

# Guide to climate-smart and water-wise cities

How cities manage water is one of the greatest challenges of our time. Faced with new water extremes and climate pressures, cities need to radically rethink every aspect of infrastructure, urban planning, and water governance. New research shows that this is not only key to strengthening the resilience of individual cities, but also of critical importance for our ability to cut greenhouse gas emissions. Here is a guide to making cities both climate-smart and water-wise.



## Authors

This policy brief has been authored by Dr Malin Lundberg Ingemarsson, Jakob Schabus, and Maria Sköld, SIWI.

**This policy brief will help decision-makers in cities develop more effective climate strategies. It builds on insights from the landmark report *The Essential Drop to Net-Zero: Unpacking Freshwater's Role in Climate Change Mitigation*. Summarizing current research, the report identifies new approaches to climate planning with water as the starting point.**

Half the global population currently lives in cities and this proportion is expected to reach 80 percent by 2050 ([UN DESA 2019](#)). This unprecedented urban boom will primarily take place in the Global South, in regions that are especially hard hit by escalating water and climate crises. Many cities, therefore, will face complex challenges in the years ahead, where uninformed policy choices could cause immense human suffering, environmental degradation, and accelerating global warming.

But solutions do currently exist, albeit under-utilized, that can improve the lives of city dwellers, restore nature, and mitigate climate change. This policy brief will explore some of them, whilst more detailed knowledge can be found in the report [The Essential Drop to Net-Zero: Unpacking Freshwater's Role in Climate Change Mitigation](#).

## Water and climate mitigation

Freshwater is much more important to climate change than previously believed, evidence of which was published in 2022. The [Sixth Assessment Report](#) from the Intergovernmental Panel on Climate Change, IPCC, demonstrated how changes to the water cycle have already been triggered by modest increases in average temperatures, and with more devastating consequences than expected. As such, water now features more prominently in the actions that the IPCC encourages different sectors to take to reduce greenhouse gas emissions.

An even closer look at this topic was taken in the report [The Essential Drop to Net-Zero: Unpacking Freshwater's Role in Climate Change Mitigation](#), the first-ever summary of

current research on the role of freshwater in climate mitigation, which was presented at the climate meeting COP 27 in November 2022. The report was the result of collaboration between five institutions: GIZ, UNDP, the Potsdam Institute for Climate Impact Research, the Stockholm International Water Institute, and the Stockholm Resilience Centre. The 40 researchers who contributed to the report analyzed how water both impacts and is itself impacted by climate mitigation in a broad range of sectors, from land use and energy to wastewater treatment. In short, climate mitigation does not work without water.

In the next phase, we will create summaries for policymakers based on these new insights, to aide them with their design of strategies. This policy brief is one such example.

## Water governance

All over the world, cities must change how water is managed. The climate crisis, environmental degradation, increasing populations, and economic growth will all place exceptional pressure on water resources. Existing infrastructure and governance systems will likely not be able to cope with these new demands, or with rising sea-levels and ever-more frequent flooding. The situation is further aggravated by inequality and wide-spread mismanagement of water. Good water governance, building on integrated approaches, will be essential to ensure sufficient, high quality water services are provided to cities.

Faced with these challenges, we will need to completely rethink urban planning, especially since the world's urbanization, to a large extent, is taking place in the most water scarce parts of the Global South. Africa's urban population is, for example, expected to double by 2050. Ensuring that the many new residents of the continent's urban areas, which are often informal settlements, have access to clean water and safely managed sanitation is an enormous undertaking that individual cities may not be able to manage on their own. ([Vitello, Schuyler, 2023](#))

It is also in everyone's interest that tomorrow's cities are as climate-smart and water-efficient as possible. Without proper planning and wastewater treatment, fast-growing cities will pose a grave threat to the world's freshwater resources, terrestrial and coastal ecosystems, and oceans. It should also be recognised how cities are dependent on surrounding landscapes, with around one-third of the world's major cities depending on protected forests for their drinking water. ([Dudley, Stolton 2003](#); [SIWI 2023](#)).

Decision-making about water seldom factors in these interdependencies and doesn't take into account that natural systems are not limited by administrative boundaries. Infrastructure, climate policy, urban planning, land management, and natural conservation are still often seen as distinct and separate concepts. They are governed and financed separately, which makes it difficult to identify synergies and trade-offs. But the report *The Essential Drop to Net-Zero* emphasizes that these barriers must be overcome, allowing for integrated and more effective approaches to governance.

There is a growing number of alternatives to the current siloed and fragmented approach to governance, such as integrated water resources management (IWRM), the water-energy-food (WEF) nexus approach, source-to-sea (S2S), the landscape approach, and integrated urban water management (IUWM). To learn more about how source-to-sea management can benefit cities, see the policy brief [Building urban resilience through strategic and environmental planning from source to sea](#).

Good water governance requires transparency, accountability, meaningful participation, and strong communication, as well as engagement of all relevant stakeholders. Policies can only be successful when they are inclusive. For cities, this means having a true representation of the cities' population in decision making, as well as basin authorities, climate experts, disaster management authorities, and private actors.

To enable good water governance, municipalities need to budget for technical assistance and capacity building of stakeholders, policy makers, regulators, utilities, and communities for topics such as WASH and climate change mitigation. However, the capacity of cities to implement water governance is widely different and a lack of resources and support can mean a major hurdle to mitigating climate change or building resilience. Whilst international development aid and climate funding for cities have increased over the years, there has been little focus on investments in water sector policy and administrative management, wastewater management, or basic drinking water supply. This needs to change.

## **Wastewater treatment and sanitation**

Cities are on the front line of experiencing climate change, yet their role in mitigation is often underestimated. There is vast mitigation potential in the water, sanitation, and hygiene (WASH) sector, as wastewater treatment and discharge account directly for 12 percent and 4 percent of global methane and nitrous oxide emissions, respectively. In addition, drinking water and wastewater management are responsible for approximately 4 percent of global electricity consumption, often associated with indirect carbon emissions. By 2030, it is expected that the sector's energy requirements will increase by 50 percent.

Reducing the release of these greenhouse gases is, therefore, a major opportunity for mitigating climate change. A significant proportion of wastewater from cities is released untreated or only partially treated, with the emissions from untreated wastewater being three times higher than those from conventional wastewater treatment plants. Providing the many millions of people worldwide who have limited or no access to sanitation with safely managed sanitation services would wield a huge mitigation potential.

Yet, we remain largely off track to mitigate climate change effects of drinking water and sanitation. A major reason being the lack of reliable data which hampers the effective integration of WASH in climate policies and mitigation strategies. This also presents a challenge for making climate finance available. More and better reporting of

actual greenhouse gas emissions needs to be prioritized by cities and available tools need to be scaled up and standardized. Though first steps are being taken and water utilities are increasingly measuring and reporting their GHG emissions and savings as part of national GHG inventories, using tools such as the publicly available Energy Performance and Carbon Emissions Assessment and Monitoring (ECAM) tool.

The release of greenhouse gases from wastewater and faecal sludge can be reduced through the improved design, management, and adjustment of operating conditions of wastewater treatment plants. Similarly, energy efficiency measures and other solutions (e.g., increased use of renewable energies) can be implemented to decrease energy consumption and reduce carbon dioxide (CO<sub>2</sub>) emissions. These are under-utilized opportunities for cities to mitigate climate change.

To achieve impact at scale, the establishment of climate platforms is the key to strengthening cooperation among climate and WASH stakeholders and enhancing action on mitigation solutions. These platforms should provide access and stimulate the exchange of information, evidence, and guidance to inform the development of climate mitigation strategies and plans at the local, national, and international scales.

## Ecosystems in and around the city

Many city dwellers are used to getting their water from a tap and may have never considered where that water comes from. But cities' water supplies are dependent on healthy ecosystems in the surrounding countryside, and often from watersheds far away. The relationship is reciprocal, too, meaning that how cities manage water will impact ecosystems in remote locations downstream.

Many cities are only starting to realize this as a growing number are now running out of water. In many cases, the water scarcity problem is at least partly caused by unplanned expansion where cities encroach on surrounding wetlands and forests that used to be their source of drinking water. Pollution of both surface and groundwater is another big threat. And a further risk factor is urban planning that favours concrete over permeable materials, which prevents water from easily percolating into the ground.

But there are smarter ways to plan a city and many good examples of cities that thrive thanks to how they co-exist with nature. In the increasingly popular **sponge cities**, trees, lakes, and parks are abundant and valued since they absorb rain by increasing infiltration and water storage capacities, reducing the risk of flooding. The sponge city concept is gaining traction across the world, as cities search for new ways to adapt to the consequences of climate change. By adding more green areas and parks, cities can reduce the risk of drought, limit flood risks, improve air quality, and reduce temperatures since trees offer places to escape excessive heat. Consultancy firm Arup has found a way to measure the “sponginess” of a city using artificial intelligence and has listed New Zealand’s Auckland and Kenya’s Nairobi as the most spongy cities of

those assessed. This type of digital mapping tools makes it possible for cities to gauge how space is used and find greener options with multiple benefits. ([Harrisberg, 2022](#))

The Ramsar Convention has initiated a special [Wetland City Accreditation](#) highlighting cities that restore and protect urban and peri-urban wetlands. The accreditation supports cities in becoming more resilient to climate impacts whilst improving access to clean water. And in the process, cities become more pleasant to live in.

Until recently, this was mainly considered of interest to cities themselves as a climate adaptation strategy. But *The Essential Drop to Net-Zero* report shows that cities can also play a critical role in mitigating climate change through their relationship with nature. In a rapidly urbanizing world, city expansion is one of the greatest threats to wetlands which often are paved over with concrete to make room for urban development. The consequences are disastrous. Wetlands cover only seven percent of the world's surface but are still crucial to mitigation as the – per area – most efficient carbon sinks on land. When wetlands are drained, they instead become a net source of greenhouse gas emissions. The role of wetlands in climate mitigation varies greatly, however, between different types of wetlands and other conditions, which must be taken into consideration. ([SIWI 2022](#)).

Cities are also much more dependent on forests than commonly understood. Urban trees and forests offer not just shade and improved air quality but cool the air through evapotranspiration, helping cities avoid dangerous heat traps. On a hotter planet, **forests need to be part of the essential city infrastructure**, which is the case for example in Canadian Toronto. ([Wilson et al 2023](#)) But in too many places, the opposite is happening – forests are chopped down to make room for sprawling cities. This approach to city development can have many unintended consequences, such as reducing the quality of life for people living in poverty on the margins of a city who often source income, food, and remedies from the forest. It could also have a disastrous impact on their access to water.

Many cities depend on forests for their drinking water, be them near or far away, and we are starting to have a better understanding of how forests influence rainfall patterns. Forests situated within watersheds are also excellent providers of water treatment since they filter sediment and prevent soil erosion, keeping both surface water and groundwater cleaner.

Forests in cities, peri-urban areas, or that have a connection with cities, are also important for climate mitigation. **Old forests are especially important** and natural forests can be up to six times more effective at storing carbon than agroforestry. ([SIWI 2022](#))

The role of rivers in climate mitigation is less studied but a topic of growing concern since polluted rivers seem to emit more greenhouse gases than previously believed. This is yet another reason why cities should do everything possible to **reduce water pollution** and improve the treatment of wastewater. ([SIWI 2022](#))

## The role of water for energy systems

Many cities are in the middle of a great energy transition, shifting from fossil fuels to low-carbon alternatives. How this is carried out can, however, have great implications for local water resources, a fact that is often forgotten when plans are made.

All energy production requires water, though wind and solar power are less water-demanding than the alternatives. Bioenergy, hydropower and thermal energy generation from solar, geothermal, and nuclear power are low-emission energy sources but with substantial water requirements. The benefits provided by these options must be weighed against potential water risks and impacts on freshwater ecosystems.

Cities must therefore pay closer attention to the connection between water and energy when planning for the future. Low-emission energy transition plans must include analysis of projected demands, availability, and impacts on water as well as potential risks to water availability caused by climate change. Transitions toward low-emission energy can reduce pressure on water, but this will depend on the future mix and management of energy sources. Effective water management is also getting more important to buffer against the impacts of climate change and protect energy infrastructure.

## Conclusions

How cities manage water is a question of enormous importance not just for their own future but for the entire planet. In a rapidly urbanizing world, choices made by cities will impact people and ecosystems, near and far away. At the same time, many of the world's fastest growing cities are located in low-income countries and should not be left to fend for themselves at a time when global heating is making city life much more difficult.

In this policy brief we have demonstrated the critical role of cities in climate mitigation, which is further proof that it must be a shared global responsibility and interest such that cities everywhere can become more resilient, climate-smart, and water-wise.

We have also pointed to measures that cities across the world can take. The report *The Essential Drop to Net-Zero: Unpacking Freshwater's Role in Climate Mitigation* has identified a range of solutions that offer multiple benefits simultaneously, for example reducing greenhouse gas emissions while also safeguarding freshwater resources, protecting biodiversity, lowering disaster risks, and ensuring sustainable livelihoods.

## A new generation of urban climate solutions

There are many steps cities can take to become more resilient, climate-smart and water-wise. Here are a few examples:

- Ensure that everyone has access to safely managed sanitation.
- Improve wastewater treatment.
- Protect the watersheds that your city's drinking water comes from, collaborating with surrounding communities.
- Apply holistic governance approaches such as source-to-sea management.
- Protect old forests which store more greenhouse gases than newly planted trees. Forests are also important for water recharge and help clean water.
- Make your city spongier by leaving room for parks, ponds and lakes. This boosts access to water, buffers against flooding and can make the city cooler.
- Limit the use of concrete and other materials that don't allow water to pass through.
- Restore and protect wetlands which are some of the most powerful carbon sequesters.
- Shift to energy production that is fossil free and that does not place too much stress on water resources.

### About SIWI

SIWI is a leading water institute, focused on water governance and capacity building in order to reach a just, prosperous and sustainable water wise world. It is well-known for its research, knowledge generation, and applied science, which helps to develop policy recommendations and supports the implementation of programmes. In addition, SIWI uses its trusted convening power to facilitate multi-stakeholder dialogues, most evident in its annual event, World Water Week.