Cooling Our Cities

Background Information

For the past century, summers have increasingly become warmer, with cities becoming even hotter. The frequency of extreme heat days has also increased. A study, which assessed more than 13,000 cities from 1983 to 2016, found that global extreme heat exposure increased nearly 200 percent. This increase poses a deadly situation for American cities.

On average, extreme heat kills more people in the U.S. than any other weather hazard. The CDC estimates that heat kills about 700 people annually, and for every one-degree increase in temperature, the risk of dying increases by 2.5 percent during an extreme heatwave. However, in many urban areas, extreme heat does not desist when the heat wave ends.

According to the EPA, daytime temperatures in urban areas can be about 1–7°F higher than in outlying areas, and nighttime temperatures can be about 2-5°F higher. This phenomenon, known commonly as the urban heat island effect (UHI), has increasingly become a significant issue for many cities. Fortunately, recent years have seen extensive research into UHIs. **As a result, we know that UHIs are caused by several factors: 1) reduced natural landscapes in urban areas; 2) urban material properties; 3) urban geometry; 4) heat generated from human activities like heat waste from AC units; 5) weather and geography.**

Methods

In order to analyze what policies and strategies are the most effective at mitigating UHIs, I compiled existing studies and strategies that are known to alleviate their harmful effects. In addition, I conducted three small case studies of cities from different regions of the country and looked at how they address UHIs. I then synthesized the two sources to develop a general list of policies and strategies municipalities can implement.

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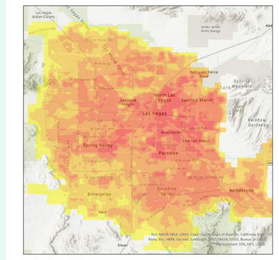
Why is this important?

Very few municipalities are taking UHIs directly. In an analysis of municipal environmental plans from around the U.S., heat is mentioned in almost all the plans, roughly 87 percent, with 78 percent explicitly targeting extreme heat. **Nevertheless, less than a quarter of cities had any policies on heat, and even fewer had policies dedicated to UHIs.**

This lack of policies is concerning as more than 80 percent of Americans live in cities. As such, most Americans will feel the effects of UHIs. Moreover, climate change is only expected to worsen the effects of UHIs and not every community can address them.

An analysis of 97 U.S. cities found that low-income areas, the vast majority of which are also communities of color, were more likely to be hotter than their wealthier counterparts. Moreover, these communities have a difficult time adapting to UHIs because they lack essential tools needed to mitigate its effects. For example, one study found that neighborhoods with a majority of people in poverty have 25 percent less tree canopy on average than those with a minority of people in poverty. In addition, communities of color in the U.S. are almost three times more likely than white communities to live in “nature-deprived” areas.



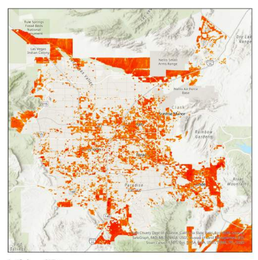


Image 1 (left): A heat map of peak summer temperatures from the summer of 2020. The more red, the greater the difference is between that summers peak temperatures and the average summer peak temperatures. Image 2 (right): A heat map of the highest observed peak temperatures.

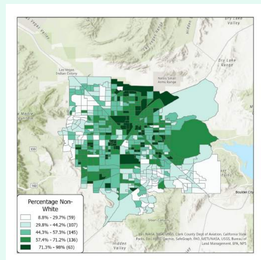


Image 3 (left): A map of 2020 Census Tracts in the Las Vegas Valley by the percent of non-white residents that reside in them.

What Works

Trees

Trees lower temperatures by providing shade and through evapotranspiration. **Shaded surfaces may be 20–45°F cooler than unshaded materials.** Trees are most valuable when planted on the west side or to shade parking lots, streets, and roofs. **Planting 50 million trees to shade the east and west walls of residential buildings can reduce cooling by 1.1 percent and peak load demand by 4.5 percent.**

Green and Cool Roofs

Green roof temperatures can be 30–40°F lower than conventional roofs and can reduce city-wide ambient temperatures by up to 5°F. In addition, green roofs can reduce building energy use by 0.7 percent and reduce peak electricity demand. **Cool roofs absorb less heat and stay up to 50–60°F cooler than conventional materials during peak summer weather.**

Cool Pavements

The term currently refers to paving materials that reflect more solar energy or has been modified to remain cooler than conventional pavements. **Every 10 percent increase in solar reflectance could decrease surface temperatures by 7°F.** The Federal Highway Administration has noted that porous asphalt costs approximately 10 to 15 percent more than regular asphalt, and porous concrete is about 25 percent more expensive than conventional concrete.

What Cities Are Doing

Las Vegas Valley

Since 1970, the average temperature in Las Vegas has risen by 5.9 °F . Las Vegas also has the most intense summer UHIs with urban areas being 7.3°F higher than rural areas. To rectify the disparate distribution of vegetation, Henderson created a landscaping program to incentivize desert landscaping among low-income residents. **The City of Las Vegas also has plans to plant over 60,000 trees by 2050 to help mitigate UHIs.**

New York City

UHI conditions have been observed in NYC for more than a century. **In 2017, New York City launched Cool Neighborhoods NYC. The $100 million program targets the most heat-vulnerable neighborhoods with funding for street tree plantings and its NYC CoolRoofs program.** NYC CoolRoofs provides New Yorkers with paid training and work experience installing energy-saving reflective rooftops. They offer free cool roof coatings residents, shelters, and nonprofits.

Denver

Denver has the third most intense observed summer UHI, with the urban areas being 4.9°F higher on average than the surrounding rural areas. To plant more trees, Denver began a pilot of a pre-apprenticeship program in the summer of 2022 to train formerly incarcerated people in urban forestry jobs. Green roofs over the REI parking garage and the EPA Region 8 building in the city also exist. Denver has even established a Climate Protection Fund to invest in resilient communities that can respond to challenges like UHIs.

Conclusion and Further Research

While there are numerous ways that cities can mitigate UHIs, they hardly do. Budget constraints, lack of community interest, and high implementation times are some of the many reasons that UHI mitigation strategies are not followed. **Climate also plays a very important role in how effective certain mitigation strategies are.** For example, in sunny climates, cool roofs present an important advantage while in moderate and cold climates green roofs seem to present higher benefits.

Some strategies that local governments can use to move forward are: **learn about national and local experience; recognize the multiple benefits of green infrastructure; learn about design variations; develop pilot programs; recognize avoided costs; recognize potential to add value; consult whole life cost tools; develop communication and outreach materials for private property owners**.

However, these strategies can not be blindly implemented. **Further research needs to be done into how UHIs can be addressed without feeding into gentrification**. In addition, more funding needs to be opened up to assist communities that lack the necessary resources to conduct these mitigation strategies.

Citations

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