

Living with Extreme Heat: Our Shared Future

March 21–22, 2023

ABOUT PERRY WORLD HOUSE

Perry World House is a center for scholarly inquiry, teaching, research, international exchange, policy engagement, and public outreach on pressing global issues.

Perry World House's mission is to bring the academic knowledge of the University of Pennsylvania to bear on the world's biggest global policy challenges and to foster international policy engagement within and beyond the Penn community.

Located in the heart of campus at 38th Street and Locust Walk, Perry World House draws on the expertise of Penn's 12 schools and numerous globally oriented research centers to educate the Penn community and prepare students to be well-informed, contributing global citizens. At the same time, Perry World House connects Penn with leading policy experts from around the world to develop and advance innovative policy proposals.

Through its rich programming, Perry World House facilitates critical conversations about global policy challenges and fosters interdisciplinary research on these topics. It presents workshops and colloquia, welcomes distinguished visitors, and produces content for global audiences and decision makers, so that the knowledge developed at Penn can make an immediate impact around the world.

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REPORT AUTHORS

Marissa O’Neill
*Master of Environmental
Studies Degree Candidate*

Lauren Anderson
*Perry World House
Program Manager*

4 INTRODUCTION

6 KEY TAKEAWAYS FOR POLICYMAKERS
REDUCING VULNERABILITY TO EXTREME HEAT 7
RAISING AWARENESS AND IMPROVING COMMUNICATIONS..... 8
CITY PLANNING: BIG AND SMALL 10
LEVERAGING TRIED AND TRUE SOLUTIONS 11
PILOTING PROJECTS 12

13 AREAS FOR FUTURE RESEARCH
HEALTHCARE..... 13
CITIES AND SOCIETY..... 13
LABOR AND INDUSTRY 13
FINANCE 14
DATA..... 14

15 APPENDIX
SURVEY RESULTS 15
PARTICIPANTS..... 17
WHAT THE EXPERTS ARE READING 18

➤ INTRODUCTION



In its latest *State of the Global Climate Report*, the World Meteorological Organization indicated that the past eight years have been the hottest eight on record.¹ In 2022 alone, almost every region from the North Pole to the Antarctic experienced heatwaves and record high temperatures. While extreme heat (and related drought and fire) events are fast becoming a new normal, policymakers have yet to sufficiently respond to their grave impacts on public health, food security, and livelihoods, especially in cities. Policymakers are also grappling with heat’s disproportionate impacts on vulnerable countries and communities—those with the least resources to adapt or protect themselves.² At the global level, the poorest quarter of the world is adapting to rising temperatures fifteen years behind the wealthiest.³

With the Intergovernmental Panel on Climate Change predicting that heatwaves will become both hotter and longer, policies are urgently needed to futureproof societal systems and services. This means anticipating and understanding the effects of rising temperatures on various sectors, industries, and segments of the global population; and pursuing novel policies, innovative technologies, and creative infrastructure to mitigate these impacts.

To build a latticework for addressing the varied and urgent policy needs associated with extreme heat, the University of Pennsylvania’s Perry World House organized the colloquium, “Living with Extreme Heat: Our Shared Future” on March 21 and 22, 2023. The first day of the colloquium brought together panels of experts to discuss how to address the impacts of extreme heat on global public health, preserve food and nutrition security, protect workers, and assure equitable heat action in urban centers. Their private deliberations form the basis of this report. The second day of the colloquium featured two public panels, accessible on the Perry World House website. The first panel addressed how to build urban resilience to heat with the Chief Heat Officers of Miami-Dade County, United States; Santiago, Chile; Freetown, Sierra Leone; Monterrey, Mexico, and the Global Chief Heat Officer, UN-Habitat. In the second panel, bestselling author Jeff Goodell discussed his book, “The Heat Will Kill You First.”

1 World Meteorological Organization. 2022. “Provisional State of the Global Climate in 2022.” <https://public.wmo.int/en/our-mandate/climate/wmo-statement-state-of-global-climate>.

2 United Nations Office for the Coordination of Humanitarian Affairs, The International Federation of Red Cross and Red Crescent Societies, and The Red Cross Red Crescent Climate Centre. 2022. “Extreme Heat: Preparing for the Heatwaves of the Future.” <https://www.ifrc.org/sites/default/files/2022-10/Extreme-Heat-Report-IFRC-OCHA-2022.pdf>.

3 Alizadeh, Mohammad Reza, John T. Abatzoglou, Jan F. Adamowski, et al. 2022. “Increasing Heat-Stress Inequality in a Warming Climate.” *Earth’s Future* 10(2). <https://doi.org/10.1029/2021EF002468>.

HEAT AND HEALTH

The colloquium opened with a conversation about the impacts of heat on public health and the recognition that heatwaves are among the deadliest of all natural disasters.⁴ Panelists emphasized the urgency of action, highlighting how heat stresses the human body, with dire consequences on health outcomes—from increased risk of cardiovascular events and respiratory diseases to declines in mental health, including in children. Participants highlighted worrisome trends: for instance, how rising temperatures are coinciding with societal declines in cardiovascular health, epidemic homelessness, and drug addiction. The impacts (and often inequitable impacts) of heat on health became a touchstone, with panelists revisiting the matter in subsequent discussions as they put forward approaches to tackle heat-related challenges.

HEAT AND FOOD SECURITY

This panel laid out a framework for understanding how extreme heat is changing the viability, quality, distribution, and overall availability of crops and livestock. Participants discussed how heatwaves destabilize food systems, noting that rising temperatures are not playing out uniformly or equitably and that their impacts on food security are compounded by other crises like conflict-fueled humanitarian disasters and natural catastrophes. At the micro level, discussants underscored that extreme heat also alters food utilization, changing the way people can prepare, cook, and absorb essential nutrients. They deliberated over global and local solutions that could mitigate the deleterious effects of global warming on food and nutrition security and help those most at risk—as well as their livestock and crops—to adapt to heat.

HEAT AND LIVELIHOODS

Prior conversations on health and food security informed a panel discussion on heat and livelihoods. Experts described how agricultural laborers were particularly at risk, identifying migrant laborers to be among the most vulnerable workers to the deleterious effects of extreme heat. Panelists discussed US-focused research showing how farm laborers can develop chronic health issues, like kidney damage, due to dehydration. They also looked at findings out of India indicating that domestic and informal women workers in informal settlements are at acute risk of heat stress. Experts debated what policies were needed to improve worker safety, especially for people operating with limited labor or legal protections.

HEAT AND CITIES

By 2030, approximately 60 percent of the world’s population will live in urban areas⁵—spaces prone to the “heat island” effect, which occurs when the built environment traps heat and amplifies temperatures. Over the coming years, cities will be increasingly tasked with keeping residents safe and cool while simultaneously reducing the emissions that cause global warming. In discussing policy approaches to this conundrum, experts examined the global context for policy, discussed city-level and community-based action, and advanced technological adaptations that could be employed to keep people safe from heat. As in prior discussions, participants recognized that disadvantaged communities were most at risk and emphasized the need to address thermal inequality in heat action policy planning.



The colloquium began with introductory remarks from Perry World House Senior Executive Director LaShawn R. Jefferson and Global Shifts Program Manager Lauren Anderson. Former Mayor of Quito, Ecuador Mauricio Rodas delivered the opening keynote.

4 Luxon, Linda. 2021. “Confronting the Health Challenges of Climate Change. United Nations Framework Convention on Climate Change. <https://public.wmo.int/en/our-mandate/climate/wmo-statement-state-of-global-climate>.

5 United Nations Department of Economic and Social Affairs. 2020. “Policies on Spatial Distribution and Urbanization Have Broad Impacts on Sustainable Development.” <https://www.un.org/development/desa/pd/content/policies-spatial-distribution-and-urbanization-have-broad-impacts-sustainable-development>.

> KEY TAKEAWAYS FOR POLICYMAKERS



The spring 2023 colloquium built on previous Perry World House workshops and colloquia,⁶ which investigated policy solutions to climate-driven vulnerabilities in the contexts of migration, geopolitics, and small island developing states.⁷ In line with this prior programming, academics, policymakers, and practitioners used this convening to propose solutions to protect the people and planetary systems most threatened by extreme heat. Recommended policy responses sought to bring equity and vulnerability considerations to the fore; promote awareness and communications that could improve safety; expand data and research to inform decision-making; make heat action planning in cities a priority; and scale up pilot projects that embrace a wide range of solutions.



During the first panel of the day, Sameed Khatana, MD MPH of Perelman School of Medicine and Harleen Marwah, MD MS of Children's Hospital of Philadelphia discussed extreme heat's impact on health.

6 Perry World House. "Past Global Shifts Workshops and Colloquia." <https://global.upenn.edu/perryworldhouse/past-global-shifts-workshops-and-colloquia>.

7 Perry World House. "Global Shifts: Urbanization, Migration, and Climate Change." <https://global.upenn.edu/perryworldhouse/global-shifts-urbanization-migration-and-climate-change>.

> REDUCING VULNERABILITY TO EXTREME HEAT

Vulnerability to heat has many layers, each complicating the efficacy, equity, and impacts of policy action. Public health emergencies like homelessness, poorly constructed housing (informal settlements or trailer parks), drug addiction, cardiovascular disease, and obesity put people at heightened risk of heat-related illness. Entire communities lacking access to basic services, green spaces, and other critical resources are more likely to suffer adverse health outcomes. Other risks derive from the lack of agency in the workplace. For instance, industry incentivizes agricultural labor to work as hard and long as possible by offering piece-rate wages. The legislative landscape limits the ability of migrant laborers to demand safer work conditions. In other instances, caregivers make decisions for infants and young children who cannot advocate for their needs, while at the same time, those caregivers, often women, cannot assure the safety of their own domestic work environments. Panelists discussed these compounding factors as they put forth solutions to reduce vulnerability to extreme heat.

POLICY RECOMMENDATIONS

1. Engage diverse stakeholders, especially vulnerable workers, in dialogue that informs all levels of policymaking.

Inclusive dialogue can improve understanding of heat-related challenges in the workplace, provide the opportunity to learn from past policy failures, and result in more equitable heat-related policies. Discourse should ensure that worker, employer, and government organizations are involved in the development of heat occupational health and safety standards. Topics to consider could include heat warning systems, personal protection equipment, appropriate worker clothing, working hours adjustments, and training and education to help workers and/or employers recognize and safely manage heat stress and illness. Mechanisms for communication must break down barriers that prevent laborers from voicing concerns and ideas. For instance, gender-segregated or private worker meetings can encourage freer expression.

Participants noted that the International Labour Organization has guidelines that can be referenced in the development of workplace standards on heat. Because crafting standards can take time, emergency temporary standards should be adopted as an interim safety measure.

2. Establish and resource social protection programs ahead of disasters.

Social protection programs that offset heat-driven losses in wages, illness, or other impacts should be established in advance of heatwaves. Resources should be pre-positioned to support proactive disaster and shock response. Providing financial assistance will boost people's ability to afford healthcare, food, and access to the resources they need to cope with extreme heat (such as energy). In the context of global food security, ensuring that farmers are connected with resources in advance of heatwaves will reduce the effects of heat on food supply as well as on livelihoods.

To remove access to finance as a barrier to heat action, financial systems should be reoriented to focus on providing adaptation financing to the most climate-vulnerable communities and people, both locally and globally. This means flipping the inverse relationship between vulnerability and access to adaptation resources that currently exists.⁸

3. Create heat insurance programs to cover workers, including informal workers.

Insurance programs, which compensate for many natural-disaster-related damages—for instance, destruction of property by flood or fire—should be expanded to cover heat. Heatwave insurance, however, should focus on reimbursing the cost of lost wages from the inability to work because it is too hot to do so safely. In the United States, there are insurance programs to manage heat risks to livestock and crops, but a program to support outdoor agricultural workers does not exist and should be created. In India, a program is under pilot to cover the wages that women who are informal workers lose when the temperature exceeds a certain threshold, and it is not safe to work. This pilot could be expanded to other labor communities and country contexts.

8 Perry World House. "Global Climate Finance." <https://global.upenn.edu/perryworldhouse/global-climate-finance>.



The panel on heat and healthcare discussed what can be done to improve the monitoring of extreme heat's impact on health outcomes, and how policy can support these improvements.

4. Save lives now, but plan for a clean energy future.

Bringing people out of hot environments and into cooler ones reduces heat-related mortality. Policymakers should expand access to air conditioning as an immediate, lifesaving solution but look to power it through more sustainable means and to transition to greener, cheaper cooling options.

Alternatives can be low-tech solutions such as tree planting, insulation, white roofs, shades, and reflective blankets over windows as well as higher-tech interventions like heat pumps, cool building design, and the transition to solar, wind, or other renewable means for generating power. Clean energy solutions should make heat-vulnerable communities a priority and bring all stakeholders to the decision-making table.

➤ RAISING AWARENESS AND IMPROVING COMMUNICATIONS

At the colloquium, medical doctors, public health specialists, veterinarians, soil scientists, sitting and former mayors, multilateral policymakers and researchers, urbanists, architects, and engineers all agreed: policies are needed to raise awareness of the dangers of extreme heat and to ensure that people, and the industries in which they work, make safer choices. Panelists discussed shorter- and longer-term strategies to improve the standard operating procedures of the medical and food complexes in the context of global warming and to improve the general public's understanding of what to do during heatwaves.

POLICY RECOMMENDATIONS

1. Develop national and international heat standards, along with improved health data monitoring.

To establish a uniform landscape from which to design policy, panelists recommended establishing global standards and definitions of extreme heat

and heatwaves. Currently, no such criterion exists. Their development needs to hinge on an algorithm flexible enough to account for the social, environmental, economic, historical, and other contexts that vary across geographies and demographics, and would therefore impact the definitions and application of heat standards. Panelists noted that a consensus on heatwave standards would also serve as a touchstone for communications, both improving the public's understanding of heat-related risks and helping national governments determine when to initiate a disaster response.

Participants also recommended improving health data collection and dissemination, noting that such information could be used to identify communities likely to suffer disproportionately—like low-income neighborhoods, the elderly, or children. Others highlighted that building better monitoring tools to track heat-related illness and deaths, for instance, would enable more equitable and more successful health-related interventions and outcomes.

2. Name and categorize heatwaves.

Developing categorization systems and naming conventions for heatwaves—as the United States has done with hurricanes since the 1950s—is a demonstrated way to bolster public awareness and increase citizen and government action. Some localities are already piloting initiatives. In 2022, Seville, Spain, officials made “Zoe” the first ever named heatwave. Seville’s city government’s categorization system monitors the hazards that make heat dangerous, including humidity and time of day. In another example, American city officials in Miami-Dade County, Florida, implemented an official “heat season,” which, much like a hurricane season, extends from May 1 to November 1 each year and improves the public’s awareness of heat-related hazards.

3. Implement heat early warning systems.

Experts pointed out that heatwaves are some of the most forecastable extreme weather events and that policymakers should institute heat warning systems to save lives and protect livelihoods. For example, governments can leverage agro-meteorological advisories and climate information services to communicate with farmers to give them adequate time to prepare. For successful citywide strategies, policymakers can look to Ahmedabad, India, and Paris, France. In Ahmedabad, the municipal government deployed an early warning system to make citizens aware of forthcoming heat risks and to inform them of potable drinking-water sites and cooling centers. The system also aimed to sensitize medical professionals to health problems in their communities as temperatures rose. After the devastating 2003 heatwave in France, the country’s public health and weather services collaborated to create a heatwave alert system. In addition to magnifying messaging on the dangers to health, panelists also recommended raising awareness of the financial implications of heatwaves, like those associated with negative health impacts or reduced wages and productivity, to encourage the general public, governments, and the private sector to make safer choices.



Panelists discussed the impact that extreme heat has on our livelihoods and the ways we work and looked at ways that workers could be protected from heat.

4. Expand clinician and patient knowledge.

Panelists recommended teaching medical professionals to better recognize, record, and treat heat stress in patients. This would raise awareness of the heat-health nexus in medical associations and the government agencies that draft occupational safety guidelines. It would also improve data on heat-related health illness and mortality. Other policy recommendations include developing and distributing anticipatory guidance to share with patients and their caregivers to improve the health outcomes of vulnerable groups like the elderly, children, pregnant and lactating women, and those with preexisting conditions. Panelists also recommended amplifying patient stories, as anecdotal evidence of lived experiences can expand public awareness and advance policy action.



The colloquium's panel on food security and heat raised questions of what the top threats to global food security from extreme heat, and how food systems can be restructured to better withstand extreme heat.

> PLANNING FOR CITIES

The policy response to extreme heat in cities must be robust, but policymakers must also pursue smaller and immediate solutions as they develop and implement longer-term and more comprehensive climate adaptation strategies.

POLICY RECOMMENDATIONS

1. Create opportunities for citizen science and community engagement.

Programs like the US National Oceanic and Atmospheric Administration's Urban Heat Mapping Campaigns engage youth in climate science and raise awareness about heat while also providing the city with useful data. These programs could be expanded and replicated, along with the development of heat-vulnerability maps. Maps like the Philadelphia Heat Vulnerability Index can help communities to visualize heat sensitivity and reveal overlap with socioeconomic indicators.⁹ Panelists noted that there is an important role for academic institutions to play in bridging the gap between the scientific research they advance and the application of this research to meet community needs.

2. Establish local-level leadership focused on heat action.

As one example, panelists cited a program funded by the Arsht-Rock Foundation that has helped establish chief heat officers, a city-level governance position tasked with collaborating across agencies and stakeholders to

galvanize heat action planning and implementation. The cities of Athens, Greece; Miami-Dade County, United States; Monterrey, Mexico; Santiago, Chile; Freetown, Sierra Leone; and Melbourne, Australia, currently have chief heat officers, from which lessons can be learned for policy action in other localities.

3. Create a heat action plan.

Heat action must be tailored to local needs and contexts, and this can be done through the development of heat action plans. Localities of all sizes can use heat action planning to take stock of the accessibility of essential services (like freshwater, air conditioning, electricity, and healthcare) and address shortages in advance of heatwaves. Policymakers can use the exercise to identify geographic areas or communities most at risk of heat stress and to plan targeted interventions. Heat action plans can also engender multidisciplinary collaborations, such as between government officials, urban planners, and landscape architects, to design adaptation strategies large and small.

4. Use nature-based solutions to counteract the urban "heat island" effect.

Nature-based solutions can be a sustainable and effective way to cool cities, expand recreational spaces, and provide other benefits. For instance, programs to increase tree canopies are a growing and successful approach in cities. Panelists highlighted the importance of selecting the types of trees that can withstand

9 City of Philadelphia. 2019. "Philadelphia Heat Vulnerability Index." <https://www.phila.gov/2019-07-16-heat-vulnerability-index-highlights-city-hot-spots/>.

climatic challenges like heat or droughts and ensuring there are adequate plans and budgets in place to maintain them. In Phoenix, Arizona, for instance, trees are grown in a “tall-pot nursery” to increase the strength and length of their taproot before being planted in the city. Parks in Bangkok, Thailand, have been designed to capture flood waters while also providing greener, shaded, and therefore cooler, spaces in the city.

5. Amend infrastructure.

Panelists highlighted many ways to adapt urban infrastructure to heat. Freetown, Sierra Leone, for example, is shading outdoor markets to protect vendors, most of whom are women. Cool roofs (painted white or covered in vegetation) are another low-tech solution that reduces energy demands and lowers building

temperatures. Santiago, Chile, and Philadelphia, Pennsylvania, are examples of cities pursuing cool roofs, with the latter adjusting its building codes to require them on all new commercial low-sloped buildings. Through a partnership with a local university, Phoenix, Arizona, is piloting the use of cool pavement, a coating that reflects heat and lowers the surface temperature of roads. Also in Phoenix, the Public Housing Authority is building solar shade canopies to cool recreation spaces and lower electric bills. Panelists noted that cities could coordinate cool roofs with solar paneling to lower energy demands and produce clean energy in tandem. As a caveat, panelists noted that investments in heat protective infrastructure must also withstand other climatic extremes, like storm surges or high winds that can take down trees and canopy shades and damage the built environment.



Audience members and panelists alike had a day of productive conversations discussing possible policy solutions to effects that extreme heat has on many aspects of life.

> LEVERAGING TRIED AND TRUE SOLUTIONS

There is often a large gap between innovation and real-world adoption of new technologies. When designing solutions to address extreme heat, policymakers and practitioners should employ the technologies and knowledge that are available and that can save lives now.

POLICY RECOMMENDATIONS

1. Farming with (and not against) nature.

Evidence has shown the benefits of organic and regenerative agriculture in restoring carbon to soils, which makes land more fertile and drought tolerant while also removing carbon from the atmosphere.

Policies should also focus on shifting practices away from industrial farming and monoculture to embrace more diverse crops, as well as animal breeds adapted to heat and other climatic extremes, like drought. Decision-makers should recognize and learn from indigenous knowledge of livestock and agricultural practices, for instance, shade-grown coffee.

2. Look to low-tech solutions for cost-effective and easy wins.

There are many ways that existing technologies can be employed to heat-proof (or weatherize) domiciles. Homes can be made less energy intensive and more heat resilient with changes to building materials and the

installation of insulation, efficient appliances, LED light bulbs, and ceiling fans, as well as by painting roofs white. Heat can be deflected from dwellings with cheap reflective foam or foil blankets. If applicable and where possible, heating and cooling systems can be upgraded to more efficient models.

3. Protect food security by shading people, crops, and livestock.

Policyholders should pilot and fund cost-effective solutions that protect agricultural workers and the crops and livestock that ensure food security. Solutions

include covering farm structures with heat-reflective materials and installing better ventilation systems. The practice of silvopasture—integrating trees into grazing lands—can further reduce temperatures, help the soil retain moisture, and protect livestock. Moveable shades can also help keep livestock cool and are easy to collapse ahead of extreme weather events like hurricanes that would destroy more permanent infrastructure or tree canopies. The use of moveable shades should be explored as a way to protect agricultural laborers from heat as well.

> PILOTING PROJECTS

Pilot initiatives can help communities, governments, and industries learn the best approaches to coping with extreme heat. Colloquium participants highlighted a few initiatives that policymakers should consider studying and replicating. They included:

- *Cool and Green Roofs:* Santiago, Chile, is piloting the use of green roofs with a 1,000-square-meter project on the top of a major hospital.¹⁰ In their heat action plan, the city of Ahmedabad, India, committed to pilot 3,000 cool roofs on low-income homes.¹¹
- *Cool Corridors:* Phoenix, Arizona, is building a network of cool corridors near arterial streets to provide a relief for residents as they walk, bike, and travel to public transit stops. These include features like trees, shading structures, drinking water fountains, cool pavement, and more.¹² The first one was created in April 2022 with the goal of creating 100 by 2030.¹³
- *Heat Insurance:* In India, several organizations have teamed up to pilot a program for parametric insurance for women working in the informal economy. On days above a certain heat threshold, women in the program can refrain from working and keep themselves safe and recover the wages they would have earned that day.¹⁴
- *Air-Conditioning Distribution Programs:* In 2020, New York City gave away more than 70,000 air-conditioning units to lower-income households to help protect families from heatwaves and the COVID-19 pandemic.
- *Cooling Centers:* While traditional cooling centers offer a respite from the heat with air conditioning or shade structures, several cities are experimenting with transforming them into broader climate-resilience hubs. In addition to air conditioning, shipping container resilience pods in Miami-Dade County offer Wi-Fi, phone chargers, food grown through hydroponics, and more.¹⁵



Audience members provided a diverse view of the ways that extreme heat affects our lives and provided key insights on how different sectors are impacted.

10 Adrienne Arshnt-Rockefeller Foundation Resilience Center. *Hot Cities, Chilled Economies: Santiago, Chile.* <https://onebillionresilient.org/hot-cities-chilled-economies-santiago/>.

11 Jaiswal, Anjali, and Prima Madan. 2019. "New Cool Roof Programs in India – Ahmedabad (Part 2)." <https://www.nrdc.org/bio/anjali-jaiswal/new-cool-roof-programs-india-ahmedabad-part-2>.

12 City of Phoenix. "Cool Corridors Program." <https://www.phoenix.gov/streets/coolcorridors>.

13 City of Phoenix. 2022. "Phoenix Plants First Cool Corridor at Cesar Chavez Park." <https://www.phoenix.gov/newsroom/environmental-programs/2321>.

14 Adrienne Arshnt-Rockefeller Foundation Resilience Center. "Fighting Extreme Heat With Parametric Insurance: Protecting The Livelihoods Of Women In India's Informal Economy Sector." <https://onebillionresilient.org/2023/03/07/fighting-extreme-heat-with-parametric-insurance/>.

15 Kingson, Jennifer. 2022. "Cooling Centers Are Turning into Next-Gen 'Climate Resilience Hubs.'" *Axios.* <https://www.axios.com/2022/08/09/deadly-heat-waves-climate-resilience-hubs>.

> AREAS FOR FUTURE RESEARCH

The colloquium revealed several areas for future research that decision-makers could use to close knowledge gaps and improve policymaking on extreme heat.



The day concluded with many suggestions for future research to help policymakers better address rising temperatures around the world.

HEALTHCARE

- How can heat's impacts on human morbidity be better monitored, including in developing countries, and how can this data be made universally available?
- What are the links between climate change, including heat, and mental health? How can these stressors be measured and treated?
- How can the financial costs of heat on health be calculated and communicated to inform policymaking and encourage heat action?

CITIES AND SOCIETY

- Which elements of heat action plans for cities are the most and least impactful?
- What does a heat-resilient city look like? Can current cities be reimagined?
- How can a city's adaptive capacity to extreme heat be assessed?

LABOR AND INDUSTRY

- What role can conscious consumers play in influencing companies to make heat safety for their workers a priority? Would a heat certification standard on products be successful?
- How might heat insurances be put in place for vulnerable workers? Could such a mechanism protect formal and informal labor?
- How will labor productivity be affected in the absence of policies to build the heat resilience of workers?



Each panel provided attendees with key insights to help influence future policies on extreme heat.

FINANCE

- How can local adaptation to extreme heat best be financed? What role can public-private partnerships play?
- How can the international financial system be redesigned so that cities can more easily access resources they need to address heat, among other climate-related challenges? Could a green development bank for cities be a solution?

DATA

- What are the gender dimensions of heatwaves? And how can gender disaggregated data be collected?
- How can heat data be standardized and made widely accessible? Can globally utilitarian data dashboards for extreme heat be created?
- Should heatwaves (like hurricanes and cyclones) be named and ranked, and if so, how can such a process be advanced and adopted globally?

By 2030, approximately 60 percent of the world's population will live in urban areas—spaces prone to the “heat island” effect, which occurs when the built environment traps heat and amplifies temperatures.

> APPENDIX

> SURVEY RESULTS

In advance of the colloquium, Perry World House surveyed participants to gauge their views and priorities to inform the convening, as well as to spark discussion and debate. The most salient survey results are presented below.

Survey respondents largely agreed that heatwaves have critical impacts on the systems underpinning societal well-being and function—such as public health, food security, livelihoods, and energy provision. Despite these challenges, over 75 percent of survey respondents thought that extreme heat does not receive enough attention globally. This indicates the important role this colloquium played in elevating discussions of extreme heat in global as well as local fora, including among research and other institutions that attended the convening.

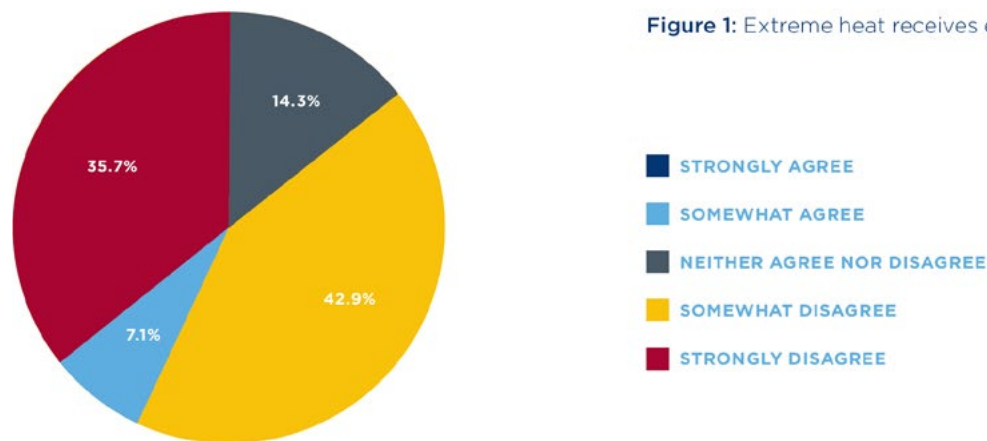


Figure 1: Extreme heat receives enough attention globally.

Over 70 percent of colloquium participants surveyed thought that decision-makers did not have data they needed to incorporate extreme heat into healthcare planning, indicating an urgent need.

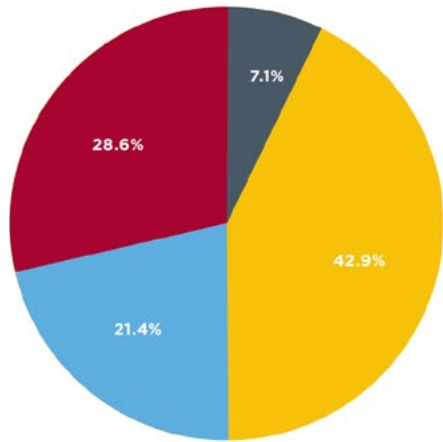


Figure 2: Decision-makers have the data they need to incorporate extreme heat into healthcare planning.



Over 90 percent of colloquium participants surveyed thought that the increasing intensity and frequency of heatwaves is a critical threat to global food security.

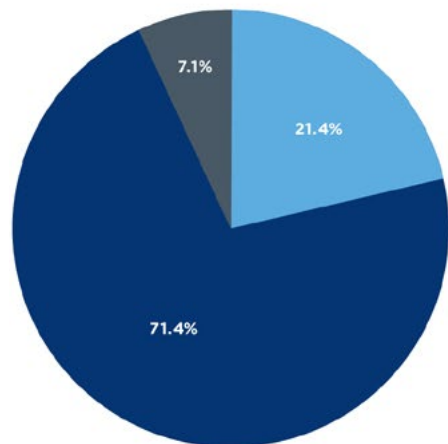


Figure 3: The increasing intensity and frequency of heatwaves is a critical threat to global food security.



Similarly, over 90 percent of colloquium participants surveyed somewhat or strongly agreed that extreme heat will have profound effects on labor productivity.

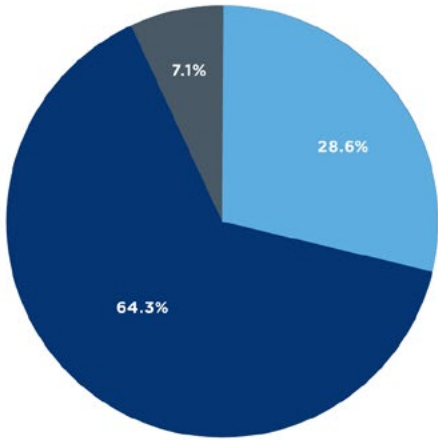


Figure 4: Globally, extreme heat is changing the way workers can do their jobs.



All (100 percent) of colloquium participants surveyed somewhat or strongly agreed that extreme heat should be at the top of cities' policy agendas.

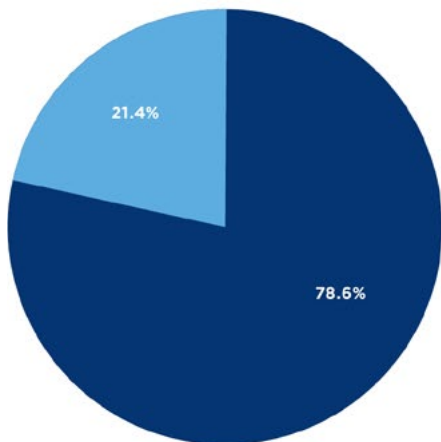


Figure 5: Cities worldwide should make addressing extreme heat a top priority.



> PARTICIPANTS

The participants listed below submitted policy briefs and/or contributed as panelists and moderators to the first day of colloquium proceedings, which form the basis of this report. This list does not reflect members of the curated audience that attended these private discussions. Participants who featured in the second and public day of the colloquium are listed on the Perry World House website.

Sévane Ananian

Research Specialist, International Labour Organization

Eugénie Birch

Lawrence C. Nussdorf Professor of Urban Research & Education, co-director, Penn Institute for Urban Research, University of Pennsylvania; Faculty Fellow, Perry World House

Russell Composto

Associate Dean of Undergraduate Education, School of Engineering and Applied Science, University of Pennsylvania

Joan Flocks

Director Emeritus, Social Policy Division Center for Governmental Responsibility Levin College of Law, University of Florida

Kate Gallego

Mayor of Phoenix, Arizona

Andrew Hoffman

Dean, School of Veterinary Medicine, University of Pennsylvania

Andrew E. Huemmler

Senior Lecturer, School of Engineering and Applied Science, University of Pennsylvania

Sameed Khatana

Assistant Professor, Division of Cardiovascular Medicine, Perelman School of Medicine, University of Pennsylvania

Vijay Limaye

Senior Scientist, Science Office, National Resources Defense Council

Rohit Magotra

Deputy Director, Integrated Research & Action for Development (IRADe)

Harleen Marwah

Pediatric Resident Physician, Children's Hospital of Philadelphia

Kathryn Milliken

Senior Climate Change Adviser, UN World Food Programme

Guillermo Ortiz-Colón

Extension Specialist of Dairy Cattle Nutrition, University of Puerto Rico-Mayagüez

Sarah Paoletti

Practice Professor of Law and Director, Transnational Legal Clinic, University of Pennsylvania

Mathilde Pascal

Climate Change and Health Project Officer, Santé publique France (French National Public Health Institute)

Greg Puley

Head of Climate Team, UN Office for Coordination of Humanitarian Affairs

Harvey Rubin

Professor of Medicine, University of Pennsylvania

Mauricio Rodas

Visiting Fellow and Scholar, University of Pennsylvania

Andrew Smith

Chief Operating Officer, Rodale Institute

Kotchakorn Voraakhom

Founder/CEO, Landprocess and Porous City Network; Visiting Fellow, Perry World House

> WHAT THE EXPERTS ARE READING

Perry World House asked participants to highlight resources that scholars and policymakers should read on extreme heat. Here is what they recommended.

BOOKS

- Aghamohammadi, Nasrin, and Mat Santamouris. 2022. *Urban Overheating: Heat Mitigation and the Impact on Health*. Berlin: Springer.
- Johnson, Ayana Elizabeth, and Katharine K. Wilkinson. 2021. *All We Can Save: Truth, Courage, and Solutions for the Climate Crisis*. New York: One World.
- Cohan, Daniel S. 2022. *Confronting Climate Gridlock*. Yale University Press.
- Klein, Naomi. 2020. *On Fire: The Burning Case for a Green New Deal*. Toronto: Vintage Canada.
- Klein, Naomi. 2015. *This Changes Everything: Capitalism vs. The Climate*. New York: Simon & Schuster Paperbacks.
- Klinenberg, Eric. 2015. *Heat Wave*. Chicago: University of Chicago Press.
- Goodell, Jeff. 2023. *The Heat Will Kill You First*. Boston: Little, Brown.
- Oke, T.R., G. Mills, A. Christen, and J.A. Voogt. 2017. *Urban Climates*. Cambridge: Cambridge University Press.
- Nyberg, Daniel, Christopher Wright, and Vanessa Bowden. 2022. *Organising Responses to Climate Change*. Cambridge: Cambridge University Press.
- Ren, Chao, and Glenn McGregor. 2021. *Urban Climate Science for Planning Healthy Cities*. Berlin: Springer
- Robinson, Kim Stanley. 2021. *Ministry for the Future*. London: Orbit.
- Stephen, Craig, and Colleen Duncan. 2022. *Climate Change and Animal Health*. Boca Raton, FL: CRC Press.
- Thomas, Leah. 2022. *The Intersectional Environmentalist: How to Dismantle Systems of Oppression to Protect People + Planet*. New York: Voracious.
- Wilson, Eric Dean. 2022. *After Cooling: On Freon, Global Warming, and the Terrible Cost of Comfort*. New York: Simon & Schuster.

JOURNAL ARTICLES

- [*Assessing Climate Vulnerabilities and Adaptive Strategies for Resilient Beef and Dairy Operations in the Tropics*](#) by G. Ortiz-Colón, S. J. Fain, Isabel K. Parés, Jaime Curbelo-Rodríguez, Esbal Jiménez-Cabán, Melvin Pagán-Morales, and William A. Gould
- [*Climate Change Mitigation in Cities: A Systematic Scoping of Case Studies*](#) by Mahendra Sethi, William F. Lamb, Jan Christoph Minx, and Felix Creutzig
- [*Global Urban Population Exposure to Extreme Heat*](#) by Cascade Tuholske, Kelly Caylor, Chris Funk, Andrew Verdin, Stuart Sweeney, Kathryn Grace, Pete Peterson, and Tom Evans
- [*Hot Weather and Heat Extremes: Health Risks*](#) by Kristie L Ebi, Anthony Capon, Peter Berry, et al.
- [*Extreme Heat Leads to Short- and Long-Term Food Insecurity with Serious Consequences for Health*](#) by Carolin Kroeger and Aaron Reeves
- [*Nature Climate Change*](#)
- [*Climate Adaptive Heat Action Plans to Manage Heat Stress in Rajkot City*](#) by Mohit Kumar, Rohit Magotra, Ajit Tyagi, and Asha Kaushik

INSTITUTIONAL REPORTS AND RESOURCES

- [*Lancet Countdown on Health and Climate Change*](#)
- [*Unworkable: Dangerous Heat Puts Florida Workers at Risk*](#) by Public Citizen
- [*Working on a Warmer Planet: The Impact of Heat Stress on Labour Productivity and Decent Work*](#) by the International Labour Organization
- [*Hot Cities, Chilled Economies*](#) by the Adrienne Arsht-Rockefeller Foundation Resilience Center
- [*Heat Island Resources*](#) by the US Environmental Protection Agency
- [*Integrating Climate Adaptation: A Toolkit for Urban Planners and Adaptation Practitioners*](#) by the Global Platform for Sustainable Cities
- [*BCN Ecologia*](#) by the City of Barcelona, Spain

NEWS ARTICLES AND PODCASTS

- [*The Ezra Klein Show*](#) (Podcast)
- [*Volts*](#) (Podcast)
- [*“Boiling Point: OSHA Must Act Immediately to Protect Workers from Deadly Temperatures”*](#) by Public Citizen
- [*“Extreme Heat Will Change Us”*](#) by *The New York Times*





UNIVERSITY OF PENNSYLVANIA | PERRY WORLD HOUSE
3803 LOCUST WALK, PHILADELPHIA, PA 19104

215.573.5730

@PERRYWORLDHOUSE
FACEBOOK.COM/PERRYWORLDHOUSE

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