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EVALUATING THE IMPLEMENTATION AND EFFECTIVENESS OF HEAT ACTION PLANS (VERSION 1.0)

Prepared for the International Federation of Red Cross and Red Crescent Societies

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Recommended Citation

Saeideh Sobhaninia, Sara Meerow, Ladd Keith, Halley Hughes, Maryam Shafiee Shakib, Alekzander Ryan, and Caroline Webster. 2026. Evaluating the implementation and effectiveness of heat action plans (Version 1.0). Red Cross Red Crescent Global Disaster Preparedness Center. DOI: 10.2458/10150.675350

Acknowledgments

This project was funded by the Red Cross Red Crescent Global Disaster Preparedness Center. Additional support for the global heat action plan content analysis was supported by the U.S. Department of Energy (DOE), Office of Science, Office of Biological and Environmental Research's Urban Integrated Field Laboratories research activity, under Award Number DE-SC0023520. We would like to thank all the interviewees from around the world who supported our research with their time. This study would not be possible without their insights. We would also like to specifically thank Jessica Robbins and Julie Arrighi at the Red Cross and Aaron Bouschor for their assistance with the project.

((cover photo taken by Alexia Webster, courtesy of the Red Cross Red Crescent Global Disaster Preparedness Center))

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Executive Summary

Extreme heat is a deadly and growing threat to cities worldwide. As recognition of heat risks increases, local governments have begun developing Heat Action Plans (HAPs) to outline goals, relevant information, and strategies for mitigating and managing heat in their communities. As a relatively new area of planning, there is limited guidance on what HAPS should contain, how they should be implemented, and how to determine if they are effective. Recognizing this need, the Red Cross Red Crescent Global Disaster Preparedness Center (GDPC) advocates for and facilitates the development of multi-stakeholder local HAPs and has commissioned this study examining the content of HAPs from cities around the world and how they are implemented and evaluated.

Project description

In collaboration with GDPC, our research team from Arizona State University, the University of Arizona, and the University of Washington systematically analyzed the content of HAPs from different regions of the world in Phase I and II of the study. In Phase III, our team interviewed local officials involved in HAP development and implementation to understand their impact. Based on this analysis, in Phase IV, we developed and piloted an actionable HAP Implementation and Effectiveness (HAPIE) Tool that can help cities to track the implementation and effectiveness of HAPs (Figure ES-1).

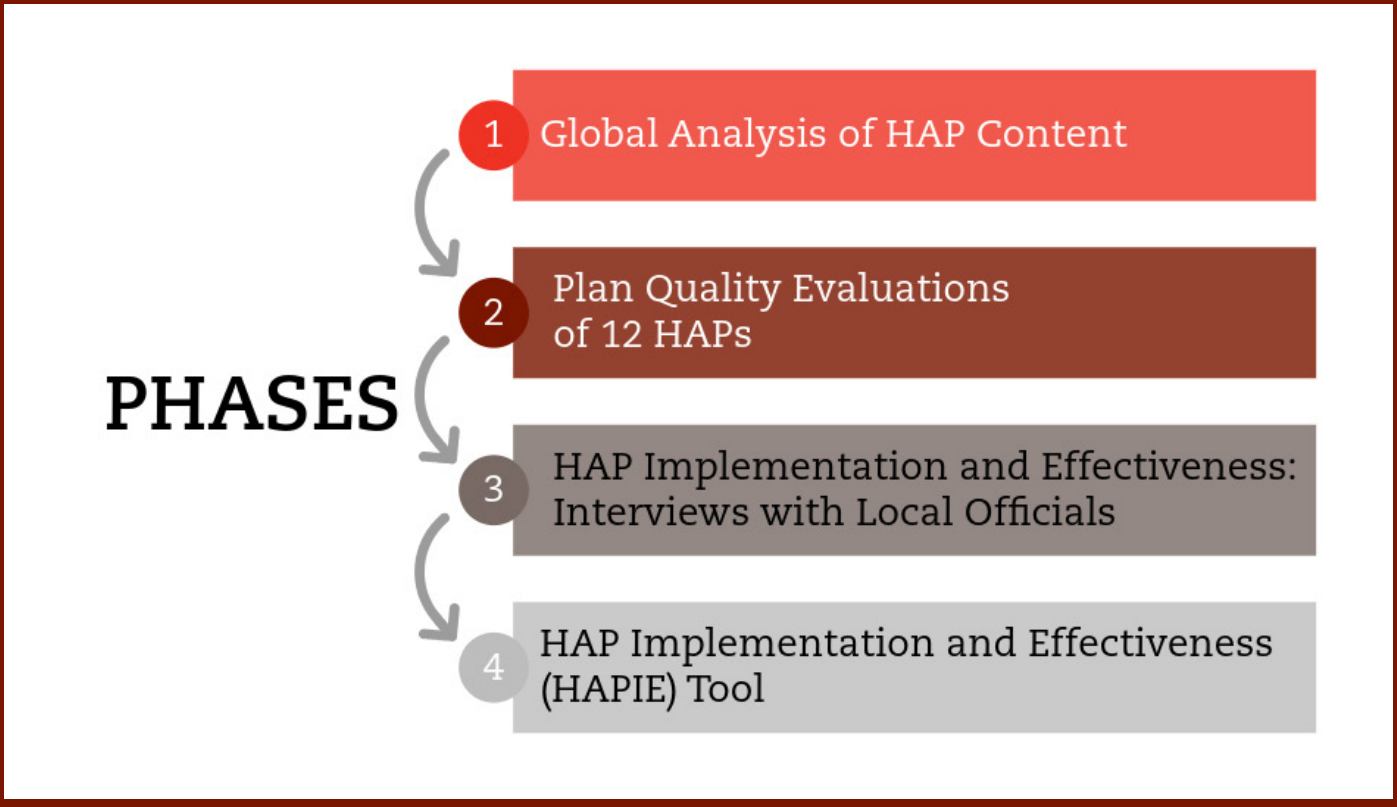


Figure ES-1: Study Phases

To examine the effectiveness of subnational HAPs, our team started by analyzing the content of HAPs that could be identified globally at the city and state level. The results of this qualitative analysis of 34 HAPs indicated that the plans mostly prioritized heat management measures, such as emergency preparedness, public health interventions, and heat education, over long-term heat mitigation strategies. Heat governance also emerged as an important, but previously overlooked, dimension of heat resilience,

encompassing institutional coordination, research, funding, and stakeholder engagement.

We selected a diverse sample of 12 subnational governments with HAPs worldwide for further examination using the Plan Quality Evaluation for Heat Resilience approach paired with interviews with relevant local officials. For the plan quality evaluation, we systematically evaluated and compared the extent to which the 12 HAPs included well-established elements of high quality plans that are more likely to be implemented and effective: heat-related goals, a strong fact base of information, prioritized strategies that account for future uncertainties, public participation, coordination, and implementation and monitoring. We also assessed the different types of heat mitigation and management strategies in the plans. We found that plans most often included criteria from the goals and fact base principles of the evaluation, while criteria for public participation and acknowledging uncertainty were frequently underrepresented. The results from the heat strategies evaluation showed that most plans included heat management strategies like early warning systems, education and awareness, and access to cooling centers, but mostly lacked mitigation strategies beyond urban greening and built shade.

The interviews with local officials in the 12 selected communities with HAPs revealed that very few track implementation and even fewer evaluate the effectiveness of their HAPs. While some jurisdictions have formal implementation monitoring processes, these primarily track whether actions have been implemented rather than their impact on outcomes, for example heat-health impacts. While most subnational governments did not quantify the outcomes of plan actions, several did have some evaluation processes, but the results of these were rarely made public. Vienna, Austria, for example, has an extensive annual internal evaluation process for its HAP, whereby responsible agencies rate implementation and effectiveness of each action using a red, yellow, green ‘traffic light’ rating, and the plan is updated accordingly.

Across these communities, limited funding, staff capacity, data availability, and regulatory authority were identified as major barriers for evaluating HAP outcomes. Consequently, subnational governments frequently rely on qualitative assessments and perceived effectiveness. Interviewees emphasized the need for stronger institutionalization of heat governance, integration of heat action into broader planning efforts, and practical evaluation approaches supported by improved data systems.

Limited availability of heat-health outcome data, evolving and differing heat risks, and varying stages of HAP implementation make it extremely difficult to measure or compare the effectiveness of HAPs across cities. Rather than proposing a universal measure of HAP effectiveness given the local nature of heat impacts and appropriate strategies, we developed a generalizable approach- the Heat Action Plan Implementation and Effectiveness (HAPIE) Tool - that guides cities and partner organizations through a structured process of identifying appropriate indicators for tracking that are aligned with plan goals and strategies in order to assess plan implementation and effectiveness. The tool was piloted on four geographically diverse cities selected from among the twelve we interviewed and whose HAPs we evaluated.

Key findings and recommendations for practice

This project highlights the global challenge of demonstrating the effectiveness of heat action planning. While HAPs commonly outline goals and actions, and cities sometimes track their implementation, they rarely specify what impact those actions are expected to produce or how that change would be measured. This gap between implementation tracking and outcome evaluation reflects structural constraints that are real and persistent: the absence of baseline data collected before implementation; the difficulty of attributing changes in population health to specific actions in

the presence of confounding factors; the privacy and aggregation constraints on health data that prevent spatial analysis at the scale at which interventions are deployed; and the resource pressures that consistently prioritize implementation over effectiveness.

This project reveals that even where subnational governments have developed monitoring systems, those systems typically track HAP implementation outputs rather than health or environmental outcomes. Closing this gap requires not just better analytical tools but also investment in collecting, sharing, and applying comparable data and required infrastructure.

Our four-city pilot of the HAPIE Tool demonstrates that it is feasible to develop a consistent, cross-contextual evaluation structure from HAPs using different terminology, action structures, and governance arrangements so that cities at different stages of evaluation capacity can locate themselves within a shared framework and identify investments needed to strengthen their evaluation practice.

Drawing on our analysis of a diverse array of local HAPs across the world, interviews with local officials who develop and implement them, and a four-city pilot of a HAPIE Tool, we propose the following recommendations for communities looking to evaluate the effectiveness of their HAPs:

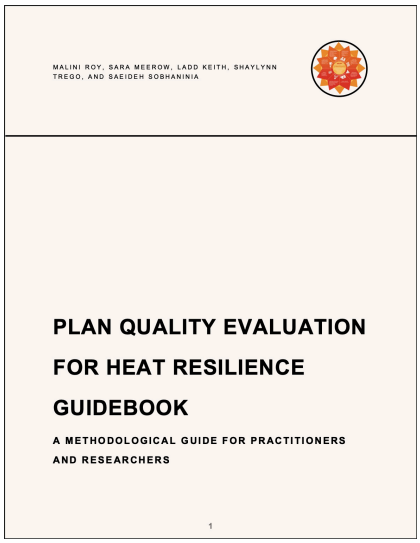
- Distinguish implementation tracking from effectiveness evaluation and invest in both separately. Implementation tracking, which focuses on the actions taken, by whom, and how many people are reached, is achievable within existing administrative systems. Evaluating effectiveness, on the other hand, likely requires additional investment in data collection and should be resourced as a distinct function, not assumed to emerge from implementation tracking alone.
- Use the goals, strategies, implementation measures, and effectiveness measures outlined in the HAPIE Tool as a structure for future HAP development. When drafting or updating a HAP, each action should take the form of a specific strategy and be linked to at least one implementation measure and effectiveness measure. Plans that complete this exercise for all major actions have a trackable structure from goal to outcome.
- Adapt the evaluation framework to the local resource and data context. In lower-resourced settings, for example, surveys might produce evidence of HAP impact without requiring heat-health outcome data from health administrations.
- Strengthen governance structures and institutional continuity for monitoring. Monitoring capacity should be embedded in permanent staff roles, rather than secondary responsibilities. The proposed institutions within the evaluation tool facilitate the identification of responsible or capable agencies to delegate tasks.
- Invest in data-sharing infrastructures. Plan evaluations should be made public. Developing standardized data collection protocols across cities will also make it easier to compare effectiveness across jurisdictions, draw causal claims, and extract generalizable lessons for enhancing heat resilience.

This study set up the HAPIE Tool, an evaluation process recommending indicators that can help cities evaluate their HAP implementation and effectiveness. Following these recommendations will help improve HAPs at a time when heat risk is increasing and ensure local efforts to address heat are more effectively evaluated, leading to improved HAP outcomes.

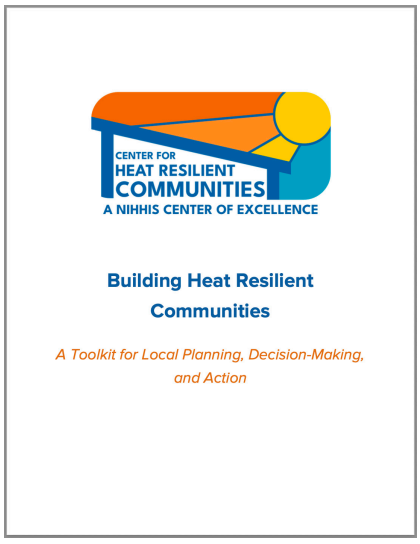
Foundational Resources

This project leverages several existing heat resilience planning resources that can provide helpful guidance and context.

PAS Report 600: Planning for Urban Heat Resilience. American Planning Association (Keith & Meerow, 2022) https://www.planning.org/publications/report/9245695/



Plan Quality Evaluation for Heat Resilience Guidebook: A Methodological Guide for Practitioners and Researchers. (Roy et al., 2025). https://repository.arizona.edu/handle/10150/677075



Building Heat Resilient Communities: A Toolkit for Local Planning, Decision-Making, & Action https://innovation.luskin.ucla.edu/publication/building-heat-resilient-communities/

Chapter 1
Global Analysis of Heat Action Plans

In this chapter we synthesize the results of the largest examination to date of subnational Heat Action Plans from around the world. We qualitatively analyze the content of 34 subnational HAPs from a diverse set of international cities revealing temporal and spatial patterns in HAP development, areas of focus, and proposed strategies.

Introduction

Globally frequency, duration, and intensity of extreme heat events are increasing, and their impacts are intensified in cities due to the urban heat island effect. The latest Intergovernmental Panel on Climate Change (IPCC) report indicates that there is strong evidence that extreme heat has intensified in cities and caused adverse impacts on human health, livelihoods and key infrastructure, and that these impacts are likely to continue to intensify as climate change progresses and the human population becomes increasingly urbanized (though rural populations also face heat risks).

Cities must plan to both mitigate and manage more extreme heat, which they can do by integrating heat goals, information, and actions into broader plans, such as land use, climate action, or hazard or disaster plans, or by developing dedicated heat plans (Keith & Meerow, 2022). Heat Action Plans (HAPs) and Heat Response Plans are the two main types of dedicated heat plans. While Heat Response Plans focus on short-term, reactive measures for acute events such as cooling centers, emergency services, and alerts (CDC, 2020; WHO, 2008), HAPs are often more proactive, long-term strategic documents that include early warning systems, public education, infrastructure adaptation, and preparedness (Martinez et al., 2019).

Methodology

We examined HAPs at the city scale by integrating both academic research and practical guidance to develop a comprehensive framework and roadmap for effective HAP development. Our process began with a thorough review of existing literature, focusing on evaluations of HAP effectiveness, identified gaps, and documented best practices (e.g., Keith et al., 2022; Rose & Göçmen, 2024; Schmeltz et al., 2023; Singh et al., 2024; Randazza et al., 2023; Kotharkar & Ghosh, 2022; Magotra et al., 2021; Ghosh, 2024). We then analyzed a range of practical guidelines used by cities and organizations to design and implement HAPs (e.g., IFRC, 2020; WHO, 2008; CDC, 2020; NCSP, 2019). By synthesizing insights from both academic and applied sources, we identified key elements, recurring challenges, critical gaps, and successful strategies.

Following a comprehensive review of the existing HAP guidelines, we identified existing HAPs at the city scale and national scale worldwide to understand how cities and countries are addressing extreme heat and what strategies are being prioritized in local responses. To identify relevant plans, we conducted a systematic search using a variety of strategies and platforms, primarily utilizing English-language search terms such as “heat action plan” and “heat response plan” through search engines like Google.

This approach yielded a sample of 34 city-scale HAPs from diverse geographic, climatic, and socio-political contexts. These plans formed the basis for our comparative analysis, allowing us to assess common elements, regional adaptations, and varying comprehensiveness and implementation level.

It is important to note that the majority of city-scale HAPs reviewed were developed in North America and India, with limited representation from other regions. This geographic imbalance poses a limitation to this study. Several factors may contribute to this pattern. First, many countries have not yet developed formal HAPs at any jurisdictional level. Second, heat adaptation strategies are sometimes incorporated into broader climate adaptation, emergency management, or public health plans rather than being published as

standalone HAPs. Finally, in some countries, limited institutional capacity or existing governance structures lead to the development of national or subnational HAPs instead of city-scale plans. It is possible that we missed some non-English language plans that were also not included within the GHHIN database. Furthermore, additional HAPs have likely been developed since this study was conducted in 2025. Nevertheless, it offers the most comprehensive snapshot of HAP content, and in doing so of planned local heat action, to date.

To gain a comprehensive understanding of the structure, processes, and strategic components of each plan, a full-text analysis of the 34 Heat Action Plans was conducted using NVivo qualitative data analysis software. This in-depth coding process allowed us to systematically extract insights about how cities design and operationalize their responses to extreme heat. Our analytical approach combined both inductive and deductive coding methods. The deductive framework was guided by Keith et al. (2022), which outlines key dimensions of heat-resilient planning. Specifically, we evaluated each plan across the following categories: clearly defined heat-related goals and success metrics; the inclusion and use of heat-related data and information; adaptation and mitigation strategies; acknowledgment of uncertainty and future climate variability; mechanisms for public participation; and plans for implementation, monitoring, and evaluation. This structured approach enabled us to compare plans across different contexts and identify patterns, gaps, and promising practices.

Our analysis began with an in-depth coding of the Tucson Heat Action Roadmap using the framework developed by Keith et al. (2022) as a foundational guide. Three coders independently coded the full plan, and based on this initial exercise, we collectively reviewed and revised the framework to better align with the realities and evolving practices

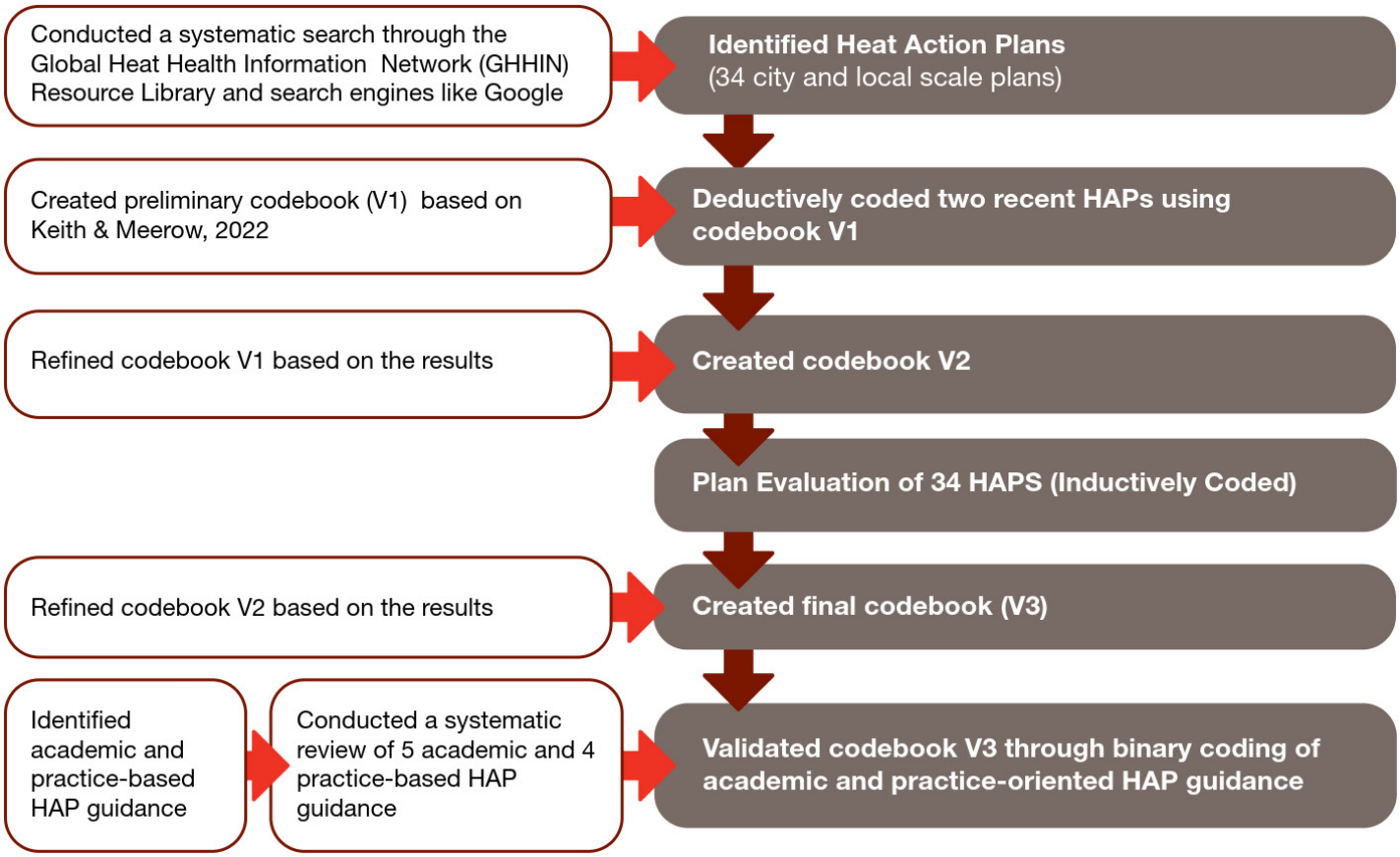


Figure 1-1: The methodology steps for the global analysis of heat action plan content

observed in contemporary heat planning. This iterative refinement led to the addition of new categories, the removal of others, and the clarification of definitions to enhance analytical precision. Using this revised coding scheme, we then applied the framework to all 34 city-scale HAPs. To ensure we captured emergent themes and context-specific strategies, we included an "Other" category within each major section to code content that did not fit within the predefined categories. After completing the coding process, we conducted a comprehensive review of all codes, further refining the thematic structure by reorganizing categories and introducing subcategories to reflect nuanced patterns and trends across the plans (Figure 1-1).

Results

We analyzed 34 city-level HAPs from diverse geographic, climatic, and socio-political contexts across the globe (Table 1-1), covering a total of 1,949 plan pages. Through our review, we identified and recorded 5,015 codes across these plans.

Table 1-1: Analyzed heat action plans

City	State	Country	Year	Plan Name	Government
Ahmedabad	Gujarat	India	2019	Heat Action Plan	City
Atlanta	Georgia	United States	2023	Atlanta Heat & Flood Risk Assessment	City
Austin	Texas	United States	2022	Actions in Preparation for Heat Advisory/Excessive Heat Warning Memorandum	City
Austin	Texas	United States	2024	Heat Resilience Playbook	City
Baltimore	Maryland	United States	2024	Code Red Extreme Heat Alert Plan	City
Boston	Massachusetts	United States	2022	Heat Resilience Solutions for Boston	City
Clarksville	Indiana	United States	2022	Beat the Heat Clarksville: Heat Management Plan	City
Darwin	Northern Territory	Australia	2021	Feeling Cooler in Darwin: Heat Mitigation & Adaptation Strategy	City/Territory
Delhi	Delhi	India	2024	Delhi Heat Action Plan	City
Greater Sudbury	Ontario	Canada	2023	City of Greater Sudbury Hot Weather Response Plan	City
Houston	Texas	United States	2023	Excessive Heat	City
Jodhpur	Rajasthan	India	2023	Jodhpur Heat Action Plan	City
Kansas City	Missouri	United States	2023	Hazard Specific Response Plan 2: Heat Operations	City
Karachi	Sindh	Pakistan	2018	Heatwave Management Plan: A Guide to Planning and Response	City
Los Angeles	California	United States	2023	Turning Down the Heat: Identifying and Addressing Heat Inequities of Frontline Communities in Los Angeles	City
Mesa	Arizona	United States	2023	Heat Action Plan for Mesa Care Neighborhood Water Tower Improvement District	City
Miami-Dade County	Florida	United States	2024	Extreme Heat Action Plan	County
Milwaukee	Wisconsin	United States	2011	Plan for Excessive Heat Conditions	City
New York City	New York	United States	2017	Cool Neighborhoods NYC	City
Philadelphia	Pennsylvania	United States	2019	Beat the Heat Hunting Park	City
Phoenix	Arizona	United States	2023	Heat Action Planning Guide For Neighborhoods of Greater Phoenix	City
Portland	Oregon	United States	2021	Extreme Heat & Wildfire Smoke: Reducing Risks to Public Health in the Portland Region	City
Ramban	Jammu & Kashmir	India	2024	Heat Wave Action Plan	City
Scottsdale	Arizona	United States	2023	Extreme Heat Existing Efforts Report	City
Seattle, King County	Washington	United States	2024	Extreme Heat Response Plan	City/County
Sedona	Arizona	United States	2024	Heat Mitigation & Adaptation Guidebook	City
Srinagar	Jammu & Kashmir	India	2024	Heat Wave Action Plan	City
Surrey	British Columbia	Canada	2024	Surrey's Extreme Heat Response Guideline	City
Tampa	Florida	United States	2024	Heat Resilience Playbook	City
Thane	Maharashtra	India	2024	Heat Action Plan for Thane City	City
Toronto	Ontario	Canada	2024	Heat Relief Strategy	City
Tucson	Arizona	United States	2024	Heat Action Roadmap	City
Tulsa	Oklahoma	United States	2018	Emergency Operations Plan	City/County
Vadodara	Gujarat	India	2024	Heat Wave Action Plan	City
Vienna	Vienna	Austria	2022	Heat Action Plan	City
Washington	District of Columbia	United States	2022	Keep Cool DC: Extreme Heat Adaptation Strategy	City

Through the identified HAPs, a clear temporal trend emerged, indicating a growing number of HAPs being developed at the city level globally (Figure 1-2).

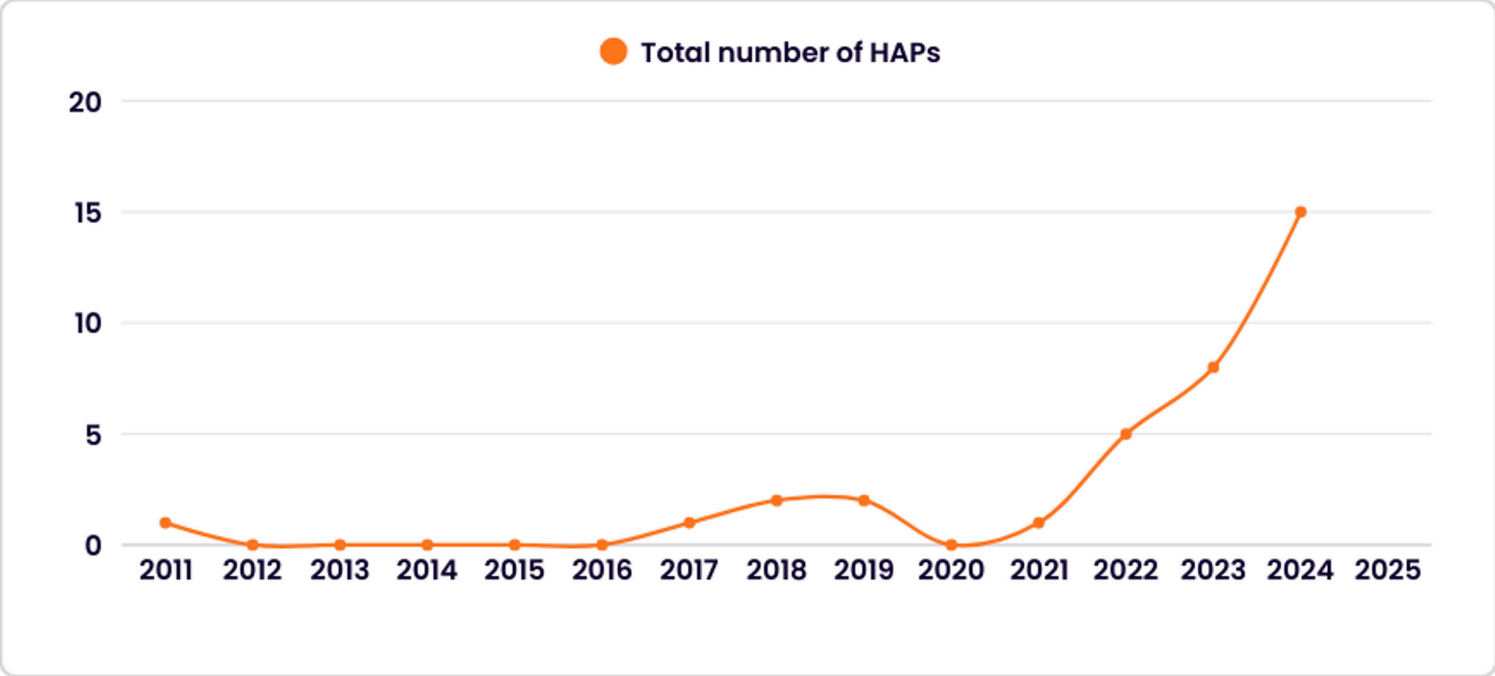


Figure 1-2: Temporal trend of identified heat action plans

In terms of geographical distribution, the majority of the analyzed HAPs originated from the United States and India, reflecting a concentrated effort in these regions. Additionally, the dataset included plans from Canada, one plan from Austria, and one from Australia, highlighting a notable gap in city-scale heat planning across other parts of the world (Figure. 1-3).

Figure 1-3: Geographical distribution of identified heat action plans

Goals and Objectives

We examined the different types of heat-related goals and objectives that HAPs aim to achieve. Consistent with Keith and Meerow's (2022) framework, plans commonly included both heat mitigation (n=92 codes) and heat management (n=223) goals, and to a lesser extent goals related to more equitable outcomes or addressing inequities (n=47). We also identified two additional goal categories after analyzing the plans: heat resilience broadly (n=63) and goals related specifically to governance (n=35). Plans less often detailed specific metrics for measuring success in achieving these goals and objectives (n=31) (Figure 1-4).

Goals & Objectives — Total: 512 codes

Categories	Heat Management	Heat Mitigation	Heat Resilience	Heat Equity	Heat Governance	Metric for Success
Code Count	223	92	63	47	35	31
Sub-categories	- Communication - Personal exposure - Education and awareness - Economic - Emergency preparedness - Health - Indoor cooling	- Urban greening – site level - Waste heat - Urban greening – promoting green infrastructure, parks, and tree coverage - Cooling surfaces and shade -Thermal comfort of pedestrians and transit users	- Social cohesion - Infrastructure	- Resource accessibility - Access to green infrastructure - Affordable housing - Inclusive engagement - Job opportunities - Communication	- Planning and governance - Partnership, coordination, and community engagement - Research (impact and vulnerability assessment) - Data accessibility and evaluation	- Outreach - Engagement - Legislations - Health - Cooling - Green infrastructure - Education

Figure 1-4: Heat action plans Goals and Objectives

The majority of goals in the HAPs focused on heat management, including heat risk communication campaigns, personal exposure reduction, public education and awareness, economic assistance for actions, emergency preparedness planning, and provision of health and indoor cooling solutions. For instance, one of the City of Thane HAP's goals was: "Reducing heat-health risks, heat stress, and heat-related illnesses by implementing robust tracking, surveillance, and innovative cooling solutions." (Thane Municipal Corporation [TMC] & Council on Energy, Environment and Water [CEEW], 2024, p. 21).

Plans contained fewer heat mitigation goals or fewer goals related to long-term, physical interventions such as urban greening at site and network scales, increasing park and tree coverage, installing cooling surfaces and shading, and enhancing thermal comfort for pedestrians and transit users. For example, one of Austin's HAP goals was to: "…design parks and transform underutilized spaces for expanded greening and cooling" (City of Austin, 2024, p. 25).
Some HAPs included broader heat resilience goals, which emphasized building social cohesion and enhancing climate-resilient infrastructure. For example, "Build resilience of community members to heat exposure in their homes and provide pathways for communities to advocate for accessible and affordable housing" (NCSP, 2019, p. 116).

Heat Equity goals addressed structural barriers to heat protection, including access to resources, equitable distribution of green infrastructure, affordable housing provision, and inclusive engagement strategies to reach vulnerable groups. San Francisco offers a strong illustration of a heat equity goal, aiming to:

> "Advance racial and social equity through the just distribution of risk reduction and resilience benefits by increasing community involvement in the decision-making process and using data driven analyses to ensure that resources are targeted to the

> frontline communities that carry the heaviest health burden of air quality and extreme heat-related hazards." (San Francisco Department of Public Health & Office of Resilience and Capital Planning, 2023, p. 12).

Heat Governance goals focused on planning processes, inter-agency partnerships, coordinated community engagement, research on heat impacts, and systematic data evaluation. For instance, one of the City of Tucson HAP's goals was: "Collaborate with Existing Initiatives [1,5–9]: Ensure alignment with other federal, state, and local plans and actions to complement long-term planning efforts and promote comprehensive resilience." (City of Tucson, 2024, p. 8).

Lastly, Metrics for Success involved defining measurable benchmarks, such as outreach reach, legislative progress, health and cooling outcomes, and green infrastructure deployment, to evaluate program performance over time. For example, Miami's metrics for success included the number of municipalities and community-based organizations involved in outreach and training and education on heat-related illnesses and deaths (Miami-Dade County Office of Resilience & Climate and Heat Health Task Force, 2022).

Fact-based Information

HAPs included a variety of heat-related information, with substantial detail on heat vulnerability, existing city heat actions, heat-health surveillance systems, and heat severity data (Figure 1-5). We found 856 references to fact-based information and categorized them into eight key categories: Heat Vulnerability (n=190), Heat Health Surveillance (n=121), Ongoing/Previous Heat Actions (n=114), Heat Severity Data (n=107), Historical Heat Data (n=106), Heat Risks (n=79), Heat Projection Data (n=78), and Supplementary Maps (n=42).

Heat Vulnerability was the largest category, highlighting population-level risk factors such as socio-demographic disparities (income, race, age), outdoor occupational exposure, immigrant status, homelessness, poor housing quality, air conditioning access, air quality issues, inadequate urban infrastructure, and social isolation (e.g., Atlanta [Urban Adapt, 2023, p. 31], Los Angeles [Abdelatty et al., 2023, p. 8], Austin [City of Austin, 2024, p. 5], Miami [Miami-Dade County Office of Resilience & Climate and Heat Health Task Force, 2022, p. 5], Clarksville [Town of Clarksville, 2022, p. 13], Vienna [Vienna City Administration & Climate Matters, 2022, p. 36], Delhi [Delhi Disaster Management Authority, 2024, p. 15], Karachi [Karachi Commissioner Office et al., 2018, p. 14]). Heat Health Surveillance included tracking morbidity, hospitalizations, ER visits, and heat exhaustion incidents to monitor public health outcomes (e.g., Rajasthan [Government of Rajasthan et al., 2017, p. 11], Vadodara [Vadodara Municipal Corporation et al., 2024, p. 11], Boston [City of Boston et al., 2022, p. 201], Portland [Oregon Metro et al., 2021, p. 23], Thane [TMC & CEEW, 2024, p. 15]). Ongoing/Previous Heat Actions documented implemented strategies like urban canopy expansion, cool roof installation, hydration centers, shading initiatives, and energy-efficient building requirements (e.g., Darwin [City of Darwin, 2021, p. 27], Tucson [City of Tucson, 2024, p. 15], Hunting Park [Philadelphia Office of Sustainability, 2019, p. 32], Tampa [City of Tampa et al., 2024, p. 11]).

Heat Severity Data captured environmental measurements including daytime/nighttime air temperatures, heat event duration, seasonal trends, thermal imagery, NDVI, precipitation, and composite vulnerability indices (e.g., Phoenix [NCSP, 2019, p. 6], Srinagar [District Disaster Management Authority Srinagar, 2024, p. 1], New York [New York City Mayor's Office of Recovery and Resiliency & Urban Heat Island Mitigation Working Group, 2017, p. 7]). Historical Heat Data recorded long-term metrics such as number of extreme heat days, temperature averages, environmental hazards, and wildfire occurrences (e.g., Austin [City of Austin, 2023, p. 2], San Francisco [San Francisco Department of Public Health & Office of Resilience and Capital Planning,

2023, p. 17], Miami [Miami-Dade County Office of Resilience & Climate and Heat Health Task Force, 2022, p. 5]). Heat Risks described the impacts of heat on infrastructure, ecosystems, human health, economic stability, agriculture, and vulnerable communities (e.g., Washington DC [Government of the District of Columbia & DOEE, 2022, p. 8], Clarksville [Town of Clarksville, 2022, p. 8], Rajasthan [Government of Rajasthan et al., 2017, p. 22]). Heat Projection Data provided forward-looking estimates for heatwave frequency, intensity, and duration, including modeled future maximum and minimum temperatures (e.g., Mesa [NCSP, 2023, p. 3], Seattle [Seattle and King County Public Health Department, 2024, p. 5], Thane [TMC & CEEW, 2024, p. 10]). Finally, Supplementary Maps offered spatial visualizations of mortality locations, land cover, rooftop characteristics, tree canopy, cooling center access, equity scores, and fire department densities.

Fact-based Information

Total: 856 codes

Categories	Heat Vulnerability	Heat Health Surveillance	Ongoing/Previous Heat Actions	Heat Severity Data
Code Count	190	121	114	107
Sub-categories	- Income, race-ethnicity, age - Outdoor workers/athletes - Immigrants - Homelessness - Housing quality - Air conditioning accessibility - Poor air quality - Poor urban infrastructure - Social isolation	- Heat-related morbidity - Heat-related hospitalization - Heat-related ER visits - Health issues - Heat exhaustion	- Tree canopy cover/greening/vertical greening - Potential sites for cool roofs - Potential bus shelters - Cooling centers/hydration centers - Development projects - Shading initiatives - Light-colored roofs - Higher-quality building design - Energy-efficiency building requirement - Installing environmental sensors - Emergency preparedness actions/campaigns - Cool corridors	- Daytime/nighttime air temperature - Heat event duration - Heat in summer - LST - Mean daytime LST - Thermal imagery - Thermal comfort - NDVI - Precipitation - Heat severity - Urban heat vulnerability

Categories	Historical Heat Data	Heat Risks	Heat Projection Data	Supplementary Maps
Code Count	106	79	78	42
Sub-categories	- Days with over X degrees - Average annual temperature - Average minimum temperature - Environmental hazards - Number of warmer nights - Global average LST - Wildfires	Impact on - Built infrastructure - Ecosystem - Health and safety - Economic prosperity and energy cost -Agriculture -Wildfire -Air pollution -Vulnerable communities -Quality of life -Education	- Daily maximum average temperature - Days above X degrees - Occurrence/frequency of heatwaves/extreme heat - Heat index over X - Fatalities - Duration of heatwaves - Average summertime maximum temperature - Annual average temperature of the city	- Heat-related mortality location - Land cover map - Dark/light rooftops - Median income - Tree canopy - Cooling center accessibility - Tree equity score - Heat vulnerability map - Fire department call density

Figure 1-5: Heat action plans Fact-based Information

Strategies

HAPs outlined a wide range of strategies, or actions to advance heat goals. We based our strategy analysis on the framework developed by Keith and Meerow (2022), which divides strategies into heat mitigation and heat management categories. Through inductive analysis, we added a third overarching category, heat governance strategies. Overall, most strategies were classified as heat management strategies (1,520 strategies), compared to heat mitigation (444 strategies) or heat governance (549 strategies) (Figure 1-6).

Strategies — Total: 2,513 codes

Heat Mitigation

Categories	Urban Design	Urban Greening	Waste Heat	Land Use
Code Count	176	171	50	28
Sub-categories	- Urban development: renewals and new developments - Shades in public places - Building design standards/cooling guidelines - Park/public space design - Parking lot - Bus shelters - Cool pavement - Transportation / cooling corridors	- Tree canopy increase/forestation/street trees - Water features/natural water accessibility - Cooling pathways and mobility - Tree maintenance and preservation - Parks - Vacant lot development - Stormwater management - Green roof - Green buildings	- Cool roofs - Building's standards and insulation - Transportation efficiency - Urban structure	- Cooling streets/corridors - Land conservation - Long-term zoning strategies - Maintain/create open spaces -Reduce landfills and waste segregation

Heat Management

Categories	Emergency Preparedness	Heat Education	Personal Exposure	Public Health	Energy	Occupational Safety Regulation
Code Count	464	394	182	145	136	114
Sub-categories	- Cooling center/shelter - Communication technology/method - Resource coordination/ accessibility - Heat alert system - Emergency transportation - Weather-monitoring/heatwave -prediction systems	- Increase awareness/outreach - Create educational program - Create information material - Training employees/practitioners	- Homeless population - Student/school - Vulnerable neighborhood/population - Assisted living/nursing home - Outdoor activities/sport - Livestock/pet - Pedestrian/commuter	- Drinking water accessibility - Heat morbidity/health - Medicine accessibility - Healthcare accessibility - Hospital staffing - Health check-in/monitoring	- Air conditioning/ ventilation - Resilient energy grid - Maintain/backup power - Weatherization - Utility assistance - Electricity cost - Energy efficiency - Cooling center energy - Renewable energy	- Raising awareness among workers - Accessible data for everyone - Workplace protection/safety - Unemployment insurance - Flexible working hours - Accessible resource for outside workers

Heat Governance

Categories	Internal & External Collaboration	Research/ Innovation	Leadership	Program/initiative Development	Policy/Plan Development	Funding/ Resource Allocation	Community Engagement
Code Count	148	124	94	75	50	41	37
Sub-categories	- Expanding internal partnership/ collaboration - Expanding external partnership/collaboration - Improve internal/external communication	- Develop research - Data collection/ mapping - Data analysis - Vulnerability/risk assessment - Monitoring/ measuring heat severity - Create dashboard/toolkits	- Leadership/ supervision - Identifying administrative barriers - Dedicated officials and roles - Implementation of policies/monitoring implementations	-Strengthening/ creating heat mitigation/ management programs and initiatives - Foster heat resilience	- Policy/strategy development - Plan development - Plan review/update - Future scenario planning	- Identify funding/financing - Manage resource allocation	- Improve communication with communities - Community engagement - Support grassroots activities/ empower communities

Figure 1-6: Heat action plans Strategies

Heat Mitigation strategies encompassed four major categories: Urban Design (n=176), Urban Greening (n=171), Waste Heat (n=50), and Land Use (n=28). Urban Design strategies emphasized physical interventions in the built environment, such as urban redevelopment, shade provision in public

areas, park and public space design, bus shelters, cool pavements, and the integration of transportation and cooling corridors. For instance, Darwin's HAP included a strategy as: "Increase shade by encouraging the installation of permanent and temporary shade structures in Darwin" (City of Darwin, 2021, p. 20).

Urban Greening prioritized increasing tree canopy cover, forestation, and street tree coverage, alongside improved water accessibility, mobility integration, and the preservation of green and vacant land. For example, the City of Thane highlighted urban greening through: "Improve green cover through plantation to enhance water ponds, fountains, and increase green parks" (TMC & CEEW, 2024, p. 47).

Waste Heat strategies focused on reducing heat gain through cool roof installations, improved building insulation standards, and urban transportation efficiency. For example: "Incentives and regulations based on efficiency may encourage developers and property owners to pursue clean energy systems, implement passive cooling measures, and utilize heat-mitigating solutions such as green or reflective roofs which improve indoor conditions on hot days." (CAPA Strategies, 2024, p. 16).

Land Use measures included cooling streets and corridors, land conservation planning, long-term zoning strategies, and reducing landfills through open space maintenance. For instance: "Reforming existing building and land use regulations in the city and cantonment areas to incentivize green urbanization" (Karachi Commissioner Office et al., 2018, p. 41).

HAPs most often focused on heat management strategies, with six high-frequency categories: Emergency Preparedness (n=464), Heat Education (n=394), Personal Exposure (n=182), Public Health (n=145), Energy (n=136), and Occupational Safety Regulation (n=114) (Figure 6). Emergency Preparedness involved establishing cooling centers and shelters, improving communication technologies, coordinating resources, providing emergency transportation, and developing weather and heatwave monitoring systems. For instance, one of the Hunting Park strategies included piloting a system for alerting and checking in on vulnerable residents during extreme heat events (Philadelphia Office of Sustainability, 2019, p. 33), while one of Surrey's strategies included assessing and validating a list of public facilities that could be used as heat refuges (Surrey Emergency Program, 2024, p. 8).

Heat Education sought to increase awareness through outreach, educational programming, informational materials, and professional training. For example, the City of Ahmedabad proposed to: "Conduct training workshops and outreach sessions with community groups and mobilizers" (Ahmedabad Municipal Corporation et al., 2019, p. 17).

Following Keith and Meerow (2022), we originally included these strategies under the Public Health category, but plans discussed these strategies to increase public awareness about heat risks so often that we decided to highlight them as a separate strategy category.

Personal Exposure reduction targeted vulnerable groups such as homeless populations, students, and assisted-living residents, along with outdoor activity modifications and protection for animals/livestock. For instance, one of Milwaukee's strategies included: "Advise all sponsors of outdoor special events scheduled during the forecast period to consider modifications of activities in light of possible heat" (Milwaukee Heat Task Force & City of Milwaukee Health Department, 2011, p. 4).

While it is true that occupational safety regulations are a type of personal exposure reduction strategy as suggested by Keith and Meerow (2022), these were so often mentioned in the plans that we separated Occupational Safety Regulation into its own strategy category. Plans emphasized workplace protections, flexible working hours,

accessible resources for outdoor workers, and unemployment mitigation during extreme heat. For example, Vienna's HAP proposed "Shady outdoor workplaces in parks" (Vienna City Administration & Climate Matters, 2022, p. 28) while Miami HAP included "Implement Heat Safety Measures for Construction Workers (Miami-Dade County Office of Resilience & Climate and Heat Health Task Force, 2022, p. 12).

Public Health interventions addressed hydration, healthcare accessibility, hospital staffing, and home-based patient monitoring. For example: "Increase the efforts to distribute the fresh drinking water to the public, expansion of potable water access during heat alert at religious places including temples and mosques etc., last heat affected areas, pouch handouts to the poor, high risk areas." (Government of Rajasthan et al., 2017, p. 25).

Energy strategies focused on improving air conditioning and ventilation, maintaining resilient energy grids, weatherization, utility assistance, and renewable energy adoption. For instance, Washington DC proposed "Expanded Cooling Assistance" (Government of the District of Columbia & District Department of Energy and Environment (DOEE), 2022, p. 26) and Thane proposed to "Promote the use of renewable energy such as solar energy for cooling and electricity needs" (TMC & CEEW, 2024, p. 48).

Heat governance approaches were divided into five categories: Internal and External Collaboration (n=148), Research/Innovation (n=124), Leadership (n=94), Program/Initiative Development (n=75), Policy/Plan Development (n=50), Funding/Resource Allocation (41), and Community Engagement (n=37). Research/Innovation involved developing research and data collection systems (e.g., "Standardize the collection and dissemination of data necessary to support the development of green infrastructure that reduces urban heat islands. Data collection should emphasize connecting green infrastructure to health benefits." [San Francisco Department of Public Health & Office of Resilience and Capital Planning, 2023, p. 31]), conducting vulnerability and risk assessments (e.g., "develop a city-wide heat vulnerability index to support decision-making." [City of Austin, 2024, p. 14]), and monitoring and measuring heat severity (e.g., "Monitor and increase the heat alert level when necessary to match the severity of the forecast and threshold established, and have the Commissioner convene a special meeting with key agency leaders." [Karachi Commissioner Office et al., 2018, p. 29]). This category also included creating dashboards and toolkits to synthesize and communicate findings in accessible ways. For example, the City of Austin emphasized "Establish a heat dashboard to understand the impacts of heat interventions and programming" (City of Austin, 2024, p. 14).

Leadership focused on clarifying responsibilities and strengthening oversight. This included assigning dedicated officials and roles (e.g., "Appoint a nodal officer to head the heat wave cell, manage coordination, and monitor all the activities of the heat wave cell." Thane), supervision (e.g., "Appointment of a senior Emergency Response Coordinator, reporting to the Commissioner, to oversee implementation of the Plan, learning and improvement" [Karachi Commissioner Office et al., 2018, p. x]), identifying administrative barriers (e.g., "Reconcile Administrative Barriers" [San Francisco Department of Public Health & Office of Resilience and Capital Planning, 2023, p. 26]), and ensuring accountability for implementation of heat-related policies and programs.

Two examples of this are "Action checklists to guide implementation partners in carrying out preparedness and response measures aligned with their mandates." [Karachi Commissioner Office et al., 2018, p. x] and "Monitor the HAP implementation on a daily basis during the heat wave season" [TMC & CEEW, 2024, p. 55].

Program/Initiative Development highlighted efforts to strengthen or create targeted programs that address heat mitigation and management. These initiatives were framed around resilience-building,

piloting interventions, and embedding heat considerations into broader climate adaptation planning (e.g., "Establish a Citywide Wellness Check Program" [San Francisco Department of Public Health & Office of Resilience and Capital Planning, 2023, p. 37] ; "Develop a comprehensive worker heat safety initiative" [City of Tucson, 2024, p. 22]).

Policy/Plan Development emphasized the need for formal strategies, including the drafting of new policies, updating existing plans, and integrating future scenario planning to anticipate heat risks.

For instance, Portland HAP proposed to "Develop a local heat action plan" (Oregon Metro et al., 2021, p. 22) and Scottsdale HAP recommended to "Develop a more robust and detailed plan for large scale heat disaster response through Emergency Management" (City of Scottsdale Office of Environmental Initiatives, 2023, p. 4).

Funding/Resource Allocation concentrated on identifying and securing financial resources, as well as ensuring that funding was effectively managed and sustained over time to support long-term heat resilience (e.g., "Seek grant funding opportunities to expand human services efforts and other similar citizen education and service programs" [City of Scottsdale Office of Environmental Initiatives, 2023, p. 3]).

Finally, Community Engagement recognized the importance of improving communication with communities, fostering grassroots participation, empowering communities, and support for local initiatives (e.g., "Create meaningful pathways for frontline community empowerment in local heat adaptation policymaking" [Abdelatty et al., 2023, p. 102]; "Engage with local communities and obtain public buy-in from the start to ensure that tree planting projects respond to their interest and needs, that trees will be welcomed and cared for, and that greening does not place an unintended burden on community members" [CAPA Strategies, 2024, p. 9]).

Managing Uncertainty, Inclusive Participation, and Coordination Across Planning Efforts

Managing uncertainty, inclusive participation in the planning process, and coordination across planning efforts are all established principles of effective climate and heat planning (Meerow & Woodruff, 2020; Keith & Meerow, 2022). We found that many HAPs touched on different aspects of these planning principles. We coded a total of 536 references to these key dimensions: Inclusive Participation (n=108), Coordination across Planning Efforts (n=412), and Managing Uncertainty (n=16).

Inclusive Participation involved Participation Techniques (n=65) such as stakeholder consultations, community visioning, organizing events, workshops, surveys, interviews, and expert panels, along with Public Participation (n=31) emphasizing direct community engagement through meetings and outreach activities.

Some of the cities that included public participation in the HAP development included Austin, Hunting Park, Karachi, Los Angeles, Mesa, Miami, and Tucson. Coordination across Planning Efforts was the most represented dimension, spanning External Coordination (n=160) with universities, city councils, NGOs, state agencies, schools, and advisory boards, Plan References (n=156) covering governance frameworks, partnerships, resilience assessments, and data accessibility, and Internal Coordination (n=91) through city departments, task forces, and resilience officers.

Managing Uncertainty, though less frequently coded, addressed critical aspects of adaptive governance, including identifying information gaps, acknowledging uncertain atmospheric conditions, and fostering adaptability in decision-making processes (Figure 1-7).

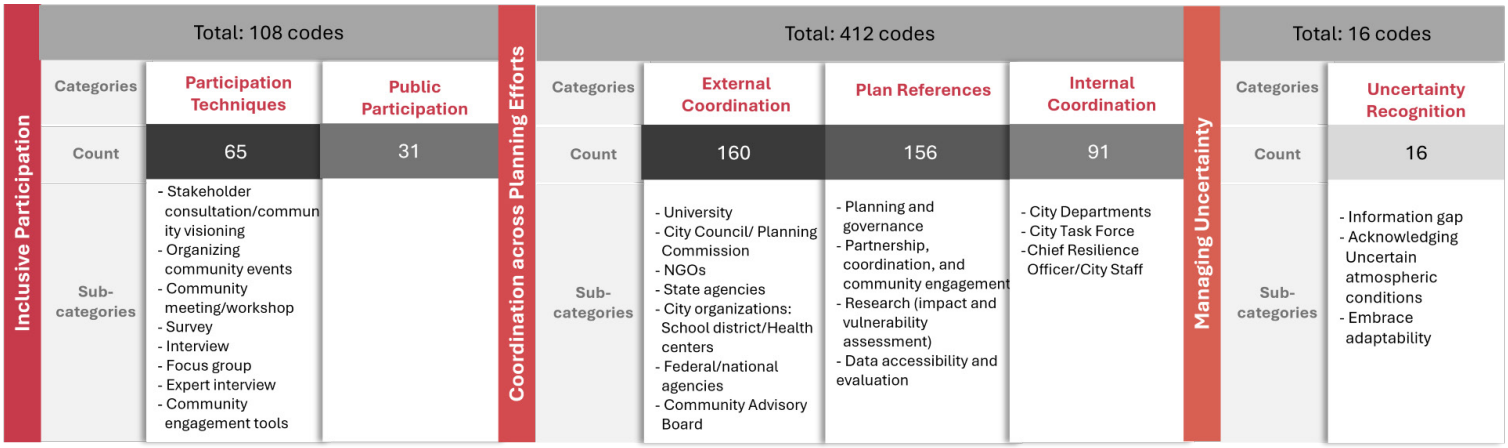


Figure 1-7: Heat action plans Managing Uncertainty, Inclusive Participation, and Coordination Across Planning Efforts

Effective Implementation, Monitoring, and Evaluation

Effective climate and heat planning requires strong implementation, monitoring, and evaluation (Meerow & Woodruff, 2020; Keith & Meerow, 2022). Our analysis showed that many HAPs addressed these principles to varying degrees. We found and coded 586 references related to Implementation, Monitoring, and Evaluation.

The findings revealed that the majority focused on Implementation Responsibility (n=357), identifying designated roles for heat committees, municipal/state officers, emergency response teams, and resilience offices. Implementation Timelines (n=89) varied from annual and ongoing schedules to action-specific deadlines, while Monitoring Plans (n=49) incorporated annual or extended reviews, short-term updates, seasonal assessments, and strategy-adjusted evaluations. Funding Sources (n=48) included municipal, state, and external funding channels, underscoring the need for sustained resource allocation.

Evaluation Metrics (n=19) assessed temperature outcomes, infrastructure improvements, reductions in waste heat, increases in cooling center/AC accessibility, water access, and the enhancement of communication/warning systems. Monitoring Responsibility (n=19) mirrored implementation roles, while Prioritized Actions (n=5) were less

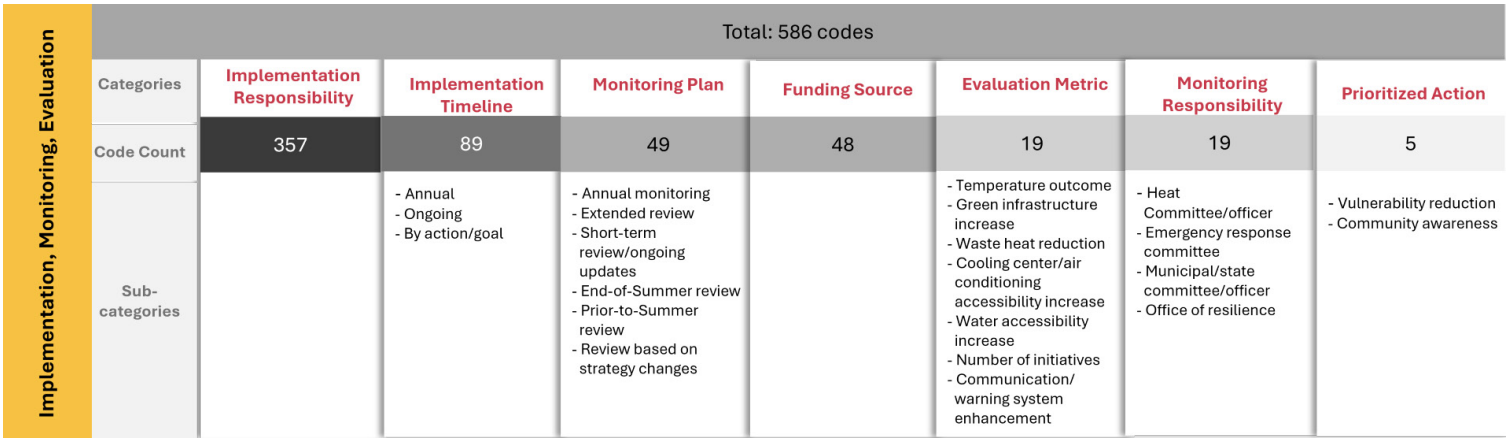


Figure 1-8: Heat action plans Effective Implementation, Monitoring, and Evaluation

common, focusing primarily on vulnerability reduction and community awareness (Figure 1-8).

Conclusion

In this phase of the study, we found that HAPs mostly prioritized heat management measures, such as emergency preparedness, public health interventions, and heat education, over long-term heat mitigation strategies.

While many plans emphasized governance-related actions, including research, innovation, policy development, leadership, and partnerships, areas such as funding, community engagement, occupational heat safety, and land-use planning remain underdeveloped. Monitoring, evaluation, and adaptive management mechanisms are also limited, with few plans including measurable targets or clear processes for assessing effectiveness.

The predominance of short-term response measures in HAP content may partly reflect the large number of heat response plans examined in this study, while mitigation actions may be addressed in other planning documents. Nevertheless, the imbalance raises concerns that cities may become increasingly reliant on recurring emergency measures without addressing the underlying drivers of urban heat. The study results also highlighted Heat Governance as an important but previously overlooked dimension of heat resilience, encompassing institutional coordination, research, funding, and stakeholder engagement.

Chapter 2
Plan Quality Evaluation for Heat Resilience

In this chapter, we evaluate and compare the quality of a geographically diverse sample of 12 subnational HAPs. We apply a previously vetted, heat-focused plan quality evaluation methodology that draws on established principles of effective planning to local HAPs for the first time, revealing common strengths and areas for improvement. The quantitative scoring approach allows for direct comparison between different plans and planning principles and complements the qualitative content analysis presented in Chapter 1.

Methodology

Plan Quality Evaluation for Heat Resilience is a systematic approach for assessing how well cities' existing plans address heat and include criteria widely believed to be important for plan effectiveness (Roy et al., 2025). The structured, two-step approach can help planners and researchers assess how effectively local plans address extreme heat. The first step, Quality Principles Evaluation, involves reviewing plan content against 56 established criteria based on seven core principles of high-quality

Table 2-1: List of evaluated plans

Jurisdiction Name	Plan Name	Year
Cities		
Ahmedabad, India	Ahmedabad Heat Action Plan: Guide to Extreme Heat Planning	2019
Cape Town, South Africa	City of Cape Town High Heat Day and Heat Wave Action Plan	2023
Dhaka, Bangladesh	Heatwave Early Action Protocol Summary Bangladesh	2023
Miami, Florida, USA	Miami Forever Climate Ready: Extreme Heat Plan	2024
Nepalgunj, Nepal	Nepalgunj Heat Action Plan	2023
Scottsdale, Arizona, USA	Identifying Strategies for a Cooler Scottsdale, Project Report	2022
Tucson, Arizona, USA	City of Tucson Heat Action Roadmap	2024
Vienna, Austria	Wiener Hitzeaktionsplan: Fur ein cooles Wein der Zukunft	2022
County		
King County, Washington, USA	King County Extreme Heat Mitigation Strategy	2024
States		
Arizona, USA	Arizona's Extreme Heat Preparedness Plan	2024
Bihar, India	Bihar Heat Action Plan	2023
Uttar Pradesh, India	Uttar Pradesh Heat Action Plan	2024

plans as proposed by Keith and Meerow (2022) building on Meerow and Woodruff (2020): goals, fact base, strategies, implementation and monitoring, public participation, coordination, and recognition of uncertainty. The second step, Heat Strategies Evaluation, examines the extent to which plans incorporate actionable strategies to mitigate and manage heat-related risks, using a heat resilience strategies framework proposed by Keith and Meerow (2022). For this project, an additional category of heat governance was added with four total strategies, bringing this evaluation step to 31 total evaluated strategies
The approach has been previously applied to a variety of plan types in diverse cities in the US and internationally and documented in peer-reviewed journal articles (Leyba et al., 2025; Meerow et al, 2024; Keith et al., 2026). A publicly available guidebook provides step-by-step instructions for conducting the evaluation (Roy et al. 2025). The guidebook is organized into three chapters: the first introduces the concept of heat resilience planning and the rationale for using plan quality evaluation; the second details the two-step evaluation process; and the third guides users in interpreting and applying results.

To evaluate the 12 HAPs, two members of the research team independently coded each plan. After evaluation, the two coders reconciled any differences to limit bias and ensure accurate evaluation results. The two-part evaluation used a binary scoring system. Included criteria from the Quality Principles Evaluation are scored +1, while those not included are scored +0. Of the 12 evaluated plans, five are from the U.S. and seven are international plans (see Table 2-1 and Figure 2-1).

Figure 2-1: Geographical distribution of identified heat action plans

Results

The results from the Quality Principles analysis show that the goals and fact base principles received the most attention throughout the 12 evaluated plans (see Table 2-2). The principles of public participation and uncertainty had the least number of criteria included, with an average inclusion of 32.1% and 17.9%, respectively. The plans of Seattle (King County) and Tucson scored the highest with 70.5% and 77.4%, respectively, while Ahmedabad (27.5%) and Dhaka (30.7%) had the most room for improvement in terms of the Quality Principles. All evaluated plans recognized heat as a hazard and included specific heat strategies, whereas no plans mentioned the cost of inaction or scenario planning.

Table 2-2: Quality Principle Inclusion for all evaluated plans

Principle	Criteria Count	Ahmedabad	Dhaka	Scottsdale	Uttar Pradesh	Miami	Bihar	Cape Town	Nepalgunj	Arizona	Vienna	Seattle	Tucson	P. Average
Goals	6	67%	17%	50%	83%	50%	50%	83%	67%	33%	67%	100%	100%	**63.90%**
Fact Base	12	33%	67%	58%	67%	67%	67%	58%	42%	58%	83%	83%	92%	**64.60%**
Strategy Identification	5	20%	40%	60%	20%	40%	20%	20%	20%	20%	40%	40%	40%	**31.70%**
Implementation and Monitoring	11	45%	27%	9%	36%	36%	55%	55%	55%	45%	45%	55%	82%	**45.50%**
Coordination	8	13%	50%	38%	25%	50%	50%	38%	50%	88%	63%	88%	100%	**54.20%**
Public Participation	7	0%	14%	14%	0%	0%	29%	14%	57%	57%	29%	86%	86%	**32.10%**
Uncertainty	7	14%	0%	0%	14%	14%	14%	29%	14%	14%	14%	43%	43%	**17.90%**
Plan Average	**56**	**27.50%**	**30.70%**	**32.70%**	**35.10%**	**36.80%**	**40.60%**	**42.40%**	**43.50%**	**45.10%**	**48.70%**	**70.60%**	**77.40%**	

The results from the Heat Strategies Evaluation indicate that the sampled plans focused more on heat management strategies with 63% of the criteria included, compared to heat mitigation strategies, with only 31% (see Table 2-3). Mitigation strategies focused on land use and urban design were the least represented across the evaluated plans. Despite heat governance being an emerging topic in heat planning, governance strategies scored relatively well with strategies focused on collaboration and future research being the most common. Each of the 31 heat strategies were included at least once within a plan. The most common strategies were for education and awareness and cooling centers; both being included in 11/12 plans. Ventilation corridors, building shape and massing, and building and street orientation were the least common strategies, only being included in one plan each. Across all evaluated plans, an average of 43% strategies were included per plan. It should be noted that not all strategies may be relevant to all communities, the goal here is to understand the diversity of strategies being employed.

Table 2-3: Heat Strategies Evaluation scores for all plans

Principle	Criteria	Dhaka	Cape Town	Scottsdale	Bihar	Ahmedabad	Vienna	Arizona	Nepalgunj	Uttar Pradesh	Seattle	Miami	Tucson	Category Inclusion
Heat Mitigation	Land Use	0%	0%	25%	0%	0%	25%	0%	25%	0%	75%	50%	100%	**25%**
Heat Mitigation	Urban Design	0%	0%	50%	0%	25%	25%	0%	25%	50%	25%	50%	75%	**27%**
Heat Mitigation	Urban Greening	0%	20%	20%	20%	20%	80%	0%	80%	40%	20%	80%	60%	**37%**
Heat Mitigation	Waste Heat	0%	0%	67%	0%	33%	0%	0%	67%	33%	33%	100%	100%	**36%**
Heat Mitigation		**0%**	**5%**	**40%**	**5%**	**20%**	**33%**	**0%**	**49%**	**31%**	**38%**	**70%**	**84%**	**31%**
Heat Management	Emergency Preparedness	67%	67%	0%	67%	67%	67%	100%	100%	67%	33%	100%	100%	**69%**
Heat Management	Public Health	100%	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	**92%**
Heat Management	Personal Heat Exposure	25%	25%	25%	50%	75%	50%	0%	25%	100%	75%	75%	75%	**50%**
Heat Management	Energy	0%	0%	0%	17%	0%	0%	100%	17%	33%	100%	100%	100%	**39%**
Heat Management		**48%**	**48%**	**6%**	**58%**	**60%**	**54%**	**75%**	**60%**	**75%**	**77%**	**94%**	**94%**	**63%**
Heat Governance	Governance	25%	50%	75%	25%	50%	50%	100%	50%	75%	88%	25%	88%	**58%**
Total Strategy Inclusion per Plan		**24%**	**29%**	**29%**	**31%**	**41%**	**44%**	**44%**	**54%**	**55%**	**61%**	**76%**	**89%**	

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Ahmedabad, India

The Ahmedabad Heat Action Plan (2019) was the first of the evaluated HAPs to be developed and is widely recognized as one of the first plans of its kind in the world. Despite the city's early adoption of heat governance, it scored relatively low on both the Quality Principles and Heat Strategies Evaluations. Given their role as leaders in the heat planning space, this plan was likely created without the current resources for heat governance that many of the other evaluated plans had access to.

The plan focused primarily on addressing immediate heat management concerns, including capacity building, public education, and activation of early warning systems based on temperature thresholds. The plan did not include any information on public participation and engagement. Lastly, there were a number of heat strategies included in the plan that were not captured by this evaluation, including the distribution of water to citizens, the protection of livestock and pets, and the standardization of hospital data to improve heat monitoring and strategy implementation.

Cape Town, South Africa

The City of Cape Town, South Africa developed their HAP, the High Heat Day and Heat Wave Action Plan, in 2023. The original plan outlines heat risk, plans to set up internal structures for heat management and governance, and initial heat response strategies. The Cape Town HAP scored very high in the Goals Quality Principle and presented a strong fact base of heat-related information in the plan. This plan, like all others evaluated in this study, did not present strong strategy identification in discussing costs, cost of inaction, and maladaptation.

This HAP did note that the city's planned

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mitigation efforts were not included in this plan, instead they are noted in the city's climate action plan, but since they were not included, they were not scored, which lowered the score of the plan significantly in this area. Cape Town's plan excelled in emergency preparedness, public health measures, and heat governance. The governance measures speak to the plan's internal focus, setting up structures for responsibility, future plan development, and research for upcoming plan iterations. This plan also did not include any of the four energy-related strategies, a potential opportunity for future expansion.

Dhaka, Bangladesh

The Dhaka Heatwave Early Action Protocol (2023) was developed in coordination with the IFRC. The Early Action Protocol (EAP) scored the second lowest on the Quality Principles Evaluation and the lowest on the Heat Strategies Evaluation. However, since this is an EAP rather than a comprehensive HAP, there are numerous differences between the plans that can explain the low evaluation scores. Despite not being a HAP, this plan had the most detailed budget framework of all the plans, indicating a strong investment toward future heat action. Dhaka's EAP also scored relatively well on the fact base principle (67% of criteria included). There are numerous opportunities for improvement in Dhaka however, particularly in identifying heat mitigation strategies, engaging in public participation, and acknowledging uncertainty.

Miami, Florida, USA

The Miami HAP (2024) had mixed results from the Quality Principles and Heat Strategies Evaluations. The plan scored the second lowest among U.S.-based plans and the fifth lowest overall in the Quality Principles Evaluation. This was the only U.S. plan that did not mention any of the public participation criteria, an important element for understanding the needs and priorities of the community. Despite scoring low on the Quality Principles, Miami scored the second highest overall for the Heat Strategies Evaluation. The city identified a number of both mitigation and management strategies, with each strategy category being included at least once. However, the Miami HAP only included one of four heat governance strategies, with opportunities to include more on collaboration and policy development in the future.

Nepalgunj, Nepal

Similar to the Dhaka EAP, the Nepalgunj Heat Action Plan (2023) was also developed in coordination with the IFRC. Compared with the other international plans, the Nepalgunj HAP scored the second highest for the Quality Principles and the highest for the Heat Strategies Evaluation. There was a strong commitment to public participation and engagement in the plan which made it stand out compared to other international plans. One potential improvement for future updates of this plan would be to include maps on existing and projected heat, vulnerable populations, and vegetative cover to help strengthen the fact base. Lastly, the Nepalgunj HAP included many urban greening strategies and one of four plans to include all the emergency preparedness strategies.

Scottsdale, Arizona, USA

Identifying Strategies for a Cooler Scottsdale, Project Report (2022) was developed with Arizona State University (ASU) for the City of Scottsdale and is more of a report of recommendations than a HAP. Since it is structured closer to a report than a plan, the fact base is robust and includes many qualities not identified in the plan evaluation process including a detailed land cover analysis and microclimate assessment. However, this plan scored the lowest compared to other U.S.-based plans for both evaluations. Most notably, the plan scored the lowest for implementation and monitoring across all evaluated plans with only 9% of criteria included. While this may reflect ASU's

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inability to commit to long-term implementation efforts on behalf of the city, this is a clear area for future improvement. Despite the low Quality Principles score, this plan was the only one to mention potential trade-offs for strategies. For the Heat Strategies Evaluation, this was the only plan not to include a strategy focused on heat education and awareness, the most popular strategy across all the plans.

Tucson, Arizona, USA

Tucson's Heat Action Roadmap, created in 2024, shows strong alignment with the plan quality principles and the heat strategies identified in the evaluation. This plan shines in the Coordination principle, detailing the involvement of a vast array of stakeholders in the planning process, including local, state, and federal agencies, local universities, nonprofit organizations, businesses, and elected officials. Tucson, like all other plans, has gaps in strategy identification. Tucson's HAP contains all the described strategies in land use, waste heat, emergency preparedness, public health, and energy. Tucson's lowest score is in the Urban Greening section, with missing scores for open space management and use of water features. The missing strategy for water features can likely be inferred from the arid, water-stressed climate of Southern Arizona.

Vienna, Austria

The Vienna HAP (2022) was the highest-scoring plan for the Quality Principles and the third highest for the Heat Strategies Evaluation amongst the international plans. It is important to note that the original plan was translated from German to English using Adobe Express, leaving the potential for certain criteria to be missed due to translation inaccuracies. The plan scored relatively high on the fact base, goals, and coordination principles of the Quality Principles Evaluation, while having significant room for improvement in the public participation and uncertainty principles. For the Heat Strategies Evaluation, Vienna was joint-highest for urban greening measures indicating a strong investment towards urban forestry and vegetated open spaces. Lastly, the plan did not include any energy or waste heat strategies.

Seattle, King County, Washington, USA

The King County Extreme Heat Mitigation Strategy created in 2024 contains a well-developed set of plan quality principles and details an array of very strong management strategies. This heat mitigation strategy scores very highly in the goals, fact base, coordination, and public participation principles. In particular, this plan showed exactly how the plan was created, who was involved, how the public opinion was consulted and incorporated, as well as ensuring members from high heat-vulnerability groups were engaged. With lower scores in Strategy Identification and Uncertainty, this plan has room to improve its acknowledgment and address uncertainties. Heat mitigation strategies were less emphasized generally, except for land use strategies. Additionally, Seattle scored highly in public health, personal heat exposure, energy, and governance strategies. The overall high score of this plan comes from the strategies all being heat specific and addressing all core quality principles.

Arizona, USA

The State of Arizona's Extreme Heat Preparedness Plan (2024) is led and implemented by the Arizona Department of Health Services. It is intended to provide governance and alignment across the State, with the understanding that many city and county plans work toward the same goals, which explains this plan's dedicated focus on heat management. Despite great scores in collaboration, this plan has room to grow in the Goals and Fact Base categories since it did not contain clearly marked overall goals or objectives, nor a heat risk reduction vision or heat equity goal. Given that this HAP is focused on management,

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the area this plan could improve on is personal heat exposure, with strategies like the operation of transit systems, parks, trails, and schools going unaddressed. This plan does very well with the newer governance strategies, scoring highly for its incorporation of plan development, coordination, and focus on future research needs.

Bihar, India

The Bihar Heat Action Plan (2023) was developed by the Bihar State Disaster Management Authority (BSDMA) for the state of Bihar in East India. The plan starts with a detailed fact base that maps the current heat in Bihar and includes heat-health data on previously reported heat strokes. The plan also has a detailed vulnerability assessment of the state using a Heat Vulnerability index tool for India. The Bihar HAP scored close to the middle for both the Quality Principles and Heat Strategies Evaluations. While the plan had a detailed fact base, it did not acknowledge uncertainty, identify relevant strategy components, and integrate public participation input. For the Heat Strategies Evaluation, the plan mostly focused on heat management rather than mitigation strategies, leaving opportunities for future investment in more comprehensive land use strategies.

Uttar Pradesh, India

The Uttar Pradesh Heat Action Plan (2024) is structured around the Indian state's response to heat before, during, and after an extreme heat event. The plan uses a detailed emergency early warning framework to guide strategies and coordination. Despite scoring relatively low on the Quality Principles Evaluation, the plan has a detailed fact base and goals section. The plan is one of three evaluated plans that did not include any of the public participation criteria, an area that could help ensure that future plan updates reflect the needs of the community. For the Heat Strategies Evaluation, Uttar Pradesh was the highest-scoring international plan with strong heat management and governance strategies. The plan also included numerous quality mitigation strategies including built shade and urban forestry measures.

Conclusion

The results of the Plan Quality for Heat Resilience Evaluation emphasize the importance of developing locally specific plans with a mix of mitigation, management, and governance strategies. It is important to note that the intent of the evaluation is not to check every single box, rather it is important that cities and states craft plans based on their current needs and resources to address extreme heat. The 12 evaluated plans represent a diverse group of cities and states with different plan types, geographic contexts, access to resources, and threat of extreme heat.

The Quality Principles Evaluation showed that communities have well established goals and fact bases within their plans. These components are important for situating and framing the context as to why extreme heat is a hazard communities should be planning for and identifying quality goals to equitably reduce risk. The principle for implementation and monitoring had mixed results, with most plans only including an average of 45.5% of the principle criteria. Only three plans mentioned their intent for a future plan update and only four plans included a detailed monitoring plan. This indicates that more investment is needed towards the implementation and monitoring of HAPs and that there is a less standardized way of approaching this step than for developing quality goals and fact bases.

The principles that showed the most room for improvement across the evaluated plans were uncertainty, strategy identification, and public participation. Acknowledging uncertainty is important for creating flexible and robust plans that address multiple climate scenarios and timelines.

Strategy identification refers to the additional details surrounding plan strategies like the cost, co-benefits, trade-offs, and the cost of inaction, and are important criteria for understanding how strategies work within a network of plans and are tied to resources. Lastly, public participation is crucial for addressing the needs and priorities of community voices and representative stakeholders. We believe that addressing these gaps could improve the quality of and effectiveness of HAPs.

The results from the Heat Strategies Evaluation suggest communities are more focused on heat management rather than heat mitigation. These findings align with the results from Chapter 1 on the global analysis of HAPs where communities are more focused on managing impact than mitigating risk. Despite heat governance being a new addition to this evaluation and an emerging topic, most of the plans included quality strategies focused on governing heat through collaboration, identifying funding, policy and plan development, and investment in future research.

There were also a number of heat resilience strategies included in plans that were not explicitly captured in this evaluation framework, including policies on water distribution to citizens, protection of wildlife and pets, and the standardization of data to ease future monitoring and implementation.

Several plans identified a lack of consistent, standardized data as a challenge and made strategies to improve the monitoring of heat-related injury and death data. Access to quality data is crucial for monitoring the effectiveness of HAPs and one of the key limitations that local governments face when planning for heat resilience (Archie et al., 2023).

The Plan Quality Evaluations for this group of HAPs is not a ranking nor is it a measure of the merit of the strategies themselves. Missing strategies do not inherently indicate a poor-quality plan but instead may demonstrate that different types of strategies are relevant for different communities.

Chapter 3
Interviews with Local Officials

In this chapter, we go beyond HAP content to examine how 11 of the 12 subnational plans examined in Chapter II are implemented and evaluated according to relevant local officials. We summarize insights from more interviews with key actors involved in developing the HAPs and putting them into practice. Interview questions focused on HAP goals, strategies, processes for monitoring and evaluation, resources and capacity for implementation, perceived effectiveness, and lessons learned for other cities.

Methodology

We conducted semi-structured interviews with local officials in cities or states to gain critical insights into HAP implementation strategies, the perceived HAP effectiveness, Cities' evaluation metrics for HAPs, Cities' goals and metrics, resources and capacities, and proposed recommendations for more effective HAPs (Figure 3-1). Interview questions centered on these topics.

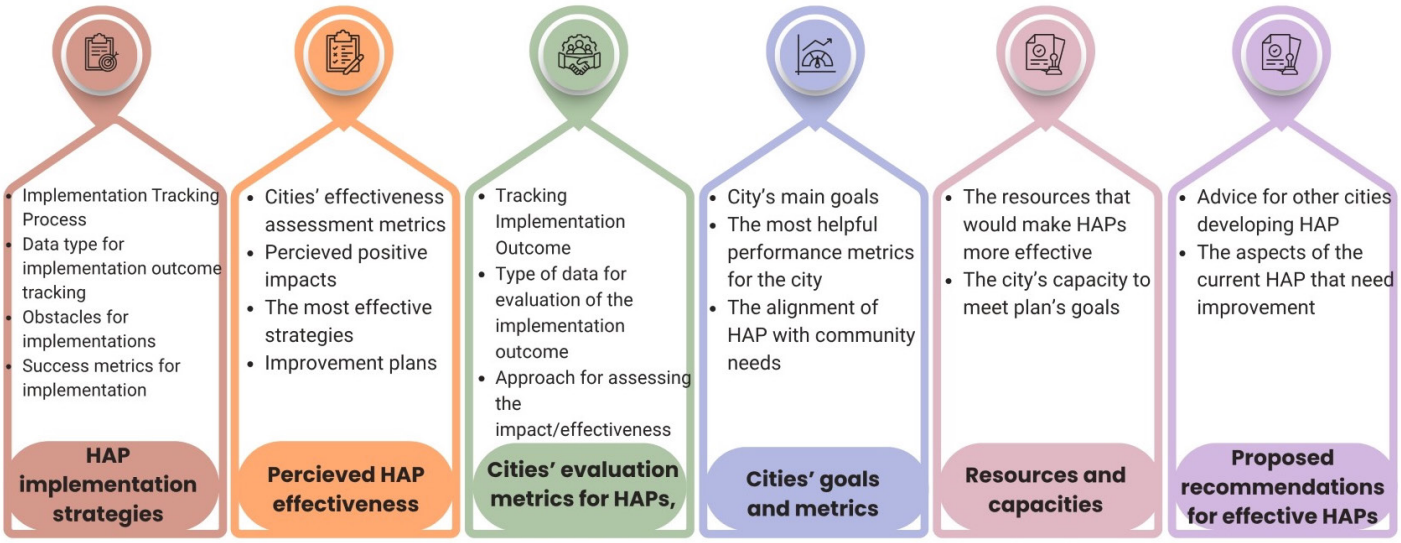

Figure 3-1: Interview outlines

The sampling strategy involved identifying city representatives who were most engaged in the development and implementation of HAPs. This was done by reviewing the plans to identify listed authors and points of contact, contacting them via email, and conducting interviews. Additional participants were identified through snowball sampling, whereby interviewees recommended other individuals involved in the process. We were also connected with several city representatives through Red Cross networks. Interviews were conducted either online or in person. In-person interviews took place in Vienna, King County, Cape Town, Tucson, and with representatives from the State of Arizona. While we assessed Bihar, India's state plan in Phase II we were not able to schedule an interview with local officials during the project timeline, meaning we focus on 11 of the 12 subnational plans.

Following the interviews with city representatives, we created an outline for each city based on the interview themes and sections (see Figure 3-1). In the subsequent phase of analysis, we examined each section across all cities and synthesized the findings by identifying common themes and key insights that emerged from the interviews. Table 3-1 shows the cities and states interviewed by our team members for this project.

Table 3-1. Cities, counties, and states interviewed

Cities and Counties	States
Ahmedabad, India	Arizona, United States
Cape Town, South Africa	Uttar Pradesh, India
Dhaka, Bangladesh	
Miami, Miami-Dade County, Florida, United States	
Nepalgunj, Nepal	
Scottsdale, Arizona, United States	
Seattle, King County, Washington, United States	
Tucson, Arizona, United States	
Vienna, Austria	

Results

Governance Structure

Each city interviewed has different methods of implementation and varying levels of tracking implementation of strategies. Two critical components of effective governance for HAP implementation are clear and stable leadership and goals as well as support from partnering government agencies and external organizations.

Some plans are implemented by a central agency, but most are implemented by many different governmental departments and partners, including NGOs, non-profit organizations, think tanks, etc. These coordinating agencies vary from offices within a general municipal government to specialized offices of climate and environment, public health, and emergency management. In Vienna, the HAP is coordinated by a "steering committee" but implemented by many different departments and partners, such as the Urban Innovation Vienna think tank. Similarly, King County, Washington and Miami-Dade County, Florida have county offices that coordinate and support efforts that are implemented by individual city governments. This includes meetings with implementing agencies to provide technical assistance or help meet other needs.

Implementation of Tucson's HAP is coordinated and mostly centralized, with strategies and programs flowing out of a small team within the city government. A strategic unit (Office of the Mayor) oversees coordination, implementation and monitoring of the HAP, led by a Chief Resilience Officer. They are supported by various city, county, community, and research entities that provide on-the-ground labor, oversight, and other assistance.

On the other hand, several cities have a single office to implement the plan, such as Scottsdale, Arizona. In India, Ahmedabad's and Uttar Pradesh's HAPs are implemented by a single appointed municipal officer with assistance from various governmental agencies and NGOs. In these cases, interviewees stressed the importance of continuity in these positions over time. However,

the Indian Institute of Public Health, the National Resource Defense Council (NRDC), and the Red Cross and Red Cresent assist with governance and implementation in India, Nepal and Bangladesh.

Most cities are not required by higher levels of government to implement HAPs, which can sometimes be an obstacle to implementation. King County, Vienna, and Miami-Dade all coordinate their HAPs but lack the power to control all implementing actors. For example, King County can support local governments when implementing strategies but cannot require them to do so.

Goals

The interviewees generally articulated the need for HAPs to be aligned with economic development goals, cultural needs, and a broader regulatory framework to support actions.

- Vienna's HAP aligns with broader strategic goals of protecting quality of life and enhancing resilience (Vienna City Administration & Climate Matters, 2022, p. 34).
- Scottsdale and King County's plans fit into sustainability goals and goals for community greening, decarbonization, and resilience (Hondula et al., 2022, p. 4; Seattle and King County Public Health Department, 2024, p. 14).
- Miami's HAP mission is "to reduce the health and economic impacts of increasing extreme heat and create a baseline for further research and new partnerships around this issue" (Miami Office of Resilience and Sustainability & Office of the City Manager, 2025, p. 2).

The most often mentioned and frequently emphasized goal, however, was equity. All interviews discussed a focus on addressing heat impacts for vulnerable populations and people disproportionately impacted by extreme heat. However, equity is approached differently for each city:

- Vienna's HAP reflects community needs by focusing on vulnerable populations, though reaching these groups remains challenging due to social and communication barriers (Vienna City Administration & Climate Matters, 2022, p. 16).
- Every action in Miami's HAP is focused on geographies (zip codes) with the highest amount of heat-related emergency department visits. Messaging is also targeted to specific vulnerable demographics (pregnant people, elderly, summer camps, and outdoor workers) (Miami Office of Resilience and Sustainability & Office of the City Manager, 2025, p. 6). In this regard, implementation of the plan is highly targeted towards vulnerable groups.
- Scottsdale centers community engagement within their extreme heat mitigation strategies (Hondula et al., 2022, p. 72). In April 2024, the city held a cross-department event delivered in both English and Spanish language: Community Conversations and Solutions to Urban Heat. The city held community discussions in the disproportionately impacted neighborhoods to co-develop extreme heat solutions.
- King County conducted a heat vulnerability assessment to identify the populations which are more vulnerable to extreme heat (Seattle and King County Public Health Department, 2024, p. 26).
- The HAPs in Dhaka and Nepalgunj align with the cities' goals to support the most vulnerable populations (IFRC, 2023, p. 2; Nepalgunj Sub-Metropolitan City Office of Municipal Executive et al., 2023, p. 11). Ahmedabad's plan attempts to target disproportionately vulnerable populations for heat impact reduction actions. Part of the plan's prioritization strategy is a focus on low-income populations (Ahmedabad Municipal Corporation et al., 2019, p. 2).
- The interviewee for Uttar Pradesh stressed the importance of how vulnerable groups (outdoor workers, elderly, pediatric people, pregnant people, and impoverished slumdwellers) experience disproportionate exposure and impact to extreme heat; interventions should be tailored to these groups.

Strategies

Interviewed officials discussed implemented similar strategies from the HAPs: improving awareness and issuing heat warnings, reducing neighborhood temperatures, improving residents' ability to stay cool both at home and in public, and improving social protections for vulnerable populations. Most interviews mentioned heat awareness and education, and all interviews discussed the importance of cooling centers/shelters where people can go for respite from the heat. In Nepal and Bangladesh, income protection in the form of cash grants is emerging as a key strategy for helping residents stay home during heat events.

- Vienna's key strategies include cooling centers, greening initiatives, and communication campaigns (Vienna City Administration & Climate Matters, 2022, p. 33-57).
- King County's strategies include improving heat awareness, reducing the temperature of homes and neighborhoods and helping people stay cool (Seattle and King County Public Health Department, 2024, p. 96-106).
- Miami's plan is organized around three main goals supported by 19 actions: 1) inform, prepare and protect people, 2) cool homes and emergency facilities, and 3) cool neighborhoods (Miami-Dade County Office of Resilience & Climate and Heat Health Task Force, 2022, p. 2). One of their key strategies is partnering with clinics and physicians to educate people about heat related illnesses (Miami-Dade County Office of Resilience & Climate and Heat Health Task Force, 2022, p. 13).
- In Ahmedabad, the key strategies are building public awareness and community outreach, initiating an early warning system, inter-agency coordination, building capacity among health care professionals, reducing heat exposure, and promoting adaptive measures (primarily via a Cool Roof Program) (Ahmedabad Municipal Corporation et al., 2019, p. 13-21).
- The Nepalgunj HAP has three main strategies: heat alerts, awareness generation, and activation of cooling centers and drinking water access points (Nepalgunj Sub-Metropolitan City Office of Municipal Executive et al., 2023, p. 7-17).
- Bangladesh's five main strategies include awareness generation campaigns and heat warnings, water distribution, cash grants, cooling stations, and ambulance support (IFRC, 2023, p. 11-12). And finally, Uttar Pradesh employs cooling centers, water access points, fans, and cool roofs (Uttar Pradesh Disaster Management Authority, 2024, ch. 5).
- An important piece of Tucson's HAP implementation is their urban forestry initiative, which comes with a tree protection ordinance (City of Tucson, 2024, p. 37).
- In the State of Arizona, a large win for data availability is the real-time data dashboard. The heat-related illness dashboard is updated 3 times a week during the heat season to provide transparent data to those who need it most (Office of the Governor Katie Hobbs, 2024, p. 10).

Resources and Needs

According to the interviewed cities, the primary barriers for HAP implementation include limited funding, staff capacity, data, and regulatory authority. We discuss each of these in more detail below:

Funding: This includes funding to implement actions as well as tracking public health and temperature data. The ability to disperse funding is also a barrier. In King County, it is challenging to deploy funding to different jurisdictions and Vienna is burdened by bureaucratic complexity.

Data accessibility to effectively evaluate actions: While in some cities, the data is collected but not specific enough or not easily accessible due to incompatible data systems or policies (Vienna, Miami-Dade County, and King County), other cities lack any formal process for collecting healthcare data. This makes healthcare data unreliable. This is exacerbated by the lack of standardized heat-health coding, when heat exposure health impacts are not always identified as such.

Administrative and regulatory challenges: Vienna is constrained by the administrative complexity of

coordinating across many departments. They also discussed the lack of a strong regulatory mandate as a limiting factor. Scottsdale is contending with shifting federal policies that have significantly reduced local support for heat action. For example, the city recently repealed their previously adopted sustainability plan. King County provides a supportive and planning role for other agencies and local jurisdictions like Seattle, rather than a direct implementation role, which reduces their capacity for direct implementation and especially evaluation. Ahmedabad highlighted government authority as an issue: Some local governments issue orders to stop all work on extreme heat days. However, it is unclear whether these rules are being followed or not.

Staffing capacity or expertise: In Vienna, Miami-Dade County, King County, and Ahmedabad a reduced staff capacity is tied to evaluation limitations because it leads to de-prioritization of evaluation and limits the expertise and manpower needed to study the effectiveness of individual actions. There are many resources available to cities for HAP development and implementation. Scottsdale partners with many of the county's public health and environmental departments to collect data and implement strategies. King County received a FEMA Grant for Building Resilient Infrastructure and Communities (BRIC) to develop their plan. Cities in India, Bangladesh and Nepal coordinate with the Red Crescent Society and NGOs such as the NRDC.

Recommendations for More Effective Heat Action Plans

Aside from improving resources, each city had recommendations for improving HAPs that fell into a few broad categories: improving institutional action and support, integrating actions with other plans, and improving evaluation methods.

Institutionalization: A common theme expressed during interviews was the importance of stable and strong institutional support.

- Vienna stressed the need for stronger legal frameworks and integration into binding policy instruments to create mandated actions.
- Miami-Dade County suggested that broader support from policy makers could improve implementation.
- Scottsdale suggested that changing political landscapes and priorities inhibited planning
- In India, a stronger national mandate for public health programs would improve resource accessibility and implementation.

Coordination: HAPs need to have coordinated and designated responsibilities.

- In Vienna, the HAP is coordinated by a specific person within the Department for Climate Affairs, a cross-cutting "strategic unit for climate governance. Then, the HAP assigns responsibility for "strategic coordination" of each action to a particular agency or organization.
- Scottsdale suggested having an implementation timeline, which would be helpful for the city to prioritize actions. In India, the lack of a national legal mandate for heat action planning reduces effectiveness. Structured guidelines with top-down approach from the national government could help improve implementation and funding. Additionally, an office for environmental and occupational health could strengthen climate and heat regulations and planning, especially for outdoor workers.
- Ahmedabad's HAP is coordinated through the Nodal Officer. Having a consistent appointed official with explicit responsibility for implementing the HAP is ideal.

Integration. Specifically, integrating heat action into other plans to improve effectiveness.

- Vienna's HAP is integrated into the city's network of plans, including the Smart Climate City Strategy (Vienna City Administration & Climate Matters, 2022, p. 5).
- Scottsdale's HAP was originally integrated with the city's Sustainability Plan which was subsequently unadopted due to a shifting

political landscape (Hondula et al., 2022, p. 73). They suggested that plans should be coordinated but independent.
- Ahmedabad suggested coordinating heat strategies with long-term land use plans to make more vacant land available for effective greening strategies.
- Dhaka suggested that an analysis of urban systems (like power and water supply) and their capacity to absorb shock during heat waves could help cities create targeted urban planning approaches to build resilience. This could be done by integrating heat action into capital improvement programming.

Other recommendations on how to collect and use data:

- A universal recommendation is that evaluation metrics and methods need to balance rigor and resource intensity. Both qualitative and quantitative data can be resource-intensive to collect and assess and should not be overly burdensome to the agencies.
- King County, Dhaka, Nepalgunj, Ahmedabad, and Uttar Pradesh are interested in compiling more detailed implementation and impact data. Ahmedabad proposed developing an effective health surveillance system to collect reliable data.
- Miami-Dade County also suggested that improving tracking and evaluation efforts by counties and local governments is critical for communicating programmatic needs. It would help demonstrate to decision makers how investments translate into health outcomes and benefits to the community. Specifically, data to support cost-benefit analysis by decision makers could be useful.

Existing Processes for Monitoring and Evaluating Heat Action Plan Implementation

While all interviews indicated a need to track and monitor HAP implementation better, half of the cities currently have formal processes for monitoring and evaluating strategy implementation. In Vienna, King County, Miami-Dade County, and Ahmedabad, the coordinating agencies conduct annual reviews of each plan's implementation. However, these reviews mostly assess the extent to which actions are implemented, not the impact or how effective they are.

- Vienna's approach combines questionnaires, workshops, and various levels of review with a 'traffic-light' assessment system, where measures are assessed in terms of their implementation and effectiveness as green, yellow, or red, with green being fully implemented or highly effective, red not implemented or effective, and yellow in between or partially implemented or effective. Organizations responsible for each action are sent the questionnaire asking about implementation and effectiveness, including the "performance indicators" for that action outlined in the plan, which are used to create the traffic light assessment. The results are compiled and shared with partner organizations. Together they discuss the results and propose new strategies and measures that will inform the updating of the plan, making it a living document.
- King County lacks the capacity to fully track actions conducted by the 39 local jurisdictions within the County but tracks the implementation of any actions done by county departments. The lead staff person conducts annual check-ins with these county departments and fills out a robust check-in form. The interviews allow the County to identify progress made and any resource or funding needs for implementation during the next budget cycle. The strategy implementation check-in forms include details on targets, work progress, successes, challenges, needs, and performance measures.
- Miami-Dade County's approach is to develop annual progress reports on specific ways that the plan's actions have been implemented and next steps in implementation.
- In the State of Arizona, the current strategy follows an annual review that captures successes, challenges, and unmet needs. The internal evaluation of progress is critical at this

evaluation lacks a defined methodology and is not currently available to the public.
- In the State of Arizona, data used for evaluation is both quantitative and qualitative, focuses mostly on implementation and outcomes rather than effectiveness. Based on the interviews, a major advancement for data availability has been the development of a real-time data dashboard. The heat-related illness dashboard is updated three times a week during the heat season to provide transparent data to those who need it most. The interviewee expressed the desire for integration of economic impact data, but expressed concern on missing data, or incomplete data, and therefore noted that they are not including this metric until a "more holistically complete" product is available. The State is also collecting data qualitatively through partner/stakeholder surveys and listening sessions, providing insights on community sentiment and needs.
- Ahmedabad also hosts annual meetings with key agencies and stakeholders to discuss actions that have been implemented, actions that have not been implemented, the associated challenges and roadblocks that prevented implementation, and actions identified for future years.
- Based on the interviews with Ahmedabad representatives, the Indian Institute of Public Health (IIPH) and NRDC recommendations for implementation and monitoring included conducting an annual evaluation of HAPs. All relevant stakeholders should participate and identify if: 1) Actions were implemented within a reasonable timeframe; 2) Populations were reached (especially vulnerable populations); 3) Resources were used or needed; and 4) If any meaningful public participation or policy changes occurred.

Other cities lack a formal process for tracking and evaluating implementation strategies. Scottsdale, Arizona claimed they were unable to track implementation due to limited funding streams from the federal government. Dhaka and Nepalgunj do not have the funding or capacity to track implementation progress. Similarly, Ahmedabad and Uttar Pradesh have experienced changes in the leadership of HAP implementation as well as uncoordinated approaches, which have created difficulties in tracking.

Outcome and health evaluations in many cities are incredibly difficult due to limited data and resources. For example, in King County, privacy issues and aggregation of data collected from different jurisdictions have impeded spatial analyses.

Therefore, success in many cities is primarily measured through implementation progress. Implementation metrics that were mentioned during interviews include:

- Number of calls to a heat hotline
- Number of training courses held and attended by community service providers, employees, etc.
- Funding secured and requested. Having a separate line item in the municipal budget for specific actions can be useful for tracking.
- Number of people reached through messaging
- Number of different platforms and methods used to reach people
- Extreme heat policies issued
- Extreme heat programs launched
- Number of partners or community-based organizations engaged
- Number of cooling facilities available
- Number of people who use cooling centers and stations
- Number of city staff that change working hours during the summer months
- Amount of funds distributed to households via cash grants
- Number of water access points
- Number of AC units installed in homes or number of low-income units retrofitted
- Number of trees planted in low (less than 20%) tree canopy areas, and number of trees overall
- Number of languages and formats in which heat resilience curricula and education materials are available

- Number of homes improved with a cool roof program
- Which geographies have been targeted (unhoused and vulnerable populations)

Existing Processes for Evaluating Heat Action Plan Effectiveness

Most cities claimed that they lack the capacity to effectively evaluate the outcomes of their HAPs with quantitative data. This is due to several factors, most crucially, a lack of reliable heat-health data over time. Heat-related health issues are difficult to quantify because hospitalizations and medical interventions are not always identified as being heat related. If there is reliable health data, it is universally challenging to attribute it to any specific HAP actions taken.

Some of the other challenges mentioned for data on effectiveness included privacy concerns, lack of baseline data to compare with, impacts that are difficult to quantify like capacity-building or take many years to show results, and confounding variables that make it hard to determine causality of any observed changes, such as rising temperatures. Lastly, resources are simply limited for tracking effectiveness. For example, Miami-Dade County stated, “The drive is so much around showing implementation… there isn't the resources put into evaluation and tracking”

Despite these limitations, there are several methods and indicators that can be applied that were suggested by cities:

Methods

Tracking Indicators Over Time: The most obvious way to evaluate effectiveness is to measure relevant outcomes before the HAP and at various intervals after implementation to see how they change. This cannot definitively establish causation but at least indicates if outcomes are moving in the right direction.

Self-assessment: Vienna uses subjective and qualitative assessments completed by organizations charged with implementing strategies to conduct an annual evaluation of implementation and perceived effectiveness. They use a simple ‘traffic-light’ evaluation system that is easy to understand and comparable.

Pre- and post- Surveys: Miami-Dade County partnered with the Florida International University (FIU) to distribute educational materials to health clinics to keep in waiting rooms. FIU then tracked pre- and post-awareness of patients. Literature suggests that community-based surveys to determine behavioral changes and heat awareness can be effective evaluation tools (Sack et al., 2025). The interviewees in Nepalgunj also mentioned that through a survey they conducted with people, they found that, about 87% of respondents have changed their actions in response to extreme heat. In other cities without a plan, less than half of people changed their actions. Additionally, 92% of people in Nepalgunj took protective responses to extreme heat compared to 67% in Bangladesh (Climate Center, 2026 (available here)).

Cost-Benefit Analysis: An evaluation of a cost-benefit analysis, where the city can make data-informed decisions on strategic priorities and actions based on effectiveness.

Indicators

Vegetation: Miami-Dade County is planning to do a tree canopy assessment to assess changes to coverage in the areas of highest need over time. Vienna also monitors its green spaces.

Emergency Response Calls: Miami-Dade County attempts to collect data on the number of 911 calls during extreme heat events. Ahmedabad is also collecting ambulance data over time to assess effectiveness.

Heat-related Mortality: Scottsdale partners with their public health department to collect and analyze data on heat-related deaths. Epidemiological studies with all-cause mortality

data can be used if death-registration and temperature data is available and reliable. In Ahmedabad, a 2018 study estimated a 30-40% reduction of all-cause mortality on peak heat days after HAP introduction; 2,380 deaths had been avoided in the post-HAP period during a similar heat wave to the pre-HAP period (Hess, 2018). This has been done in several other studies (Palecki, Changnon & Kunkel, 2001; Delaroziere & Sanmarco, 2004; Smoyer-Tomic & Rainham, 2001). These studies should balance the need for optimal comparison populations with the collection of enough data from extreme heat events. A shorter study period will provide populations that are more similar and less likely to have been influenced by confounding variables. However, a longer study period will provide more data points from heat events.

Heat-related Morbidity: In 2022, when Miami-Dade County started their heat action campaign, they recorded the lowest rates of heat-related emergency room visits in Florida. However, this type of metric would be difficult to attribute to any specific actions. Any study of heat-related health impact data will be improved by a) collecting baseline data ahead of implementation and b) correlation with temperatures (IIPH & NRDC Recommendations).

Economic Impacts: Data on the loss of working hours can be used to assess if any action to reduce heat in the transportation and workplace sectors has been successful.

Perceived Effectiveness of Heat Action Plan Strategies

Despite a lack of quantitative study on individual HAP strategies, cities asserted that many strategies are effective. There are multiple factors that can contribute to success. In Vienna, the most effective strategies appeared to be recurring and practical measures, such as cooling centers, communication campaigns, and greening initiatives. King County staff asserted that strategies could become more effective if they are accessible, highly requested by partner agencies, and/or deliver multi-benefit solutions. In Dhaka, several components of heat action planning contribute to perceived success: effective inter-agency coordination, stakeholder coordination to tailor strategies to local and cultural practices and needs, and feasibility. Recommended strategies need to be actionable, affordable, and technically feasible.

The HAPs in Nepalgunj and Ahmedabad are highly regarded in Nepal and India respectively and have influenced national consideration of extreme heat. Promoting national policy and support is key to building effectiveness, as discussed in the "Reccomendations" section. Ahmedabad and Uttar Pradesh pointed to the need for more awareness of strategies and suggested translating and piloting new cooling technologies and other innovations in their cities. Certain strategies were recommended by cities because they were measured or perceived to have high levels of effectiveness:

Greening Initiatives: Most cities stressed the perceived long-term effectiveness of green infrastructure and urban forestry. Tree canopy improvements cool entire areas and efforts tie into existing programs. These actions are particularly effective because they are politically popular, target vulnerable geographical areas, provide health benefits aside from heat reduction, and can reduce local temperatures by up to 10 degrees F in some areas.

Heat Pump Installations: Heat pumps align with both health and decarbonization goals, ample funding exists, and they allow people to stay in their homes during extreme heat.

Heat Safety Awareness: Social media campaigns, public announcements, etc. Miami-Dade partners with local physicians' offices to set out informational pamphlets. In Nepalgunj, household visits are conducted by Red Cross volunteers to check on vulnerable residents and ensure they have access to necessary information for responding to extreme heat.

Building Codes: Building and development codes provide long term benefits.

Cash Transfers: King County distributes cash grants to local organizations to implement actions. In Dhaka, the most effective heat action strategy is cash distribution. It provides flexibility for people and is especially impactful when residents lose income due to extreme heat. However, this strategy is limited by available funding and identifying the residents with the greatest need is challenging.

Cool Kits: In King County, local partners identified the cool kits as the most effective action for them to take as it was both affordable and accessible.

Multi-Benefit Actions: This includes actions that reduce urban heat but also improve overall health, increase wellness, or reduce flooding. These may be more palatable to local agencies as they offer multiple benefits, improving their return on investment. For example, tree preservation, maintenance, and planting lowers urban heat and improves health conditions like heart disease.

Conclusion

The interview results suggested that very few cities evaluate HAP effectiveness. Additionally, interviews with local officials revealed that HAP implementation is highly context dependent, yet several common themes emerged across cities. Effective implementation relies on clear governance structures, stable leadership, collaboration across agencies and organizations, and sustained institutional support. Despite differences in administrative arrangements and local priorities, most cities emphasized protecting vulnerable populations through awareness campaigns, early warning systems, cooling infrastructure, and other measures that improve people's ability to cope with extreme heat.

A consistent finding across interviews was that limited funding, staffing capacity, data availability, and regulatory authority constrain both implementation and evaluation. While several cities have established formal processes for monitoring implementation, these efforts focus primarily on tracking whether actions have been carried out rather than assessing their effectiveness. Quantitative evaluation remains difficult because reliable heat-health data are often unavailable, health impacts are challenging to attribute to interventions, and resources for long-term monitoring are limited. As a result, cities frequently rely on implementation metrics, qualitative assessments, and perceived effectiveness to judge success.

The interviews also highlighted several lessons for strengthening HAPs. Cities emphasized the importance of institutionalizing heat governance through stronger legal frameworks, clear responsibilities, dedicated leadership, and integration with broader planning efforts. Although robust evidence on the effectiveness of individual strategies remains limited, interviewees consistently identified practical, accessible, and multi-benefit measures, such as urban greening, cooling centers, awareness campaigns, heat pumps, and cash assistance, as particularly valuable.

Chapter 4
Heat Action Plan Implementation and Effectiveness (HAPIE) Tool

In this chapter we focus on four of the cities where we evaluated HAP quality and interviewed local officials, using these case studies to develop a Heat Action Plan Implementation and Effectiveness (HAPIE) Tool. Given cities' very different heat risks, governance capacities, and data landscapes, it is not realistic to propose a universal measure of HAP effectiveness. Instead, we propose a common process that cities and partner organizations can use to identify appropriate indicators aligned with plan goals. Piloting the tool with these diverse cities makes it more generalizable.

Methodology

We selected four cities across four continents as HAPIE Tool pilot cases: Seattle (United States, North America), Vienna (Austria, Europe), Cape Town (South Africa, Africa), and Nepalgunj (Nepal, Asia) to represent diversity in governance structure, socio-economic context, and climate zone. For each case study, we analyzed their HAP in detail and interviewed multiple key officials involved in the plan development and implementation - traveling to the cities in person for all but Nepalgunj and used the plan and interview content to populate the HAPIE Tool and identify context-specific goals, actions, and indicators.

Our completed pilot tools can be found here: http://hdl.handle.net/10150/675350

We used the pilots to refine the generalizable HAPIE Tool, which consists of a template spreadsheet that is ready for any community to fill out as part of a HAP development or evaluation process. Note that our team piloted the tool for the cities, neither the tool nor the pilot results have been used by any of the cities to evaluate or update their HAPs at this time.

HAPIE Tool Development Process

The HAPIE Tool is a simple spreadsheet that walks users through the process of clearly delineating HAP goals and actions, identifying indicators to assess each goal's implementation and effectiveness, and assigning responsibility for tracking those indicators.

The HAPIE Tool is organized around nine heat resilience strategy domains. This is because cities' heat-related goals and actions tend to cluster around a recurring set of strategies. This structure lets us compare and aggregate city-specific goals and actions within shared clusters of strategies, even when city-specific terminology differs.

We triangulated three sources to build the tool. First, we drew on PAS Report 600: Planning for Urban Heat Resilience (Keith & Meerow, 2022), which provides a typology of eight heat mitigation and management strategies: Urban Greening, Urban Design, Land Use, Waste Heat, Energy, Emergency Preparedness, Public Health, Personal Exposure. Based on the findings of the review of HAPs described in Chapter II, we added a ninth strategy category: Governance. These nine categories of strategies serve as our strategy domains. Second, we drew on the Heat Resilience Planning Framework and Workbook developed by the Center for Heat Resilient Communities (2026) to identify potential indicators within each domain.

Third, clusters of goals and actions derived from the four pilot cities supplied empirical content within each strategy domain. Within this structure, we merged functionally equivalent strategies or actions from different cities into shared strategy domains. For example, cooling center operations appeared under different headings across all four plans and were merged under Emergency Preparedness. We also preserved novel actions within the most appropriate shared domain. For example, traditional water body restoration, identified as a strategy through the pilots, was categorized within the Urban Greening strategy domain.

A strategy domain communicates a direction of interest but does not specify required observations to confirm whether an action was

implemented or effective. To operationalize each strategy domain for evaluation, we paired each domain with two components: implementation and effectiveness measures.

Implementation measures are specific, verifiable counts confirming whether contributing actions were carried out (e.g., number of trees planted, number of cooling centers open during a heat event), extracted from the actions and indicators documented in city plans. Effectiveness measures are causal outcome metrics that specify the expected change in the domain if those actions are carried out, with a defined comparison basis (e.g., ambient air temperature in areas with expanded tree canopy compared to comparable low-canopy areas during peak summer heat).

Effectiveness measures were rarely stated explicitly in the plans, but were often implied in the plans' descriptions of goals or actions. Each plan states a goal, clarifies an action, or describes a strategy with an implicit expectation of what that action should change, even without specifying how that change would be measured. We treated these stated or implied expectations as the starting point for constructing effectiveness measures using three questions: what heat resilience effect is the stated goal or action intended to produce? In what unit is that heat resilience effect measurable? And what should the basis of comparison be for attributing change in the heat resilience effect to the action?

For each strategy domain, the tool also identifies the responsible agencies. We replaced city-specific organization and agency names with generic role descriptors (e.g., public health department, emergency management authority) based on the pilots and the research team's judgment, so practitioners can apply the tool in any city without requiring familiarity with the specific institutions of the pilot cities. Figure 4-1 illustrates the HAPIE Tool development process.

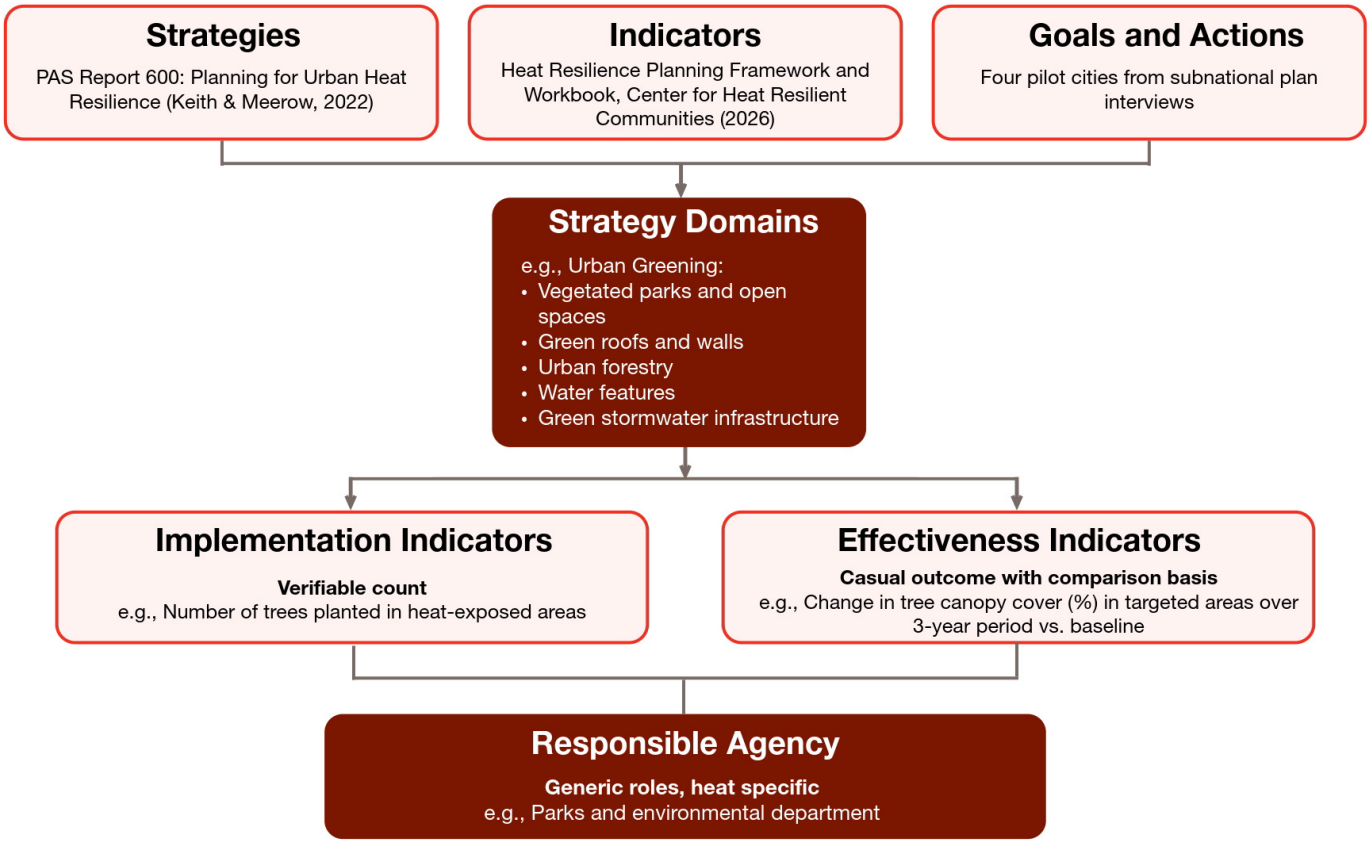

Figure 4-1: HAPIE Tool development process

Applying the Evaluation Tool to Assess the Effectiveness of HAPs

A central question for any HAP evaluation system is whether a plan's stated goals are traceable to specific, measurable implementation indicators and, ultimately, to effectiveness measures confirming whether those goals were achieved. Most of our pilot plans state goals and actions at a level of generality that does not connect to measurable outcomes. The evaluation tool addresses this through a strategy-to-indicator tracing structure. A plan is well-structured if each goal or action links to at least one implementation indicator and at least one effectiveness measure, with a defined basis for comparison. Plans that specify goals and actions but lack implementation and effectiveness measures are difficult to monitor or evaluate. Figure 4-2 illustrates how a city's planned action can be translated into generalizable strategy domains and then into trackable indicators using the HAPIE Tool. This process could be useful for developing a new HAP that can be easily monitored and evaluated or applied post-hoc to assess the effectiveness of an existing plan.

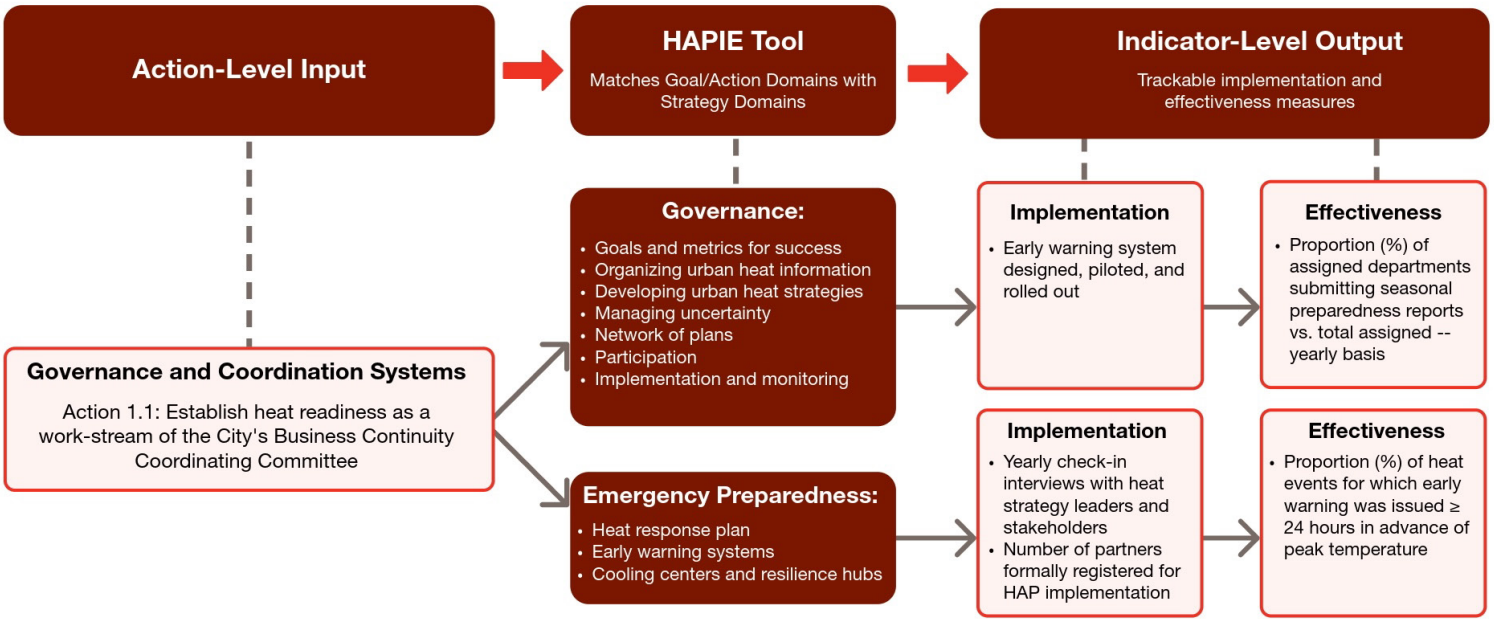

Figure 4-2: An example of how HAPIE Tool connects specific city actions to trackable indicators.

Results

HAPIE Tool Pilots

Seattle, King County, Washington, USA

King County, Washington, in collaboration with the City of Seattle, developed and published the King County Extreme Heat Mitigation Strategy in July 2024. The plan is a regional planning strategy and guidebook of 20 strategy actions for county partners and the county's 39 local jurisdictions, the largest of which is the City of Seattle. Each strategy falls under six categories, including: 1) Help people stay cool and safe indoors; 2) Help people stay cool and safe outdoors; 3) Cool our neighborhoods; 4) Design for heat; 5) Increase heat safety awareness; and 6) Support heat action.

To develop the plan, the King County Executive Climate Office and the Climate & Health Equity team coordinated with the Public Health team, community members and partners from local jurisdictions, including the City of Seattle, to conduct outreach to vulnerable and disproportionately impacted communities. The plan is rooted in geospatial analysis and data: the

County used demographic and heat island data mapping (from tree canopy and impervious services) to identify areas within the county that may experience disproportionate exposure and vulnerability to extreme heat.

I. Implementation Strategies

King County's Extreme Heat Mitigation Strategy (EHMS) is primarily overseen by the ECO and implemented by County partner agencies and organizations. Local jurisdictions are encouraged but not required to implement strategies, and the county does not monitor or evaluate local actions. However, the County does support local heat action implementation. Some of the interviewees join forums with local jurisdictions and meet with them as requested to provide technical assistance on topics such as heat-resilient local building codes. King County also hosts webinars to support and inform Community Based Organizations (CBOs) that are implementing strategies. The EHMS is meant to serve as a suggestive "guidebook" to help local partners implement various heat mitigation strategies.

While local implementation is supported, tracking and monitoring are only done for actions implemented by County agencies. Still, tracking is central to King County's heat mitigation goals:

> "King County will be the steward of the strategy, tracking implementation and working with stakeholders to leverage opportunities and partnerships, address barriers to action, and evaluate the need for future updates to the strategy" (p. 8).

However, interviewees discussed the difficulties related to tracking the progress of a regional plan. Each local jurisdiction implements actions from the plan that serve its local interests, and one interviewee stated, "we can't track all 39 cities." While monitoring is possible, it is not required and is outside of the County's jurisdiction. This makes tracking and implementation actions different from those in other heat action plans developed, implemented, and tracked by cities themselves.

In response to this difficulty, the County developed an Implementation Plan for 2024-2029 to track commitments and strategies implemented by King County and its partners. The County maintains details for each action in the Implementation Plan, including:

- Partnering with King County agencies (such as the Office of Emergency Management)
- Existing programs that can be leveraged to improve implementation
- Programs, initiatives, and policies that may impact implementation
- Implementation goals, targets, and deliverables with associated time frames
- Resource needs (e.g., training, funding, staffing, research, supplies/materials, translation services)
- Equity considerations, potential unintended consequences, and co-benefits
- Performance metrics (e.g., number of facilities and attendance during heat event)

Part of the implementation plan is strategy monitoring. This mostly takes the form of yearly check-in interviews with strategy leaders from King County agencies and update worksheets to understand progress on strategies implemented during each two-year budget cycle. Interviews for 2025 have been conducted but de-prioritized due to short staffing. The interviews allow the County to identify progress made and any resource or funding needs for implementation during the next budget cycle. The strategy implementation check-in forms include details on targets, work progress, successes, challenges, needs, and performance measures, and are discussed further in Section III.

The County is struggling to quantify (for example, the percentage of actions completed) strategy implementation and progress. This is especially true for complex actions that include many

sub-actions, some of which may be progressing while others stall.

II. Perceived Effectiveness

Interviewees discussed the challenges of tracking and monitoring the plan in a large, geographically diverse county. It is especially difficult to evaluate specific actions and correlate them with positive health outcomes due to data constraints. Although they noted several ways in which tracking is limited, they also perceived several strategies to be effective.

Health Outcomes

The County tracks heat-related illnesses but the staff capacity to track at the city level doesn't exist. Ideally, the County would track heat related health outcomes and heat actions at a finer level, but resources such as time and technical expertise are limited. The County built a publicly available dashboard to share data on heat related illnesses and inform county-wide programs and policies. Unfortunately, the County has been unable to broadly promote the dashboard, so it is not yet as popular the County would like. The dashboard provides many health metrics, including heat related illnesses by emergency room visits and 911 calls.

One interviewee discussed how the resolution of impacts is poor because data is required to be masked and aggregated to the County level. This poses a challenge to evaluate the effectiveness of specific actions implemented in different areas of the County. Ironically, as more actions are implemented and heat related health impacts are reduced, the ability to correlate health outcomes with heat actions is reduced because there are less datapoints on heat related illnesses. The interviewee expanded on this: "the more we're mitigating the health impacts, the less availability we have to spatially communicate that data on where people are being impacted... which is a good problem to have but a challenge".

Heat Mitigation Strategies

Unfortunately, the County lacks the resources or funding to continuously measure performance indicators of heat strategies such as surface temperature across the county. However, the perception of one interviewee was that several strategies are effective. These strategies are viewed to be effective depending on the perspective or local goals. Strategies can become more effective if they are accessible, highly requested by partner agencies, and/or deliver multi-benefit solutions. Strategies perceived as effective included heat pump installations, urban forestry, heat safety awareness campaigns, building and development codes, and grants to local groups.

III. Evaluation Metrics

One of the interviewees stressed that the goal of the Implementation Plan is not to fully complete each of the 20 strategies but rather to "make progress on all of the actions and the commitments that King County makes".

As mentioned before, it is too resource intensive to continuously measure heat and health outcomes and correlate them with specific mitigation actions. Therefore, the County mostly focuses on tracking implementation progress undertaken by county agencies and partners. This tracking is recorded in the check-in forms for each of the Implementation Plan's 25 actions. The forms include a section on key performance indicators (KPIs) for the partner to track, including the staff person or team responsible for tracking and the data reporting frequency.

KPIs and associated measures vary for each action and are updated annually as interviews develop understanding of action implementation. As mentioned above, performance tracking is more difficult for complex actions that require multiple steps. Examples of KPIs in check-in forms include:

Action 18 - Co-develop heat resilience trainings with community-based organizations:

- Funding available to support co-creation of climate communications with community service providers, collected annually by the communications team
- Number of CBOs engaged in development and piloting of heat resilience curricula, collected quarterly
- Number of languages and formats in which heat resilience curricula and education materials are available, collected quarterly by the communications team
- Evaluation of effectiveness of curricula from participants, collected annually
- Number of community service providers completing train-the-trainer sessions on climate specific hazards, collected quarterly (Action 18 King County Extreme Heat Mitigation Strategy Implementation Check-in Form, 2025)

Action 4 - Provide wrap-around services at public cooling centers:
- Number and cost of shelter supplies purchased and distributed to local partners
- Number of cooling location training sessions held with CBOs and other interested facilities
- Number of multilingual communication materials developed for distribution (Action 4 King County Extreme Heat Mitigation Strategy Implementation Check-in Form, 2025)

One interviewee expanded on data that is being collected for different heat action strategies. For Category #1 on staying cool indoors, KPIs include the number of CBOs engaged, program funding, and the number of activated community facilities. Category #3 strategies rely on measures of open space or tree canopy coverage from geospatial LiDAR data; however, these metrics take many years to evolve. The EHMS suggests actions to "maximize tree survival", including securing funding for and implementing monitoring of newly planted trees (p. 68). One strategy in Category #5, extreme heat training, includes both quantitative and qualitative metrics:

- Funding available
- Number of engaged CBOs
- Number of languages and formats of materials
- Evaluation of effectiveness of curricula (qualitative)
- Number of community service providers completing the training

IV. Goals & Metrics

The primary goal of the EHMS is to build regional planning to improve "heat readiness and preparedness" after the 2021 Heat Dome that led to over 30 deaths in the County. To do this, the County put forth their 20 extreme heat strategies for county agencies and local jurisdictions to implement. Heat-related illnesses are tracked at the county level and published in the County's Heat and Health Data Explorer Tool. Ideally, these data and the strategies are being used to inform local policies and programs. The EHMS aligns with other local and county goals, such as improved public health, community greening, and decarbonization.

V. Resources & Capacity

Several resources were mentioned during the interview. The County received a FEMA Grant for Building Resilient Infrastructure and Communities (BRIC) to develop the EHMS. The interviewees discussed their participation in the King County Cities Climate Collaboration (K4C). In this group, King County climate change staff collaborates with climate staff from about 27 cities to "bring together folks" to discuss climate preparedness. One of the interviewees joins these forums to support extreme heat related strategies. King County also provides support to local jurisdictions as requested.

The County provides a supportive and planning role for other agencies and local jurisdictions, rather than a direct implementation role. This complicates their capacity to meet the EHMS goals. One interviewee said that ideally, King County would have staff and funding to dole out money to local jurisdictions through grants, which would include monitoring and evaluation.

However, with the present capacity, “evaluation is secondary” to program work and action implementation. From their perspective, local jurisdictions need more academic support to conduct monitoring and evaluation that the County cannot provide.
Interviewees also discussed several resources that would support their efforts, primarily funding and staff capacity. These include:

- Funding to track public health and temperature data. Community Engagement in the EHMS findings show that local governments are interested in improving their heat data collection and monitoring efforts (p. 45).
- Staff capacity for local outreach and tracking. The primary King County staff dedicated to conducting interviews with partners is currently unable to do so because their time is being diverted to another grant. Ideally, the department would hire someone specifically dedicated to tracking local implementation efforts.
- Staff capacity and expertise to track how planning outcomes are being translated into actionable policy and being “transformed into upstream effects”.
- Understanding of how to monitor progress for complex actions with many sub-actions and represent complex performance metrics.

VI. Proposed Recommendations for Effective Heat Action Plans

A common stressed point throughout the interview is how the County is highly interested in compiling finer data on heat mitigation strategies being implemented by local jurisdictions and heat related illnesses. They simply lack the staff and funding capacity to collect it and make any correlations. County staff repeatedly mentioned that they looked forward to developing a better understand from this study of what data is needed and how it can be collected.

Lessons Learned from Seattle for the HAPIE Tool

The structure of King County's monitoring system, more than that of other pilot cities, served as a model for the generalizable HAPIE Tool template. The County's check-in forms pair each action with a named responsible party, a data source, and a reporting frequency, which we adopted for the tool. Seattle is the only pilot city with two plans simultaneously active, operating at different governance scales and time horizons. King County maintains the most granular internal tracking mechanism among the pilot cities, including annual check-in interviews with agency leads, captured in a structured format that records targets, progress, successes, challenges, and resource needs, supplemented by a publicly available heat and health data dashboard. The check-in forms themselves, however, are not published externally.

King County's interview clarification for why effectiveness tracking falls short shaped one of the tool's core designs. The interview confirms King County's limited capacity to track actions across all 39 local jurisdictions, with only county-level departmental actions monitored. This leaves the majority of local implementation invisible to the evaluation system. Masked and aggregated health data and the difficulty of quantifying actions confirm that effectiveness measures need to be built around what a city can realistically track. This finding led us to include alternative measures in the tool for situations where primary data is unavailable due to scale, aggregation, or resource constraints. For example, when illness or temperature data is not available at the level required for an action, the tool suggests using proxy measures such as service utilization rates, emergency call volumes, or self-reported outcomes, which remain trackable in the absence of ideal data.

The County also noted that evaluation is often a lower priority and that staff responsible for tracking outcomes typically balance evaluation with multiple other responsibilities. Interviews reveal that tracking gaps stem not from coordination failure but from jurisdictional design: local jurisdictions are encouraged, not required,

to implement strategies, and the County has no mandate to monitor their actions. As a result, only County agency actions are tracked, leaving the majority of local implementation invisible to the evaluation system. This finding reinforces a lesson for the tool that monitoring efforts become vulnerable when they depend on the capacity of individual staff members rather than on clearly defined institutional roles. In response, the tool incorporates responsibility assignment as a core component of its structure rather than treating it as a downstream implementation detail left to each city to figure out on its own.

King County's plans enriched several strategy domains directly, including Energy drew on heat pump installations and indoor cooling access; Urban Greening drew on tree canopy assessment via LiDAR and tree survival monitoring; Emergency Preparedness drew on cooling center wraparound services and multilingual materials; and Personal Exposure drew on cool kit distribution to unhoused residents, which county partners identified as their single most effective and accessible action. Table 4-1 illustrates how Seattle city-specific goal and action domains are split across nine HAPIE strategy domains.

Table 4-1: Mapping Seattle Goal/Action Domains to the HAPIE Tool Strategy Domains

City	City-Specific Goal/Action Domain	Equivalent HAPIE Tool Strategy Domains
Seattle	Indoor Cooling and Safety	Energy
	Outdoor Heat Safety	Personal Exposure
	Cooling Centers Operations	Emergency Preparedness
	Green Infrastructure and Heat-Resilient Built Environment	Urban Greening; Urban Design; Personal Exposure (schools)
	Heat Safety Awareness and Communication	Public Health
	Governance and Partnerships	Governance
	Heat Readiness Monitoring	Emergency Preparedness
	Heat Health Data Documentation	Public Health

HAPIE Tool Pilots

Vienna, Austria

The City of Vienna developed its HAP, the Vienna Heat Action Plan: For a cool Vienna (translated from German), in 2022, and has continued to update it through an annual evaluation process. The original plan outlines the city's heat risks and vulnerabilities, the governance approach, and details 29 measures. Most of which focus on heat management, but also focus on longer-term mitigation. The HAP is embedded within the city's extensive climate change governance and planning landscape. This includes a 2025 city climate law, a climate change coordination agency, and various plans.

I. Implementation Strategies

Implementation of Vienna's Heat Action Plan (HAP) is coordinated but also decentralized, involving multiple departments and a central coordinating unit. As one interviewee explained, climate adaptation work is "highly distributed within the city… there are a lot of city departments actually doing this stuff". A strategic unit (Office of Climate Affairs) oversees coordination, monitoring, and development of the HAP. They are supported in all their "climate agenda tasks" by a city-owned think tank, Urban

Innovation Vienna. There is a steering committee for the plan, a scientific advisory board, and then four thematic working groups ("Communication", "Education", "Health and Social Services", and "Public Space") made up of the various organizations responsible for individual actions in the plan.

The plan recognizes the importance of monitoring and evaluation. As the English version states:

> "The primary objective of the Heat Action Plan is to protect the population – especially vulnerable groups – against the impacts of heat in the city. Therefore, it is important to conduct regular reviews of the effectiveness of the measures and the communication cascade in consultation with relevant players and stakeholders and to adjust and optimize them, if necessary. The evaluation and monitoring of the Heat Action Plan continuously accompanies its implementation" (p. 52)

The process follows an annual cycle that combines questionnaires, workshops, and various levels of review by the aforementioned governance bodies. At the heart of this evaluation is a traffic-light assessment system, where measures are assessed in terms of their implementation and effectiveness as green, yellow, or red, with green being fully implemented or highly effective, red not implemented or effective, and yellow in between or partially implemented or effective. "Red, green, [or] yellow… whether it's fully implemented, whether it's in a way, or… stopped". Organizations responsible for each action are sent the questionnaire asking about implementation and effectiveness, including the "performance indicators" for that action outlined in the plan, which are used to create the traffic light assessment, which is then compiled, and the city together with Urban Innovation Vienna convenes four thematic workshops with representatives from the organizations responsible for strategic coordination and for supporting that action to discuss the results, "propose new measures," and ultimately inform the updating of the plan. In this way, the HAP becomes a "living document". The full evaluation of the plan is not made public.

The data used for evaluation is largely qualitative and focuses more on implementation rather than outcomes or effectiveness, which reflects a perceived lack of robust outcome data as one interviewee conceded, "the implementation, it's quite easy to answer, but then effectiveness is quite hard to answer.". Some of the challenges mentioned for data on effectiveness included privacy concerns, lack of baseline data to compare with, moving climate targets, impacts that are difficult to quantify like capacity-building.

All interviewees expressed doubt about the availability of local heat-health data including morbidity or mortality. One interviewee even questioned the accuracy of any heat mortality data that would be available, noting that tracking health impacts is difficult because "they're struggling… how to get the data… and how to anonymize it" and it can be difficult to determine when a death is heat related. Success in Vienna is therefore primarily measured through implementation progress and usage indicators (e.g., number of calls to a heat hotline) rather than measurable heat-health outcomes.

Interviewees agreed that most of the plan's measures were being implemented. However, at least one interviewee reflected that this could be because the actions were not ambitious enough: "most of the measures are implemented, but that's also one of the, not challenges, but maybe we are not fast enough with formulating additional measures to what we're actually already doing."

II. Perceived Effectiveness

As previously noted, the HAP's effectiveness is assessed by the city qualitatively through expert judgment rather than rigorous quantitative evaluation in Vienna. Effectiveness assessments are described as "not a scientific thing… more like… based on experience and… daily working routines and business of the people involved".

One interviewee noted that the city's formal evaluation, the 'traffic light' system, suggests a high degree of perceived effectiveness across the actions. "Overall looks pretty effective. A lot of green. I don't see a lot of red." Another gave the plan a 3.5 out of 5 in terms of its effectiveness in improving heat-health outcomes. They noted that while "it's very hard for me to say how effective one specific plan is, I do think that the network of plans …and… all of these processes raise a lot of awareness and support." On the other hand, this individual noted that some of the actions were already in place before the plan was developed, calling into question the magnitude of the plan's effect. They suggested that perhaps the plan ought to be "more ambitious" and "include measures that we're not yet able to implement, but we're working towards implementation."

In general interviewees highlighted positive impacts such as widespread implementation of measures and increased awareness of heat risks. The most effective strategies appeared to be recurring and practical measures, such as cooling centers, communication campaigns, and greening initiatives.

Key obstacles include funding constraints, coordination challenges across the departments involved in implementing the plan, limits to what is within the city's control (e.g., housing that is privately owned or national policies), and lack of strong mandates. As one interviewee stated, "we have a lot of support… but… we're lacking the concrete mandate" from political leadership in the city.

III. Evaluation Metrics

The city relies on a structured but largely qualitative evaluation process, combining questionnaires, workshops, and stakeholder input. Departments report on implementation and effectiveness annually, and results are discussed collaboratively. As described, "we send them questionnaires… then we do a pre-evaluation… and then… workshops… [to] discuss each measure".

The traffic-light system is central to this process, applied to both implementation and perceived effectiveness. However, effectiveness assessments remain subjective, as "implementation… is quite easy to answer, but… effectiveness is quite hard… it's a qualitative assessment". While some quantitative indicators exist (e.g., number of users of cooling zones), they lack baselines, making interpretation difficult: "if 10,000 people visited, can we say it was effective? … we don't really [know]". Overall, evaluation focuses more on tracking actions than measuring outcomes.

IV. Goals & Metrics

Vienna's HAP aligns with broader strategic goals of protecting quality of life, enhancing resilience, and safeguarding vulnerable populations. The HAP is embedded within a wider policy framework, where strategic plans define goals and sectoral plans like the HAP define actions. As one interviewee explained, "the heat action plan … is kind of a very specific sector strategy… [that] tells you who is responsible for implementation".

Performance metrics are most useful when they are concrete and linked to responsibilities, addressing a common issue in planning where "if you do not name anybody who [is] to do that, nothing will happen". The plan also reflects community needs by focusing on vulnerable populations, though reaching these groups remains challenging due to social and communication barriers.

All interviewees recognized that the HAP was more focused on heat management than long-term mitigation measures. As one described it, "This plan is less focused on these sorts of long-term measures, while they're included… it's more focused on these kind of emergency or social measures." Although it was noted that more recent updates to the plan expanded the mitigation section. For example, in the original plan no performance indicators are given for the

long-term measures, but this distinction has been changed in more recent updates.

V. Resources & Capacity

Vienna demonstrates strong institutional capacity, with a clear governance structure, dedicated coordination structures, and integration across sectors. However, implementation is still constrained by financial limitations and administrative complexity. For example, infrastructure-related measures can be slow because "it's… connected to funding… maybe it's not as fast as we would like it to proceed" and the city is grappling with a budget deficit.

Capacity challenges also relate to data and evaluation, as well as the complexity of coordinating across many departments. At the same time, the city's planning system shows strong long-term capacity, particularly in areas like green infrastructure, which are seen as essential for heat mitigation. As one interviewee emphasized, "green spaces are one of the most important [measures]".

VI. Proposed Recommendations for Effective Heat Action Plans

Advice for other cities included strengthening legal and coordination mechanisms and combining short-term emergency responses with long-term planning strategies. The importance of integrating spatial and social approaches was also highlighted, as effective adaptation requires addressing both infrastructure and vulnerable populations. Key areas for improvement in Vienna's HAP include better outcome data and evaluation methods and clearer success criteria. Overall, while the plan is well-integrated and widely implemented, its effectiveness might be increased with more ambitious actions and stronger outcome-based evaluation.

Institutionalizing heat action: Interviewees emphasized the need for stronger legal frameworks and integration into binding policy instruments to scale them up and ensure long-term impact. One noted that without regulatory changes, efforts to address heat or other climate challenges are mostly limited to city-owned property or pilot projects. "To really have an impact you have to go into the laws… otherwise it's always too much… city money on a few pilot projects". In fact, the city passed the Vienna Climate Act in 2025, which aims to advance mitigation and adaptation in a variety of ways.

Integrated network of plans approach: All interviewees and the plan itself recognize that Vienna's HAP is integrated into the city's network of plans. These plans have a 'nested' design, operating at different levels of specificity and serving different functions. For climate issues, the Smart Climate City Strategy outlines the strategic vision and long-term goals, the Vienna Climate Guide outlines the objectives, and the "sectoral strategies", including the city's HAP, detail the specific actions.

Assigning responsibility for coordination: The city recognized the importance of having a "coordinating unit". Vienna has the "Bereitsleitungen für Klimaangelegenheiten" or Department for Climate Affairs, a cross-cutting "strategic unit for climate governance" that is also "responsible for the coordination and the development and the monitoring process of the heat action plan". While this unit has a large staff in Vienna, the critical feature is having someone whose job it is to coordinate.

Additionally, Vienna's HAP assigns responsibility for "strategic coordination" of each action to a particular agency or organization. Interviewees thought this was important because "if you do not name anybody to do that, nothing will happen". Moreover, these organizations play a critical role in the annual evaluation process, providing feedback on implementation and effectiveness of the action.

Balancing rigor and resource requirements for HAP evaluation: There may be a tension between the need for robust indicators of effectiveness

and the resources required for responsible organizations to collect the data. One interviewee reflected on the difficulty of "trying to balance" evaluation "indicators that helps us gain reliable results without being too scientific and…too much burden and too much effort".

More broadly it was recognized that even Vienna's more qualitative evaluation process was fairly time- and resource-intensive. Not all cities likely have the capacity to administer such a process. As one interviewee put it:

> "That's a lot of investment on the city's part of, you know, obviously they're spending some time on this evaluation and monitoring which I think is impressive these green spots indicate quite a lot of work below because you got those 4 groups and these 4 groups are then responsible to. Talk to everybody within that framework and figure out if they've done it or not and then report it up and then report it up again to the to the very next level and and every year they're proposing new measures of course we're learning all the time."

Lessons Learned from Vienna for the HAPIE Tool

Vienna's core contribution to the tool is methodological. Its plan applies a standardized template to every action, including the target group, impact, responsibility, contributors, and performance indicators. The target group identifies the population an action is intended to serve, which aligns directly with the tool's need to disaggregate effectiveness measures (e.g., distinguishing older adults in care facilities from outdoor workers). The impact field classifies actions as either seasonal preparedness measures or longer-term interventions. Responsibility identifies a lead organization, and contributors list the supporting organizations, which are incorporated into the Responsible Agencies category of the tool.

The performance indicators in Vienna's plan are predominantly implementation measures, such as the number of downloads, frequency of service use, or the number of participants registered with only a few effectiveness measures, such as satisfaction with municipal services among people experiencing homelessness or feedback from target group members. However, these effectiveness measures also remain subjective, self-reported measures rather than effectiveness measures. The key lesson for the tool is to distinguish implementation measures and effectiveness measures as separate fields, because a single indicator field tends to prioritize activity tracking over outcome evaluation.

Vienna operates the most structured HAP evaluation process among the pilot cities. The process includes annual questionnaires completed by the agency responsible for each action, followed by thematic stakeholder workshops and a final traffic-light assessment of both implementation progress and perceived effectiveness. However, the interview revealed a critical need: the system evaluates activity rather than outcomes because effectiveness measures lack a defined baseline. An interviewee believed that, without a baseline, it is impossible to determine whether 10,000 visits to a cooling center represent success. This concern provided justification for the tool, which ensures that every effectiveness measure includes an explicit basis for comparison.

Vienna's plan also showed strong alignment with the HAPIE strategy domains: Urban Greening, Land Use, Public Health, and Governance, providing a particularly detailed set of implementation measures within each. For example, under Urban Greening, the plan tracks the location and suitability of new tree planting sites to maximize shade and cooling benefits or Under Public Health, it includes measures such as the number of heat-related emergency calls during heat events and the number of multilingual heat-safety materials developed with community partners. Table 4-2 illustrates how the Vienna city-specific goal and action domains are split across the nine HAPIE strategy domains.

Table 4-2: Mapping Vienna Goal/Action Domains to the HAPIE Tool Strategy Domains

City	City-Specific Goal/Action Domain	Equivalent HAPIE Tool Strategy Domains
Vienna	Communication tools	Public Health
	Training and education tools	Public Health
	Cooling infrastructure tools	Urban Greening; Urban Design; Waste Heat
	Health service response tools	Public Health
	Workplace protection tools	Personal Exposure; Waste Heat
	Service for vulnerable groups tools	Emergency Preparedness; Personal Exposure
	Planning and programs tools	Land Use; Governance

HAPIE Tool Pilots

Cape Town, South Africa

The City of Cape Town, South Africa developed their HAP, High Heat Day and Heat Wave Action Plan in 2023. The original plan outlines the threat of heat, plans to set up internal structures for heat management and governance, and the beginning of heat response, noting that mitigation efforts are covered within other plans the city has passed.

The HAP is embedded within the network of plans, including the city's Resilience Planning document passed in 2019, and their Climate Action Plan, passed in 2022. Cape Town is the second largest municipality in South Africa with a sprawling metropolitan area of differing densities, development levels, and socioeconomic characteristics.

I. Implementation Strategies

The implementation of Cape Town's HAP is coordinated by the city's Risk and Resilience Department, despite no heat mandate being part of their duties. They hired a Chief Heat Officer in 2025 to oversee the plan and heat resilience in the city. Implementation is also tasked to the Environmental Management Department, and some actions are beginning to be discussed with outside partners for development. The overall impression from the interviews was that implementation is in its "early stages" and much more "internally focused to city operations".

At the time of the interview, only a small team at the city is involved in any heat-related actions or activities. The scope of the initial plan included setting up the governing structures and evidence base for responding to heat, of which, the interviewees agree there is medium success in accomplishing.

The plan has no formal evaluation process outlined, instead section 5.3 notes that:
"A range of existing and new short-, medium-, and long-term indicators will be developed based on the objectives of the High Heat Day and Heat Wave Action Plan. The indicator set will be developed by the City's Business Continuity Co-ordinating Committee and appended to this Action Plan once completed." (p.20)

The informal evaluation of the HAP thus far has been annual reports that track implementation progress. The evaluation focuses on the completion of the action, not its impact on heat reduction or heat-related health impacts. Currently, for some of the actions that involve community outreach, there are post-intervention questionnaires that "…ask very specific

questions, related to heat. Did it impact them and ...and how, are they using what we gave them, and you know, what else would help them?"

The lack of data available for adding new actions and for evaluation is a major obstacle and a key area for improvement across all interviews. "It's impossible to get real-time weather information," said one of the interviewees, with another interviewee noting that getting heat-health data would be "complex…and very hard." Hospitals in Cape Town are a mix of provincially run and privately-run, and the healthcare and medical examiners being largely untrained in identifying heat-contributed or caused illness and mortality.

Early and informal internal evaluation has led to agreement that the heat action plan needs to be adjusted to begin to focus on external impacts. The city is also transitioning to using tools and frameworks to further guide monitoring, effectiveness, and evaluation including the new GHHIN framework and the C40 Cities Climate Leadership Group.

Most interviews also mentioned the interconnected nature of the Climate Action Plan and the Heat Action Plan, noting that initiatives and evaluations might be best done holistically to ensure all heat mitigation, management, and governance efforts are being captured, measured, and evaluated.

Progress on the heat action plan is moving steadily, with some unexpected wins, and some expected delays on some measures. The wins they're seeing include targeted communication campaigns in social media, heat risk mapping, and early cooling center deployment. "… I'd say medium success, but more success on the ground than I think we'd anticipated at this stage of implementation…". What is slowing down implementation and re-evaluation of the plan is a desire to better understand community needs and experiences.

One of the interviewees shared that "We're still in the early stages. We're still trying to figure out, what happens to people on these high heat days? … What are they doing and what maybe are they not doing."

Some of the actions that haven't been implemented include heat preparation plans, establishing heat thresholds, early warning systems, and home and building heat resilience (weatherization, efficiency, etc.). This seems to be due to the lack of funding, data, and personnel to move these initiatives forward.

Other measures lagging behind in the plan's progress are weatherization efforts and a residential home strategy, including energy audits, electrification, and weatherization.

II. Perceived Effectiveness

In its third year of implementation, the perceived effectiveness of the plan is above average despite stark challenges in public and city motivation for heat resilience work. The country has identified climate change as a threat, but heat as a disaster is relatively unexplored. Heat is not a part of the mandate that the City's constitution has laid out and is therefore struggling to find a foothold politically.

However, because of the innovation of their small, dedicated team as well as recent heat waves drawing more support, the HAP has made significant progress. When asked to rate the effectiveness of the HAP, the interviewees averaged a 3 out 5, with the lowest score being a 2 and the highest being a 3.5.

Perceived effectiveness is impacted by the inability to access data that would be able to show heat-health impacts. Two interviewees shared that their perceived effectiveness of the plan is lowered because of the lack of public resources in the city to activate as "cooling spaces". Additionally, the public resources like libraries, pools, and splash pads are still impacted by apartheid spatial planning, leaving people most in need of resources farthest away from them.

Key obstacles include lack of funding, lack of political will related to heat, and lack of data that could help refine actions and create data-informed strategies. One of the interviewees details both the unique political and fiscal landscape in which the HAP operates,

> "It becomes challenging in that you're like, okay, we want to do this, but then we've got to find a budget for it, you've got to find support for it, and you've got to make it so that it's airtight…so that when the auditing part of it is done, it all works. And so, to get people on board with that sometimes can be a bit difficult, because it's not something that's easily understood. As [my colleague] says, local government is quite new to [the people of South Africa]".

The perception of the HAP's effectiveness outside of city employees is that it has been incredibly slow progress, with one interviewee saying, "Personally, I haven't seen anything, haven't tangible yet". Another observation was that implementation is held back by public perception of heat as low-risk and intangible compared to many challenges that take up the mental and physical plate of many residents. "It's a difficult thing because what you are talking about in South Africa primarily is housing, unemployment, access to food, poverty, inequality. So those… so how you link heat to those things is actually how you have to have the conversation. It can't be as a standalone. How does heat link to housing? How does it link to access to early childhood development?".

III. Evaluation Metrics

The City of Cape Town is monitoring the completion of their HAP, but is not collecting data to prove impact, since the actions are focused on governance, communication, and planning. Beyond the tracking of completion of specific strategies, the city is transitioning to several initiatives that they believe would really begin "…to move the needle".

This includes their public outreach and engagement program modeled after New York's "Be a Buddy" campaign, designed to train community members as heat ambassadors for their neighborhood. Also in development is an initiative to install weather stations on city-owned property to try to get non-proprietary and real-time temperature data during the hotter months. Additionally, they want to incorporate research assistance from the University of Cape Town to create data-informed heat thresholds that they can use to consistently communicate in a heat response plan, public-facing communication, and intervention priority.

IV. Goals & Metrics

The City of Cape Town's measure of success in their HAP would generally be the idea of "mainstreaming" heat as a significant impact in the eyes of all City departments and the public. Within the city government, heat remains rather insular to the small team that are directly involved. One interviewee reflected that, "[Heat] is still very much like a… It's like a niche. We got this heat wave, and then everybody panicked and put out communication, which wasn't actually done in a very coordinated way."

One of the interviewees noted that the City of Cape Town employs 32,000 people, one of the largest employers in the area, so to have coordinated and informed champions in every department would both set an example to other large employers as well as increase public awareness and trust regarding extreme heat

Additionally, a goal shared amongst all interviewees was to better understand the conditions their community is experiencing during high heat days. "Ultimately, we need to understand what people go through," said one of the interviewees, and another interviewee reflected, "What do community members, what do residents, especially those in, kind of, more vulnerable areas. What do they actually want to see government do to support them on a high heat day?" Having community-responsive

measures that are quick to impact people in need and are defensible to the department's constitutional directives is the big-picture goal.

V. Resources & Capacity

Cape Town demonstrates strong initiative despite small personnel and fiscal capacity. Budget was brought up several times in each interview, with all participants expressing worry that since heat is not in the typical mandate for the city's directive it may not get the funding it needs to properly protect communities from heat. "There is, like, a general lack of funding and any perceived sort of diversion of funds for, like, those kinds of things are difficult. I think, um, disaster response in people's minds [is] very defendable. But investing in long term risk reduction is more difficult".

Other city employees pointed out that everyone is always worried about their budget allocation, but the funding is out there, and it comes down to "how and where to find it" and being able to "motivate appropriately" when communicating the need to other city departments.

As the team has researched cooling center deployment and all of the resources that entails, they've discovered the number of owned public spaces that could be turned into cooling centers is too low to meet the need of the city. One of the interviewees brought up an innovative way they are thinking about what a cooling center could be, "I think there's a lot of focus on the symptom and on technology, which I think is slightly short-sided. You can plant a cooling center…and in the space of 2 to 3 years…you can have a flourishing ecosystem that can provide all the benefits of a technological, uh, cooling center".

Capacity challenges also permeate the plan's implementation extent and efforts toward evaluation. All interviewees felt they were under-resourced to implement the strategies outlined in the plan. As the HAP moves away from governance and into management, resources are a top-of-mind consideration.

Cape Town, South Africa, has a unique set of circumstances for which to work from that reduces capacity to collect data and implement strategies that might work for other countries or settings. The high number of informal settlements makes gathering EMS data harder, since ambulances typically don't travel into these areas as there is no infrastructure. Since the city government was established in 1995, post-apartheid, there is a sentiment that the city has only provided services such as trash collection and water delivery. The city is generally not seen as a "blue sky cellar" where conceptions of community resilience would be co-produced and implemented.

Lessons Learned from Cape Town for the HAPIE Tool

Cape Town's plan contains no indicators and states that the indicator set will be developed and appended to the Action Plan once completed. Many of its actions focus on systems building rather than operational tracking, and the interview confirmed that heat currently has no constitutional mandate within Cape Town's city governance. Cape Town's plan is explicit that its current focus is on establishing internal structures, and interviewees described implementation as in its early stages rather than an absence of progress.

Actions such as establishing a process to consider heat readiness through Business Continuity Management Plans and establishing a Climate Change Response Community of Practice are examples of the plan actions illustrating this governance-establishment stage, which the tool now recognizes as a tracking target rather than a precondition to skip over.

The interviews also pointed out a historical condition reinforcing the need for spatially disaggregated measures. Interviewees explained that public cooling resources, libraries, pools, and splash pads, remain distributed according to

apartheid spatial planning, farthest from the people most in need of these resources. The tool treats this legacy spatial pattern as justification for prioritizing disaggregated measures over aggregate city metrics.

A related caveat is that some data sources structurally exclude Cape Town's most vulnerable population. The interview revealed that ambulances do not enter informal settlements, as the road infrastructure to support them does not exist, meaning emergency calls contain no data point for these areas at all. The tool addresses this by offering alternative measures for populations without administrative data points, treating the post-intervention questionnaires Cape Town already uses for outreach recipients as a primary data source for these populations.

Despite the absence of any stated indicators, Cape Town's planning steps were specific enough for us to propose measures. The plan populated several strategy domains directly: Emergency Preparedness drew on its early-warning system design process and business continuity integration; Personal Exposure drew on its worker heat guidelines, departmental risk assessment tool, and effectiveness measures built from its threshold-setting and exposure-mapping actions; Public Health drew on its vulnerable group identification and heat-health communication plan; and Governance drew on its heat threshold and exposure mapping work.

Table 4-3 illustrates how the Cape Town goal and action domains are split across the nine HAPIE strategy domains.

Table 4-3: Mapping Cape Town Goal/Action Domains to the HAPIE Tool Strategy Domains

City	City-Specific Goal/Action Domain	Equivalent HAPIE Tool Strategy Domains
Cape Town	Governance and Coordination Systems	Governance; Emergency Preparedness
	Heat-Health assessment	Personal Exposure; Governance
	Real-Time Monitoring and Early Warning	Emergency Preparedness
	Communication and Public Outreach	Public Health
	Cooling Infrastructure	Urban Design (water features); Emergency Preparedness (cooling centers)
	Health Sector Preparedness	Emergency Preparedness
	Worker Health, Safety and Operating Guidelines	Personal Exposure
	Critical Infrastructure Maintenance	Energy

HAPIE Tool Pilots

Nepalgunj, Nepal

The Nepalgunj Heat Action Plan 2023 was developed in coordination with the International Red Cross Society and the Nepalgunj Sub-Metropolitan City government. It was informed by a 2021 study, Identification of Heat Threshold and Heat Hotspots in Nepalgunj, Nepal which identified hot spots in the city and vulnerable groups. Note that while multiple officials were interviewed for the other three pilots, only one key official involved in Nepalgunj's plan's development could schedule a virtual interview during the study period.

I. Implementation Strategies

The Nepalgunj HAP has three main strategies: heat alerts, awareness generation, and activation of cooling centers and drinking water access points. The interviewee stated that the most successful strategies are targeted awareness campaigns (specifically one-on-one household visits and neighborhood loudspeaker announcements) and water access points, or water ATMs. Awareness generation has been implemented quite extensively. This includes awareness campaigns starting at the beginning of the heat season in vulnerable communities and schools. The campaigns utilize multiple mediums to target different demographics (social media and news videos, "miking": speakers on streets to make announcements, household visits).

Household visits are conducted by Red Cross volunteers to check on vulnerable residents and ensure they have access to necessary information for responding to extreme heat. Cooling centers are another main strategy. To fund the centers, the municipality budget contributes 75% funds and the remaining 25% is supplied by the Red Cross. There is currently no tracking system in place to monitor implementation or effectiveness. The Interviewee stated that they want to develop a checklist to track the number of people impacted by specific actions. Implementation also depends on resource availability (such as funds from Red Cross and partner societies or municipalities).

II. Perceived Effectiveness

The interviewee expressed how, although implementation and health outcomes are not specifically tracked, the Nepalgunj HAP is highly effective. The plan has prompted the Nepal national government to consider heat as one of the primary hazards impacting public and economic health. This is critical because heat is a slow onset hazard and silent killer. Changing the perception of the danger of extreme heat is a critical step for creating policy and securing funding.
A comparative study from the Red Cross was published on June 2, 2026, titled The Life Experiences of Vulnerable Populations in the Context of Extreme Heat. This is a study on how residents' perception of extreme heat has changed since implementation of a HAP. The Red Cross surveyed residents in five cities in Nepal and Bangladesh, some of which have HAPs and some of which do not. They also conducted focus groups with different vulnerable groups and interviews with people on how people respond to extreme heat. They found that in Nepalgunj, 87% of respondents have changed their actions in response to extreme heat. In other cities without a HAP, less than half of people changed their actions. Additionally, 92% of people in Nepalgunj took protective responses to extreme heat compared to 67% in Bangladesh. It is important to mention that the Nepalgunj experience is just an example of conducting surveys to understand perceived effectiveness. For more information on the survey, please refer to the document linked here.

Despite limited access to health evaluation indicators, the interviewee explained several components of Nepalgunj's HAP that have contributed to its perceived success. First, they noted the importance of effective coordination. Working with municipalities and the red cross network is the biggest success factor for developing and implementing the plan. Second, stakeholder coordination at every stage is critical for success.

The HAP should be developed with an understanding of indigenous and local practices. Actions should fit within local context; they should align culturally and practically. Third, recommended strategies need to be actionable, affordable, and technically feasible. For example, the interviewee talked about water ATMs which have been installed throughout the city and they consider to be one of the most successful actions. They are low cost, flexible, technically feasible, and are economically sustainable with an economic model.

III. Evaluation Metrics

Health outcome tracking is lacking in most South Asian countries. Many hospitals lack patient registrations and even mortality data is limited.

IV. Goals & Metrics

The HAP aligns with the city's economic development goals and goals to support the most vulnerable populations.

V. Resources & Capacity

There are two critical resources lacking in Nepal that impact HAP effectiveness: health data and funding. First, healthcare data is difficult to access and is not reliably recorded. This includes mortality and heat-related illness data. Second, there is very little funding for extreme heat strategies.

VI. Proposed Recommendations for Effective Heat Action Plans

The interviewee recommended several ways to improve HAP effectiveness. First, they called for more heat impact data to help measure effectiveness and substantiate risk assessments. Additionally, they thought an analysis of urban systems (e.g. electricity and water infrastructure) and their capacity to absorb shock during heat waves could help cities create targeted urban planning approaches to build resilience. Third, they felt a mechanism to track and report plan implementation is critical.

Lessons Learned from Nepal for the HAPIE Tool

Nepalgunj's plan provided the clearest test case among the pilot cities for constructing effectiveness measures from the plan's description of the action alone, as it contains no explicit effectiveness indicators. Working through this plan pushed us to develop an evaluation approach for cases in which a plan's intent is implied rather than explicitly stated.

The cool roof activity example from the plan clarifies this: the plan specifies white paint applied to fifty households in named, tin-roofed wards, which already supplies the mechanism (reflective coating), the metric (surface temperature), and the comparison group (painted versus unpainted roofs in the same wards) required for evaluation.

Nepalgunj's interview confirmed that not every action can be isolated for individual measurement. The plan's Awareness Generation strategy, for example, bundles loudspeaker announcements, household visits, social media, and posters together, with no way to attribute outcome to a single channel. The Red Cross comparative study is a case in point, treating changed protective behavior in the population as a valid effect of the whole bundle rather than any individual action within it. The insight for the tool is that where actions are inseparable, the effectiveness measure should track the bundle rather than force attribution into individual actions.

The interview highlighted that the feasibility of measures is a critical consideration for an evaluation tool. Installing water ATMs were cited as a successful action specifically because they are low-cost, technically feasible, and culturally appropriate. The lesson for the tool is to preserve context-specific, lower-cost actions like this as standalone components under the Urban Greening and Water Access domain, rather than folding them into more resource intensive interventions where its low-cost, locally adapted character would be lost. Another insight came from the interview that health outcome tracking is underdeveloped across South Asia, and mortality data is limited.

This reinforced the tool's need for alternative measures where health infrastructure is inefficient. In the absence of reliable health data, comparing population protective behavior between cities with and without a HAP, as the Red Cross study did, is a valid substitution.

Table 4-4 illustrates how the Nepalgunj goal and

action domains are split across the nine HAPIE strategy domains.

Table 4-4: Mapping Nepalgunj Goal/Action Domains to the HAPIE Tool Strategy Domains

City	City-Specific Goal/Action Domain	Equivalent HAPIE Tool Strategy Domains
Nepalgunj	Governance and Post Action Review	Governance; Emergency Preparedness
	Public Awareness and Communication	Public Health
	Capacity Building and Training	Public Health; Personal Exposure
	Health Data and Surveillance	Public Health
	Cooling Centers and Water Access	Emergency Preparedness; Urban Design
	Worker Protection and Workplace Safety	Personal Exposure
	Utility and Infrastructure Preparedness	Energy; Emergency Preparedness
	Long-term Urban Heat Resilience	Urban Greening; Waste Heat

Conclusion

Cross-comparison of the four pilot cities revealed a lack of standardized structure across HAPs, confirming the need for a generalizable tracking tool that is flexible enough to accommodate this variation. We identified three structural types: plans organized around general and long-term measures with limited implementation measures; plans grouping actions into thematic focus areas while deferring indicator development to a subsequent phase; and plans structured as departmental responsibility framework without a unifying action unit.

Figure 4-3 illustrates the diversity of heat action plans' structure across the pilot cities, summarizing their different components. This diversity reflects different conceptions of a HAP that the evaluation tool must accommodate without flattening.

Across pilot cities, we found that success is primarily assessed through implementation progress or broadly stated intended outcomes rather than measurable causal impact. Where cities used questionnaires, workshops, or annual surveys to review plan effectiveness, these assessed action progress rather than outcome attribution. Interviews revealed that several cities maintained internal tracking mechanisms, including check-in forms capturing the number of organizations engaged, coordination frequency, and action progress, that were never published in official plans and had no clear institutional home or designated authority. The core contribution of the evaluation tool is to provide a flexible framework that stewards these fragmented structures into a shared and inclusive system.

Analysis of the four pilot plans identified unique themes and mechanisms. These include livestock mortality monitoring during heat events especially in rural areas, fire preparedness activities including hot spot mapping and mock drills, ex-gratia compensation payments to families of verified heat-related deaths, community volunteer household visits as a systematic alert and welfare mechanism, and water safety and drowning prevention components for cities with heavily used recreational water bodies during heat season.

We retained these novel mechanisms in the evaluation tool as conditional components, with contextual notations indicating the governance of climate settings for which they are most relevant.

Nepalgunj		Cape Town		Seattle		Vienna	
Phases	Pre-season / During-season / Post-season	Focus Area	Priority areas of focus for the plan	Category	Categories of focus (e.g., help people stay cool indoors	Temporal Measures Across Target Group	Temporal measures (e.g., greening long-term, training of physicians as a seasonal measure)
Theme	Communication, Awareness Generation, Capacity Building, Cooling Centers, etc.	Actions	Actions to address each focus area	Action	Actions under each category	Actions (Planning Actions)	Actions equivalent to planning actions under each measure
Key Activity	Specific action implemented under each theme	Planning Actions	Detailed planning actions under each action	Activities	Components or activities that make up each action	Performance Indicators	Indicators to measure progress of each action
Leading and Coordinating	Departments responsible for leading and coordinating each activity	Key Departments (per action)	Departments responsible for each action	Partnering Agencies	Agencies and organizations partnering on each action	Responsibility and Contributors	Entities responsible and contributors for each action

Figure 4-3: Diversity in the structure of heat action plans across pilot cities

Applying the evaluation tool across pilot cities revealed the strongest alignment in Urban Greening, Energy, and Emergency Preparedness, suggesting the most consensus exists to initiate effectiveness measuring requirements or where the data and systems are more available and accessible. Piloting also identified areas where existing frameworks require further development: water access as a primary heat resilience mechanism in the South Asian pilot plans, including water distribution points, traditional water body restoration, and water tanker deployments, but there was no dedicated indicator equivalent. The Waste Heat domain had the weakest strategies and measures across all pilots, indicating that this strategy area has not yet fully translated into practice in the cities studied. More work on this topic is needed.

The Comparison Basis: A Prerequisite for Effectiveness Evaluation

We constructed each effectiveness measure to answer the question: if this action were fully implemented, what specific, measurable change in what unit would be observable, and how would that change be distinguished from background variation? For example, an effectiveness measure for cooling centers is heat-related illness incidence rate per 1,000 population in areas with activated cooling centers compared to comparable areas without, during the same heat event. For installing cool roofs, an effectiveness measure could be the surface temperature of cool-roofed buildings compared to unpainted conventional roofs at the same location during peak heat hours. A fundamental methodological principle of the tool is that no count, however large, constitutes evidence of effectiveness without a comparison. The tool therefore requires every effectiveness measure to specify its comparison basis explicitly.

Calibrating Measures to Data Availability

We found that formal health data was either unavailable or aggregated at scales too coarse to support action-level attribution across most pilot cities. Where data existed, privacy protections and incompatible systems across jurisdictions prevented

the spatial disaggregation needed to link outcomes to specific interventions. The evaluation tool responds to this by calibrating effectiveness measures to data feasibility and prioritizing metrics that cities across diverse resource contexts can realistically collect, while flagging those that require baseline investment before application. For example, where health data is unavailable, emergency call volumes from areas with cooling centers compared to comparable areas on the same heat days serve as a lower cost proxy. The tool prioritizes effectiveness measures anchored in datasets that already exist in most governance contexts, while introducing data measures cities can work toward as monitoring capacity and data availability expand. Table 4-5 synthesizes the major findings of the pilot study and the corresponding principles incorporated into the proposed HAPIE Tool.

Table 4-5: Summary Table of findings from pilot cities and their implication for the HAPIE tool

Key Finding	Evidence from Pilot Cities	Implication for the HAPIE Tool
Structural diversity of Heat Action Plans	The four pilot cities followed different organizational structures: phased plans (Nepalgunj), focus-area frameworks (Cape Town), category–action hierarchies (Seattle/King County), and audience/timeframe-based measure structures (Vienna).	The tool must be flexible and generalizable, accommodating multiple plan structures rather than assuming a standardized format.
From implementation to effectiveness	Existing evaluations primarily measured implementation progress (e.g., completed actions, workshops, surveys, coordination meetings) rather than causal outcomes.	The tool extends evaluation from counting completed actions to measuring whether actions produce observable and attributable outcomes.
Context-specific actions	The pilot plans included context-specified strategies such as livestock mortality monitoring, fire preparedness, and ex-gratia compensation, community volunteer household visits and drowning prevention / water safety.	These context-specific actions were retained as conditional components to preserve local relevance while maintaining a common evaluation framework.
Domain alignment across cities	Strongest consistency across plans occurred in Urban Greening, Energy, and Emergency Preparedness. Water Access was underrepresented in both the Circle and Center frameworks despite being a primary mechanism in South Asian contexts, and Waste Heat strategies were the least developed across all pilots.	The tool prioritizes domains with existing consensus while expanding indicator coverage for underdeveloped but important areas.
Need for explicit comparison	Most plans lacked a defined comparison basis for assessing effectiveness. Absolute implementation counts were commonly used without demonstrating impact.	Every effectiveness indicator requires an explicit comparison (e.g., intervention vs. non-intervention areas, or before–after) to support causal interpretation.
Data availability constraints	Health outcome data were frequently unavailable, aggregated, or inaccessible due to privacy and institutional limitations.	The tool calibrates indicators to local data availability, prioritizing feasible proxy measures while identifying higher-level indicators for future monitoring capacity.

Recommendations

The most consistent finding across all study components is that HAPs commonly outline goals and actions, and cities sometimes track their implementation. However, they very rarely specify what impact those actions are expected to produce or how that change would be measured. This gap between implementation tracking and outcome evaluation reflects structural constraints that are real and persistent: the absence of baseline data collected before implementation; the difficulty of attributing changes in population health to specific actions in the presence of confounding factors; the privacy and aggregation constraints on health data that prevent spatial analysis at the scale at which interventions are deployed; and the resource pressures that consistently prioritize implementation over effectiveness. The insight that the better the heat action works, the less data is available to demonstrate its effectiveness spatially captures a fundamental tension in heat resilience evaluation that no methodological tool alone can resolve.

Interviews with local officials revealed that even where cities have developed monitoring systems, those systems typically track implementation outputs rather than health or environmental outcomes. Closing this gap requires not just better analytical tools but also investment in collecting, sharing, and applying comparable data, as well as the required infrastructure. Drawing on our analysis of a diverse array of local HAPs, interviews with local officials who develop and implement them, and a four-city internal pilot of a HAPIE Tool, we propose the following recommendations:

- Distinguish implementation tracking from effectiveness evaluation and invest in both separately. Implementation tracking as what was done, by whom, reaching how many people, is achievable within existing administrative systems. Effectiveness evaluation mostly requires additional investment in data collection and should be resourced as a distinct function, not assumed to emerge from implementation tracking alone.

- Use the strategies, indicators, implementation measures, and effectiveness measures as a structuring tool early in the plan development phase. When drafting or updating a plan, each action should be linked to at least one evaluation tool strategies, at least one indicator, and at least one implementation measure and effectiveness measure. Plans that complete this exercise for all major actions have a trackable structure from strategy to outcome.

- Adapt the evaluation framework to the local resource and data context. In lower-income settings, the priority should be to identify high priority effectiveness measures that are trackable through the lowest cost available comparison design. For example, surveys which produce evidence of HAP impact without requiring health administrative data.

- Strengthen governance structures and institutional continuity for monitoring. Monitoring capacity should be embedded in permanent staff roles rather than treated as a secondary responsibility. The proposed institutions within the evaluation tool facilitate the identification of responsible or capable agencies to delegate tasks.

- Invest in data sharing infrastructures. Developing standardized data collection protocols across cities will make them compatible with divergent needs of different authorities.

The four-city pilot study demonstrates that it is feasible to develop a consistent, cross-contextual evaluation structure from plans using different terminology, action structures, and governance arrangements so that cities at different stages of evaluation capacity can locate themselves within a shared framework and identify the next investments to strengthen their evaluation practice. The next step would be for these cities to actually implement the tool, track indicators, and use it to evaluate their HAPs.

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Appendix

Interview Results

As part of the interview process, we created separate forms for each case study. The interview results for each city were organized according to the structure shown in Fig. 3-1 and applied consistently across all case studies.

This appendix presents the completed forms for each individual case study not selected for the HAPIE Pilot including:

Cities

1. Tucson, Arizona, United States
2. Scottsdale, Arizona, United States
3. Miami, Florida, United States
4. Dhaka, Bangladesh
5. Ahmedabad, India

States

6. Uttar Pradesh, India
7. Arizona, United States

Tucson, Arizona, United States

The City of Tucson developed their HAP, Heat Action Roadmap: An action roadmap to prepare for extreme heat in 2024. The original plan outlines the city's heat risks and vulnerabilities, governance approach, and details three main goals, ten intersectional strategies and 61 actionable items, which broadly focus on both heat management and heat mitigation. The HAP is embedded within the network of plans, including the city's Climate Action Plan, Tucson Resilient Together, passed in 2021, and Pima County's Climate Action Plan, the Comprehensive Climate Action Plan, presented in 2024.

I. Implementation Strategies

Implementation of Tucson's Heat Action Plan (HAP) is coordinated and mostly centralized, with strategies and programs flowing out of a small team within the city government. A strategic unit (Office of the Mayor) oversees coordination, implementation and monitoring of the HAP, led by a Chief Resilience Officer. They are supported by various city, county, community, and research entities that provide on-the-ground labor, oversight, and other assistance.

The plan recognizes the importance of monitoring and evaluation. As the plan states:
The City of Tucson prioritizes community engagement, data driven strategies, and continuous adaptation to evolving needs. This approach addresses the immediate challenges posed by rising temperatures and fosters a more resilient and equitable city for all Tucsonans. (p.6)

The evaluation of the HAP thus far has been non-substantive, but there are plans to become more systemic in evaluating this year's efforts. The interviewee points to the evaluation matrix that the city's Climate Action Plan uses as a model to facilitate the line-by-line review of the HAP. Currently, more holistic evaluations of the heat season specifically are occurring, "We're evaluating [internally], like, the Southern Arizona heat season, and what went well, what can we improve? And so, we're tweaking every year on, like, specific actions or strategies".

Data used for evaluation is robust but is currently focused on the adaptive management of the plan from year-to-year. Tucson is collecting cooling center usage data, geolocated emergency calls related to heat, mortality data, hospital utilization for heat-related illnesses, worksite heat incidents, as well as community feedback. Community feedback has been gathered through a series of annual forums, the Southern Arizona Heat Summit, being the largest with over 300+ participants recorded in 2026. Interviewee points to more formal evaluation methods as being desired, noting "I think it would be amazing to have data to do some sort of, like, regression analysis to see how, like, effective the plan as a whole is".

Early and informal internal evaluation has led to re-evaluating assignment of roles and

Tucson, Arizona, United States

responsibilities of lead implementers on the HAP. The interviewee reflected that new partnerships have developed, and certain collaborations have strengthened, so they can now rethink the ownership of strategies and programs.

Interviewee affirmed that most of the plan's measures were being implemented. The plan's goal to use data-informed and adaptive implementation measures can be seen in the strategic selection of locations for targeted heat management actions. "We use data from the county and city to select the location for both the heat walks and the distribution of [heat relief] kits. Our GIS expert created a tool for selecting out cooling center locations...". Early successes such as robust heat-season outreach and a Heat Protection Ordinance for outdoor and vulnerable workers came up when discussing implementation.

Some of the actions that haven't been implemented are now being reevaluated, showing adaptive management of key heat-policy measures.
I think there is one [action] about creating some sort of... like, sending out messages around heat. There are already some apps, that are in existence, but not one from the city. And so we need to reevaluate, like, is that something that... is that a role that the city plays. Are we the trusted messengers for, emergency messages? And maybe not. Maybe, like, you know, the weather service is doing a good job, and the other, alert systems from, like, the county... are doing a good job.

Other measures lagging behind in the plan's progress are weatherization efforts and a residential home strategy, including energy audits, electrification, and weatherization. Specific areas within Tucson that are less successful in implementation are southern sections of the city where there are higher rates of low-income neighborhoods and marginalized communities. The interviewee points to the additional labor that is required for city-promoted rebates being a barrier for the households that need heat resilience strategies the most.

II. Perceived Effectiveness

In its second year of implementation, the perceived effectiveness of the plan is high despite changes at the federal level, seemingly mitigated by extremely strong partnerships. Interviewee describes community groups, non-profits, and city, county, state governments working in "lockstep" to achieve the same goals, leading to increased effectiveness.

This collaboration and coordination have led to resource sharing, diffused leadership, and ownership of initiatives by groups other than the city team. When asked to rate the effectiveness of the HAP, the interviewee responded with a 3 out 5, noting that, "we could always do better, but we're...walking in the right direction."

Perceived effectiveness is impacted by issues that stand at a crossroads of conflicting community desires. An important piece of Tucson's HAP implementation is their urban forestry initiative, which comes with a tree protection ordinance. The interviewee described this conflict between shade and perceived safety, "There's people that, you know, dislike the unhoused neighbors, and they don't want them in their businesses, they don't want them in the neighborhoods. And it is very obvious that [unhoused neighbors] are gonna want to find shade during the heat to protect themselves, and so businesses and homeowners are cutting trees."

Key obstacles include funding constraints and limits to what is within the city's control (e.g., housing policy or national program funding). The interviewee described how they've met these fiscal constraints, "We are really trying to be very creative with [our] energy collaboration agreement to fund a lot of the work in the… in the Heat Action Roadmap". Another observation was that implementation is held back by a lack of skilled workforce to scale up energy audits and

Tucson, Arizona, United States

weatherization work.

III. Evaluation Metrics

The city has experience with structured evaluation processes through the Climate Action Plan but hasn't completed this process for the HAP yet. Beyond the tracking of completion of specific strategies, the city is evaluating effectiveness for the programs themselves. The interviewee detailed how they re-evaluated a mix of variables to determine the best location for a ward's cooling center based on heat-related EMS calls, vulnerable population locations, and heat-related illness data.

An additional evaluation metric the interviewee was considering for Tucson's HAP was alignment with plans from other levels of government. The interviewee suggested an analysis looking at what roles each level of government was best suited to play, how effective plans are regionally or state-wide, and begin to collect data across jurisdictions in a systematic and scaled-up method. An evaluation method also under consideration is a cost-benefit analysis where the city can made data-informed decisions on strategic priorities and actions based on effectiveness.

IV. Goals & Metrics

The Tucson HAP's goal of ... aligns with the interviewee's perception of the plan's success, being "...the notion that the community feels safe in the summer. They know where to go...or they can stay in their homes safely, or they're aware of the resources in existence. Additionally, a long-term goal and measure of success that came up several times in the interview is using housing as a strategic defense against heat. Having "... more direct benefits in people's homes? Like, weatherizing people's homes, having, like, a resilient home? To me, that would be, like, amazing". Being able to quantitatively show that "all these actions actually have all these benefits..." is a primary consideration for the city when moving forward in evaluating the HAP.

V. Resources & Capacity

Tucson demonstrates strong institutional capacity, with integration across governmental sectors and extremely strong collaborative partnerships. However, implementation is still constrained by financial limitations and staffing challenges. Interviewee alluded to the lack of a skilled workforce to implement some of the strategies, even if the funding did exist. Capacity challenges also permeate the plan's implementation extent and efforts toward evaluation.

The interviewee felt that they're under resourced to complete the strategies outlined in the plan. "Yeah, I would love an army of volunteers or interns to do, like, the heat season work. It is a lot of administrative work, and a lot of, like, not administrative, but I guess coordination across different communities, and just to do, like, one effective event." Additionally, a lack of engagement and hesitancy from many involved stakeholders, such as energy utilities, limits the team's ability to complete the plan's outlines actions.

VI. Proposed Recommendations for Effective Heat Action Plans

Data-informed on-the-ground initiatives; Integrated network of plans approach; Assigning responsibility for coordination, making sure it doesn't all fall on one entity; "You go farther with partnerships. Nothing beats that."

Scottsdale, Arizona, United States

This interview covers the Extreme Heat Existing Efforts Report, developed by the City of Scottsdale Office of Environmental Initiatives (OEI) in 2023. This is a preliminary report to support heat mitigation planning efforts. To develop the report, city officials conducted extensive community engagement. They worked with Spanish speaking residents and tribal residents in Scottsdale and held focus groups.

The plan was funded by a Community Development Block Grant and recognized by the US Department of Housing and Urban Development (HUD). Central to the plan is a focus on addressing public health disparities in two zip codes that have disproportionally high exposure to extreme heat. Recommendations from the Identifying Strategies for a Cooler Scottsdale study conducted by Arizona State University will also be incorporated into Scottsdale's heat mitigation plan.

I. Implementation Strategies

The city continues to center community engagement within their extreme heat mitigation strategies. In April 2024, the city held a cross-department event delivered in both English and Spanish language: Community Conversations and Solutions to Urban Heat. The city held community discussions in the disproportionately impacted neighborhoods to co-develop extreme heat solutions. Recommendations from the report include:

- Increase shade and connectivity to community assets
- Increase education, workshops and outreach
- Highlight mental health and self-care
- Engage people as active partners

There is currently no centralized process to track implementation of strategies by the city. Part of the reason for this is due to changes in federal housing policy since Scottsdale's report was published in 2023. HUD has deprioritized resilience and heat mitigation. This has an impact on what cities can do because they control future funding allocations from the federal government.

However, Scottsdale deals with very extreme temperatures and some heat actions are being undertaken by the city. The interviewee mentioned several strategies:

- One strategy is improving green spaces and tree canopy in impacted zip codes, although this is not included in the report. This is currently being tracked by another department.
- The city has multiple cooling stations as part of a heat relief network. These stations are in human resource centers and libraries and provide bottles of water and a place to sit for residents. There is also a day relief respite station for homeless residents to cool off. The city tracks the number of people who use these stations.
- The Human Resources department tracks data on how many city staff change hours during the summer.
- Scottsdale University provides heat-related illness training which is required for all city employees.

II. Perceived Effectiveness

The interviewee noted that there aren't presently any processes or procedures to evaluate the effectiveness of strategies at the city level. However, they suggested looking at the Blue Zones Project Scottsdale. This organization focuses on improving health and wellbeing for communities.

III. Evaluation Metrics

Although Scottsdale does not currently evaluate heat mitigation strategies, there are several strategies mentioned by the interviewee that could be used. This includes using data on heat-related deaths from the public health department, especially for the two disproportionally impacted zip codes, as well as data on disease impacts from extreme heat,

Scottsdale, Arizona, United States

specifically on how air quality is impacting health.

IV. Goals & Metrics

During initial development, the report was well aligned with city-wide sustainability goals. Scottsdale City County "prioritized extreme heat planning in its 2022 Organizational Strategic Plan" and the Sustainability Plan (p. 1). However, the sustainability plan was unadopted in 2026, meaning that city priorities have shifted away from extreme heat mitigation.

V. Resources & Capacity

The interviewee mentioned several agencies that can provide resources and capacity for inter-agency coordination in the report, including:

- Works with data from Maricopa Public Health Dep and the Arizona Dep of Env Quality on air quality with daily updates
- Maricopa Public Health Dep
- The Arizona Department of Environmental Quality provides daily updated of air quality data
- The Parks and Recreation department assists with natural space cooling projects and tree planting
- The Salt River Project (SRP) is Arizona's electric power and water utility company and could provide conservation education and outreach for customers

The interviewee stressed several limitations to the implementation of strategies included in the report. Most importantly is shifting federal priorities, which limits funding. Council support is also a crucial factor in implementation. However, Council's priorities have shifter in line with the federal trend, as reflected in the un-adoption of the sustainability plan.

VI. Proposed Recommendations for Effective Heat Action Plans

The interviewee identified several ways to improve the plan and its effectiveness. Additional strategies to be included would be to install water stations next to bus stops and increase educational opportunities. Having an implementation timeline would be helpful for the city to prioritize actions. Finally, the plan needs a standalone element on recommended strategies to reduce dependency on other city plans (this is a problem because the sustainability plan was unadopted). In a polarized and shifting political landscape, plans should be independent.

Miami-Dade County, Florida, United States

The Miami-Dade County Office of Resilience developed an Extreme Heat Action Plan in 2022. This planning is critical, as Florida has the highest overall number of heat related emergency department visits in America. The Heat Action Plan (HAP) is organized around three main goals supported by 19 actions: 1) inform, prepare and protect people, 2) cool homes and emergency facilities, and 3) cool neighborhoods. The Hap is also guided by equity, safety, environmental stewardship, and alignment with communities (Miami-Dade has 34 local jurisdictions, the largest of which is the City of Miami) and county initiatives and plans (the County Strategic Plan, Resilient305 Strategy, Thrive305 Action Plan, Climate Action Strategy, Comprehensive Plan, and more) (p. 4).

I. Implementation Strategies

The County is the lead on the plan but has multiple partners to help with implementation and tracking. "Actions are led and/or supported by multiple internal and external partners. Miami-Dade County's Office of Environmental Risk and Resilience (OERR)'s role is to continue to catalyze the next wave of change needed in each of our goal area" (Extreme Heat Action Plan Progress Update, May 2025). For example, the County partners with the Florida Clinicians for Climate Action (FCCA) to improve heat awareness and how clinicians can interact with vulnerable populations.

To prepare the HAP, the county conducted workshops and collected survey results to prioritize strategic actions (p. 8). They also conducted a heat vulnerability assessment to identify populations in the County which are more vulnerable to extreme heat, guided by the principle of equity.

The County tracks progress on implementation and has released two progress update reports. The report includes specific ways in which each of the 19 actions have been implemented and next steps in implementation. The progress report includes metrics on the number of trainings held, funding secured and requested, number of people reached through messaging, policies issued, programs launched, and different partners or community-based organizations engaged (Extreme Heat Action Plan Progress Update, May 2025).

II. Perceived Effectiveness

The interviewee discussed how effectiveness of HAP actions is difficult to measure, especially health outcomes. This is due to limited data and staff capacity, discussed further on. However, there are some perceived effective measures and outcomes. For example, the interviewee stressed the perceived long-term effectiveness of tree planting. These actions are particularly effective because they are politically popular, target vulnerable geographical areas, provide health benefits aside from heat reduction, and can reduce local temperatures by up to 10°F in some areas.

One measurable and positive health outcome is that in 2022, when Miami-Dade County started their heat action campaign, they had the lowest rates of heat related emergency room visits in Florida. However, this type of metric would be difficult to attribute to any specific actions. Additionally, it is the same year as the HAP was published.

III. Evaluation Metrics

The County closely tracks implementation of the HAP, however, the interviewee discussed the challenges of tracking health outcomes. It is hard to obtain data and directly attribute it to any specific HAP action. This is especially true for long-term actions, such as tree planting. Tracking for implementation progress and effectiveness is delineated by HAP goal.
For education and outreach (Goal 1):

- The County partnered with the Florida International University (FIU) and FCCC to distribute educational materials to health clinics to keep in waiting rooms. FIU then tracked pre-

Miami-Dade County, Florida, United States

and post-awareness of patients. This had "great results in terms of heat risk awareness".
- The County tracks public awareness actions. This includes the number of people reached, people trained, number of ways that people are reached, and the geographies that are targeted (specifically, the most vulnerable and unhoused populations).
- The County also attempts to evaluate and modify efforts where possible. They underwent some formative assessments regarding public awareness. They received feedback from CBOs on messaging and training effectiveness. The County then adapted their materials accordingly. During trainings, the County collected feedback from participants. They also collected informal feedback from community representatives on public messaging (social media, bus stop ads, billboards ads, etc.)

For Goals 2 and 3, the county tracks cooling site distribution, number of AC units installed, low-income units retrofitted, number of trees planted in low (less than 20%) tree canopy areas, and number of trees overall. The County is planning to do a tree canopy assessment to assess changes to coverage in the areas of highest need over time. They are relying on existing studies that correlate trees with positive health outcomes (for example, heart stress and respiratory).

Finally, the County collects 911 calls from the County but there each local jurisdiction has their own responses and data collection. Currently the County's resources to compile all of this data is limited. The County determined that the number of 911 calls during extreme heat waves "doubled".

IV. Goals & Metrics

The HAP's mission is "to reduce the health and economic impacts of increasing extreme heat and create a baseline for further research and new partnerships around this issue" (p. 2). The plan is organized around three main goals supported by 19 actions:

1. Inform and prepare people for heat risks to prevent heat illness and exhaustion.
2. Cool homes and emergency facilities, especially to ensure widespread cooling coverage in the event of a power outage. The primary goal is to help people stay home affordably during extreme heat events.
3. Cool neighborhoods (the County specifically targets neighborhoods with less than 20% tree coverage and areas with higher poverty rates).

Every action is focused on geographies (zip codes) with the highest amount of heat-related emergency department visits. Messaging is also targeted to specific vulnerable demographics (pregnant people, elderly, summer camps, and outdoor workers). In this regard, implementation of the plan is highly targeted towards folks with the highest need for intervention.

V. Resources & Capacity

One resource that would improve HAP tracking and evaluation would be better data. Ideally, the County would have better access to state-collected data on heat-related illnesses, hospitalizations, and deaths. The County wants information for 2024 and 2025, but it is not yet published. The interviewee stated, "we would need great more up-to-date data", including baseline emergency room visits, hospitalizations, 911 calls. This data could then be correlated with environmental conditions over time. This study would need 2-3 years of data both pre- and post-intervention with similar extreme heat events for comparison. In Miami, this may not currently be possible due to resource constraints: staffing capacity, expertise, and time.

The lack of data availability is exacerbated by the fact that heat exposure health impacts are not always identified as such (such as diabetes or pre-term births). Ideally, health impacts exacerbated by heat exposure will be identified. The County is coordinating with the organization Healthcare without Harm to improve coding and identify heat related illnesses, but they are "a long

Miami-Dade County, Florida, United States

way away". The County discussed data improvement as one potential way to measure health outcomes, "Additionally, the County also discussed potential ways to measure the effectiveness of public awareness actions through something like pre- and post-intervention surveys. However, "The drive is so much around showing implementation… there isn't the resources put into evaluation and tracking".

VI. Proposed Recommendations for Effective Heat Action Plans

The interviewee discussed several ways that HAPs could be more effective. This includes:

- Policy Action. Decision makers should prioritize and support HAP policies and funding. Politization of extreme heat is a general challenge to implementation. For example, certain policy makers are supportive of tree planting efforts but not others. Broader support from policy makers could improve implementation.
- Tracking. Improving tracking and evaluation efforts by counties and local governments is critical for communicating programmatic needs. It would help demonstrate to decision makers how investments translate into health outcomes and benefits to the community. Specifically, data to support cost-benefit analysis by decision makers could be useful.
- Multi-Benefit Actions. The Agency should prioritize heat island mitigation actions that provide multiple benefits. This includes actions that reduce urban heat but also improve overall health, increase wellness, or reduce flooding. These may be more palatable to local agencies as they offer multiple benefits, improving their return on investment. The interview again stressed tree preservation, maintenance, and planting as it lowers urban heat and improves health conditions like heart disease.

Dhaka, Bangladesh

The Bangladesh Heatwave Early Action Protocol Bangladesh Red Crescent Society was developed in 2023 in coordination with the International Federation of Red Cross and Red Crescent Societies (IFRC).

I. Implementation Strategies

The Bangladesh Heatwave Early Action Protocol (EAP) has five main strategies:

1. Awareness generation campaigns and heat warnings
2. Drinking water distribution
3. Cash grants distributed to vulnerable residents, especially women. This is very important because many residents cannot lose wages during heat waves and may work through dangerous temperatures. Cash grants allow residents to stay home. Although the impact of these grants is not monitored, this strategy is the only one mentioned that can be tracked. This is because there is a defined number of people being targeted, limited by the amount of funding available. For example, the city may have enough cash to distribute to 5,000 households.
4. Cooling or "resting" stations with fans and water across the city, especially in areas with a lot of vulnerable residents
5. Ambulance support (EAP p. 2)

Because Bangladesh's plan is an action protocol rather than mitigation plan, these actions are mostly anticipatory and triggered by extreme heat. While there is no formal tracking system, coordinators of the plan are looking to develop a system to track how many people are impacted by specific actions. One of the ways they track the implementation is through volunteers. They track volunteering numbers and the number of households were reached using the reports from volunteers. They also track how residents receive the cash benefits.

II. Perceived Effectiveness

The interviewee stressed that the most effective heat action strategy in Bangladesh is cash distribution. It provides flexibility for people and is especially impactful when residents lose income due to extreme heat. However, this strategy is limited because available money is limited and identifying the residents with the greatest need is challenging.

Despite limited access to health evaluation indicators, the interviewee explained several components of heat action planning that contribute to perceived success:

- Effective coordination. Working with municipalities and the red cross network is the biggest success factor for developing and implementing the plan.
- Stakeholder coordination and engagement. Stakeholder coordination at every stage is critical for success. The HAP should be developed with an understanding of indigenous and local practices and should be based on their feedback on early action protocols. Actions should fit within local context; they should align culturally and practically.
- Feasibility. Recommended strategies need to be actionable, affordable, and technically feasible. Strategies should be based on What people need not what the city can offer.

III. Evaluation Metrics

Health outcome tracking is lacking in most South Asian countries. Many hospitals lack patient registrations and even mortality data is limited. While there have not been specific studies on the effectiveness of cash transfers during heat waves, the Interviewee mentioned a study on anticipatory cash transfers for flood response. The study evaluated the impact of "pre-arranged financing and data-driven triggers", which reduce uncertainty and delay and likely had a "much greater impact that the traditional response" (Relief Web, 2024, Cash Before Calamity: Anticipatory Action for Flood Resilience). The Red Cross also simulated anticipatory cash transfers through social protection systems in response to climate shocks. After a warning, cash was

Dhaka, Bangladesh

transferred to residents already receiving an old-age allowance. “The simulation exercise provided evidence that it is feasible for social protection systems to deliver anticipatory actions such as cash transfers... in Bangladesh” (Red Cross Climate Centre, 2026, Blog: Simulating social protection as an engine for anticipatory action in Bangladesh). Additionally, after they distributed money, they contacted the recipients to see how the distributed money supported and helped them. During heat wave, they also collected data on the mortality rate and hospital visits.

IV. Goals & Metrics

The HAP aligns with the city’s goals to support the most vulnerable populations.

V. Resources & Capacity

There many critical resources lacking in Bangladesh that impact HAP effectiveness:

1. Limited impact data. Healthcare data is difficult to access and assess and is not reliably recorded. This includes even mortality data, so heat related illness data is certainly not being tracked and reported.
2. Limited funding for extreme heat strategies.
3. An implementation and operational plan in addition to the plan itself to guide how to implement the plan
4. Aligned private and public resources

VI. Proposed Recommendations for Effective Heat Action Plans

The interviewee recommended several ways to improve HAP effectiveness:

- More impact data would be great to help measure effectiveness and substantiate risk assessments.
- An analysis of urban systems (like power and water supply) and their capacity to absorb shock during heat waves could help cities create targeted urban planning approaches to build resilience.
- Mechanisms to track and report the implementation are critical.
- More coordination with local governments and agencies.
- Recommended strategies need to be actionable, affordable, and technically feasible. Strategies should be based on What people need not what the city can offer.

Ahmedabad, India

The Ahmedabad Heat Action Plan (HAP) was created in 2013 and updated in 2019. The plan focuses on extreme heat alerts as well as long-term cooling programs. The Ahmedabad Municipal Corporation (AMC) partnered with international NGOs and academic institutions to develop, implement, and study the effectiveness of the plan. Ahmedabad's HAP was the first of its kind in India and continues to serve as a national model for its effectiveness and demonstration of cooperation between NGOs and municipal government. It has also been studied and reported on in several studies (Knowlton, et al., 2014 and NRDC, n.d.)

I. Implementation Strategies

According to the Ahmedabad HAP 2019 update, the key strategies are building public awareness and community outreach, initiating an early warning system, inter-agency coordination, building capacity among health care professionals, reducing heat exposure, and promoting adaptive measures (primarily via a Cool Roof Program) (p.1).

The interviewee listed several strategies to reduce urban heat impacts, especially for vulnerable populations. These include insurance programs to pay workers when they cannot work during extreme heat events, keeping gardens open to the public, improving access to free water, municipal tree planting, cool roofs, misting fans, and cooling centers. Another important strategy was collaborating with the NRDC and other academic institutions to help the Indian Weather Service forecast temperatures to inform the public about upcoming extreme heat events.

Ahmedabad's HAP is primarily implemented through the AMC, the IIPH, and several Non-Governmental Organizations (NGOs) that work in the region, the most involved of which is the National Resource Defense Council (NRDC). Locally, the plan is implemented by an appointed AMC Nodal Officer, who can issue heat alerts, organize training sessions and community outreach, and coordinates with key leaders and agencies. HAP development and implementation is a relatively new process in India and is not mandated by the national government (compared to tuberculosis or malaria programs which are many decades old and are mandated), which means that many actions are implemented on a needs-basis only when funding is available. It also results in a scattered approach which is not easily tracked or measured. The is further complicated when commissioners in charge of implementation are not consistent over the years, resulting in changing priorities and objectives.

II. Perceived Effectiveness

Although the interviewee discussed many challenges associated with implementation and evaluation, Ahmedabad's HAP is perceived to be highly effective and is well regarded in India. As mentioned above, it continues to be a national model. This is partly due to it being the first HAP developed in India as well as the amount of academic research that has been conducted on its impacts. The interviewee shared two graphs which depict downward trends in the relative risk of death in extreme heat as well as heat stroke and heat stroke deaths after HAP implementation. Most emphasized during the interview as a perceive effectiveness measure was the outcome of a 2018 study which estimated a 30-40% reduction of all-cause mortality on peak heat days after HAP introduction (Hess, 2018).

III. Evaluation Metrics

Ahmedabad city officials use three primary evaluation processes: annual reviews of implementation actions, all-cause mortality data, and heat related health surveillance from the city's five largest hospitals.

The HAP is evaluated during annual meetings during the post-heat season, which is organized by the AMC Nodal Officer and is facilitated by the IIPH and NRDC. The meetings include key

Ahmedabad, India

agencies and stakeholders, such as medical colleges and hospitals, public health managers, labor department officials, emergency services, and urban health centers. The meeting cover actions that have been implemented, actions which have not been implemented, the associated challenges and roadblocks that prevented implementation, and actions identified for future years. This part of the annual review is qualitative.

The review also has quantitative components. For example, the heat alert system - in initial years, alerts were sent through email, then evolved to include social media and print media. The reviews have quantified the number of emails and assessed if the temperature predictions were true (to understand the accuracy of the system). If there were red alerts (temperatures exceeding 45 deg C), officials also reviewed which actions were taken. This review system is highly informal and dependent on funding. It is also incomplete, as some NGOs operating in the city conduct their own separate implementation and tracking (such as providing water access points). The interviewee also stressed that documentation in municipal governments in India is not very good. This is complicated by the fact that HAP strategies do not have a separate budget item, so it is challenging to track implementation through financial metrics.

According to the HAP, in addition to organizing annual evaluation meetings, the AMC Nodal Officer also "evaluates the HAP process based on performance and revises accordingly" and "evaluates the reach and impact of the Plan and revise[s] accordingly" (p. 5).

The process evaluation includes reviewing "quantitative and qualitative data" (p. 9). The reviewed plan is then posted to the AMC website. AMC has tracked some implementation actions and included outcomes in the revised HAP: "The AMC and knowledge partners have conducted several cool roof pilot programs, including pilots in 2017 and 2018, applying white lime wash to 3,000 low-income homes in the city, with 500 in each city zone, covering almost 2% of the city's low-income households."

Several indicators are used to assess the effectiveness of Ahmedabad's HAP. The primary indicator used is all-cause mortality, which has been analyzed before and after HAP implementation. Fortunately, data on death registration is better than other cities (such as Nagpur, where some data is unreliable and unpublishable). A 2018 study showed that 2,380 deaths had been avoided in the post-HAP period (Hess, 2018). Other health indicators exist but have issues related to accuracy and availability. For example, access to water points is a key indicator for HAP implementation. Heat-related illness is another key indicator for HAP effectiveness and has been tracked by a national program for several years. However, illnesses outside of heat stroke are difficult to attribute to heat, which causes reporting issues. Additionally, ambulance data can be useful but is not widely shared between government agencies.

Temperature data is also critical for correlating health outcomes with heat waves. However, the interviewee stated a problem with temperature data collection. In Ahmedabad, the temperature is taken from the airport, which is outside of the city and therefore much cooler. This reduces the ability to track heat wave impacts.
Other potential evaluation indicators could include non-health related heat impacts, such as the loss of working hours. However, the interviewee stressed the importance of balancing implementation with monitoring and tracking. This is because monitoring systems can be intensive and data that is too granular can be misleading and inaccurate. The interviewee provided one example: a risk assessment showed that a single ward had high temperatures and a high level of vulnerable people, so the idea would be to have cooling centers in that ward. However, that would not help people who live in that ward but work in another. For that reason, the interviewee prefers broader, more integrated

Ahmedabad, India

strategies (such as improving access to water all over the city) over larger, more centralized strategies, such as cooling centers.

IV. Goals & Metrics

The interviewee discussed important goals of addressing inequities across the city. It is important to note that the HAP attempts to target disproportionately vulnerable populations for heat impact reduction actions. Part of the plan's prioritization strategy is a focus on low-income populations. The HAP also references the 2014 Ahmedabad Slum Free City Action Plan, tying the plan to broader city-wide goals to address inequalities.

The interviewee discussed how integrating cooling strategies into urban planning objectives would be much more effective than isolated approaches such as centralized cooling centers. For example, the Ahmedabad government is rapidly building metro and bus stations but are not considering cooling infrastructure or access to water. This leaves vulnerable commuters at higher risk during extreme heat events. Cooling should be integrated into all aspects of public infrastructure projects to reduce heat risk across the city and reduce impacts.

V. Resources & Capacity

According to the interviewee, Ahmedabad HAP implementation and tracking faces several resource and capacity deficiencies. These include:

- Limited and scattered funding. Projects are funded on a case-by-case basis. Additionally, different departments have their own funding, which means that actions are implemented in isolation with limited tracking and limited data sharing.
- Some local governments issue orders to stop all work on extreme heat days. However, it is unclear whether these rules are being followed or not.
- The Ahmedabad metropolitan area has over 9 million residents. Government agencies are understaffed with too many priorities and needs.

VI. Proposed Recommendations for Effective Heat Action Plans

The interviewee proposed several short-term recommendations:

- Structured guidelines with top-down approach from the national government
- Dedicated funding for HAP strategies with specific budgets
- Dedicated human resources or health officials at the city and district levels to specifically protect outdoor workers and vulnerable populations
- Translating and piloting new cooling technologies and other innovations
- An effective health surveillance system to collect reliable data

And several long-term recommendations:

- There is currently no environmental health division within the national government, which is a blind spot in India's governance structure. There should be an office for environmental and occupational health that can strengthen climate and heat regulations and planning, especially for outdoor workers.
- More research is needed to understand how heat impacts different populations.
- Long-term urban planning initiatives are needed to reduce urban heat. There is presently a lot of pressure on municipalities to devote all vacant land to development due to the high price of land in urban areas. However, keeping some land available for cooling blue and green infrastructure, including tree planting, would have great benefits to public health. This needs to be better appreciated by policy makers.

Varanasi and Ayodhya, Uttar Pradesh, India

The Uttar Pradesh State Disaster Management Authority published the Heat Wave Action plan (HAP) in May 2024 with help from the Indian Institute of Public Health (IIPH) at Gandhinagar. Uttar Pradesh is in the central zone of India.

The Plan addresses extreme heat in two cities in Uttar Pradesh: Varanasi and Ayodhya. These cities are religious centers for the region, resulting in different populations in need of planning efforts for extreme heat.

I. Implementation Strategies

The implementation of Uttar Pradesh's HAP relies on a "Nodal Officer" to coordinate government actions and review the plan each year. This can be beneficial if the officer remains consistent. However, the interviewee spoke about how some cities have periodical changes to leadership and officers. This results in new and different objectives in how the plan is implemented.

Implementation heavily depends on which funds are available. External coordination with IIPH and NRDC is also crucial for monitoring implementation.
One major HAP strategy discussed was cooling centers. These are especially important for building equity across the city and assisting vulnerable populations like gig workers.

India has an increasing level of people working in informal occupations, who might have limited workplace protections and places to cool down. Other strategies include cooling stations, increasing water access points, mesh fans, cool roofs, etc.

II. Perceived Effectiveness

Mortality and heat related illness data are used extensively for assessment.

III. Evaluation Metrics

Mostly, monitoring and evaluation indicators are similar to the Ahmedabad HAP. There is one key difference between Ahmedabad and the cities in Uttar Pradesh: Varanasi and Ayodhya are religious and tourism centers.

Therefore, many secondary indicators are monitored by the Temple Trust. This includes additions of cooling centers and mist fans as well as the number of people using each cooling center, how much time is spent there, and how people are accessing available medical advice or services. These secondary indicators are as important to track as health parameter indicators.

For the past two to three years, heat related illnesses (heat stroke and heat stress) are tracked by a government mandate in the National Surveillance Portal. However, there are data accuracy issues stemming from reporting difficulties and diagnostic difficulties.
Mortality is the primary indicator for evaluating HAPs. However, secondary indicators such as access to water points are also very useful.

IV. Goals & Metrics

Interventions should take vulnerability into account because exposure and impact from extreme heat is not even across a city. The interviewee listed five disproportionately vulnerable groups: outdoor workers, elderly, pediatric people, pregnant people, and impoverished slumdwellers.

HAP strategies should be customized to those groups. However, indicators are much harder to tailor to each group so granularly, so they should be general.

V. Resources & Capacity

Limited funding is a major obstacle for local implementation and monitoring.

Varanasi and Ayodhya, Uttar Pradesh, India

VI. Proposed Recommendations for Effective Heat Action Plans

The interviewee addresses several resources that could make their HAP more effective:

1. Structured guidelines with top-down approach from the Indian government
2. Dedicated funding with specific budgets
3. Dedicated human resources or heat-health officials at the city and district levels
4. Translating and piloting new cooling technologies and other innovations
5. Effective surveillance systems

State of Arizona, United States

The State of Arizona developed their HAP, Arizona's Extreme Heat Preparedness Plan in 2024, notably identifying the appointing of a Chief Heat Officer role who would coordinate heat relief activities across all 15 counties, focusing on standardizing heat and health messaging. The original plan outlines the state's heat risks and vulnerabilities, governance approach, and details 16 recommendations, most of which focus on heat management, but some address longer-term mitigation. The HAP is designed to work in concert with the ecosystem of heat plans in Arizona at the county and city level.

I. Implementation Strategies

Implementation of the State of Arizona's Heat Action Plan (HAP) is headed by the Governor's Office of Resiliency (OOR) but coordinated by the Chief Heat Officer, who a part of the Department of Health Services. The plan recognizes that implementation will take "...cross-agency and cross-sector collaboration", identifying the Department of Emergency Management and Military Affairs (DEMA), Department of Economic Security (DES), Department of Administration (ADOA), Industrial Commission (IC), Department of Housing (DOH), and the Residential Utility Consumer Office (RUCO) as agencies responsible for leading specific recommendations within the plan.

The plan identifies the Interagency Resiliency Forum (IRF), comprised of agency leaders and private sector and community-based partners, with a focus on preparing for extreme heat events and other resiliency efforts. In addition to the state-level engagement of IRF members, an all-partner working group called the Arizona Heat Preparedness Network will be established as a component of the IRF. The Arizona Heat Preparedness Network will ensure statewide interests are incorporated into all activities, to build statewide capacity and ensure robust input from Tribal and local governments and cross-sector stakeholders.

The plan recognizes the importance of timely monitoring and evaluation.

"The Governor's Extreme Heat Preparedness Plan, and that was, distributed in [2024], that is a more static document that will be re-evaluated down the road to see what updates need to be made. And then we have a yearly public health perspective from [AZDHS], a recommendations and findings document that is published once a year, that kind of takes a look from a public health perspective. What has been done and what is going to be done in the following heat season, and what'll be the focus of that, along with some of the progress and pieces that have been made overall," said the interviewee.

The current strategy follows an annual review that captures successes, challenges, and unmet needs. The internal evaluation of progress is critical at this governance level, "If you have a static plan, that is not a plan. And so. it is just [going to] collect dust and not get you where you need to be". The yearly evaluation does not have an identified methodology and is not currently available to the public.

Data used for evaluation is quantitative and qualitative, focused mostly on implementation and outcomes rather than effectiveness. Interviewee mentioned that a large win for data availability is the real-time data dashboard. The heat-related illness dashboard is updated 3 times a week during the heat season to provide transparent data to those who need it most. The interviewee expressed the desire for integration of economic impact data, but expressed concern on missing data, or incomplete data, and therefore withholding this metric until a "more holistically complete" product was available. The State is also collecting data qualitatively through partner/stakeholder surveys and listening session insights "...to really get a handle on what community is feeling and what their needs are".

The interviewee asserted that their internal trackers show that all priorities are addressed "we've made strides on 100% of those

State of Arizona, United States

strategies, and that's included within the work plan", with "most of the short-term and long-term priorities are on track...with two specific segments...requiring additional attention". Implementation progress is strongest in urban cores, relative to heat management strategies such as vulnerable population identification, Workplace Heat and Safety measures, and expansion of the heat response network of cooling and respite centers.

Progress has also been noted in multimodal communication, with a robust social media presence and tailored campaign strategies, "We've had over...46,000, heat alert subscribers and we've had over 330 members within our heat preparedness network on Civic Roundtable".

II. Perceived Effectiveness

The interviewee's response to assessing the effectiveness of the state HAP was overwhelmingly the heat-related death metric and the emergency department visits related to heat. The state currently tracks the number of emergency departments participating in up-to-date data sharing, noting 91 out of 98 EDs in Arizona participating. Additionally, engagement from social media campaigns influence's the interviewee's perception of effectiveness, noting that their 600 posts in 2025, and over a quarter million impressions "...is really great!"

When asked to rate the effectiveness of the plan on heat-health outcomes, the interviewee reflected that in terms of its effectiveness in improving heat-health outcomes, the plan would be between a 3.0 or a 3.5 out of 5. They noted that "...if we we're seeing our heat-related deaths going down to near zero, we'd be at a 5, right? I mean, honestly, that is the overall goal that we want to see here. But I think we've made some really great strides...". They suggested that perhaps the plan ought to be "more ambitious" and "include measures that we're not yet able to implement, but we're working towards implementation."

In general, the interviewee highlighted positive impacts such as widespread breaking of silos in inter- and cross-governmental departments and increased awareness of heat risks. The most effective strategies appeared to be recurring and practical measures, such as cooling centers, communication campaigns, and real-time data and surveillance.

III. Evaluation Metrics

The state has used an annual internal reflection for 2024 but is planning on conducting a formal evaluation for efforts in 2025. The interviewee mentioned that their department did quite a bit of research and outreach to the federal government over the last year and found that it was "...very difficult to find appropriate assistance to look at the evaluation of heat". The 2025 evaluation will include the contracting an external entity to provide a holistic evaluation of the HAP.

Overall, evaluation thus far has focused on tracking actions and measuring outcomes but hasn't yet developed processes or procedures for evaluating the actual effectiveness of measures in the plan. The State is currently collective data and/or tracking metrics for cooling center utilization, substance use disorder data, heat-related morbidity, heat-related emergency room utilization, outdoor worker heat-related incident data.

IV. Goals & Metrics

The State of Arizona's HAP is embedded within a wider policy framework, having to fit within the context of already ongoing heat plans in cities and counties, as well as accommodating and guiding new plans in the state. As one interviewee explained, "we have so many people knocking on our door wanting to see what we do, because they're struggling too...".

Performance metrics are widely collected and now publicly available with an update time of 3

State of Arizona, United States

times per week, providing rare access to widespread heat-health data. However, the interviewee noted that there are several metrics that the state does not yet collect or would like to update their method of data capture such as standardizing cooling center data information, economic data, expanding vulnerability and demographic data, and increased access to more granular medical examiner data.

The interviewee recognized that the HAP had a mix of short-term and long-term strategies, mostly focused on management over mitigation, and guiding theme of the plan is state-wide coordination. A primary metric of success for the plan overall would be when heat-related deaths are at zero. The primary focus of the plan at this time is four-fold, “We're looking at expanding preparedness across our state, which is a huge goal. We're looking at expanding relevant workforce. We're looking at expanding our heat relief site and cooling site networks, and [finally] we’re looking at innovative ways when it comes to housing, and cooling, across the state”.

V. Resources & Capacity

The State of Arizona demonstrates strong institutional capacity, with a clear governance structure, dedicated review structures, and coordination across sectors. Implementation is generally successful but still constrained by financial limitations and inter-agency complexity. For example, incorporating heat-related personnel in the state housing policy discussions would help, and having better integrated data from economic and medical offices would improve the precision of some HAP strategies.

The interviewee noted that they’ve achieved a high leadership capacity to meet challenges faced in the coordinating of many departments cross-governmentally. However, it was noted that there is a “heavy reliance” on the over 400 community partners that the actions in the HAP rely on to provide the on-the-ground effort. Despite strong governance, the plan would be “dead in the water” without these informal, largely volunteer based collaborative relationships built across the state.

VI. Proposed Recommendations for Effective Heat Action Plans

Advice for other cities or states included strengthening governance and coordination mechanisms as well as beginning efforts, no matter the scale. “Just start somewhere. Whether it's in your government meetings, or planning meetings, or working with your stakeholders, bring up heat in the conversation, and how you're going to attend to it. ...You can't, you know, really treat heat as a standalone public health issue,” said the interviewee. Additionally, incorporating continual review into implementation, tracking, and evaluation is key. “If you just think you’ve written it up once and you’re good to go for a decade, you are sorely mistaken”.

Key areas for improvement in the State of Arizona’s HAP include expansion of measures and tracking into economic, housing, and mortality data to create holistic measures and shift from reactivity to proactivity. Overall, the plan is well-integrated and widely implemented, but its effectiveness has yet to be evaluated informally or formally. Intentionality in assigning ownership and access; Assign points of contact for key partners; Avoid blanket and blasting leadership, find points of contact that will reliably deliver messages to partners or areas; Systematic and integrated network of data; Increase the scope of what heat-related metrics are: Beyond public health data and into housing, weatherization, economic modeling, causality data, effectiveness measures, etc.