Chapter 5:

Mapping the Solution Space for Climate Action: The Role of Urban Planning and Design

Quick facts

1. The share of green spaces in urban areas globally decreased from 19.5 per cent in 1990 to 13.9 per cent in 2020.

2. Climate action plans remain either underdeveloped or completely absent in cities of developing countries.

3. Inadequate capacity within local governments and institutional barriers are an impediment to the development and effective implementation of climate-resilient plans.

4. Climate-resilient planning aligns with the broader principles of inclusive, sustainable urban development. Thus, it can be implemented without requiring painful trade-offs when it overlaps with other local development priorities.

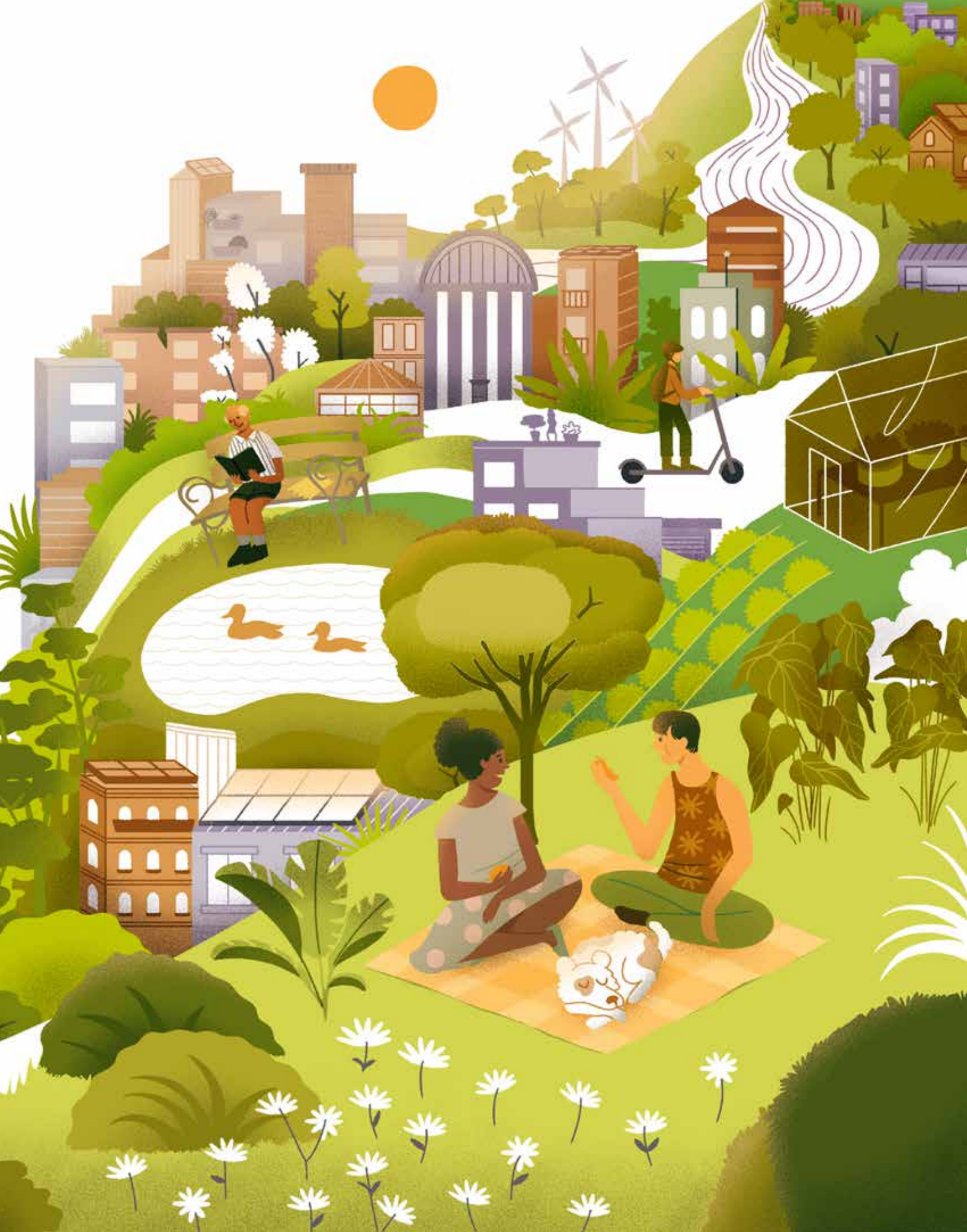
Policy points

1. Integrating climate action into urban planning and design frameworks is essential for a sustainable future.

2. It is imperative to embed climate considerations within urban policies. National urban policies should urgently address mitigation and adaptation.

3. Urban planning and design should promote localized, context-specific climate solutions.

4. Cities should invest in nature-based solutions. For an inclusive and just distribution of their benefits, they should be equitably spread throughout the urban landscape.



Climate change poses one of the most pressing challenges of the 21st century for urban areas. A variety of UN reports and documents, including the New Urban Agenda (NUA), have recognized its unprecedented threat to urban societies, ecosystems and economies. Besides underscoring the necessity of climate action at all levels, from the national to the local, these call for the integration of climate adaptation and mitigation strategies within urban planning and design.[1] With the appreciation that "cities are where the climate battle will largely be won or lost",[2] the role of urban planning and design comes to the fore as a frontline response to climate change.[3]

It is against this backdrop that this chapter begins by delving into the role of urban planning in achieving the Nationally Determined Contributions (NDCs) through National Urban Policies (NUPs), discussing their interplay as well as the causes and consequences of misalignment between them. The chapter then proceeds to focus on urban climate action plans (CAPs) in the second section, offering a snapshot of how climate adaptation and mitigation are mainstreamed into planning frameworks in various regions. Recognizing that the existing urban planning and design capacities to respond to climate change vary significantly across different regions of the world, the third section delves into the multifaceted ways in which planning and design—and their connections to urban management and governance—can deliver climate change action. The last section highlights the obstacles that hinder the effective implementation of otherwise well-thought-out climate-resilient plans, while concurrently discussing measures to overcome them.

5.1 Nationally Determined Contributions (NDCs) and National Urban Policies (NUPs): A Vital but Often Complicated Relationship

In the face of rapid urbanization and escalating climate change, the global community, led by the United Nations, has been at the forefront of advocating for coordinated efforts to mitigate GHG emissions and foster sustainable urban development. As highlighted in previous chapters, central to this endeavour are the NDCs, which outline each country's commitments to reduce emissions and adapt to the impacts of climate change as part of the Paris Agreement.[4] NUPs, meanwhile, provide the needed direction and coordinated course of action—including mainstreaming climate action—to support sustainable urbanization.[5]

Both NDCs and NUPs encompass sectoral and integrated strategies and serve as roadmaps for countries to mitigate and adapt to climate change. Accordingly, NDCs and NUPs shape budgetary allocations and policy priorities at the national and subnational levels.[6] At the heart of these efforts lies the intricate interplay between NUPs and municipal/local CAPs to guide sustainable urban development through various mechanisms laid out in the NUA.[7,] The alignment between NDCs and NUPs is therefore crucial, yet it is often hindered by several barriers that lead to missed climate targets, inefficient resource allocation and exacerbated social inequities.

5.1.1 National urban policies as a roadmap to achieving NDCs

A survey of 86 countries carried out by UN-Habitat, OECD and Cities Alliance in 2020 found that NUPs contributed to advancing the Paris Agreement's commitments in over half of the Member States (53 per cent).[8] The *Global State of National Urban Policy 2021* points to an increasing awareness of the role of NUPs in this regard, particularly in Asia and the Pacific. Generally, past studies by UN-Habitat and partners have shown that NUPs and their processes can play a vital role towards achieving climate goals, through:[9]

- providing regulatory *frameworks and standards* for sectors (transportation, buildings and construction, energy, waste and water management) and financial incentives (grants, subsidies, tax credits and preferential loans) that support climate-friendly urban initiatives.
- supporting *local capacity building* among urban planners, policymakers and other stakeholders to integrate climate considerations into urban development plans and projects.
- facilitating *collaborations and partnerships* (for example, among different levels of government, private sector actors, civil society organizations and academic institutions) to leverage resources and expertise for climate action in urban areas.
- supporting research, development and deployment of *innovative technologies and practices* for urban climate action (such as renewable energy, smart grids, green building materials and urban farming).
- promoting *public engagement and awareness campaigns* to engage citizens in climate action initiatives.
- providing mechanisms for *monitoring, reporting and evaluating* the effectiveness of urban climate action initiatives to track progress, identify gaps, and adjust policies and programs as needed to achieve climate goals.

Ideally, NUPs promote integrated urban planning and design that coordinate action across various sectors including, among others, land, transportation, energy and infrastructure development to reduce GHG emissions and enhance climate resilience. Recognizing the interconnectedness of ecosystems and human settlements, these approaches should also consider the interaction of urban and rural areas to ensure mutually beneficial climate resilience outcomes.[10]

5.1.2 Root causes for misalignment between NDCs and NUPs

Whilst NDCs provide a broad framework for climate action, synergy with NUPs is often lacking. The resulting misalignment of the two hinders comprehensive and effective climate action at the urban level. The root causes of this misalignment centre around a number of factors, discussed below.

Whilst NDCs provide a broad framework for climate action, synergy with NUPs is often lacking

The fragmentation of national level policy frameworks: Often, climate policies and urban development policies are generated and implemented in isolation. This leads to inconsistencies, conflicting objectives and inefficiencies in various dimensions. Yet, there are numerous cross-cutting issues between the national and the urban levels including, among others**,** ecosystem services and nature-based solutions (NbS), public spaces**,** circular economy and informal settlements.[11] However, as illustrated in Chapter 2, the NDCs still suffer from glaring gaps with respect to these cross-cutting issues, with far more emphasis placed at the national than at the urban level. These gaps are symptomatic of a lack of integrated approaches that synchronize climate action with urban planning and design.[12] For instance, a country may have ambitious emission reduction targets in its NDCs, but its NUPs may prioritize modes of economic growth that are inconsistent with sustainability and mitigation, resulting in the proliferation of carbon-intensive infrastructure and land use patterns.[13] UN-Habitat encourages consistency between a city's guiding vision and the climate planning objectives.[14]

Underdeveloped NUPs: NUPs, as crucial instruments for sustainable urban development, remain mostly underdeveloped. The failure to prioritize and invest in urban planning and design hampers the potential of cities to contribute meaningfully to NDCs,[15] with only 48 per cent of NUPs in 2020 addressing climate resilience (though this was a significant improvement from just 36 per cent in 2018).[16] In many cases, NUPs lack the necessary depth and specificity needed to address urban areas' unique challenges, particularly with regards to fiscal tools, which hinders effective climate action.[17]

Limited or inadequate representation of urban issues in NDCs: Despite growing urbanization trends, NDCs often focus predominantly on national-level emissions sources, such as energy production and transportation, and overlook the significant contributions of cities to GHG emissions. As illustrated in Chapter 2, more still needs to be done to strengthen the urban content of NDCs. Indeed, 65 (or 34 per cent) of the 195 NDCs submitted to the United Nations Framework Convention on Climate Change (UNFCCC) before 27 June 2023 contained either "low or no" urban content.[18] Moreover, there is need to amplify mitigation responses at the urban level: as discussed in Chapter 2, mitigation responses are more frequently addressed at the national level than at the urban level. It is worth noting that NDCs frequently lack specific targets and strategies to address emissions from urban sectors like buildings,[19] waste management[20] and land use planning,[21] despite the fact that urban areas account for a significant proportion of energy-related CO_2 emissions (69-72 per cent in 2020)[22] and are usually disproportionately affected by climate change impacts.

Neglect of heterogeneous forms of urbanization: Although cities and settlements exhibit diverse forms of urbanization shaped by local contexts, many NUPs fail to acknowledge this heterogeneity. This oversight results in generic policies that may not be suitable for addressing the unique challenges posed by different urban forms—from sprawling metropolises to small, densely populated urban settlements. For effective climate action, the untapped potential of urban areas, regardless of size, should be harnessed through contextualized, integrated and territorial approaches to urban development.[23]

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Limited implementation of urban policies: Implementation gaps further compound the challenges associated with NUPs. Even when NUPs exist, their impact is often diluted due to weak enforcement mechanisms, lack of political will, capacity constraints and other institutional shortcomings. There is therefore a need for effective governance structures that ensure the translation of NUPs into tangible actions on the ground.[24]

Bike share system in Masdar City, Abu Dhabi, UAE. © Shutterstock

Limited coordination mechanisms: Lastly, the lack of effective coordination mechanisms between relevant government agencies further exacerbates the misalignment between NDCs and NUPs.[25] Many countries struggle to establish robust coordination mechanisms, leading to disjointed policy implementation and missed opportunities for synergies between climate and urban agendas.[26] Recognizing the need for connecting climate action at the local, national and global levels, COP27 initiated the Sustainable Urban Resilience for the next Generation Initiative (SURGe). Similarly, COP28 initiated the Coalition for High Ambition Multi-level Partnerships (CHAMP) for climate action to further enhance national-subnational collaborations.[27]

5.1.3 The consequences of misalignment between NDCs and NUPs

The misalignment between NDCs and NUPs often results in inefficient allocation of resources that undermine the effectiveness of climate mitigation and adaptation efforts. These gaps may lead to investments in infrastructure that perpetuate carbon-intensive practices and exacerbate climate vulnerability.[28] At the same time, the absence of strategic links between NUPs and NDCs often leads to missed opportunities for allocating support and resources for climate action in urban areas and for scaling up local solutions.

The misalignment between NDCs and NUPs often results in inefficient allocation of resources that undermine the effectiveness of climate mitigation and adaptation efforts

The failure to align NDCs with NUPs also increases the likelihood of missing climate targets set under the Paris Agreement.[29] Indeed, of the NDCs submitted by 2023, the vast majority identify future needs at the national level, mostly for technology (160 NDCs), capacity building (155 NDCs) and finance (141 NDCs). In contrast, only an extremely limited number of NDCs include specific future requests at the urban level, whether it is for finance (26 NDCs), capacity building (9 NDCs) or technology (7 NDCs).[30] This indicates the persistence of gaps between NDCs and NUPs. Yet, as urban areas continue to expand and intensify, their emission trajectories diverge from national projections, making it challenging to achieve emission reduction goals. Meanwhile, inadequate consideration of urban vulnerabilities in NDCs may leave cities ill-prepared to cope with climate change impacts such as extreme weather events (e.g., heatwaves and extreme rainfall) and sea-level rise, leading to adverse social, economic and environmental consequences.[31]

Most importantly, the misalignment between NDCs and NUPs can exacerbate differentiated vulnerabilities and social inequities. Marginalized populations, including Indigenous communities and residents of informal settlements, are disproportionately affected by climate change due to their limited access to basic services, inadequate infrastructure and precarious housing conditions.[32] When NUPs neglect climate resilience and fail to prioritize equitable development, the most excluded communities bear the brunt of environmental degradation and climate-related disasters, further widening existing disparities in cities.[33]

Flooding in Dhaka in Dhaka, Bangladesh © Shutterstock

In sum, urban planning and design play a critical role in achieving NDCs, necessitating stronger NDC—NUP alignment and foregrounding the role of subnational and local levels through integrated policy frameworks, enhanced community engagement, capacity building and knowledge sharing. Planning processes must also recognize the diverse forms of urbanization shaping cities to achieve effective, context-specific strategies.

5.2 Urban Climate Action Plans (CAPs)

With increasing calls to ramp up action on synergies between climate action and the Sustainable Development Goals (SDGs), there is growing awareness that the climate battle will be won or lost in urban areas. The Glasgow Pact has emerged as a critical driver for integrating climate action in planning at all levels to achieve global climate goals while emphasizing context-specific equity considerations.[34] The NUA, meanwhile, recognizes the pivotal role of cities in achieving the SDGs and provides a comprehensive framework to achieve them through integrated, participatory urban planning that promotes synergies between climate action and global development agendas.[35]

5.2.1 A kaleidoscope of CAPs across the globe

More cities are recognizing the important connections between climate resilience and sustainability in their planning processes, including through CAPs.[36] This integration, however, varies widely across cities and depends on each city's unique vulnerabilities and adaptive capacities. There is a dearth of information on the absolute number of cities that have developed CAPs globally. Whilst global networks of cities such as C40 Cities are making efforts to track CAPs among their membership,[37] CAPs remain absent in many countries. In fact, they are only compulsory in a handful of countries like France, Ireland and the UK.[38]

Even when CAPs are in place, data gaps and capacity constraints can lead to mixed results. For instance, in cities across Europe there is need for better indicators and stronger quantitative cost assessments to improve the moderate levels of adaptation and mitigation actions currently integrated into urban policy.[39] As for the content of CAPs, the scant data available reveal a variety of issues in different countries and regions (Table 5.1). In general, it is notable that cities tend to prioritize mitigation over adaptation in their CAPs and frequently lack the necessary data, resources and targets to implement effective climate actions.

Table 5.1: An overview of common barriers to effective CAP implementation

Key challenges	Specific examples
Prioritization of mitigation over adaptation	In **Canada,** a survey of the 63 largest urban areas in Canada found that, in addition to inadequate implementation, monitoring and evaluation mechanisms, "municipal climate change plans prioritize climate change mitigation over adaptation". [40]
Insufficiently ambitious targets	Evidence from 327 small, medium and large cities in **Europe** reveals that although the CAPs address mitigation more than adaptation, with the majority including specific emission reduction targets, these on average would only lead to a 47 per cent decrease: to achieve the Paris Agreement's zero emissions target by 2050, then, cities will need to double these efforts.[41]
Lack of coherence and existing norms	In the **United States,** an assessment of CAPs of 29 major cities shows that successful climate action is being undermined by a lack of coherence and the continued dominance of car-oriented development.[42]
Inadequate data for monitoring and evaluation	In **Latin America**, a study of 74 cities reveals that as of 2022 only 30 have published CAPs. Even these fall short on indicators, however, which reflects gaps between the translation of strategies into action and monitoring the outcomes.[43]
Limited application of CAPs	In some regions, CAPs are still relatively scarce, despite the evident need for urban adaptation and mitigation efforts. For example, although studies highlight the negative impacts of the climate crisis on cities in the **Middle East**,[44] CAPs remain absent for the most part, or underdeveloped where they exist.

5.2.2 Mainstreaming climate action through CAPs

Today, cities are adopting a slew of strategies to mainstream climate action through CAPs. To begin with, they are increasingly *leveraging international agreements* such as the Paris Agreement, the Sendai Framework and the SDGs to guide their climate action efforts. In Denmark, for example, of 98 municipalities, 95 have aligned their CAPs with the Paris Agreement—potentially reducing emissions by 73 per cent by 2030.[45] By aligning with international frameworks for global emissions targets and best practices, cities are accessing technical assistance, knowledge-sharing networks and funding to support their climate goals.[46] Networks like C40 Cities, for instance, are financing investments in the green economy to support climate mitigation.[47]

Concurrently, *leveraging urban policy frameworks* to prioritize climate change considerations is essential for successful climate action. Robust and coherent policy frameworks entail adjustments to existing plans, policies and regulations to align urban CAPs with NUPs and NDCs while integrating new strategies that address emerging challenges. They are vital for mainstreaming climate adaptation and mitigation considerations into all stages of the decision-making process, from project inception to implementation and evaluation, while ensuring coherence among sectoral policies such as energy, transportation, housing and land use. The integrated approach to sustainability in Vancouver (Canada) has ensured stability and predictability for various stakeholders (Box 5.1).

Leveraging urban policy frameworks to prioritize climate change considerations is essential for successful climate action

Box 5.1: A coherent policy approach to Vancouver's energy transition

In Canada, Vancouver's Greenest City 2020 Action Plan, in effect since 2010, focused on the triad of zero emissions, zero waste and healthy ecosystems. The Green Economic Development Policy, central to this plan, transitioned over 3 per cent of the city's employment into green jobs.[48] Furthermore, 93 per cent of the city's energy is from renewable sources, while its building code is considered the greenest in North America.[49] Vancouver has ensured coherence through a phased but coordinated policy approach—including the Renewable City Strategy (2015), the Zero Emissions Building Plan (2016) and most recently, the Climate Emergency Action Plan (2020)—building on shared objectives and avoiding inconsistencies between the various instruments.[50] Notably, Vancouver supports its approach through a robust methodology and rigorous data.[51]

Importantly, this report highlights pertinent issues concerning climate resilience in various chapters that are fundamental for putting people (in particular, marginalized and vulnerable groups) at the centre of climate-responsive urban planning, such as the ability to *cope with hazards* (Chapter 3). Indeed, the ability to cope with hazards from extreme weather events is a crucial aspect of climate-responsive urban planning. In addition to policy frameworks that regulate development in hazard-prone areas and investments in early warning systems, CAPs should contain measures that minimize the impact of climate change and build resilience. Coping measures include disaster preparedness, resilient infrastructure and community-based approaches that reduce the risk of loss and damages and build adaptive capacity. For coastal and low-lying cities, the options range from *protection* (through either engineered structures or

soft, ecosystem-based adaptations) to *accommodation* (through advanced planning, land use and building codes changes, ecosystem conservation, insurance policies and strict development requirements) to *planned retreat* (through managed realignment, setbacks or even development prohibitions altogether and the withdrawal of government subsidies).[52] In the US, for instance, dozens of cities in California have been actively engaging with managed retreat from their shorelines in response to sea-level rise and extreme weather events.[53]

CAPs need to *address differentiated vulnerabilities* and the varying adaptive capacity among communities attributed to socioeconomic disparities within cities, as underscored in the previous chapter and in section 5.1.3.[54] For example, flooding hazards in Toronto, Canada, impact the four most vulnerable socioeconomically neighbourhoods (i.e., poor, immigrant communities) more than the rest of the city due to their proximity to flood plains, aging infrastructure, and the proliferation of impervious surfaces.[55] Although Toronto's CAP underscores the need for inclusion, evidence reveals that these communities are still disproportionately exposed to flooding and continue to be excluded from climate adaptive blue-green infrastructure.[56]

Accordingly, in the integration of sustainable infrastructure and design principles—including investments in public transportation systems, compact and mixed-use developments, critical infrastructure and

CAPs need to address differentiated vulnerabilities and the varying adaptive capacity among communities attributed to socioeconomic disparities within cities

climate-responsive urban design that capitalizes on ecosystem services—an intersectional perspective is vital to ensure that CAPs do not entrench systemic inequities. Indeed, CAPs need to address differentiated vulnerability and climate justice directly through the inclusion of vulnerable and marginalized groups. The engagement of marginalized communities should not be an afterthought: instead, it should be at the core of planning and implementation processes (Figure 5.1).

Lastly, adopting a more agile and responsive approach that continually monitors, updates and improves the planning process and its implementation to ensure no one is left behind is key. Figure 5.2 illustrates a typical climate action planning process.[57] It is worth noting that such processes are diverse and do vary depending on the urban context.[58] In recent years, C40 Cities has provided a step-by-step guide for cities to develop CAPs that are both consistent with the objectives of the Paris Agreement and holistic to address urban communities' socioeconomic needs.[59]

Figure 5.1: Guiding principles for city climate action planning

City climate action planning should be:

Ambitious
Setting goals and implementing actions that evolve iteratively towards an ambitious vision

Inclusive
Involving multiple city government departments, stakeholders and communities (with particular attention to marginalized groups), in all phases of planning and implementation

Fair
Seeking solutions that equitably address the risks of climate change and share the costs and benefits of action across the city

Comprehensive and integrated
Coherently undertaking adaptation and mitigation actions across a range of sectors within the city, as well as supporting broader regional initiatives and the realization of priorities of higher levels of government when possible and appropriate

Relevant
Delivering local benefits and supporting local development priorities

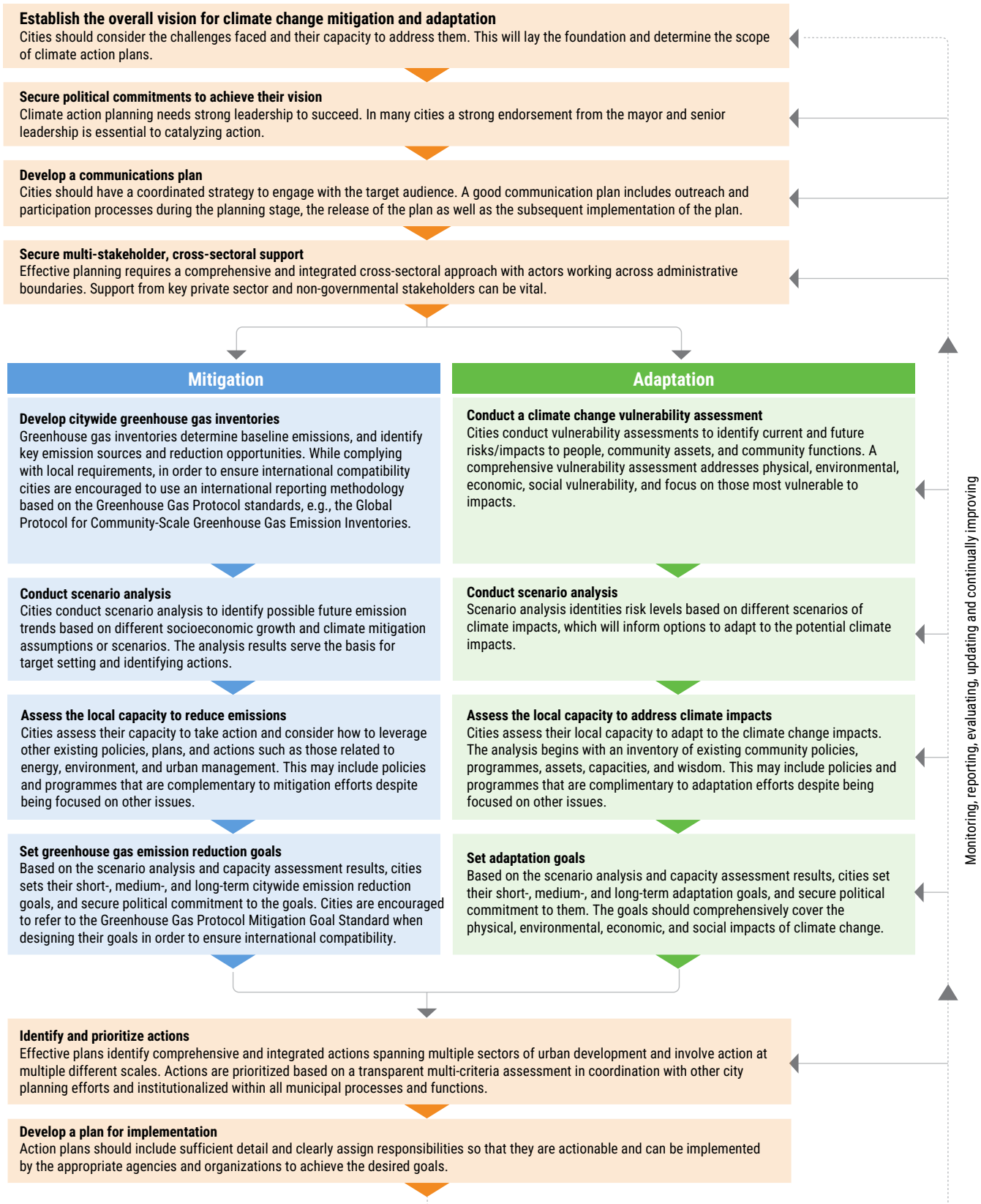
Actionable
Proposing cost-effective actions that can realistically be implemented by the actors involved, given local mandates, finances, and capacities

Evidence-based
Reflecting scientific knowledge and local understanding, and using assessments of vulnerability and emissions and other empirical inputs to inform decision-making

Transparent and verifiable
Following an open decision-making process, and setting goals that can be measured, reported, independently verified, and evaluated

Source: UN-Habitat, 2015a.

Figure 5.2: Typical climate action planning process



Source: UN-Habitat, 2015a.

5.3 The Solution Space for Climate Action

The initial chapters of this report underscore the enormous contribution of urban areas to GHG emissions. Urban planning and design can significantly reduce these emissions and foster sustainability by embedding climate considerations within existing policies, plans and urban governance. For instance, integrating spatial planning (e.g., land use regulations), urban design (e.g., compact, mixed use and transit-oriented spatial layouts), and urban management (e.g., efficient public transportation systems) contribute effectively to mitigation, and consequently, to sustainability.[60]

Simultaneously, this report underscores the value of a people-centred approach to climate action that tackles the underlying drivers of vulnerability. This means recognizing the interconnectedness of climate-resilient urban planning and design with social policy. Public transportation, for example, besides the immediate health and environmental benefits it can bring through reduced emissions, traffic congestion and air pollution, is also key in meeting social objectives: it provides vulnerable populations with improved access to jobs and essential services while simultaneously contributing to mitigation and sustainability efforts.[61] Indeed, integrating social policies within urban planning and design aligns with the broader agenda of creating sustainable, inclusive and climate-resilient cities.[62]

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As discussed in Chapter 4, social policies and measures that address underlying risk drivers, such as poverty reduction strategies, access to affordable housing and universal healthcare, are integral to building adaptive capacity and resilience within urban communities, particularly for vulnerable populations.[63] Minorities and Indigenous Peoples, for instance, are especially vulnerable to climate change due to systemic inequities that exclude them from basic urban services.[64] To reduce these vulnerabilities and enhance resilience, climate adaptation needs to be mainstreamed into city plans.[65] Moreover, the inclusion of diverse voices (e.g., across gender, age, race, ability and cultural backgrounds such as Indigenous knowledge) to develop inclusive and effective climate-resilient urban areas is essential for the successful implementation of mitigation and adaptation strategies and for ensuring equity and justice.[66]

The following subsections delve into the multifaceted ways in which urban planning and design, supported by urban management and governance, can deliver climate change action. Whilst these aspects are interrelated, the following subsection bands the tools/approaches/strategies in the respective fields as it focusses on the "how-tos". Importantly, it is essential to carefully tailor these approaches to align with each context's unique conditions and urbanization patterns.[67] Rapidly urbanizing regions require different strategies compared to established urban centres, so do formally planned areas compared to informally settled urban areas. Simultaneously, it is also imperative to develop urban planning and design strategies at various scales, spanning from the neighbourhood and local community to the urban and regional. UN-Habitat emphasizes the need to identify the most suitable scale for each strategy, recognizing that emissions and climate hazards often extend beyond the administrative boundaries of cities.[68]

Elevated linear park in New York, USA © Shutterstock

Table 5.2: An overview of planning instruments for climate action

Planning instruments for climate action	
The tools	**How the tools work**
Urban legislation and regulations ▪ CAPs ▪ Building codes ▪ Zoning ordinances ▪ Environmental regulations	▪ Set GHG reduction targets ▪ Incentivize energy efficiency (carbon pricing) and transitions (renewable energy and green buildings) ▪ Regulate land use practices
Urban land policies ▪ Smart growth strategies (infill and brownfield redevelopment) ▪ Urban revitalization ▪ Land use planning	▪ Minimize environmental degradation ▪ Conserve natural ecosystems ▪ Restore lost ecosystems
Slum upgrading, urban regeneration, and housing policies ▪ Community-driven approaches ▪ Provide social and physical infrastructure ▪ Upgrade housing	▪ Secure housing tenure ▪ Incentivise climate-resilient housing design features (elevated foundations, flood-resistant materials, and passive cooling) ▪ Locate affordable housing within transit catchments
Urban transport and mobility ▪ Invest in low- to zero-carbon transport infrastructure (such as public transit; walking, cycling, and shared micromobility; electric vehicles; shared mobility) ▪ Adopt universal accessibility measures ▪ Integrate public transit and land use planning ▪ Provide EV charging infrastructure ▪ Invest in intelligent transportation systems (ITS)	▪ Enhance the range, accessibility and convenience of low- to zero-emissions mobility ▪ Concentrate development, employment and social infrastructure around transit hubs ▪ Manage transit and traffic in real-time ▪ Incentivize transitions to zero-emissions mobility
Urban energy systems ▪ Renewable urban energy and storage infrastructure (e.g., solar panels, urban wind turbines, and battery storage systems) ▪ Renewable energy district heating and cooling networks ▪ Intermittent renewable energy sources ▪ Smart grid technologies, advanced metering infrastructure, demand response systems, and grid automation	▪ Facilitate energy transitions ▪ Decrease GHG emissions
Mapping, spatial data, and knowledge sharing ▪ Invest in climate, energy data, and spatial data ▪ Capitalize on innovations (such as AI) ▪ Adopt knowledge sharing approaches and technologies	▪ Steer evidence-based planning, proactive risk management, and climate adaptation ▪ Understand change over time to urban and environmental land cover ▪ Identify vulnerable populations and areas ▪ Empower citizens to participate in data collection

5.3.1 Urban planning instruments for climate action

Urban planning can significantly reduce GHG emissions and foster sustainability by embedding climate considerations within existing policies and plans.[69] The following section provides some practical measures for addressing climate change which are summarized in Table 5.2.

Urban legislation and regulations

Legislation and regulations provide the legal foundation for climate action in cities. They establish mandates, standards and guidelines for addressing climate change and foster sustainable development while promoting social equity and resilience. CAPs, building codes, zoning ordinances and environmental regulations are among the legal instruments that govern urban development and shape the built environment to reduce GHG emissions, adapt to climate hazards and enhance resilience.

Urban legislation should be designed to drive transformative change towards low-carbon, climate-resilient urbanization

Urban legislation should be designed to drive transformative change towards low-carbon, climate-resilient urbanization by setting targets for emission reductions, promoting energy efficiency and regulating land use practices.[70] Moreover, legislation should incentivize climate-friendly behaviours and investments through mechanisms such as carbon pricing, renewable energy mandates and green building incentives. For instance, pricing mechanisms like carbon taxes or emissions trading systems incentivize businesses and individuals to reduce their carbon footprint and invest in clean technologies, hence internalizing the social

and environmental costs of emissions. Similarly, subsidies, grants and tax credits stimulate private sector investment in renewable energy, energy efficiency retrofits and sustainable transportation infrastructure.

Robust regulatory frameworks support aligning new developments with stringent environmental standards that reduce GHG emissions (e.g., building codes) and mainstream adaptation (e.g., NbS) for enhanced climate resilience in cities like Oslo (Norway), Copenhagen (Denmark) and Stockholm (Sweden).[71] Today, UN-Habitat, through applied tools such as the Urban Law Module of the Law and Climate Change Toolkit, is supporting countries as diverse as Malawi, Oman, Colombia, India and Tajikistan to improve their legal and governance frameworks for effective implementation of the Paris Agreement.[72]

Urban land policies

While avoiding land use planning inequities highlighted in Chapter 4, urban land policies should guide urban development to prevent environmental degradation and maximize resilience. Accordingly, cities should adopt smart growth strategies that promote infill development, brownfield redevelopment and the revitalization of underutilized urban areas. Also, land policies should concentrate development around transit hubs, employment centres and amenities to minimize urban sprawl and its associated carbon emissions. Collectively, these measures encourage transit use, reduce sprawl, alleviate development pressures on greenfield sites, preserve natural landscapes and promote sustainable development.[73]

Concurrently, cities should develop land policies that incentivize sustainable land management practices such as agroforestry, urban agriculture and sustainable forestry which enhance carbon sequestration, improve soil health and promote equitable local food security. Cities must also develop zoning and land use regulations that promote the conservation of natural ecosystems such as forests and coastal mangroves. Previous World Cities Reports (2020 and 2022)

It is imperative to ensure that ecosystems are sustainably used and effectively conserved, even under pressure for changes in land uses

have emphasized the value of these urban ecosystems and their role in climate change adaptation and mitigation. They provide essential ecosystem services, sequester carbon (mitigation) and protect from extreme weather events (adaptation). For instance, urban natural areas, wetlands and waterfronts provide natural buffers against coastal erosion, sea-level rise, coastal storm surges and inland flooding, hence protecting communities and infrastructure from climate-related risks.[74] It is thus imperative to ensure that ecosystems are sustainably used and effectively conserved, even under pressure for changes in land uses. In the conservation and restoration of ecosystem services, UN-Habitat advocates for a territorial approach that mainstreams urban-rural linkages into planning and development processes.[75] In this regard, NUPs are an important guiding framework.

Additionally, urban land policies should also restore lost ecosystems and develop new ones, especially in cities where blue and green spaces have been declining. Regarding urban green areas, recent data from UN-Habitat reveals their steady decline (see Box 5.8), with severe implications for climate mitigation and adaptation. This feature highlights people-centred measures to enhance the provision of quality urban green spaces. Urban blue spaces are also becoming increasingly rare. To reverse this, urban stream daylighting is an innovative practice for bringing back to the surface and restoring urban streams that previous development has buried in underground culverts. Cheonggyecheon restoration project in Seoul, Republic of Korea, and Zürich, Switzerland's 'Bachkonzept' for stream daylighting are testament to the transformative impact of what such interventions can also achieve on the ground (Box 5.2).[76]

Solar and wind power plant © Shutterstock

Box 5.2: Urban stream daylighting: two different approaches in Zürich and Seoul

Zürich's (Switzerland) *bächkonzept* policy
- Large number of micro-scale interventions since 1986
- 24 kilometres of streams daylighted

Seoul (Republic of Korea) Cheonggyecheon restoration project
- One mega-scale project between 2003-2005
- 10 kilometres of stream (Cheonggyecheon and Seongbukcheon) daylighted

Zürich's Bachkonzept

- Improved biodiversity
- Restored infiltration & evapotranspiration
- Ecological connectivity
- Urban connectivity & active mobility

Seoul's Urban Streams

- Improved biodiversity
- Decreased pollutants
- Urban heat mitigation
- Enhanced mobility & transit

Source: Khirfan, Mohtat & Peck, 2020

Slum upgrading, urban regeneration and housing policies

Importantly, UN-Habitat underscores the necessity of "effective and fit-for-purpose land administration systems" for implementing policies that are both environmentally sustainable and socially inclusive. For instance, climate-resilient land governance is key both for improving tenure security and strengthening community resilience.[77] Cities must prioritize upgrading housing, infrastructure and services in urban slums and informal settlements through community-driven approaches that empower residents to participate in decision-making processes, build social cohesion and strengthen adaptive capacity. UN-Habitat, for instance, through programmes like the Participatory Slum Upgrading Programme (PSUP), has supported countries to mainstream human rights-based approaches to incremental in-situ upgrading, thus building resilience for slumdwellers. Concurrently, based on its experience, UN-Habitat has set out key principles to be applied when considering climate change measures in informal settlements (Box 5.3).[78] Today, examples of innovative approaches slum upgrading abound in cities in developing countries such as Iquique, Chile's inclusive approach to slum upgrading (Box 5.4).[79] A shift toward a transformative, people-centered approach to climate action (see Chapter 4) also necessitates slum upgrading to address the underlying drivers of vulnerability, such as poverty, inequality, inadequate infrastructure and housing tenure, in order to contribute to strengthen urban resilience.

Box 5.3: Principles for action when applying climate change measures in informal settlements

Based on experience, UN-Habitat recommends the following key tenets to be applied when considering and implementing climate change measures in informal settlements:

- Address development deficits with climate action in mind and vice versa
- Downscale vulnerability assessments and responses to city and neighbourhood level
- Incorporate local knowledge in climate change responses
- Strengthen education and training
- Build capacity at the neighbourhood level
- Apply a balanced mix of adaptation options
- Scale up action through co-production and collaboration between actors
- Recognize the opportunities by integrating informality into adaptation and mitigation
- Use recovery processes as an opportunity for low carbon and resilient development

Source: UN-Habitat, 2018a, p.ix

Housing policies should promote climate-resilient housing design features

Likewise, housing policies should promote climate-resilient housing design features, such as elevated foundations, flood-resistant materials and passive cooling, that protect residents from climate hazards while reducing energy consumption and GHG emissions.[80] Incentives should be devised to encourage homeowners and developers to adopt sustainable building practices and technologies (see subsection 5.3.2), including tax credits, subsidies and financing mechanisms (such as EcoCasa in Mexico Box 5.5). At the same time, various levels of government should effectively manage the delicate balancing act between sustainability and affordability of housing. Indeed, sustainable housing should be affordable to ensure social accessibility and equity. Exploring affordable housing models that make sustainable housing more accessible is of essence. Importantly, affordable housing initiatives and subsidized housing should be located close to accessible public transit not only to reduce emissions, but also to enhance social equity and access to essential services.[81]

Box 5.4: Half a House: An integrated approach to informal settlements in Iquique, Chile

The Quinta Monroy project in the city of Iquique, Chile provides a hundred families with "half a house" of 40 square metres each, built on the public land they have been occupying for over 30 years to avoid displacing them. This maintains the families' access to their social networks, public transit and social services. Moreover, the structurally sound new houses are built to withstand natural hazards using recycled material from the original slum, while solar energy provides up to 70 per cent of the household needs. Secured property titles allow owners to incrementally expand their houses and motivate them to invest in energy-efficient appliances, safe in the knowledge that they will not be subjected to evictions in the future. Post-occupancy assessments reveal satisfaction with the thermal comfort, ventilation and natural light of the houses.[82]

Source: Núñez Collado & Wang, 2020


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Box 5.5: EcoCasa: Financing low-carbon social housing, Mexico

The residential sector is key to Mexico's commitment of reducing GHG emissions to 50 per cent (below 2002 levels) by 2050. Over the past years, the expansion of Mexican cities—with housing representing at least 60 per cent of this growth—has significantly increased their carbon footprint.

The EcoCasa program is contributing to the supply of environmentally efficient housing in an affordable way, thus improving the quality of life for low-income families. As sustainable housing requires adequate investments, by increasing both the production of low-carbon housing and the supply of mortgages for the same, EcoCasa is helping Mexico reduce its greenhouse gas emissions. The program is part of a multi-pronged approach to help Mexico follow a low-carbon growth path over the medium- to long-term.

Providing financing to build more sustainable houses is contributing to lower energy consumption and spending, cutting greenhouse gas emissions and strengthening government policies and initiatives. In the first seven years the EcoCasa program has helped build over 27,000 houses and finance an additional 1,700 "green" mortgages.

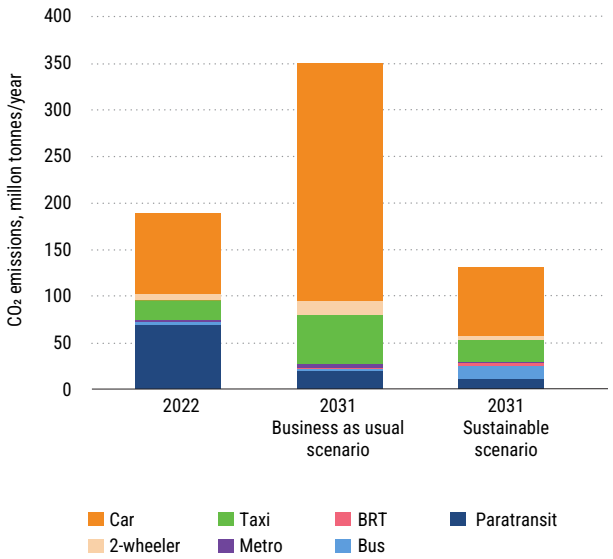
While the immediate outcome of the program is the construction of houses with lower lifecycle GHG emissions, is envisaged that it will provide additional, long-lasting benefits to the housing sector in Mexico (as part of Mexico's Nationally Appropriate Mitigation Action)—contributing to the mainstreaming of sustainability criteria in the housing industry.

Source: UNFCCC, 2023f.

Urban transport and mobility

Given the contribution of urban transport to greenhouse emissions, air pollution and energy consumption, cities should implement sustainable, low-carbon transport solutions (such as public transport, cycling, walking and shared mobility) to reduce emissions, provide equitable access to jobs and services, and encourage sustainable, active travel behaviours that improve public health and urban livability.[83] Previous editions of World Cities Reports have underscored the imperative for investments in public transport infrastructure in cities to promote modal shifts away from private vehicles, reduce traffic congestion, lower GHG emissions and improve air quality. A recent study by ITDP, UNEP and UN-Habitat indicates that to achieve a sustainable transport scenario by 2031 in African cities, the net infrastructure requirements include "21,000 kilometres of footpaths, 6,000 kilometres of cycle tracks, 790,000 bikeshare cycles, 310,000 buses, 3,000 kilometres of BRT and 250 kilometres of metro".[84] As illustrated in Figure 5.3, this scenario would cut CO_2 emissions by 220 million tonnes per year, or about 63 per

Figure 5.3: CO_2 emissions by scenario for African cities



Source: ITDP, UNEP and UN-Habitat, 2022

cent, from the 351 million tonnes projected by 2031 in a "business as usual" scenario (to 131 million tonnes in the "sustainable" scenario).[85] Importantly, well-designed and inclusive public transport also provides equitable access to jobs and urban services.

Public transit measures should be integrated with land use planning through transit-oriented development (TOD) to promote compact, mixed-use urban environments that further reduce the need for long-distance commutes and private vehicle travel.[86] This integration should be accompanied by investments that encourage sustainable travel behaviour and reduce the reliance on fossil fuel-powered vehicles including pedestrian, cycling and shared micromobility infrastructure such as bikes, e-bikes and e-scooters. It is important that cities adopt universal accessibility measures (e.g., for wheelchairs, roller skates and skateboards) that enhance safe and equitable access to non-motorized modes of transport for children and individuals living with disability.[87] Equitably distributed multi-modal mobility that is accessible to people with various (dis)ability levels ensures social equity in access to employment, social infrastructure and critical services during climate emergencies.[88]

Furthermore, to accelerate emission reductions from the transport sector, various levels of government should embrace and support technology advancements and innovations in transport, such as intelligent transportation systems, shared mobility and electric vehicles. Intelligent transportation systems (ITS) and smart mobility solutions, including traffic management technologies, real-time transit information and ride sharing for trips not well covered by existing public transport networks, optimize traffic flow, reduce congestion and facilitate efficient multimodal transportation options. ITS solutions help minimize idling times and optimize route choices, so reducing fuel consumption and vehicular emissions.

Equitably distributed multi-modal mobility that is accessible to people with various (dis) ability levels ensures social equity in access to employment, social infrastructure and critical services during climate emergencies

Importantly, these innovative approaches to transportation should be linked to integrated long-term planning and policy-making processes. With regard to e-mobility, for instance, Rwanda is a model of a rapidly urbanizing country accelerating its adoption through the deployment of a fleet of shared and electric bicycles and scooters, accompanied by accessible docking stations and a single app that facilitates convenient use.[89] In Norway, meanwhile, Oslo's successful transition to electric vehicles (EVs) (including battery operated and plug-in hybrid models) ensued from providing EV charging infrastructure combined with transitions to renewable energy sources.[90] Various levels of government should also develop incentives (subsidies, tax credits) to support the transition to zero-emissions mobility systems and enhance their range, accessibility and convenience for urban residents.[91] As e-mobility is key to decarbonizing the transport sector and cannot be envisaged without improved urban planning or wider investments in shifting transport towards improved public transport and active mobility, UN-Habitat outlines 10 principles for its successful implementation:[92]

i. Integrate electric mobility in the context of improved urban planning and in a balanced "Avoid-Shift-Improve" framework

ii. Prioritize people and public transport over private cars

iii. Plan and design to accommodate a rich mix of electric mobility options integrating active and high-capacity modes of transport

iv. Identify opportunities for multimodal transit hubs through the strategic location of electric mobility charging infrastructure

v. Design an integrated transport policy approach seeking synergies between national and local measures

vi. Build cross-cutting institutional cooperation

vii. Engage with all relevant stakeholders across multiple sectors, strengthen public-private partnerships, and create co-ownership of the transition

viii. Promote equity and inclusion in the deployment of electric mobility

ix. Increase the share of renewable energy sources and move towards a zero-emission future

x. Provide adequate access to information on electric mobility to users.

Box 5.6:The transition of Pakistan's public transit to EVs

In 2019, Pakistan approved its first National Electric Vehicle Policy. In addition to climate change concerns, Pakistan's policy seeks to decrease urban air pollution and oil imports.[93] To support this policy, planning measures include investments charging infrastructure and financial incentives, such as reduced customs and sales taxes. Pakistan's ambitious target is that by 2030, 30 per cent of all new sales of cars and trucks will be EVs, rising to 90 per cent by 2040. For bikes and rickshaws, the policy aims even higher, with a target of 50 per cent new vehicles to be electrified by 2030, reaching 90 per cent in 2040. The policy has already helped incentivize domestic electric vehicle manufacturers to invest in e-buses and the production of electric motorcycles.[94]

Urban energy systems

Given that the energy sector is a major contributor to GHG emissions, it is essential to develop urban planning strategies that facilitate the transition to clean, renewable energy sources and improved energy efficiency. Initiatives like ICLEI's 100% Renewables Cities and Regions Roadmap project, among others, support cities and regions in developing strategies and action plans toward renewable energy transition.[95] These plans should prioritize renewable urban energy infrastructure, such as solar photovoltaic (PV) panels on rooftops, wind turbines in urban areas, community solar projects, hydroelectric systems and geothermal power.[96] They should also include district heating and cooling networks that integrate renewable (e.g., geothermal) and waste heat sources for efficient energy distribution and utilization, particularly in densely populated urban areas. In addition to mitigation, renewable and district energy systems reduce the reliance on centralized power plants, thus strengthening adaptive capacity by avoiding an all-out system failure in the case of extreme weather events.[97]

It is essential to develop urban planning strategies that facilitate the transition to clean, renewable energy sources and improved energy efficiency

Urban planning should also facilitate the integration of intermittent renewable energy sources into urban grids through innovations in energy storage technologies, such as pumped hydro storage, flywheel systems and battery storage systems. These systems store excess energy generated during periods of low demand and supply it during peak demand hours, so enhancing grid stability and reducing the reliance on fossil fuel backup power.[98] Concurrently, urban planning should integrate smart grid technologies (e.g., advanced metering infrastructure, demand response systems and grid automation) to optimize energy distribution, reduce transmission losses and enhance grid efficiency. Smart meters enable real-time monitoring of energy consumption patterns, thus empowering community members to adjust their behaviour and optimize their energy use, while automated grid controls and sensors improve grid reliability and responsiveness to fluctuations in supply and demand.[99] Overall, the following timeless key attributes of sustainable energy action planning, outlined by UN-Habitat, UNEP and ICLEI in 2009 remain relevant today: a "whole system" approach designed first and foremost around carbon mitigation and energy needs, flexible enough to adapt to changing conditions and cognizant of the different social and economic costs involved.[100]

Mapping, spatial data and knowledge sharing

Robust monitoring, reporting and verification mechanisms that track progress, measure impacts and ensure accountability are key to achieving equitable and just climate action.[101] Cities should harness data from sources such as energy consumption, transportation patterns and waste generation to develop targeted interventions and policies to reduce GHG emissions and transition to low-carbon energy systems. Likewise, cities must invest in climate data to enable evidence-based, proactive risk management and climate adaptation. For instance, geographic information systems (GIS) integrate layers of demographic, land use, transportation networks and environmental hazards data. Similarly, remote sensing technologies, such as satellite imagery, aerial drones and Light Detection and Ranging (LiDAR) provide valuable insights into urban land cover, vegetation, water resources and environmental changes over time.[102]

Cities must invest in climate data to enable evidence-based, proactive risk management and climate adaptation

As illustrated in Chapter 3, these tools facilitate mapping vulnerability indicators (e.g., socioeconomic factors, infrastructure vulnerabilities and environmental hazards) to identify areas and populations that are most at risk from climate change impacts, such as flooding, heatwaves and sea-level rise. This in turn can inform decision-making around urban planning, infrastructure design and emergency response to protect vulnerable urban communities. For example, cities in the Netherlands (e.g., Delta Programme) and Japan (e.g., Tsurumi River Multipurpose Retarding Basin) use advanced modeling techniques and risk assessment methodologies to identify vulnerable areas, manage flood risks and prioritize investments in infrastructure and land use planning for coastal protection. Their data-driven, forward-looking approaches demonstrate exemplary disaster risk reduction and resilience-building efforts.[103]

Cities should also capitalize on innovations in data collection, namely artificial intelligence (AI). For instance, AI can help improve efficiency in water resource planning and management, particularly in contexts of water scarcity, through more accurate data that combines annual use, locational constraints and vulnerability assessments.[104] Equally important, cities much empower citizens to participate in data collection themselves, for instance through crowd-sourced mapping and on-line engagement platforms that leverage technology to foster transparency, accountability and community resilience.[105]

5.3.2 Urban design solutions for climate resilience

As the global community grapples with the urgent need to address climate change, urban design should serve as a catalyst for emission reductions and enhanced adaptive capacity. Through sustainable urban form regulations, low-carbon building materials, energy-efficient design and inclusive public spaces, urban design can support adaptation and mitigation efforts. Several misconceptions, however, have provoked public resistance to climate-responsive urban design.

Table 5.3: An overview of urban design solutions for climate resilience

Urban design solutions for climate resilience	
The tools	**How the tools work**
Urban and built form regulations ▪ Compact, intensified, mixed-use, and transit-oriented development patterns ▪ Balance compactness and open spaces ▪ Harmony with nature ▪ Building codes (e.g., minimum elevations, stormwater management, structural codes)	▪ Contribute to mitigation and adaptation ▪ Facilitate prompt response during/after climate hazards ▪ Foster healthy and safe communities
The building sector ▪ Retrofit grants for low-income communities ▪ Contextualized passive design principles and survivability features ▪ High performance building envelopes, efficient HVAC systems, and energy management systems ▪ Bioclimatic architecture principles ▪ NbS measures ▪ Circularity and sustainable, eco-friendly materials ▪ Embodied carbon building codes (local building materials) ▪ Repurpose existing buildings	▪ Incentivize energy efficiency retrofits (e.g., insulation, lighting, heating, ventilation) ▪ Incorporate Indigenous and traditional knowledge ▪ Ensure habitable conditions during extreme events ▪ Minimize energy consumption, lower operational costs, and reduce emissions ▪ Avoid emissions through circularity, shift to sustainable materials, and improve extractive materials' production ▪ Decrease emissions and costs ▪ Foster local economic development ▪ Extend buildings' lifespan ▪ Reduce the need for new construction ▪ Minimizes resource consumption ▪ Support local economy development ▪ Preserve cultural heritage
The design of public urban spaces ▪ Prioritize public transit and active mobility ▪ Adopt universal accessibility principles ▪ Preserve natural habitats and protect biodiversity ▪ Mandate urban reforestation and NbS	▪ Improve urban livability and reduce environmental impacts ▪ Facilitate equitable access to public spaces, transit, active mobility, employment and social infrastructure ▪ Reduce automobile reliance and lower emissions NbS: ▪ Protect coastal communities and infrastructure from coastal erosion, sea-level rise, and storm surges ▪ Sequester carbon and improve air quality ▪ Manage stormwater runoff and alleviate inland and coastal flooding risks ▪ Increase biodiversity ▪ Enhance aesthetic appeal ▪ Provide educational opportunities ▪ Harvest rainwater and increase water and food security ▪ Provide shade, enhance thermal comfort and mitigate the UHI effect ▪ Enhance water infiltration and recharge groundwater
Water and sanitation infrastructure ▪ Design WRM ▪ Retrofit water and sanitation infrastructure ▪ Conduct climate risk assessments ▪ Mandate engineering standards and adaptive design features ▪ Implement community-based adaptive management strategies	▪ Enhance water and sanitation systems resilience ▪ Ensure continuity of service during extreme events ▪ Balance competing water demands and environmental needs ▪ Address climate change impacts on water availability, quality, and resilience sanitation
Nurture climate responsive forms of living ▪ Designated bike storage spaces ▪ Recycling and composting facilities ▪ Complete communities, the 15-minute city, and intensification policies	▪ Encourage cycling over car use ▪ Encourage circularity ▪ Balance water and environmental demands ▪ Avoid sprawl and car-dependency ▪ Foster social equity and environmental justice ▪ Create inclusive, accessible, resilient and self-sustaining communities

Urban form regulations

Urban form regulations and densification policies should be designed to contribute to net-zero targets through compact, mixed-use and well-connected development patterns that reduce automobile dependency, increase public transit and promote active mobility options, fostering healthier, more livable communities and reduced air pollution. Given the decline of urban green areas (see Box 5.8), urban form regulations should balance intensification with blue-green infrastructure, as these spaces contribute to both mitigation (through carbon sequestration) and adaptation (for example, by absorbing excess stormwater runoff, replenishing underground aquifers and alleviating the urban heat island (UHI) effect). The balance of compact and connected urban form with open spaces also facilitates prompt response and action during (e.g., evacuation) and after (e.g., reconstruction) both rapid and slow onset climate hazards.[106]

Additionally, urban and built form regulations should set minimum elevation requirements for structures in flood-prone areas and mandate stormwater management systems to ensure flood resilience. Building codes should also ensure structural integrity against extreme weather events like hurricanes. Adhering to urban form regulations protects lives, livelihoods, property and infrastructure from the impacts of climate change.[107]

The building sector

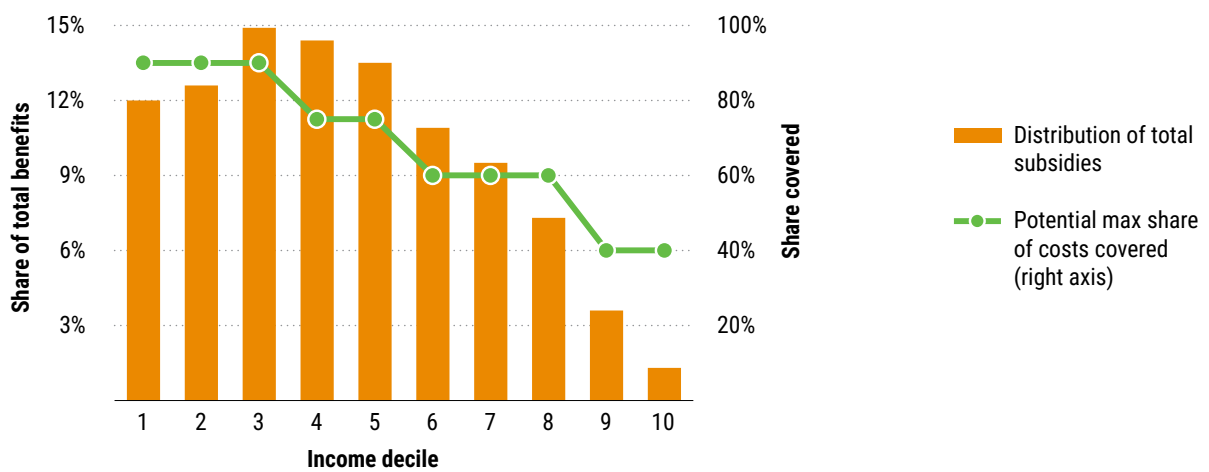
The building sector is responsible for 37 per cent of GHG, rendering it among the largest source of emissions.[108] These comprise both *operational* (those generated by the everyday heating, cooling and powering of the buildings) and *embodied* (those produced by the construction, renovation and eventual demolition of the building, including the sourcing of building materials) emissions. At present, the majority of emissions generated are still operational, a situation reflected in the fact that decarbonization efforts have tended to prioritize reductions in this area through energy-efficient building design. Firstly,

People-centred and inclusive approaches are key to ensure vulnerable low-income households are not left behind through targeted support in form of grants and subsidies

energy efficiency retrofits —including insulation upgrades, light emitting diode (LED) installations, and heating, ventilation, and air conditioning (HVAC) system optimizations—enhance buildings' energy efficiency, comfort, and lower utility bills and operating costs.[109] Unfortunately, not all households can afford these retrofits as they require significant upfront costs. People-centred and inclusive approaches are therefore key to ensure vulnerable low-income households are not left behind through targeted support in form of grants and subsidies. As examples, *Better Energy Warmer Homes Scheme* and *Warmth and Well-being Scheme* in Ireland and in France's *MaPrimeRénov'* (whose distribution of allocation is illustrated in Figure 5.4) ensure fairer distribution of retrofit grants.[110]

Secondly, *high performance building envelopes* (i.e., that integrate solutions for temperature control, airflow regulation, moisture control), efficient HVAC systems and energy management systems (e.g., building automation systems, smart thermostats, automated controls, sensors, and energy-efficient appliances) minimize energy consumption, lower operational costs and reduce emissions. Likewise, building codes should require well-insulated walls, roofs and windows that minimize heat transfer, to improve thermal comfort and reduce the reliance on mechanical heating and cooling systems powered by fossil fuels.[111] Particularly for cities in the tropics, UN-Habitat offers detailed guidance on minimizing buildings' energy demand in the *Energy and Resource Efficient Urban Neighbourhood Design Principles for Tropical Countries: Practitioner's Guidebook*.[112] Overall, in addition to emission reductions, these measures also result in significant cost savings for building occupants over time.

Figure 5.4: Distribution of allocations of MaPrimeRénov' grant and maximum share of retrofit costs covered by household income, 2020-2022, France



Source: International Energy Agency, 2024, p.122

Thirdly, *passive design principles* that are foundational to Indigenous and traditional building practices, such as optimized building orientation, maximized natural daylighting and shading devices, reduce the need for artificial lighting, heating, and cooling, thus lowering energy demand and emissions associated with electricity generation while addressing the unaffordability of more expensive systems.[113] Accordingly, cities should develop contextualized passive design standards, energy-efficient features and renewable energy systems. For instance, green building certifications, such as Leadership in Energy and Environmental Design (LEED) or Building Research Establishment Environmental Assessment Method (BREEAM) are becoming increasingly prevalent in cities in both developed and developing countries, showcasing a shift towards low-carbon building practices and sustainable urban development construction.[114] They also provide frameworks for assessing and recognizing sustainable building practices, thus incentivizing developers to adhere to higher environmental standards. Passive survivability features like robust building envelopes, redundant systems and natural ventilation strategies ensure that buildings maintain habitable conditions during power outages or extreme heat events, so reducing the risk to occupants' health and safety.[115]

Fourthly, building design should integrate *NbS measures* such as blue and green roofs, green walls, permeable pavements and rain gardens. For example, tropical cities like Singapore have implemented green roof strategies to sequester carbon, cool buildings and alleviate the UHI effect, decreasing energy consumption by up to 63 per cent.[116] NbS also provide multiple co-benefits, such as enhanced aesthetic appeal, increased biodiversity, educational opportunities and improved air quality.

Lastly, building design should incorporate measures for indirect emissions reductions through behavioural change toward sustainability, including designated bike storage spaces that encourage cycling over car use[117] and recycling and composting facilities that encourage circularity.[118]

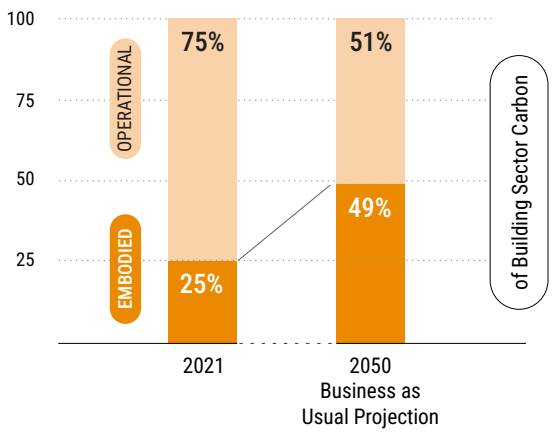
However, the past few decades have witnessed a steady rise in the share of global emissions associated with the production of various materials such as metal, cement, plastic and wood. While in 1995 this accounted for 5 gigatonnes of emissions, amounting to 15 per cent of the total of 35 gigatonnes worldwide, by 2015 this had more than doubled to 11.5 gigatonnes—almost a quarter (23 per cent) of all global emissions—with the construction sector responsible for around 40 per cent.[119] Despite this, climate adaptation and mitigation efforts have generally prioritized enhancing the energy efficiency of building through these measures, in part because significantly more emissions are generated through the operation of buildings at present than their construction. However, this is likely to change in the near future. While embodied emissions are estimated to comprise just a quarter (25 per cent) of emissions associated with buildings as of 2021, by 2050 the proportion is projected to rise to almost half (49 per cent) (Figure 5.5).[120] Consequently, the area of embodied emissions is likely to become a greater priority in the near future. Accordingly, the building sector can effectively contribute to emission reductions through decarbonatization of materials and the adaptive reuse of buildings.[121]

While embodied emissions are estimated to comprise just a quarter (25 per cent) of emissions associated with buildings as of 2021, by 2050 the proportion is projected to rise to almost half (49 per cent)

In this regard, the selection of *appropriate building materials* can significantly reduce embedded carbon and contribute to adaptation and sustainability. To achieve this, UNEP identifies a triad of actions: "*avoiding* emissions through circularity, *shifting* to sustainable materials, and *improving* the production of extractive materials".[122] Accordingly, cities should develop building codes that encourage circularity (for example, through designing for deconstruction and reuse) to allow materials to be salvaged and repurposed at the end of a building's life cycle. Further, cities should mandate embodied carbon building regulations that encourage the use of local building materials sourced from nearby or regional suppliers to minimize embodied carbon emissions. Doing so helps foster local economic development and reduces dependency on imported materials, thereby enhancing community resilience to economic shocks and disruptions.[123] Also, as illustrated in the case of Sana'a (Yemen) in Box 5.7, local building materials leverage traditional and Indigenous knowledge in adapting to local environmental conditions, so enhancing resilience to climate change impacts.

Green facade in Singapore © Shutterstock

Figure 5.5: Projected contributions from embodied and operational carbon within the building sector



Embodied emissions *are all the emissions associated with the construction (and deconstruction) of a building.*
Operational emissions *are the emissions generated through the function and maintenance of the building.*

Source: UNEP, 2023b.

Finally, the *adaptive re-use of buildings* involves repurposing existing buildings to extend their lifespan, reducing the need for new construction and the additional resource consumption this would bring. Additionally, it contributes to the local economy through job creation, sense of place and aesthetic appeal (for residents, businesses and cultural tourism), giving rise to artisanal activities while also contributing to cultural heritage preservation.[124] It also enhances collaboration and community engagement.[125]

Box 5.7: Traditional building materials in Sana'a, Yemen

Sana'a's unique mud high-rise buildings are inscribed on UNESCO's World Heritage List. The combination of mud bricks (for the walls) and locally procured wood (for the ceilings) minimize construction emissions and costs while offering remarkable resilience to extreme weather events. Moreover, the building materials, orientation and the location, size and placement of the stained glass (*qamariya*) and wood covered windows (*mashrabiyyah*) provide natural light and passive cooling in the summer and heating in the winter. Urban agriculture takes place in the backyards and contributes to food security, while the wells offer a much-needed water supply.[126] Old Sana'a's vernacular urban form has proven to be more sustainable than its contemporary neighbourhoods particularly when considering urban form metrics around compactness and density; walkability and connectivity; and thermal comfort.[127]

The design of public urban spaces

Public spaces should encourage walkability and cycling and incorporate blue-green open spaces to contribute to mitigation, adaptation, improved urban livability and reduced environmental impacts.[128] The design of public urban spaces should also align with sustainable land use planning to preserve natural habitats and integrate NbS, whether through green infrastructure (e.g., green roofs and walls, trees, community gardens, and permeable pavements) and/or blue infrastructure (e.g., rain gardens, bioswales, bioretention systems, and naturalized stormwater management systems). NbS contribute to mitigation, adaptation and overall urban sustainability through a range of functions. Besides sequestering carbon, they provide shade, enhance thermal comfort and mitigate the UHI effect, hence minimizing heat-related risks[129]—as green spaces within cities are on an average 0.94°C cooler than built up areas without greenery.[130] They also manage stormwater runoff, alleviate inland and coastal flooding risks, enhance water infiltration and recharge groundwater, thereby contributing to integrated water resource management.[131]

The design of public urban spaces should align with sustainable land use planning to preserve natural habitats

In addition to improved air and water quality, NbS's co-benefits include increased food security, enhanced aesthetic appeal, increased biodiversity, ecological resilience and recreational opportunities. Therefore, ecosystem-based adaptation (EbA) and NbS present a unique opportunity to integrate and mainstream climate adaptation and mitigation within urban design to support the development of more liveable urban environments. Singapore's Active, Beautiful, Clean Waters and Landscaping for Urban Spaces and High-Rises initiative is an exemplar in this regard: through an extensive programme of "naturalizing" its riverways, it has successfully reduced its flood-prone area from 3,200 to 32 hectares, generated savings of approximately US$390 million every year and returned much of the city's waterways to community use.[132] Similarly, Laos PDR is currently building climate resilience among local communities in the riverine cities of Vientiane, Paksan, Savannakhet and Pakse through an integrated approach to flood management. The project marks a shift in urban flood management in Laos from grey (hard engineered) infrastructure towards integrated urban EbA.[133]

Ecosystem-based adaptation (EbA) and NbS present a unique opportunity to integrate and mainstream climate adaptation and mitigation within urban design to support the development of more liveable urban environments

Lumphini Park, Bangkok city, Thailand © Shutterstock

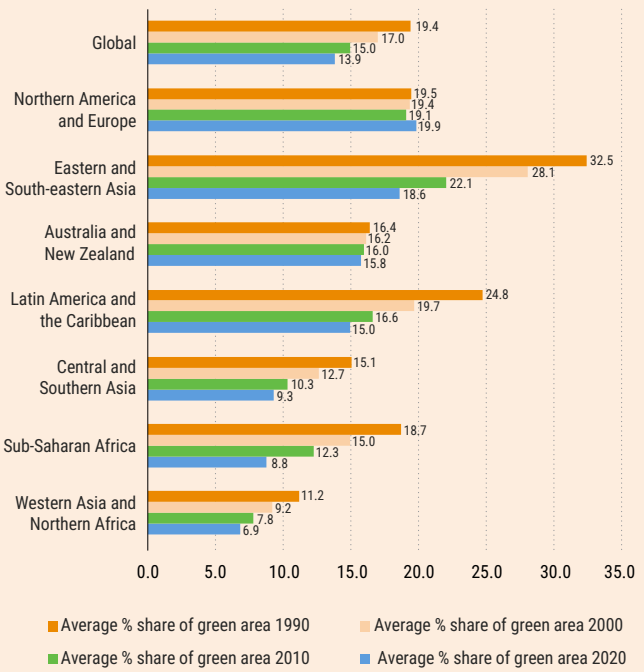
Box 5.8: Reversing the global decline of urban green areas

Green spaces play a number of critical roles in cities, boosting biodiversity, enhancing human well-being and aiding both adaptation and mitigation of climate change.[134] Despite the clear need for urban green spaces, however, new data produced by UN-Habitat across 660 cities from across the world regions shows that, between 1990 and 2020, urban green areas recorded a steady decline. The global average share of green spaces in urban areas – encompassing forests, individual trees, forests, shrubs, perennial grasses and other types of long-term vegetation - decreased from 19.5 per cent in 1990 to 13.9 per cent in 2020. This overall decline was consistent in all regions, except North America and Europe, and was most pronounced in Eastern and South-eastern Asia, Sub-Saharan Africa and Latin America and the Caribbean (Figure 1).

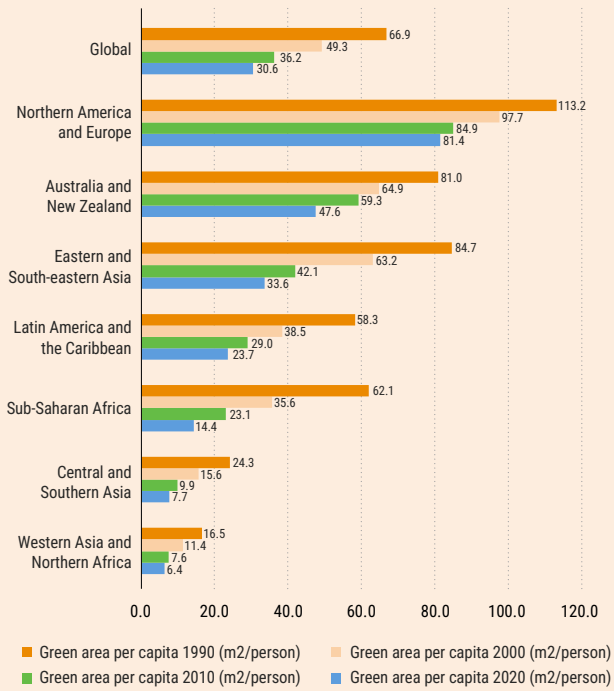
The declining shares of urban green areas, coupled with growing urban populations, have translated into a 54 per cent decline in the global average green area per capita: from 66.9 square metres per person in 1990 to 30.6 square metres per person. The decrease in green area per capita was observed in all world regions, with the highest declines observed in Sub-Saharan Africa, Central and Southern Asia, Western Asia and Northern Africa and Eastern and South-Eastern Asia. In absolute numbers, Northern America and Europe recorded the highest average green area per capita, estimated at 81.4 square metres per person in 2020, more than double the global average (30.6 square metres/person) and 12 times more than the average in Northern Africa and Western Asia (6.4 square metres/person) (Figure 2).

As illustrated in the statistical annex of this report, these variations become even more extreme when comparing specific urban centres in different climatic zones, be they in the same country or across regions.[135] At the same time, despite the overall decline in the share of urban green areas across different regions between 1990 and 2020, many cities have made deliberate efforts to either maintain their greenery or even establish new green areas.

Average percentage share of green area in cities and urban areas 1990—2020

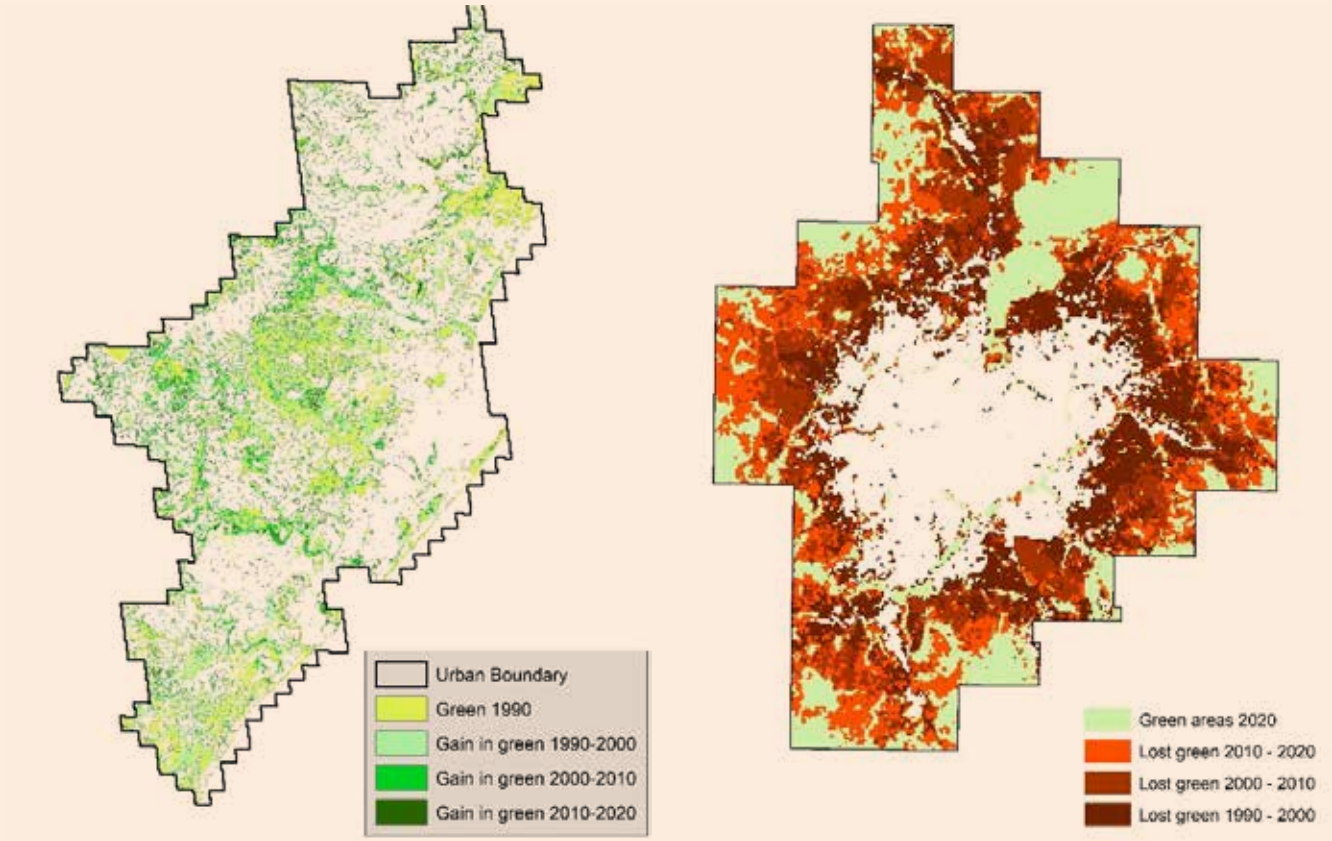


Average green area per capita per region 1990—2020 (m2/person)



Source: UN-Habitat, 2024d.
Note: Methodology and city specific data points available at: https://data.unhabitat.org/pages/open-spaces-and-green-areas

Area increase in Durban, South Africa (left) and decrease in Nzérékoré, Guinea, 1990-2020



Increasing green areas in Durban, South Africa

Decreasing green areas in Nzerekore, Guinea

While the proportion of green areas in Nzérékoré, Guinea, declined—from 70 per cent of the total urban area in 1990 to 16.6 per cent in 2020—Durban, South Africa, saw a rise (from 14.7 per cent to 25.1 per cent) during the same period.[136]

How can cities add green spaces?

It is important for cities to not just be concerned about the quantity of green spaces, but also about their quality and integration with the rest of the urban fabric. Rather than focusing solely on meeting aggregated targets, planners should promote city-wide greening strategies that include qualitative standards and social policies about their use, access and social effects. A human-centered approach takes into account the social function and necessary diversity of public green spaces, from smaller neighbourhood parks close to homes, to larger urban parks connected by public transport, as well as even larger nature reserves on the edge of cities.

Importantly, cities should ensure their green spaces are not fragmented, but part of an interconnected blue-green network: green spaces that are connected with waterbodies typically have greater impact on lowering urban heat island effect.[137] Cities need to apply ecological principles when choosing vegetation type and promote plants that are appropriate for the local climate,[138] which can endure and flourish without excessive support, in particular in drier climates or seasons when water in scarce. Additional irrigation to plants should try to use recycled grey water as much as possible.

Meeting standards on adequate green space in cites is not an easy task, as past and current modes of urban development have led to high rates of built-up and impervious area. However, cities can promote trees and vegetation on private land by mandating green standards, as well as enhance existing public spaces by retrofitting greenery into their design. Furthermore, through the adaptive use of underutilized land or urban infrastructure, including rail corridors, underutilized back alleys and brownfield sites, extensive greening of cities can be achieved.[139] Cities are encouraged to explore low-hanging fruit when it comes to greening, such as reduction of lanes for traffic to allow for tree-lined streets, before resorting to more expensive and maintenance-intensive options.

Water and sanitation infrastructure

Water and sanitation infrastructure are essential for enhanced urban resilience and reduced vulnerability. Cities should design integrated water resource management and retrofit water and sanitation infrastructure to withstand climate change impacts, such as sea-level rise, extreme weather events and prolonged droughts. Cities also need to incorporate climate risk assessments, engineering standards and adaptive design features into infrastructure planning and investment decisions to ensure that water and sanitation systems can continue to provide essential services to urban populations in the face of future climate shocks.[140] A variety of resources are available to support policymakers, planners and service providers in this process, such as UN-Habitat's *Climate Proofing Toolkit for Basic Urban Infrastructure, with a Focus on Water and Sanitation*. The toolkit offers useful technical steps for integrating climate change risks and opportunities into the design of water and sanitation infrastructure, as well as key principles for making such infrastructure more resilient.[141] Knowledge exchange and capacity sharing can also make a vital contribution for cities seeking to make their water and sanitation systems more resilient. For example, through the Global Water Operators' Partnerships Alliance (GWOPA), UN-Habitat is providing expertise on water-related solutions for impactful climate action. Through Water Operators' Partnerships (WOPs), the alliance is strengthening capacities for building climate-resilient infrastructure for water and sanitation in Gabès (Tunisia), among other places.[142]

Cities should design integrated water resource management and retrofit water and sanitation infrastructure to withstand climate change impacts, such as sea-level rise, extreme weather events and prolonged droughts

Citizen involvement, particularly of marginalized communities in informal settlements, is essential at every stage of these processes. The benefits of community engagement are demonstrated by the Lima Ecological Infrastructure Strategy (LEIS), developed in peri-urban areas of Lima, Peru, based on water-sensitive urban design principles. The programme, combining integrated spatial planning with granular micro-level interventions, included the establishment of a water treatment plant and children's water park in a poorly connected, insecure area in the northern periphery of the city. A central feature of the programme was its participatory approach to the design and implementation of its activities, ensuring its outputs aligned with local needs. This in turn helped build the foundation for the facilities to be community-managed after their completion.[143]

Climate responsive forms of living: 'Sustainable proximities'

It is important to recognize that urban design can modify human behaviour, in addition to modifying urban form, to achieve climate responsive, sustainable and equitable outcomes. UN-Habitat thus advocates for the application of urban design principles to achieve a people-centred built environment that is compact, connected, inclusive, vibrant and resilient.[144] Notions like "complete communities"[145] and the "15-minute city" paradigm[146] have recently re-emerged as transformative ideas for the built environments that envision neighbourhoods where residents can access essential services, amenities and job opportunities within a short walk or bike ride from their homes.[147] Thus, they minimize the need for long commutes and reduce the reliance on private automobiles, resulting in cleaner, safer urban environments. They also reduce the dependence on long-distance supply chains and promote local businesses, markets and services. Accordingly, these urban development models, if implemented in line with the principles espoused in key design resources such as UN-Habitat's *MY Neighbourhood*,[148] not only promote social cohesion by creating more inclusive, accessible and vibrant communities but also foster resilient, low-emission communities. Moreover, decentralized energy systems, such as rooftop solar panels and district heating networks, further reduce their reliance on centralized fossil fuel-based energy sources, further lowering their emissions and enhancing their energy security, particularly during extreme weather events.[149]

Urban design can modify human behaviour, in addition to modifying urban form, to achieve climate responsive, sustainable and equitable outcomes

Navigating public contestation and related pitfalls

Navigating contestations that may arise due to multiple reasons is essential. This is because the effective implementation and enforcement urban design regulations require collaboration among policymakers, developers, builders and local communities to achieve meaningful progress in addressing climate change. Some of the key challenges and controversies are discussed below.

While pushing for climate responsive and sustainable urban design solutions, cultural sensitivity is crucial to respect local traditions and cultural identities

The tension between innovation and tradition: While pushing for climate responsive and sustainable urban design solutions, cultural sensitivity is crucial to respect local traditions and cultural identities.[150] Striking a balance between innovation and tradition ensures that urban design solutions resonate with the unique characteristics of each city. For example, adopting traditional and Indigenous passive cooling techniques in low-income housing projects, such as natural ventilation and shading to reduce energy consumption, may not be sufficient for improving indoor comfort during extreme heatwaves and may warrant the support of thermal insulation and/or mechanical support.[151] Most importantly, in line with the design justice principles outlined in Chapter 8 of this report, participatory design approaches should engage local communities in the co-creation of climate-responsive urban spaces and empower them to contribute to design solutions that address their specific needs and vulnerabilities. Tagum City in the Philippines, for instance, promotes social cohesion, environmental stewardship and climate adaptation through community-led design for hazard-prone areas.[152]

Equity concerns: While compact, mixed-use developments can promote walkability, reduce emissions and enhance social interaction, they have been criticized for their focus on physical proximity as the primary

Jakarta, Indonesia © Shutterstock

determinant of accessibility, overlooking the role of social and economic factors in shaping urban mobility patterns. Critics argue that simply reducing travel distances may not address underlying inequalities in accessing opportunities and resources, particularly for marginalized communities who face barriers such as income inequality, discrimination or lack of affordable housing. Therefore, to avoid exacerbating spatial segregation and gentrification, notions like complete communities and the 15-minute city model must be accompanied by social policies that ensure equitable access to public services and affordable housing to protect vulnerable communities from displacement. Moreover, they should be accompanied by adequate infrastructure investments and urban design interventions to avoid overcrowding and pollution, as well as ensure equitable access to blue-green infrastructure.[153]

Resistance to change: Various urban design interventions often require context-specific adaptations and modifications to ensure their relevance and effectiveness. This requires a nuanced understanding of local contexts, collaborative governance approaches and a genuine commitment to inclusive, participatory urban design processes: [154] otherwise, resistance will often emerge. In the case of complete communities and the 15-minute city, opposition may arise for a number of reasons, including concerns over the enormous cost of retrofitting urban environments and skepticism about their applicability in other contexts. There may also be significant social and cultural factors in negative attitudes towards them: for instance, the perceived threat they pose to other lifestyles (in particular, the "freedom" of private car use)[155] and the potential for homogenized solutions that disregard the diverse needs, preferences and living conditions of different urban areas. [156]

Thus, engaging the public from the inception of urban design projects helps address concerns, ensures equitable development and fosters community ownership. In addition to avoiding public contestation, inclusivity also promotes social equity through urban design and development, recognizing that resilient cities are those that cater to the needs of all residents by addressing issues of accessibility to all, affordability and equity. Thus, urban development can actively promote social justice through the adoption of disability-inclusive, gender-sensitive and child-friendly design.[157]

5.3.3 Urban management for resilience and resource efficiency

Effective urban management is essential for translating climate-sensitive urban planning and design into tangible actions on the ground. However, evidence from across the globe reveals that all too often, urban management systems remain "rigid and technocratic".[158] In this context, it is essential for cities to adopt more inclusive approaches to planning and decision-making, such as participatory budgeting and citizen science projects, that foster a sense of ownership and collective responsibility for addressing climate change impacts at the local level. Boston's Youth Lead the Change and the European Commission's Urban Water Atlas for Europe are examples of such initiatives.[159]

Effective urban management is essential for translating climate-sensitive urban planning and design into tangible actions on the ground

Table 5.4: An overview of urban management measures to enhance resilience and resource efficiency

Urban management	
The tools	**How the tools work**
Integrated waste management ▪ Phase out conventional waste disposal methods ▪ Adopt sustainable ISWM strategies (reduce, reuse, recycle) ▪ Engage communities	▪ Increase resource recovery and energy production ▪ Enhance urban hygiene ▪ Reduce emissions and environmental problems ▪ Save natural resources ▪ Support urban and peri-urban agriculture
Water and sanitation ▪ Develop IWRM programs (sustainable stormwater management like BGI, EbA, NbS, permeable pavements, and rainwater harvesting) ▪ Wastewater reuse and recycling systems (greywater reuse and treated wastewater) ▪ Water conservation and efficiency measures (low-flow fixtures, water-saving appliances, and drought-tolerant landscaping) ▪ Public awareness campaigns and incentives	▪ Promote circular urban water management ▪ Reduce urban runoff and alleviate flooding ▪ Replenish and improve underground water quality ▪ Conserve freshwater resources ▪ Reduce energy consumption for water treatment ▪ Reduce water demand and enhance urban water security ▪ Encourage responsible water use behaviour and foster a culture of water stewardship
Circular economy initiatives ▪ Circular economy policies (closed-loop economy: product reuse, repair, remanufacturing) ▪ Incentivize circular economy practices ▪ Extended producer responsibility (EPR) policies and product stewardship programs	▪ Minimize waste generation ▪ Conserve resources ▪ Reduce GHG emissions ▪ Incentivize eco-design and product innovation

The ongoing maintenance of critical urban infrastructure is vital for climate resilience. While cities in developed countries benefit from well-established institutions and access to financial resources and technical expertise, they face significant urban management challenges in relation to the retrofitting of existing infrastructure to meet evolving climate threats. For instance, legacy critical urban infrastructure—whether in small or large cities like Charlottetown (Canada) and New York (the US)—requires significant investments to withstand rising sea levels and extreme weather events.[160] In contrast, although many cities in developing countries grapple with institutional fragmentation and governance challenges that undermine their urban management efforts, a significant portion of their infrastructure has yet to be built. Consequently, cities in developing countries have a unique opportunity to integrate sustainable and resilient practices into their infrastructure development from the outset.

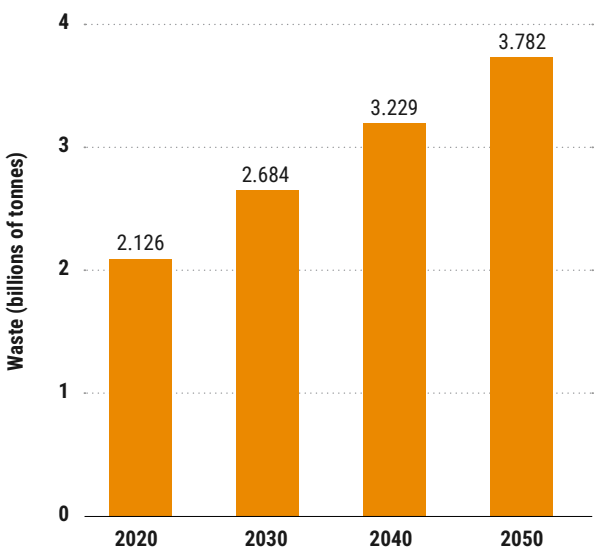
Integrated solid waste management (ISWM)

Effective management of municipal solid waste is integral to sustainable urban planning and design. Already, if urgent action is not taken, global municipal solid waste generation is predicted to grow from around 2.1 billion tonnes annually (as of 2020) to almost 3.8 billion tonnes by 2050 (Figure 5.6).[161] This portends negative outcomes for the climate, ecosystem and human health, particularly in developing regions where there uncontrolled waste disposal practises such as open burning and dumping are commonplace (Figure 5.7).[162] Cities should thus phase out such conventional waste disposal methods that pollute air and soil, contaminate groundwater and contribute to GHG emissions.[163]

If urgent action is not taken, global municipal solid waste generation is predicted to grow from around 2.1 billion tonnes annually (as of 2020) to almost 3.8 billion tonnes by 2050

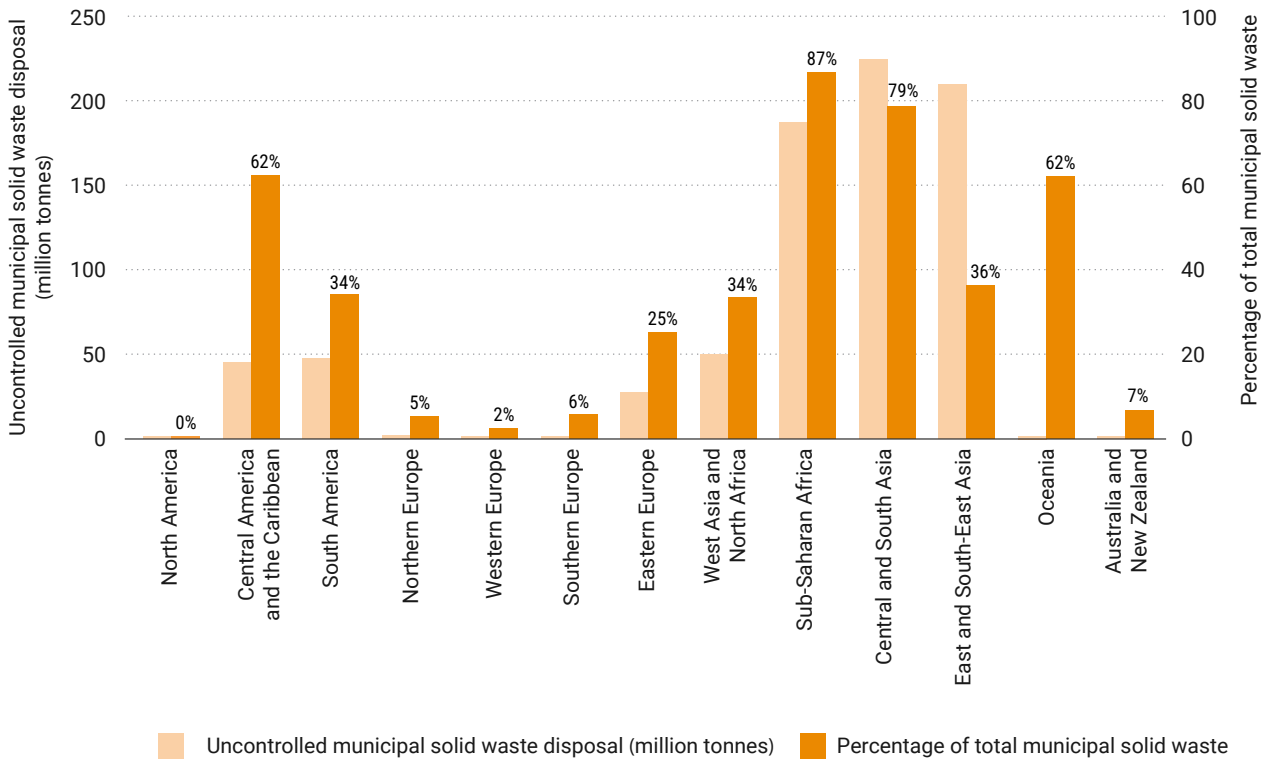
UN-Habitat's Waste Wise Cities initiative, supporting 55 cities to date across the world, offers a variety of lessons on to tackle urban waste

Figure 5.6: Estimated global municipal solid waste generation, 2020–2050



Source: UNEP, 2024, p.18

Figure 5.7: Uncontrolled disposal of municipal solid waste (MSW) by region, in million tonnes and percentage of total MSW (2020)



Source: UNEP, 2024, p.28

management problems.[164] Among other activities, in 2021 UN-Habitat launched the Waste Wise Cities Tool, a methodology based on SDG indicator 11.6.1, to assess a city's municipal solid waste management performance.[165] The approach is underlined by the so-called "5Rs": rethink, reduce, reuse, recycle and refuse of single-use items.[166] For instance, composting and recycling divert organic waste and recyclable materials from landfills, thereby reducing emissions and conserving natural resources. In Yangon (Myanmar), UN-Habitat improved solid waste management by supporting the implementation of the innovative "Fukuoka Method", leading to faster decomposition of waste and lower methane gas emissions in Htein Bin open landfill.[167] The same low-cost method has been applied in Addis Ababa and Bahir Dar (Ethiopia) and Kiambu County (Kenya).[168]

ISWM should entail such waste audits as well as environmental and economic assessments of the impacts of waste management options. These are critical in guiding cities to design and implement effective waste reduction and resource recovery programs that contribute to climate change mitigation and sustainable development. Throughout, it is essential for ISWM strategies to optimize the management of solid waste through community engagement, including waste generators from all sectors, service providers, regulators, multi-level governments and local communities.[169]

Water and sanitation management

Effective water and sanitation management is critical for addressing climate change impacts on urban water resources and infrastructure. Therefore, cities should develop integrated water resource management (IWRM) programs that connect water supply, wastewater treatment, stormwater management and ecosystem conservation for a circular and sustainable approach to urban water management. For instance, cities must adopt sustainable stormwater management practices (such as NbS, permeable pavements, and rainwater harvesting systems) that reduce urban runoff and alleviate flooding while also replenishing and improving the underground water quality in cities.[170]

Cities should also develop wastewater reuse and recycling systems, such as greywater reuse for non-potable, irrigation and industrial uses. These systems conserve freshwater resources, reduce energy consumption for water treatment and enhance urban water security. Advanced wastewater treatment technologies and decentralized reuse infrastructure also maximize resource recovery, minimize environmental impacts and promote sustainable water management practices.[171] Importantly, water conservation and efficiency measures should also be implemented at the building scale, such as low-flow fixtures, water-saving appliances and drought-tolerant landscaping, to collectively reduce water demand and energy consumption for water treatment and distribution. These

measures should be paralleled by water conservation policies, public awareness campaigns and incentive programs to encourage responsible water use behaviour and foster a culture of water stewardship among residents and businesses. As illustrated by efforts in Cape Town and São Paulo (Box 5.9), these measures are integral in the quest to transition into a water-sensitive city.

Box 5.9: Coping with water scarcity: São Paulo, Brazil and Cape Town, South Africa

Across the world, the threat of water scarcity in cities is rising against the backdrop of climate change, with some projections suggesting that more than 1 billion urban residents could soon be facing inadequate supplies.[172] Some cities, however, when confronted with severe water scarcity, have been able to convert their rapid-onset hazards into opportunities by transforming their water management systems through more efficient water use, recycling and the protection of water sources. To achieve this often requires not only the adoption of new technologies and the restructuring of existing management systems, but also behaviour change, governance reform and partnership building.

In São Paulo (Brazil), the combined effects of drought and inadequate management of the city's water distribution culminated in 2015 in chronic water shortages. With reservoir supplies close to depletion, the crisis provoked protests and ultimately brought to light a number of underlying challenges that needed to be addressed, including significant water loss from leakages, protracted under-investment by the authorities and the urgent need to diversify existing water sources. Ultimately, the crisis prompted the city to adopt more integrated water management strategies and promote water-saving technologies to ensure more sustainable supplies in future.

Similarly, between 2017 and 2018, Cape Town (South Africa) was also experiencing severe drought, with only a fraction of its normal water reserves to draw on. This led it to implement a combination of context-specific approaches to transition into a water-sensitive city. This included demand-side management measures that involved the local communities in climate action (for example, through public awareness and trust building campaigns to cultivate prudent water usage and water usage restrictions) and supply-side interventions to address future risks (including infrastructure upgrades, stormwater management and aquifer recharge).[173]

Circular economy initiatives

Circular economy initiatives, such as product reuse, repair, remanufacturing and sharing platforms, minimize waste generation, conserve resources and reduce the GHG emissions associated with virgin material extraction and production processes.[174] Cities should develop circular economy policies that foster a closed-loop economy to maximize resource efficiency and minimize environmental impact. Cities should also develop policy measures, regulatory frameworks and economic incentives to create a conducive environment for businesses, industries and consumers to engage in sustainable consumption behaviours. For instance, extended producer responsibility (EPR) policies and product stewardship programs hold manufacturers accountable for the entire lifecycle of their products, from production to end-of-life disposal, so incentivizing eco-design, product innovation and waste reduction. Cities that adopt EPR policies and programs shift the responsibility and cost burden of waste management back to producers, thus encouraging more sustainable consumption patterns upstream to reduce the environmental footprint of consumer goods.[175]

Cities should develop circular economy policies that foster a closed-loop economy to maximize resource efficiency and minimize environmental impact

5.3.4 Multi-level governance and collaboration: Leaving no one Behind

Governance structures are essential for coordinating, implementing and managing climate action and creating a feedback loop across multiple levels, sectors and partners. Accordingly, and as discussed in Chapter 7, multi-level governance frameworks should engage national, regional and local authorities to align policies, resources and priorities toward addressing climate change at different scales. Simultaneously, urban governance mechanisms should ensure the effective collaboration, coordination and accountability in climate planning and implementation among local government agencies, private sector actors, academia, civil society organizations and community groups. Many cities, for instance, establish dedicated climate agencies or task forces to coordinate efforts across various departments and partners: this can help streamline decision-making processes and ensure a coherent approach to urban planning and design. Moreover, effective urban governance requires institutional capacity-building, knowledge-sharing and technical assistance. Among other opportunities, local governments can strengthen their capacity by partaking in city networks like C40 Cities and ICLEI (Local Governments for Sustainability).[176]

Importantly, cities should adopt inclusive and intersectional governance processes, such as community consultations, citizen engagement platforms and participatory budgeting, to ensure that climate policies and projects that directly affect residents are community-led.[177] Inclusive policies and programs should prioritize marginalized groups, including low-income communities, ethnic and racial minorities, LGBTQ+ individuals and people living with disabilities. Indeed, "access-ability" and disability-inclusive urban planning can only be achieved through

"Access-ability" and disability-inclusive urban planning can only be achieved through engagement with people living with disabilities to understand their worldview and accessibility needs, particularly in relation to emergency response and resilience building

engagement with people living with disabilities to understand their worldview and accessibility needs, particularly in relation to emergency response and resilience building.[178] In the same vein, gender-responsive approaches to climate planning and design recognize and address the differentiated impacts of climate change on women, men and gender-diverse individuals.

Likewise, youth have a vested interest in shaping climate policies and initiatives, making it all the more important that they are engaged and championed as agents of change.[179] Youth-led initiatives such as Fridays for Future and Youth Climate Summits mobilize young activists to advocate for climate action, raising awareness in their communities and holding governments to account. Accordingly, intersectional methods should acknowledge the diverse social identities within urban populations and work towards equitable and inclusive climate action, fostering transparency, accountability and legitimacy while building social capital and trust among diverse parties.

At the same time, inclusive planning and design for climate change demands incorporating multiple forms of knowledge, including traditional and Indigenous perspectives. Indigenous communities possess valuable insights into local ecosystems and climate patterns, making their inclusion crucial for effective climate responsive planning.[180] Indeed, as discussed earlier in this chapter, urban planning and design rooted in traditional and Indigenous knowledge have historically responded well to local climatic conditions. Many communities developed sustainable and climate-resilient urban forms that align with their context and cultural practices. Known as vernacular architecture, these traditional settlements are well-suited to their local climates by virtue of their usage of local materials, orientation, and passive cooling and heating.[181] For instance, traditional architecture in hot and humid climates developed a range of innovative solutions to alleviate local conditions, including building orientation, solar loading, cross ventilation and water retention, strategies among others.[182]

Rapid urbanization, land use changes and external pressures, however, pose threats to traditional and Indigenous planning knowledge systems. Therefore, these practices should be urgently integrated within contemporary climate mitigation, adaptation and sustainability urban planning and design strategies.[183] However, while traditional approaches to the built environment can provide natural and locally appropriate solutions to climate change impacts, it is sometimes the case that they can be complemented or enhanced with the use of modern techniques or materials. For instance, while vernacular housing in Vietnam adopts various climate-responsive strategies that render it adaptable to the local conditions, it nevertheless requires contemporary insulation and ventilation to enhance its indoor thermal comfort during extreme heat.[184]

5.4 Planning for Climate Resilience: Current Challenges and Future Opportunities

Although cities across the world are increasingly developing climate-resilient urban plans to mitigate and adapt to the climate crisis, many face numerous obstacles that hinder their effective implementation. The discussion below delves into the current challenges and opportunities they present for the future.

5.4.1 Institutional barriers

Institutional barriers undermine the ability of cities to implement timely climate actions, leading to a disjointed and fragmented approach to climate action that hinders the adoption of integrated, cross-cutting climate strategies.[185] The complex challenges posed by climate change require seamless coordination across various city departments and collaboration across different sectors and levels of government. Yet, bureaucratic silos and processes often delay the formulation and implementation of climate policies and impede prompt, effective climate action. Meanwhile, rigid planning approaches struggle to keep pace with the rapidly changing climate scenario, leading to loss and damages that could have been mitigated with more proactive measures. This is exacerbated by risk-averse decision-making—often attributable to fear of legal repercussions, political fallout and/or financial mismanagement—that favours conservative, less impactful solutions, thus hindering the ability of cities to address the dynamic challenges presented by climate change.[186]

It is imperative for cities to adopt more agile, well-coordinated, flexible and responsive urban planning frameworks and mechanisms that facilitate swift adjustments to emerging climate risks

Therefore, it is imperative for cities to adopt more agile, well-coordinated, flexible and responsive urban planning frameworks and mechanisms that facilitate swift adjustments to emerging climate risks and embed climate considerations into every stage of urban planning and development.[187] This involves incorporating climate risk assessments into planning processes, establishing climate-responsive and decentralized urban governance structures, and investing in innovative climate-resilient urban infrastructure. Equally important is the establishment of cross-sectoral collaborations,[188] such as interdisciplinary task forces, that contribute to capacity building and knowledge transfer, foster an understanding of the interconnected nature of climate change impacts, and facilitate the development and implementation of integrated climate adaptation and mitigation measures.[189]

5.4.2 Data availability and management challenges

Data gaps are among the most common challenges facing many cities across the globe and hinder effective planning and management responses to climate change. Robust data systems are essential to inform evidence-based decision-making in urban areas. Lack of data and

inconsistent data formats, for instance, can be major hurdles in taking climate action, meaning there is a lack of reliable information to guide interventions.[190] Therefore, municipal and local governments need to enhance their capacity in data gathering and analysis, with indicators and assessment methods to facilitate the development of climate responsive policies and action.

Access to information and data can be increased through experimentation and knowledge exchange. Local testing, such as through pilots or demonstration sites, plays a crucial role in illustrating the potential impact of innovative solutions. Moreover, facilitating knowledge sharing among cities is important, as urban leaders are more likely to embrace new solutions when they witness successful implementations elsewhere. International cooperation through initiatives like C40 Cities supports the building of urban planning and management capacities globally, helping to bridge disparities between cities and countries through knowledge exchange, partnerships and technical assistance.[191]

Furthermore, innovation and technological advancements that facilitate access to accurate and up-to-date monitoring, evaluation and learning empower planners to make data-driven and timely decision-making. These tools include GIS and LiDAR mapping, smart city technologies, data analytics, remote sensing tools and climate modeling. The use of these tools should aim for equitable and just outcomes, whether through the inclusion of social vulnerability indicators[192] or through direct engagement of local stakeholders in the collection, interpretation and application of the data. In Vancouver, Canada, for instance, authorities have actively sought to disseminate the data collected through their Greenest City programme to other organizations to use in their own work.[193]

5.4.3 Financial hurdles

One of the foremost challenges hindering the implementation of urban climate-resilient plans is limited and/or inadequate financial resources. As noted in Chapter 9, a significant financing gap exists. In many parts of the world, municipal finance primarily relies on intergovernmental transfers and on property taxes.[194] The cumbersome nature of bureaucratic budget approval processes leads to delayed budget allocations on climate action projects.[195] Moreover, local governments often face budget constraints and competing financial priorities that divert resources away from financing climate adaptation to address impending risks. Also, many cities are confronted by insufficient or inadequate quantitative mechanisms to assess the costs and funding schemes for implementing adaptation and mitigation interventions.[196] Many local governments struggle to secure sufficient financing to fund just and equitable climate-resilient interventions such as public transit and flood-adaptive NbS. These financial hurdles exacerbate existing inequalities as vulnerable communities often bear the brunt of climate impacts.

As discussed further in Chapter 9, innovative financing mechanisms decentralize and transfer financial resources from the national level to subnational levels and create opportunities for public-private partnerships. Furthermore, international cooperation and innovative global funding mechanisms enable cities in low- and middle-income countries to overcome financial bottlenecks through access to climate finance, capacity building and technology transfer. These innovative financing mechanisms, like the Loss and Damage Fund, offer promising avenues for mobilizing resources and accelerating climate adaptation efforts.[197]

5.4.4 Inadequate capacity

Inadequate capacity within local governments and institutions poses a critical barrier for the effective implementation of climate-resilient plans. Insufficient knowledge, skills and expertise within local planning agencies hinder the formulation and execution of robust CAPs. Furthermore, failure to engage with local residents to understand their needs and values jeopardize the trust between planners and communities.[198] For instance, in both New York City, United States and Copenhagen, Denmark, well-intentioned climate interventions were implemented without a nuanced understanding of local vulnerabilities: this led to adverse outcomes, including eco-gentrification and displacement, that exacerbated rather than decreased the insecurity of the affected communities.[199]

Insufficient knowledge, skills and expertise within local planning agencies hinder the formulation and execution of robust CAPs

Investments in capacity-building programs present an opportunity to enhance the technical skills of urban planners, particularly in cities in developing countries, to empower them with the skills and knowledge necessary to integrate climate considerations into urban planning, design and urban management practices. Capacity building includes training programs, knowledge-sharing platforms and collaboration with academic institutions. Furthermore, peer-to-peer learning networks and partnerships facilitate the exchange of best practices and lessons learned among different municipalities.[200]

5.4.5 Competing priorities and fragmented approaches

The clash of priorities presents a pervasive obstacle in the effective implementation of climate-resilient plans at the local level. As mentioned before, urban areas are often faced with a multitude of challenges, such as poverty, housing shortages and social infrastructure needs, that divert attention and resources away from climate action. Rather than siloed and fragmented approaches, these challenges should further emphasize the need for an integrated approach to urban planning and design that aligns climate resilience, social planning and societal needs.[201] Such integration was recommended in "The future we want"—the United Nations Conference on Sustainable Development which was held in Rio de Janeiro, Brazil, between 20 and 22 June 2012[202]—and is further emphasized, based on strong evidence, in the UN-Habitat's International Guidelines on Urban and Territorial Planning.[203]

5.4.6 Lack of political will

Political considerations, driven by short-term electoral cycles and vested interests, may impede the adoption of stringent climate policies. Political will and leadership are essential for driving transformative change toward climate action. A study of cities across the province of British Columbia, Canada, found that political interests constitute the foremost barrier to implementing transformative climate action due to

Political will and leadership are essential for driving transformative change toward climate action

leadership swings with electoral cycles, the lack of coordinated action across governance scales, and policy incoherence across governance levels.[204] Likewise, evidence from cities across Switzerland attributes implementation gaps to a lack of political commitment at multiple levels (national and cantonal/municipal)—a situation that also leads to policy fragmentation across governance levels.[205] Therefore, increased awareness and advocacy for climate action among politicians demands long-term perspectives that prioritize sustainability and resilience over immediate political gains.[206] Furthermore, civil society organizations, grassroots movements, and environmental activists play a crucial role in holding policymakers accountable and fostering a culture of climate consciousness.

5.4.7 Polarity between planning and development regimes

The perceived tension between planning-led regimes that prioritize the collective good and development-led regimes that focus on economic growth and expansion represents a significant obstacle to the implementation of climate-resilient plans. The perception of dichotomy between these approaches often leads to conflicts and compromises that undermine the effectiveness of climate action initiatives. Recent experiences in New York City, United States demonstrate the potential for an "infrastructure-first" approach to generate tensions with the local communities (Box 5.10). Instead of a dichotomy, a harmonized approach that integrates both planning and economic development goals is essential for climate action, whereby urban and territorial planning serves as a "catalyst for sustained and inclusive economic growth" concurrently with "social development and environmental sustainability".[207]

A harmonized approach that integrates both planning and economic development goals is essential for climate action

Box 5.10: The "Big U" shift, New York City

New York City's experience with Hurricane Sandy in 2012 highlighted the urgent need for coastal climate resilience measures. In response, the BIG U project, designed through several rounds of community engagement, aimed to create a ring of bermed parkland as flood protective NbS around Lower Manhattan. Although over US$335 million in national and municipal funding was secured, the project was subsequently amended in 2018 when city authorities announced that the plan would be significantly altered. Major changes to the design disposed of the berms, replacing them with infill that would raise the low-lying areas and add significantly to the cost.

This seemingly unilateral decision, announced after years of consultation with local residents, resulted in a breakdown of trust between communities and the city government. There were also concerns that the proposals seemed to be triggering several luxury housing towers, which not only indicated a business-as-usual approach, but also the dominance of development-led planning that triggers green gentrification. Although work is now progressing on a different plan that will for the time being provide greater protection from further flooding, a development that some locals have welcomed, others lament the destruction of the park's existing ecosystem to accommodate it. Furthermore, the abandonment of previous plans to treat the riverside areas as a "sponge" that could absorb extreme flooding when it did occur in favour of hard engineering was criticized as short-sighted, given the possibility that continued climate change could render the new protection redundant in future.[208]

Flooded tunnels, damaged steeples, uprooted trees in Manhattan and Brooklyn, the aftermath of Hurricane Sandy © Shutterstock

5.4.8 Conflict and migration

Regions facing conflicts and high rates of migration experience additional challenges in implementing climate-resilient plans. Climate change and environmental degradation exacerbate existing social, economic and political vulnerabilities and contribute to displacement. The number of refugees and asylum seekers fleeing from highly climate-vulnerable countries continues to rise exponentially: 70 per cent of all refugees and asylum seekers in 2022, a significant increase from 56 per cent in 2012. In many instances, conflict and environmental disasters "interact and overlap as triggers and drivers of displacement".[209]

In addition to derailing climate action in the countries of origins, conflict often also negatively impacts the host cities due to strains on their resources that complicate both the development and execution of CAPs. This renders host communities also vulnerable and facing a severe lack of resources to withstand or address climate risks. Even international organizations' ongoing relief efforts to the refugee crisis contribute to GHG emissions.[210]

5.4.9 Limited public awareness and participation

Common challenges across all contexts include a lack of inclusive and just governance.[211] As discussed in the previous section, inclusive governance empowers diverse sub-communities in shaping their urban environment, fosters a sense of ownership, and promotes sustainable practices. Likewise, limited public awareness and apathy or skepticism toward participation and engagement hinder the implementation of climate initiatives. Examples abound of the need to cater for the public's demands for better evidence of the benefits of climate action and for demonstrating that climate action complements, rather than compromises, other important urban agendas like social, health or economic development. In Rio de Janeiro, Brazil, while communities were satisfied with the construction of Madureira Park, the city has reportedly faced difficulties in convincing the community of the benefits of proposed green spaces ahead of their construction. This was despite the evident benefits, from recreational areas to lower temperatures in local neighbourhoods, that these brought once completed.[212]

Therefore, it is essential for climate action to combine evidence-based decision-making with inclusive planning processes that engage the perspectives, experiences and knowledge of diverse urban populations. Evidence shows that perseverance in inclusive governance and citizen participation in climate action ultimately enhances the legitimacy and effectiveness of climate action initiatives in the longterm.[213] Also, leveraging the power of civil society organizations for public education campaigns, community-based initiatives and transparent communication channels all contribute to building public awareness and fostering community engagement.[214]

Inclusive governance empowers diverse sub-communities in shaping their urban environment, fosters a sense of ownership, and promotes sustainable practices

5.5 Concluding Remarks and Lessons for Policy

While integrating climate change adaptation and mitigation into urban planning and design undoubtedly poses challenges, it also presents opportunities crucial for sustainable urban development. As cities increasingly face the impacts of climate change, it is imperative to embed climate considerations within existing policies and plans. This requires promoting coherence across different policy domains and fostering cross-sectoral collaborations. The chapter demonstrates that urban planning and design play a pivotal role in achieving NDCs as outlined in the Paris Agreement. Whilst NDCs and NUPs serve as roadmaps for countries to mitigate emissions and adapt to climate change, this chapter discusses the causes and implications of their misalignment. Consequently, effective climate action in urban areas necessitates integrated approaches, enhanced community engagement, and strengthened coordination mechanisms.

This chapter shows that CAPs are instrumental in mainstreaming climate action at the local level. In mapping the solution space, it highlights the diverse range of planning instruments for climate action within CAPs. Urban design solutions play a vital role in climate change mitigation by reducing emissions while also reducing vulnerabilities and enhancing communities' adaptive capacity. In discussing the design strategies, this chapter notes that challenges like public contestation will inevitably arise: in these contexts, policymakers should balance innovation with cultural sensitivity, engage communities early to address socioeconomic concerns, and adapt strategies to local contexts to foster inclusive, equitable urban development.

This chapter also brings out the critical role urban management plays in promoting urban circularity and sustainable consumption. Lastly, in the solution space, the chapter underscores the importance of collaborative governance, noting that multi-level governance frameworks and community engagement mechanisms foster collaboration, coherence and accountability in climate planning and implementation. Indeed, this chapter illustrates that whilst varying challenges exist in both developing and developed countries with respect to climate-resilient urban planning and design, innovative participatory and community-led approaches offer many promising solutions.

In discussing the present challenges and future opportunities in planning for climate resilience, this chapter underscores the imperative for enhancing institutional capacities; the necessity to integrate climate action with other priorities; the need for political goodwill and effective leadership; the importance of harmonized planning and development goals; the urgency to address social vulnerabilities to ensure inclusive and equitable climate action (noting the intersectionality of climate change with social, economic and political vulnerabilities); and the need for enhanced public engagement.

Endnotes

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