Heat Resiliency at Sun Tran Bus Stops

Tucson, AZ

Figure 1: A Sheltered Sun Tran Bus Stop (Sept 2023)

Purpose

Sun Tran needed a better understanding of how to mitigate heat stress at bus stops within the Tucson area. This study was conducted to provide a clearer image of the effect of Sun Tran's existing bus stop infrastructure on heat resiliency.

Background

Sun Tran, a fixed-route bus service, operates within the City of Tucson, the City of South Tucson, Unincorporated Pima County, the Town of Marana, the Town of Oro Valley, and the Pascua Yaqui Tribe area. Sun Tran averages over 51,000 daily riders.

Tucson is located in the Sonoran Desert, which is known to be the hottest desert in both Mexico and the United States. The National Park Service remarks that the desert's summer air temperatures regularly surpass 104°F and often reach up to 118°F.

While located in the desert, Tucson is an urban area, suffering from the Urban Heat Island effect. Structures in the built environment generally absorb and re-emit heat at higher rates than natural structures, causing urban areas to become 'islands' of higher temperatures compared to the surrounding undeveloped areas.

According to the NOAA National Weather Service, July 2023 was Tucson's hottest month on record and hit triple-digit temperature highs each day. The previous record hottest monthly average was 91.5°F in August 2020, while the July 2023 average was 94.2°F. The increase in extreme heat is accelerating and can only be expected to become more catastrophic each year.

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Between January and August 2023, the Tucson Fire Department responded to approximately 172 heat-related calls. Heat-related illnesses, such as heat exhaustion and heat stroke, can be avoided, yet they are becoming increasingly common.

Tucson residents are all at higher risk for skin cancer, which is exacerbated by direct and extended exposure to the sun. The University of Arizona's Skin Cancer Institute reports that the State of Arizona routinely diagnoses a higher rate of Invasive Melanoma than any other state in the United States. While melanoma is a relatively curable cancer, it can be avoided altogether.

Transit riders spending a significant portion of their journey outdoors are particularly vulnerable to direct sun exposure. Bus stops provide a valuable opportunity to lessen the harmful impacts of Tucson's harsh climate and to protect transit riders from both uncomfortable and life-threatening experiences.

There are nearly 2,200 bus stops in the Sun Tran system. Of those 2,200 bus stops, 43% of them are sheltered. When physical Sun Tran shelters are not available, riders must rely on nearby vegetation for relief from the harsh sun. The amount of vegetation surrounding each bus stop varies but is alarmingly scarce along Tucson's major roadway corridors and newly developed lands.

Findings

Figures 2 and 3: Sun Tran Staff Measures Temperatures at Bus Stops (Aug 2023)

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During an Excessive Heat Warning on August 4, 2023, Sun Tran staff visited multiple bus stops throughout the City of Tucson and measured both ambient and ground temperatures. By gathering this temperature data at varying styles of bus stops, Sun Tran staff was able to identify the amenities that best mitigated heat. Bus stops that had vegetation nearby, not necessarily even providing shade, were found to have lower ambient air temperatures than the bus stops without any vegetation. The presence of a bus stop shelter alone notably reduced the ground temperature at the bus stops, but it was equally as effective in cooling the ambient air as vegetation. When both a bus stop shelter and nearby vegetation were present, the reduction in temperature was most significant.

Bus Stop Location	Bus Stop Description	Ground Temperature	Ambient Temperature	Time (AZ (GMT-7))
Martin Luther King Jr Way/36th Street (SE)	No Shelter, No Vegetation, No Tree Shade	124°F	108°F	01:56 PM
Park Avenue/Tucson Marketplace (NE)	No Shelter With Nearby Vegetation	111°F	107°F	02:08 PM
6th Avenue/29th Street (NE)	Shelter with Tree Shade	108°F	107°F	01:20 PM
Martin Luther King Jr Way/Tucson Marketplace (NW)	Shelter with Nearby Vegetation	109°F	106°F	01:49 PM

Figure 4: Bus Stop Temperature Data Collected by Sun Tran

Results

The results of this study have been used to develop an 'ideal bus stop' project and have been incorporated into City of Tucson grant applications. The most notable of these to date is the Tucson Resilient Together Bus Stop Enhancements project.

Tucson Resilient Together is the Tucson Climate Action and Adaption Plan that was adopted by Tucson Mayor and Council on March 7, 2023. As a part of this plan, funding has been set aside for climate resilient bus stop enhancements, which is the perfect opportunity to pilot Sun Tran's 'ideal' heat resilient bus stop as a proof of concept.

Six bus stops have been selected to receive Tucson Resilient Together improvements based on a tiered system. Tier 1 bus stops are planned to receive shelters, static information displays, benches, solar powered lighting, and a tamper-proof trash receptacle. Tier 2 bus stops will receive the same amenities as Tier 1, but also additional native vegetation, green stormwater infrastructure, a dynamic information kiosk, an emergency call button, and security cameras. Tier 3 bus stops will receive all the same amenities as Tier 2, but also a bike-share station.

Figure 5: Digital Mock-Up of a potential Tier 3 Tucson Resilient Together Bus Stop

This project resulted in a new appreciation and consideration of heat resiliency in the design of Sun Tran bus stops and selection of amenities. It was evident from this study that the existing bus stop infrastructure could be improved to better prepare the city for the increasingly high temperatures of Tucson's climate.

Next Steps

Sun Tran strives to continue to combine improved existing infrastructure with innovative measures to mitigate Tucson's extreme heat. Sun Tran staff continues to look for new methods and green infrastructures, while repairing and maintaining what is already in use. It is important to note that not all bus stops are eligible for enhanced amenities due to limited Public Right of Way, but these bus stops still need solutions for extreme heat conditions.

In the Public Right of Way, it is also important to prioritize accessibility. The Americans with Disabilities Act (ADA) requires that the pedestrian travel surfaces be firm, stable, and slip-resistant. The current standard material used for constructing accessible pathways is standard concrete, which is known to reflect heat and contribute to the Urban Heat Island effect. It would be advantageous to the heat resiliency of Tucson to identify and consider other materials for the ADA compliant bus stop pads and pedestrian access routes.

It is necessary for future research projects on heat resiliency at bus stops to be conducted to supplement Sun Tran's findings. After the implementation of the Tucson Resilient Together Bus Stop Enhancements project, Sun Tran staff plan to conduct a similar study to ensure that the solutions identified by this study are functioning to reduce heat as expected.

Sun Tran's initial study was conducted in response to Sun Tran and City of Tucson staff preparing a grant application for heat resilient infrastructure targeting specific qualifying bus stops. While this study focused on the presence of a shelter and vegetation at bus stops, it should be noted that Sun Tran has multiple styles of bus stop shelters, which may have differing levels of heat resiliency. It would be more beneficial to future bus stop projects if this work was expanded upon to include a larger number and variety of bus stops in order to determine the effectiveness of specific types of bus stop shelters.

All future Sun Tran bus stop enhancement projects will incorporate this study's findings into their design, placing a new emphasis on native vegetation plantings. Sun Tran hopes to continue to improve our bus stops and the experience they provide for our riders.

Contact

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