

# BEATING THE HEAT:

A SUSTAINABLE  
COOLING HANDBOOK  
FOR CITIES

EXECUTIVE SUMMARY

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In cooperation with





# EXECUTIVE SUMMARY

The world's cities are heating up at twice the global average rate due to rapid urbanization and the urban heat island effect. By 2100, many cities across the world could warm as much as 4 degrees Celsius (°C) if GHG emissions continue at high levels – this is more than double the Paris Agreement's goal of limiting global temperature rise to no more than 1.5°C.

Hotter cities could be catastrophic for public health. If the current trends in urbanization and increasing heat continue, it is expected that the urban population exposed to high temperatures – that is, average summertime highs above 35°C – will increase 800 per cent to reach 1.6 billion by mid-century. The challenge is compounded by the fact that the impacts of urban heat are not evenly distributed. Lower-income districts within a city are often hot spots due to a lack of green spaces and to the co-location of industrial operations, and residents of these areas are also less likely to be able to afford or access cooling for thermal comfort. These communities are usually the most vulnerable to heat, disproportionately bearing the negative impacts of excess warming.

In the absence of focused policy and market-based interventions, market behaviour defaults to an increasing number of people relying on air conditioners to address rising heat. Already, 2.3 billion people in the increasingly affluent lower-middle class in developing countries are on the verge of purchasing an entry-level air conditioner – typically the unit that is the most affordable, and likely the least efficient, on the market. This can be a quick and localized fix for those who can afford it, but it comes with severe consequences, where the emissions and waste heat from cooling perpetuate a vicious cycle where mechanical cooling is further warming our cities, necessitating even more cooling and further compounding the equity divide for those who are unable to afford access.

There is an urgent need to transition to more sustainable and equitable ways to cool our cities and ensure access to cooling where needed, without further warming the urban environment.

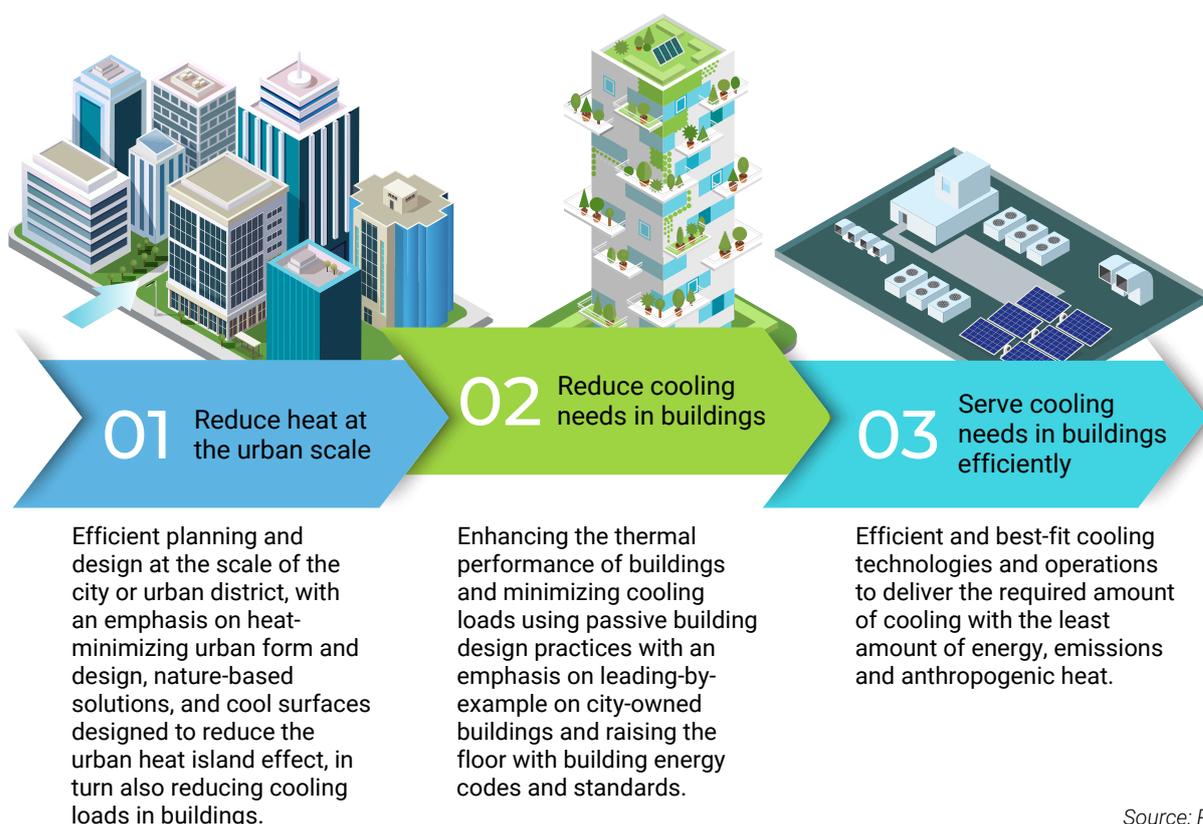
**City officials working to make their cities cooler and more liveable are faced with a wide range of approaches – the challenge is where to start.**

Against this backdrop, the Cool Coalition, the United Nations Environment Programme (UNEP), the Rocky Mountain Institute (RMI), the Global Covenant of Mayors for Climate & Energy, Mission Innovation and the Clean Cooling Collaborative have launched a Sustainable Urban Cooling Handbook, which offers cities an accessible and holistic pathway and clear actions to keep their cities cool.

**THE HANDBOOK IS AN ACTION-ORIENTED GUIDE WITH A “WHOLE-SYSTEM” APPROACH AT ITS FOUNDATION.**

The handbook offers a comprehensive overview of sustainable urban cooling approaches within an integrated “whole-system” approach. It includes actionable guidance to support cities in organizing and prioritizing action towards sustainable and equitable urban cooling tailored to their unique context, contributing to increased city resilience and reduced emissions. Because multiple factors contribute to increasing warming in cities, often with inter-related effects, the whole-system approach suggests multi-pronged strategies to effectively address urban cooling. This includes three core steps: reduce heat at the urban scale, reduce cooling needs in buildings and serve cooling needs in buildings efficiently – as summarized in figure ES1.

**Figure ES1** Whole-system approach to optimally address urban cooling



Together, the three steps have a powerful compounding effect, such that: lowering urban heat results in less cooling load on buildings, thermally efficient buildings lead to smaller requirements for mechanical cooling, and the reduced cooling requirements can then be served with smaller cooling systems.

### KEY INTERVENTION PATHWAYS FOR SUSTAINABLE URBAN COOLING

The handbook offers a range of interventions for cities – both at the urban/community scale and at the building scale – that combine policies and regulations that spur demand for sustainable urban cooling with financial instruments, awareness-building and capacity-building that facilitate the supply for addressing the demand. These interventions apply across the three areas underpinning the whole-system approach: reduce heat at the urban scale, reduce cooling needs in buildings and serve cooling needs in buildings efficiently. However, the scope and range of interventions that are available to cities within each of the areas will vary, given the preemption of state or national regulation. They fall broadly within the following categories (see also figure ES2):



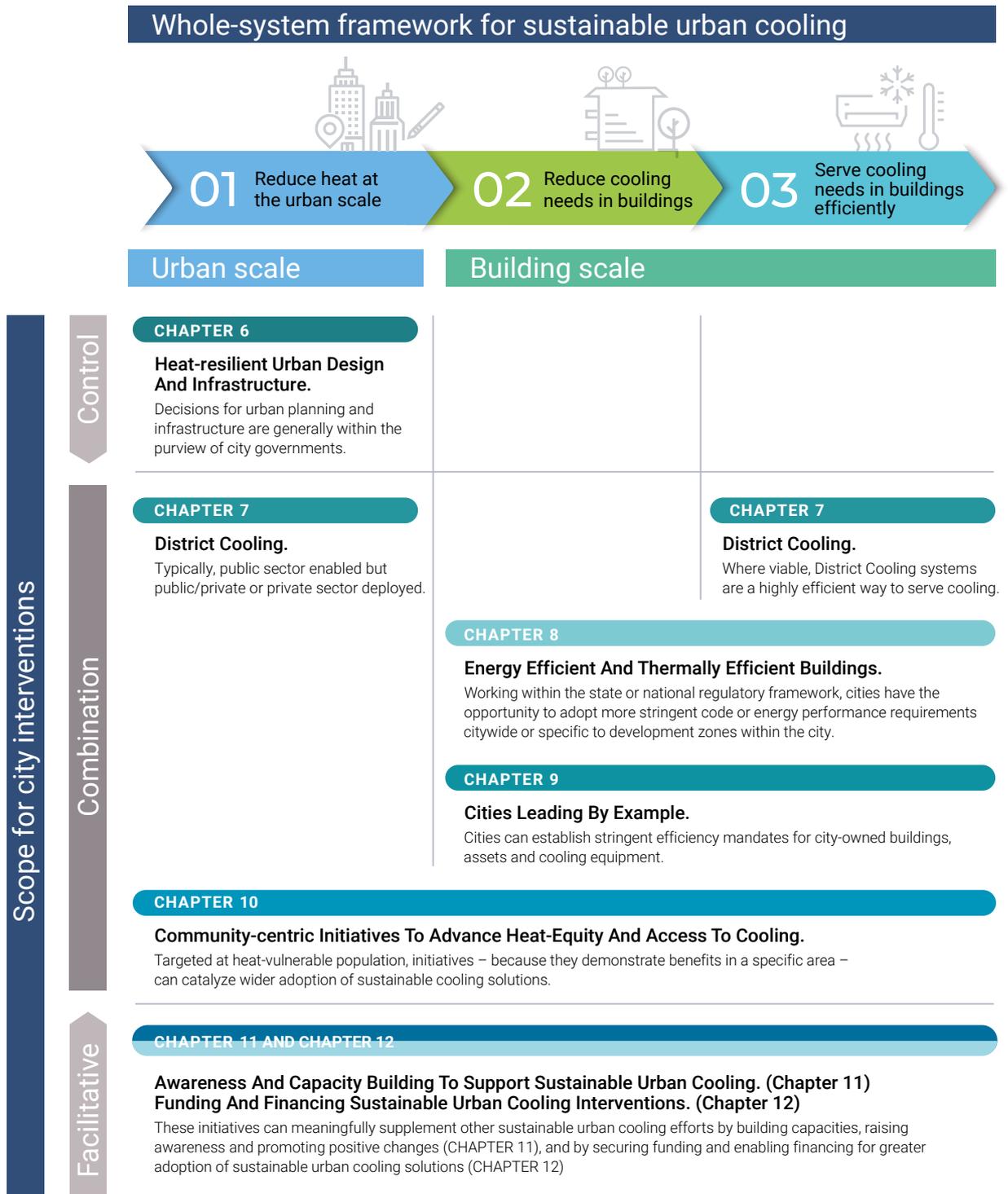
■ **CONTROL STRATEGIES:** By leveraging the authority of city governments, interventions in this category are designed to directly control and steer actions that lead to sustainable urban cooling. Many of the interventions in the “reduce heat at the urban scale” category are “control” strategies, because decisions for urban planning and infrastructure – such as zoning statutes, urban planning regulations for mitigating heat islands, transport planning and mandates for green cover – are generally within the purview of city governments.

■ **COMBINATION STRATEGIES:** Combination strategies, in the context of this report, are interventions where cities may not have full and direct control but can apply partial or modified control. Interventions in the “reduce cooling needs in buildings” category are generally “combination” strategies. For instance, while working within the state or national regulatory framework, cities can adopt and enforce (implying modified control) building energy codes and disclosure ordinances and evaluate the opportunity to adopt more stringent requirements (referred to as beyond code or stretch code) city-wide or specific to development zones within the city.

■ **FACILITATIVE STRATEGIES:** Facilitative strategies enable cities to influence or facilitate actions towards sustainable urban cooling, such as through raising mass awareness, helping develop financial instruments to spur demand and helping build capacity to meet demand. These strategies help amplify the impact of control and combination measures, and help reinforce the actions generally regulated at the national or state level. Much in the category of “serve cooling needs in buildings efficiently” lies outside of the direct control of cities and generally is regulated at the national or state level (such as energy performance standards for cooling appliances), although city governments can adopt higher efficiency requirements for their own facilities.



Figure ES2 Key intervention pathways for sustainable urban cooling



Source: RMI

### AS IMPORTANT AS THE “WHAT” TO DO IS THE “HOW” AND THE “WHEN”.

With the whole-system approach as the underpinning, the handbook advocates for, and provides guidelines for, developing a cohesive urban cooling action plan, where the impacts of synergistic and coordinated actions are greater than those of individual actions. The guidelines are a sequence of logical activities that provide a consistent pathway while allowing cities the flexibility to adapt to their unique context and needs (figure ES3).

A starting point for such cohesive planning is city leadership demonstrated through a champion (sometimes referred to as a Chief Heat Officer) – who can build and channel the momentum towards sustainable urban cooling – and the development of a city-wide baseline assessment. The baseline assessment includes an understanding of the existing impacts of the urban heat island effect and existing equity issues, and an estimation of the current cooling demand and future outlook. Such assessment provides a view into the impacts of business-as-usual approaches to cooling and serves as an informed basis for cities to plan and prioritize actions towards neutralizing these impacts through sustainable cooling approaches.

Given the urgency to act “now,” the handbook takes the approach of “plan cohesively and act strategically.” This approach implies that, by keeping in perspective the inter-linkages and synergies between the various cooling strategies, cities can immediately undertake certain actions (even while they develop cohesive plans), designed in a way that these eventually integrate into the larger cooling master plan (figure 3). To this end, the handbook includes a framework to guide cities to prioritize and organize the various interventions. There are three essential steps to this framework: the first two, explained below, are sequential and generally targeted at specific intervention areas.

Source: RMI



**NO-REGRETS ACTIONS:** As a foundational step, cities should undertake preparatory measures that will establish/ensure the authority to act when appropriate trigger points occur (for example, establishing the authority to apply covenants on land to be developed or redeveloped that can apply conditions beyond code). In addition, cities should undertake immediate implementation of low-cost/no-cost interventions – that is, interventions that are cost-effective, relatively simple to implement in terms of requisite dependencies, and have substantial environmental and/or social benefits (such as municipal cool roof programmes). These immediate actions can also help mitigate future heat challenges, which can be crucial to avoiding larger future costs, especially in low-capacity urban regions.

Figure ES3 Cohesive planning and strategic action





**CITY INTERVENTIONS CATALYSED BY TRIGGER POINTS:**

While cities may choose to pursue sustainable cooling interventions at any time, depending on the local needs, there are certain trigger points whose occurrence offers synergistic implementation opportunities for specific interventions. Typically, cities will see trigger points falling within the following five categories:

- 1 Planned new development and/or major re-development
- 2 Introducing or initiating city planning processes
- 3 Introducing new or updated codes / zoning requirements
- 4 Evaluating or initiating major city infrastructure projects
- 5 Evaluating city land acquisition/ sale.

These trigger points are a logical catalyst for cost-effectively dovetailing specific urban cooling interventions, such that they build on past and pending actions paving the way for a sustainable urban cooling future. The third step in the framework is a set of cross-cutting facilitative interventions that enable cities to influence or facilitate actions towards sustainable urban cooling through policies and programmes that raise awareness, build capacities, secure funding and enable financing solutions. These interventions are typically supplementary in nature and, when implemented in conjunction with other interventions, can enhance their impact and positive benefits.

This framework of no-regrets decisions and preparatory measures can ensure that key trigger points for synergistic implementation of intervention strategies are not missed.

**LEVERAGING PAST SUCCESSES**

In discussing the various intervention strategies, the handbook presents a set of 80 supporting examples and case studies from across the globe in order to guide cities in developing an action-oriented and integrated approach that is the best fit for their unique context. For example:

■ **Seoul, Republic of Korea:** An effort to restore the Cheonggyecheon stream that runs through the city replaced 5.8 kilometres of elevated expressway that covered the stream with a mixed-use waterfront corridor. The waterfront corridor decreased temperatures by 3.3°C to 5.9°C compared to a parallel road a few blocks away.





■ **Medellín, Colombia:** Green corridors were created that follow and restore the geography of the area prior to recent development. From 2016 to 2019, the city created 36 corridors, 18 along major roads and 18 along waterways, covering more than 36 hectares. The areas with green corridors have already seen temperature reductions of up to 4°C.

■ **Paris, France:** The city is home to the first and largest district cooling system in Europe. When the water temperature is below 8°C, water from the Seine River is distributed directly through this system as “free cooling.”

■ **Toronto, Canada:** The municipal government implemented the largest lake-source cooling system in the world. Commissioned in 2004, Enwave’s Deep Lake Water Cooling (DLWC) system, with a capacity of 264 megawatts of refrigeration, uses Lake Ontario’s cold water as a renewable energy source.

■ **Guangzhou, China:** The municipal government made the decision to implement regional centralized cooling as part of a green and environmentally friendly modern urban centre in the core area of the Pearl River New City development. The local environmental temperature in the core area of Zhujiang New Town was reduced by an estimated 2-3°C through a decrease in anthropogenic heat from the avoided distributed cooling systems.

Such examples and case studies demonstrate the effectiveness of the strategies outlined in the handbook and can also help cities find an approach best suited for their unique contexts.

### **CITIES CAN BE A MAJOR CONTRIBUTOR IN TACKLING THE GLOBAL CLIMATE CRISIS THROUGH TRANSFORMATIVE SOLUTIONS.**

Science tells us that to keep global temperatures from rising more than 1.5°C, cities have to achieve net zero emissions by mid-century. Sustainable and equitable urban cooling thus is not only essential to ensure that our cities are livable for all, but also a major contributor in tackling the global climate crisis.



**The benefits of sustainable urban cooling are far reaching, including improved health and productivity, reduced power requirements, lower emissions and economic benefits.**

In this decisive decade of climate action, cities have a pivotal role to play by urgently accelerating the transition to sustainable and equitable urban cooling – and the handbook provides much-needed actionable guidance to support this transition.



# BEATING THE HEAT: A SUSTAINABLE COOLING HANDBOOK FOR CITIES

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