



Center for Sustainability  
and Economic Performance

A black and white photograph of an outdoor cafe or restaurant. Numerous people are seated at tables, some under large patio umbrellas. The scene is lively and appears to be a public space. The image is overlaid with a semi-transparent white box containing text.

# City of Houston Heat Resilience

**HOUSTON, TX**

A TECHNICAL ASSISTANCE PROJECT FROM THE ULI RESILIENT LAND USE COHORT

MAY 27, 2021



## Marissa Aho

Chief Resilience Officer

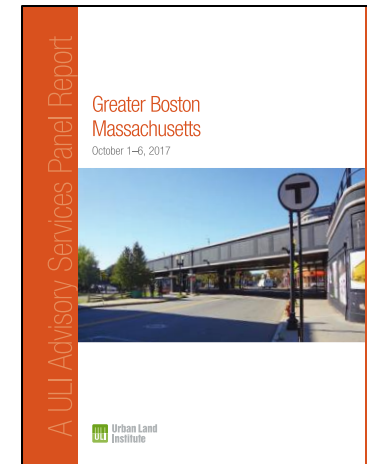
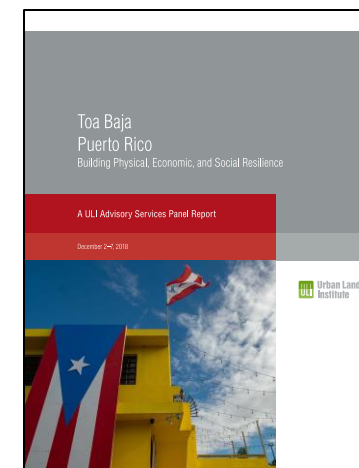
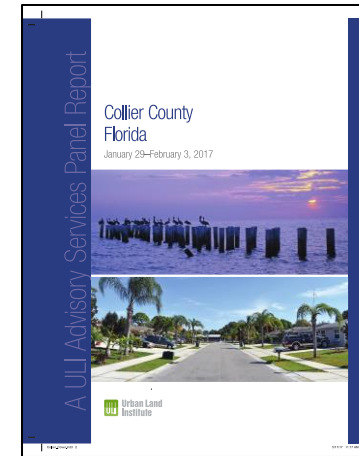
Officer of Mayor Sylvester Turner

City of Houston

# About the Urban Land Institute

ULI Mission: to provide leadership in the responsible use of land and in creating and sustaining thriving communities worldwide

- A multi-disciplinary membership organization with more than 45,000 members in private enterprise and public service
- What the Urban Land Institute does:
  - Conducts Research
  - Provides a forum for sharing of best practices
  - Writes, edits, and publishes books and magazines
  - Organizes and conducts meetings
  - Directs outreach programs
  - Conducts Advisory Service Panels



# Urban Resilience at ULI

- The Urban Resilience program brings ULI's expertise in land use, real estate, and climate resilience to communities nationwide.
- Resilience panels:
  - Provide land use and development strategies for vulnerable sites
  - Assess policy opportunities to enhance community resilience
  - Craft strategies for implementation and funding of resilience projects and programs



# Resilient Land Use Cohort (RLUC)

## Program Overview

- RLUC is platform for **advisory services, technical assistance, and knowledge sharing** between 8 cities and their ULI District Councils.
- RLUC leverages ULI member expertise to identify strategies for cities to be more resilient in the face of climate change and other vulnerabilities, as well as the related social, environmental, and economic impacts.
- The project is generously supported by JPMorgan Chase through a grant to the ULI Foundation.





THANK YOU TO OUR SPONSORS

JPMORGAN CHASE & Co.



## THANK YOU TO OUR STAKEHOLDERS

Keiji Asakura, Asakura Robinson Company • Yvonne Forrest, City of Houston • Deborah January-Bevers, Houston Wilderness • Colley Hodges, Kirksey Architecture • Steve Stelzer, City of Houston • Randy Wile, Wile Interests • Mili Kyropoulou, University of Houston • Tanya Debose, Independence Heights Redevelopment Council • Bruce Race, PhD, FAIA, FAICP, University of Houston • Johanna Lovecchio, Columbia University • Veronica Gorczynski, East End District • Kathy Payton, Fifth Ward Community Redevelopment Corporation • Jennifer Ostlind, City of Houston Planning and Development Department • Davis Koleas, Guardtop • Josh Vanlandingham, Affiliated Engineers, Inc. • Kelli Ondracek, City of Houston Parks and Recreation • Irmak Turan, MIT, Lecturer • Gwen Tillotson, Office of the Mayor • Mustapha Beydoun, HARC • Adele Houghton, Biositu, LLC • Stephan Fairfield, Orchard Communities • John Nielsen-Gammon, Texas A&M University • Jessica Abbinett, Harris County Public Health • Mary Lawler, Avenue CDC • John Williams, K. Hovinian Homes • Marlon Marshall, Midtown Redevelopment Authority • Justin Levine, Levcor, Inc. • Michael Bloom, R. G. Miller Engineers, Inc. • Rebecca Reyna, Greater Northside Management District • John Paul Garland, The Hanover Company • Kathleen O'Reilly, Museum Park Super Neighborhood

# ULI Panelists

Selected for their subject matter expertise to provide **objective, volunteer** recommendations

## Dalia Munenzon (Panel Co-Chair)

Associate  
One Architecture

## Angela Cotie (Panel Co-Chair)

Project Executive  
Gilbane Building Company

## ULI Staff

David Kim  
Executive Director  
ULI Houston

## John Bolduc

Environmental Planner  
Cambridge Community Development Dept  
City of Cambridge, MA

## Bungane Mehlomakulu

Head of Building Science & Performance  
ICON Technology, Inc.

## Misty Loocke

Director  
ULI Houston

## Myrrh Caplan

Senior Sustainability Director  
Skanska USA Building

## Andrew Richards

Owner  
AEME

## Elizabeth Foster

Manager  
ULI Urban Resilience

## Rachel Claire Wilkins

Landscape Architect  
SWA

## Kelly Annis

Director  
ULI St. Louis/Branch  
Communications





# Setting the Stage



## KEY THEMES

Reduce the Urban Heat Island Effect  
Prepare People and the Built Environment  
for What's Coming

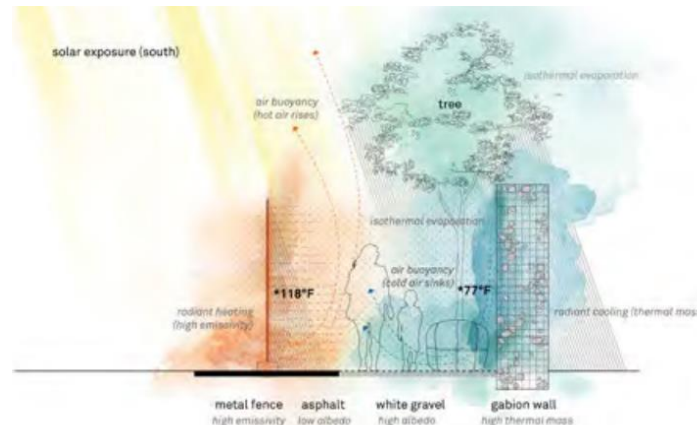
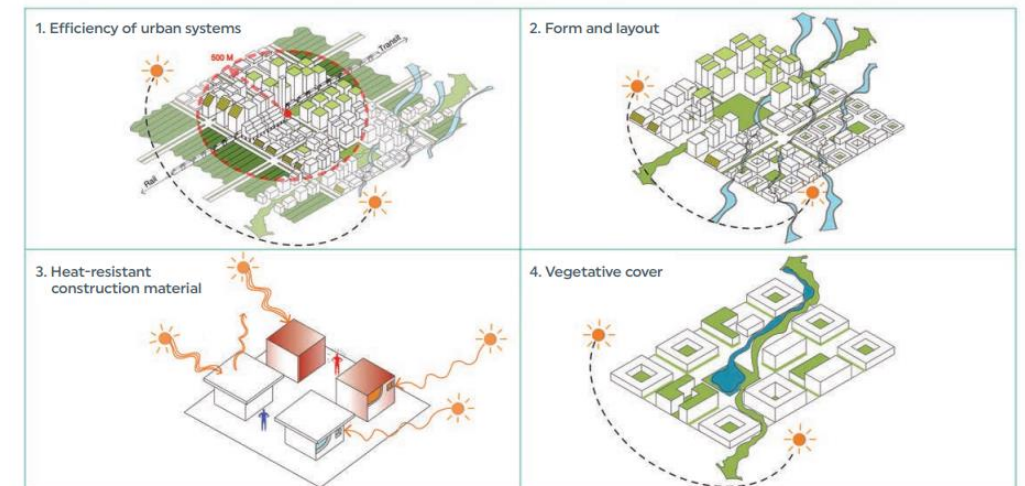
# Why does the City of Houston Need Heat Resilient Strategies?

## Health, Environmental and Financial Consequences

- By 2050, if we do not curb our greenhouse gas emissions globally, we can expect...
  - the **hottest day of summer will be 7 degrees warmer** than today,
  - there will be **22 more days that exceed 100°F**,
  - there will be **50 more nights that exceed 80°F**, and
  - summers overall will be 55 days longer** than today.
  
- Urban Heat Island (UHI) effect
  - Can raise temperature up to ~10 degrees within a city
  - UHI is driving temperatures more than climate change currently
  - Local change we can affect



### HEAT ISLAND MITIGATION STRATEGIES (DISTRICT SCALE)



# City of Houston - Desired Outcomes

- Greater consensus among stakeholders moving forward to achieve their desired improvements;
- Recommendations with clear priorities to focus efforts of consultants, leaders, funders, and other stakeholders; and
- A tool for productive dialogue with public officials and potential private sector partners who seek to use limited public resources well.

# Panel Scope

*Address the following questions:*

- What are the various building and site-scale landscape design heat resilience strategies that are commonly used in Houston today and those that, if implemented more widely, have the potential to help the City achieve its extreme heat resilience goals? (Potential strategies include but are not limited to cool and green roofs, cool pavement, tree planting, prairie restoration, green stormwater infrastructure, and shade structures.)
- What are opportunities and challenges for demonstrating short-term feasibility by referencing relevant regulations and potential financing mechanisms to help the City achieve its heat mitigation goals?
- How could possible future city policy encourage local property owners and developers to mitigate extreme heat at their projects and open spaces?
- Are there relevant examples or best practices (either regionally or nationally) that provide opportunities for guidance or lessons learned?





# Foundational Recommendations

# Education & Engagement

**INDIVIDUALS**

**NEIGHBORHOOD**

**BUSINESS COMMUNITY**

**WATERSHED (ECO-LEVEL)**

**CITY-LEVEL**

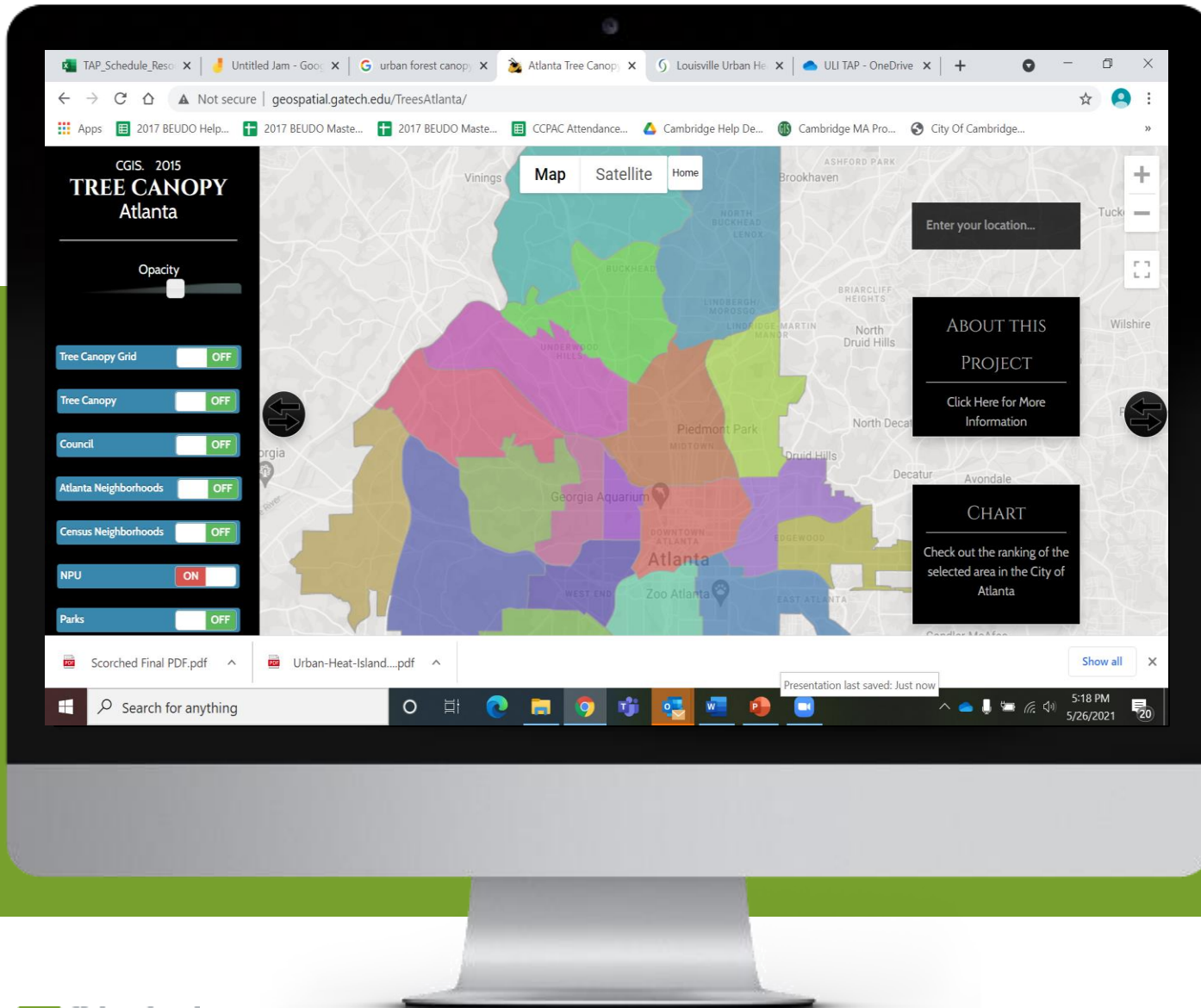
**REGIONAL-LEVEL**



# Multi-Level Mapping (e.g. StoryMap)

Overlay multiple GIS layers to identify urgent needs and areas to accelerate

- Impervious Area
- Tree Canopy
- Ground Vegetation
- Surface Reflectance/Albedo
- Air Temperature
- Demographics (Social Vulnerability)



# Heat Map Assessment & Modeling

Understand how heat relates to socioeconomic and demographic areas of the city and model future impacts

- Overlay and analyze existing heat mapping to understand the relationship between heat and local communities; perform vulnerability assessment.
- Identify populations at risk of disproportionate impacts due to heat island effects and target needed solutions (cooling centers) in those areas.
- Develop models to test strategies that will work best in specific areas.



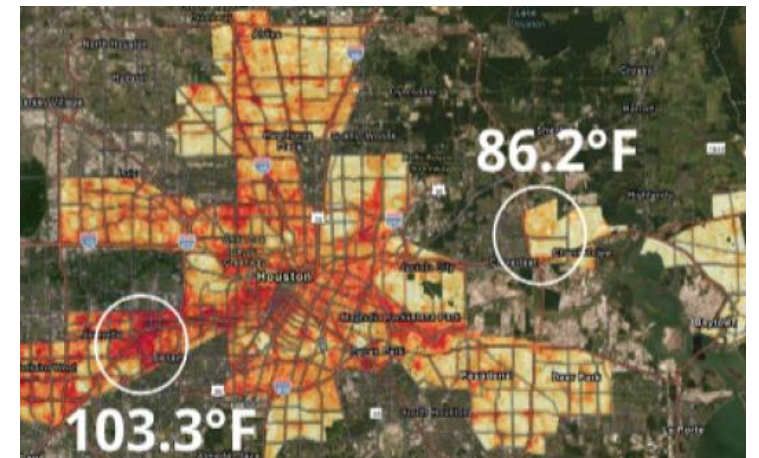
2018 CANOPY

CITY AND STATE OWNED TREES

PRIVATE TREES

REED HILDERBRAND

CAMBRIDGE URBAN FOREST MASTER PLAN



Resilient Land Use Cohort: Houston, TX ( May 2021)



# Opportunities and Challenges

# Community Awareness

Raise Awareness and Seek Engagement

- Spread awareness of the dangers of extreme heat
- Heat Island Effect is not perceived as a universal challenge

Engage communities to identify community-level solutions

Example:  
Boston Green Ribbon Commission





# Economic Vehicles & Costs

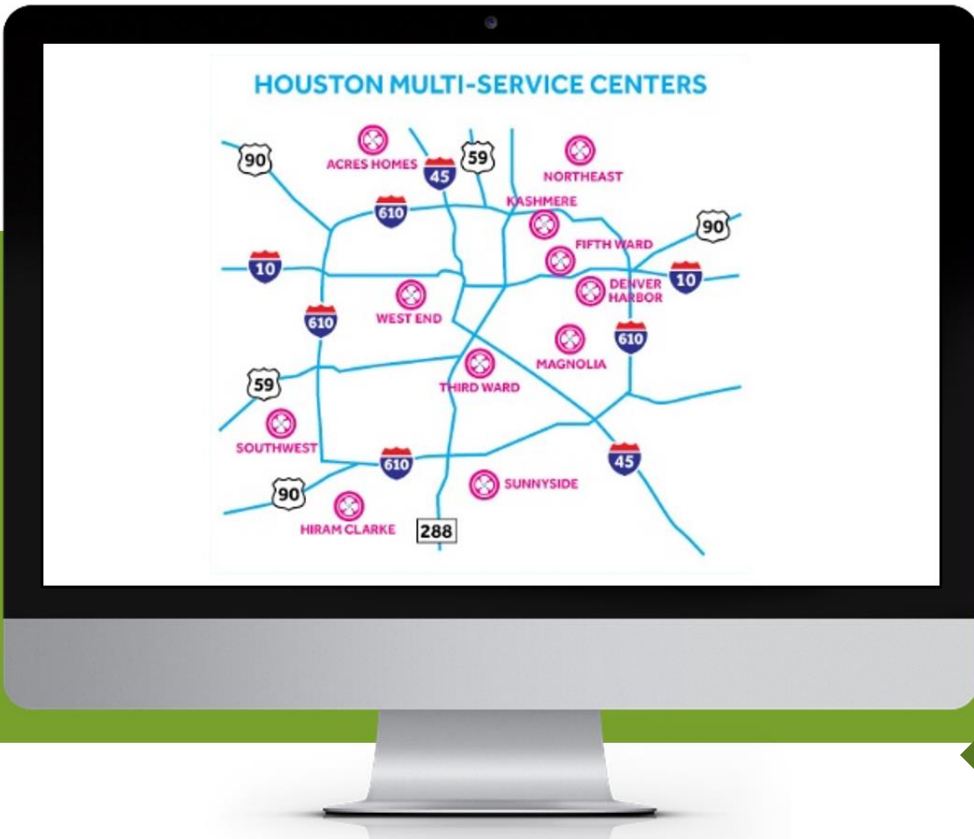
## Clear and Accessible Economic Incentive Vehicles

- Existing tax abatement program for green infrastructure
  - Expand to include heat island mitigation and management approaches
- Tax Increment Reinvestment Zones (TIRZs) currently being piloted for condensing parking
- Ensuring equitable distribution and access to all new programs and policies
  - Review any solutions through an equity lens to ensure relief and funds will be accessible and used by the communities that need them
- New code requirements can add cost pressures to projects and developments with little short-term ROI

# Energy Resilience

## Solutions for Natural Disasters and Emergencies

- Air conditioning is not always guaranteed
- Hurricanes cause wide power outages, and are also accompanied by a heat wave
- Operable windows are not generally used in Houston, but can provide relief for heat during power outages that often occur after a storm.
- Low-income and underserved communities prioritize more immediate needs



Expand Cooling Center Framework: Build upon the existing centers and target needs against heat map results and outcomes

# Competing Code Priorities

Identify and resolve competing code requirements across multiple levels of jurisdiction

- Construction of detention basins remove large forested areas without adequate canopy mitigation
- Cost increases to owners of low-income housing will be passed on to renters
- Lack of interagency communication between jurisdictional entities
- Existing City of Houston Tree Mitigation ordinance does not account for the size of tree canopy removal and replacement

Mayor's focus for resilience provides clear direction on priorities to resolve competing priorities.



# Culture of Property Rights

How ownership influences large scale mitigation efforts

- Motivate and highlight the value of property owner and developer cooperation and how it affects Heat Island Mitigation on a large scale
  - Residential Trees Canopies
  - Tree Mitigation Ordinance Compliance
- Address the cultural perception of property rights in Houston



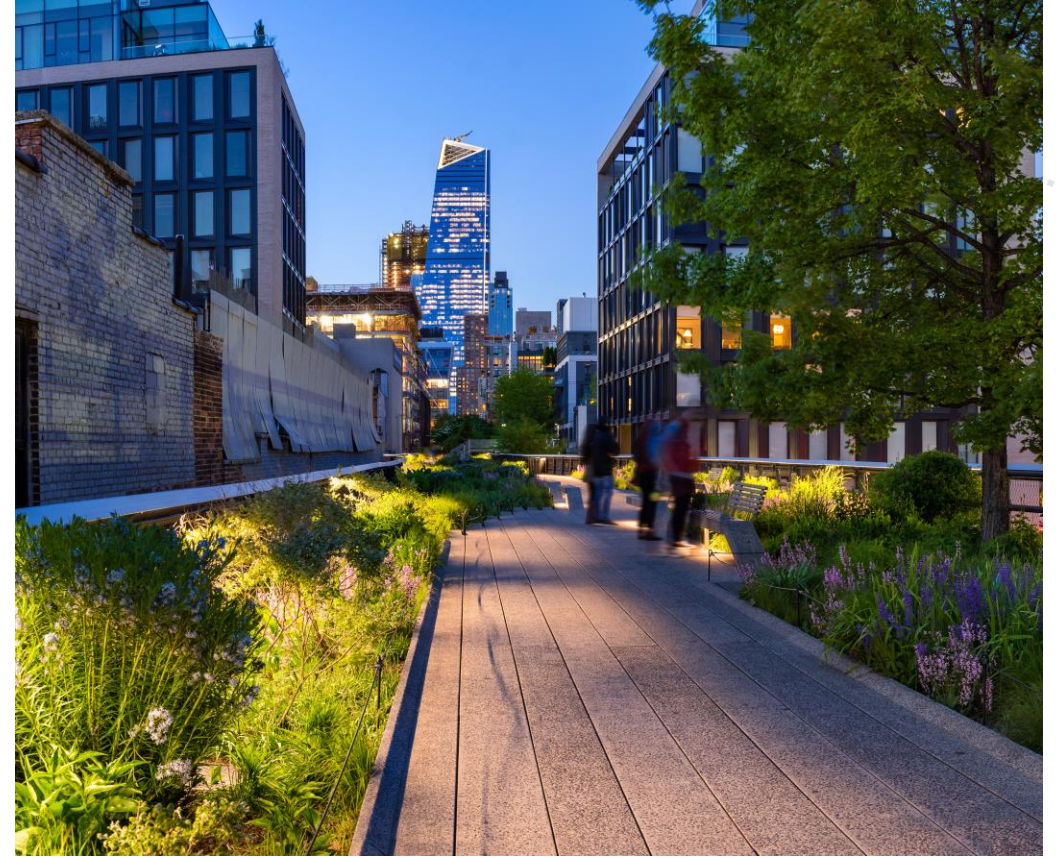
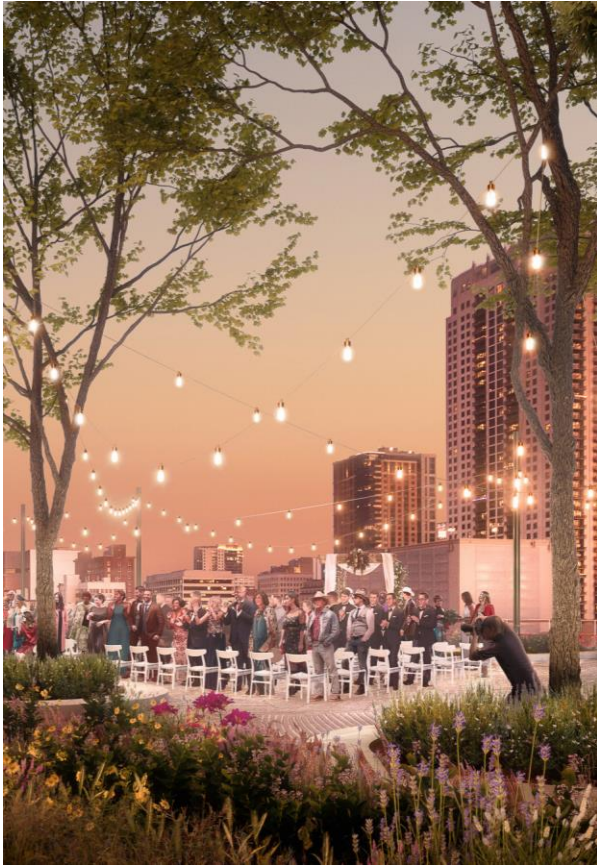
SACRAMENTO MUNICIPAL UTILITY DISTRICT





# Actions & Tactics

# Nature Based Actions and Tactics





DESERT SHADE TREES

LOOKING NORTH AT ROESLEY PARK

LOW WATER USE SPLASH PAD

EMERGENCY BLUE LIGHT  
BUS SCHEDULE  
SHADED BUS STOP

ADDITIONAL SHADED BENCHES

DRINKING FOUNTAIN  
PERMEABLE PAVING

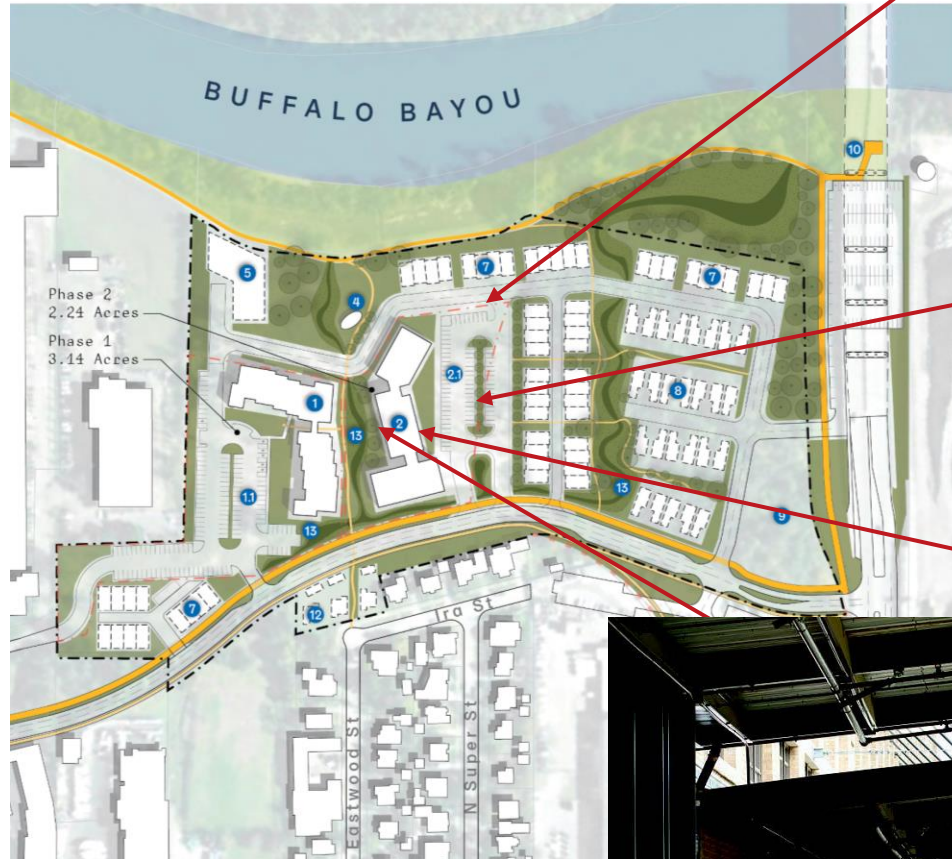
LANDSCAPE BUFFER  
AND BIOSWALE

ATLANTA AVE

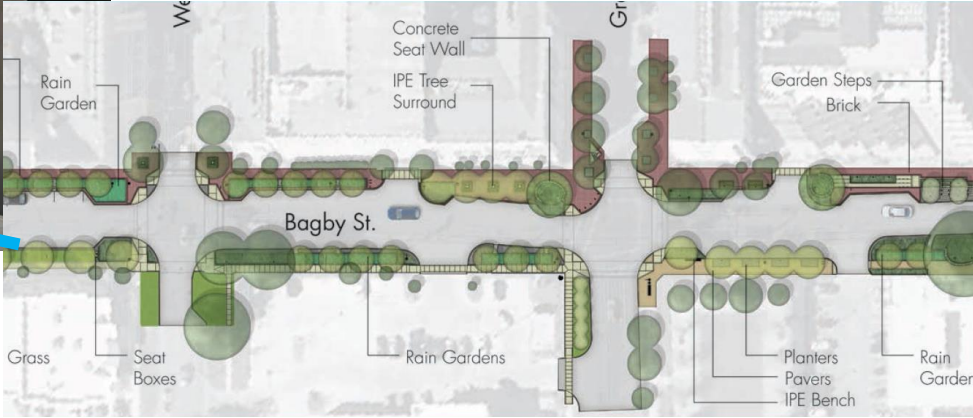
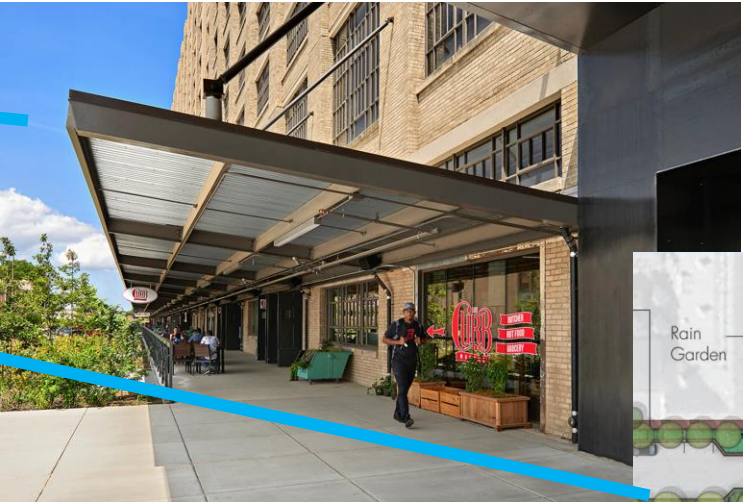
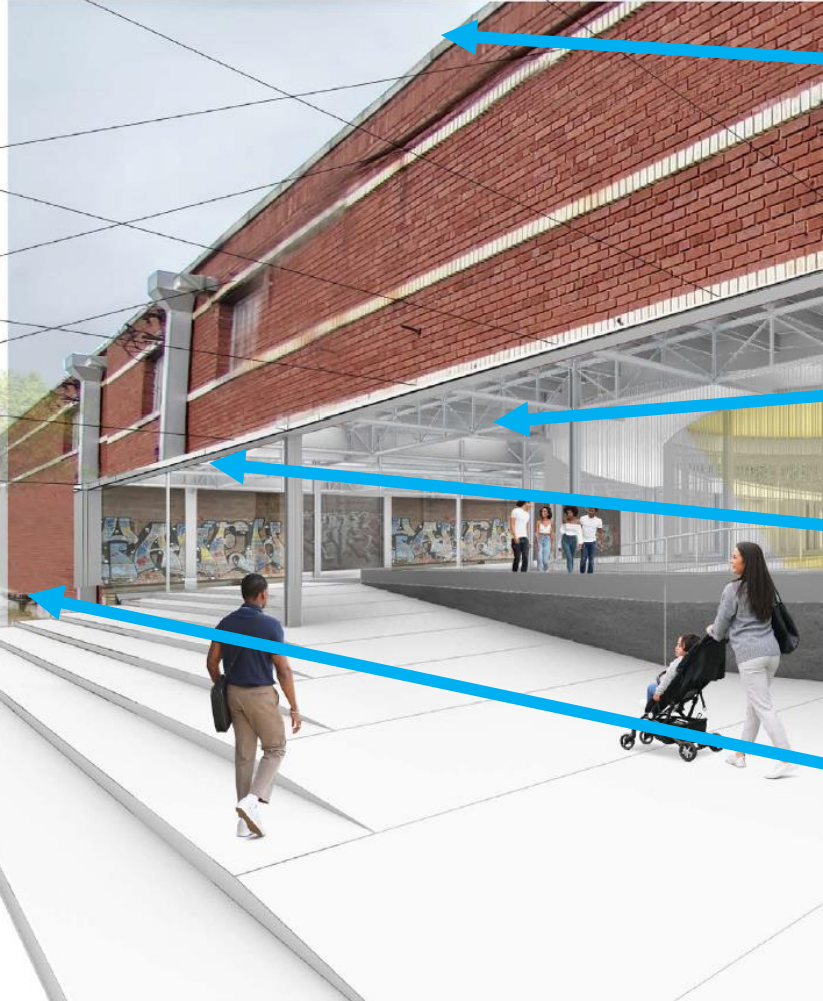


Heat Action Planning Guide Greater Phoenix - Water park for children/Roesley Park (perspective)

# New Development



# Retrofits & Adaptations





# Policy & City Initiatives

# Future City Policy Initiatives

## Lead by Example (Public-Driven Initiatives)

- Moving activities outdoors in shaded areas to allow people to experience and acclimate to the heat  
*(Heat burden is greater at the beginning of summer)*
- Improve shading along existing public pathways, routes, and public spaces in at-risk neighborhoods (*i.e.* Gulfton)
- Pilot and measure performance of proposed strategies on public buildings – in order to showcase benefits with local developers

Memorial Union Plaza – ASU, Phoenix AZ



# Future City Policy Initiatives

## Stakeholder Awareness

- Finding solutions that pencil ...
- Creating a toolkit for developers, architects, and designers with materials, strategies, and benefits
- Establishing and communicating best practices
- Leverage emerging interest in comfort base certifications (LEED IAQ, WELL, etc) to highlight the importance of urban heat in the development and ownership of real estate

Mitigation And Adaptation Strategies: Buildings And Sites (*Scorched*, ULI)

### **BUILDING DESIGN**

Orientation, Shape, Massing

### **BUILDING MATERIALS & ENGINEERING**

Building Envelopes, Shading Structures, Waste Heat Reduction, HVAC, Lighting, Sensors and Smart Buildings

### **LIGHT-COLORED & REFLECTIVE SURFACES**

Cool Roofs, Cool Walls, Cool Pavement

### **GREEN INFRASTRUCTURE**

Green Roofs, Green Walls

### **OPERATIONAL CHANGES**

Thermostat Control, Schedule Modifications

### **URBAN DEVELOPMENT PATTERNS**

Urban Geometry and Density, Ventilation Corridors, Open Space, Waste Heat Reduction, Urban Canopy, Water Features



# Future City Policy Initiatives

## Policy and Guidelines Opportunities

- Building codes need to address health impacts as it relates to heat resilience – require operable windows for ventilation, roofing improvements, and materials that radiate less heat
- Performance based evaluation
  - Edit the COH Landscape Ordinances to better address dissipating heat energy
  - Use of simulation tools to evaluate designs as microclimates
  - Building level performance metrics (energy use, comfort, health etc. )

The Chicago City Hall green roof measures almost 80°F (40°C) (EPA Green Roofs)



# Examples of Plans, Policies & Collaborations in Other Cities

## Policies & Plans

- Chicago Green Roof FAR Bonus
- Washington DC storm water credit trading
- Site Greening/Cooling Rating Systems
  - Seattle Green Factor
  - Washington DC Green Score
  - Cambridge Cool Factor (in development)
- Urban forest master plans & tree ordinances
- Urban heat plans
  - Dallas Urban Heat Island Management Study
  - Boston Heat Resilience Study (in development)
  - Louisville Urban Heat Island Project
  - Philadelphia-Hunting Park Community Heat Relief Plan

## Collaborations

- Los Angeles Urban Cooling Collaborative
- Boston Green Ribbon Commission
- Southeast Florida Regional Climate Change Compact
- San Diego Regional Climate Collaborative



# Summary/Conclusion

# Next Steps

	<b>FOUNDATIONAL</b> (Meaning baseline or 'step one')	<b>ACCELERATING</b> (Meaning it creates a level of change)	<b>LEADERSHIP</b> (Meaning doing something different than anyone else, leading the pack, aspirational)
<b>Individuals</b>	Education, Health info, Energy cost relief for low-income, Access to free/low-cost supply chain	Know where resources are and data suggested they are being used, tools such as rebates are being redeemed	Individuals are feeling more safe from heat and health-concerns, clear stories are shared in media, meetings, etc., feel supported and part of mission
<b>Neighborhood</b>	Education, Health info, Organized event(s)	Regularly scheduled events on heat, environment, etc., clear awareness and engagement from neighborhood groups	Low income neighborhoods equal to others in terms of leading change, rep'd at 'table'; tree counts maximized; health issues reduced
<b>Business Community</b>	Education, Pilot/ Examples, CoH meetings, Process clarity and improvement	Tax incentives/rebates are good enough to start change; business leaders state this is a differentiator	Business owners and leaders are partners with CoH and other organizations; leaders are sharing their resiliency measures in media and annual reports, etc.
<b>Watershed (Eco-level)</b>	Assess eco gaps, overlay heat map	Plan put into place to fill 'gaps' and related barriers are tackled; all agencies and stakeholders engaged	The watershed is a 'reborn' heat sink that resolves much of the area's issues through its natural processes
<b>City-level</b>	Code, campaign (with focus on health), key partnerships, mapping of neighborhoods/trees/ health/income/water completed	Providing rebates, education and management that shows a marked change in activity/practices, mapping exercise results in custom approaches based on segmented needs	CoH is recognized globally as an innovator who took its major issues with extreme heat and created a city with the same temps across neighborhoods, decreased mortality from heat, and adopted innovative practices and policies; citizens happy; no longer have cascade effect of power loss after/during extreme heat
<b>Regional-level</b>	Campaign, partnerships, vulnerability assessment completed	Consistent rebates and messaging, comms on why	Similar to City-Level, region is recognized globally as an innovator, though now with an added emphasis on collaboration with results. Multiple municipalities working together to benefit the entire region, including smaller communities with smaller budgets

# Q&A

THANK YOU

Uli Houston

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