poorest and most vulnerable.

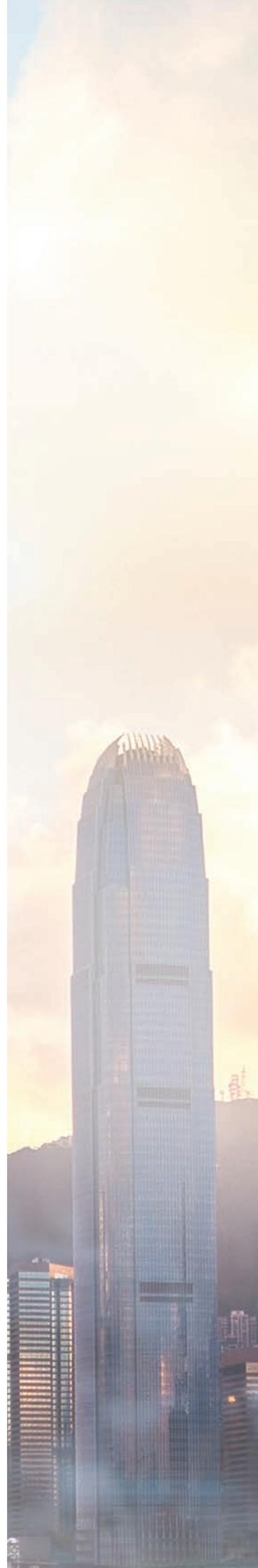
Within well-planned decarbonised cities, typical win-wins are:

- Cleaner, healthier, more pleasant places to live
- Enhanced productivity
- Green jobs in a vibrant economy
- Resilience against severe weather and extreme climate events
- Economic agility and resilience
- Increased economic growth
- Better transport and connectivity for leisure and economic activity

For planning to translate effectively into climate resilience, it must be supported by building regulations and clear guidance. It needs to be long term, not linked to short-term targets or timelines. It must promote an alternative to the carbon-intensive buildings and construction processes favoured in existing building codes. Industries will also need to agree upon new, climate-specific standards and definitions, which are currently lacking.

An overhaul of standards will result in buildings containing less concrete, benefiting from passive heating and cooling systems, and incorporating high thermal insulation standards. Buildings will embody less GHG emissions in their construction processes and materials, conforming to specific low-emission standards set out and recognised across the world, and transparently applied.

As shown opposite, Denmark has demonstrated that progress can be achieved even when the global landscape is far from perfect for the pursuit of green cities. Every city has the opportunity to make progress; and such progress can be accelerated as national and international standards are hammered out and implemented.



## The Danish Building Code – regulating GHG emissions in the built environment

The Green Building Council of Denmark (GBCDK) was established in 2010. Not long after, Denmark adapted the German DGNB standard<sup>x</sup>, establishing requirements for Life Cycle Assessments (LCAs) and Life Cycle Costs (LCCs) in all new buildings. In late 2015, LCA data from 60 primarily DGNB-certified buildings was used to establish reference values for Danish LCA regulation. And in 2018, Denmark's Ministry of Housing adopted these LCA reference values as a benchmark for future building code requirements. Figure 1 shows the timeline for this benchmark development process.

<sup>x</sup>DGNB stands for Deutsche Gesellschaft für Nachhaltiges Bauen, which has offered its own certification of buildings since 2009. DGNB is linked to the UN Global Goals for Sustainable Development and provides a global benchmark for sustainable life-cycle based certification.

## The road to LCA regulation of GHG-emissions in the Danish Building code

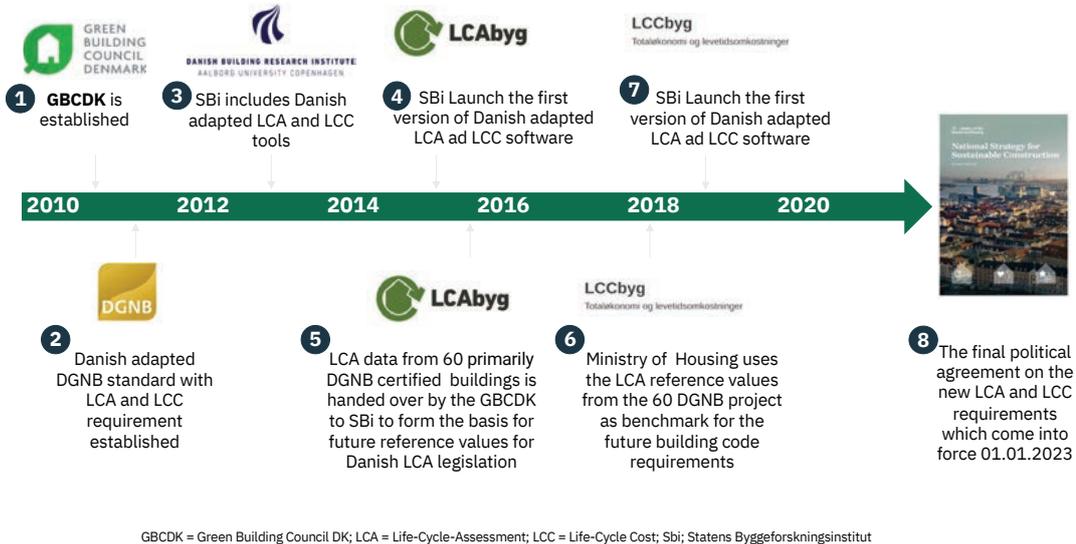


Figure 1: The road to Life Cycle Assessment (LCA) and Life Cycle Costs (LCC) regulation of GHG-emissions in the Danish Building Code (with thanks to Rasmus Grosen Olsen, Nrep and Urban Partners)

In 2020, a final political agreement was reached in Denmark on the LCA and LCC requirements and they came into effect on 1 January 2023. All new buildings over 1,000m<sup>2</sup> will now be required to meet embodied CO<sub>2</sub> equivalent limits. Designed to help decarbonise the country's construction sector and meet national emissions reduction targets, this progressive regulation will have lasting positive effects on human health and the environment.

## Coordination

If cities are to play their part in tackling the climate crisis, multi-stakeholder engagement and institutional coordination are vital. Strong integration at all levels creates consistency and coherence in the formulation of policies, plans and regulations. This leads to better implementation and 'no regrets' adaptation. Cross-sector collaboration is a key attribute of urban climate governance.

Cities that take a collaborative approach to their climate action plans deliver twice as many actions as those that implement through non-partnership approaches<sup>37</sup>. Local government is also more effective when in communication with the private sector and civil society. For example, only 30% of required emissions reductions in the energy sector have been found to be within a city's direct jurisdiction<sup>38</sup>. Remaining reductions in energy-related emissions would typically depend on actions taken by the private sector, individuals and the state. Achieving coordination between all actors, aligning regulation, messaging and all other signals, is therefore absolutely critical.



## Funding

Funding is self-evidently central to the delivery of any climate action plan or project, including the development of climate-resilient, zero-emissions cities. Currently there is a significant gap in climate finance<sup>x</sup> – a gap that can only be closed through collaborative work between industry and the state.

Nonetheless, the challenge of radically transforming our cities is the ‘business opportunity of our generation’<sup>39</sup>. Private finance has a clear role to play in driving the shift in cities to net-zero, as it will probably provide 80-90% of total investment in this transition in the coming decades<sup>40</sup>. Private finance must be mobilised to secure greener cities with lower embodied carbon footprints and radically reduced operating emissions. This mobilisation will only happen when opportunities are clearly signposted by regulation and consistent policy; when engagement with climate-based standards is mandated; and when, in some cases, new approaches are strategically ‘de-risked’<sup>xi</sup>.

To date, regulatory and market failures have created systemic bottlenecks, including a major misalignment of interests between developers, financiers, governments and end-users. For example, climate and carbon are not currently reflected in asset valuation. Without data being collected and calculated in comparable ways, carbon performance cannot be leveraged to influence market mechanisms, tenant demand, financing or insurance. And this restricts investment in liveable net-zero cities. At the same time, fossil fuel use continues to be subsidised in many contexts – creating perverse incentives and skewing messages about the importance of deep, rapid and immediate action.

**“There are still barriers which lock in traditional models of capital allocation and prevent trillions of dollars from flowing into transitioning the built environment<sup>41</sup>”.**

The pyramid of instruments needed, globally, to effect the necessary change is set out in Figure 2. This pyramid was developed by Nrep, part of Urban Partners, in its work on developing green private finance. By tackling each layer of the pyramid at local and global levels, transparency and accountability can be systematically designed into building codes, industry standards, practices and investment.

<sup>x</sup>According to the United Nations Framework Convention on Climate Change (UNFCCC), ‘climate finance’ refers to ‘local, national or transnational funding – drawn from public, private and alternative sources of financing – that seeks to support mitigation and adaptation actions that will address climate change’. United Nations Climate Change ‘Introduction to Climate Finance’ <https://unfccc.int/topics/introduction-to-climate-finance#:~:text=What%20is%20climate%20finance%3F,that%20will%20address%20climate%20change>.

<sup>xi</sup>‘De-risking’ can involve many approaches, such as subsidies to kick-start markets, or the provision of loans by government that share risk with private finance.

## Transparency from brick to portfolio necessary to ensure action

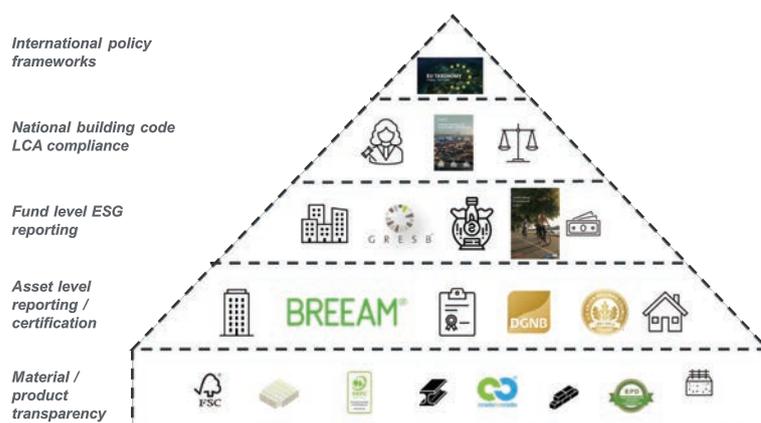


Figure 2: Pyramid of Instruments – Transparency from brick to portfolio to ensure action (with thanks to Rasmus Grosen Olsen, Nrep and Urban Partners)

Real estate is by far the biggest asset class on the planet, with buildings representing US\$6 trillion in investment each year. An additional US\$630 billion will be needed annually to transition 85% of existing building stock to net zero by 2050<sup>42</sup>. And overall, a big investment push to enable emerging markets and developing countries to meet their climate and development goals will require external financing of US\$1 trillion per year by 2030<sup>xii</sup>.

But investors and insurers are wary of urban assets and climate projects they perceive to be risky or unstable. Despite the clear need to leverage private finance for sustainable cities, the vast majority of investment continues to flow to high-carbon assets. According to SYSTEMIQ/Nrep, in recent years annual investment in energy efficiency represents just 2% of total investment in buildings<sup>43</sup>.

This situation is compounded by the fact that the buildings and construction sector is not on track to achieve its 2050 decarbonisation targets. In fact, the gap between current performance and the decarbonisation pathway is widening<sup>44</sup>. In order to harness the opportunity – and to put an end to unfit-for-purpose building practices – the public sector must step up to provide clear signals and guidance. Only then will the private sector shift its trajectory to align with the climate-resilient outcomes needed.

Planning laws, taxes, subsidies, zoning, building codes and guidance on building materials all need to point in the same direction: reduced embodied carbon as well as reduced emissions in building operations, alongside green public transportation and traffic policies. Governments must put in place mandatory codes and set out pathways to achieve zero carbon for buildings old and new as quickly as possible<sup>45</sup>. As already outlined, Denmark leads the way here. The rest of the world must catch up fast.

Investors will invest in assets that hold their value, with de-risked exposure to both the natural world and the financial realities of a global economy. Cities have a powerful voice in seeking to align those requirements through transparent, rigorous and consistent implementation of policy instruments. Only through such changes will we overcome the barriers to investment and unlock the opportunities inherent in a more sustainable and resilient built environment. The result will bring huge benefits to city populations at all levels.

<sup>xii</sup>This figure is calculated by reference to need, not by reference to what wealthy countries may be willing to offer. The US\$100 billion per year originally promised by developed countries to be achieved by 2020 has failed to be delivered, eroding trust in the COP system of consensus building and promises (Songwe et al 2022, page 5) <https://www.lse.ac.uk/granthaminstitute/publication/finance-for-climate-action-scaling-up-investment-for-climate-and-development/>

## The business case for green investment<sup>46</sup>

- Business opportunities related to more sustainable cities could be worth over US\$3.7 trillion annually for the private sector by 2030.
- The shift to sustainable urban environments has the potential to generate almost 170 million jobs and tackle major public health costs, including those linked to air pollution.
- Private investment in the building sector transition could make up 90% of total financing. This translates to an annual investment of roughly US\$570 billion from private finance to decarbonise the existing building stock by 2050.
- There are clear economic benefits from shifting investment towards more efficient, better designed buildings and greener cities:
  - Greener buildings offer lower total cost of ownership, e.g., LEED buildings and retrofits have demonstrated operational cost savings of 20% and 10% respectively.
  - Green spaces in cities raise asset values and property tax revenues, while reducing cooling and healthcare costs.

# Carbon pricing and progressive green finance:

## further lessons from Denmark

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Denmark currently leads the way in sustainable investment and construction. Within the Danish market, there are currently several key players working to promote progressive green finance in urban real estate. Urban Partners, a Danish-based platform of differentiated investment verticals, is one of them.

Urban Partners' primary focus is creating ESG (Environmental, Social and Governance) transparency in the development and operation of buildings. As shown in Figure 2, this work builds from the EU Taxonomy, a classification system designed to help identify environmentally sustainable economic activities and investments.

Providing transparency 'from brick to portfolio', the approach offers 100% visibility across all materials, products, certifications, codes, reporting schemes and frameworks relating to asset construction and retrofits. In doing so, it builds trust and reassurance among key actors to help catalyse private investment in sustainable urban development. The aim is to optimise decarbonisation throughout the asset-holding period and to collect ESG data as part of the asset-exit process.

Through the rigour of these processes and the credibility of a strong certification scheme, risk perception among banks, investors and developers is reduced. This shows how being ahead of the curve on carbon regulation can protect actors from falling foul of new emerging building codes and policies. Sweden, Finland, Norway and California have recently made moves in the same direction as Denmark, while New York is also meeting low emissions standards in its building codes faster than expected, with carbon emissions penalties for non-compliance. Such developments show there can be a guarantee that secure green assets will deliver long-term sustainable value, removing the uncertainty often associated with carbon pricing and investment in the private sector.





## ENDNOTES

<sup>1</sup><https://www.worldbank.org/en/topic/urbandevelopment/overview#1>

<sup>2</sup>[https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/files/documents/2020/Jan/un\\_2018\\_worldcities\\_databooklet.pdf](https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/files/documents/2020/Jan/un_2018_worldcities_databooklet.pdf)

<sup>3</sup> <https://www.worldbank.org/en/topic/urbandevelopment/overview#1>

<sup>4</sup>Ibid

<sup>5</sup> [https://www.sciencedirect.com/science/article/pii/S0959652622005509?ref=pdf\\_download&fr=RR-2&rr=7efda503ae3048cb](https://www.sciencedirect.com/science/article/pii/S0959652622005509?ref=pdf_download&fr=RR-2&rr=7efda503ae3048cb)

<sup>6</sup>[https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/files/documents/2020/Jan/un\\_2018\\_worldcities\\_databooklet.pdf](https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/files/documents/2020/Jan/un_2018_worldcities_databooklet.pdf)

<sup>7</sup><https://www.nature.com/articles/s41591-023-02419-z>

<sup>8</sup><https://public.wmo.int/en/media/news/copernicus-confirms-july-2023-was-hottest-month-ever-recorded#:~:text=air%20temperature%20highlights-,The%20global%20average%20temperature%20for%20July%202023%20is%20confirmed%20to,the%20average%20for%201850%2D1900>

<sup>9</sup><https://press.un.org/en/2019/sgsm19607.doc.htm>

<sup>10</sup><https://royalsocietypublishing.org/doi/full/10.1098/rstb.2019.0124#RSTB20190124C9>

<sup>11</sup>[https://www.c40knowledgehub.org/s/article/How-to-adapt-your-city-to-sea-level-rise-and-coastal-flooding?language=en\\_US](https://www.c40knowledgehub.org/s/article/How-to-adapt-your-city-to-sea-level-rise-and-coastal-flooding?language=en_US)

<sup>12</sup><https://www.worldbank.org/en/topic/urbandevelopment/overview#1>

<sup>13</sup>Ibid

<sup>14</sup><https://www.nature.com/articles/s41467-019-12808-z>

<sup>15</sup>[https://www.systemiq.earth/wp-content/uploads/2022/11/System-iq\\_Better-Finance-Better-Built-Environment\\_vFinal.pdf](https://www.systemiq.earth/wp-content/uploads/2022/11/System-iq_Better-Finance-Better-Built-Environment_vFinal.pdf)

<sup>16</sup>New York-New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study' page iv [https://www.nan.usace.army.mil/Portals/37/NYNJHATS%20Draft%20Integrated%20Feasibility%20Report%20Tier%201%20EIS\\_3Oct2022.pdf](https://www.nan.usace.army.mil/Portals/37/NYNJHATS%20Draft%20Integrated%20Feasibility%20Report%20Tier%201%20EIS_3Oct2022.pdf)

<sup>17</sup>Letter NYC Mayor's Office of Climate and Environmental Justice to USACE (Colonel Matthew W Luzzatto) 24th March 2023

<sup>18</sup>Schneider (2023) 'A New Plan to Save NYC From Flooding Would Be a Disaster—Here's Why' Architectural Digest <https://www.architecturaldigest.com/story/new-plan-save-nyc-flooding-would-be-disaster-heres-why>

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- <sup>20</sup><https://360info.org/rising-sea-levels-could-swamp-sinking-shanghai/>
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- <sup>22</sup>Ibid
- <sup>23</sup><https://www.dhakatribune.com/bangladesh/dhaka/305282/dhaka-among-top-10-25-cities-at-risk-from-climate>
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