



Tackling Extreme Heat: The Critical Role of Trees in Urban Areas

Discover how cities can beat the heat with proven, data-driven strategies to reduce urban temperatures, improve public health, and build more resilient, livable communities.

Trees Are Part of the Solution

Cities around the world are grappling with unprecedented challenges as climate change intensifies, and among the most consequential is the Urban Heat Island (UHI) effect. Characterized by [significantly higher temperatures in urban areas compared to their rural surroundings](#), the UHI phenomenon is driven by the replacement of natural landscapes with heat-absorbing materials like asphalt and concrete well as the concentration of human activities and emissions. These elevated temperatures persist well into the night, exacerbating the frequency and severity of extreme heat events, straining public health systems, and disproportionately impacting vulnerable communities. As urbanization accelerates, understanding and addressing the UHI effect has become a critical priority for planners, foresters, and policymakers seeking to safeguard the health, infrastructure, and overall livability of cities.

This eBook explores the multifaceted impacts of extreme heat and the Urban Heat Island effect, highlighting both the challenges and the [actionable solutions](#) available to urban leaders. We delve into the role of urban forestry and green infrastructure as scalable, data-driven strategies to mitigate urban heat, reduce energy consumption, and [promote environmental equity](#). Through real-world examples and a framework for effective implementation, this guide empowers readers to translate scientific insights into practical action—building cooler, healthier, and more resilient cities for generations to come.





Understanding Urban Heat Islands

Urban Heat Islands (UHIs) are one of the most pressing and underestimated challenges cities face in an era of climate change and rapid development. As natural landscapes are replaced with heat-absorbing surfaces like asphalt, concrete, and rooftops, urban areas can become several degrees hotter than surrounding rural environments. These elevated temperatures persist into the night, creating chronic “urban heat hotspots.”

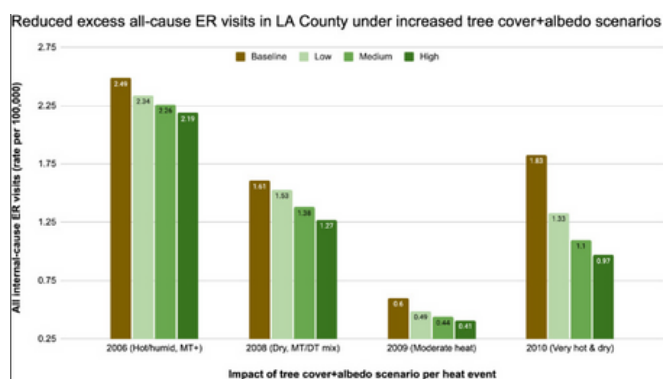


Figure 1: The impact of tree cover and albedo scenarios on reductions in the rate (per 100,000 people) of excess all-cause ER visits in LA County during the four heat events. Credit: Sheridan, NIH National Library of Medicine

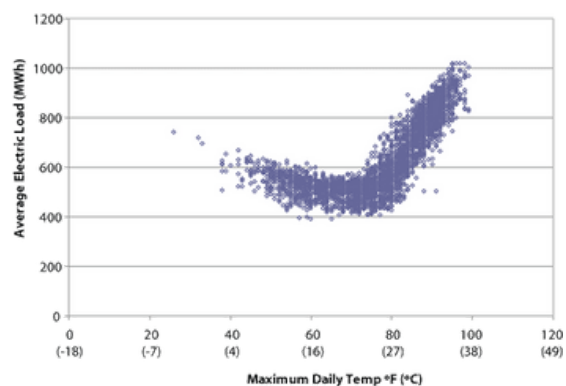
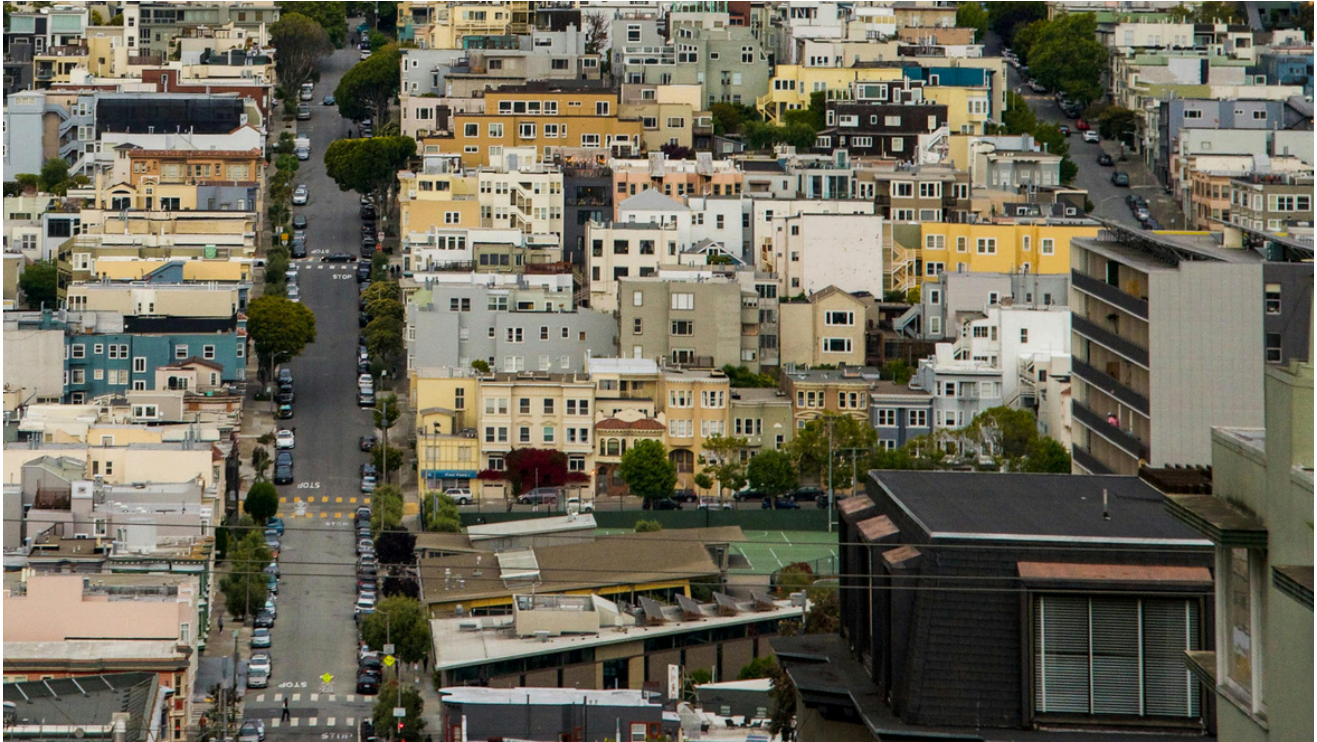


Figure 2: As shown in this example from New Orleans, electrical load can increase steadily once temperatures begin to exceed about 68–77°F (20–25°C). Credit: EPA

UHIs aren't classified as natural disasters but dramatically amplify extreme heat events, which are becoming more frequent and deadly. UHIs strain public health systems, stress energy infrastructure, and disproportionately impact vulnerable communities, particularly those in dense neighborhoods with limited green space, by intensifying the severity and duration of heat waves.



Why does this matter to planners and foresters? UHIs drive up energy costs, accelerate infrastructure degradation, degrade air and water quality, and pose serious public health risks. However, with strategic urban forestry and green infrastructure investments, cities can mitigate these effects and build long-term climate resilience.



Key Facts about Urban Heat Islands and Their Impact on Cities



ECONOMIC IMPACTS

- Increase in energy costs: Higher temperatures caused by UHIs significantly raise demand on energy systems, with an elevated risk of overloading them during extreme heat events. For each 1°F (0.6°C) increase in temperature, the increased cooling demand [ranges from 1.5-2.0%](#), suggesting [up to 5-10%](#) of overall electrical demand within a community is used to compensate for UHIs.

Roadway type	Correct asphalt grade	Asphalt grade incorrect by one increment	Asphalt grade incorrect by two increments
Net present cost (US\$ km⁻¹)			
Interstate	1,183,702	1,270,095 (6.80%)	1,312,235 (9.80%)
National route	723,106	775,997 (6.80%)	807,514 (10.5%)
State route	403,589	444,591 (9.20%)	472,737 (14.6%)
Local road	231,742	257,804 (10.1%)	280,576 (17.4%)
Net present cost (not including the initial construction cost) (US\$ km⁻¹)			
Interstate	199,240	285,632 (43.4%)	327,773 (64.5%)
National route	132,429	185,319 (39.9%)	216,837 (63.7%)
State route	108,251	149,252 (37.9%)	177,398 (63.9%)
Local road	84,072	110,135 (31.0%)	132,906 (58.1%)

Bottom four rows of table show the cost impacts if the initial construction costs are not included in the NPV. Note actual impacts carry slightly higher precision than shown in the table as round-off difference may be present.

Figure 3: Impacts by pavement type when using the correct asphalt grade. Credit: Underwood, Nature Climate Change



- Degradation of infrastructure: Prolonged heat exposure accelerates the deterioration of critical infrastructure, such as roads and bridges. Urban materials [buckle and deform under high temperatures](#), leading to costly repairs and maintenance. For example, it is estimated pavements originally intended to last 20 years will now require rehabilitation [after 14-17 years](#), depending on the pavement grade, bearing significant, unprecedented costs.



ENVIRONMENTAL IMPACTS

- Altered local climates: UHIs can [disrupt local weather patterns](#), increasing rainfall in some areas due to enhanced convection while at the same time reducing it in others, exacerbating drought conditions. These changes in precipitation [strain local water resources and alter ecosystems](#). Similarly, when higher surface temperatures heat stormwater runoff as it is released into bodies of water, it can be particularly stressful and fatal to aquatic ecosystems.
- Increase in air pollution: Overall air quality deteriorates both indirectly from increased demand on energy systems as well as directly from the elevated temperatures that are a result of UHIs. When volatile organic compounds (VOCs) react with nitrogen oxides (NOx) in the presence of warmer weather, it [increases the rate of ground-level ozone](#) in the atmosphere.



SOCIAL IMPACTS

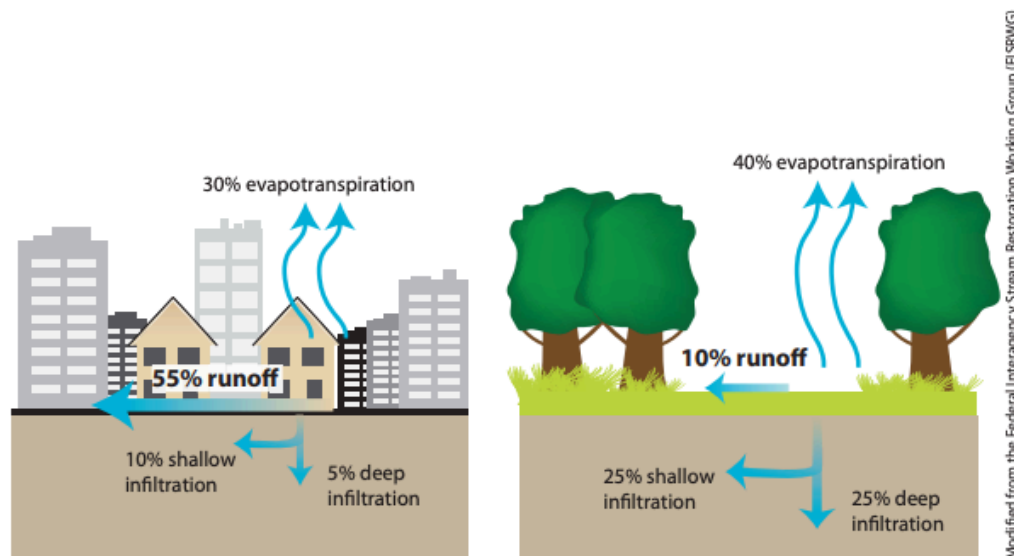
- Risk to public health: Elevated temperatures due to UHIs increase the risk of heat-related illnesses, such as heatstroke and dehydration, particularly among vulnerable populations. Over the past thirty years, extreme heat has led to [more fatalities](#) than all other extreme weather events, signaling a significant public health concern that increasingly strains our healthcare systems.

Urban Forestry: A Nature-Based Solution

Urban forestry is a scalable, cost-effective strategy to combat UHIs and improve urban livability. Trees and green spaces cool cities by providing shade, reducing surface temperatures, and releasing moisture into the atmosphere through evapotranspiration.

Cooling Impacts of Green Infrastructure:

- A tree canopy within 10 meters can [reduce daytime air temperature by ~19°F \(0.7°C\) and up to 35°F \(1.5°C\)](#) within a 60–90 meter radius.
- Urban parks and green spaces are often [up to 42°F \(6°C\) cooler](#) than surrounding built-up areas, extending their cooling effect into nearby neighborhoods.
- [Cool pavements](#) with higher reflectivity can reduce surface temperatures by up to 42°F (5.6°C), while extending the life of roads and sidewalks.



Highly developed urban areas (right), which are characterized by 75%-100% impervious surfaces, have less surface moisture available for evapotranspiration than natural ground cover, which has less than 10% impervious cover (left). This characteristic contributes to higher surface and air temperatures in urban areas.

Figure 4: Impervious surfaces and reduced evapotranspiration. Credit: EPA

FROM DATA TO ACTION: REAL-WORLD EXAMPLES

Cities like [Fremont, California](#), and the [Port of Bellingham, Washington](#), are leading the way with data-driven plans developed in partnership with PlanIT Geo to cool their city.

Fremont aims to increase its tree canopy from 14–15% to 24% over the next 40 years. [The Urban Forest Management Plan](#) includes public engagement tools like the Tree Maintenance Manual for Residents, which empowers homeowners to care for street trees and contribute to long-term forest health.

The Port of Bellingham [Urban Tree Canopy Assessment](#) used high-resolution multispectral imagery and machine learning to map canopy coverage and pinpoint priority planting zones based on UHI intensity and stormwater needs. The assessment identified industrial zones as high-impact opportunities for reducing localized temperatures and improving environmental outcomes.

A FRAMEWORK FOR IMPLEMENTATION

Planners and foresters can follow this five-step framework to integrate urban forestry into UHI mitigation:

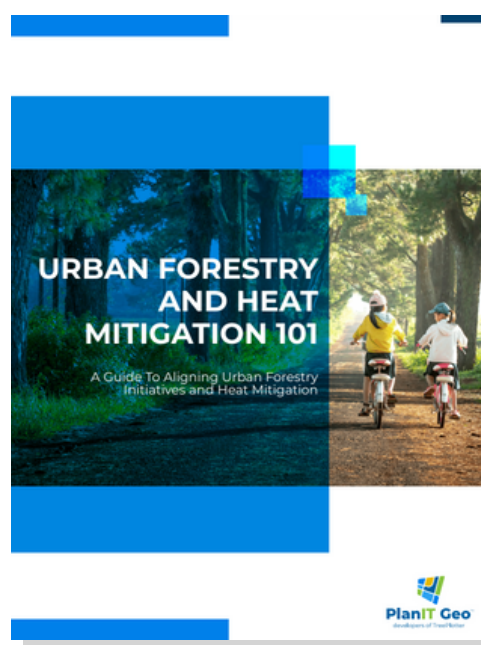


DATA-DRIVEN JUSTIFICATION FOR INVESTMENT

Urban forestry offers measurable returns: A [study in Los Angeles](#) found that expanding tree canopy and using reflective surfaces could reduce heat-related emergency room visits by up to 50%, translating to significant public health savings. Accurate urban forestry data strengthens applications for climate adaptation funding by quantifying benefits like reduced runoff, improved air quality, and enhanced livability. With tools like Urban Tree Canopy Assessments, cities can generate the data they need to secure grants and make informed policy decisions.

Extreme heat is intensifying but cities aren't powerless. Strategic, data-backed urban forestry offers a high-impact, low-tech solution to cool neighborhoods, protect health, and increase resilience. Planners and foresters can build greener, calmer, and more equitable cities with actionable insights, the right tools, and community engagement.

Download PlanIT Geo's guide, [Urban Forestry and Heat Mitigation 101](#), to align local initiatives with best practices.



About PlanIT Geo™

Since 2012, PlanIT Geo has provided cutting-edge technology and planning services globally for urban forestry, parks management, and arboriculture. Our TreePlotter Software Suite and expert team of arborists and consultants are ready to help your program become more proactive. If you would like to know more about our urban forestry software or services, please explore our website and feel free to send us your questions.