Healthy Urban Environments (HUE) Initiative
Arizona State University

Project Update: Second Year, Fourth Quarter, 2021
Date of Report: April 30, 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				2022	
	Project Quarters	1	2	3	4	1	2	3	4	1	2	3	4
Communication, networking and solutions hub													
Convene ASU heat and air quality researchers		■											
Create Network of Concerned Parties and Advisory Council			■										
Aggregate relevant plans from local and external entities		■	■										
Research, solutions and innovation incubator													
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						■	■	■	■				
Implementation and Evaluation													
Scale-up of Proposed Interventions										■	■	■	■
Evaluate Changes of Perceptions										■	■		
Public, workforce, and management education + capacity building													
Workforce, Public, and Management Educational Programs					■	■							
Share Solutions for Relevant Stakeholders						■	■	■	■	■	■		
Offer Training for New Jobs								■	■	■	■	■	■

Gantt Chart for ASU Healthy Urban Environments 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.

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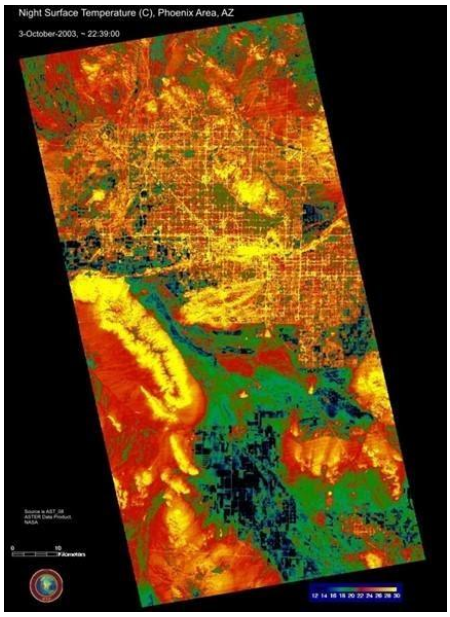

Figure 1. Night surface temperature. Phoenix, AZ October 2003

Pavements play an important role in the transportation infrastructure but can contribute to the urban heat island effect by storing heat from solar radiation (Figure 1). Globally, about 90% of roadways are made of asphalt mixtures. In the USA, 500 million tons of asphalt mixtures are produced annually at a cost of about 40 billion US dollars. Beyond efforts to use reflective pavement treatments to reflect incoming solar energy, pavement materials properties can play an equally important role in minimizing heat transfer and storage. In addition, the use of modifiers in asphalt binders and mixtures has been one of the most common methodologies to address distresses and improve the performance of asphalt pavements. These modifiers focus on the elastic properties of the binder, leading to a greater fatigue resistance, and a reduction in the crack propagation as well as permanent deformation.

This research project involved the design, development and testing of innovative asphalt mixture modifier for urban cooling and better pavement durability. The research team at ASU's School of Sustainable Engineering and the Built Environment investigated the use of this product and function as a high-performance material with unique thermal resistance properties. This research project is one of several research initiatives at ASU in partnership with The Global KAITEKI Center to address mitigation to urban heat island. This effort, while funded by another source, has been integrated into ASU's HUE program and plays a key role in advancing the urban heat and air quality solutions from HUE into real-world practice; for this reason, we are highlighting this work in our current report.

After initial development in the laboratory, the research team focused on-field production of the novel asphalt binding material, testing thermal properties, testing of asphalt mixtures with various modification levels, and modeling the impact of asphalt modification on temperature and heat storage. Six test slabs and three road test sections were constructed for performance monitoring (Figure 2). The research team was assisted by Fisher Industries, a leader in heavy civil construction. Preliminary results from the field data collection showed favorable behavior of the modified mixtures in potentially mitigating the urban heat island effect; however, the research team is looking forward to analyzing data during hot summer periods in 2021.

Figure 2. Performance monitoring of asphalt mixtures

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.

April 30, 2021 Status:

One of the challenges limiting progress on extreme heat is the lack of systematic tools, frameworks, and accountability and management structures available for institutions to use to evaluate their progress and set goals. Compared to other environmental hazards like air quality and flood control, which are addressed via dedicated regulatory structures and government agencies, heat governance typically happens in a much more ambiguous environment. Progress is currently only realized when governance leaders voluntarily elect to dedicate attention and resources to the problem; an approach at odds with increasing recognition of heat as a major challenge for health, quality of life, and economic vitality in Maricopa County. ASU researchers supported by the Healthy Urban Environments Initiative are working to change this narrative at two scales—cities and schools—through the creation of HeatReady Standards.

The goal of HeatReady Standards is to recognize and motivate efforts to identify, prepare for, mitigate, track, and respond to urban heat dangers. ASU researchers began developing concepts for HeatReady Standards as early as 2018, in partnership with the City of Phoenix. Today, the HeatReady portfolio of action has engaged more than 75 experts to develop criteria for recognizing and certifying the efforts of municipal governments and, newly, individual schools. HeatReady is increasingly mentioned by local leadership as an aspirational theme of efforts to cool the places where Maricopa County residents live, work, learn, and play, and efforts to protect residents when hot weather occurs.

Our HeatReady Standards for cities are being pilot-tested with multiple cities in the Southwest. While the Covid-19 pandemic was an interruption to our activities, we are learning valuable feedback about how to improve the certification process to appropriately balance the administrative burden for city staff completing the application while simultaneously providing a sufficiently rigorous and meaningful tool to compel action. We have also had productive conversations with regional leadership from the National Weather Service about the path to share the Standards with a broader audience. The HeatReady Standards for Cities include 21 separate action items across three broad domains (Figure 3):

- Adaptation Actions (those that help people cope with heat)
- Mitigation Actions (those that make the city cooler and more comfortable),
- Internal Actions (those that support decision-making by city staff).

We are particularly excited about the alignment of HeatReady Cities with the new Office of Heat Response and Mitigation that has been proposed on the City of Phoenix trial budget for 2021. If funded, we fully anticipate the HeatReady Standards helping to shape the expectations and responsibilities for the city's new Chief Heat Officer and other supporting staff.

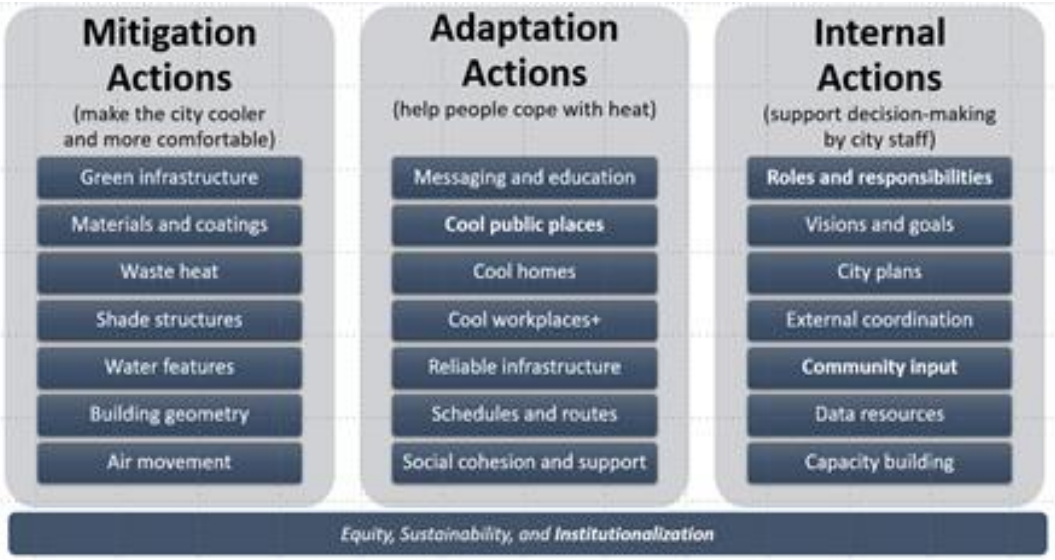

Figure 3. HeatReady Standards for Cities Action Items

ASU researchers have now expanded the HeatReady portfolio to more specifically address our schools. An ASU Graduate student led a one-year effort to identify the key components of HeatReady Schools and develop a tool that schools could use to chart their progress toward becoming increasingly HeatReady. This research used interviews and a Delphi expert panel survey approach to iteratively produce 30 specific recommendations for schools. The expert panel included perspectives from public health professionals, educators, parents, academic researchers, and others with expertise on school communities, drawing particularly from neighborhoods in South Phoenix. The HeatReady Schools rubric spans five Action Areas: School Policy, Environment, Training, Prevention, and Community.

Future work will develop processes for implementation of the HeatReady Schools rubric more broadly across the County. Critical lessons learned through the development of the rubric are that (1) current heat safety resources are not widely known or used across school communities and (2) heat has clear and negative impacts on student experiences and health both inside and outside of the classroom. Our HeatReady Schools work is well aligned with the upcoming release of new school heat policies and recommendations by the Arizona Department of Health Services, which we anticipate accelerating action on heat in schools across the state (Figure 4).

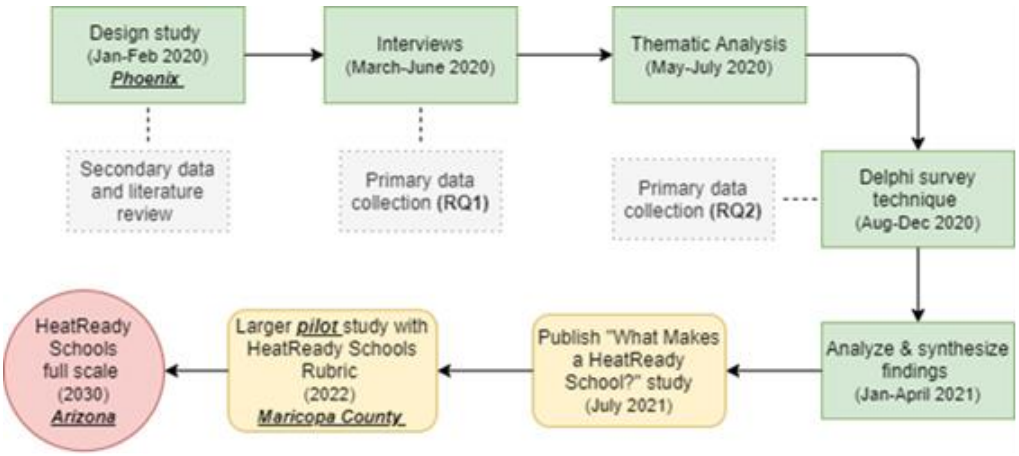

Figure 4. General process for developing HeatReady Schools standards

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.

April 30, 2021 Status:

One of the major targets of efforts to reduce urban heat island effects is parking lots, which from late spring to early fall can become significant sources of heat exposure. One example is the Phoenix Zoo parking lot, which though primarily serves the Phoenix Zoo, is owned and maintained by City of Phoenix's Papago Park. This older parking lot has few trees or structured shade and can become an extremely hot place for the 1.5 million visitors that visit the Zoo annually, including students participating in hundreds of school field trips. The parking lot is a significant source of heat exposure for children that must pass through it to get into the zoo and pass back through it when they leave the zoo.

In 2019 the City of Phoenix approved funds for the improvement and expansion of the parking lot on the condition that the Zoo, which is privately owned, takes over maintenance and the project is designed as sustainable as possible. To help create a more sustainable parking lot, the City of Phoenix asked ASU to provide advice on the design of the new parking lot and enhancements to the existing parking lot. ASU focused its advice on stormwater runoff (Figure 5) and heat.

Figure 5. Stormwater swale in new Zoo parking lot

HUE provided funding and expertise to work with the City of Phoenix on the design efforts and to conduct pre and post-assessments of the project, including heat mitigation strategies. Based on a collaborative design between the Zoo, the City of Phoenix, and ASU and utilizing funds from the City's parking project, $30,000 from HUE, and a $50,000 match from a Zoo supporter, shade structures are being built along the path students use to wait by their buses and walk from their buses to the Children's Zoo entrance and exit (Figure 6).

Figure 6. Shade structure on the pathway to Children Zoo entrance

A large shade structure at the school bus parking area has been constructed (Figure 7) and the remaining pathway shade structures are scheduled to be constructed this May and June 2021.

ASU researchers have utilized the biometeorological MaRTy cart to quantify the pre-shade structure project heatscape experienced by students as they walk to and from the Children's Zoo. This will be followed by a post-assessment this summer after the shade structures have been constructed to quantify the impact of the project.

Figure 7. Shade structure for school bus parking lot

The team is also working with Zoo staff to assess the heat landscapes within the Children's Zoo itself. A landscape architecture class has completed an assessment of existing conditions among the various Zoo exhibits and pathways and is developing strategies and projects the Zoo may undertake in the future to reduce children's exposure to heat.

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.

April 30, 2021 Status:

The purpose of the "Heat & Health Maps for Decision-Making in Tempe, Arizona" project is to support the city's commitment to mitigating extreme heat by translating relevant heat and health data into usable and learnable decision tools that align with the City's strategic priorities and equity goals. Our project specifically supports the goal of equitable urban cooling, i.e., to create the most cooling in those areas of the city that are experiencing the worst impacts of heat exposure and vulnerability. Figure 8 illustrates a local cooling solution.

Figure 8. Bioswells provide localized cooling solutions and harvest stormwater. Credit: City of Tempe

To facilitate city staff's interpretation, communication, and application of heat and health data, we co-created communication and educational materials that ground this data in people's lived experiences with heat. This helps to create a heat practice that employs heat and health data not as a single decision-point or as an element written in a city plan, but as a mindset and culture of safety that accounts for heat and health data in city staff's everyday practices.

To build this heat practice various educational materials were co-created so that city staff and residents can:
1. Develop Climate Literacy by identifying and describing where in the city it is hot, for whom, and why.
2. Communicate how the placement and design of infrastructure contributes to equitable urban cooling.
3. Identify different options to improve equitable urban cooling from the touch- to city-scale.

Figure 9. Urban Heat Walk at Kiwanis Park. Credit: Mary Wright

The City of Tempe and the ASU team conducted a Heat Walk in Kiwanis park and collected data from community members who participated in the walk. Figure 9 illustrates a couple being interviewed by an ASU researcher and his team. Data from the Heat Walk was integrated into HUE decision-making and educational materials.

The following table shows the tools which city staff and researchers co-created to support each of the three areas above. These tools will be hosted on the community engagement website platform.

Climate Literacy	Communication	Decision-Making
• Got-A-Minute videos explaining complex project terms, such as Mean Radiant Temperature (MRT) • Data Resource Bank providing an overview of available heat datasets • Introduction video for Module 3 (see below)	• Library of Resources explaining the History, Project Outline, Project Intervention, and our Project Intention • Community-facing graphics depicting how diverse infrastructures contribute to urban cooling	• Heat Mitigation Graphics portraying opportunities for infrastructures to reduce rising temperatures • Social Infrastructure Graphics visualizing how strong social networks contribute to resilience to extreme heat

The Heat & Health Maps for Decision-Making project funded through the HUE Initiative created some of the educational foundations for another project, called Cool Kids Cool Places Cool Futures, funded through the Robert Wood Johnson Foundation (RWJF), which creates a training program on Climate, Equity & Decolonization:

- Module 1: Indigenous Concepts of Resilience and Decolonization (RWJF supported)
- Module 2: Racial Equity and Deconstructing Structural Racism (RWJF supported)
- **Module 3: Climate Justice, Heat Equity and the Promise of a Collaborative Movement for Urban Cooling (HUE + RWJF supported)**
- Module 4: Supporting Trauma-informed Intersectional and Empathetic Leadership (RWJF supported)

- Module 5: Co-Creation and Movement Building Through the Arts and Science (RWJF supported)

Module 3, building on the HUE work, entails videos and online content presenting the persisting impacts of colonization, segregation, and infrastructure decisions that cause climate injustice and reinforce urban heat inequities. Module 3 heightens awareness around how racism is embodied in our built infrastructure by providing specific information on how heat and health data can inform action to support equitable urban cooling. This HUE project enabled the creation of tools to use heat and health data in the context of lived experience, informing our collective education on building and sustaining equitable urban cooling.