Analysis

CITIES TAKING THE HEAT: ADAPTATION AND HEATWAVE PREPAREDNESS IN EUROPE

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EXECUTIVE SUMMARY

In the run-up to the summer of 2025, European cities are bracing for yet another season of record-breaking temperatures. Heatwaves pose a serious challenge for urban areas when it comes to infrastructure, economy, public health and ecosystems. Heat-related hazards now account for over 85% of climate-related fatalities across Europe.

This paper has four main objectives, reflected in its structure as follows: first, to explore the impacts of heatwaves upon cities and urban populations in general, placing it in the wider context of climate change and how it falls within the wider EU policy priorities.

Heatwaves pose a serious challenge for urban areas when it comes to infrastructure, economy, public health and ecosystems.

The second objective is to introduce the most relevant types of adaptation measures designed to counter the impacts of urban heat. The interventions discussed most notably include nature-based solutions. While green infrastructure (i.e. green corridors, roofs, facades, or schoolyards) harnesses the power of greenery, blue infrastructure (i.e. wetlands, natural and artificial water bodies or permeation techniques) builds on the potential of water.

Further, the paper discusses the relevance of technical aspects such as materials, surfaces and cooling used in urban areas. This is to explore measures of different technological sophistication, from painting streets white to developing bioclimatic facilities and surfaces.

The third objective is to explore the most effective measures of heatwave mitigation, drawing on examples from cities regularly affected by extreme

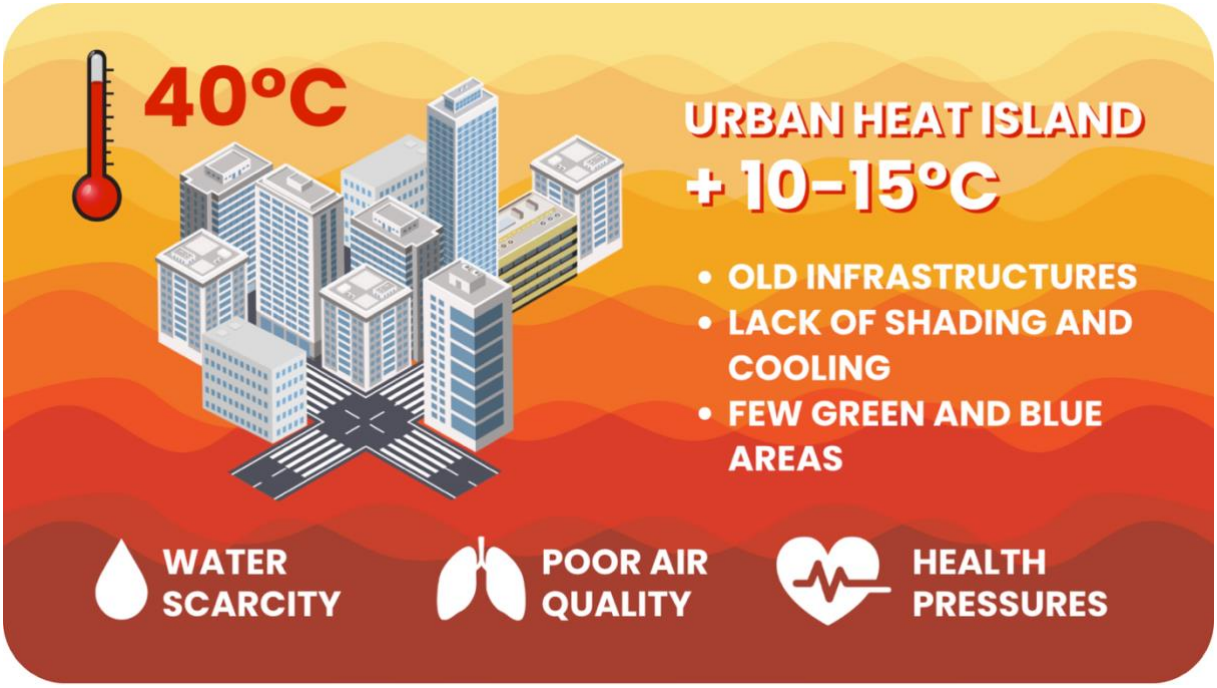
seasonal heat. The practices discussed include climate shelters, temporary shading elements and water-based installations.

Finally, the fourth objective is to open the question of governance and public awareness. Specifically, the paper puts forward the importance of political leadership, crisis management and public engagement in facing climate emergencies such as heatwaves.

Drawing on innovative practices from Europe and beyond, the paper aims to offer an overview of the most relevant solutions currently available. Reflecting on their strengths and limitations, it attempts to contribute to the relevant policy and public discussion about how to counter the next heatwave.

Facing Climate Emergencies: Heatwaves as a Global Phenomenon

Cities are increasingly affected by impacts of climate change. The looming threshold of global surface temperatures increasing by 1.5°C above pre-industrial levels has global consequences, well covered by the Intergovernmental Panel on Climate Change (see IPCC, 2018). The local impacts of the warming climate, however, are particularly visible and acute in urban areas.



The 2024 Global Climate Highlights by the Copernicus Climate Change Service released in January 2025 confirmed that 2024 was the hottest year on record (beating the previous record year of 2023), with a global average temperature 1.48°C above the pre-industrial baseline. Multiple records were broken; Europe experienced its second warmest year on record, with extreme

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heat conditions particularly affecting southern regions such as Spain, Italy, and Greece. Record sea surface temperatures, the highest global annual mean for ocean temperatures, and reduced polar ice cover were all observed in 2024 (Copernicus, 2025a).

Heatwaves are now among the most serious natural hazards in Europe, demonstrating the lethal consequences of extreme heat. Heat-related hazards now account for over 85% of climate-related fatalities across Europe. Focusing on the period between 2000–2019, studies have shown that approximately 489 000 heat-related deaths occurred globally each year, with 36% of these in Europe and 45% in Asia (World Health Organization, 2024). In the year of 2003 alone, an unprecedented number of casualties – over 70,000 – was due to extreme summer temperatures in Europe (Ballester et al, 2023).

Europe Taking the Heat: Cities, People and Ecosystems

Why do climate extremes cause such serious problems for cities? Urban areas literally turn into hotspots due to the concentration of concrete and glass-covered buildings, paved areas and a relative lack of natural elements such as greenery and water (compared to semi-urban or rural areas). Due to the materials predominantly used in urban areas, heat is absorbed by surfaces and objects, further warming up the air and the surrounding areas. Without sufficient shading, technical cooling and blue-green infrastructure, surface temperatures are difficult to bring down. Throughout hot summer seasons, this has serious impacts on the entire urban ecosystems and the liveability within them.

Europe has some of the oldest city centres in the world, with 42% of all buildings built prior to 1950, with an average renovation rate at around 1% of buildings per year (Economidou et al., 2019). Old infrastructures are not easy to maintain – and generally not adapted (or adaptable) to withstand current and future climate conditions.

Climate risks in cities extend beyond temperature and include water scarcity, reduced air and water quality, and increased health pressures, particularly affecting vulnerable populations.

Urban environments can be up to 10–15°C warmer than surrounding areas due to the urban heat island (UHI) effect, with growing vulnerability due to heatwaves and rising nighttime temperatures. UHI exacerbates the impact of heatwaves, placing immense stress on urban populations, infrastructure, public health systems, and ecosystems.

Furthermore, climate risks in cities extend beyond temperature and include water scarcity, reduced air and water quality, and increased health pressures, particularly affecting vulnerable populations. Life expectancy in Europe is rising, while birth rates are decreasing. Taken together, Europe's increasingly older population will be left more vulnerable to climate change (European Environment Agency, 2024, p. 15).

Urban Resilience and Climate Adaptation as EU Priorities

The European Union has long recognized the impacts of climate change on cities and regions, and has come up with rigorous programs to adapt its economy, society and ecosystems, widely framed as the green transition.

In the context of cities specifically, the European Covenant of Mayors for Climate & Energy launched in 2008 has brought together over 10,000 urban authorities for the purpose of climate action in (and by) cities. While this initiative is voluntary, it

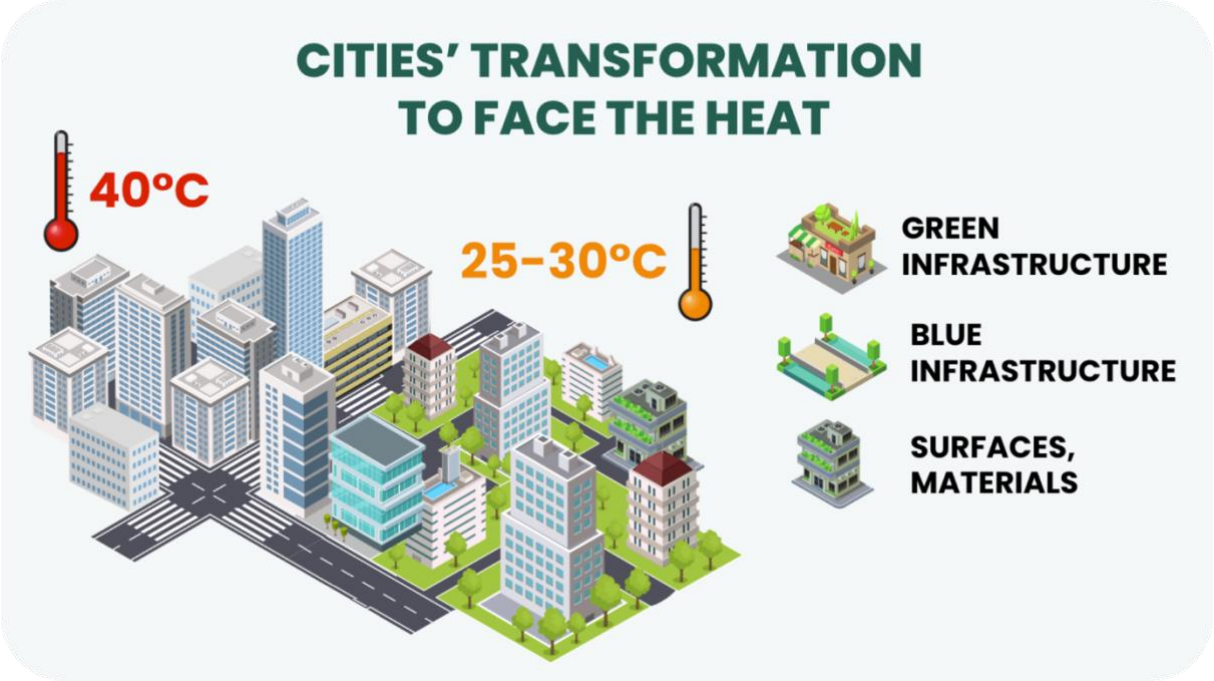
has become a powerful international platform for thousands of committed European mayors to adapt their cities to climate change (see ECMC, undated). Furthermore, the European Commission has partnered with the European Environment Agency, a respected authority in the field of climate research, in order to launch Climate-ADAPT platform. This now serves as a knowledge hub for adaptation actions, funding, and relevant case studies across European cities (Climate-Adapt, undated).

Climate adaptation of cities indeed requires considerable funding and investment. Horizon Europe counts with a Cities Mission under the current programming period. This means that the key EU's research and innovation program has allocated considerable resources to help 150 regions and communities become climate-resilient by 2030 (European Commission, undated). Another European funding program, LIFE, has also supported city-led initiatives to implement nature-based solutions,[1] heat resilience measures, and climate-proof infrastructure (CINEA, undated). The European Urban Initiative, for its part, offers financial and expertise support to implement urban innovations and build capacity of municipal staff. A considerable part of these fall under the priority area of climate resilience and adaptation (European Urban Initiative, undated).

[1] Nature-based solutions are strategies that harness natural resources and processes—like planting trees, restoring wetlands, or greening rooftops—to tackle climate challenges while making urban areas cooler, healthier, and more liveable.

From Blue and Green to Light Grey: Cities' Transformation to Face the Heat

Adapting cities to a warmer climate has become a cornerstone of urban policy and planning. The following pages explore a range of practical and innovative strategies cities in Europe and beyond have used to address heat stress. In particular, these practices evolve around nature-based solutions, emergency response strategies, public governance, and community engagement.



Green Infrastructure: Greening for Cooling

Green is the new gold – especially when it comes to adapting cities to climate change. Urban greenery is among the most effective and multifunctional tools for climate adaptation. Vegetation cools the urban environment through evapotranspiration and shading, reduces the UHI effect, and enhances biodiversity and overall quality of life.

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As of 2018, green infrastructure constituted about 42% of urban land across European cities, but the accessibility of green spaces has remained uneven. For instance, only 3% of city land is constituted by publicly accessible green space (such as parks) on average. Some cities do much better in this regard than others – for instance, Geneva or The Hague boast over 15% of the city land covered by publicly accessible greenery (European Environment Agency, 2024, p. 87). Beyond standard parks and tree lanes, some more innovative greenery-based solutions have gained popularity in the recent decade, from tree-covered urban corridors to green roofs, facades and schoolyards.

Green Corridors and Superblocks

The city of Madrid has made headlines for developing an extensive Metropolitan Forest, effectively creating a vast green belt with a projected 2 million trees (Durrer, 2023). This scale of urban greenery is quite unique in Europe, where urban density somewhat limits development of vast green areas. This is why green corridors have gained prominence, growing within the existing urban fabric. They have appeared in multiple metropolises, including Vienna and Berlin. Green corridors bring an added value by connecting to the existing parks and forests, creating 'ventilation lanes' for cool air to circulate. They also literally serve as green backbones within densely built urban environment, providing spaces of shade, fresh air and leisure for the cities' residents.

In Barcelona, green corridors are referred to as "ejes verdes" (green axes). The city has come up with an integrated approach to urban greenery. Barcelona is turning selected streets into shaded and pedestrianized spaces full of greenery, integrating principles of safety, social inclusion and climate adaptation together. The existing network of green axes has substantially grown over the years, intersecting together in urban plazas, serving as extended green public spaces (Urbidermis, 2025). The Catalan capital has also pioneered the concept of "supermanzanas" (superblocks). These take advantage of the dense block-based urban planning of the city, turning selected areas composed by 9 (3x3) blocks into green, traffic-free and pedestrian-focused spaces (Castrezzati, 2023). This practice has inspired countless cities and towns across Europe to bring similar (albeit smaller scale) projects to life.

Redesigning schoolyards and playgrounds

Adapting school buildings and facilities to the changing climate is also bringing interesting innovations. Under a project named OASIS, Paris is transforming

hundreds of schoolyards into shaded cool islands, targeting the most heat-prone districts. The innovation lies in the type of materials used for infiltration, thermal performance, and low carbon footprint. It also counts with rainwater recovery systems and nature-based solutions to enhance shading, evapotranspiration, and drought resistance (Portico, 2022a).

Redevelopment of schoolyards to withstand increased risk of urban heat is also part of above-mentioned Barcelona's climate plan. Within the larger framework of Barcelona's climate shelters, dozens of schoolyards have been redesigned, integrating greenery and water elements, broadening the areas protected by shading and creating a more liveable environment. This benefits the students but also the residents and communities as all climate shelters are publicly accessible (Portico, 2022b).

Other European cities have focused on playgrounds. In summer, shadeless "desert" playgrounds become empty on hot days due to high temperature. To address this problem, the city of Poznań in Poland has designed several natural playgrounds, using materials such as wood, sand, grass and earth, instead of commonly used synthetic ones (Soos, 2021). Integrating natural elements and bringing in a significant portion of greenery and shade brings children closer to the nature and creates a bearable, shaded environment which is priceless for the hot days of summer.

Green roofs, walls and parking lots

Imagine rooftops not as heat traps, but as lush, living landscapes. That's the potential of green roofs and walls — they are natural air conditioners, keeping buildings cooler while soaking up rainwater and cleaning the air. This is why many cities in Europe have supported – sometimes even mandated – greening the buildings' surfaces where possible. In addition to roofs, designing green walls has

also been on the rise, due to a similar set of advantages – in short, cooling effects like shading and transpiration (see Koch et al, 2022).

Basel in Switzerland passed an amendment to its Building and Construction Law in 2002, requiring all new and renovated flat roofs to be greened (Climate-ADAPT, 2020). Since 2010, the Danish capital of Copenhagen has required that all municipal buildings have green roofs if technically possible, that is, if roof slopes are less than 30 degrees (Interlace, undated). Amsterdam's RESILIO project has deployed smart blue-green roofs that retain rainwater and provide cooling, with monitoring technology embedded (Portico, 2023). The City of Brno in Czechia has run a grant program for green roofs that led to development of dozens of local projects. However, new approaches sometimes require adjustments. The city has recently conditioned its financial support by requiring roofs to boast at least 10cm depth of substrate in order to reduce the vulnerability of vegetation to prolonged drought (Archiweb, 2024).

With many European cities partially to largely dependent on car traffic, vast carparks have become a challenge both in terms of urban planning and heat adaptation. This is because most standard parking lots have been designed as soulless slabs of asphalt. However, innovative green solutions have been developed in some cities, with the use of permeable or semi-permeable paving and lush landscaping to soak up rainwater (see Naturally Resilient Communities, undated). One of such flagship projects is the Green parking facility in Rotterdam, the Netherlands (Mobilane, undated). As a result of such adaptations, parking zones can be turned into cooler and greener pockets of the city.

Blue Infrastructure

Harnessing Water for Urban Cooling

The second key element to the “magical” green-blue matrix, water is a precious resource to be harnessed for the purpose of urban climate adaptation. Blue or water-based infrastructure is increasingly being developed not just for flood mitigation, but also for the sake of urban cooling and biodiversity.

Embracing Wetlands and Rain

Cities are looking for innovative ways of using and protecting water resources, preventing flood or drought, and creating quality public spaces. In cooperation among several municipalities, the Vlijmen-Den Bosch natural buffer area in the Netherlands has integrated 750ha of agricultural, natural and recreational areas into a natural overflow and water retention area (European Environment Agency, 2024, p. 94). The City of Malmö, Sweden has developed a sustainable drainage system in a broader effort to reach climate resiliency. The project has improved the local biodiversity by increasing wetland habitat for animals and plants, and has provided additional spaces of recreation for the residents (Adapterra, undated a).

Meanwhile, the city of Gothenburg in Sweden, where it rains 40% of the time, is promoting creative initiatives such as “Rain Gothenburg”. This is to celebrate and use the rainfall, treating it as a resource by creating rain playgrounds or visible stormwater channels in schoolyards (European Environment Agency, 2024, p. 95). Rain-focused adaptation measures have also been embraced by private developers. The headquarters of the CSOB Bank located in Prague’s 5th district has gained international recognition for its rainwater management techniques. The Bank campus draws rainwater from its roofs into storage tanks, using it to irrigate intensive green roofs and greenery around the buildings (Adapterra, undated b).

Natural and Artificial Water Bodies

Cities of all sizes across Europe have used their lakes, rivers and canals as thermal buffers. Urban riverside areas have been developed for better flood resilience as well as places for leisure. The City of Copenhagen has designed a floodable park for this purpose. The Enghavepark project's main innovation lies in redirecting rainwater to a vast reservoir and a retention chamber. Rainwater thereby becomes a valued resource, circulating in a channel for visitors to interact with, and utilized in a fountain garden. In periods of heavy rains, the gates close, which allows the park to absorb a large volume of water and thereby protect the nearby urban district (see Third Nature Architects, undated).

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The Spanish city of Seville, which has faced serious heatwaves and droughts over the years, has revived ancient Persian "qanat" water tunnels to cool streets in a passive, energy-efficient manner. The system of underground water channels and vertical shafts that pump the water upwards to cool down buildings and spaces has a persuasive use case in a city where summer temperature regularly tops 40 degrees (Chase-Lubitz, 2024).

Water Retention and Permeation

Cities throughout Europe have experimented with semi-permeable or permeable surfaces in order to prevent the loss of rainwater to the drainage system. The objective is to retain as much rainwater as possible to be used for evaporation and irrigation of the existing greenery in times of heat stress. This is particularly relevant in regions affected by prolonged drought periods.

The city of Rotterdam's Climate Change Adaptation Strategy set the priorities more than a decade ago, pledging to develop underground water storage and infiltration facilities, namely Johan Idaplein and Centraal Station (City of Rotterdam, 2013, p. 88). The city of Prague has restored its vast Stromovka park, developing multiple ponds and replacing tarmac paths by packed gravel, to ensure natural permeation of water (Adapterra, undated c). The London Sustainable Drainage Action Plan and its relevant sectoral plans set an annual target of adapting 50,000 m^2 of impermeable surface to improve water permeation and strengthen flood resiliency (C40 Cities Climate Leadership Group, 2022). Multiple cities in China have adopted a 'sponge city' strategy of permeable paving street upgrades since 2015, which has been found to be highly effective at managing heavy rainfall (ibid).

Building Cities to Be Cool: Surfaces, Materials and Cooling

Trouble with AC

In large part of Europe, cooling of interiors is often necessary in the peak of summer, although classical air-conditioning has its economic and ecological drawbacks. First, it is relatively expensive, pointing to the issue of resources and social inequality. Second, it consumes a lot of energy in order to temporarily cool down a specific commercial or housing unit, while excess heat is literally pumped outside, putting the very sustainability principle into question. Third, many European cities and towns restrict the installation of air-conditioning units in selected streets or entire neighbourhoods, due to heritage protection codes.

As a result, mechanical means of air-conditioning are not as commonly used in Europe compared to other world regions such as the United States. This is where the negative externalities such as the outdoor heat emissions and the considerable energy consumption connected to standard AC use in large glass

buildings are most pronounced. Furthermore, overreliance on AC cooling systems in fact makes the US cities and populations more vulnerable in case of a sudden technical breakdown or a blackout. A recent study has shown that a two-day blackout in Phoenix, Arizona, where heatwaves are frequent, could in worst case scenario leave half of the population hospitalized and kill as many as 12 thousand residents in their own homes (Stone et al, 2023).

Passive Cooling Measures

For the reasons described above, passive cooling measures often make more sense than mechanical cooling. For example, the Spanish city of Zaragoza has constructed bioclimatic social housing that maximizes summer shading and winter solar gain. This enhances thermal comfort without relying on energy-intensive solutions. Passive house approaches[2] are gaining popularity across Europe as indoor thermal comfort becomes a public health necessity, particularly for vulnerable populations who spend 80–90% of their time indoors (European Environment Agency, 2024, p. 75).

Equally related to passive cooling, some innovative materials and interventions are increasingly emphasized in European urban design. The Spanish capital Madrid has used white roofs and photocatalytic surfaces to reflect solar radiation and improve air quality (ibid.). In Paris, traditional zinc roofs are being adapted and thermally insulated to reduce overheating (Mooney, 2025).

[2] These are strategies that maximize natural heating, cooling, and ventilation to maintain comfortable indoor temperatures year-round with minimal energy use.

Keeping public places such as squares cooler also makes a big difference. Rethymno, Greece has designed bioclimatic public squares using cool pavements. Measured results showed a surface temperature reduction of 8.45°C and improved user thermal comfort by 46% (European Environment Agency, 2024, p. 76).

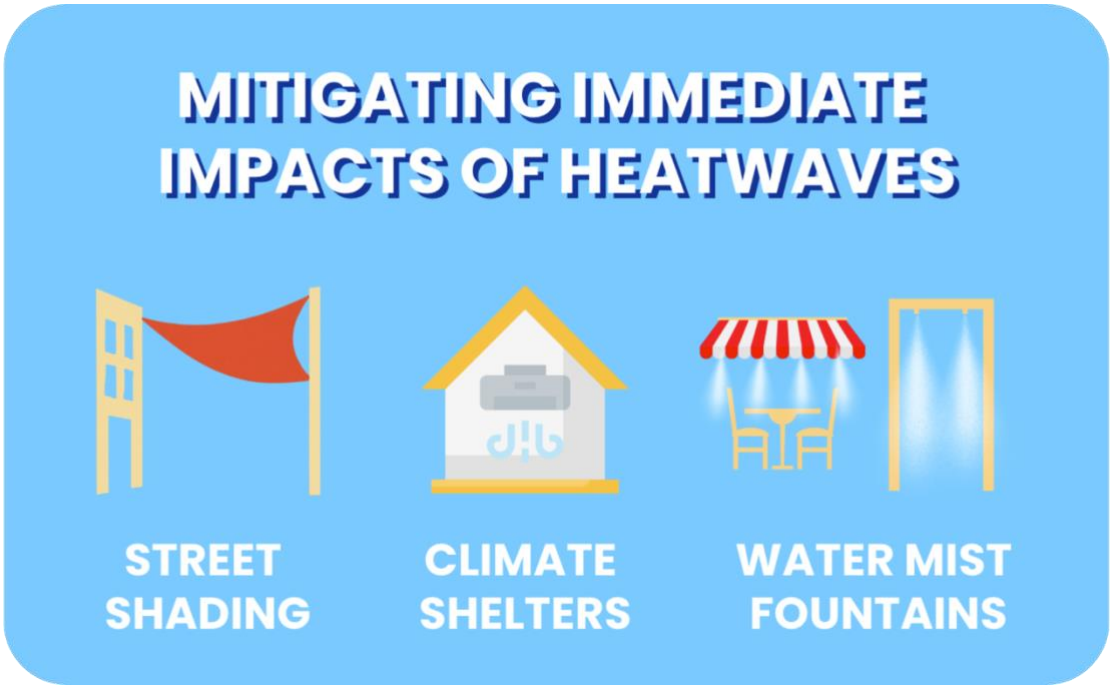
However, reflective surfaces come with an unexpected drawback. Multiple studies have found that the glare from the reflective coating in fact increases the heat directly above it.

The city of Los Angeles, California has painted some of its streets white, to reflect sunlight and reduce surface temperatures (Capatides, 2018). The city of Phoenix, Arizona has come up with light grey coating for its paved roads, hoping to reduce unbearable surface temperatures in the summer.

However, reflective surfaces come with an unexpected drawback. Multiple studies have found that the glare from the reflective coating in fact increases the heat directly above it. Thus, a person standing on the studied pavements felt several degrees warmer compared to a regular (non-reflective) pavement (Poon, 2023). This points to the conclusion that even the seemingly logical adaptation solutions should not be taken as a silver bullet; each new solution should be properly tested before being widely implemented.

Mitigating Immediate Impacts of Heatwaves

While long-term adaptations are key in preparing cities to face climate change, immediate heatwave responses are just as essential. Taking a proactive approach can help to prevent or reduce the worst impacts of high temperatures. Due to their vulnerability and exposure, southern regions of the United States and Europe already had to adopt a set of preventive measures as standard practice.



Climate Shelters and Cooling Centres

Cooling centres or climate shelters – with the terminology varying from one region to the next – refer to publicly accessible buildings and facilities equipped with air-conditioning, drinking water and seating spaces. Designed to help citizens withstand the worst of heatwaves, these places are set up by city authorities in order to serve anyone – but predominantly the most vulnerable populations.

Commonly referred to as cooling centres across the United States, these have been set up across the country, with particular concentrations in places like Phoenix, Arizona. The cities either use existing public buildings such as school

gyms, libraries or museums. Repurposed shipping containers equipped with air-conditioning and necessary interior equipment present another alternative. However, practice has shown that setting up cooling centres is not enough for people to start using them. Weak public awareness or inconvenient locations might pose major obstacles. According to a study which mapped 1.433 cooling centres across the US Southeast, only 36% of the region's population lives within a 15-minute drive from one (see Hirji, 2024).

The issue of physical and social access has been tackled with more success in the Mediterranean region. This is partly due to the fact that European urban areas are denser. Also, they are usually served with good quality public transport which helps access without necessarily using cars. All of this makes it easier to strategically place climate shelters within reach of urban populations. The city of Barcelona, well-known for its proactive approach to heatwave management and public health, has recently broaden the range of climate shelters to also include places like pharmacies. The current count of active climate shelters is over 380 in the run-up to the heatwave season of 2025 (see Ayuntamiento de Barcelona, 2025). In contrast to the US cities, Barcelona has held up a 10-minute access rule – over 98% of the city's residents live within 10-minute walk from the nearest climate shelter, while 68% can access one within 5 minutes (Ayuntamiento de Barcelona, 2024).

The current count of active climate shelters in the city of Barcelona is over 380 in the run-up to the heatwave season of 2025.

Temporary Shading and Water-Based Installations

Bringing shade and water elements to the streets is another way of mitigating the worst of impacts brought by urban heatwaves. Spanish cities have plentiful experience with a variety of urban umbrellas and canopies, which have become a

stable part of street fabric throughout the entire summer season. From villages and small towns in Andalusia all the way to Spanish metropolises, fabric canopies have been designed using plain white, beige but oftentimes also typical municipal colours.

Barcelona has an ambitious plan to create over 200 new shaded spaces by 2027, particularly on children's playgrounds, schoolyards and busy streets and squares especially vulnerable to heat. These will have a form of either fixed shading structures integrating solar panels to generate clean energy, but also of temporary structures such as urban umbrellas meant for the months of the most intense heat (Ayuntamiento de Barcelona, 2025b).

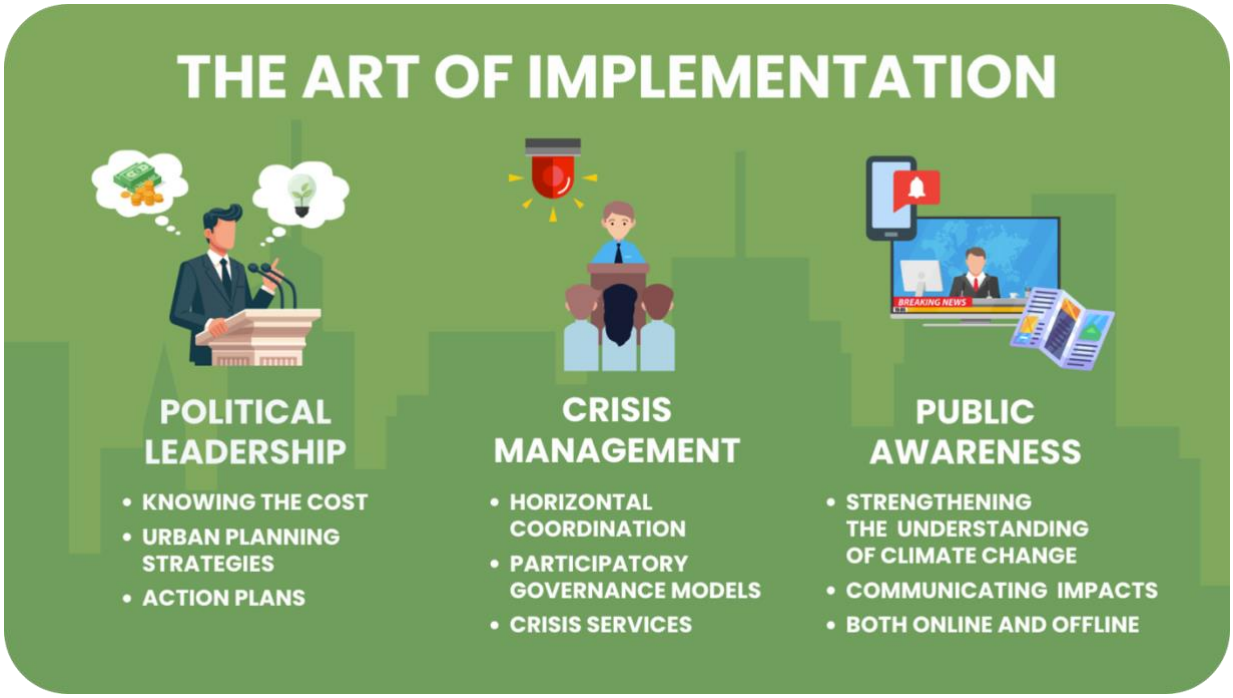
In the meantime, the city of Sevilla has commenced with installations of seasonal fixed shading canopies over one third of its urban streets at the end of this past April. The shading elements will remain in place throughout the entire summer, possibly extending into the fall, depending on the climatic conditions in the city preparing for another season of heatwaves (Aranda, 2025). Time2Adapt project designed to help European cities such as Lille, France, has also introduced the use of mobile shading devices and pop-up urban furniture to create adaptable outdoor refuges for times of heat stress (Bonneau, 2024).

European cities have also come up with innovative ways of bringing water mist to cool down heat-affected urban districts. Mobile fountains, misting systems and drinking water stations have appeared throughout European capitals such as Brussels, Paris, Lisbon, Prague, Rome and countless others, including smaller towns and villages. These are relatively inexpensive but very effective as short-term heatwave mitigation measures. In addition, historical fountains have been upgraded in urban centres such as Athens, now serving a dual purpose of cultural heritage and climate adaptation.

The city of Vilnius, Lithuania has a practice of installing a mobile mist system operating in conjunction with the city's water supplier. This is used to cool down the Town Hall square during the days of summer heat (Iolov, 2023). Barcelona has installed misting systems in schoolyards and parks to reduce ambient temperatures and provide hydration points. This has become invaluable in the city regularly affected by heatwaves (Portico, 2022b).

The Art of Implementation: Governance and Public Awareness

Adaptation comes at a high financial cost. The above-described measures and practices are often technically complex, intervening with a multitude of previously existing urban engineering networks, building and heritage protection codes – needless to say they are typically very costly and take years to implement. The measures also fail to work in a copy-paste manner, as each city is unique.



Political Leadership and Climate Adaptation

Cities which have been successful in facing climate emergencies typically have a political leadership cognisant of the impacts of climate change, that is, knowing the cost of inaction. While political directions shaping cities' agendas usually change every few years with each new municipal elections, climate adaptation has found its way to urban planning strategies and action plans. This also has to do with the fact that the European Union funding often requires rigorous climate adaptation strategies on the side of the projects' beneficiaries (i.e., cities). On top of that, climate emergencies such as heatwaves, severe storms or floods have become more frequent, helping to strengthen the climate adaptation momentum despite some criticism coming from the grounds of "unnecessary" or "too high" public expenditure.

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The Action Plan for Climate Emergency 2030 of the City of Barcelona is an example of an integrated approach. At the municipal level, a climate office and a political-technical working group were created to specifically address climate change, bringing together representatives from all municipal departments. In addition, specific meetings were held with technical staff from municipal departments involved in managing climate emergencies. Several informational sessions were conducted, and an internal participation session has taken place with all municipal management units to define and agree on the measures included in the Plan. Furthermore, several cross-departmental working groups have been established for major flagship projects with high complexity, as well as for targeted sectors such as energy or transport (Ayuntamiento de Barcelona, 2021).

The Art of Climate Crisis Management

Preparing an adaptation plan is one thing – managing a crisis already unfolding is quite another. Here also, municipal authorities, agencies, businesses and communities must work together in what is a multi-stakeholder arena where successful strategies involve horizontal coordination across city departments and participatory governance models (see European Environment Agency, 2024).

When it comes to managing the impacts of heat specifically, Chief Heat Officers have been appointed in many cities around the world. This practice was first introduced in Athens, with cities like Miami and others following suit. This reflects a growing institutional commitment to urban heat resilience. The mandate of the Chief Heat Officer is to coordinate across departments and engage with the public to ensure preparedness and response measures are equitable, efficient, and science-based (European Environment Agency, 2024, p. 145).

Heatwaves are a type of climate emergency, and thus require the entire system to me mobilized – including the City authorities responsible for environment and public health, emergency services (above all, medical), and key municipal agencies such as transport, water and energy, due to heat impacts upon critical infrastructure. These need to directly reach local communities, particularly those more exposed or vulnerable. Building functional connections among all these stakeholders in times of normalcy is a prerequisite for mobilizing an effective response in once a heatwave occurs.

Engaging the Public: From Apps to Print Leaflets

Building public awareness is an integral part of crisis mitigation. In addition to strengthening the general understanding of climate change, communicating its local impacts and how to cope with them is helpful. Extreme heat poses significant public health risks, particularly for vulnerable populations - elderly, children, pregnant women, individuals with chronic illnesses, and those living in urban areas or low-income settings. Prolonged exposure to high temperatures can lead to heat stress, exacerbating existing health conditions like cardiovascular, respiratory, and kidney diseases (World Health Organization, 2024b).

Public authorities can use their own communication channels and social media. News broadcast with national coverage can play a key role, spreading updates and recommendations.

Public messaging regarding heatwaves usually includes recommendations to stay hydrated by drinking water regularly, to wear light and loose-fitting clothes and take cool showers or baths (World Health Organization, 2021). It is wise to avoid strenuous activities during the hottest parts of the day and to stay in shaded or air-conditioned environments when possible. Importantly, the WHO emphasizes the need to regularly check on vulnerable individuals, such as those over 65 years old, people with chronic health conditions, and those living alone (World Health Organization, 2024a).

Public authorities can use their own communication channels and social media. News broadcast with national coverage can play a key role, spreading updates and recommendations coming from meteorological services and municipal, regional or national authorities. Some European countries use the EU-Alert Public Warning System designed to disseminate emergency alerts to mobile phones based on cell broadcast technology, while others opt for location-based SMS. In addition, there

are specialized mobile applications such as EXTREMA which originated in Athens, with the objective to evaluate the real-time personalised health risk of users based on location and other factors (see European Commission, 2017).

In order to reach the most vulnerable populations such as the elderly, sometimes the non-digital methods prove most effective; for instance, various Spanish cities regularly print leaflets to hand out in public spaces or deliver them directly to mailboxes. This is because the use of smartphones and applications is not universal, and often weaker among the vulnerable target groups. Municipal newspapers that are regularly delivered to residents can also be used for this purpose.

Conclusion: Cities as Sites of Impact and Sites of Change

Copernicus Climate Change Service has made confident predictions indicating that the summer of 2025 is set to bring above-average temperatures throughout Europe (Copernicus, 2025b). Cities will likely have to brace for another season of extreme summer heat. Many of those traditionally relying on reactive heat management are shifting towards more proactive approaches. It is clear that urban heat adaptation is not merely an environmental concern but also a matter of social justice, public health, and economic resilience. Nature-based solutions, cooling infrastructures, material innovation, and public awareness all play a role in this transformation.

Urban heat adaptation is not merely an environmental concern but also a matter of social justice, public health, and economic resilience.

Best practices from cities across Europe and the globe demonstrate that the tools for adaptation are within reach. What is required is the political will, intersectoral collaboration and community engagement to mainstream these solutions. By

taking decisive action today, cities can not only mitigate the impacts of heat but also build healthier, more equitable, and climate-resilient futures for all urban residents.

While a multitude of successful interventions exist, challenges remain in scaling them equitably. These include institutional fragmentation, political resistance, funding gaps, and knowledge asymmetries—particularly in smaller and economically constrained municipalities (see European Environment Agency, 2024). Future success will hinge on sustained governance innovations, cross-sector collaboration and an emphasis on equity. The investment of time, effort and resources into adaptation measures today will help us withstand the climate emergencies of tomorrow. If anything, European cities are well positioned to learn from past successes – and failures – to be prepared for the next heatwave.

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