

## Healthy Urban Environments (HUE) Initiative Arizona State University

**Project Update: Second Year, Third Quarter, 2021**

**Date of Report: February 8, 2021**



### Project Overview

As outlined in the Healthy Urban Environments (HUE) Initiative proposal, ASU has launched HUE as a solutions-focused research, policy and technology incubator to rapidly develop, test and deploy heat-mitigation and air-quality improvement strategies and technologies. This will be accomplished through four project components: 1) research, solutions and innovation incubator; 2) communication, networking and solutions hub; 3) implementation and evaluation of new insight in real world contexts; and 4) public, workforce and management education and capacity building. The schedule for delivery of each component as proposed is shown below; we will report on progress for each of these components separately in the following pages.

HUE Work Plan - Gantt Chart	Project Year		1				2				3			
	Calendar Year		2019				2020				2021			
	Project Quarters		1	2	3	4	1	2	3	4	1	2	3	4
<b>Communication, networking and solutions hub</b>														
Convene ASU heat and air quality researchers														
Create Network of Concerned Parties and Advisory Council														
Aggregate relevant plans from local and external entities														
<b>Research, solutions and innovation incubator</b>														
Laboratory Investigations - Year 1														
Laboratory Investigations - Year 2														
Laboratory Investigations - Year 3														
Pilot Field Experiments														
Model Proposed Interventions														
Behavioral Research on Perceptions of Heat and Air Quality														
<b>Implementation and Evaluation</b>														
Scale-up of Proposed Interventions														
Evaluate Changes of Perceptions														
<b>Public, workforce, and management education + capacity building</b>														
Workforce, Public, and Management Educational Programs														
Share Solutions for Relevant Stakeholders														
Offer Training for New Jobs														

Figure 1: Gantt Chart for ASU Healthy Urban Environment project deliverables

### 1. Research, Solutions and Innovation Incubator

#### Overview:

ASU will develop a research, solutions and innovation incubator to test novel heat and air pollution mitigation technologies; deploy field demonstration projects to quantify the heat and air quality mitigation effectiveness; and modeling projects to simulate the impact of heat and air quality mitigation approaches.

#### February 8, 2021 Status:

#### Impact of Environmental Factors on Heat-Associated Mortalities in Maricopa County

Exposure of vulnerable populations in urban areas to extreme heat and poor air quality can lead to adverse health effects. A troubling trend in rising heat-associated mortalities in Maricopa County, Arizona has led to additional scrutiny of environmental factors that can contribute to increased risks for heat-associated mortalities. Ten summers of data (2010-2019) were used to construct a model for daily

heat-associated mortalities. Potential predictors tested in the model formulation included year, day of year, daily average air temperature, daily average dew point temperature, and air pollution measurements for ozone and particulate matter. Lagged effects for environmental variables, calculated as the average over previous days, were also tested as potential predictors.

After testing various model formulations using the aforementioned potential predictors, the final best performing model selected for further analysis included the environmental factors of air temperature, dew point temperature, and particulate matter concentration. This final model selected was mostly successful in predicting the days with 0-1 heat-associated mortalities. However, the model tended to underpredict the number of daily heat-associated mortalities for days with more than 2 observed heat associated mortalities. On an annual basis, the model captured the sharp increase in the preliminary number of heat-associated mortalities for the summer of 2020.

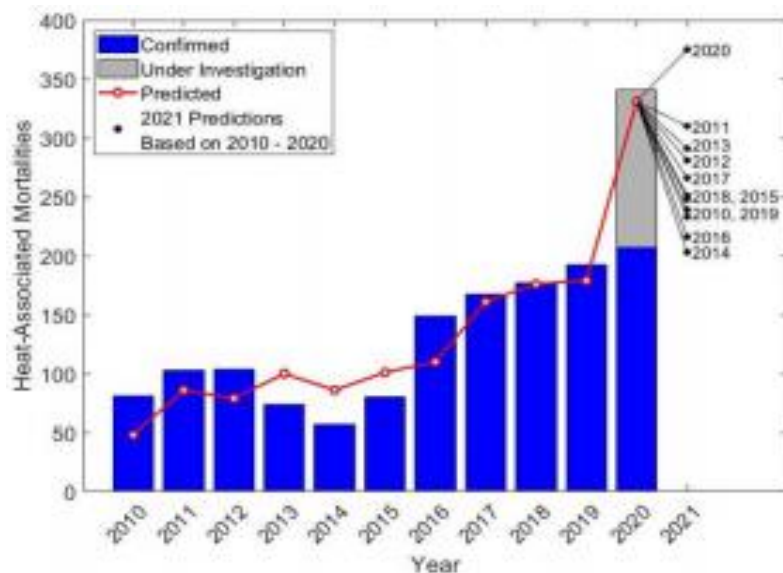


Figure 2: Annual heat-associated mortalities in Maricopa County from 2010-2020 with a range of predictions for 2021

Finally, predictions for summer 2021 based on 2010-2020 yielded a wide range of values (203-375) for the total number of heat associated mortalities, as shown in the following figure. Results from this study have been used for a manuscript to be submitted to a peer-reviewed journal and lend insights into factors that increase the risk for heat associated mortalities and can be used to better inform strategies for reducing these risks.

Figure 2 illustrates heat-associated mortalities in Maricopa County for 2020 include all confirmed and under investigation summer

mortalities, including those outside of the May-September window used in the model hindcast. The model-predicted value for 2020 is hindcast based on the model built using data for 2010-2019. Various predictions for 2021 are shown based on conditions from each summer from 2010-2020.

## 2. Communication, Networking and Solutions Hub

### Overview:

Arizona State University (ASU) will convene workshops to share mitigation approaches, initiate new inquiries to expand on urban heat and air quality improvement strategies, and provide summative reports on relevant community strategies for interventions for urban heat and air quality.

### February 8, 2021 Status:

HUE has established a new collaboration with ULI (Urban Land Institute) Arizona. Through a series of meetings, the working group came up with goals and future actions. The goals of the collaboration include:

- Increase extreme heat and air quality mitigation awareness and knowledge among ULI Arizona members.
- Suggest language to improve local practices through system change and policies.
- Share collaboration findings with ULI national to increase awareness and knowledge on a national scale.



Figure 3: January 2021 ULI Arizona Newsletter post

To achieve our goals, we are planning the following activities. HUE is composing posts for the ULI newsletter. In our [first post](#) we introduced the initiative and some of our projects, and asked the readers for their interests, preferences, and input. Hue will continue to provide new content once a month based on topics that we are working on and based on the ULI community input. On our February post we are elaborating on our pavements initiatives and focusing on the Maricopa County Facilities Management parking lot Project (update below).

In April HUE may participate in ULI's largest local conference - Trends Days. This year the conference will be virtual and will bring together experts from around the world to discuss the most current real estate trends including climate change. In the summer, we

are hoping to convene a roundtable discussion with selected professionals. The exact topic has not been selected and will be determined during the summer. We are currently considering problems of heat today and tomorrow, solutions and evidence, vision for cool Arizona, heat solutions in affordable housing, and incentive and financing.



### 3. Implementation and Evaluation of New Insights in Real World Context

#### Overview:

ASU will test new solutions developed as part of HUE; conduct surveys and in-depth interviews with community members; and enable Technology Transfer and Intellectual Property licensing on all projects sponsored by HUE.

#### February 8, 2021 Status:



Figure 4: West side of the parking lot is cover with GuardTop and East side kept in original conditions for control.

Rising local temperatures in Phoenix are driven by both climate change as well as locally induced warming due to the characteristics of the environment. Cities are like sponges for heat, absorbing more heat from the sun during the day and then releasing that heat into the environment: this phenomenon is called the urban heat island. HUE is working on innovative cooling measures including shading strategies and pavement treatments to solve the urban heat island.

Maricopa County Facilities Management Department is working to offset urban heat by applying a reflective surface (GuardTop™) to half of a parking lot in downtown Phoenix, Arizona as shown in Figure 4. This effort has provided a unique opportunity for HUE researchers to collaborate with Maricopa County officials and conduct an “in the field” assessment of the cooling impacts of reflective asphalt treatments.



Figure 5: Installing winter sensors in the Maricopa County Parking lot

Meteorological sensors measuring air temperature, wind speed, and radiation exchanges have been deployed above the reflective treated and untreated portions of the parking lot by the HUE team as shown in the Figure 5.

The commercial GuardTop treatment applied to the parking lot does not dramatically change the appearance of the parking lot. Unlike some approaches that use white paint to reflect visible radiation, GuardTop looks a lot like traditional asphalt but reflects the infrared portion of solar radiation to cool the surface without the blinding reflection that occurs with white paint. GuardTop and other commercial cooling surface coatings have been tested in

numerous cities and have shown a localized impact on the urban heat effect after deployment. However, HUE researchers are trying to answer two key questions that have not been resolved: how durable is the treatment and would treatment to parking surfaces throughout the entire region lead to a regional reversal of the urban heat island?

Initial results from HUE research demonstrates that the parking lot treatment reduces absorbed solar radiation by about 50% by increasing the fraction of reflected radiation from 0.15 to 0.30 as shown in Figure 6a. We also measure emitted surface radiation which is reduced approximately 10% (Figure 6b) and indicates that peak surface temperature is cooled by 8 °C at the daily solar maximum. However, despite an approximate decrease of 25% in heat exchange at the treated site (Figure 6c), we found no differences in air temperature above the treated and untreated portion of the parking lot (Figure 6d). This is probably due to mixing in the atmosphere and motivates the key question: if all parking lots in the Phoenix region were treated, would there be an impact on the urban heat island? In coming months, HUE researchers will use data from the Maricopa County parking lot experiment to conduct regional climate modelling to answer this question.

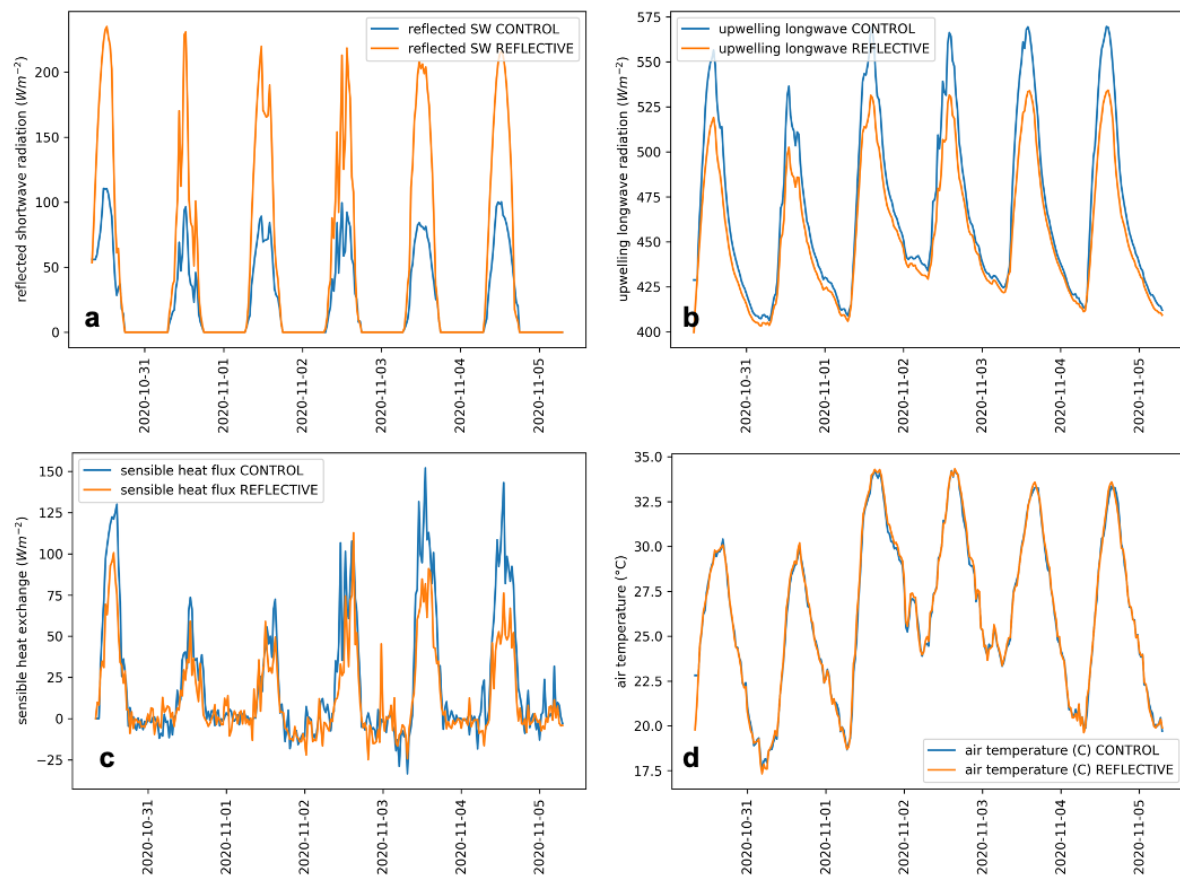


Figure 6: Results from parking lot Experiment for 6 days period in November 2020: (a) reflected shortwave radiation, (b) upwelling longwave radiation, (c) sensible heat flux, and (d) air temperature

Additionally, HUE researchers worked with Maricopa County Facilities Management Department to raise awareness of the impact of paved surfaces on urban heat and how solutions can help offset this heating. This signage, shown in Figure 7, acknowledges the collaboration between Maricopa County Industrial Development Authority, Arizona State University, Maricopa County Facilities Management Department and HUE researchers.



Figure 7: A sign describing the project to parking lot users.

#### **4. Public, Workforce, and Management Education and Capacity Building Overview:**

ASU will enable capacity through development and implementation of workshops aimed at stakeholders and community members; create online modules to be integrated into existing ASU outreach programs; and develop material for new workforce training programs.

#### **February 8, 2021 Status:**

As of late January, HUE has brought on board a PhD student in the School of Human Evolution and Social Change to work on developing educational programs in occupational heat health and safety for outdoor workers who do not fall under OSHA heat training requirements. We anticipate the target audience of these programs will include delivery drivers, outdoor logistic support workers (such as parking attendants), and other types of employees who are not considered under traditional definitions of outdoor employee roles. The project will start with scoping the existing literature and guidance for outdoor workers and collaborate with biometeorology experts at ASU to identify gaps. Next a strategic plan will be created for producing future educational programs aimed at these populations. Another outcome of this project will include building industry partnerships by investigating collaboration opportunities with private and public companies and services that employ labor that may present heat related health risks but are not currently receiving educational resources.