



# Beat the Heat – A Quick Guide

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Heat waves have become a recurring challenge in urban areas around the world. These prolonged periods of extreme heat not only pose risks to human health but also put pressure on urban infrastructure, including transport systems. In this booklet, we delve into the impact of heat waves on cities and urban transport and explore the essential measures and adaptations needed to create cooler and more resilient urban environments. With a specific focus on transport, we uncover innovative strategies to mitigate heat-related issues and ensure comfortable and efficient mobility for city dwellers.

# Preface

While some may argue that dealing with heat waves is common sense and that people will naturally adapt, the reality is more complex. As urban areas continue to expand and temperatures soar, the impact of heat waves becomes increasingly significant. Here's why focusing on heat waves is important:

- **Neglecting sustainable planning strategies:** In the pursuit of urban development, the importance of common-sense measures to combat heat waves has often been neglected: Trees that previously served as a natural air conditioning system are being cut down to make way for parking spaces and traffic lanes. Parks are being reduced to make room for buildings and vehicles. Large buildings prevent natural air circulation. House fronts hardly offer any natural protection for passers-by, e.g., through colonnades, but are becoming more and more hostile in order to reduce maintenance costs and to deter unwanted guests. More asphalt and concrete are being laid, exacerbating the urban heat island effect and creating inhospitable environments.
- **Shifting demographics:** Heat waves pose significant challenges to the livability of cities, especially for vulnerable populations such as the elderly – and their proportion is rising. Older adults, who may have difficulty adapting to extreme heat, are particularly susceptible to heat-related illnesses.
- **Climate change indications:** Climate change projections indicate that heat waves are likely to become more frequent and intense in the coming years. Focusing on heat wave adaptation now allows us to future-proof our cities and ensure their long-term sustainability. By implementing effective strategies today, we can mitigate the potential risks and challenges posed by heat waves in the future.

# Background

As the world faces effects of climate change, cities are at the forefront of the battle to adapt and become resilient to extreme weather conditions. Among the most pressing challenges are heat waves and flooding, both of which pose significant risks to urban environments and the well-being of their inhabitants.

As we are right in the middle of the summer season in the northern hemisphere, we would like to focus on the topic of heat. The presence of the confirmed El Nino effect suggests that we can anticipate very high summer temperatures, in fact already today the surface temperatures of the oceans are considerably elevated (Hughes, 2023).<sup>1</sup>

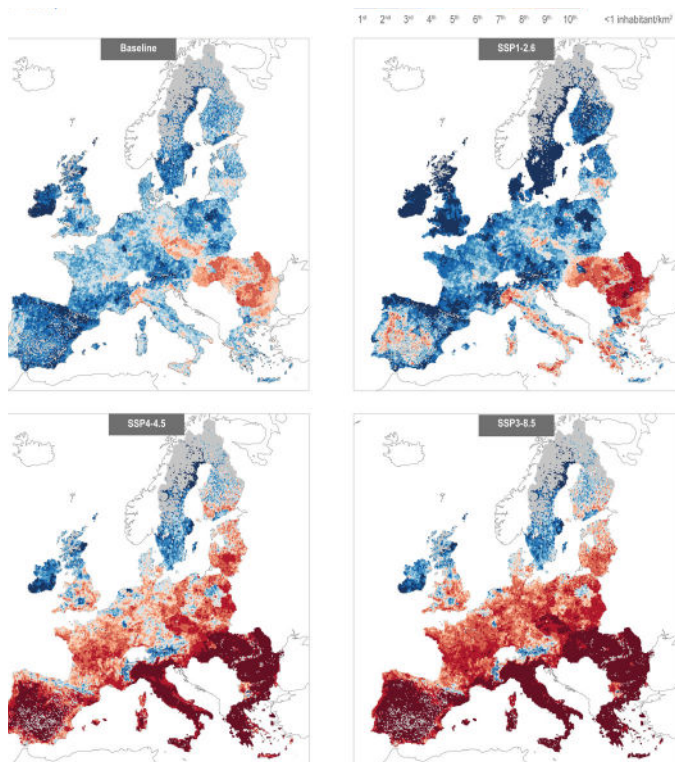
Globally, 56% of people live in cities, and they feel the effects of the heat the most (The World Bank, 2023). Especially during summer, city residents must deal with a lot of heat – which is amplified by the heat island effect. This is created by having areas in a city that have relatively little vegetation, with natural areas replaced by concrete, buildings, and parking lots. The heat is stored and accumulated in buildings, roads, roofs etc. during the day and the heat is released again at night (COWI, Deloitte, Ramboll, DMI, KU-Life, Gras, 2011), which has the consequence that at night the temperature does not cool down. These tropical nights in urban areas now happen up to three times more frequently per year compared to non-urban regions (Fischer, 2022).



Figure 1 Urban Heat Island Profile

<sup>1</sup>The El Nino effect is a climate phenomenon characterized by the warming of ocean surface temperatures in the central and eastern tropical Pacific. This increase in temperature intensifies the heat in the affected regions and has implications for global weather patterns. El Nino contributes to the amplification of heat waves, leading to higher-than-average summer temperatures in many areas.

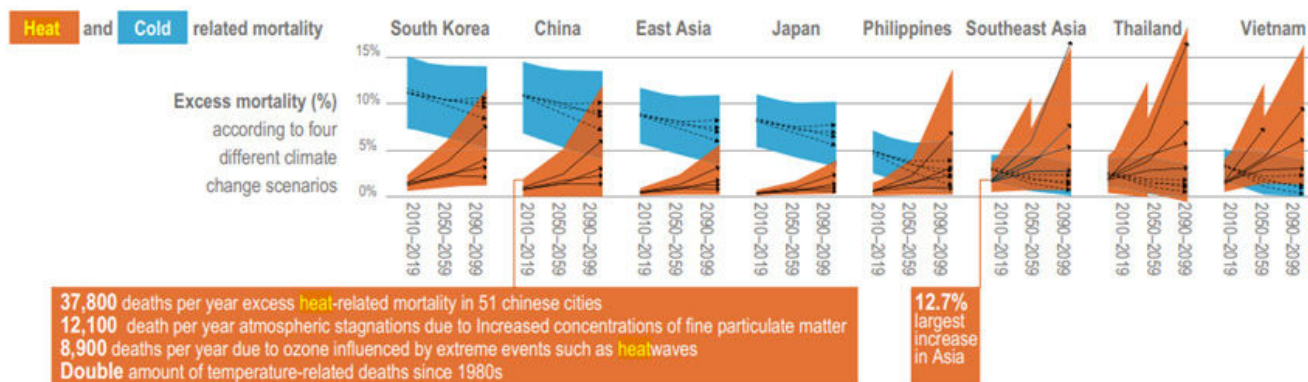
According to the IPCC, heat waves in Europe will become more frequent, more intense & will last longer. By 2050, about half of the European population may be exposed to high or very high risk of heat stress during summer.



Source: [IPCC Sixth Assessment Report, chapter 13](#)

For Asia, an increase of heat-related mortality is projected – with greatest impact in South, East and Southeast Asia:

### Projected health impacts due to climate change in Asia



Source: [IPCC Sixth Assessment Report, chapter 10](#)

A recent discussion paper by the German Association of Cities quotes temperature differences between inner cities and suburban areas of more than ten degrees Celsius on hot days.<sup>2</sup> Even within differently built-up areas of the same city, temperature differences of around 4K (Kelvin) have been measured in various European cities.<sup>3</sup>

The effects of heat do not only have tremendous impact on residents in urban areas, workers in the transport and delivery sector are equally or even more affected by extreme heat. Between 2015 and 2021, an examination of Occupational Safety and Health Administration (USA) records by E&E News showed that the parcel delivery and mail services sector ranked second in term of frequency of workers failing ill due to heat-related conditions. The only industry surpassing it in reported incidents was construction. The exposure to environmental heat for delivery workers can increase the perceived temperature in delivery vehicles by up to 20-degree Fahrenheit (6-degree Celsius), if they are not equipped with air conditioning (Wittenberg, 2022).

<sup>2</sup>Diskussionspapier: Damit Hitze nicht krank macht: wie Städte cool bleiben: Deutscher Städtetag ([staedtetag.de](#))

<sup>3</sup>Urban form features determine spatio-temporal variation of ambient temperature: A comparative study of three European cities – ScienceDirect

# Approach

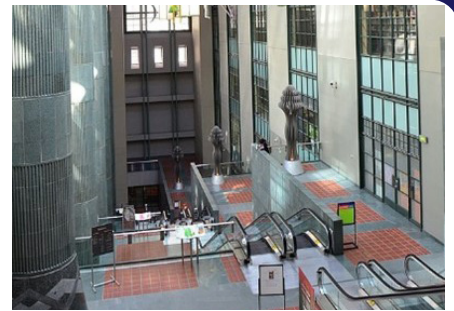
It is necessary to strengthen societal and individual capacities to adapt to heat events. There are several measures that can be taken, with short, medium, long-term perspectives. In the face of limited data on the impact of anti-heatwave measures, we must remember that some actions are „no-regret“ measures. These are actions that, regardless of the exact magnitude of their effectiveness, still bring tangible benefits and contribute to the overall resilience of our cities. Installing shade structures, increasing green spaces, improving ventilation, and promoting heat awareness campaigns are all examples of such measures.

## Short-term measures

What specifically can cities do in a **short period of time** to implement specific measures for their residents?

### Cooling spots

Suitable facilities like public libraries, museums or institutional spaces should be prepared as cooling spots. These publicly accessible locations can provide cooling shelters. Suitable directional signs should give the public the shortest way to those facilities.



Library © Mquach, Wikicommons CC BY-SA 3.0

### Fire hydrants with spray caps

New York uses fire hydrants equipped with spray caps to dispense water and to beat the heat.



Fire hydrants © Phil Roeder, Wikicommons CC BY 2.0

### Drinking water

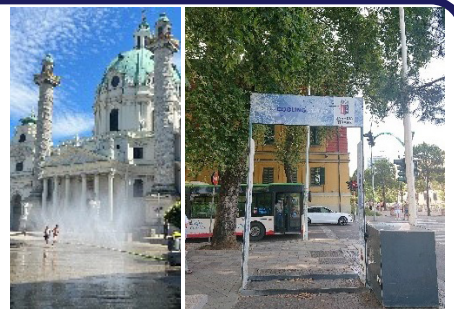
Consider installing public water dispensers and water mist systems and consider free availability of drinking water in gastronomies and public facilities.



Fountain © Dori, Wikicommons CC BY-SA 3.0 US

### Water mist spray

The tiny water droplets evaporate due to surrounding heat, absorbing energy and reducing air temperature, providing immediate relief and increased comfort. It attracts visitors, promotes community engagement, and is environmentally friendly. Consider climate and water conservation for optimal effectiveness.



Cooling spots in Vienna and Tirana © Authors

## Shading of public spaces

Use temporary sun sails or similar structures to create shade in public spaces.

- Impact: Up to 16°C decrease on ground temperature and 6°C on façade temperature (Garcia-Nevado, Beckers, & Coch, 2020)



Textile shading (Left © Jean Housen, Wikicommons CC BY-SA 3.0.; Right © Authors)

## Tinted windows public transport

Install tinted windows in public transport (not the windshield) to provide effective sunshade and reduce cooling energy consumption.

- Up to 8°C decrease on interior air temperature (Nasir & Jasni, 2012)



Reduced cooling energy consumption of up to 35% during the peak of the cooling season. © Atomic Taco, Wiki Commons CC BY-SA 2.0

## Early heat warning

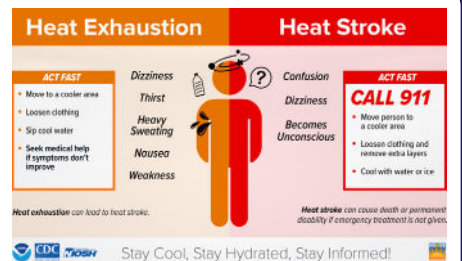
Implement early heat warning systems across different communication channels, such as social media, apps, and TV, to allow people to prepare for heat waves in advance.



(Source: Powerbi)

## Information and advice for personal planning, habits and First Aid measures

Offer information and advice to help individuals plan and adapt to hot weather conditions. This includes checking weather forecasts before going out, choosing appropriate clothing and travel times, and considering protective clothing for sun and radiation. Ensure clear communication of symptoms and first aid measures for various heat-related disorders.



© National Weather Service, CDC, NIOSH

## Frequency of public transport

Increase the frequency of public transport to reduce occupancy of individual vehicles and provide more breathing space and improved ventilation.



BRT in Salvador, Brazil ©TUMI

## Intermodality

Facilitate intermodality by allowing the carrying of bikes on public transport during extreme weather conditions and support users in planning their trips based on changing weather conditions.



E-scooters © Soninha Vill / GIZ Brasil

## Medium-term measures

### Unsealing of surfaces

Surfaces that store heat and contribute to the heat island effect should be replaced by green measures such as green spaces with trees or blue measures like water streams or ponds to create a cooling effect on hot days.

Pavement design is also crucial: introducing permeable materials will decrease the risk of floods as well as decrease surface temperature in summer months.



Unsealing © TUMI

### Installing green roofs and green facades

Evaporation from green roofs and green facades has a cooling effect on their surroundings and indoor climate.

- Reduce city-wide ambient temperatures by up to 2,7° Celsius (EPA, 2023)

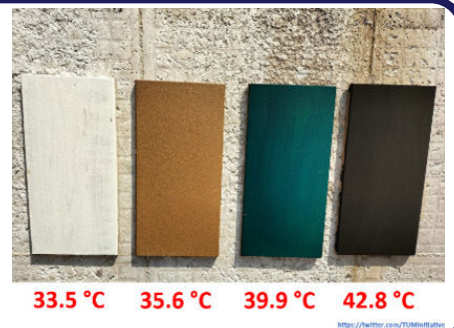
Example: [Cool Roof Challenge India](#)



Green Roof © E. Berrod, Wikicommons, CC BY-SA 4.0

### Light/bright colors

Consider using light/bright colors for surfaces as they have low heat absorption and turnover. Apply light/bright paint to building exteriors to reduce absorbed solar radiation.

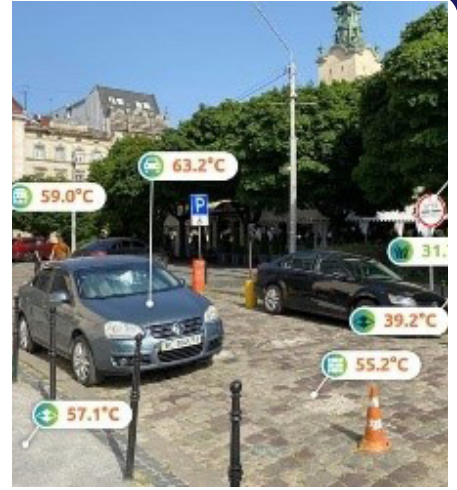


## Trees for greening & shading

Plant trees along walking and cycling routes to provide shade and create a natural habitat for wildlife. Preserve or add green spaces like parks, urban forests, and community gardens to counter the heat island effect.

- Evapotranspiration in combination with shading can reduce temperatures between 1°C and 5°C (EPA, 2022).

While greening cities can offer numerous benefits, including improved air quality, enhanced aesthetics, and increased biodiversity, it is important to implement appropriate vegetation choices and management practices to minimize water usage and waste.



© City of Lviv

## Improved ventilation/air conditioning systems of buses & metro

Enhance the ventilation and air conditioning systems of buses, trams and metro trains to provide better cooling for passengers.

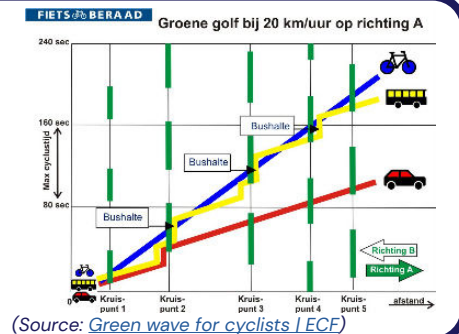


© Soninha Vill / GIZ Brasil

## Priority signalization for pedestrians and cyclists

Implement priority signalization for pedestrians and cyclists, such as a „green wave“ for bicycles at 15–20 km/h on major cycling routes, to reduce waiting times and improve travel experiences.

Example: [Green Waves for bicycles in Copenhagen | Centre For Public Impact \(CPI\)](#)



## Facilities for washing and changing

Provide adequate facilities for cyclists to freshen up and change clothes after their commute, ensuring they can maintain personal hygiene and feel comfortable after cycling.

## Bus/tram shelters

By building shelters in most of the public transport stops, you introduce a shaded / fresher stop moment and give passengers (as well as bypassers) a space for relaxation out of the extreme heat. In combination with green roofing and green facades, it has a cooling effect through evapotranspiration. In addition, it should be surrounded by trees so that there is still enough shade due to the movement of the sun.



(Source: Design: Taller ARQUIURBANO. Photography: Alejandro Arango)



## Long-term measures

In the **long run** some measures are much more fundamental and need a long time until they can be implemented:

### Ventilation/ fresh air corridors

Meadows and other green areas cool overnight and produce cold air. If suitable green corridors exist, this air flows into populated areas and provides comfortable temperatures.

Maintain these open pathways for fresh air circulation in cities. Ensure that buildings and new construction areas do not obstruct these corridors to preserve the cooling effect.



© Authors

### Urban design

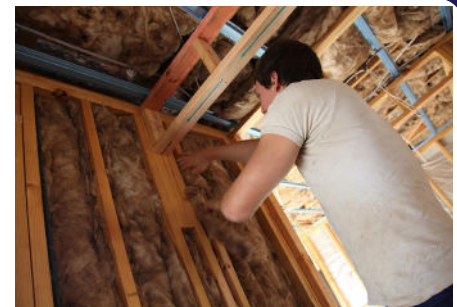
Plan cities with strategies to withstand and mitigate heat, including narrower streets, reduced sealed surfaces, and the incorporation of colonnades. Learn from historical urban design practices that utilized narrow alleys and covered markets to provide natural cooling in hot climates.



© Authors

### Building guidelines

Guidelines for the construction of buildings should adapt with regard to climate change. Buildings should have good thermal insulation in summer and low heat loss in winter. In addition, the orientation of the building with its windows should not face the direct sun and the window to wall ratio should remain low.

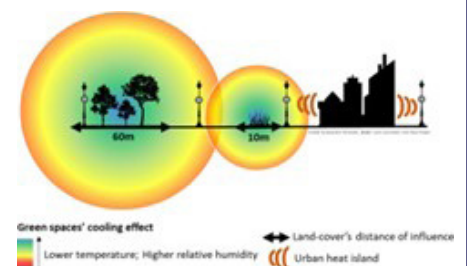


Insulation © RachelWI

### Trees, trees, trees

Plant trees throughout urban areas to serve as natural heat sinks, provide shade, and reduce the urban heat island effect. Trees' canopies help cool the air, while their leaves absorb and filter pollutants, enhancing air quality. Additionally, trees aid in water management by absorbing rainwater and reducing the risk of flooding and soil erosion. Consider tree species that can withstand intense heat and little water.

Example: Strasbourg/France  
<https://www.strasbourg.eu/plan-canopee>

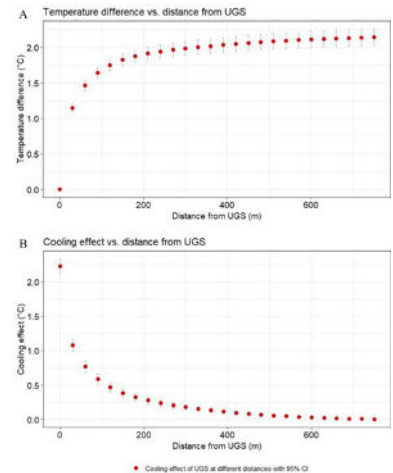


(Source: ScienceDirect)

## Green infrastructure

Implement green infrastructure measures such as parks, green roofs, and urban gardens. These spaces act as cool oases, offering relief from the heat and providing gathering places for communities. They also promote biodiversity, create habitats for species, and contribute to ecosystem health. Green infrastructure aids in stormwater management by capturing and filtering rainwater.

- Increasing tree coverage to 30% would cool cities by mean of 0.4°C. (Lungman, et al., 2023)



(Source: Shah, Garg and Mishra, 2021)

## 15-minute cities

Embrace the concept of 15-minute cities, which promotes mixed-land-use planning to minimize walking and cycling distances. By keeping travel distances short, heat stress on the human body can be reduced.

Read more: <https://transformative-mobility.org/multimedia/the-15-minute-city/>



© TUMI, 2021

## Administrative approaches

Government or local authorities should develop effective coordination mechanisms at both inter and intra-departmental levels to address heat waves. This can be achieved through the establishment of heatwave committees and the appointment of chief heat officers, as seen in various cities and states worldwide. These committees, led by a designated coordinating agency (e.g. the Disaster Management Authorities) should be formed at different administrative levels, such as states and districts.

The coordinating agency should collaborate with relevant departments such as health, transport, education, and energy, ensuring smooth communication and timely dissemination of information. Additionally, the committees can organize training programs and capacity building initiatives. It is also important to involve civil society organizations in these efforts to ensure a comprehensive and coordinated response to heat waves.

Another good approach is to find synergies between health programs and heat adaptation programs, especially in social isolation and aging programs, to create synergies between the two.

Local governments are key to the implementation of heatwave measures. Therefore, local heatwave adaptation plans are important, as well as local emergency teams and integration with other institutions such as local organizations working with the elderly, homeless etc.

Measures against heat can be summarized in heat action plans and related guidance documents. Find a selection of examples on the following pages.

## UK: Hot weather and health:

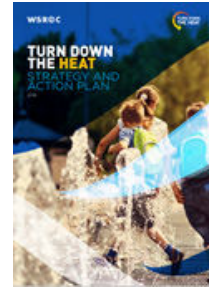
This guidance helps professionals and the public address those risks.

[Hot weather and health: guidance and advice](#)

## Turn Down the Heat Strategy and Action Plan: Western Sydney Regional Organization of Councils/Australia

The action plan is organized around five strategic drivers that represent the resilience outcomes that can be achieved through implementation of this strategy:

- Take Action together
- Design and plan to cool the built environment
- Cool with green space water
- Build a community that is healthy and prepared
- Innovative and responsive infrastructure

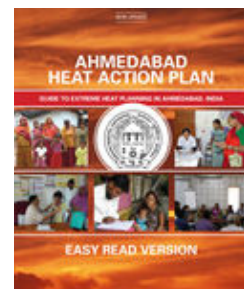


(Source: [ghhin.org](#))

## Ahmedabad Heat Action Plan

Key Strategies:

- Building Public Awareness and Community Outreach
- Initiating an Early Warning System and Inter-Agency Coordination
- Capacity Building Among Health Care Professionals
- Reducing Heat Exposure and Promoting Adaptive Measures



(Source: [nrdc.org](#))

## France

15 Flagship actions to cope with heat waves – Summer 2023

On national level, the French heat action plan is organized around four main axes:

1. Limiting the impact of the daily lives
2. Ensuring continuity of basic public services
3. Ensuring continuity of economic life
4. Protecting the natural environment and resources

Immediate measures include the census of cool islands and public fountains in the communes, dissemination of prevention messages in transport and the control of refreshed rooms that can accommodate exams for youth. (Ministère de la Transition écologique, 2023)



(Source: [Ecologie a](#), [Ecologie b](#))

## Vienna – Heat Action Plan

The Vienna Heat Action Plan sets out measures to prevent the city from overheating and to cope with the heat in acute cases. Health, nursing and care facilities are prepared for „emergencies“. The main goal is to protect the population from the negative health effects of heat.

The focus of the heat action plan is on acute measures and measures that need to be taken at relatively short notice in order to be well prepared for heat waves in summer. The measures range from urban cool spots to the establishment of heat standards for hospitals and care facilities.



(Source: [wien.gv](http://wien.gv))

## Germany – National heat action plan

Germany has announced a national heat action plan with measures such as targeted addressing sick and elderly, educating them about symptoms of impending heat stroke or heat death. The possibility of cold shelters and free water dispensers would also be explored (Spiegel, 2023). In June 2023, the German government has launched a webpage, <https://hitzeservice.de/>, with recommendations for municipalities.



## Approach

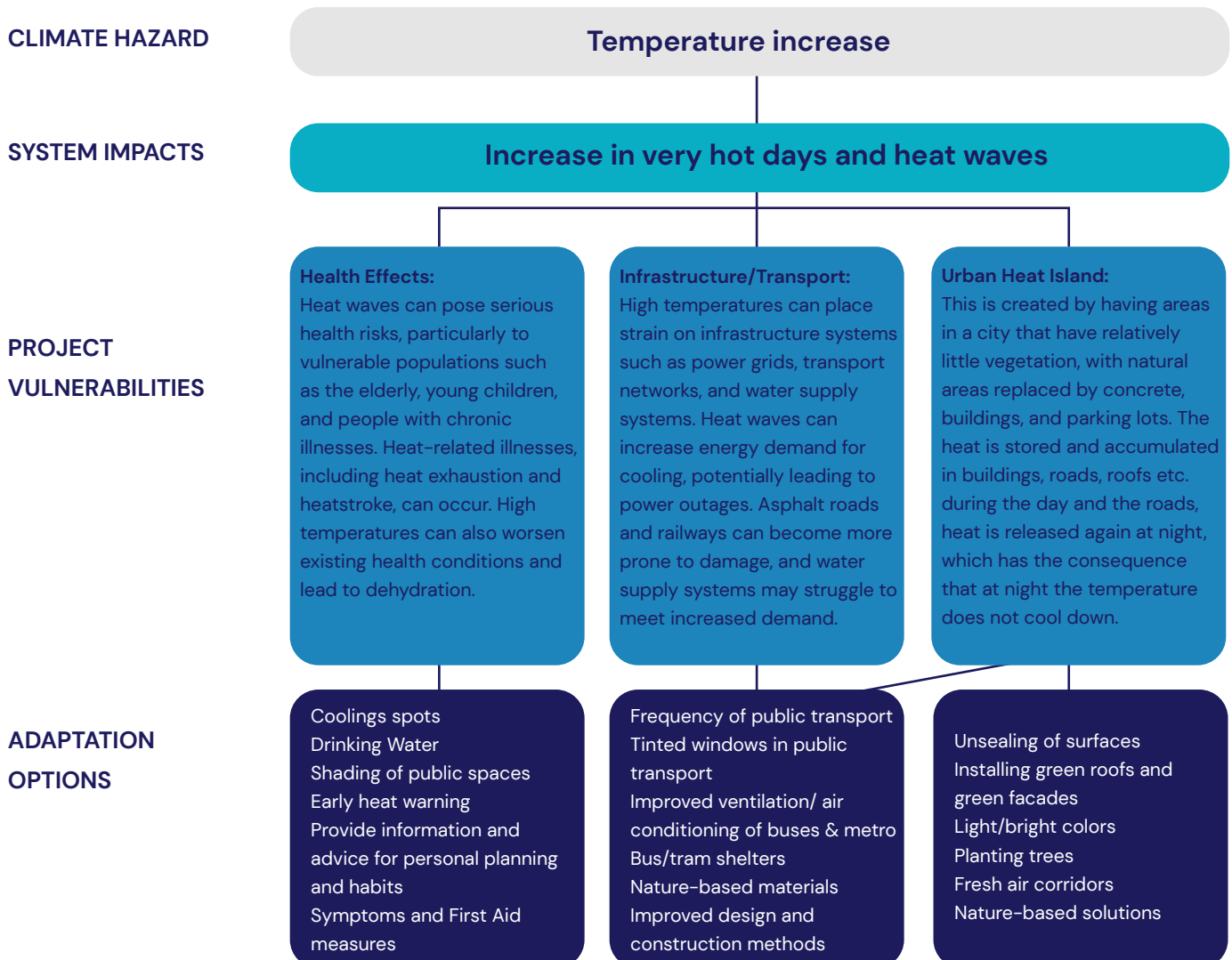
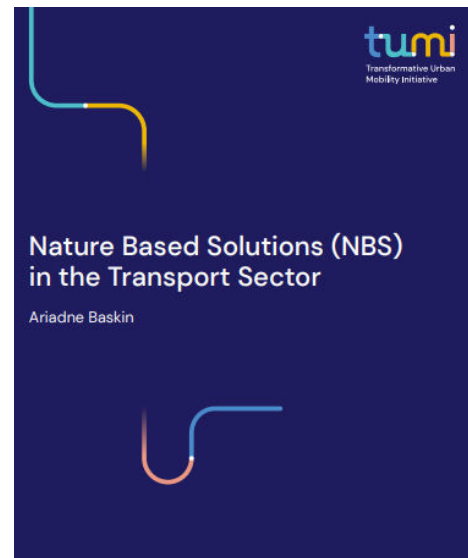


Figure based on: [SUTP, 2021](https://www.sutp.de/)

# Summary

As cities grapple with the challenges of heat waves, it is crucial to implement measures to protect residents and infrastructures. In the short term, cities can establish cooling spots like libraries and museums, provide free drinking water, adjust public transport frequency, create shaded public spaces, issue early heat warning and in general raising awareness how to cope with extreme heat through suitable campaigns. Medium-term measures include replacing heat-absorbing surfaces like concrete with green infrastructure such green urban spaces and blue infrastructure such as water ponds, using nature-based solutions like installing green roofs and facades, and planting trees for shade. Unsealing sealed surfaces is the basic measure for creating a less heat-absorbing urban environment. Long-term strategies involve preserving fresh air corridors, planning cities to withstand heat, and prioritizing green infrastructure.

Learn more in our thread: [TUMI Initiative](#)



Read also: [Nature Based Solutions \(NBS\) in the Transport Sector](#)

The paper explores how nature based solutions (NBS) in urban transport offer the potential to build resilience and adapt to the effects of climate change and address the transport infrastructure gap.



Read also: [Adapting Urban Transport to Climate Change](#)

Many transport decision-makers in developing countries are already confronted with extreme weather events, such as flooding, sea level rise and storms, all of which are expected to increase with climate change. In the worst case, transportation systems may not be able to recover between such events, resulting in exponential damages. This module is intended to raise awareness and describes the expected impacts of climate change on urban passenger transport as well as possible adaptation measures.

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