Opportunities for Community Ownership Within Urban Heat Resilience Planning

A Master's Thesis submitted by

Ella Brady

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Advisor: Christine Cousineau

Reader: Sumeeta Srinivasan

Abstract

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Addressing escalating threats from climate change, this thesis focuses on the critical issue of urban heat disproportionately affecting communities facing historic systemic threats and underinvestment. This thesis advocates for an inclusive approach to urban heat planning, emphasizing community ownership through the development of Heat Vulnerability Indexes (HVIs) tailored to local needs. The analysis underscores the importance of diverse data sources and community interaction to refine indexes and foster a sense of ownership for more effective interventions. Moreover, this research examines one of the most comprehensive reports on urban heat: the American Planning Association (APA)'s 2022 *Planning Advisory Service (PAS) Report 600: Planning for Urban Heat* (the PAS Report) (Keith and Meerow 2022).

Through the lens of the 2020 "Spectrum of Community Engagement to Ownership", developed by the nonprofit Facilitating Power (the Spectrum) (Gonzalez 2020), the thesis moves through each of the proposed heat mitigation and management strategies and assigns a ranking range on the Spectrum to the strategy. Next, this thesis incorporates additional strategies from the field and literature that push the solution category further into community ownership. The thesis concludes with an overall analysis of the state of urban heat strategies, with a look towards how these practices can center community health, wellbeing and sustainability, and an understanding of the research's limitations.

Acknowledgements

Thank you to my thesis advisor Christine Cousineau, my thesis reader Sumeeta Srinivasan, and all of my peers, professors, family and friends that helped me complete this work, over the course of many years. I will always be grateful for my time at UEP.

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1 Introduction

Whether a 1.5- or 2-degree Celsius change in the earth's temperature, or a city experiencing an abnormally hot summer, the global climate change discourse is stewarded by the fear of a warming world and what may come with it. Although extreme heat occurs universally across most geographic regions, planners, policymakers, and community members often focus on the heat that is felt in dense, urban spaces. In the United States, the work to combat this threat is largely conducted in cities and towns. These same cities and towns often function as spatial representations of the imbalances that government and industry have exacerbated over time through years of racist planning, housing and infrastructure policies. In the past, when urban spaces have confronted a high stakes resilience threat or natural disaster, the easiest solution is often one that reinforces these power imbalances that are so steeped in our built environment – keeping the safe residents safer and leaving vulnerable residents without support.

This moment in time, however, reaches the planning field at a point where we have started to engage in discourse around supporting the collective power of those communities that have experienced historical harm, and what it takes to begin the process of repair. Under capitalism, ownership and power is often the most valued currency we have. Therefore, this thesis is a practical examination of the opportunities for community ownership of urban heat resilience planning practices – in an effort to add a justice lens to the practices we will rely on in the future.

This research examines of the most comprehensive reports on urban heat planning: the American Planning Association (APA)'s 2022 *Planning Advisory Services (PAS) Report: Planning for Urban Heat* (the PAS Report) (Keith and Meerow 2022). The thesis analyzes the report through the lens of the 2020 "Spectrum of Community Engagement to Ownership" developed by Rosa Gonzalez of the nonprofit Facilitating Power (the Spectrum) (Gonzalez 2020). The Spectrum of Community Engagement to Ownership is recognized as a valuable

framework, providing a nuanced understanding of the varying levels of community involvement in planning processes, from obligatory involvement to full ownership.

Research Questions

The research questions in this thesis include:

1. How does urban heat fit within the context of the climate movement?
2. Who is impacted by the escalating threat of urban heat, and in what ways are these populations affected?
3. How does urban heat and community resilience fit within the narrative of how we plan American cities?
4. How do we map urban heat?
    i. How does this mapping currently engage with the community?
    ii. Where are there opportunities for community ownership in future urban heat mapping?
5. What are the current strategies proposed by the PAS Report for heat mitigation and heat management?
    i. How do these strategies currently engage with the community?
    ii. Where are there opportunities for community ownership within these strategies?
    iii. What are additional field strategies related to research center community ownership?
6. What can a future with community at the center of urban heat planning look like?
7. What are the limitations of this research?

Thesis Structure

This thesis is divided into a framework analysis and subsequent findings. It has five chapters: Introduction, Methodology, Literature Review, Framework Analysis, and Findings. The

framework analysis examines two of the seven principles of the *PAS Report: Planning for Urban Heat Resilience* (Keith and Meerow 2022), through the lens of the "Spectrum of Community Engagement to Ownership", (Gonzales 2020).

The two principles of the PAS report studied through this work are 1) Organizing Urban Heat Information and 2) Developing Urban Heat Strategies, together which provide practitioners with guidelines for how to collect, analyze, and distribute urban heat information as well as comprehensive strategies to cool down cities over time and respond to individual heat exposure for residents. Following this analysis, I review the existing literature on heat vulnerability assessments, the standard tool used to study urban heat experiences to date. This chapter also includes a case study of a community-sourced heat vulnerability index project, sourced from key stakeholder interviews. Finally, this chapter concludes with the opportunities for community ownership within existing practices for organizing heat information, as well as additional strategies that support community power building while focusing on the utilization of heat data that will be beneficial for practitioners.

The remaining body of the framework analysis is split into two sections: heat mitigation and heat management, each containing four sub-categories of planning strategies. Each strategy section contains three sub-headers: 1) **Framework:** a review and analysis of the strategies provided in the PAS Report, 2) **Supplemental:** additional strategies sourced from original research and interviews with key practitioners and 3) **Analysis**: an analysis of which strategies proposed in each section scores a 3-5 on the Spectrum of Community Engagement to Ownership.

The Findings chapter includes a visual representation of this research and analysis, merging the Spectrum and the strategies proposed throughout, to create a visual understanding of the gaps and opportunities within the field. The chapter concludes with a view into what a

future with community at the center of urban heat planning looks like, and an understanding of where we are today.

2 Methodology

This thesis uses a mixed-methods approach to construct a critical analysis of *Planning for Urban Heat Resilience* (Keith and Meerow 2022), including using the "Spectrum for Community Engagement to Ownership", a literature review, research on additional strategies used by practitioners when planning for, or combatting urban heat, and interviews with industry and academic experts. Recommendations for planning practices are derived from these analysis exercises and added to the findings of this work.

The thesis analyzes two of the seven principles of the Planning Advisory Service (PAS) Report, *Planning for Urban Heat Resilience,* using the "Spectrum of Community Engagement to Ownership" to assess where these strategies fall on the spectrum and identify opportunities for community ownership of resiliency practices in planning for urban heat. The two principles are: 1) Organizing Urban Heat Information and 2) Developing Urban Heat Strategies, the latter including both heat mitigation and heat management.

The remaining principles of the PAS report were not analyzed because they did not align as well with the opportunities for community engagement outlined in the Spectrum, as compared to the two principles chosen. For these other principles, research already exists on best practices for engaging community in these areas (e.g. Setting Urban Heat Goals, Managing Uncertainty, Addressing Urban Heat Across the Network of Plans, Participating in Urban Heat Planning, and Implementation and Monitoring). The two principles chosen are both highly topic-specific, and therefore lack the support of existing research in the field on how these components can align with community.

For the Organizing Urban Heat Information section, I review existing literature on heat data analysis and include a consideration of the future of heat information methodologies based

on this literature review. The evaluation consists of peer-reviewed academic journals, articles and book chapters and concludes with a framework analysis, applying the “Spectrum of Community Engagement to Ownership” to the future implications of organizing urban heat information.

For the Developing Urban Heat Strategies section, this thesis moves through each category of work (waste heat, urban greening, urban design, land use, energy, personal exposure, public health, and emergency preparedness) and provides context on the reported use of each strategy (i.e. how Keith and Meerow (2022) speak to each category). I then research additional strategies not included in the PAS Report, and analyze where each strategy lies on the Spectrum and where opportunities for growth exist. The additional research was gathered through multiple sources including academic research, coursework, webinars, podcasts, and conversations throughout my time at UEP and my year-long internship at the Metropolitan Area Planning Council.

In order to validate and supplement the findings of this work, I conducted expert interviews with practitioners and academics in the field. As this field is rapidly evolving, the best way to understand existing practices is through conversation with those involved in this work and research day to day. To prepare for interviews, I crafted scripts and guides based on both the thesis’s guiding research questions and initial findings from the research. Interviewees included: Sara Meerow, author of the PAS Report, Daniel Horton, Co-Lead of Diffusing Disasters, and Michelle Litwin, Heat Response Program Manager at the City of Phoenix.

3 Literature Review

Overview

This review begins with a focus on the global discourse surrounding climate change, and the questions and solutions posed given the context of a changing world. It then delves into the specific impact of urban heat, emphasizing its manifestation in dense, urban cityscapes. The narrative then moves to cover the environmental justice movement, tracing its origins in the late 1980s and its ongoing impact on policies and regulations. The discussion intertwines the history of redlining practices in the U.S., connecting discriminatory housing policies to the spatial distribution of the urban heat island effect. The text then analyzes present-day disparities in heat resilience, highlighting the systemic lack of resources in marginalized communities. Additionally, it centers on the existing challenges in heat resilience planning, in terms of governance, institutional coordination, and adaptive strategies found throughout cities. The review concludes with a spotlight on ongoing heat planning research, introducing the report that this thesis analyzes, and the framework used to do so.

Urban Heat

The presence of heat in an urban area, as it is experienced today, is a product of climate change, natural variability, and the urban heat island effect (Kleerekoper et al. 2012). The urban heat island, or UHI, is the phenomenon in which metropolitan areas retain hotter temperatures during day and night due to a variety of factors, most commonly identified as a lack of tree canopy, excess impervious surface, large-scale infrastructure, and less green space (Anderson 2020). As the warming of the world steadily increases due to climate change, and natural variability pushes a heat wave towards a particular geographic area, the effects of the wave are felt by city dwellers, and the energy is trapped within the built environment (Kleerekoper et al. 2012). Urban heat manifests not only as heat waves; many cities and towns in the United States

(as well as globally) are experiencing an increase in uncomfortably hot days in the warmer months of the year (Tong 2021). Extreme heat is the deadliest of all weather-related disasters (Hondula et al. 2015). Over 700 deaths occurred in the 1995 Chicago heat wave (Davis et al. 2003). Between 2004 and 2018, the US saw an average of 702 heat-related deaths and 9,235 hospitalizations annually (CDC 2023). Since 2018, these numbers have only increased. In 2021 alone, heat was a contributing factor in 1,577 U.S. deaths, a 56% jump from 1,012 in 2018 (Davis 2022). This threat does not affect populations within cities equally; we cannot fully understand and address the threat of urban heat without understanding the adverse effect of urban heat on low-income communities of color. Such communities have been historically under-resourced and systemically subjected to extreme heat due to a lack of equitable resiliency planning, among other factors (Anderson 2019). Researcher Sara Meerow cites heat as the "most obvious fingerprint" of climate change, as communities can feel tangibly feel the degree changes over time in urban spaces[1].

Environmental Justice

The environmental justice movement began in the late 1980s, as the disparities in the burden of environmental degradation and pollution facing low-income minority communities came into public view (Sierra Club 2001). The movement's spotlight on issues of environmental justice sparked the publication of Benjamin Chavis' study *Toxic Wastes and Race* in 1987 (Sierra Club 2001). Robert Bullard, dubbed the father of environmental justice, published his seminal book *Dumping in Dixie* in 1990 and was involved in planning the First National People of Color Environmental Leadership Summit. In 1991, delegates to this Summit drafted and adopted 17 principles of Environmental Justice (Principles of Environmental Justice 1991). Over the following decades, the federal government and local municipalities formalized officers and offices of environmental justice, while creating metrics to identify "environmental justice

[1] Sara Meerow, Zoom, March 2, 2024

communities". The Environmental Protection Agency (EPA) defines environmental justice as "the fair treatment and meaningful involvement of all people, regardless of race, color, national origin or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies (EPA 2024c). However, those involved in the fight for environmental justice often expand this definition to include an acknowledgement of the past harm inflicted upon low-income communities of color in this country. The history of the movement is rooted in its efforts to organize against point source pollution, sometimes overshadowing the long-standing legacy of environmental resilience and conservation resources existing within affluent areas, leaving under-resourced communities of color with less adaptive capacity and adverse health effects (Norgaard et al. 2011, 66-68).

Urban heat is an environmental justice issue. From the planting of trees to accessing air-conditioning, low-income communities of color have less access to environmental benefits than white communities. Many communities have little to no tree canopy in their neighborhoods, few to no green open spaces, and less natural and artificial cooling. They therefore experience hotter temperatures and are less resilient to hot days and heat waves. Race, socioeconomic status, and physical resources affect both heat resiliency and heat mortality rates. Studies have shown that heat mortality rates for Black people in the United States are higher than that of other racial groups in the country (Gronlund 2014).

Redlining and Urban Heat

In 1917, when the Supreme Court in Buchanan v. Warley ruled against exclusionary zoning laws and city ordinances that enforced housing segregation and discrimination in the United States, these racist policies were replaced by homeowners' use of racially restrictive covenants. Covenants allowed property owners to ban certain racial groups from purchasing homes in designated neighborhoods (Lockwood 2020). Racially restrictive covenants, which were enforced from 1920 to 1948, became legally unenforceable after this period, but were still

used by developers and homeowners from 1948 to 1968. During this extended period, the federal government worked to create housing policies that would increase confidence in investment and stimulate more home construction (Greer 2014). In 1934, the Federal Housing Administration (FHA) was created as part of the New Deal, with the intent of helping families afford homeownership by insuring mortgage loans and new housing construction. The FHA, however, considered insuring homes for Black Americans too risky, leading to a practice referred to as “redlining” (Xu 2018). Mortgage redlining specifically harnessed the power of government by refusing to insure mortgages in and near predominantly Black neighborhoods (Lockwood 2020). Instead of taking the place of homeowners’ use of racially restrictive covenants, this practice solidified the use of covenants in mortgage lending practices. The enforcement of redlining practices in the US, while now illegal, has had lasting effects on the predominantly Black communities that experienced the adverse effects of redlining (Perry and Harshbarger 2019).

Throughout these developments, the FHA created mortgage insurance implementation maps, which visualized the rollout of the mortgage insurance program. The Home Owners Loan Corporation (HOLC) produced the Residential Security Maps, which at the time gauged mortgage risk at the neighborhood level for most U.S. cities. Over 200 HOLC maps were drawn for cities with populations of 40,000 or more (Nelson 2020).

Studies have documented that as climate change effects are felt with more intensity every day, Black and Brown people in the United States are disproportionately more vulnerable to extreme negative environmental impacts, due to the legacy of our country’s racism and oppression in planning (Armstrong 2020). Past federal practices such as mortgage redlining, which have shaped the urban landscape of cities over time, have affected the spatial distribution of the urban heat island effect. In comparing the legacy of policy to a cities’ environmental

landscape, researchers are able to identify target areas for climate resilience planning such as long-term cooling measures.

The data which best allows this relationship to be explored is published through the University of Richmond's Digital Scholarship Lab as a product of the "American Panorama" project, which functions as an interactive atlas of United States history. Within American Panorama, the project "Mapping Inequality: Redlining in New Deal America", digitizes historical Home Owner's Loan Corporation redlining maps and creates interactive tools as well as downloadable spatial data containing the boundaries of formerly redlined areas (Nelson et al. 2017).

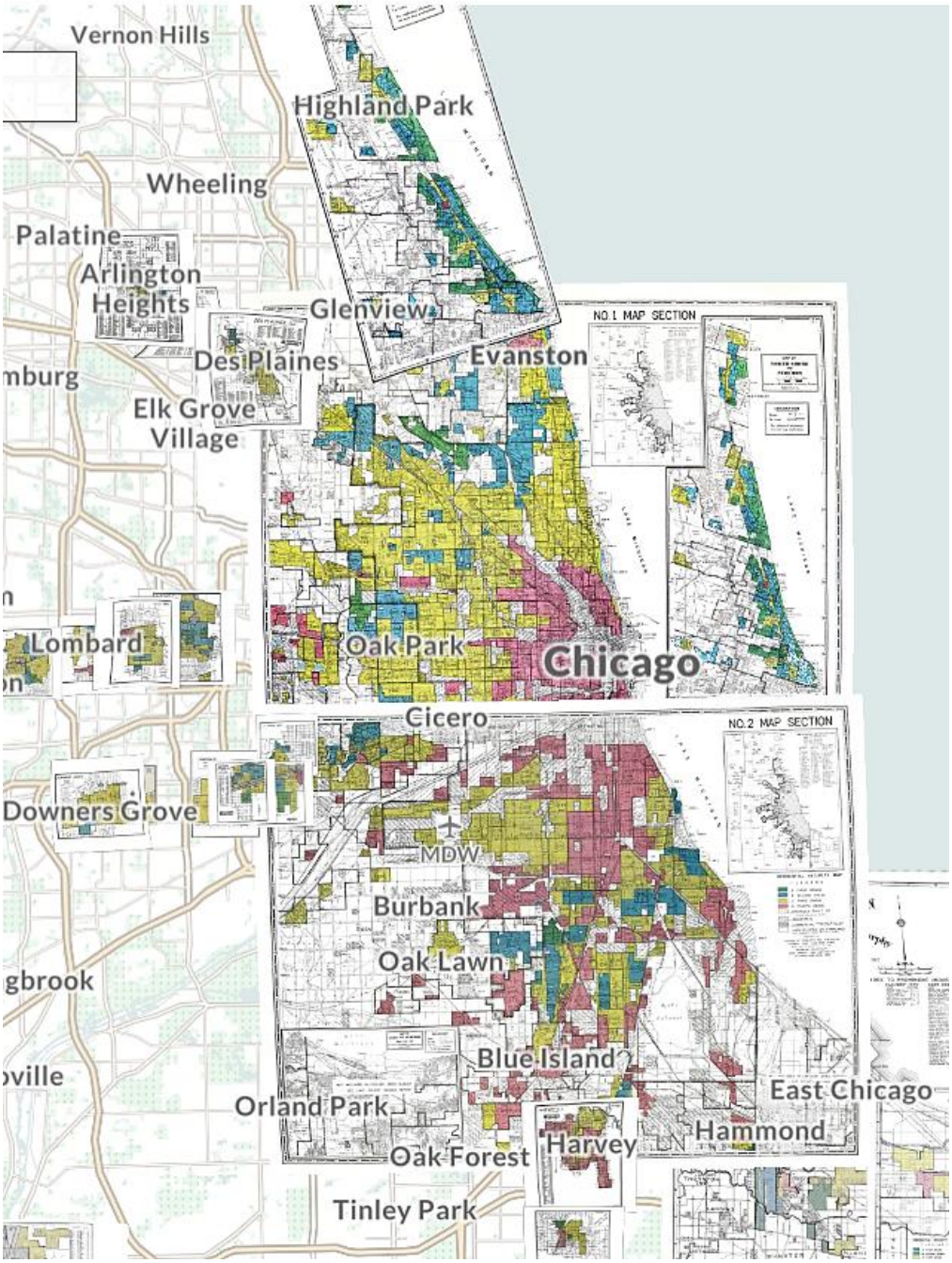


Figure 1. Redlining Maps of Chicago, 1940. (Source: Nelson et al. 2017. Mapping Inequality: Redlining in New Deal America)

Following the release of these public datasets in conjunction with the increase in research surrounding environmental justice, one study has interrogated the relationship between urban heat and redlining. The research by Hoffman et al. (2020), titled, “The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban

Areas", ties the HOLC Maps to the urban heat island effect using satellite land surface data, and suggests a correlation between formerly redlined areas and urban heat (Hoffman et al. 2020). Researchers from this team also worked specifically to supplement land surface data in Richmond, Virginia with community-sourced heat data in order to build out a heat vulnerability index that was analyzed alongside the *Mapping Inequality* shapefiles. The culminating effort was a story map in partnership with Groundwork RVA, in Richmond, VA.

Heat Equity

Segregation produced and enforced by federal, state, and local policies as well as by private real estate practices leaves low-income communities of color without the same tools that whiter, wealthier communities wield to protect themselves from hot days and heat waves. Mapping access to such tools produces similar spatial trends to other common resource disparities in the country. For example, those without access to functioning air conditioning units also see less access to affordable housing and lower rates of home ownership (Montgomery 2020). With a high demand for air conditioning for cooling comes the problem of potential rolling blackouts due to the increase in energy use during hot days and heat waves (Mckenna and Simon 2023). Rolling blackouts are especially dangerous for individuals with disabilities, who may rely on a connection to power to maintain their wellness (Collins 2019). These disparities also support the existence of fuel poverty, with lower income individuals paying higher bills for less temperature regulation, due to the quality of the rental housing stock and the lack of agency of tenants in the United States (Kwon and Jang 2017). There is also an imbalance in green infrastructure, with more affluent communities having access to sustainable buildings and biophilic design. Gentrification pervades this issue, as seen when the implementation of sustainable development displaces current residents and raises property values (Anguelovski et al. 2019). Overall, formerly redlined communities see higher proportions of impervious surface, lower tree canopy, green space and vegetation that cool the body under duress from heat

(Hoffman et al. 2020). Despite these historical and present inequities, heat resiliency planning does not currently account for the imbalance of extreme heat in cities. Resources such as cooling centers and splash parks are often distributed evenly throughout the city or wherever possible, instead of concentrated in low-income communities of color, which, based on historic trends, have suffered from years of disinvestment and environmental injustice.

Those working to fortify communities against current and future threats of extreme heat cite equity as a high priority for resiliency planning (Keith and Meerow 2022); yet current practice does not reflect an awareness of the deep history of resource disparities between different neighborhoods within cities, and between urban and suburban communities.

Heat Resilience Planning in the United States

Extreme heat differs from other climate risks due to its historic lack of governance, legal regulatory structure, and its invisibility in the built environment (Keith and Meerow 2022). This sets it aside from other hazards such as flood risk, which is highly accounted for in governmental and environmental practices. Additionally, where heat resilience planning exists within federal, state, and local governments, it is often under-resourced and under-coordinated.

Arizona State University researchers analyzed qualitative data from planners in the US, in which professionals in the field expressed high levels of concern over the hazard of heat, yet climate adaptation resources lacked a focus on heat (4 percent of 3,500 climate adaptation resources analyzed) (Keith et. Al. 2019). This research suggests that even where heat risks are acknowledged and resiliency practices are understood, they are not always given equivalent priority compared to other community values (Keith et al. 2019).

Heat resilience planning also exists in silos within government. A high degree of cooling strategies fall under the jurisdiction of municipal emergency management departments, who also often work on emergency notification communications. In parallel, Mayors' offices and other policymakers focus on the policy implications of extreme heat, while environmental departments

work on supporting sustainable solutions to warming communities, and building departments manage residential heating and cooling within their housing stock. Heat is often perceived as a component of a larger issue, often included in generalized, long-range climate planning, with cities and states compiling climate action plans. Increasingly, however, some government entities have started to create separate heat action plans.

Almost all studies that engage with the heat planning process call for more governance capacity around extreme heat risk, certainly in comparison to other climate risks (Koop et al. 2017). There is a desire to bring city departments together, increase collaboration between different neighboring local government jurisdictions, and partner with the private sector (Sailor et al. 2019). A specific institutional challenge that studies focus on is the fact that heat governance planning work must compete for the limited time and resources sought after by those interested in a range of other climate threats, some with seemingly more urgent effects (Keith and Meerow 2022).

Despite existing institutional barriers, as greater effects of climate change are experienced, and hotter days become more frequent, heat resilience is evolving within the field. Researchers are creating tree equity indexes and spatially analyzing green space, cities are supporting tree canopy expansion and remediation of land, and community members are involved in environmental stewardship and advocacy. Cities are subsidizing residential cooling measures such as air conditioning and supporting emergency management tactics including cooling centers, splash parks, splash buses, cool pavements, cool murals, and shade structures (EPA 2024a). Some municipalities have pushed this work further, implementing heat departments, offices and/or officers. As of March of 2024, Phoenix, Los Angeles and Miamiare the only cities that have heat offices.

In light of mounting concern over extreme heat, scholars and practitioners across disciplines are advancing the understanding of causes and responses to this risk. Examples of

early and new work being produced in this field include: identifying and managing sources of heat vulnerability among the population; furthering inter-agency collaboration and preparation, streamlining climate planning materials that involve heat planning (Keith and Meerow 2022); reducing long-term heat in the built environment by way of increasing green infrastructure and reflective or lighter building materials; employing new heat sensing tools beyond satellite heat surface temperature (Hoffman et al. 2020); involving community in gathering and analyzing heat-related data (Hoffman et al. 2020), research on integrating environmental justice into heat resilience planning; and furthering interactive web applications with relevant data to engage community.

In Phoenix, the Office of Heat Response and Mitigation has grown to support many arms of the municipal government. Specifically, over five years after the office's creation, staff and projects are deeply connected to the city's case workers for individuals experiencing homelessness, providing water, sunscreen, and other heat response resources for folks on the street, paired with support for short- and long-term housing and shelter options. Staff at the city believe that reducing the number of individuals sheltering on the street will lower the potential heat related mortality rate[2]. The city's office is divided into two arms: heat response and heat mitigation, with the former addressing how to keep people safe on the ground, and the latter referring to work to plan for the future. Overall, one of the office's primary roles is to provide other groups and city departments with expert knowledge (housing, public works, public health, and emergency response). This is paired with an emphasis on supporting individuals with co-occurring vulnerabilities such as individuals seeking shelter and individuals abusing substances[3].

Although Phoenix is often cited as a leader in the urban heat space, this work is growing across most geographic areas of the country. As this work continues to evolve across the nation, researchers have also focused on formalizing frameworks to organize these efforts.

[2] Michelle Litwin, City of Phoenix. *Zoom, March 7, 2024.*
[3] Michelle Litwin, City of Phoenix. *Zoom, March 7, 2024.*

Planning for Urban Heat Resilience

Researchers from Arizona State University have focused on assessing the current state of practice and producing principles to guide the work of others in this field. Combining previously developed seven principles of strong climate change planning (Meerow and Woodruff 2020) with heat mitigation and management strategies, Keith and Meerow described efforts needed for effective urban heat resilience planning, in the 2022 PAS report *Planning for Urban Heat Resilience*, published by the American Planning Association (Keith and Meerow 2022). The principles include:

(1) Setting goals and metrics for success
(2) Organizing urban heat information
(3) Developing urban heat strategies
    a. Heat Mitigation
        i. Waste Heat
        ii. Urban Greening
        iii. Urban Design
        iv. Land Use
    b. Heat Management
        i. Energy
        ii. Personal Exposure
        iii. Public Health
        iv. Emergency Preparedness
(4) Managing uncertainty
(5) Addressing urban heat across the network of plans
(6) Participation in urban heat planning
(7) Monitoring and evaluation

Figure 2. Keith and Meerow. 2022. *Planning for Urban Heat Resilience*, PAS Report, p. 39.

Keith and Meerow's research acknowledges that US cities should ready themselves for unprecedented heat and confront systemic inequalities in heat-related risks. The work also calls for planners to help communities equitably prepare for and adapt to heat risk (Keith and Meerow 2022). Although equity is cited as central to this effort, planning in the United States has a history of negligence when it comes to spatial equity and justice in resilience preparation. True equity comes by allowing the affected community to participate, inform, and in some cases own resilience practices, programs, and tools.

This thesis provides an analysis of the PAS Report: *Planning for Urban Heat Resilience* principles using the "Spectrum of Community Engagement to Ownership" to assess where these strategies fall on the Spectrum and the opportunities for community ownership of resiliency practices in planning for urban heat.

Spectrum of Community Engagement to Ownership

Community engagement is a necessary, if not required, phase of formalized planning efforts. The "Spectrum of Community Engagement to Ownership", developed by Rosa González of the nonprofit *Facilitating Power,* draws on public participation tools such as Arnstein's Ladder of Citizen Participation and the Public Participation Spectrum created by the International Association for Public Participation (González 2020). The contents have been piloted in cities and with organizations across the country (González 2020).

The Spectrum is designed to acknowledge marginalization, assert a clear vision, articulate a developmental process, and assess community participation efforts (González 2020). Overall, assessing where processes and programs fall on the spectrum allows those involved to recognize where their work is located, and thus determine where to go through a conscious and collective process (González 2020). The desired outcome is ultimately transforming systems and shifting culture (González 2020).

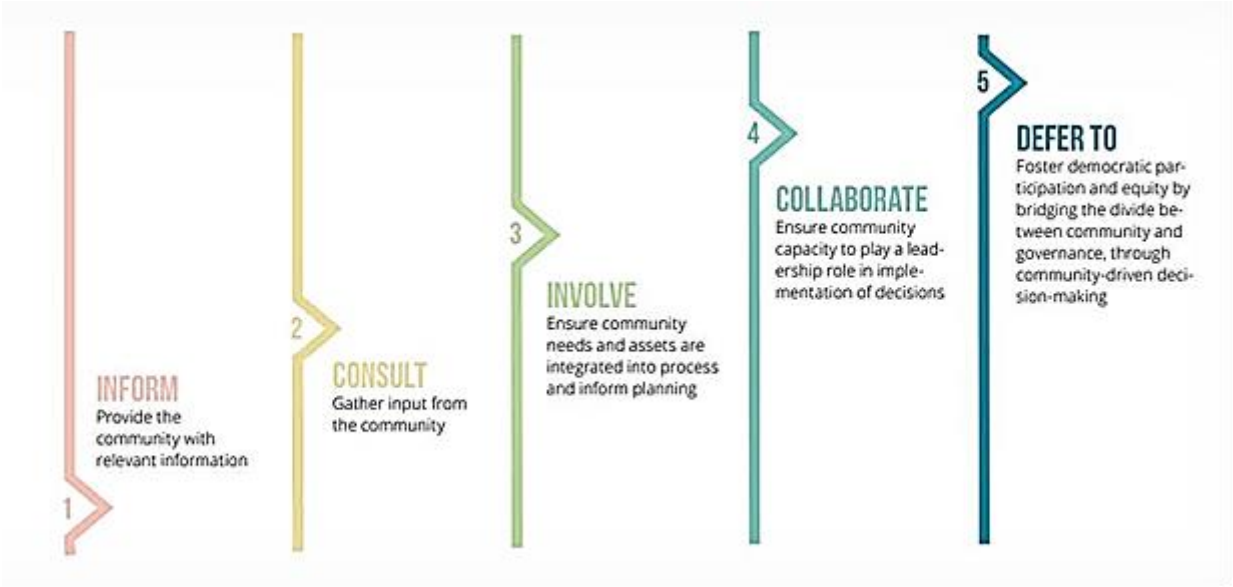


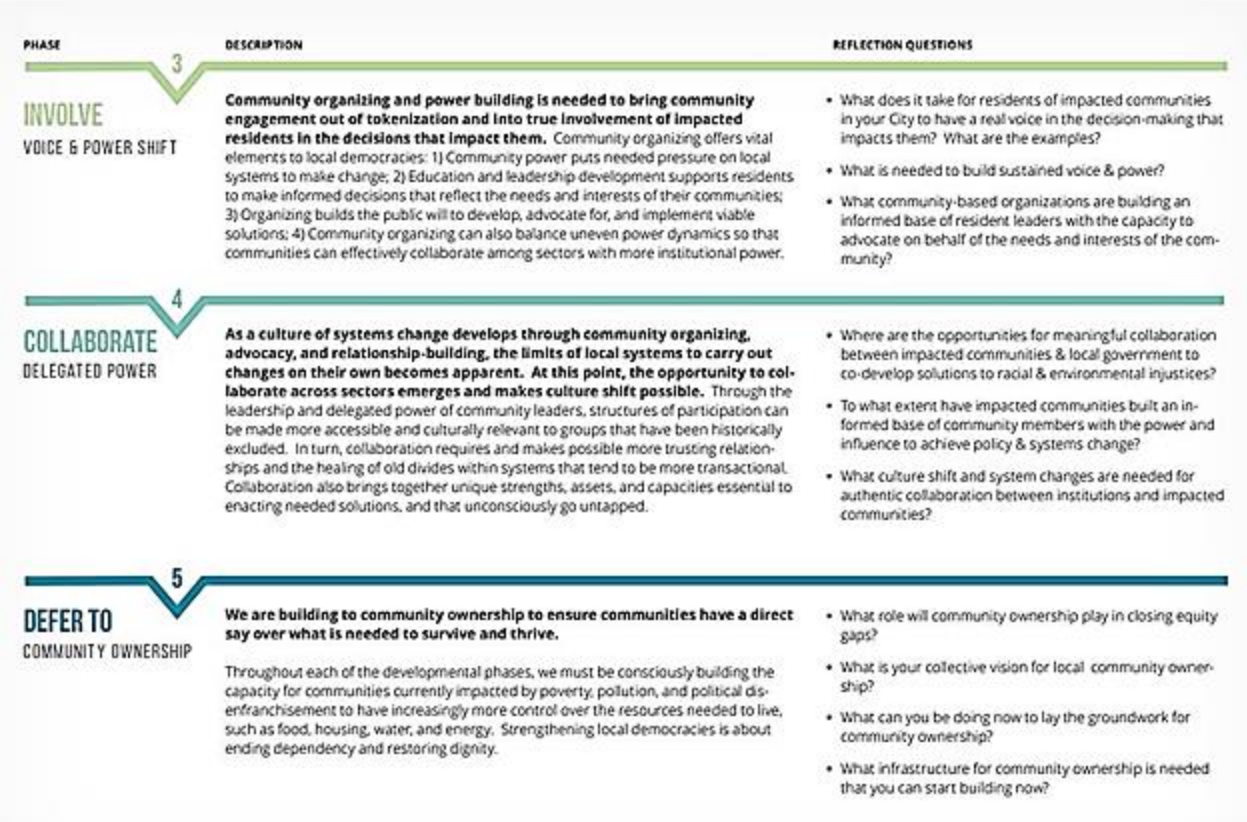
Figure 3. Spectrum of Community Engagement to Ownership, González 2020, p. 5.

UNDERSTANDING THE SPECTRUM WITHIN LOCAL CONTEXTS

Through facilitated dialogue, reflect on each of the developmental phases in the context of your city/region.

PHASE	DESCRIPTION	REFLECTION QUESTIONS
0 IGNORE MARGINALIZATION	**Marginalization represents the status quo, given current systems have been historically designed to exclude certain populations. If concerted efforts are not made to break-down existing barriers to participation, then by default, marginalization occurs.** The history of the United States can be understood as generations of social movements striving to extend the rights of democracy to groups that have been previously excluded. The health of our democracy AND our economies depends on our capacity to recognize and address marginalization and exclusion. There is a direct connection between economic exclusion (slavery, taking land by force, taxation without representation, exploitation of labor, etc.) and political exclusion (denying citizenship and voting rights, top-down decision-making practices, etc.).	• What are the roots of systematic marginalization in your city/region? How is political exclusion related to local economic factors? • How does the legacy of political exclusion based on race and class persist to today? What forms does it currently take in your city/region?
1 INFORM PLACATION	**Information is the foundation for taking action towards real solutions to the threats we face. As the saying goes, knowledge is power. If, however, community engagement efforts remain at the level of one-way information sharing, such efforts result in placation.** The role of the community is reduced to absorbing information from those with more positional power; meanwhile, the notion that every day people can actually shape solutions is stifled. Community-based organizations can play a key role in ensuring access to information about issues, services, solutions, etc. in ways that are culturally rooted and relevant.	• What does information flow look like for impacted communities in your city/region? What is contributing to information flow? What is hindering it? • Reflecting on existing community assets, what will it take for impacted communities to have equitable access to information about the issues that directly impact them?
2 CONSULT TOKENIZATION	**The most common fom of 'community engagement' among mainstream institutions is consultation, usually in the form of semi-interactive meetings in which members of the community have the chance to offer input into pre-baked plans.** This is of course a step up from one-way information-sharing; a two-way exchange is initiated. The biggest critique of this form of engagement is that decisions are often already made; the community input period simply serves to check a box. What's more, if the people participating have not had the chance to develop a shared analysis of the problem or articulate a shared vision, values, and priorities, with their peers, then they don't actually represent a 'community,' they are simply participating as individuals, and therefore are only 'tokens' of the community they are supposed to represent. This is the trap of consultation.	• When is it appropriate for impacted communities to be in a consultation role? What should impacted communities in your city/region be consulted on? • Where, in your experience of community engagement does it feel like consultation can be a trap? • What is needed to move beyond consultation and get to solutions that benefit from the genuine involvement of impacted communities?

Figure 4. Spectrum of Community Engagement to Ownership, González 2020, p. 6.



PHASE	DESCRIPTION	REFLECTION QUESTIONS
3 INVOLVE VOICE & POWER SHIFT	**Community organizing and power building is needed to bring community engagement out of tokenization and into true involvement of impacted residents in the decisions that impact them.** Community organizing offers vital elements to local democracies: 1) Community power puts needed pressure on local systems to make change; 2) Education and leadership development supports residents to make informed decisions that reflect the needs and interests of their communities; 3) Organizing builds the public will to develop, advocate for, and implement viable solutions; 4) Community organizing can also balance uneven power dynamics so that communities can effectively collaborate among sectors with more institutional power.	• What does it take for residents of impacted communities in your City to have a real voice in the decision-making that impacts them? What are the examples? • What is needed to build sustained voice & power? • What community-based organizations are building an informed base of resident leaders with the capacity to advocate on behalf of the needs and interests of the community?
4 COLLABORATE DELEGATED POWER	**As a culture of systems change develops through community organizing, advocacy, and relationship-building, the limits of local systems to carry out changes on their own becomes apparent. At this point, the opportunity to collaborate across sectors emerges and makes culture shift possible.** Through the leadership and delegated power of community leaders, structures of participation can be made more accessible and culturally relevant to groups that have been historically excluded. In turn, collaboration requires and makes possible more trusting relationships and the healing of old divides within systems that tend to be more transactional. Collaboration also brings together unique strengths, assets, and capacities essential to enacting needed solutions, and that unconsciously go untapped.	• Where are the opportunities for meaningful collaboration between impacted communities & local government to co-develop solutions to racial & environmental injustices? • To what extent have impacted communities built an informed base of community members with the power and influence to achieve policy & systems change? • What culture shift and system changes are needed for authentic collaboration between institutions and impacted communities?
5 DEFER TO COMMUNITY OWNERSHIP	**We are building to community ownership to ensure communities have a direct say over what is needed to survive and thrive.** Throughout each of the developmental phases, we must be consciously building the capacity for communities currently impacted by poverty, pollution, and political disenfranchisement to have increasingly more control over the resources needed to live, such as food, housing, water, and energy. Strengthening local democracies is about ending dependency and restoring dignity.	• What role will community ownership play in closing equity gaps? • What is your collective vision for local community ownership? • What can you be doing now to lay the groundwork for community ownership? • What infrastructure for community ownership is needed that you can start building now?

Figure 5. Spectrum of Community Engagement to Ownership, González 2020, p. 7.

The Spectrum includes five levels of community engagement and their effect. This thesis seeks to identify urban heat strategies that involve (3), collaborate with (4), and defer to (5) community. The effect on community of each of these types of actions is to: voice and shift power, delegated power, and attain community ownership, respectively.

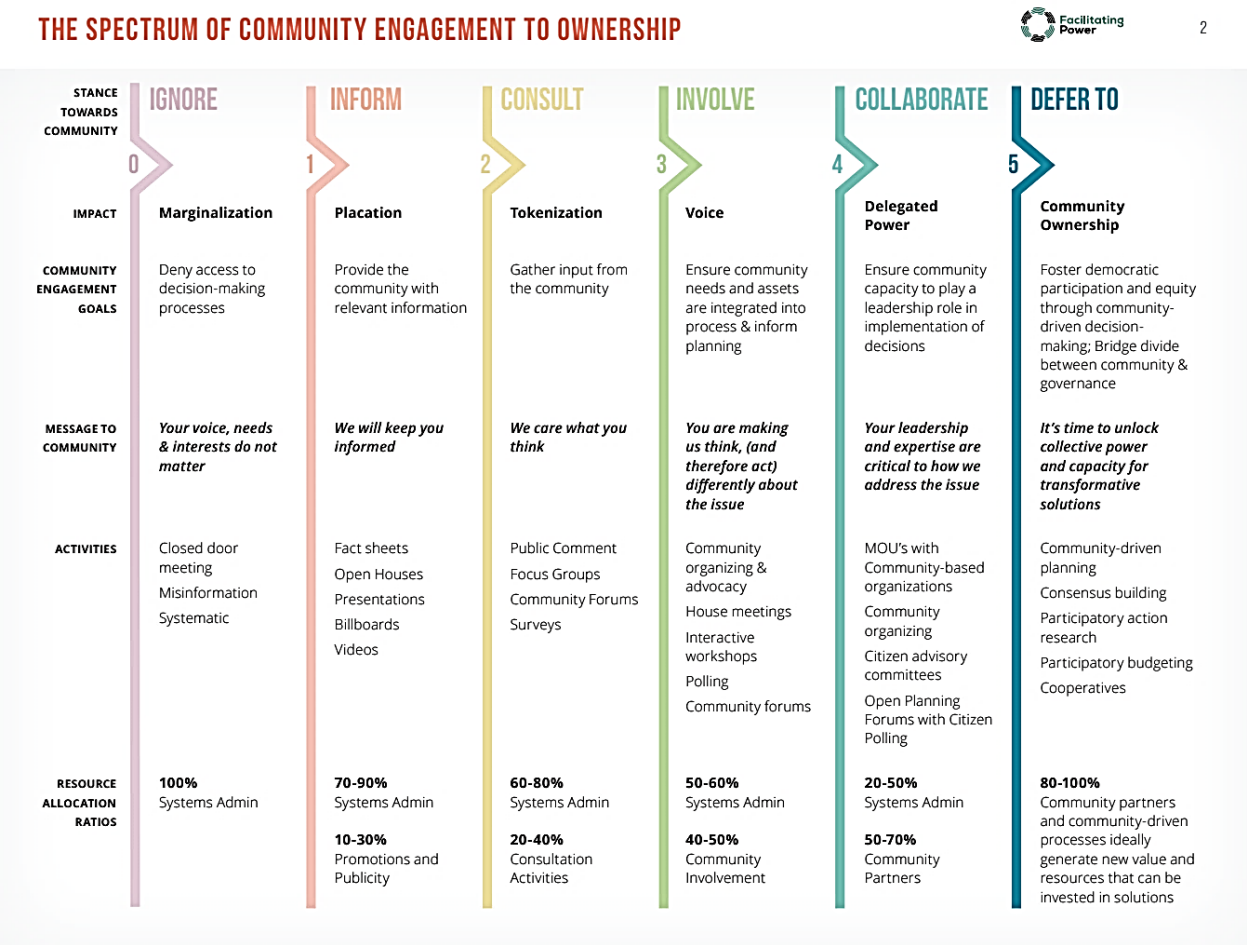


Figure 6. Spectrum of Community Engagement to Ownership, González 2020, p. 2.

4 Framework Analysis

Organizing Urban Heat Information

A vast majority of the efforts deployed by planners, policymakers and community members to understand how to work with data to explain and describe extreme heat have focused on spatial modeling of past and present vulnerability to heat. In an analysis of 589 articles on extreme heat planning, researchers found that 68 percent (399) of the studies were modeling papers (Keith and Meerow 2022), often categorized as heat vulnerability indexes (HVIs), which combine a series of vulnerability variables to extreme heat to identify target geographic areas in a city. Keith and Meerow's *Planning for Urban Heat Resilience* PAS Report calls for planners to collect relevant information from available sources, including information on historical temperatures, maps of the current UHI effect, heat vulnerability and demographic data, and future climate projections for heat (Keith and Meerow 2022). The report also acknowledges the need for planners to help their communities comprehensively understand current and future urban heat planning needs. Although many of these sources will be essential in mapping urban heat for communities to harness power, the history and future use of such maps require further interrogation to understand how communities can be accurately represented and, as the Spectrum of Community Engagement to Ownership calls for, involved in, collaborated with, and/or deferred to when it comes to gathering and processing such information.

Heat Vulnerability Indexes (HVIs)

Over the past three decades, HVIs have been built by the public and private sectors based on a series of templates. In 2009, one of the first studies to include an HVI template mapped and analyzed 10 vulnerability factors for heat-related morbidity and mortality in the United States (Reid et al. 2009). These factors included six demographic characteristics and two air conditioning use variables from the U.S. Census, vegetation cover from satellite images,

and diabetes prevalence data from a national survey (Reid et al. 2009). The authors performed a factor analysis of the variables and found four dominate factors in predicting vulnerability to heat: a) social/environmental vulnerability (combined education/poverty/race/green space), b) social isolation, c) air conditioning prevalence, and d) proportion of elderly/diabetes. Subsequent studies have cited, analyzed and built upon this model in the years since.

In 2010, researchers Wilhelmi and Hayden published “Connecting people and place: a new framework for reducing urban vulnerability to extreme heat”, which highlighted the need for both quantitative and qualitative analysis when configuring an index for heat. Although census data summarizes relevant demographic and socio-economic characteristics of cities at the census tract level and above, a gap exists in determining accurate adaptive capacity, perception, and coping ability at the ground level when it comes to heat (Wilhelmi and Hayden 2010). Furthermore, previous research indicates that while such factors can be measured at a national and regional level, these findings may not translate into successful adaptations to climate change at the local level (Wilhelmi and Hayden 2010). Therefore, the need for interview and stakeholder-based data to contextualize societal vulnerability and validate the mapping and modeling results is emphasized (Wilhelmi and Hayden 2010).

Satellite imagery has also continued to grow as a tool for determining heat vulnerability within HVIs. Researchers and practitioners have often used the Normalized Difference Vegetation Index (NDVI), a graphical indicator used to analyze remote sensing measurements. The index assesses whether the area observed contains green vegetation and other land cover classifications from the NASA Moderate Resolution Imaging Spectroradiometer (MODIS) instrument and satellite capturing Land Surface Temperature (commonly Landsat 8) (Weber et al. 2015).

Not all deliverables in this field have been produced as static papers or studies. Some HVIs have informed municipal heat vulnerability applications (Wilson and Chakraborty 2017). In

the “Open Heat Vulnerability Mapper,” scholars from the University of Illinois at Urbana-Champaign show historical patterns and future conditions by using climate model projections and scenario analysis (Wilson and Chakraborty 2017). In order to understand the accuracy of HVIs, it is important to validate the outcomes of the mapping exercise. One way this is possible is through the validation of indexes by comparing results to previous outcomes, such as health or mortality records from previous heatwaves (Johnson et al. 2013).

The Future of Organizing Heat Information

The way we analyze heat is rapidly changing. Rising attention to the topic, advances in technology, and the increase of the threat of climate change have all played a role. Scholars, activists and community members are leading the way in pushing this work further. Below, suggested practices for how to proceed with this work are detailed, followed by an analysis of where these practices may fall on the “Spectrum of Community Engagement to Ownership”.

Data

As our built and natural environments both affect heat in various ways, numerous potential factors may be considered when building out a heat vulnerability index. The choices made to refine such factors involve access to data, the weight of the impact of the factor on the presence of heat, and the relevance of the factor in the current understanding and existing strategies to mitigate heat. While it is suggested that researchers include as many relevant indicators as possible, and that each indicator be able to be accurately acquired or measured (Cheng et al. 2021), it is also important that factors be understood by the reader and tailored to the community. Each community faces heat with a specific climate, distinct legacy of its particular built environment, the intentional creation of communities, and the history of displacement. A universal template may not be used as the lived experience of heat, as it is not universal in nature. Therefore, factors should be based on the quality and accuracy of the data, as well as the specific nature of ecological conditions of the space.

As the use of such mapping becomes more tangible, it is also important, in choosing data, to include intentionality in its outcome and use. If health metrics are included in an index, the index could be used to inform public health work. The same goes for general planners, activists, emergency management stakeholders, those in economic development, and more.

More specifically, the model using satellite imaging has been analyzed for its limitations. In “Integrating Satellite and Ground Measurements for Predicting Locations of Extreme Urban Heat” Shandras et al. (2019) study the integration of satellite and ground measurements for predicting extreme heat. The authors explain that both types of temperature readings have merit, and they further posit that the combination of the two methods may improve both the spatial resolution and global application of heat measurements (Shandas et al. 2019). While hypothesizing about this integration, the research also deems the use of TIR-capable platforms such as Landsat or Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) for urban heat island analyses inappropriate when targeting findings on human comfort and health (Shandas et al. 2019). In contrast to previous models’ sole use of satellite measurements, Shandras’ research team collected ground data through vehicular travel across the study areas of Richmond, VA, Baltimore, MD and Washington D.C. Volunteers in each of these cities collected data at one-second intervals over one-hour time frames with vehicle mounted temperature sensors along with a GPS (Shandas et al. 2019).

The novelty in this project lies not only in the integration of data sources but also in the process for involving community in data collection. Before each city’ campaign began, community outreach was conducted when “boundary organizations” were identified and contacted. Here, boundary organizations are defined as organizations that have a mission or conduct community based work that aligns with the reliance building to climate change” (Shandas et al. 2019). This practice, acknowledged as a loose form of collective leadership:

> enables each of the organizations to then form collective and shared goals for the urban heat island data, while also allowing them to reach out to their social and professional networks to gather sufficient volunteer interest to build the collection teams […] These volunteers, owing to their extensive backgrounds of working within the environmental, equity, and/or civic engagement landscape of their cities, were able to then offer each campaign a form of indigenous knowledge and experience of each city's unique LULCs [land use/land cover] that the authors could never independently integrate before undertaking the projects. (Shandas et al. 2019, 3-4).

This is not the only instance of innovation when it comes to gathering heat data. The SHaDE Lab at Arizona State University, directed by Dr. Ariane Middel, explores heat sensed by biometeorological instrumentation, heat experienced by humans, and heat modeled using simulations (The SHaDE Lab n.d.). The lab has produced a tool called MaRTy, which is a mobile biometeorological instrument platform that measures air temperature, humidity, wind speed and direction, GPS coordinates, and mean radiant temperature (The SHaDE Lab n.d.). Other tools produced by the lab include a thermal camera to measure surface temperature, heat stress trackers, and ENVI-met, a computational fluid dynamics model created to simulate neighborhood outdoor microclimates (The SHaDE Lab, n.d.).

Analysis

A first step toward improving analysis of heat vulnerability factors is the use of qualitative data. Whether this is for interviews, focus groups, or surveys, the greater the level of community input, the greater the reliability of the data. Qualitative analysis may also be used for validation, another important step in the process of producing heat data analysis. Research suggests that in order to produce analysis that is more accurate and not subject to scaling errors, studies may consider leveraging diverse data sources (Cheng et al. 2021). This could involve pooling together multiple data sets such as hospital records, mortality data, health survey records, and social media posts related to heat emergencies in order to capture a greater picture of the impact of the event (Cheng et al. 2021).

This research can also be improved by matching the source of vulnerability to the suggested strategy in the area. For example, if the leading determinant of heat vulnerability in a geographic area is socioeconomic disparities, then the solution proposed should support individual households' wellbeing; if the leading risk factor is environmental, a solution could target climate-responsive urban design (Cheng et al 2021).

While a scale has not yet been proposed to weigh varying heat vulnerability factors and proposed solutions by environmental or social significance, several steps have been created, which are designed to acknowledge the differential impact of distinct solutions. Air conditioning, for example, while providing cooling relief, also increases energy consumption without providing long-term cooling support (Shandas et al. 2019); therefore, it should be notably differentiated from other solutions with more long-term, sustainable impact.

Use/Distribution

Where possible, heat vulnerability indices should be deployed for a distinct purpose that serves the community. The purpose can range from allowing government to deploy resources where most beneficial to community or provide data-backed predictors of future cases of extreme heat. As was done by New York City, cities can create heat vulnerability index web applications that allow for the search of particular geographic areas, and the understanding of what factors affect heat vulnerability in that area (City of New York n.d.). When distributing data to the public, an application should be readable, employ factors that are commonly understood, and include opportunities for viewer participation and deeper engagement (links to additional resources, etc.). Including the validation techniques used in the analysis, perhaps an option to toggle between heat vulnerability and mortality rate or health impact data, is also useful.

As municipalities advance heat resiliency planning, the purpose of heat vulnerability indices may need to be adjusted for more immediate and practical applications.

Case Study – Diffusing Disasters

Diffusing Disasters is a project, co-led by Daniel Horton from Northwestern's Weinberg College of Arts & Sciences, and George Chiampas from Northwestern's Fienberg School of Medicine, whose core mission is to create a heat vulnerability index that will be adopted and co-created with the City of Chicago. Although adoption of the HVI is the goal, the city's current administration is piloting a co-governance model, where policy decisions are made in partnership with the community. Therefore, in order to have this particular HVI be adopted, the researchers behind this work are deploying practices further along on the Spectrum for Community Engagement to Ownership than have been exercised in many previous projects. In an interview for this thesis, project co-lead Daniel Horton reflected on the learnings from this project that seeks to push the boundaries of HVI creation.

Daniel noted that the genesis of the project began with an informal group of researchers at Northwestern who were in conversation with the Chicago Department of Public Health and the City of Chicago. The influence of the Buffet Institute, who supports this project, means that while the project is intended to serve communities at a local scale in Chicago, the pilot seeks to establish a national and international model for community-driven heat vulnerability index creation[4].

Horton notes that within earth and planetary sciences, researchers have always prided themselves with sharing their data widely and freely in order to garner community trust and support. Therefore, this project began with a commitment to open access data. Due to their academic experience, getting environmental data was not particularly challenging, however, for a multi-disciplinary team, getting access to public health data was one of the largest challenges. Specifically, public health is often confidential or has limitations around sharing, with the

[4] Daniel Horton, Diffusing Disasters. *Zoom, February 27, 2024.*

additional challenge that the findings from this work are intended to be shared with the community.

The data acquisition portion of the project has largely not involved the community. The notable exception took place when the City of Chicago applied for and won participation in the National Oceanic and Atmospheric Administration's (NOAA)'s urban heat island initiative, where cities can map out the urban heat island supported by community volunteers. The city picked the hottest day in July, and volunteers spread out across the city, gathering data that created an urban heat island map for the day, adding to the repository of data analyzed for the HVI.

In Spring of 2024, now that the team has access to the majority of the relevant data for the HVI, they are in the process of developing a co-governance structure, that begins with community involvement in decisions about weighing and prioritizing data. Horton reflected on the fact that that if the researchers wanted to prioritize, weight, and conduct a statistical analysis without input, they could have, but this project requires some level of choice and co-creation and waiting to make decisions until the community is at their side[5], stating: 'This is not a data science project, this is a project where they [Diffusing Disasters] will consider a bunch of data alongside community members and determine what the pros and cons are of these datasets. Other people have created HVIs for the City of Chicago, but none has been adopted"[6]. If and when the city adopts the HVI, the goal is to make it a tool that the city can use to make decisions with the people in Chicago that are most vulnerable to extreme heat.

Diffusing Disasters is also using an online platform for residents to go out into the community and take pictures to tell stories of their lived experience with urban heat. Participants answer prompts including questions pertaining to how they feel heat, where they feel heat, how

[5] Daniel Horton, Diffusing Disasters. *Zoom, February 27, 2024.*
[6] Daniel Horton, Diffusing Disasters. *Zoom, February 27, 2024.*

communities manage heat, and what researchers may be missing by looking purely at quantitative data.

Overall, Horton highlighted the need for a "guide" in this space, or an analysis of what other groups and government bodies are doing to create community-centered HVI's, and what is working.

Spectrum of Community Engagement to Ownership Analysis

With a few exceptions, most community engagement involved in organizing and understanding heat information falls under the developmental stage of "Inform" on the "Spectrum of Community Engagement to Ownership" (see the stages of the Spectrum at Figures 2, 3, and 4). This developmental stage warns that if community engagement efforts remain at the level of one-way information dissemination, these efforts may result in placation (González 2020). With the community reduced to simply absorbing heat data when it is both provided and readable, there is no notion that everyday people can shape solutions to the climate threat (González 2020). Although Keith and Meerow's report acknowledges a need for active information sharing, this communication appears to be one-way, with a lack of an implementation strategy.

Additional literature review suggests that data gathering and analysis that allows for community data capturing, interactive community dashboards and accessible methodologies and findings start to move this work into the "involve" category on the Spectrum. This work can be pushed further, however, in two ways: 1) by centering qualitative community-driven data sources and gathering to inform location-specific findings, and 2) by planners and policymakers committing to sharing data, promoting community interaction with data, and opening up data dialogues. As this work moves out of a purely academic science, it is essential to center those most affected by urban heat in community information sharing and storytelling. The Diffusing

Disasters team is pushing the boundaries of this work, and starting from a place of involving the community, with the opportunity to reach greater heights on the scale as the work progresses.

Developing Urban Heat Strategies

The strategies proposed in this section are divided into heat mitigation and heat management. As defined in the PAS Report:

Heat mitigation strategies "aim to reduce the build environment's contribution to extreme heat through design and planning interventions such as land-use policies, urban design, urban greening, and waste heat" (Keith and Meerow 2022, 8).

Heat management strategies "aim to prepare for and respond to extreme heat, and address energy, personal exposure, public health and emergency preparedness" (Keith and Meerow 2022, 8).

In their research, Meerow and Keith call out the need for attention to co-benefits and tradeoffs when choosing urban heat strategies. While many co-benefits naturally occur when centering community engagement in planning, numerous trade-offs also exist. Leveraging community voice and action may lead to the selection of heat strategies that are not, on paper, the most effective, efficient, or multi-faceted solutions. However, these solutions are based on community need, identity, and goals that have other long-term benefits. The tension between these two paths is central to the ongoing climate justice discourse in the U.S.

This section will summarize the report's suggested strategies, provide supplementary examples based on additional research, and provide an analysis of existing opportunities within the "Spectrum of Community Engagement to Ownership". The goal of this exercise is to understand where opportunities for community ownership lie within the bounds of a heat governance plan.

Heat Mitigation

Land Use

A. PAS Report

The first strategy for heat mitigation proposed in the PAS Report is land use. Within this strategy, the authors suggest leveraging urban development patterns that work beneficially to slow the growth of the urban heat island effect. This includes planning for complete streets, eliminating parking requirements, narrowing roads, using the right-of-way for sidewalks, including vegetated space, shading structures, and varying ground materials (Keith and Meerow 2022). Another relevant strategy for large and dense coastal cities includes ventilation corridors (Keith and Meerow 2022). This category of land use also encompasses land conservation strategies such as protecting natural land, returning developed land to its natural state (wilding), establishing urban growth boundaries, and creating conservation land systems (Keith and Meerow 2022).

B. Additional Strategies

Beyond what is suggested in the report, there are several other land use approaches that support urban heat mitigation by centering, creating and preserving green spaces in the community: a transfer of development rights, the use of community gardens on private property, community green space stewardship, land trusts, and conservation easements for urban green space. Cool pedestrian and transit corridors are another form of land use for urban spaces with high vehicle traffic.

Governments can adopt a Transfer of Development Rights (TDR) program to preserve green space within a municipality while also promoting complex urban development and economic growth in other geographical areas. This program combines two desirable goals in land use—urban development and land conservation. A Transfer of Development Rights

program allows for “sending area” landowners to sever and sell their development rights to developers in “receiving areas” (Adams, n.d.). Sending areas are often identified by the government as those in need of preservation or areas which include environmentally sensitive lands or historic sites (Adams, n.d.). Receiving areas are typically locations where growth is desired and capacity for increased density exists (Adams, n.d.). Although a TDR program is a powerful and effective land use tool, the success of the program is dependent on political will, demand for bonus development, the ability to customize receiving areas, create strict sending area regulations, the availability of few alternatives to increase density without TDR, and market incentives (Adams, n.d.).

Community Gardens are another land use approach that can reduce urban heat. Community gardens are frequently used as a way to create green space in urban areas by fostering community activity, supporting local identities, public health, and mitigate heat. In the United States, many low-income and predominantly BIPOC communities have little to no green space access, starkly contrasting wealthier, whiter communities nearby. Therefore, a land use tool to increase community gardens and decrease sprawling urban development or vacant land could involve government permitting or allowing community gardens by-right on private property.

Community gardens located on private property may be sponsored by local government, funded by a private investor, or community started and supported in a grassroots fashion (Bosse, n.d.). Adopting an ordinance that classifies community gardens as permitted or by-right removes the regulatory barriers that limit the permissible areas for these gardens (Bosse, n.d.). This action provides more flexibility to local governments when seeking to enrich community health (Bosse, n.d.).

Ordinances that promote and allow community gardens on private property should be adopted after a community engagement process has identified the characteristics and needs of

the surrounding community. This process should clarify the gardens' purpose, the maintenance structure, rules, intended quality and use of materials and chemicals, regulation for the sale and distribution of any garden produce, indemnification for owners and government entities, and the role of gentrification and response to gentrification from local government or community actors (Bosse et. al., n.d.)

Green space stewardship exists in many forms: community clean-ups, vacant lot remediation, the creation and cultivation of community gardens, and more. Community green space stewardship relies on the participatory nature of stewardship through relationships with dedicated community members and community groups. Although volunteer opportunities in green space have long existed, community green space stewardship specifically provides an opportunity for those who live in a certain area to feel ownership and belonging in a green space. The government should not rely solely on the labor of community members; instead, government should facilitate, compensate and sustain these projects because they protect the health and safety of the public.

Land trust models also serve as a way to protect and preserve open and green space, both large and small, typically through the means of an open space land trust. However, the use of a community land trust, which can acquire and hold land for the benefit of an entire community, can also allow community to guide urban development in ways that are beneficial to residents, such as development that lowers the risk of extreme heat.

As government actors and community members grapple with the tension between development and conservation of the remaining land and its ecological benefits in the city, conservation easements for urban green space can be used as a tool to effectively meet green space and stewardship goals. Although well-established tools exist to preserve large parcels in low density sections within municipalities, the battle to protect urban green space proves to be less straightforward.

A conservation easement is another tool that can be used to further community-centered land use. A conservation easement is a negative restriction on a parcel of land that prevents the alteration of a property's ecological, natural, open or scenic features (Korngold 2011). A conservation easement requires both a grantor and a grantee, with the grantor being the landowner and the grantee holding the easement and enforcing it. The grantor limits the future land use of the site while still retaining ownership of the land and receiving tax benefits for the donation of the land. Historically, conservation easements involving a private landowner granting a non-profit organization (NPO) with a conservation easement has been a popular way to preserve and protect open space (Korngold 2011). Conservation easements are often created in perpetuity, which allows these stipulations to run with the land forever, thus strengthening the tool further (Korngold 2011). In the case of a private landowner and an NPO, the NPO is often a land trust, which works to protect many parcels of land over time.

Although the dominant use of conservation easements involves a private landowner and an NPO, government is also able to bring an easement. Although through government processes the land to be conserved is subject to more bureaucracy, this process also produces a larger public incentive. In private conservation easements, public use of the parcel is not mandatory (nor is it mandatory when working within government, yet it is more likely). Government can also use the structure of a public land use plan to fit parcels with conservation easements into a greater strategy for the municipality's open space. Land trusts, with their sole purpose often being to conserve what land they can, initiate a more scattered process dependent on resources available.

Cool pedestrian and transit corridors provide an opportunity to combine goals for efficient road and park ways with the cooling effects of ventilation corridors. Additionally, these corridors can become public spaces with co-benefits for community members.

C. Analysis

I seek to identify actions within the bounds of the framework that reach an “Involve”, “Collaborate” or “Defer To” on the “Spectrum of Community Engagement to Ownership”. These three levels were chosen due to their impact, as designated by the Spectrum: “Voice, Delegated Power, and Community Ownership”, respectively. Where these categorical goals are not reached, I identify opportunities to push strategies into these categories, which subsequently alters the results of these actions.

Land use is often left to government and regulatory actors at the local level, and as a result zoning, development, and planning can fall victim to ignoring, informing, or simply consulting the public through bureaucratic processes. However, community gardens on private property, community green space stewardship, and land trusts provide options to push community engagement further.

In order to cultivate community gardens on private property, use must be either permitted or by-right, which requires the adoption of an ordinance (in a city) or bylaw (in a town). An ordinance or bylaw requires government action, but also relies on community organizing and advocacy, which falls under the “Involve” as well as the “Collaborate” ranking on the Spectrum. Other ways that can be used to meet community needs include community forums, polling, Memorandums of Understanding (MOU)s, and Community Benefit Agreements (CBA)s with community-based organizations, all of which fall under these two categories. The collaboration between the community, private partners, and government to design a specific garden space allows for a co-creation of a space and leaves room for government to let those with knowledge of the community and garden uses to obtain ownership of parts of the processes.

Opportunities for ownership within community green space stewardship are similar; types of stewardship take up different places along the Spectrum. For example, an open call for volunteers by a government agency does little to delegate power or defer to the community. With an organization such as NeighborSpace in Chicago, this structure looks different.

NeighborSpace is a nonprofit urban land trust that preserves and sustains gardens on behalf of dedicated community groups (NeighborSpace, n.d.). In this case, the City of Chicago, Chicago Park District, and Forest Preserve District of Cook County came together after consulting with community leaders and non-profit organizations to preserve and expand open space, and established NeighborSpace as a nonprofit (NeighborSpace, n.d.). While the nonprofit now conducts the stewardship, the three governmental agencies continue to provide leadership and financial support to “protect community-managed open spaces in Chicago” (NeighborSpace, n.d.). The nonprofit urban land trust provides basic insurance, access to water and links to support networks so that community groups can focus on gardening their space (NeighborSpace, n.d.).Through this work, NeighborSpace “Involves”, “Collaborates” and “Defers To” community. In removing barriers to community stewardship, the nonprofit and government actors backing this work defer to the community’s local knowledge of space that the community possesses and allows for community ownership of the gardens that are cultivated.

The use and partnership with land trusts are also ways for a municipality to strive towards community ownership of land use for heat mitigation. In this case we are often talking about an open space land trust. However, the use of a community land trust, which can acquire and hold land for the benefit of a community, can also allow for community to guide urban development in ways that are beneficial to residents, such as development that lowers the risk of extreme heat (Center For Community Land Trust Innovation, n.d.). A land trust is an organization that acquires either land or conservation easements or stewards the land or easements (weconserviepa.org, n.d.). Open space land trusts work to preserve community assets or restrictions on the land. Two examples of land trusts working to preserve open space are the Neighborhood Gardens Trust in Philadelphia, which works to ensure sustainable ownership for community gardens, and Thriving Communities Institute that works in part to protect urban land in Ohio (Detroitfuturecity.com, n.d.).

Land trusts, as an alternative to land ownership structures, allow for community or community organizations to have greater control of the land and how it is used. Therefore, these can potentially attain the highest three rankings on the Spectrum, spanning from “3-5”, with impacts “Voice, Delegated Power, and Community Ownership”. Land trust models often work in partnership or as cooperatives, with community-driven planning and consensus building. A “5” on the Spectrum points to bridging the divide between community and governance, which is a step that land trusts are able to take as they straddle their organizational role, connection to governance, and their own governance models.

Urban Design

A. PAS Report

The PAS Report suggests that various urban design strategies may be employed in order to increase shade, building efficiency, and energy use, and at the time support construction that decreases heat susceptibility in architecture and planning. Additionally, building shape determines the amount of exposure to solar radiation that occurs (Keith and Meerow 2022). Innovating pavement also works to mitigate urban heat through strategies such as cool pavement coatings and evaporative pavements in areas with more water availability (Keith and Meerow 2022).

B. Additional Strategies

Whereas cool pavements are road surfaces that use additives to reflect solar radiation, road painting has also been used as a tactic for heat mitigation. Painting both roofs and roadways white or a lighter color may decrease the urban heat island effect, with a lighter exterior reflecting heat better than the typical dark color (Ingram 2014). These projects could be coupled with necessary road repaving. Major cities such as Los Angeles have been covering their streets in a lighter coating known as CoolSeal (Capatides 2018). In terms of roofs,

opportunities are present within the different types of buildings in a cityscape. Opportunities also exist to paint the roofs of parking garages or other transportation hubs.

Figure 7. CoolSeal Project in Los Angeles. Photo credit: City of Los Angeles Public Works

Although research has been conducted to identify the ways in which urban heat can be mitigated through urban design, these design guidelines have not been codified or enforced (Parapari et al. 2015). As cities and towns brace for worsening effects of climate change, it may be effective to introduce standards for new construction or retrofits that reduce waste heat where possible. These changes should be paired with the introduction of a formalized heat office, officer, or governance strategy, and they should be in line with municipalities overarching sustainability goals.

C. Analysis

While the act of creating cool pavements requires workers with experience and access to appropriate machinery in order to complete a project, painting roadways and roofs may offer an alternative with a greater capacity for effective community engagement. Involving community members in this heat mitigation tactic falls under the “Involve” category on the “Spectrum of Community Engagement to Ownership”.

While standalone urban design is often left to planners, designers and architects, certain design processes can involve community collaboration. Community forums and interactive workshops fall under the “Involve” category on the Spectrum, and open planning forums with citizen polling fall under the “Collaborate” category on the Spectrum. Such forums can be mediated and organized by planning professionals, but community members should guide the narrative around the design. The use of models, sketching, and polling members on design styles, elements amenities, and anything that centers the needs of community through urban design are effective methods available for deployment. This effort must actively involve community for it to be weighted heavily in the closed-door process.

Urban Greening

A. PAS Report

As a category in the report, urban greening covers both planned and unplanned green spaces, as well as the systems of green spaces within municipalities. According to planners, urban greening strategies are the most common heat mitigation strategies used across the United States (Keith and Meerow 2021). The design, implementation and maintenance of urban green spaces should be deeply intentional. The report emphasizes that factors such as maintenance cost and water resources are often overlooked in deploying these projects. Here, the authors also identify that urban greening should seek to close the environmental justice gap, specifically: “new parks and open spaces should be strategically planned in neighborhoods that lack them but also carefully designed with those communities to avoid green gentrification (Hoover et al. 2021; Wolch et al. 2014)”.

A common urban greening tactic many US cities have pursued is the support of urban forests. Increasing urban forestry is shown to decrease the UHI effect by 3.6-5.4 degrees Fahrenheit on average, with the number of trees needed for this effect varying by geography

and climate (Keith and Meerow 2022). In order to offset the water consumption needed for the expansion of such urban greening tactics, cities and towns can select native and drought-tolerant tree species, and use green stormwater infrastructure such as bioswales, curb cuts, and rainwater harvesting gardens to help supplement watering needs (Keith and Meerow 2022). Parks and open spaces also play a significant role in cooling outcomes. However, these outcomes often correlate to the size of the park, with large parks that are greater than 20 acres holding consistently cooler temperatures than their surroundings, while small and medium parks are only slightly cooler. Green roofs and walls cool the insides and outsides of buildings. On lower buildings, these walls and roofs can also improve outdoor human thermal comfort at the pedestrian level. Water features are another strategy suggested within urban greening, although they are typically less effective in areas of high humidity versus lower humidity levels. Examples of such features include natural or constructed bodies of water within urban areas, fountains, splashpads, and mechanical misting systems (Keith and Meerow 2022).

B. Additional Strategies

Whereas supporting urban tree canopy at a governmental level is a common municipal agenda item across the country, planting and nurturing street trees in targeted areas of heat vulnerability within a community can bring residents who suffer from heat injustice into the planning process. In Chelsea, Massachusetts, a pilot program currently exists in which researchers select a target block and deploy multiple cooling strategies at once—a Cool Block (Bebinger 2022). Support for street trees includes planting, watering, maintaining and advocating for trees. It is important, however, when relying on community labor to increase resiliency in a neighborhood, to fairly compensate those working towards this goal (Bebinger 2022).

Tension surrounding street trees emerged in Boston's public discourse in the summer of 2020, sparked by a project proposal for a street redesign of Melnea Cass Boulevard in Roxbury.

The state and federally funded street design project involved removing 124 of 515 existing street trees lining the boulevard (MilNeal 2020). Community organizers, news outlets, critics and residents spoke out in opposition to the project, citing the removal of street trees as an act of environmental racism, given that the trees were to be cut down without a public shade tree hearing in an environmental justice community. Additionally, the community of Roxbury has a long history of the exclusion of Black and Brown voices in the public planning process. Allowing community to play a part in government recognition, cultivation and acknowledgement of the past, present and future importance of street trees, can work as a productive strategy for community-centered heat mitigation (MilNeal 2020).

Figure 8. Boston city council president Kim Janey and her granddaughter Rosie, at a protest October 24, 2020. Photo credit: Riley Robinson. Source: The Scope Boston.

Pocket parks also serve as an urban greening tactic, especially in communities where the presence of larger green space is sparse. Pocket parks work to increase vegetation, sense

of place, and native plants and animals, while also potentially decreasing the amount of heat-trapping vacant land or parking lots, overall diminishing the urban heat island effect (Blake, n.d.). An example of a well-known pocket park is Greenacre Park in Midtown Manhattan, New York City (Blake, n.d.).

The presence of green space in cities has been mapped over and alongside spatial representations of the social vulnerabilities of residents, census demographic profiles, and formerly redlined neighborhoods, all leading to the same conclusion: historically under-resourced neighborhoods have less access to this type of space, whether through parks large or small, for playgrounds, schools, industrial, commercial, or residential uses. These historically under-resourced areas are predominantly low-income, BIPOC, and formerly redlined communities. This cycle of systemic oppression has created a crisis of environmental justice and public health, with the most vulnerable populations also the most susceptible to heat danger. These patterns continue to this day: when green space is introduced in a community without the proper protections, the cycle of gentrification is catalyzed, with property value increasing and residents becoming vulnerable to displacement. Therefore, in choosing areas for urban greening, planners, policymakers, and community members have an opportunity to invest deeply in communities long subject to the worsening effects of climate change. This can be done by creating equitable heat vulnerability mapping that factors in the effects of past harm, making space for and promoting community ownership in the process of designing cooling tactics, and creating public space by and for community during the process of implementing green space.

Scholars from the University of Utah and UCLA put together a toolkit for “Greening Without Gentrification: Learning from Parks-Related Anti-Displacement Strategies Nationwide” (Rigalon and Christianson, n.d.). This toolkit calls for projects that use multidisciplinary approaches, integrate affordable housing, workforce development, and support for small

businesses (Rigalon and Christianson, n.d.). Examples included in greening without gentrification:

- Just Cause eviction ordinance
- Rent control
- Rent review board
- Renters workshops (education and empowerment)
- Risk mitigation fund for displaced renters
- Renters commission
- Foreclosure assistance
- Forgivable loans for home improvements
- Homebuyers club (education)
- Homebuyer financial assistance
- Property tax freeze for low-income homeowners
- Accessory dwelling units and compact lot subdivision
- Job creation for long-time, low-income residents
- Small business creation and preservation
- Single-room occupancy preservation
- Condominium conversion ordinance
- Inclusionary zoning
- Production incentives
- Community benefits agreement
- Housing linkage fee
- Commercial linkage fee
- Housing trust fund
- Community land trust and other non-profit or city-owned affordable housing
- Value capture (e.g. tax increment financing)
- Competitive funding for parks requiring or incentivizing anti-displacement strategies

Additionally, the Barcelona Laboratory for Urban Environmental Justice and Sustainability has developed a toolkit for developing just urban greening policies and programs (Oscilowiz et al. 2021).

C. Analysis

Urban greening provides multiple examples of strategies that can achieve the “Involve” placement on the Spectrum, which include the cultivation of street trees and pocket parks, justice-oriented planning for green space, and the work to halt the process of green

gentrification. Whereas using community labor and planning to introduce more street trees in a neighborhood may not actively include community voice, allowing for street trees to bolster community identity may do so. Here, government must be careful not to tokenize or use community input and labor and must instead allow for residents to take leadership positions, building upon their lived experience in community. The same goes for pocket parks – these types of parks are most beneficial in identity creation when they provide a space for community voice and input throughout the process.

Planning for just, equitable green space and the fight against green gentrification involves integrating community needs and assets into the planning design. It is essential that planners and government actors are infusing an understanding of past systems of oppression into the site selection and implementation process when it comes to green space, and centering residents rights to housing, even through cycles of change, while allowing for cooling tactics to be deployed.

Waste Heat

A. PAS Report

Waste heat is sometimes overlooked as a contributor to the urban Heat island effect. In attempts to reduce waste heat, an opportunity often presents itself to reduce local greenhouse gas emissions. It is also possible to recover waste heat in district energy systems, which in turn decreases energy consumption (Keith and Meerow 2022).

The report suggests improving building energy efficiency by retrofitting systems, introducing weatherization programs, or installing more effective HVAC systems (Keith and Meerow 2022). Other examples included are solar collectors, solar shading, and cool roofs and walls (Keith and Meerow 2022). There is also mention of the intersection between transit and waste heat, with

the notion that increasing other modes of transit besides cars and improving public transit will reduce vehicle waste heat, an under-rated type of heat (Keith and Meerow 2022).

B. Additional Strategies

One alternative offered to cool roofs and surfaces, similar to road painting, is centering public art as a cooling function. The Zeus Eco-Mural in LA is a mural with solar reflective coating to reduce surface temperatures (Metropolitan Area Planning Council, n.d.). Here, a local artist was commissioned to paint a mural with the co-benefits of creating special identity while working to cool surfaces and community members.

In rental housing stock, the burden of tenancy falls disproportionately on BIPOC and low-income families, and families with lower incomes pay more for utilities due to lack of insulation and proper efficiency standards. Setting standards that would change structures and appliances in rental housing stock, paired with actions to increase transparency regarding energy efficiency as it is communicated between tenants and landlords can work to reduce these burdens. One approach is for municipalities to mandate energy auditing or release energy efficiency benchmarks to renters before signing a lease (Kontokosta et al. 2020). Through heightened attention, municipalities also create a window for ongoing transparency through updates on sustainability issues, changes in energy use, or emergency concerns. Increasing notifications should be paired with an avenue for feedback given to the tenant of the unit, in order to create a two-way dialogue. This dialogue should also occur when the municipal ordinance is written, with a participatory process encoding benchmarks for landlords based on the needs of the community, given that individual units will not require all of the same work. In mandating standards and retrofitting benchmarks, municipalities should subsidize changes that are made that bring units above certain benchmarks, and work to create a sustainable system of labor that brings dollars back into the local economy.

C. Analysis

Cooling community and reducing waste heat through public art reaches a number 3: “Involve” on the “Spectrum of Community Engagement to Ownership”. By commissioning artists with voices in the community, residents feel more connected to the project and the public space. There is also an opportunity to engage groups of artists, volunteers, and youth in the creation of cooling infrastructure, such as murals.

As stated in the report: “Weatherization mandated for landlords, when paired with efforts to reduce green gentrification and support tenant’s rights, reaches a “3” on the “Spectrum of Community Engagement to Ownership”. A “3”, or “Involve” on the Spectrum is awarded this tactic due to the presence of community advocacy, and the demonstration that government is acting with renter’s rights in mind. Here, government would be working toward heat governance that places the burden on the landlord, while increasing energy efficiency and reducing renter’s utility burden.

Heat Management

Energy

A. PAS Report

This report emphasizes the need for planners to work with energy providers and update building codes in order to build resilient energy grids. To provide cooling, municipalities need to create an ideal energy system, one which will reduce blackouts and energy consumption in high-heat periods. The report identifies the highly correlative relationship between indoor cooling, and class and race. One study proves that in the 1990s in Detroit, Chicago, Minneapolis and Pittsburg, half as many Black households had central air conditioning as white households, with this disparity leading to higher numbers of heat-related deaths (O’Neill et al. 2005). Proposed energy planning options for heat management include: updating landlord

regulations to include temperature maximums, developing requirements for indoor cooling for institutions, and introducing programs that subsidize the cost of purchasing and installing indoor cooling. Also noted is the essential need to protect tenants from having utilities shut off due to delinquent bills, and to provide access to weatherization and federal supports to preserve the affordability and accessibility of energy (Keith and Meerow 2022).

B. Additional Strategies

Both Boston's Chinatown and Chelsea, Massachusetts have started projects that support energy resilience for a changing climate: cloud-based energy microgrids. Microgrids are made up of batteries and backup diesel generators that may be turned on when the main power from the larger electric grid fails (City of Chelsea, n.d.). Although both Chinatown and Chelsea are designated environmental justice communities within the state, Chelsea is the only municipality where every neighborhood is labeled an environmental justice population. This solution provides other benefits besides supporting the municipalities' energy in an emergency situation. Specifically, when the energy grid is operating normally, the microgrid allows the municipality to sell excess energy back to the electric company, which generates revenue and reduces costs for community members (Gellerman and Greene 2021).

In times of unexpected climate hazards, utility companies, residents and cities alike must prepare for the ever-growing problem of rolling blackouts caused by electricity shortages (Collins 2019). With a demand surge for energy, or for air conditioning in the case of heat, power service can be cut for thousands of people at a time (Collins 2019). For people with disabilities, connection to power can mean more than temporary discomfort; it can also mean losing connection to life-saving equipment. Mutual aid networks exist outside of formal government systems; however, there is room for governmental supports to be put in place in the case of emergency blackouts, such as increasing early warning systems or creating emergency plans and resources for residents.

Increasing fans and AC units in older homes provides a temporary solution to a greater problem. Whereas the goal in heat governance is to provide affordable, sustainable cooling for all, AC units often increase energy consumption while inefficiently cooling. However, keeping residents safe is necessary to continue on the path to a cooler city. Therefore, cities and towns can accept the trade-offs provided by this situation and subsidize or provide such amenities to families in need (Ny.gov n.d.).

C. Analysis

If executed with community centered at the decision-making table, introducing an energy microgrid falls under a level “5” on the “Spectrum of Community Engagement to Ownership”. “5”, or “Defer To”, with the impact of “Community Ownership”. The level conveys the message to community: “It’s time to unlock collective power and capacity for transformative solutions” (González 2020). A cloud-based energy microgrid is transformative by nature, as it changes the energy system that has been in place over time to center communities in need during times of uncertainty. Collective power is sourced through the revenue generated by this system, as well as the jobs created. It is important to note that the resource allocation ratio needed to uphold this status on the spectrum is 80-100%, including “community partners and community driven processes” that “ideally generate new value and resources that can be invested in solutions”, which must be maintained throughout the system.

If those who have incorporated mutual aid into their communities are involved in and provided resources to support community planning for rolling blackouts, such actions would fall under a “3”, or “Involve” on the Spectrum. Government should not attempt to recreate systems of aid that have existed over time during periods of suffering; instead, they should raise up,

support and compensate those who have given back to their community in this way and provide resources to expand the system. In this role, two essential actions must be taken in order to provide an effective solution: notifying those who will be affected by the blackouts, and providing action steps for when such blackouts occur.

Moreover, an opportunity for community involvement exists when balancing community need for indoor cooling with the effects of energy consumption on the climate. Although policymakers often confront the tradeoffs between personal exposure and climate goals, it is essential to share this conversation with the community and understand the needs of residents in real time.

Personal Exposure

A. PAS Report

The PAS Report positions transit, schools, parks, trail and occupational safety regulations under the category of personal exposure within heat management. Improving transit operations functions as a heat management tactic for the transit rider. Improving efficiency and reducing delays allow the rider to spend less time at transit stops and accounts for less personal exposure. The report advises planners to add shading structure, misting and water resources to transit stops. School operations can add similar amenities such as shading structures, water resources, and cool surfaces for buildings and playgrounds. Schools can also function as partners or stakeholders in heat governance. Parking and trail operations can also be maintained and updated to support healthy activities and lower heat risk. Occupational safety regulations are also important for workers' safety.

B. Additional Strategies

Workers are especially vulnerable to rising and extreme heat, especially those who labor outdoors and do not have a workplace with air conditioning (Kirven 2022). This population is at risk for heat-related illnesses, and in the United States, workers of color are disproportionately victims of heat-related death (Kirven 2022).

The Metropolitan Area Planning Council suggests that additional federal policy is needed to "further protect workers from extreme temperatures and address the inequitable impacts of extreme heat" (Kirven 2022). Under the Biden administration, the federal government is working with the Occupational Safety and Health Administration (OSHA) to undertake new initiatives to protect workers and reduce exposure to extreme heat (Kirven 2022). Such initiatives center on decreasing and preventing heat-related hazards, setting workplace standards, increasing and emphasizing heat inspections, creating a rulemaking process to enforce a workplace heat standard, and developing education and sharing best practices between workers (Kirven 2022).

Although in some municipalities and states agreements between landlords and tenants about heating in the colder months exist, the same does not apply to tenant's exposure to heat. In Massachusetts, although tenants have rights to a 'habitable' living space, an apartment without air conditioning does not apply. Although this problem surfaces the tension between sustainability goals and personal exposure, as heat-related death and illness increase as climate stability declines, there is an opportunity to expand tenant's rights.

Worker's vulnerability to heat exposes a larger call for labor rights in the U.S. An alternative worker model, such as the solidarity economy model, may provide additional support and power-building structures for workers so that they may be guaranteed a safe and cool workplace. Solidarity economy is a social justice movement seeking to transform political and economic systems, alongside our worldviews (Solidarity Economy Initiative 2017). Solidarity economy sits within the intersection of shifting consciousness, building power and creating economic alternatives and prototypes (Solidarity Economy Initiative 2017). In the state of

Massachusetts, solidarity economy initiatives have taken the form of worker-owned coops, community land trusts, and community-controlled capital (Solidarity Economy Initiative 2017). In terms of workplace personal exposure, worker-owned coops provide an example for building power and solidarity between those in the workplace, allowing them to remain cool and safe when confronting extreme heat. Solidarity economy pushes coops beyond their baseline structure and helps those involved find value in non-monetary support without hierarchy. Ideally, in a space incorporating solidarity, cooling and public health would be a right protected by all and for all.

While messaging about heat threats and providing resources outside of the home can reduce heat risk, some of the most vulnerable populations will suffer. As the Cool Neighborhoods NYC Report states, “A heat emergency is not the time to identify vulnerable residents. Rather, it is important to build social networks that can help share life-saving information prior to such emergency and can reach out to at-risk neighbors during an extreme event” (Nyc.gov n.d.). The Be a Buddy program, established by the Cool Neighborhoods program in New York city, pairs local residents with most-at-risk residents to educate the community about climate preparedness and to provide hands-on assistance (Nyc.gov n.d.). Therefore, residents at risk are already identified and resources have been put in place for support prior to the climate event.

C. Analysis

If heat equity is prioritized by workers and owners participating in solidarity economy, there is the potential to reach a 5 on the scale and create community ownership. Solidarity economy practices each of the activities highlighted within community ownership: community-driven planning, consensus building, participatory action research, participatory budgeting, and cooperatives.

When working toward fair heat standards for workers or tenants in offices and residential buildings or homes, progress is achieved through community engagement and organizing. Community forums, house meetings, and interactive workshops are all tools that can be engaged in order to push back against the power of employers and landlords. Therefore, activism for heat standards for workers or tenants falls under the “Involve” category on the Spectrum, awarded a 3 out of 5.

Although it is possible to use data to determine who is vulnerable in situations of extreme heat and subsequently target solutions towards vulnerable populations, not all at-risk residents cannot be accounted for. This is especially true for older adults and individuals with disabilities, as well as those without access to cooling features in their living space. Therefore, increasing community accountability by systemizing wellness checks by trained professionals and community members can target individuals in their homes in situations of extreme heat. Such accountability can also stretch as far as community organized events, phone trees, and messaging systems. Depending on how power is sourced for these actions – whether supported by government or produced out of a lack of resources – this strategy could range from involve (3) to defer to (5) on the Spectrum.

Public Health

A. PAS Report

Public health is another facet of heat management highlighted in the report, which is essential for heat management because it involves sharing information with the public and conducting awareness campaigns. Materials should ideally include visualizations and multimedia; Information should be tailored to various demographic groups and audiences, and materials should be offered in different languages (Keith and Meerow 2022). The report also

suggests the use of health care as well as mental health care providers to act as partners to disseminate information, (Keith and Meerow 2022).

B. Additional Strategies

Training for heat safety is an essential component of public health. Similar to the introduction of community accountability and wellness checks, heat safety training for public safety and institutions supports the wellbeing of community. Residents can work to understand how to treat someone who is ill from extreme heat, and how to cool the body when necessary.

State and municipal public health departments, in partnership with community organizations and regional planning authorities, are also often responsible for heat safety messaging campaigns. Not only does this work support community accountability, it also spreads awareness for individual and household safety, in educating the public on what to do in case of an emergency. States, municipalities, regional planning authorities and community-based organizations can function as resource hubs and intermediaries to build out support in the wake of extreme heat.

C. Analysis

An increase in accessible public health information allows for opportunities to involve or, in some cases defer to, community leaders and organizers. Activities that broach these Spectrum positions include: thorough community analysis of data, increasing readability of data, and taking analytic results and tying them to real-world outcomes and implications.

Increasing community representation in conversations about heat and introducing messaging campaigns allows for community involvement. True involvement, however, requires a shift from tokenization to centering of community members, compensating participation, and opening the design process. Throughout all, there must be an ongoing process of

understanding how to best reach community members (language, mode of communication). Those in power should consider who is missing from the decision-making table as it stands.

Emergency Preparedness

A. PAS Report

The PAS Report highlights the inconsistencies in governance structure when it comes to planning for extreme heat. Although heat response planning often falls under the jurisdiction of public health departments, planning departments, emergency management organizations, hospitals and healthcare groups, universities, school districts, utilities, faith-based organizations, the National Weather Service and others also take part in this work. Specifically, emergency management departments function to support emergency response and preparedness measures in times of extreme heat. Emergency preparedness, as defined by the report, is comprised of heat response planning, early warning systems, cooling centers, and resilience hubs (Keith and Meerow 2022).

Heat response planning is identified as often involving “increased surveillance for heat-related illness or emergency visits, heat-related public communication, increased social services, outreach to vulnerable individuals, cooling centers, water and fan distribution, and energy assistance (Abbinett et al. 2020). Heat early warning systems offer community members notice in advance of forecasted extreme heat events (Abbinett et al. 2020). As noted within this document, “since the most vulnerable community members are often the hardest to reach physical signage in public locations and messaging coordination with key social service providers and community workers is also critical” (Abbinett et al. 2020).

Cooling centers, when deployed effectively, can serve many vulnerable residents in times of extreme heat. However, it is not always the case that existing cooling center infrastructure meets the needs of communities. In planning for such spaces, practitioners must

take into account resident's access to transportation, pets in the home, need for shelter at night or on weekends, and consistency in operation. It is also important to consider the spatial placement of cooling centers and access to backup power in the case of widespread power outages. Lastly, cooling centers must be advertised effectively to all members of the community.

The report also elevates the concept of resilience hubs, or "community-serving facilities that support residents and coordinate communication and resources before, during and after disruptions" (Baja 2018). These hubs, established in existing neighborhood locations, can stock physical supplies and provide community services. Although such hubs are marketed towards use in all emergencies, these spaces may also be used as cooling centers. The City of Phoenix's Office of Heat Response and Mitigation is, in 2024, in the process of attempting to set up resilience hubs that will be partner led in order to expand their capacity by working with community based organizations (CBOs) in the city[7].

B. Additional Strategies

Cities, towns and communities have made space for innovation when it comes to emergency preparedness for heat threats. Though the report mentions the necessary considerations when planning cooling centers, an opportunity also exists for a community design process for such centers, repurposing additional public space, co-creating community space as cooling centers, creating multi-purpose cooling centers, or pop-up, mobile cooling centers. Additional water resources can be used for emergency cooling, such as splash parks and spray stations. Cooling buses have also been used in certain cities as a mobile alternative.

In speaking with staff in the heat office in the City of Pheonix, I learned that the office has taken steps to advertise community cooling effectively to all members of the community. In Pheonix, the city, county and state all operate cooling centers within the municipality, and many

[7] Michelle Litwin, City of Phoenix. *Zoom, March 7, 2024.*

were advertised with different branding and logos. In an effort to effectively market the resource to community members, all cooling centers shifted to using the County logo[8]. City staff also found that most people find out about cooling centers through word of mouth[9]. Interviews with the City of Phoenix also highlighted the need for an intentional strategy for evaluation, as surveying provides engagement challenges (difficulty determining community member's intended use of the space without asking or making assumptions, staff capacity across sites)[10]. The City of Phoenix's Office of Heat Response and Mitigation also created three separate uses of space that meet specific resident needs[11]:

1) Hydration stations, where residents can stop in, often times community centers and senior centers. Community members cannot stay uninterrupted. Staff at hydration stations will, where possible, connect community members to a ride to a cooling center.
2) Cooling centers where residents can stay interrupted, but cannot sleep. In Phoenix, these are all of the municipal libraries.
3) Respite centers where community members can stay interrupted and can sleep (there is one operating in the city as of 2024).

When determining where to locate new resources (listed above), the office utilizes 911 calls and community data to determine the hottest spots with the most emergency calls that will and/or should be target areas for resources[12]. Because these are often community resourced repurposed for cooling (i.e. youth center), staff listens to community input on how to use the spaces.

[8] Michelle Litwin, City of Phoenix. *Zoom, March 7, 2024.*
[9] Michelle Litwin, City of Phoenix. *Zoom, March 7, 2024.*
[10] Michelle Litwin, City of Phoenix. *Zoom, March 7, 2024.*
[11] Michelle Litwin, City of Phoenix. *Zoom, March 7, 2024.*
[12] Michelle Litwin, City of Phoenix. *Zoom, March 7, 2024.*

Expanding resources including aquatic programs, water features and resource protection and hydration stations can also lead to less heat-related illness in cities (Hines n.d.). Supporting the hiring of more lifeguards and extending pool hours is another strategy included within emergency preparedness (MAPC 2020). City-wide notifications can be expanded; in the case of the threat of rolling blackouts, resources and city-supported mutual aid networks can be leveraged for those in need. Examples (MAPC 2020):

- Cool it With Art Toolkit—Austin's "My Pool, etc." (MAPC)
- Playstreets (From Cool It With Art)
- Cool Streets (Red Hook and Chelsea)
- Splash JAM (Cool it With Art—Lexington KY)
- The Refreshing Waters NYC (Outdoor Cooling Center)
- Keep Cool Somerville and Heat Response Philly (Are these public health?)
- Water Protector Mural and Solar Panels (Duluth, MN)
- My Park, My Pool, My City (Austin)
- Refuge 2017: Heatwave
- Shade Panels at Park and Rides (Phoenix)
- Schools of Thought on Climate Change (Greater Boston)
- Nature's Cooling Systems Heat Coping Stories

C. Analysis

As standalone products, most emergency preparedness tools do not inherently involve elements of community ownership in their design. However, through participatory design, and allowing for community to steward the placement, rollout, and sustainability of such tools, there is room for ownership of resources within community. Strategies such as developing pool reform and aquatics programs, increasing hydration stations, and supporting wellness checking and notification systems may be limited to involving community because such decisions often come from pre-established government actors. Involving community may look like activities such as surveying residents on where these resources would be most impactful, partnering with

community organizations, and creating space for community decision-making. Participatory budgeting could be useful in this space as well.

In particular cases – namely, cooling buses, resilience hubs, community design processes for cooling centers, cooling centers as community spaces, cooling pop ups, splash parks and spray stations – government has the opportunity to defer to community on where, when and how these resources are deployed, and to involve community in sustaining, participating in, and creating such resources. All four activities mentioned within the "Defer to" space on the Spectrum are applicable with regard to such resources: MOU's with community-based organizations, community organizing, citizen advisory committees, and open planning forums with citizen polling. Integrating spatial justice from the beginning of this work is essential; these resources deployed unevenly does not support equitably resiliency.

5 Findings

Organizing Heat Information

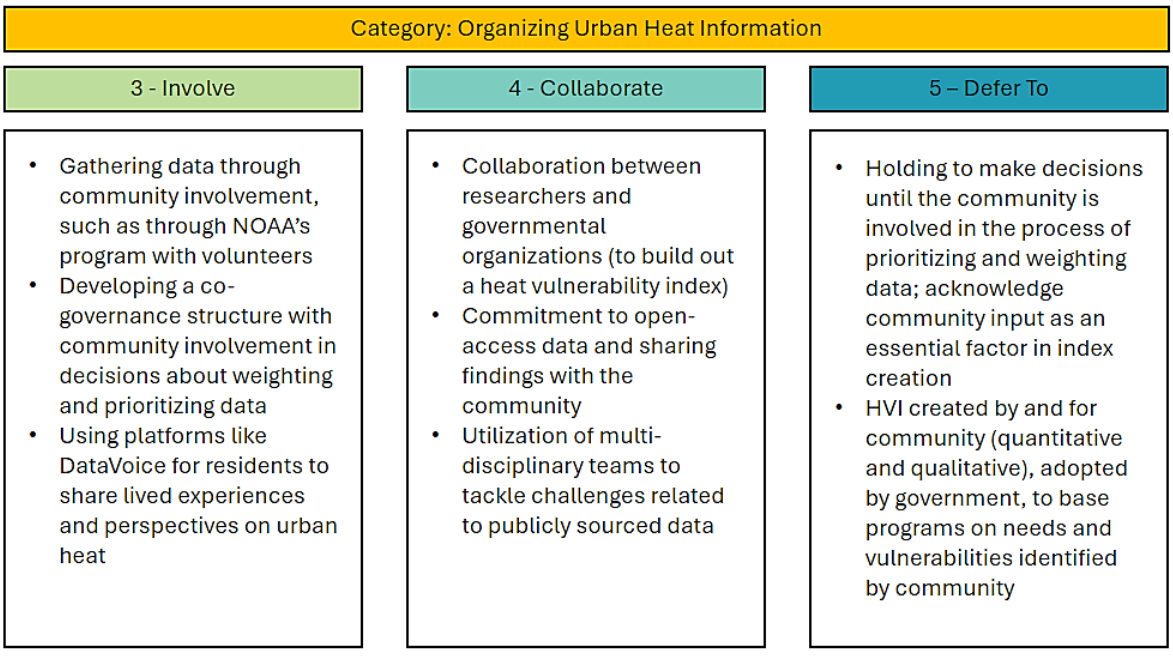


Figure 9. Organizing Urban Heat Strategies

Centering the Spectrum of Community Engagement to Ownership in the development of heat vulnerability indexes is crucial for ensuring that the unique characteristics and ecological conditions of each community are as essential as other data sources in the planning process. By actively engaging community members in data collection and analysis processes, practitioners can tailor the factors influencing heat vulnerability to the local context, improving the accuracy of HVIs and ensuring that the findings are more relevant and actionable. This approach aligns with the higher levels of the Spectrum, empowering community members to take ownership of the data and its implications.

Incorporating qualitative data in the analysis of heat vulnerability factors can help move beyond the “Inform” stage on the Spectrum by fostering meaningful two-way communication with the community. Engaging community members through interviews, focus groups, or surveys not only enhances the reliability of the findings but also ensures that their experiences and coping strategies are given due consideration. Involving community stakeholders in the local validation process further strengthens community ownership of the data and the solutions it informs.

Leveraging diverse data sources and integrating satellite and ground measurements can significantly improve the accuracy and spatial resolution of urban vulnerability assessments. By collaborating with local boundary organizations and community members in data collection efforts, it is possible to ground information gathered for the HVI in the community’s lived experiences. This community-centered approach encourages active participation and ownership, which facilitates its movement along the Spectrum toward higher levels of engagement.

Engaging community members in the process of identifying the leading factors contributing to heat vulnerability in a specific area can lead to more effective and targeted interventions. By actively involving the community in assessing the various vulnerability factors

and the potential impacts of different interventions, practitioners can promote greater ownership of solutions.

Enhancing the distribution and accessibility of heat vulnerability data can empower communities to move beyond passive information consumption towards more active engagement and ownership. Developing user-friendly web applications and interactive community dashboards can encourage individuals and communities to better understand the factors affecting heat vulnerability in their area and thus take an active role in shaping the development of mitigation and adaptation strategies.

Overall, promoting community ownership of heat vulnerability data is essential for fostering more inclusive and equitable resilience planning. By actively involving community in all levels of data gathering, analysis, and validation processes, we can create a sense of shared responsibility, agency and hope in addressing urban heat challenges. This can be achieved by encouraging dialogue among stakeholders, emphasizing the importance of community participation in shaping policies and initiatives related to urban heat, and centering the process around learnings from the Spectrum of Community Engagement to Ownership.

Developing Urban Heat Strategies

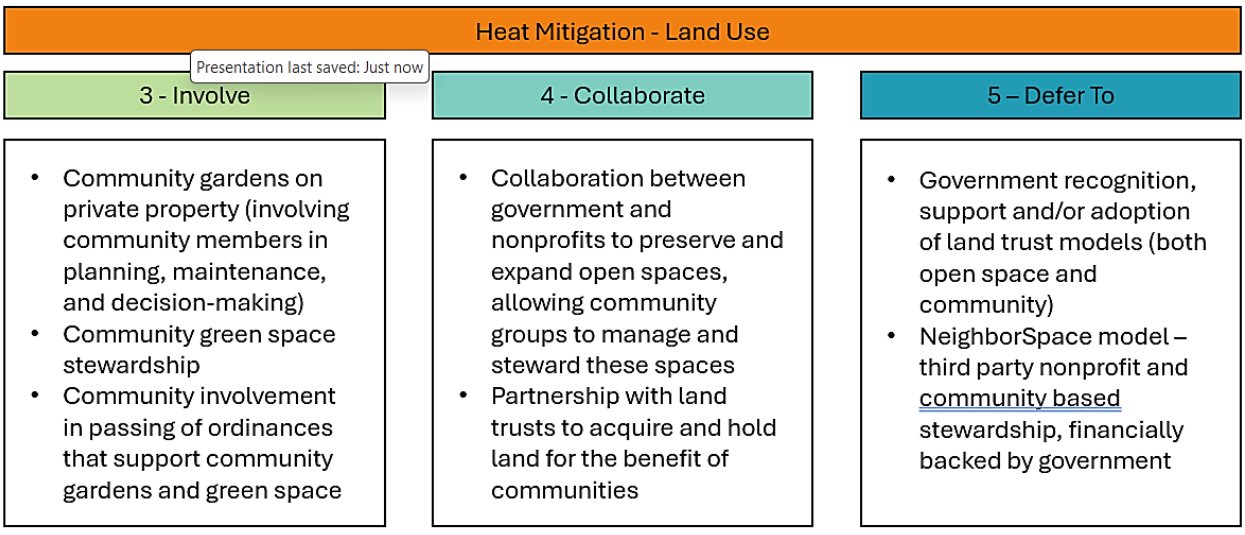


Figure 10. Developing Urban Heat Strategies

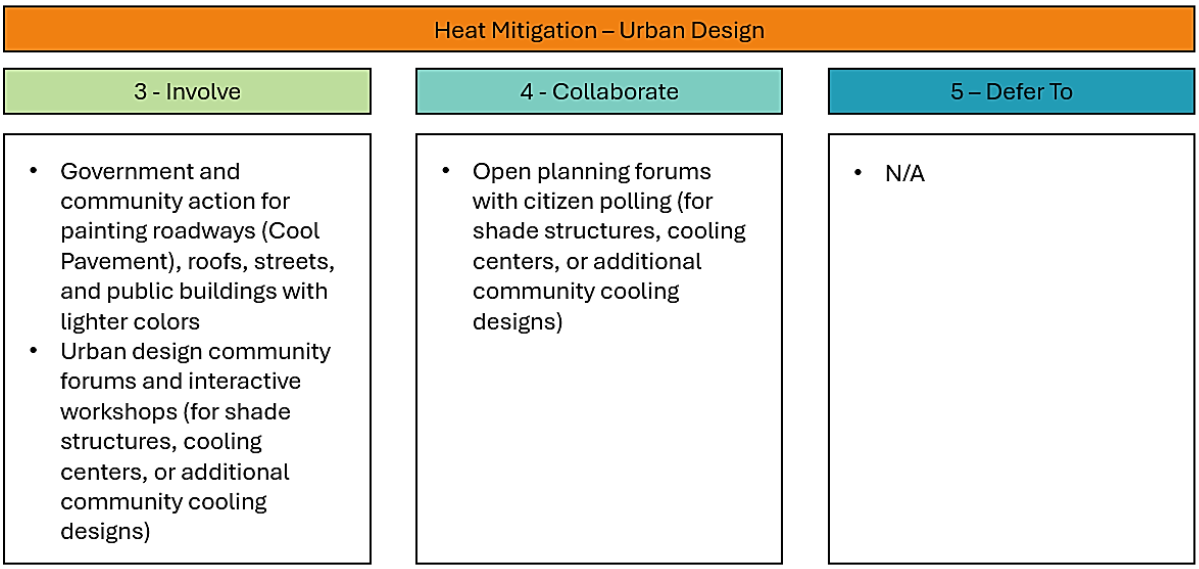


Figure 11. Developing Urban Heat Strategies

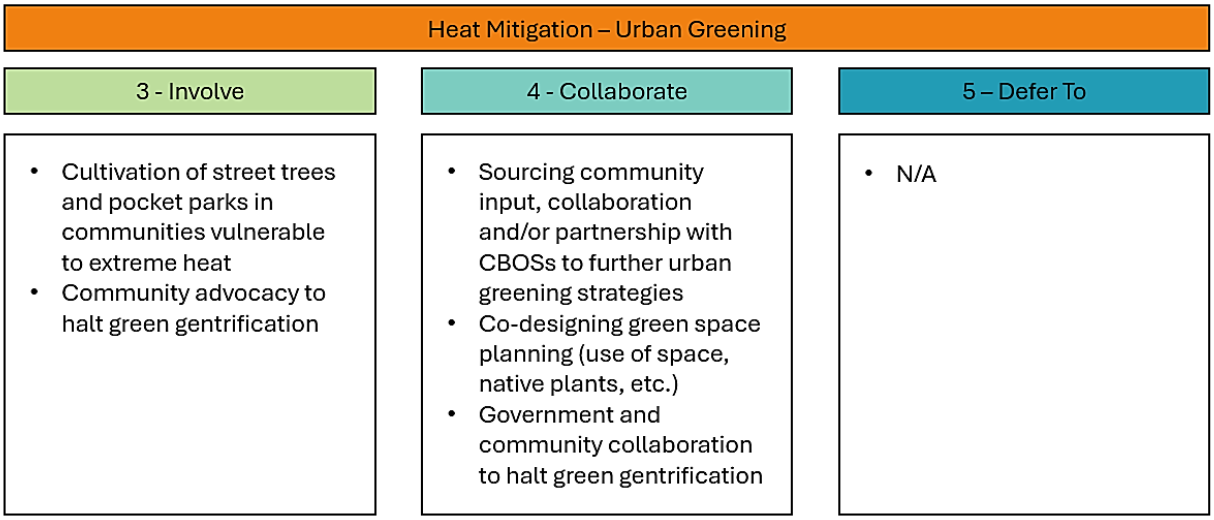


Figure 12. Developing Urban Heat Strategies

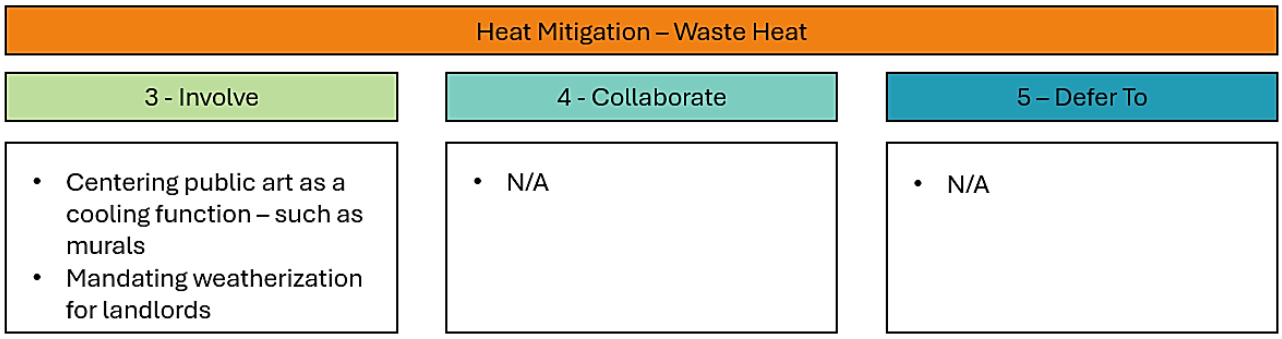


Figure 13. Developing Urban Heat Strategies

In the realm of heat mitigation, opportunities for building community ownership are abundant. The establishment of community gardens on private property, green space stewardship, and land trusts offer varying degrees of involvement, collaboration and deference to community. By engaging communities in these initiatives, there are opportunities for community power building, ultimately leading to more sustainable and effective solutions. Additionally, innovative methods such as participatory budgeting can be employed, enabling community members to allocate funds towards their preferred heat mitigation strategies, thereby promoting a sense of ownership and investment in the outcomes.

Urban design efforts can also empower communities in their implementation of heat mitigation measures. By shifting toward more inclusive planning processes that involve community members, urban design efforts can encourage the adoption of cool pavements, interactive workshops, and open planning forums. This inclusive approach not only results in more context specific and effective solutions, but also promotes a shared understanding of urban heat challenges and the importance of addressing them collectively.

In the context of urban greening initiatives, expanding community ownership involves not only fostering active involvement in projects such as street trees and pocket parks but also addressing the critical issue of green gentrification. By focusing on justice-oriented planning and prioritizing the needs of historically under-resourced communities, urban greening efforts can

strive to become more equitable. To further push the boundaries of innovation, cities can adopt new technologies such as urban sensors and crowdsourced data platforms, thereby enabling communities to monitor the impact of greening initiatives and contribute their insights to the decision-making process.

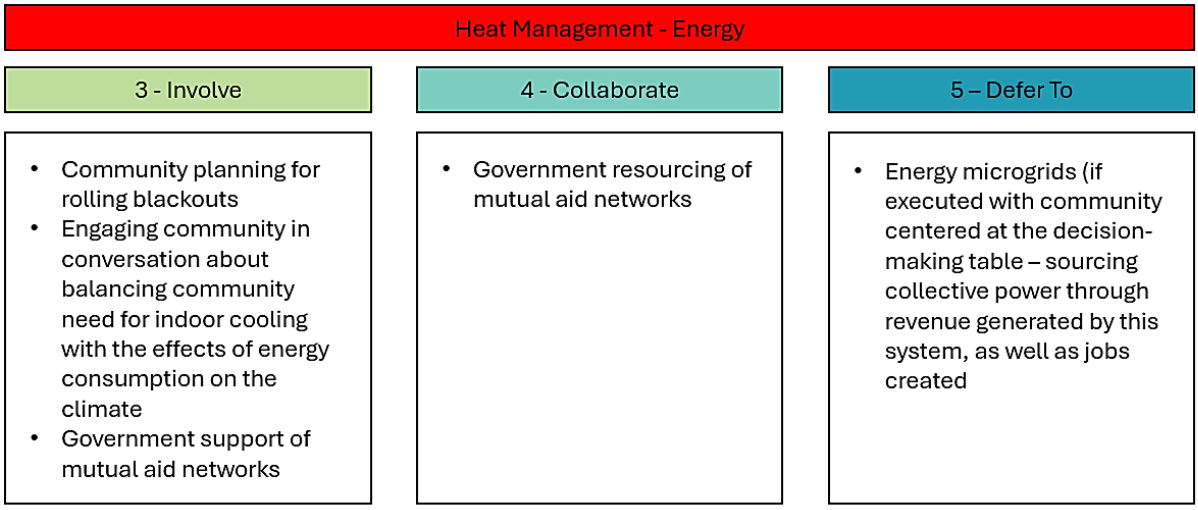


Figure 14. Developing Urban Heat Strategies

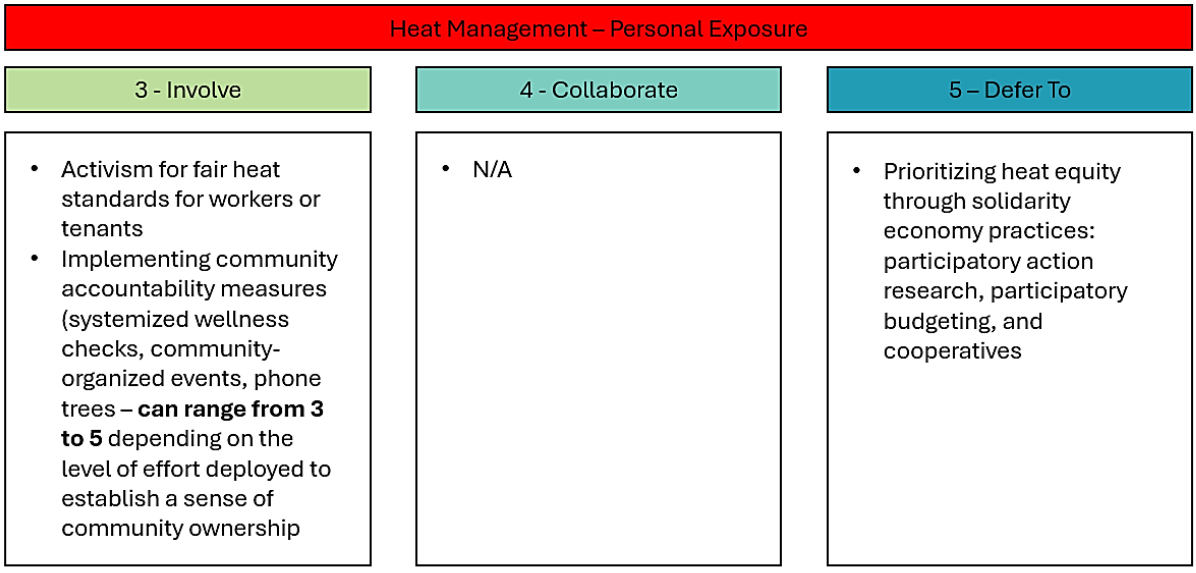


Figure 15. Developing Urban Heat Strategies

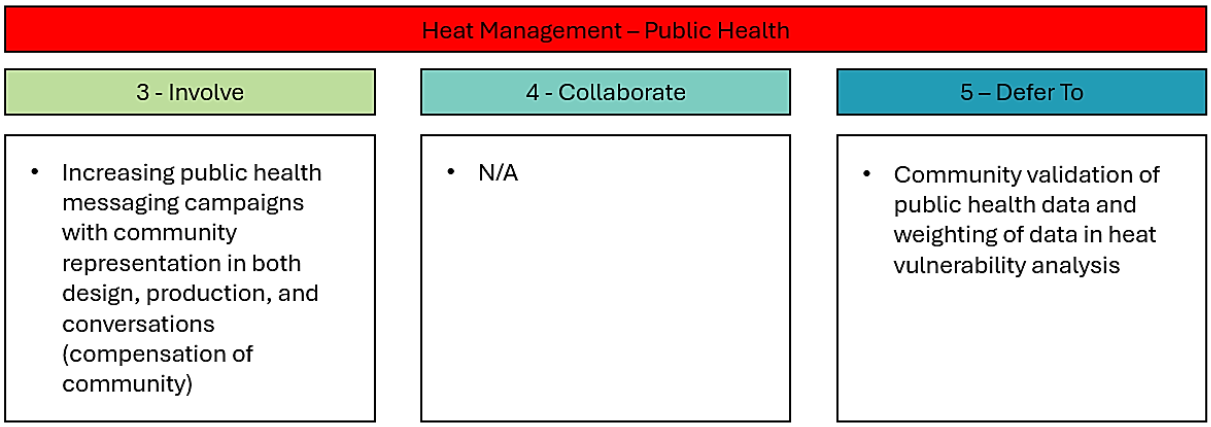


Figure 16. Developing Urban Heat Strategies

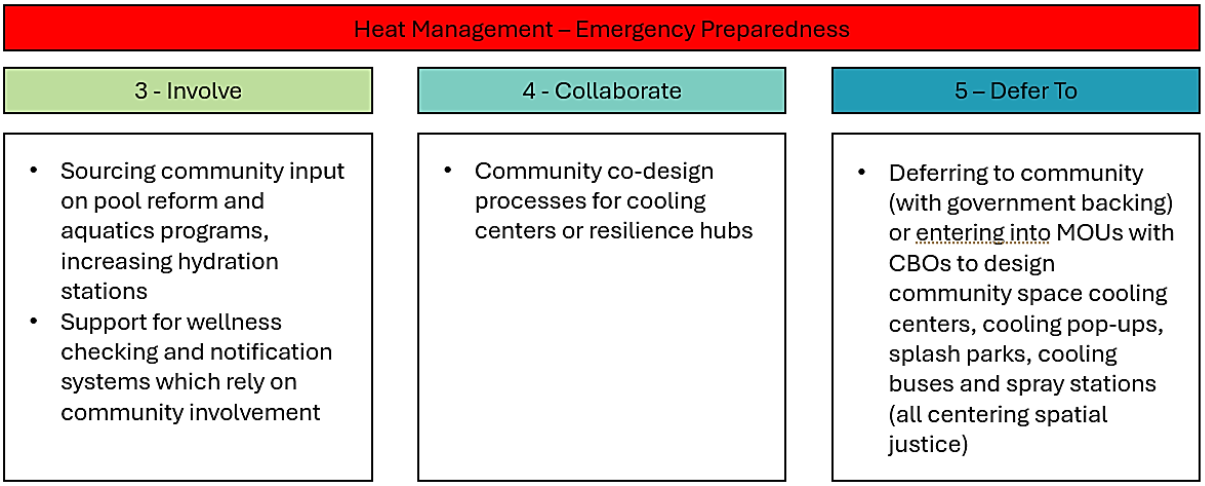


Figure 17. Developing Urban Heat Strategies

Heat management presents a unique set of challenges and opportunities for community engagement and ownership. For instance, the introduction of energy microgrids and mutual aid programs can lead to greater deference to community control. Innovative approaches such as community solar or localized renewable energy projects may be employed to reduce energy costs, improve energy resilience, and foster a sense of ownership over energy resources.

Personal exposure mitigation efforts, such as establishing heat standards for workers or tenants and implementing wellness checks, can range from “involve” to “defer to” depending on their execution. By embracing collaborative decision-making processes and exploring creative

solutions such as worker-owned cooperatives, communities can develop and implement heat management strategies that best serve their unique needs and preferences.

Finally, public health initiatives can further enhance community ownership by promoting the use of accessible data and encouraging community-driven analysis. These initiatives require moving beyond tokenism and centering community members in decision-making process, compensating their participation, and ensuring diverse representation. Innovative tools such as digital heat mapping and mobile applications can be utilized to gather real-time data on heat exposure and inform targeted interventions. By pushing the boundaries of community ownership and embracing novel approaches, urban heat planning frameworks can become more equitable, effective and responsive to the needs of diverse populations.

The Spectrum of Community Engagement to Ownership proves to be helpful in the context of urban heat planning frameworks because it encourages a nuanced understanding of various degrees of community involvement. By recognizing that community engagement can range from involvement to ownership, planners and policymakers can develop more tailored strategies that prioritize the specific needs and preferences of diverse communities. This approach fosters a shared understanding of risk and agency within community, leading to more sustainable and effective heat mitigation and management solutions. Moreover, by acknowledging the disparities in power and resources between various stakeholders, the Spectrum enables a more equitable distribution of benefits and responsibilities. Researcher Sara Meerow emphasizes that science does not currently do a good job of telling us which strategies are most “impactful”, in terms of the relative cooling impact of strategies[13] Therefore, given that there is not a strong evidence base for how to make strategy decisions, there is all the more reason for community members to choose which strategies they prefer, or to work with community to suggest specific strategies that support community power building. From the city

[13] *Sara Meerow, Zoom, March 3, 2024*

side, the co-author of the *PAS Report* notes that it is also helpful to establish heat related goals, and match strategies to those goals[14]

However, there are limitations to this analysis. Primarily, the Spectrum of Community Engagement to Ownership offers a simplified view of a complex and context-dependent process. Communities and their dynamics are multifaceted and can vary significantly from one place to another, which makes it challenging to develop universally applicable recommendations. Additionally, the analysis may not fully capture the intricacies of power dynamics and historical injustices, which can further complicate the implementation of community-driven initiatives. It is also essential to know that with power comes responsibility, and responsibility often drains resources from those who may not be in a position to act. This thesis hopes to promote opportunities for power-building that do not re-inflict harm on communities that often experience disproportionate burdens. While the Spectrum provides a useful starting point, its application must be adapted to the unique needs and circumstances of each community.

In conversation with Sara Meerow, she revealed that the next phase of her research will investigate optimal governance models for proactive heat planning, considering factors such as institutional placement and sustainability across different administrations[15]

Future research and improvement can also focus on developing a more context-specific understanding of community engagement and ownership in urban heat planning. By examining case studies and analyzing real-world examples, researchers can identify best practices and lessons learned that can inform more effective strategies. Additionally, interdisciplinary collaboration between urban planners, policymakers, public health experts, and community leaders is crucial to ensure a comprehensive understanding of the challenges at hand. Finally,

[14] *Sara Meerow, Zoom, March 3, 2024*
[15] *Sara Meerow, Zoom, March 3, 2024*

exploring the potential innovative technologies and data-driven solutions, such as urban sensors, crowdsourced data platforms, and digital heat mapping, can empower communities to better understand and address urban heat challenges. By building on the foundations of the Spectrum of Community Engagement to Ownership and delving deeper into the complexities of community dynamics, we can work towards more inclusive, equitable and effective urban heat planning frameworks, at a time where the threat of increased urban heat looms near in our communities.

6 Conclusion

There are many strategies deployed in our cities, and included in this thesis, that do not reach a “3” on the Spectrum of Community Engagement to Ownership. The status quo of planning practices often includes an obligatory engagement process with few accountability measures in place to ensure that resident voices inform implementation. Knowing that natural disasters and climate resilience threats have the capacity to exacerbate the existing inequalities in our cities, planners, policymakers and communities should focus on the implementation of strategies that reach a 3 or higher on the Spectrum.

Overall, a theme that emerged throughout this work is the recognition that deploying cooling strategies – whether short term or long term – is not an exact science. To deploy strategy, the process should include a careful design of a community’s urban heat goals and metrics, and then a targeted mix of approaches that foster community ownership and meet these specific shared targets. This is not work to be done in a vacuum of a statistical or scientific model.

Lastly, community ownership is not the only lens in which we can organize and analyze these strategies. It is just one framework that meets one need of community. This type of framework analysis, however, provides an example of a qualitative approach to prioritizing city programming and planning when it comes to resilience planning.

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