Duke NICHOLAS INSTITUTE *for* ENERGY, ENVIRONMENT & SUSTAINABILITY



Confronting Heat Challenges—Cross-Sector Strategies for National Resilience

A Report from the 2024 HeatWise Policy Partnership Summit

The Heat Policy Innovation Hub

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The Nicholas Institute for Energy, Environment & Sustainability at Duke University accelerates solutions to critical energy and environmental challenges, advancing a more just, resilient, and sustainable world. The Nicholas Institute conducts and supports actionable research and undertakes sustained engagement with policymakers, businesses, and communities—in addition to delivering transformative educational experiences to empower future leaders. The Nicholas Institute's work is aligned with the Duke Climate Commitment, which unites the university's education, research, operations, and external engagement missions to address the climate crisis.

The Heat Policy Innovation Hub

The Nicholas Institute's Heat Policy Innovation Hub is the first program in the United States dedicated to cross-disciplinary innovation on extreme heat policy and practice. Located in a region profoundly affected by extreme heat, Duke University is particularly well-situated to influence—and potentially transform—our nation's approach to this critical issue. The Heat Policy Innovation Hub brings together Duke's globally recognized expertise in medicine, health, policy, engineering, the environment, and ministry.

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Preface

Heat is a deadly hazard, posing severe risks to human health and contributing to more fatalities than often recognized. Its devastating impact on human health, well-being, and regional economies—including workforce productivity, operational costs, and the stability of critical industries—has not received as much attention as warranted given the magnitude of its impact (Hsiang et al. 2017). This oversight is particularly acute in the Southern United States, where susceptible populations, under-resourced communities, and key economic sectors are most at risk.

Climate scientists warn of longer, more intense heat seasons, with increasingly hot days and persistently warmer nights. Many communities are already grappling with the early effects of these changes. Adapting to rising heat stress requires structural reforms in heat governance, such as establishing cooling standards, revising building codes, and enhancing worker protections. However, the current policy landscape offers little protection against the dangers of extreme heat. Even when policies exist, they often fail to include the voices of disadvantaged communities and key stakeholders, resulting in ineffective or impractical solutions. This exclusion not only leaves at-risk populations unprotected but also jeopardizes investments and private sector interests by creating strategies that are unsustainable or misaligned with on-the-ground realities.

There is also a risk that communities will not fully capitalize on the historic federal investments in climate resilience made by the Biden administration, as access to these funds—especially for the communities most in need—is hindered by complex bureaucratic processes and limited capacity to navigate and manage them. Without focused attention and resources dedicated to inclusive policymaking and ensuring that the investments made through those policies are accessible to the groups that need them, both communities and economic interests remain vulnerable to the escalating impacts of heat.

The record-breaking heat season of 2023 revealed the inadequacy of existing policy measures to tackle this growing challenge (NOAA 2024), prompting new political will and global attention to heat, as highlighted at the 2023 UN Conference of the Parties meeting on climate change (COP28). Despite this momentum, a leadership void remains in the United States. The HeatWise Policy Partnership—a brain trust of leaders committed to accelerating extreme heat solutions—was designed to meet this moment. The Heat Policy Innovation Hub (HPIH) at Duke University's Nicholas Institute for Energy, Environment & Sustainability is the first program in the United States dedicated to cross-sectoral engagement for policy solutions on extreme heat. Recognizing that innovative and effective solutions require public-private partnerships and close engagement with at-risk communities, the HPIH organized the inaugural HeatWise Policy Partnership Summit. This first-of-its-kind, three-day forum brought together experts, policymakers, business leaders, and community representatives to foster collaboration and establish a leadership coalition aimed at mitigating the impacts of rising temperatures on health, the environment, and the social and economic well-being of communities.

The HeatWise Summit is a key component of a cyclical two-year program that encompasses stakeholder engagement, event planning, biannual convening, reporting key findings, and outreach to policymakers. During the 2023 engagement phase, HPIH Director Ashley Ward held regular meetings with legislators and agency leaders at the federal, state, and local levels, as well as with leaders from the philanthropic, finance, and insurance sectors, and community and faith-based organizations. These discussions informed the three core themes for the inaugural HeatWise Policy Partnership Summit:

- **Rural Heat Vulnerability:** Developing tailored strategies for rural contexts, considering unique characteristics and needs of rural populations
- **Data for Risk, Exposure, and Impact:** Addressing data gaps in heat mitigation and resilience for informed decision-making
- **Blended Finance and the Future Role of Insurance:** Exploring financial tools for mitigating heat impacts through public-private partnerships

The Summit convened 106 participants, including participants from civil society (10), the private (23) and public sectors (19), community organizations (23), academia (27), and philanthropy (4), marking a significant step toward building a coalition to confront the escalating threat of extreme heat. Participants were asked to summarize a key takeaway from the event in a post-event survey (see Appendix). These takeaways reflect a broad consensus on the need for immediate action, collaboration, and targeted approaches to address the challenges posed by extreme heat, particularly for the most disadvantaged populations.

As written and adopted, this report seeks to capture the essence of participant conversations, but individual participants may not agree with every aspect of the report. Rather, in affixing their name as a signatory, a participant is signaling support for the overarching concept of the series and the broad outcomes discussed herein. The participants took part in their individual capacity and their affiliations and titles are included here for identification purposes only. Their organizations are not responsible for the findings, principles, recommendations, or other content of this report.



Welcome event at the NC Museum of Life and Science.

EXECUTIVE SUMMARY

Key Findings

- Systemic disinvestment, compounded by isolation and poverty, is a key driver of heat vulnerability in rural and tribal communities. Addressing both immediate and systemic challenges in these areas requires context-specific approaches and cross-sector collaboration.
- The government's response to heat-related challenges is not well-understood. Existing systems and policies are inadequate to address heat as either a chronic or an acute stressor. New frameworks and approaches are urgently needed to guide future actions and focus the work. An integrated approach across sectors and levels of government is critical.
- Engaging sectors such as finance, insurance, and technology can drive significant change, while health insurance and utility companies are currently under-engaged in discussions. Additionally, the impacts of heat on the private sector, including operations, logistics, and transportation, are largely overlooked, representing untapped opportunities for engagement.

Rural Heat Vulnerability

- Rural areas face a dangerous convergence of outdated housing, grid instability, and unaffordable energy costs, creating a cycle of heat vulnerability.
- Limited access to healthcare, strained emergency services, and widespread substance abuse and mental health challenges in rural areas collectively exacerbate heat vulnerability and delay critical care during emergencies.
- Rural communities face distinct occupational vulnerabilities often overlooked by existing or proposed protections, highlighting the need for a federal baseline to safeguard workers' rights.

- Addressing heat vulnerability in rural and tribal communities requires a place-based, integrative approach that considers their unique governance structures, engages private sector partners, is based on the latest research, and centers community perspectives.
- Effective heat resilience in rural areas requires trusted local messengers, an understanding of the diverse needs of subpopulations, and a focus on relatable concerns and tangible solutions.

Data for Risk, Exposure, and Impact

- Businesses, individuals, and policymakers struggle to effectively assess and manage heat-related risks because of fragmented information, conflicting priorities, and a lack of standardized metrics and shared goals. This leads to inadequate preparation, inconsistent policy responses, and increased vulnerability to extreme heat events.
- Despite significant advancements in the spatial and temporal resolution of climate data, without a central coordinator to synthesize this data into community-relevant applications, the impact is limited.
- Differences in temporal and spatial resolution between climate and impact data, coupled with fragmented data across sectors, obscure the full effects of heat events, mask localized risks, and hinder comprehensive analysis and informed decision-making.
- To bridge critical data gaps in rural areas, researchers must confront entrenched assumptions about rural communities and recognize the unique social, economic, and historical factors that shape their resilience.

Blended Finance and the Future Role of Insurance

- Financial tools traditionally applied to physical infrastructure are expanding to encompass heat mitigation and soft infrastructure needs, revealing a largely untapped resource for heat resilience strategies.
- The absence of clear, long-term federal policies disincentivizes private-sector investment in addressing extreme heat, as the private sector thrives on stable rules that enable sustained investment.
- Innovative collaborations between government agencies, communities, and insurers are emerging as powerful tools to enhance heat resilience.



Talk by Jeff Goodell (author of The Heat Will Kill You First: Life and Death on a Scorched Planet*).*

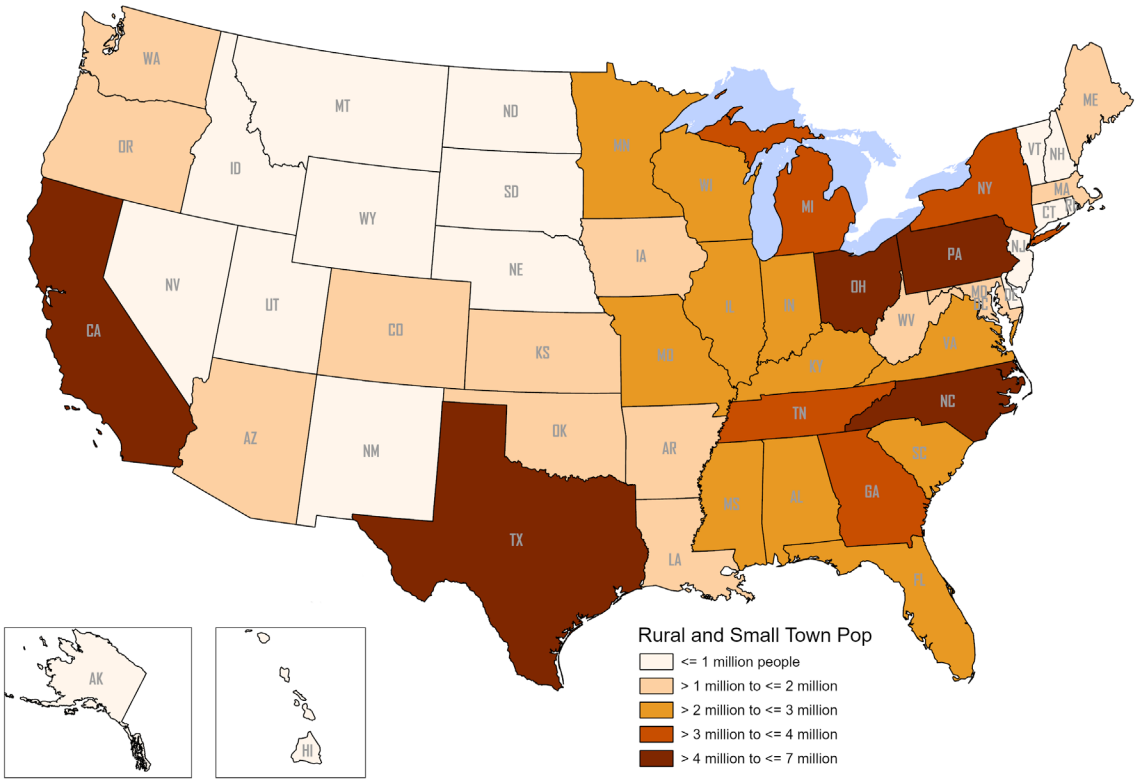
RURAL HEAT VULNERABILITY

Rural communities are particularly susceptible to extreme heat as a result of systemic disinvestment and limited access to critical resources (Cromartie et al. 2020). The low population density and ongoing population loss in rural areas further threaten economic security by reducing the tax revenue base, making it more difficult to address the underlying issues that exacerbate heat risk. This lack of resources often results in inadequate access to information, news, and broadband transmission, hindering rural communities' ability to stay informed and connected during heat events (FCC 2021).

Limited healthcare access compounds the impact of heat-related health issues, particularly for those with chronic conditions or who take medications that impede the body's ability to thermoregulate (SCORCH 2024). Additionally, rural housing is often insufficient to provide adequate protection from extreme temperatures (HAC 2018), and high poverty rates contribute to energy poverty, where even those with access to air conditioning cannot afford to use it (DOE 2019). Furthermore, the remoteness of rural areas and the logistical challenges of transporting at-risk rural community members to cooling centers means rural communities have fewer options for providing cooling respite than urban areas. This section explores how these factors contribute to the heightened vulnerability of rural populations.

We acknowledge that heat is an amplifier of historic disinvestments across both urban and rural regions. However, recent efforts have focused primarily on quantifying and addressing the urban heat island effect. While urban investments, such as cooling centers, impact a greater number of people, these solutions are often not transferable to rural communities and do not adequately address rural heat vulnerability, inadvertently leaving these areas behind.

Figure 1. Rural and small town population by state



Notes: Rural and small town population is the inverse of high population areas. High population areas are a subset of the Census Bureau's urban areas and is defined as urban areas containing 50,000 or more people with a population density of at least 1,000 people per square mile. The total rural and small town population in the US is 95,321,968 million; the total high population area population in the US is 236,127,313.

While much of the nation is urbanizing, there are large numbers of people who live in rural and small town areas for whom many urban solutions to extreme heat are not transferrable.

Housing, Energy, and Extreme Heat Vulnerability

> Rural areas face a dangerous convergence of outdated housing, grid instability, and unaffordable energy costs, creating a cycle of heat vulnerability.

In rural areas, aging and poorly insulated homes, such as older farmhouses and mobile homes, are ill-equipped to protect against extreme temperatures, leaving residents increasingly vulnerable to extreme heat (Joint Center for Housing Studies of Harvard University 2019). Efforts to retrofit these homes are hindered by outdated building codes and limited resources. Energy poverty forces families to choose between cooling and other essentials, often leading to housing insecurity (DOE 2019).

Power outages during heat waves disproportionately affect rural populations (Do et al. 2023). As extreme heat drives up electricity demand, rural grids—already vulnerable due to delayed upgrades—face severe stress (Lin et al. 2022). Geographic isolation and limited repair resources can extend power restoration times to days or even weeks, exacerbating

the dangers during heat events (Do et al. 2023). These outages are particularly dangerous for at-risk populations such as the elderly and those with chronic health conditions (Dugan et al. 2023). Even when the grid remains operational, skyrocketing energy costs during peak usage puts low-income households at risk of utility shutoffs, which can be life-threatening during heat waves (ACEEE 2020). While the Low-Income Home Energy Assistance Program (LIHEAP) is designed to alleviate the burden of energy costs, it primarily focuses on winter heating needs and falls short of addressing extreme heat in rural areas (LIHEAP 2021, Jensen 2023). Funds are typically disbursed in January, leaving little support available when summer heat waves hit (HHS 2020). This timing issue, combined with rising costs and inconsistent service, contributes to growing distrust in utilities and undermines efforts to integrate heat resilience into broader energy strategies. LIHEAP has a contingency fund that can be deployed at the discretion of the President and the Secretary of Health and Human Services, but it has not received congressional appropriations since 2011 (HHS n.d.).

Addressing these intertwined challenges requires coordinated strategies to enhance financial assistance programs, promote energy efficiency upgrades, and modernize the energy grid. Integrating heat mitigation into housing policies through initiatives like the Department of Energy's weatherization assistance programs and Housing and Urban Development's (HUD's) disaster recovery efforts offers a path forward for rural populations. By balancing immediate relief with long-term resilience, communities can be better protected against the compounded impacts of heat and energy poverty, which climate change continues to intensify.

Utility shutoff moratoriums have been one response to protect low-income households; however, relying solely on these moratoriums is unsustainable. While they provide temporary relief for low-income consumers, depending upon their states' policies, they may push small utilities toward financial instability and leave households accumulating debt, deepening long-term financial burdens (Andre et al. 2024). This dynamic threatens service availability and drives up costs for all customers. It also presents an opportunity for innovation in other sectors to develop financial or insurance products that cover energy costs for qualifying residents. Paired with more targeted moratoriums, these solutions could provide a sustainable approach to ensuring energy access while protecting both consumers and utilities. In addition, investments in grid modernization, decentralized energy solutions like microgrids, and targeted infrastructure upgrades are critical (Lin et al. 2022). By embedding heat resilience into broader energy strategies at state and federal levels, rural communities can better withstand the mounting risks posed by extreme weather and rising temperatures.

Health and Healthcare: A Crisis of Access and Compounding Risks

> Limited access to healthcare, strained emergency services, and widespread substance abuse and mental health challenges in rural areas collectively exacerbate heat vulnerability and delay critical care during emergencies.

Rural communities experience higher rates of chronic health conditions like cardiovascular, renal, and respiratory disease, which heighten sensitivity to heat-related illnesses (SCORCH 2024). These conditions are often poorly managed as a result of limited healthcare facilities, ongoing hospital closures, inadequate insurance coverage, distance to medical facilities, and high out-of-pocket costs. The lack of regular check-ups, screenings, and preventive care leaves many conditions untreated or poorly managed, exacerbating risks during heat waves.

Financial barriers and the inconvenience of accessing care often cause residents to downplay or ignore heat-related symptoms until conditions become severe, delaying intervention and further increasing risk.

Compounding the lack of access to care, emergency services in rural areas are often stretched thin, with fewer hospitals and personnel struggling to meet demand during extreme heat events. It is common in rural areas for emergency medical personnel to hold multiple public service roles, limiting their capacity to respond effectively to these events (RHIhub 2024). The unique nature of extreme heat also adds to this burden. Unlike short-term disasters, heat waves can last for weeks or months, creating sustained pressure on emergency services and leaving communities less able to manage ongoing risks (O'Donnell et al. 2021; Mason et al. 2022).

The lack of access to medical care also extends to services for combating substance use and mental health issues, which often magnify heat vulnerability. Alcohol and opioid use impair the body's ability to regulate temperature—alcohol causes dehydration and reduces cooling capacity, while opioids depress respiratory function and disrupt thermoregulation (SCORCH 2024). Limited access to emergency care and addiction treatment in rural settings heightens these risks, leading to potentially deadly outcomes during extreme heat events. Additionally, medications commonly prescribed for depression and anxiety, such as antidepressants and antipsychotics, can impair the body's ability to cool itself, increasing the likelihood of heat-related illnesses (SCORCH 2024). These factors, coupled with high levels of isolation, magnify the impact of extreme heat and create significant barriers to managing heat risks in rural areas.

Addressing these overlapping risks requires integrated strategies. For example, health systems should adopt coordinated heat governance processes, including established protocols that activate at certain temperature thresholds, along with clinician education and public awareness campaigns. Additionally, addiction treatment programs present an opportunity to share heat safety information with at-risk populations. Embedding heat risk education into mental health and addiction services can help rural communities protect those most susceptible to heat-related illnesses, providing practical strategies to reduce exposure and safeguard health during extreme heat events.

Labor and Occupational Health

> Rural communities face distinct occupational vulnerabilities often overlooked by existing or proposed protections, highlighting the need for a federal baseline to safeguard workers' rights.

Rural economies rely heavily on industries such as agriculture, manufacturing, warehousing, construction, and prison labor—sectors where workers are frequently exposed to extreme heat. The pressure to maintain productivity, especially during peak seasons, often forces workers to endure hazardous conditions with limited labor protections and minimal regulatory oversight, increasing their risk. Furthermore, many rural workers have limited access to cooling at home. For these workers, high overnight temperatures hinder recovery from daytime heat exposure, leading to cumulative stress that increases their vulnerability to heat-related illnesses and other heat-related morbidities over time.

Outdoor Workers

Outdoor workers in agriculture, construction, and landscaping, as well as law enforcement, emergency management, and other safety personnel, are particularly at risk, spending long hours in direct sunlight under intense physical demands. Agriculture, a cornerstone of many rural economies, poses acute risks as physical exertion combined with high temperatures and humidity significantly increase the likelihood of heat-related illnesses like heat exhaustion and heat stroke. Existing regulations often fall short of addressing these specific dangers.

While adjusting work hours to early mornings or late evenings is suggested as a strategy to reduce heat exposure, it's often infeasible for many agricultural and construction jobs (OSHA 2023). Certain crops must be harvested during daylight hours to avoid spoilage, and construction tasks like roofing require daylight for visibility and safety. These limitations underscore the need for more tailored solutions that align with the specific demands of predominately rural industries.

Worker Protections: The New OSHA Rule

The Occupational Safety and Health Administration (OSHA) has recognized the dangers of extreme heat and is currently developing new regulations to protect workers (OSHA 2024). However, the rulemaking process is complex and, even with an expedited timeline, it may take years before meaningful protections are implemented. Moreover, the new OSHA rule will not extend to all workers, including many who work for state and municipal governments. Despite this, it would provide minimum standards, important in states where state governments have opted to override protections implemented by municipal governments with more lenient standards (Michaels 2023). This gap in protection highlights the limitations of relying solely on federal action and underscores the need for proactive state or local-level initiatives (Constible 2024).

Some states, such as Florida and Texas, have taken steps to override local-level heat protections for workers, weakening existing safeguards (e.g., prohibiting rest or shade protocols) for those in heat-intensive industries (Ndugga et al. 2024; Levitan 2023). While other states, such as California and Oregon, have taken proactive steps in developing worker protections from heat, these state-by-state differences in worker protections highlight the urgent need for a federal baseline that cannot be undermined by individual state policies. Without a strong federal standard, the most at-risk workers—especially those in rural areas—will continue to face disproportionate risks from extreme heat.

Indoor Workers

Indoor workers in rural manufacturing and warehouse settings also face severe heat risks. These environments can become dangerously hot during the summer as a result of the combined threat of heat events and heat waste from industrial processes, especially in facilities lacking proper ventilation or air conditioning. The physically demanding nature of these jobs, combined with mandatory protective gear, further elevates the risk of heat-related illnesses. Similar to outdoor workers, indoor employees often endure sustained high temperatures throughout their shifts with limited opportunities to cool down.

Migrant Workers

Migrant workers, who make up a substantial portion of the agricultural labor force in rural areas, face additional vulnerabilities due to isolation and cultural barriers. Many migrant workers have limited access to healthcare, are unfamiliar with their rights, face language barriers, or justifiably fear employer retaliation in the form of deportation and blacklisting, preventing them from advocating for better working conditions. These challenges are compounded by the lack of social networks and support systems, making it difficult for migrant workers to seek help or take protective measures during extreme heat events.

Prison Workers

Incarcerated individuals required to work—whether indoors or outdoors—are another highly unprotected group. Prison laborers often have little choice in their work assignments and are frequently exposed to extreme heat without adequate protection. The lack of autonomy, harsh conditions, and limited legal recourse create an especially dire situation. Compounding this issue, many prisons still lack air conditioning, meaning that prisoners return to stifling housing units after work without the opportunity to recover from heat exposure, increasing the risk of heat-related illnesses. Prison staff face similar risks, often contending with the same inadequate cooling infrastructure.

Rural occupational heat risks are complex and varied, requiring robust protections that go beyond one-size-fits-all approaches. Addressing these challenges through a federal baseline for worker protections, coupled with industry-specific strategies, is essential to safeguard rural workers from the growing threat of extreme heat.

Governance

> Addressing heat vulnerability in rural and tribal communities requires a place-based, integrative approach that considers their unique governance structures, engages private sector partners, is based on the latest research, and centers community perspectives.

The disproportionate focus on urban heat islands has created a governance gap in rural areas, where unique vulnerabilities to extreme heat are often overlooked. Current strategies that concentrate on city-level interventions fail to meet the distinct needs of rural and tribal regions. To build rural heat resilience, a shift toward a whole-of-state approach that integrates efforts across public agencies at every scale is crucial. This type of approach encourages collaboration across agencies and ensures equitable investment. Rural communities and tribal regions operate under governance structures that demand tailored strategies. Unlike urban areas led by municipal governments, rural governance relies heavily on county commissioners, tribal governments, and state-level actors. These entities are key to implementing and sustaining heat mitigation efforts, yet they remain underrepresented in state and federal resilience planning.

The focus on city-level solutions often ignores the complexities of rural governance. Without adequately engaging localized structures, resilience strategies miss the mark for rural communities. Listed awards on the websites of federal programs—like National Integrated Heat Health Information System's (NIHHIS's) heat mapping campaigns, the Federal Emergency Management Agency's Building Resilient Infrastructure and Communities, and HUD's Community Development Block Grants—reveal a funding disparity, with urban areas receiving the bulk of investments, leaving rural and tribal communities under-resourced for heat resilience.

A coordinated, whole-of-government approach is the most efficient and effective method to address pervasive heat vulnerability. Federal agencies must further align their efforts in a cohesive strategy that integrates rural and urban priorities, ensuring both benefit from comprehensive planning and investment. However, effective governance also hinges on building local capacity and fostering coalitions among local governments, nonprofits, and community organizations. For example, appointing dedicated heat officers who understand rural challenges and integrating rural perspectives into state-level plans are critical steps toward closing the governance gap. Supporting grassroots coalitions and initiatives like the White House's interagency working group on extreme heat can help ensure all communities receive the resources needed to adapt and build resilience. Strengthening these networks enables rural areas to actively shape strategies that reflect their specific contexts. This combined approach of top-down coordination and bottom-up capacity-building ensures strategies are comprehensive and rooted in the communities they serve.

The private sector also plays a crucial role in rural heat governance. In rural areas, much of the critical infrastructure—including manufacturing facilities, medical facilities, construction firms, and agricultural operations—is privately owned (Cromartie et al. 2020). These entities control key assets that directly impact the region's ability to manage extreme heat risks. Integrating private-sector interests into heat governance can amplify the effectiveness of mitigation strategies by aligning business operations with community resilience goals. For example, public-private partnerships are essential for mobilizing resources, modernizing infrastructure, and implementing effective heat mitigation. Engaging private companies in planning processes enables rural governance models to leverage the resources and expertise these entities provide, ensuring that economic drivers are aligned with the strategies needed to address escalating heat risks.

To further complement these efforts, incorporating qualitative research and oral histories is an underutilized yet innovative approach to informing rural heat governance. Rural residents possess deep knowledge of local challenges, which data-driven methods often overlook. Capturing these narratives provides invaluable insights that shape policies attuned to the realities of rural life. These stories can also be a powerful way to build empathy and understanding among policymakers and the public. Universities can play a key role in gathering these insights, leveraging their social science expertise to inform more effective policies.

Communication and Trust

> Effective heat resilience in rural areas requires trusted local messengers, an understanding of the diverse needs of subpopulations, and a focus on relatable concerns and tangible solutions.

Building extreme heat resilience in rural and marginalized communities hinges on the involvement of trusted local messengers who can deliver culturally relevant, action-oriented information that addresses immediate community needs. Using messengers like schools, libraries, faith-based organizations, fire departments, health providers, weather broadcasters, and even familiar community spaces like grocery stores, hair salons, and barber shops can enhance engagement and preparedness. For example, nurses—among the most trusted communicators of healthcare information—can play a key role in raising awareness about heat risks. These entities, being trusted and highly accessible, are well-positioned to communicate practical, actionable information about heat safety and resilience. This approach

is especially crucial in communities with diverse subpopulations that have unique needs. Tailored communication strategies are essential for reaching these groups effectively, particularly when considering language barriers and concerns, such as fears of deportation among immigrant populations.

Effective strategies must also consider the realities of rural life. Simply advising people to stay indoors is insufficient when many rural homes lack adequate cooling and insulation, making indoor conditions as dangerous as outdoor ones. Moreover, many people prefer to stay at home during extreme heat events, and some may not have the option to leave because of mobility or transportation issues. Local solutions should focus on making homes safer and more comfortable by combining heat safety information with support for practical measures that improve daily living conditions. Women play a central role in building community resilience, particularly in rural areas where they are often primary family caregivers and decision-makers. Empowering women to take leadership roles in heat resilience initiatives can significantly enhance their effectiveness. By involving women in the planning and implementation of heat mitigation strategies, rural communities can tap into a vital resource for building stronger, more resilient responses to extreme heat.

While addressing climate change is crucial at the policy level, when communicating heat solutions to individuals, it's often more effective to focus on immediate, actionable steps for personal and community safety rather than debating the root cause. Reframing the conversation from climate change to a more immediate focus on heat resilience can engage rural communities more effectively. The abstract nature of climate change can feel disconnected from daily experiences, and the topic is often politically polarized. Cultural perspectives in many rural areas also shape how people view environmental issues, with some finding it difficult to align the concept of human-driven climate change with their spiritual beliefs. By focusing on the tangible, immediate threat of extreme heat—an issue directly impacting health, livelihoods, and daily life—communication becomes more culturally relevant and resonates more deeply with local values and perspectives.

Focusing on practical solutions like improving home cooling, protecting workers from heat stress, and safeguarding vulnerable at-risk populations makes discussions more relevant and actionable. This shift in framing fosters greater community involvement and support for local heat mitigation efforts. It also allows for more inclusive dialogue that respects the diverse perspectives and priorities of rural communities, leading to more effective and sustainable resilience strategies.



Panel during the HeatWise Policy Partnership Summit.

DATA FOR RISK, EXPOSURE, AND IMPACT

This session revealed gaps, inconsistencies, and underutilized resources in efforts to mitigate, adapt, and build resilience to extreme heat. Despite the availability of large amounts of climate and environmental data, significant challenges remain in effectively leveraging this information to address extreme heat risks. Some decision-makers are overwhelmed by the volume of data, resulting in inaction, while at the local level, critical data gaps inhibit decision-makers' ability to identify effective interventions. This data differential is further complicated by the abundance of private-sector data that remains unutilized for public benefit. The result is a paradoxical situation: in some instances, there is ample data but an inability to turn data into actionable solutions, while in others leadership is operating with limited information, particularly where local decision-making is most crucial.

Fragmented Information and Lack of Standardization

> Businesses, individuals, and policymakers struggle to effectively assess and manage heat-related risks because of fragmented information, conflicting priorities, and a lack of standardized metrics. This leads to inadequate preparation, inconsistent policy responses, and increased vulnerability to extreme heat events.

Efforts to enhance heat resilience face significant challenges as a result of the divergent goals of organizations involved in data collection, analysis, and application. For example, public health departments may prioritize tracking heat-related illnesses, while urban planners focus on infrastructure resilience and industry on labor loss. This misalignment results in a fragmented data landscape where complementary datasets are held by various organizations, inhibiting the development of coordinated heat resilience strategies. Furthermore, the disconnect between the priorities and incentives for scientific data collection and the needs of policymakers complicates the process. Scientific research often lacks the economic and social context required for policymakers to justify new initiatives or is presented in formats that are inaccessible to nonscientific audiences. Moreover, research timelines do not always align with the urgent needs of policymakers, leading to delays in translating scientific insights into actionable policies.

This fragmentation extends beyond differing priorities. Data are often dispersed across multiple sectors and agencies, creating substantial barriers to developing a comprehensive understanding of heat risks. Siloed information leads to incomplete risk assessments and inefficient resource allocation. Reliance on separate data sources may also result in conflicting public communications, potentially undermining trust and effective response efforts. The time required to gather and synthesize data from varied sources further slows decision-making processes, delaying critical responses to heat-related emergencies.

These issues are exacerbated by the absence of a standardized taxonomy for assessing heat risks across jurisdictions. Without universally accepted metrics, it is nearly impossible to compare data across regions or sectors, evaluate the effectiveness of interventions, or establish consistent policy responses. For example, one region might assess heat risk based on vulnerability factors like age and underlying health conditions, while another region emphasizes infrastructure readiness, such as cooling center capacity or shaded public spaces. This discrepancy can lead to conflicting risk assessments and inconsistent guidelines, even between neighboring regions: one city might assess heat risk using air temperature thresholds, while another uses a combined index that includes humidity and wind speed. As a result, determining the most effective interventions across different contexts becomes challenging. The lack of standardization complicates not only the assessment of heat risks but also the allocation of resources based on reliable comparative analyses. A common framework that aligns scientific rigor with policy relevance and emerging technologies could address these challenges by enabling more effective data translation and ensuring that risk assessments and policy responses are both comprehensive and cohesive.

Data Resolution Dilemma

> Despite significant advancements in the spatial and temporal resolution of climate data, without a central coordinator to synthesize this data into community-relevant applications, the impact is limited.

The past decade has seen considerable progress in climate data, particularly in spatial and temporal resolution. These advancements provide more precise insights into the spatial distribution of heat exposures and projections, creating new opportunities for detailed analysis of extreme heat risks. However, the increased complexity of high-resolution data introduces challenges in translating this information into actionable insights for communities. High-resolution data, while scientifically valuable, often lacks the local context necessary for effective heat resilience planning and response efforts. Without considering local factors that influence heat vulnerability and resilience, the practical application of this data in community-specific efforts remains limited.

Resource disparities further exacerbate this issue. Smaller communities, particularly those with limited means, may struggle to interpret and employ this data for specific use cases, widening the gap in heat resilience preparedness between well-resourced and under-resourced areas. Even when these data are available, some local decision-makers may lack the necessary data proficiency to apply it in a meaningful way. Contextualizing these large datasets for practical use in local heat resilience planning can impose a significant barrier, as decision-makers—ranging from municipal planners to public health officials—may not have the tools or guidance to integrate complex climate data into their decision-making processes.

NIHHIS is a partnership between the National Oceanic and Atmospheric Administration, the Centers for Disease Control and Prevention, and the FEMA. It is the established federal lead on coordinating the response of more than 30 federal agencies. Given NIHHIS' position across these agencies, respectively tasked with environmental, health, and disaster data collection and management, NIHHIS is the appropriate mechanism to contextualize and synthesize this data. However, insufficient congressional support prevents NIHHIS from reaching its full potential to lead effectively and engage across sectors and organizations. There are significant funding disparities across federal programs. Some programs, such as those related to drought, receive substantial congressional support; others, like NIHHIS, are disproportionally underfunded. Without support for this recognized lead, valuable climate data remain underutilized or misaligned with the needs of those on the front lines of heat resilience. A concerted approach is needed to bridge this gap, ensuring that scientific advancements translate into practical, community-level strategies for mitigating heat risks.

Interoperability Issues

> Differences in temporal and spatial resolution between climate and impact data, coupled with fragmented data across sectors, obscure the full effects of heat events, mask localized risks, and hinder comprehensive analysis and informed decision-making.

The disparity in temporal resolution between climate and impact data presents a significant barrier to fully understanding the consequences of heat events. Climate data are often available at an hourly resolution, whereas impact data—covering public health outcomes, economic losses, and infrastructure stress—are usually aggregated at coarser time scales, such as weekly or monthly intervals. This temporal mismatch makes it difficult to link specific heat events with their associated impacts. For example, a brief but intense heat wave might trigger immediate health issues, yet if health data are only available monthly, attributing these outcomes to the event becomes nearly impossible. This misalignment not only obscures the true scope of heat impacts but also restricts the ability to deploy timely and targeted interventions.

Spatial inconsistencies compound the problem. While climate data can provide high-resolution insights into localized phenomena, such as urban heat islands, impact data are often aggregated at much broader scales, such as citywide, countywide, or even statewide levels. This spatial mismatch masks critical localized risks. For instance, a neighborhood might experience heightened heat exposure, but if health outcomes are only reported city-wide, the localized impacts remain hidden, hindering responsive resource allocation and intervention. The disconnect between granular climate data and aggregated impact data creates significant gaps in understanding how heat-related risks are distributed within communities.

Beyond these temporal and spatial issues, data fragmentation across sectors further impedes comprehensive analysis and informed decision-making. Heat-related impacts span multiple sectors including healthcare, utilities, transportation, and many others, yet data from these sectors remains siloed, with limited capacity for integration. The inability to cross-analyze this data prevents researchers and policymakers from developing the holistic understanding necessary for effective heat resilience strategies. For example, correlating energy consumption patterns with health outcomes could shed light on the effectiveness of cooling strategies, while integrating transportation data with heat exposure levels could identify mobility vul-

nerabilities during extreme heat. However, the lack of interoperability, standardized formats, and shared protocols between sectors impedes such analyses. This fragmentation undermines the development of multi-sector approaches to addressing heat risks, leaving valuable insights untapped and critical vulnerabilities unaddressed.

Data Gaps in Rural Areas

> To bridge critical data gaps in rural areas, researchers must confront entrenched assumptions about rural communities and recognize the unique social, economic, and historical factors that shape their resilience.

Rural communities are particularly disadvantaged by significant data gaps, which make them more vulnerable to extreme heat and hinder their ability to build heat resilience. Inconsistent observation methods, limited real-time monitoring infrastructure, and historical disinvestment leave these areas "data-blind," preventing decision-makers from accurately assessing heat-related vulnerabilities. This lack of timely, localized data also obscures important distinctions in heat risk across different rural communities, especially in sectors like agriculture and manufacturing that dominate their economies. Addressing these gaps requires more than just technological solutions; it involves building trust with communities wary of external data collection due to past experiences and promoting localized, community-led data initiatives that reflect the specific needs and concerns of rural populations.

Understanding rural America's vulnerability to extreme heat requires moving beyond outdated assumptions, particularly regarding economic drivers and historical disinvestment patterns. Recognizing these realities is crucial for accurate analyses and for developing tailored resilience strategies that reflect the specific needs of rural populations. However, addressing these issues is not solely a matter of gathering more data; it requires overcoming deep-seated distrust in many rural areas. This distrust often stems from historical marginalization and concerns over data sovereignty, with communities often wary of sharing sensitive information due to negative past experiences with government or private entities.

Data collection in rural settings is inherently an equity issue. The lack of robust and consistent data in these areas perpetuates disparities by limiting the ability of rural communities to advocate for resources or develop effective heat resilience plans. Poorly designed reporting mechanisms can further burden already resource-strapped communities. Tackling these issues demands localized, community-led data initiatives that prioritize the needs and concerns of rural populations. Such efforts not only build trust but also ensure that data collection aligns with community values and offers local control over information.

Ultimately, bridging these data gaps and overcoming systemic challenges requires targeted and intentional approaches. This goes beyond merely increasing the volume of data collected; it necessitates gathering data in ways that are contextually appropriate and fully supported by local communities. By empowering rural populations to take the lead in these efforts, it becomes possible to overcome historical barriers, capture more accurate datasets, and, ultimately, develop more effective heat resilience strategies tailored to the unique circumstances of rural America.



Panel during the HeatWise Policy Partnership Summit.

BLENDED FINANCE AND THE ROLE OF INSURANCE

Risk matching is crucial for leveraging blended finance and insurance to address extreme heat challenges. Risk is often underpriced in the current market. If risk pricing was adjusted to more accurately reflect true costs, it could lead to economic shocks, particularly affecting disadvantaged communities (Deghi et al. 2020). While the Biden administration issued an Executive Order on Climate-Related Financial Risk and agencies are beginning to act on it (The White House 2021), the federal government and the Federal Reserve have yet to fully embrace a systemic approach to risk assessment, often overlooking the broader implications of climate-related challenges (Gómez 2019). However, financial institutions and the insurance sector are starting to recognize the importance of addressing these risks. For example, banks are increasingly requiring clients to report their climate-related risks, a practice that could drive more significant mitigation efforts (TCFD 2017). By partnering with the finance and insurance sectors, solutions can be developed that not only appropriately price risk but also encourage proactive strategies to enhance resilience against the impacts of climate change.

Innovation

> Financial tools traditionally applied to physical infrastructure are expanding to encompass heat mitigation and soft infrastructure needs, revealing a largely untapped resource for heat resilience strategies.

Applying lessons learned from infrastructure financing reveals the potential to develop funding mechanisms that support proactive, community-level heat resilience projects. One promising approach to lowering transaction costs and increasing efficiency is bundling multiple heat resilience projects together. Bundling allows for economies of scale, making it feasible to finance smaller projects that might otherwise be overlooked. By aggregating projects across regions—particularly in rural areas—communities can access larger pools of capital, enabling them to implement comprehensive heat mitigation strategies tailored to their unique challenges.

This concept of blended financing for heat resilience can be further expanded by adapting and leveraging existing financial tools traditionally used for other types of infrastructure. State revolving funds (SRFs) are essential financial mechanisms that provide low-interest loans to support a wide range of public infrastructure projects, ensuring sustainable investment through the reinvestment of loan repayments. While SRFs have traditionally focused on hard infrastructure, with the most prominent examples being clean water and drinking water SRFs, there are many other SRFs dedicated to various sectors, such as environmental cleanup and transportation infrastructure (GFOA 2024). The Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM) Act of 2021 established a new fund specifically for climate resilience, including extreme heat mitigation (FEMA 2023). Although relatively new and not yet implemented in all states, the STORM Act offers flexibility that could potentially support soft infrastructure projects, such as community-based heat resilience programs (CRS 2023).

Green banks, financial institutions designed to accelerate private investment in clean energy and climate resilience, also play a vital role. By partnering with state revolving funds, Green banks can provide the expertise and capital necessary to develop and deploy innovative heat resilience solutions at scale. This collaboration can help bridge the gap between public funding and private investment, ensuring that communities have the financial tools needed to protect themselves from the increasing risks associated with extreme heat.

Through these approaches—bundling projects, leveraging the STORM Act, and enhancing the role of green banks—communities can develop more resilient infrastructure. These strategies not only mitigate the immediate dangers of extreme heat but also strengthen the overall capacity to adapt to a changing climate, effectively expanding traditional financial tools to meet emerging heat resilience needs.

Role of Government in Catalyzing Investment

> The absence of clear, long-term federal policies disincentivizes private-sector investment in addressing extreme heat, as the private sector thrives on stable rules that enable sustained investment.

Additionally, the private sector is less incentivized to invest when disaggregated projects with high transaction costs, reluctant consumers, and uncertain returns cannot compete with other projects with better certainty and higher returns on investment.

Government plays a critical role in catalyzing investment for heat resilience and mitigation. Federal and state policies can significantly influence private-sector engagement by creating a conducive environment for funding and innovation. By shaping market dynamics, government policies reduce the risks and provide clear guidelines, often paving the way for private investments. For instance, policies that set standards for building codes, energy efficiency, and urban planning can drive demand for heat mitigation technologies, incentivizing private investment. Governments can help identify ways to aggregate and pool discrete projects (e.g., providing air conditioning across prisons across a given state), potentially lowering transaction costs and making the investments more interesting to large investment funds. Additionally, tax incentives, grants, and subsidies for heat resilience projects can lower the financial barriers for private investors, making it more attractive for them to engage in these areas. Currently, the Departments of Energy and Treasury offer direct pay tax provisions for

tax-exempt and governmental entities (that do not owe federal income taxes) for building qualifying clean energy projects or making qualifying investments. These types of programs can provide a model for other kinds of heat-reducing investments.

However, the current policy landscape is misaligned with the realities of chronic stressors like extreme heat. Existing disaster relief laws are designed for acute, short-term events. These laws operate under the assumption that recovery involves a return to predisaster conditions with predictable environmental patterns. However, this model fails to account for the new reality of ongoing climate-related stressors or the sustained impacts of extreme heat. The absence of long-term, stable policies creates uncertainty for private investors, discouraging their participation in heat resilience projects. This situation leads to a misalignment between short-term public funding cycles and the longer timeframes needed for private investment to yield returns. Unlike established environmental frameworks such as the Clean Water and Clean Air Acts, which provide consistent guidelines over extended periods, the current approach to heat resilience lacks similar long-term, predictable rules, hindering private entities from confidently planning and executing investments in heat resilience solutions.

Further complicating sustained investments in extreme heat is continuing confusion as to whether these investments should be focused on human health impacts, infrastructure impacts, or environmental and/or climate change concerns. The way heat is defined and managed within these policies is critical. Unlike other natural disasters where a discrete event triggers the need for response, recovery, and investment, extreme heat is harder to define under a specific period of time and may vary in nature depending on the overall geography and climate of the state or community. On one hand, stronger federal policy would trigger public investment, ensuring that resources are quickly mobilized to protect at-risk populations. This could be particularly beneficial in responding to immediate crises and in building long-term resilience through publicly funded infrastructure projects. On the other hand, if public investment becomes the primary response mechanism for heat-related risks, it could potentially disincentivize private investment. Private investors might perceive heat mitigation as a responsibility predominantly shouldered by the government, reducing their motivation to develop or invest in innovative solutions.

To avoid this potential disincentive, government policies must be designed to complement rather than replace private investment. For instance, governments can adopt a blended finance approach, where public funds are used to de-risk private investments in heat resilience projects. Additionally, clear policies that outline the roles of both public and private sectors in addressing heat-related challenges can ensure that private investors remain engaged and see value in contributing to this critical area. Given the diversity of missions across the federal family of agencies, one agency should be designated as the lead agency to address extreme heat. Ultimately, the government's role should be to set the stage for robust private-sector involvement by creating policies that align public investment with market incentives. This can be achieved by ensuring that public investment addresses the gaps that private investment alone cannot fill while encouraging private sector innovation and participation in building a heat-resilient future.

Insurance Levers

> Innovative collaborations between government agencies, communities, and insurers are emerging as powerful tools to enhance heat resilience.

By leveraging new insurance products and models, such as parametric products and community-based pools, these partnerships are enabling a more integrated approach to heat resilience that aligns risk-reduction strategies with local needs and broader climate adaptation goals.

A key innovation in heat resilience financing is the development of parametric insurance products, currently piloted in international contexts (Swiss Re 2024). Unlike traditional insurance, which relies on time-consuming claims assessments, parametric insurance offers quicker payouts based on predefined triggers, such as exceeding a certain temperature threshold. For instance, a parametric insurance product could be designed with a predictive trigger for municipalities to receive funds to support cooling centers and other interventions just ahead of a heat event. This approach allows communities to receive immediate financial support during extreme heat events, bridging critical gaps while awaiting larger government interventions. These swift, targeted payouts can be crucial for addressing urgent needs, such as deploying emergency cooling measures or bolstering healthcare responses.

Another promising strategy is the creation of community-based insurance pools, which allow communities to collectively manage risk and provide a buffer against the financial impacts of extreme heat. By pooling resources, communities can access insurance coverage that might otherwise be unaffordable, particularly in regions disproportionately affected by heat. Community-based insurance pools can also be structured to incentivize proactive mitigation measures, such as investing in heat-resilient infrastructure or adopting heat mitigation technologies.

To further advance resilience efforts heat-related coverage can be bundled with other insurance products to enhance coverage and reduce costs. By integrating heat-related risks into existing insurance packages, such as property or crop insurance, communities can ensure comprehensive protection against a range of climate-related threats. This bundling strategy also encourages broader adoption of heat resilience measures by making them a standard part of risk management practices.

Risk-based pricing underpins all of these innovative insurance strategies. By setting insurance premiums according to actual heat exposure risks, insurers can encourage investments in mitigation measures that reduce vulnerability. For example, buildings with enhanced insulation or cooling systems might qualify for lower premiums, incentivizing property owners to make these improvements.

To ensure the success of these insurance strategies, education and awareness initiatives are essential. Communities and individuals need to understand the risks they face and the benefits of investing in heat resilience. This includes educating property owners about the importance of adopting heat-resistant building materials and systems, as well as informing them about available insurance products that can protect against heat-related losses.

The Underwriters Laboratory (UL) could also play a significant role in this landscape. UL develops safety standards and certification processes for a wide range of products and systems, including those related to building materials, electrical systems, and environmental sustainability. By establishing rigorous standards for heat resilience, UL can help ensure that the materials and systems used disadvantaged by consumers are capable of withstanding extreme heat, thereby reducing overall risk and enhancing the effectiveness of insurance products.

By employing these insurance levers—parametric products, community-based pools, bundling strategies, risk-based pricing, and the role of UL—government agencies, communities, and insurers can work together to build a more resilient future. These strategies not only provide immediate financial relief during heat events but also foster long-term investments in heat resilience, aligning local actions with broader climate adaptation goals.



Presession at the HeatWise Policy Partnershpi Summit.

THE PATH FORWARD

The second year of HeatWise will focus on engagement with legislative offices, national organizations representing state and local governments, and industry organizations. The purpose of these engagements will be to share the key findings of this report, foster dialogue on potential policy levers to address extreme heat, and identify specific and effective mechanisms to convert the aspirations expressed at HeatWise into policy.

To stay informed about the Heat Policy Innovation Hub's ongoing work and latest developments throughout the year, please visit our website.



Attendees at the HeatWise Policy Partnership Summit welcome event.

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APPENDIX A. KEY TAKEAWAYS

The HeatWise Summit convened 106 participants, including participants from civil society (10), the private (23) and public sectors (19), community organizations (23), academia (27), and philanthropy (4), marking a significant step toward building a coalition to confront the escalating threat of extreme heat. Participants were asked to summarize a key takeaway from the event in a post-event survey.

The key takeaways presented herein are derived from survey responses submitted by participants and do not constitute the Heat Policy Innovation Hub's comprehensive summary of the meeting, but rather a distillation of written feedback.

1. **Urgency and Action**: There is a strong emphasis on the need for immediate and decisive action to address heat-related issues, particularly those affecting at-risk communities. Some participants raised concerns about the current lack of urgency and recognition of the problem's scale.
2. **Collaboration and Coordination**: Many respondents highlighted the importance of cross-sector collaboration, including the government, the private sector, and affected communities. This includes the need for consolidated lobbying efforts at state and federal levels and better coordination between agencies and stakeholders.
3. **Focus on Disadvantaged Communities**: The most at-risk communities must be prioritized in policy decisions and resource allocation. The unique needs of these communities, particularly in rural areas, should be central to discussions.
4. **Private-Sector Involvement**: There is a call for greater leadership and resources from the private sector, especially in financing and grant writing support. The involvement of insurance companies and financial firms in addressing heat vulnerability is also seen as crucial.
5. **Frameworks and Simplification**: The need for clear, simple frameworks and definitions was mentioned, with a focus on communicating the severity of heat as a public health issue. There is a desire for basic, easily communicated information to become common knowledge.
6. **Multifaceted Approach**: Respondents advocate for a multi-agency, multi-level approach that includes both immediate and long-term solutions, recognizing that heat is interconnected with broader socioeconomic and environmental issues and requires integrated strategies.
7. **Innovation and Adaptation**: The importance of innovative solutions, such as data sharing and interagency collaboration, was discussed. Additionally, there is a recognition that different contexts (urban versus rural) require tailored solutions.
8. **Health and Societal Benefits**: Emphasizing health as a key connector, respondents called for the integration of cooling strategies with public health policies. Some respondents also suggested including insurance as part of funding solutions for heat adaptation measures.

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