



Building Heat Resilient Communities

*A Practical Framework and Workbook for
Local Planning, Decision-Making, and Action*

DRAFT. March 23rd, 2026.

The Luskin Center for Innovation at UCLA acknowledges the Gabrielino/Tongva peoples as the traditional land caretakers of Tovaangar (the Los Angeles basin and So. Channel Islands). As a land grant institution, we pay our respects to the Honuukvetam (Ancestors), ‘Ahihirom (Elders) and ‘Eyoohiinkem (our relatives/relations) past, present and emerging.



The Center for Heat Resilient Communities was established with funding from a grant provided by the National Oceanic and Atmospheric Administration (NOAA) and the National Integrated Heat Health Information System (NIHHIS) (OMB Control Number: 0648-0828, Expiration Date: 9/30/27). This in-progress report was partially completed before funding was terminated in May 2025. The Luskin Center for Innovation at UCLA contributed additional funding and staff time to finalize the report for publication in its current form.

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Center for Heat Resilient Communities

Introduction

The Center for Heat Resilient Communities, founded as a National Oceanic and Atmospheric Administration (NOAA) & National Integrated Heat Health Information System (NIHHIS)-funded Center of Excellence, is dedicated to supporting local governments and communities in determining the best strategies to advance heat resilience. This first-of-its-kind effort brought together teams of experts and over 50 cross-sector partners to create a roadmap for community heat resilience.

Heat resilience refers to the ability of a community and its constituent social, environmental, and technical systems to maintain or quickly return to desired functions, adapt to change, and transform when the status quo limits current or future capacity to mitigate and manage the causes and impacts of chronic and acute high temperature conditions across the many systems and sectors it affects (Meerow et al. 2016, Keith et al. 2020).

Heat management refers to preparation and response strategies for extreme heat events, often within the domains of emergency management or public health, whereas heat mitigation refers to design and planning strategies to reduce the built environment's contribution to urban heat (Keith, Meerow, and Wagner 2020).

The purpose of the Center for Heat Resilient Communities (the Center) is to provide technical assistance to communities seeking to advance heat resilience, pilot technical assistance tools for heat resilience, and ultimately make recommendations to the federal government on ways to support communities on their path to heat resilience. The Center aims to support practitioners, governments, agencies, Tribal Nations, and other groups or institutions that seek to advance heat resilience in their communities.

In this case, the term community refers to a social group with a common geographic base (Stebbins et al. 1987). Communities may be cities, counties, unincorporated regions, neighborhoods, school districts, Tribal communities, military bases, etc., with formal jurisdictional authority, as well as informal groups with the ability to make decisions that impact a particular territory.

The Center was established to support communities as they determine and communicate the impacts of extreme heat, assess their capacity to respond, and design locally tailored blueprints to advance heat resilience. The center developed three products to provide technical assistance to communities: The Guiding Framework¹, The Roadmap Workbook (the “Workbook”), and Interactive Technical Assistance and Support: workshops, peer-to-peer learning, and ongoing consultation².

The Guiding Framework

The Guiding Framework (the “Framework”) is a learning support document. The Framework provides an introduction to key concepts and terms, recommended readings, and a broad overview of the goals, objectives, and actions the Center recommends for communities seeking to improve heat resilience. The Framework offers grounding in the key concepts that will be applied in the Workbook.

The Roadmap Workbook

The Roadmap Workbook (the “Workbook”) is an interactive, virtual set of tools for communities to put the Framework concepts into action. The Workbook features activities organized around recommended guiding questions to support communities in advancing heat resilience planning and data-informed decision-making. Workbook offerings include downloadable tools, resources, and templates that can be used and tailored to collect key data points to support community heat resilience planning. Workbook activities are tiered to enable communities to engage at different levels of depth depending on their needs and capacities.

Interactive Technical Assistance and Support

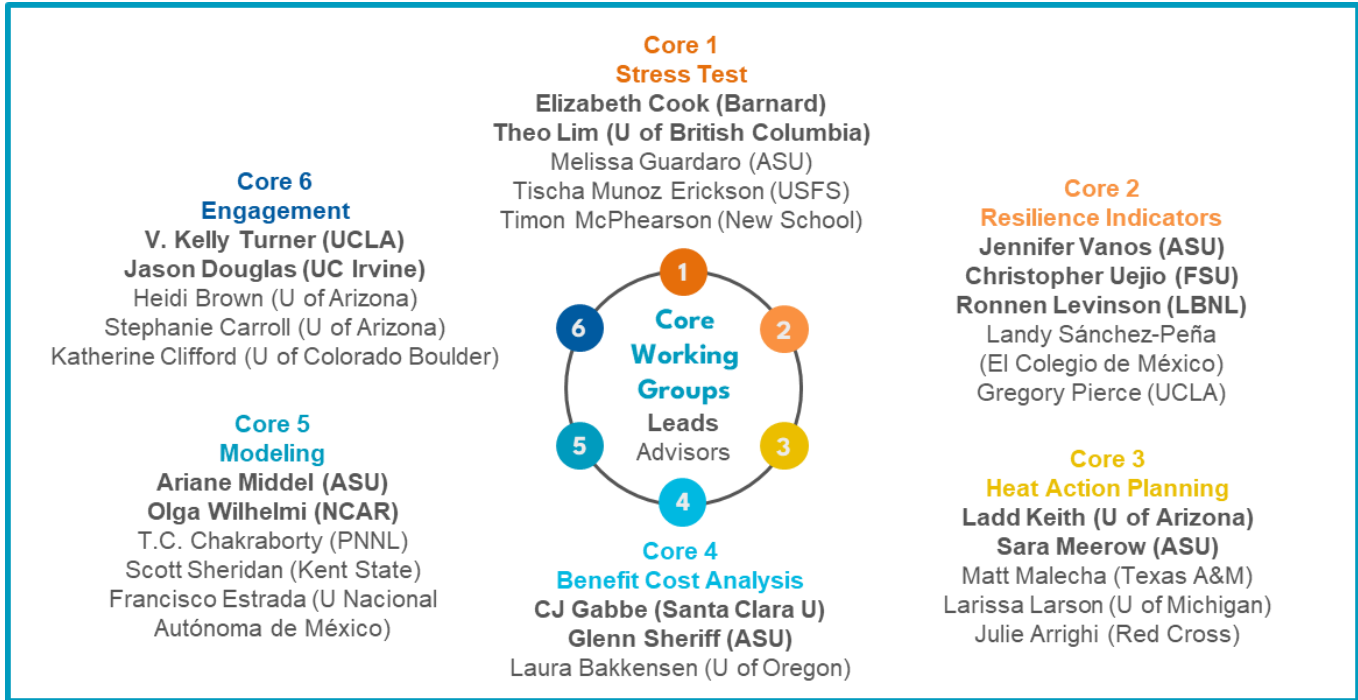
Center staff and experts developed a series of engagement and technical support initiatives for communities, including workshops, peer-to-peer learning opportunities, and consultations.

¹ The ‘Framework’ reflects the Center activities completed prior to the early termination of funding on May 4th, 2025.

² The ‘Interactive Technical Assistance and Support’ products had to be modified due to the early termination of funding on May 4th, 2025.

CENTER FOR HEAT RESILIENT COMMUNITIES

Center Leadership & Administrative Staff	Co-PI Ladd Keith Senior PM Trace Lane	PI V. Kelly Turner Program Coord. Zach Wampler	Co-PI Sara Meerow Affiliate PM Edith DeGuzman
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Center-wide Advisory Committee	
<p style="text-align: center;">Municipal, County, & State Officers</p> <ul style="list-style-type: none"> • David Hondula (Director, Phoenix Office of Heat Response and Mitigation) • Jane Gilbert (Chief Heat Officer, Miami-Dade County) • Marc Coudert (Climate Resilience & Adaptation Manager, City of Austin) • Cheye Flores (Philadelphia Office of Sustainability) • Braden Kay (Extreme Heat Program Manager, CA Governor's Office) • Theresa Cullen (Pima County Department of Health) • Hsini Lin (AZ Department of Health Services, Office Chief for Environmental Epidemiology) • White House Interagency Working Group on Extreme Heat <p style="text-align: center;">Private Sector</p> <ul style="list-style-type: none"> • ISeeChange • America Adapts Podcast 	<p style="text-align: center;">Regional Networks</p> <ul style="list-style-type: none"> • Southeastern Sustainability Directors Network (SSDN) • Climate Assessment for the Southwest (CLIMAS) • Great Lakes Integrated Science and Assessment (GLISA) • Great Lakes Partnership Network (GLPN) • Los Angeles Regional Collaborative (LARC) <p style="text-align: center;">Non-profit / NGOs</p> <ul style="list-style-type: none"> • Arshat-Rockefeller Extreme Heat Resilience Alliance (EHRA) • World Bank Global Facility for Disaster Reduction & Recovery (GFDRR) • National League of Cities • Climate Resolve <p style="text-align: center;">Tribal</p> <ul style="list-style-type: none"> • Udall Center Native Nations Institute

Additional Team Affiliations *Non-exhaustive

Dr. Kara Schlichting (Queens College)	Morgan Rogers (UCLA) Alianza MX	Global Heat Health Information Network	NSF National Research Center for Atmospheric Research
Dr. David Eisenman (UCLA) Erin Coutts (LARC)	DOE Southwest Urban Corridor & Field Laboratory (SW-IFL)	International Association for Urban Climate	NOAA Climate Adaptation Partnership (CAP) Western Water Association
Dr. Sahar Derakhshan (Cal Poly Pomona)		International Association of Biometeorology	

Center Leadership and Staff

Kelly Turner, Ph.D.

Co-Principal Investigator

Dr. Kelly Turner (she/her) is the Director of the Center for Heat Resilient Communities, Co-Principal Investigator, and a lead author for the Engagement section of the Framework and Workbook. Dr. Turner is an Associate Professor of Urban planning and Geography and serves as Associate Director of the Luskin Center for Innovation (LCI) at the University of California Los Angeles. She leads LCI's research on heat which provides evidence-based approaches to protect people where they live and work. Dr. Turner's current research encompasses heat governance and policy, planning for climate resilient communities, and producing actionable data for heat-health. Her work has been published in *Nature*, *Environmental Research Letters*, and the *Journal of the American Planning Association* and funded by the National Science Foundation, the Robert Wood Johnson Foundation, and the Strategic Growth Council of California. She has served as a panelist for the National Academy of Sciences and as a Science Advisor to the Arsh-Rockefeller Extreme Heat Resilience Alliance.

Ladd Keith, Ph.D.

Co-Principal Investigator

Dr. Ladd Keith is a Co-Principal Investigator for the Center for Heat Resilient Communities and a lead author for the Heat Action Planning section of the Framework and Workbook. Dr. Keith is an assistant professor in the School of Landscape Architecture and Planning and a faculty research associate at the Udall Center for Studies in Public Policy at the University of Arizona. An urban planner by training, he has over a decade of experience planning for climate change with diverse stakeholders in cities across the U.S. His research explores heat planning, policy, and governance to help communities increase their heat resilience. He is the UA lead of the DOE-funded Southwest Urban Corridor Integrated Field Laboratory (SW-IFL), the heat research lead of the NOAA-funded Climate Assessment for the Southwest (CLIMAS), co-investigator of the CDC-funded Building Resilience Against Climate Effects (BRACE), and co-investigator of the NIH-funded Southwest Center on Resilience for Climate Change and Health (SCORCH). He also serves on the WHO and WMO's Global Heat Health Information Network (GHHIN)'s Management Committee.

Sara Meerow, Ph.D.

Co-Principal Investigator

Dr. Sara Meerow is a Co-Principal Investigator for the Center for Heat Resilient Communities and a lead author for the Heat Action Planning section of the Framework and Workbook. Dr. Meerow is an Associate Professor in the School of Geographical Sciences and Urban Planning at Arizona State University. She is an interdisciplinary scholar working at the intersection of urban planning and geography to make cities more resilient in the face of climate change and other hazards, while at the same time more sustainable. Her research focuses on climate change adaptation planning with a focus on heat and flood hazards, green infrastructure, and conceptualizations of

urban resilience. Her work on heat resilience planning has been published in *Nature*, *Journal of the American Planning Association*, *Journal of Planning Education and Research*, and by the American Planning Association. Some of her recently funded projects include a National Science Foundation grant on flood resilience planning, Department of Energy-funded work on urban climate resilience, a National Oceanic and Atmospheric Administration-funded project on extreme heat resilience, the National Center for Atmospheric Research's early career fellowship, and a Humboldt Research Fellowship in Germany.

Trace Lane

Senior Project Manager & Researcher

Trace Lane (she / her / hers) is the Senior Project Manager for the Center for Heat Resilient Communities and lead author for the Social, Cultural, and Equity Considerations of Heat section of the Framework. Trace is the Senior Project Manager at the UCLA Luskin Center for Innovation's Heat Research Team. Trained as an interdisciplinary hydro-social climate scientist, Trace completed a B.S. in Organizational Psychology and an M.P.A. in Political Science and Public Affairs from the University of Alabama, and an M.S.W. - A.M. in International Social Welfare and Human Rights from the University of Chicago. Her interdisciplinary doctoral studies in human rights and governance and coastal resilience management focused on strategies for designing epistemologically diverse climate resilience solutions. Trace's climate resilience work includes designing benefit-cost analysis tools for the Los Angeles Bureau of Street Serves, conducting community-based action research on barriers to wildfire evacuation with the Santa Barbara County Fire Safe Council, conducting socio-legal water rights research for the Human Rights Commission of Maharashtra, India; serving as a senior sustainability consultant to the Environmental Protection Agency; and is the founder of SOCIO, a method that bridges story with science to describe environmental change and identify sociocultural climate risks.

Zach Wampler

Program Coordinator

Zach Wampler (he/him) is the Project Coordinator for the Center for Heat Resilient Communities. He entered the role after completing positions in local and regional government working to increase community capacity to implement local cooling solutions and heat-resilient land use policies. Zach's professional interests include urban climate metrics and policy, science translation and communication to improve decision making and build community power, and utilizing participatory methods in addressing sustainability and community resilience. He completed a B.S. in Human & Organizational Development from Vanderbilt University where he researched how geospatial vulnerability assessment approaches affect how uneven harms from climatic hazards are conceptualized and responded to using extreme heat in Nashville, TN as a case study.

Kathrine Wall

Graduate Student Researcher

Kathrine Wall (she/her) is the Graduate Student Researcher supporting the Center for Heat Resilient Communities. She is currently pursuing a Masters of Urban and Regional Planning at the UCLA Luskin School of Public Affairs with a concentration in Climate, Environment, and Society with Urban Design. Her professional background includes data analysis for local, state, and federal projects supporting urban resilience, cultural conservation, and community-focused climate adaptations. Her professional and academic interests include urban climate analytics, local natural disaster resilience planning, and equitable access to public resources. She completed a B.A. in Geography/Environmental Science and Political Science with a minor in Geospatial Information Sciences from UCLA, where she researched inequitable environmental health outcomes as a result of discriminatory housing policies. Her current research focuses on wildfire resilience in hillside communities throughout Los Angeles, CA as well as public access to urban heat resources in Los Angeles, CA and Paris, FR.

Core Leads

Core Leads are the experts who led section content development for the Guiding Framework, Workbook activities, and resources intended to operationalize best practices across the different dimensions of planning for heat for practitioners and climate champions to implement in their own communities through the Center for Heat Resilient Communities.

Ariane Middel, Ph.D.

Climate Modeling & Microscale Climate Modeling

Dr. Ariane Middel (she/her) is a lead author for the Climate Modeling & Microscale Climate Modeling section of the Framework and Workbook. Dr. Middel is an Associate Professor in the School of Arts, Media & Engineering and the School of Computing & Augmented Intelligence at Arizona State University. Her research interests lie in the interdisciplinary field of urban climate with a focus on extreme heat. Dr. Middel's applied and solutions-oriented research uses unconventional field methods such as MaRTy (a mobile weather station), microclimate simulations, and human-centric heat exposure modeling. Dr. Middel is the President of the International Association for Urban Climate (IAUC), serves on the Board of the American Meteorological Society (AMS) Built Environment, and directs the SHaDE Lab at ASU. She received an NSF CAREER award on "Human Thermal Exposure in Cities" and has published over 100 peer-reviewed articles in journals such as Nature Communication, BAMS, Sustainable Cities and Society, and Landscape and Urban Planning. Her work has been featured by Good Morning America, CNN, National Geographic, and the New York Times.

Olga Wilhelmi, Ph.D.

Climate Modeling & Microscale Climate Modeling

Dr. Olga Wilhelmi (she/her) is a lead author for the Climate Modeling & Microscale Climate Modeling section of the Framework and Workbook. Dr. Wilhelmi is a Project Scientist in the

Research Applications Laboratory at the NSF National Center for Atmospheric Research (NCAR). Dr. Wilhelmi founded NSF NCAR's GIS Program, where she leads actionable and convergent research on societal risks and resilience to extreme weather and climate change. Dr. Wilhelmi brings 20 years of experience in extreme heat research and applications working with communities and decision-makers from local to national levels. Her work has been funded by the National Science Foundation, Environmental Protection Agency and National Aeronautics and Space Administration, and National Oceanic and Atmospheric Administration. Dr. Wilhelmi has recently served as an author on the Human Health Chapter of the Fifth National Climate Assessment. Her current research focuses on responses to heat risks across the U.S.

Elizabeth M Cook, Ph.D.

Stress Testing, Maturity Modeling, & Tabletop Exercises

Dr. Elizabeth Cook (she/her) is a lead author for the Stress Testing, Maturity Modeling, & Tabletop Exercises section of the Framework and Workbook. Dr. Cook is an Assistant Professor in Environmental Science, Sustainability at Barnard College-Columbia University. Elizabeth is an urban ecosystem scientist. Her work uses mixed methods and participatory approaches to explore cities as complex social-ecological-technological systems. She co-leads a National Science Foundation Growing Convergence project that applies transdisciplinary approaches to explore future sustainability and resilience of North American and Latin American cities to changing climate and extreme events. She works collaboratively with interdisciplinary scientists and local practitioners through participatory methods to envision positive futures and the transformative capacities needed to achieve future climate resilience. She also co-leads the global NATURA network studying and implementing nature-based solutions to improve urban resilience. Her other current projects explore human-environment interactions and people's perceptions of nature and ecosystem services under changing environmental conditions.

Theo Lim, Ph.D.

Stress Testing, Maturity Modeling, & Tabletop Exercises

Dr. Theo Lim (he/him) is a lead author for the Stress Testing, Maturity Modeling, & Tabletop Exercises section of the Framework and Workbook. Dr. Lim is an Associate Professor in the School of Community and Regional Planning at the University of British Columbia. He specializes in research and teaching in urban environmental and climate adaptation planning, environmental science-policy interfaces, and community engagement. He has led two projects that use participatory action research methods to address governance gaps in planning for rising temperatures in Roanoke, Virginia: the H.O.P.E. for Heat Resilience project, funded through the National Science Foundation's CIVIC Innovation Challenge, and Heat Ready Roanoke, funded through NOAA's Environmental Literacy Program. His work has been published in the Journal of the American Planning Association, Landscape and Urban Planning, and Sustainable Cities and Society. Theo also serves on the Editorial Team of the journal Planning Theory & Practice.

Jason A. Douglas, Ph.D.

Stakeholder Engagement

Dr. Jason A. Douglas is a lead author for the Engagement section of the Framework and Workbook. Dr. Douglas is a community-engaged environmental health disparities researcher in the Department of Health, Society, and Behavior and the Center for Environmental Health Disparities Research at UC Irvine. Leveraging community-based participatory action research, Douglas works with community-based organizations and residents in Black and historically marginalized communities to investigate and redress environmental health disparities. His work ranges from structured observation of neighborhood-level assets and challenges that may encourage or encumber health-promoting behaviors to large-scale geospatial examinations of health and place. His current research examines air pollution- and urban heat-related health disparities, legal drug retail (e.g., tobacco shops, liquor stores), access to recreational spaces and physical activity opportunities, and community organizing practices for advancing health and wellbeing. Supported by state and federal funding, Douglas has developed and adapted innovative participatory methodologies—e.g., structured observation and neighborhood mapping—for examining novel public health challenges.

Ronnen Levinson, Ph.D.

Indicators of Heat Resilience

Dr. Ronnen Levinson is a lead author for the Indicators of Heat Resilience section of the Framework and Workbook. Dr. Levinson is a Staff Scientist and Leader of the Heat Island Group at Lawrence Berkeley National Laboratory (LBNL) in Berkeley, California, where he develops cool roof, wall, and pavement materials; improves methods for the measurement of solar reflectance; quantifies the energy and environmental benefits of cool surfaces; and promotes resilient cooling of people, buildings, cities, and the planet. He serves on the boards and technical committees of the Cool Roof Rating Council and the Global Cool Cities Alliance, and advises policymakers, code officials, utilities, and building rating programs about cool surfaces. He holds a B.S. in engineering physics from Cornell University and an M.S. and a Ph.D. in mechanical engineering from the University of California at Berkeley. He has authored or co-authored over 140 publications, serves as an Associate Editor for *Energy & Buildings* and a Guest Editor for *Nature Scientific Reports*, and sits on the editorial boards of *Energy & Buildings*, *Solar Energy Advances*, and *Nature Scientific Reports*. He received the 2016 Marty Hastings Award for outstanding contributions to the Cool Roof Rating Council, and a 2016 R&D 100 Award for invention of the Cool Roof Time Machine.

Chris Uejio, Ph.D.

Indicators of Heat Resilience

Dr. Chris Uejio (he/him) is a lead author for the Indicators of Heat Resilience section of the Framework and Workbook. Dr. Uejio is a Professor of Geography and Public Health. Earlier in his career, he worked with public health departments to develop evidence based extreme heat

maps. He partnered with Emergency Medical Services to build the evidence base for indoor heat exposure levels that are harmful to human health. As a member of NASA's Health and Air Quality Applied Science Team (2020-2024), his team is creating reproducible workflows to map air temperature and the urban heat island effect. Finally, he is a member of a team that evaluates the process and outcomes of extreme heat interventions. This work has been funded by multiple U.S. federal (NASA, NIH, CDC, EPA, NSF, NOAA), state, and non-profit institutions (e.g., Wellcome Trust).

Jennifer Vanos, Ph.D.

Indicators of Heat Resilience

Dr. Jennifer Vanos is a lead author for the Indicators of Heat Resilience section of the Framework and Workbook. Dr. Vanos is an Associate Professor in the School of Sustainability at Arizona State University. As a human biometeorologist, she works to strengthen the understanding and practice surrounding how we protect people from extreme heat and air pollution in a changing climate. Her work on extreme heat addresses risks and challenges within heat - sensitive and heat - exposed groups, including children, athletes, and outdoor workers. She also runs the HeatReady™ Schools program at ASU. Dr. Vanos was awarded an NSF Early Career research grant in 2021, and is co-authoring new WHO Heat & Health guidance. She is PI of the Human Biometeorology lab at ASU, a scientific advisor for the Korey Stringer Institute, and Outgoing Chair of the American Meteorological Society's Board on Environment & Health. Dr. Vanos previously worked at UC San Diego, Texas Tech, and Health Canada, and received her Ph.D. and bachelor's degrees from the University of Guelph in Canada.

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Benefit-Cost Analysis

Dr. C.J. Gabbe (he/him) is a lead author for the Benefit-Cost Analysis section of the Framework and Workbook. Dr. Gabbe is an Associate Professor in Santa Clara University's Department of Environmental Studies and Sciences. His research focuses on identifying and mitigating impacts of climate hazards in the United States, particularly through land use planning and housing policy interventions. He collaborates with local governments and community-based organizations, and serves as co-chair of Santa Clara County's Heat and Air Quality Resilience Working Group. C.J. has a Ph.D. in Urban Planning from UCLA and a Master of Urban Planning degree from the University of Washington.

Glenn Sheriff, Ph.D.

Benefit-Cost Analysis

Dr. Glenn Sheriff is a lead author for the Benefit-Cost Analysis section of the Framework and Workbook. Dr. Sheriff is an associate professor in Arizona State University's School of Politics and Global Studies, with a research focus on the distribution of benefits and costs of environmental, natural resource, and climate policy. He received his master's and doctorate in agricultural and resource economics at the University of Maryland. Before joining ASU, he taught at Columbia University and served as an economist at several federal agencies including the U.S. State

Department, White House Council on Environmental Quality, Environmental Protection Agency, and Department of Agriculture. His work has been published in outlets such as the *Journal of the Association of Environmental and Resource Economists*, *Nature Communications*, *Environmental Research Letters*, and *Demography*, and funded by grants from the National Science Foundation, NASA, the U.S. Environmental Protection Agency, and the U.S. Department of Agriculture.

Florian Schneider, Ph.D.

Climate Modeling & Microscale Climate Modeling

Dr. Florian A. Schneider (he/him) is a lead author for the Climate Modeling & Microscale Climate Modeling section of the Framework and Workbook. Dr. Schneider is Senior Research Advisor at Third Way's Climate and Energy Program, where he combines rigorous policy analysis with international collaboration to advance evidence-based strategies for clean energy deployment, industrial decarbonisation, and climate resilience in Europe and the United States. His background bridges climate science, sustainability, and urban heat research, with a focus on equitable and transdisciplinary approaches to climate adaptation. Dr. Schneider earned his Ph.D. in Sustainability from Arizona State University, where his research focused on sustainable urban heat mitigation and co-producing usable, policy-relevant science with city practitioners and communities. He has led major decarbonisation modelling efforts in Poland and Romania, directed the EU-wide Annual Decarbonisation Perspective, and policy briefs that inform EU and Member State energy strategies. He also holds BS and MS degrees in Atmospheric Science from Universität Leipzig and previously contributed to the European Space Agency's EarthCARE mission as a scientific programmer at TROPOS Leipzig, developing satellite data processing algorithms for global climate monitoring.

Additional Content Contributors

Additional content contributors are subject matter experts that developed Workbook materials to supplement the materials developed by the core leads.

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Heat Alert Development

David Eisenman, MD, MSHS, is a professor at the David Geffen School of Medicine at UCLA and has a joint appointment at the UCLA Fielding School of Public Health where he directs the Center for Public Health and Disasters. Dr. Eisenman is also an Associate Natural Scientist at RAND.

Erin Coutts

Heat Alert Development

Erin Coutts is the Executive Director of the Los Angeles Regional Collaborative for Climate Action and Sustainability (LARC). Housed at UCLA, LARC is a membership organization that works to facilitate a sustainable and resilient Los Angeles. Erin is focused on convening local and regional

decision-makers who perform climate mitigation and adaptation work. She completed a master's degree in Urban and Environmental Policy and Planning at Tufts University.

Kara Schlichting, Ph.D.

Social, Cultural, & Equity Considerations Case Study

Kara Murphy Schlichting is an Associate Professor of History at Queens College, CUNY. She earned her Ph.D. from Rutgers, the State University of New Jersey. Schlichting's current research explores climatological aspects of environmental history. She is also a co-investigator on the Wellcome Discovery Award project "Melting Metropolis: Everyday Histories of Health and Heat in London, New York, and Paris since 1945," which explores the impact of climate change and rising temperatures on urban life.

Morgan Rogers, Ph.D. Candidate

Climate Modeling & Microscale Climate Modeling

Morgan (she/her) is a doctoral student in Urban Planning, a graduate student researcher at the UCLA Luskin Center for Innovation (LCI), and a National Science Foundation Research Trainee (NSF NRT). She uses remote sensing, GIS, spatial statistics, and 3D modeling methods to study urban environments with the goal of translating this research into actionable insights for environmental planning. At LCI, Morgan applies 3D modeling, shaped by community feedback, to explore and propose effective, low-cost outdoor cooling interventions for communities most impacted by extreme heat.

Sahar Derakhshan, Ph.D.

Heat Vulnerability Assessment

Dr. Derakhshan received her doctorate in Geography from the University of South Carolina, her Master of Public Policy (MPP) from the University of California, Berkeley, and holds a Bachelor of Science in Civil Engineering from University of Science and Culture, Iran. Dr. Derakhshan employs geospatial analytics in her interdisciplinary research to study and assess the effect of inequalities, institutions, and social and economic status, in taking action to foster change in mitigation planning and disaster recovery, for a safer and more resilient community.

Core Working Groups

The Core working group members were expert advisors that provided review of materials contained in the Framework and Workbook.

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Laura Bakkensen, University of Oregon

Larissa Larson, University of Michigan

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Melissa Guardaro, Arizona State University

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Stephanie Carroll, University of Arizona

T.C. Chakraborty, Pacific Northwest National Laboratory

Timon McPhearson, The New School

Tischa Muñoz Erickson, U.S. Forest Service

Center-Wide Advisory Committee

The Center-Wide Advisory Committee included public officials in local, state, and federal government, non-profit organizations and advocacy groups, and private sector representatives that provided review of materials contained in the Framework and Workbook.



Guiding Framework

Introduction

The following core concepts form the basis of the Center for Heat Resilient Community's recommended approach to advancing heat resilience: climate modeling and microclimate modeling; heat exposure settings; vulnerability; social, cultural, and equity considerations; stress testing, maturity modeling, and tabletop exercises; heat action planning; community engagement; indicators of heat resilience; benefit-cost analysis; policy analysis; and public communication/alerts. This Guiding Framework (the Framework) introduces each of these core concepts and serves as a primer for the heat resilience planning activities in the Workbook. The Framework includes the following:

- Conceptual overview of core concepts
- Best and leading practices
- Examples of goals, objectives, and actions for each concept
- Tiered approach to recommended activities³
- Key terms
- Recommending readings and resources

³ A key goal of the Center for Heat Resilient Communities is increased access to heat resilience for a variety of different communities. In recognition that not only priorities and contexts vary among communities but also capacity and resources, each part of the Workbook includes three tiers of recommended activities. The tiers are ranked in increasing order of the resources required for their execution.

Climate Modeling & Microscale Climate Modeling

Lead Authors:

Olga Wilhelmi, Ph.D.
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Florian Schneider, Ph.D.

Conceptual Overview

A *climate model* is a research tool used to simulate future climate scenarios based on the current climate and past patterns of change. Climate models generate *projections* of future climate that are based on numerical representations of the physical, chemical, and biological properties of climatic systems, their interactions, and their *feedback processes*.

A *microscale climate model* is a highly detailed computer model that illustrates how climate affects very small areas within cities, such as individual buildings, streets, or neighborhoods. These models reveal how local features such as trees and tall buildings create unique weather patterns at very small scales, explaining why some parts of a city are hotter than others.

Climate and microclimate modeling are crucial to advancing heat resilience. These models empower communities with information needed to understand current heat exposure and plan for future heat burdens. Projections from global, regional, and locally downscaled models can be used to estimate future extreme heat conditions and develop adaptation and resilience strategies. County or city-scale climate information helps assess long-term trends in frequency, intensity, and duration of heat extremes (Wilhelmi and Boehnert 2019). These projections empower communities to reduce heat-related fatalities by proactively planning for heat management and mitigation.

For example, a *heat exposure* assessment studies how people feel heat in different city areas, focusing on air temperature, humidity, sunlight, wind, and surfaces like pavement. A heat exposure assessment can describe the amount of heat our bodies are absorbing, and how shade from trees or buildings can reduce it. This research helps understand how to make cities that experience chronic heat and extreme heat events safer and more resilient to heat. Resulting data allows communities to prioritize resources and identify locally-relevant strategies for heat mitigation and risk management.

Challenges to Anticipate:

Producing more specific information with greater accuracy & precision requires a greater investment of time, access to equipment, and alignment between goals & available resources.

Historic daily climate information helps communities establish associations between extreme heat and key community health and wellness outcomes. For example, a community can better

understand the impact that heat has on public health by identifying locally-relevant heat indicators, such as emergency room visits during chronic heat and extreme heat events.

Because describing a community's current and future heat exposure is a key part of understanding the need for heat resilience action, modeling will play a key role in Part 1 of the Workbook: Make the Case. Communities can find guidance in accessing, interpreting, and collecting the modeling-based information they need to assess and respond to projected changes in extreme heat, including changes to warm season average temperatures; number of hot days and warm nights; frequency, intensity, and duration of locally defined extreme heat events; and other climatologically meaningful indicators of heat hazard and exposure.

Climate Modeling & Microscale Climate Modeling: Best and Leading Practices

1. Climate science is ever-evolving. Climate models are improving and we are using the best available science now, but this is an iterative process. As urban landscapes, societies, adaptations, and climate evolve, cities should use updated climate projections for planning and resilience building.
2. The Fifth National Climate Assessment (NCA5) is the most comprehensive and current report by the US government on climate change impacts, risks, and responses (USGCRP 2023). The report provides a big-picture view of the US, highlights changes in extreme heat across regions, and their implications for sectors and communities.
3. The Climate Resilience Information System (CRIS) includes data and interactive web portals such as the [NCA5 Interactive Atlas](#) and [Climate Mapping for Resilience and Adaptation \(CMRA\)](#). Communities can use this information to explore changes in extreme heat at the county or census tract scale.
4. Climate projections are not specific predictions or forecasts. They represent average climate and extreme heat events statistically. They cannot be used to predict the temperature for July 25, 2050, but they can provide information on the increased frequency of hot days and warm nights during summers around 2050. This information can help communities to plan for energy consumption, public health response, or economic activities that may be impacted by extreme heat.
5. Many DOs and DON'Ts for using climate information described in this recent article can be adapted for urban heat management and resilience planning (Vano et al. 2018).
6. Climate model outputs can be imported into a Geographic Information System (GIS) for visualization, integration with land-surface and socio-economic data, and analysis of exposure and heat risk (Wilhelmi et al. 2016, Wilhelmi et al. 2019).
7. County or city-scale climate information helps assess long-term trends and projected changes in frequency, intensity, and duration of heat extremes (Wilhelmi and Boehnert 2019). Neighborhood-scale climate information helps prioritize resources and identify locally relevant strategies for urban heat mitigation and risk management.
8. Multidisciplinary approaches from climatology, urban planning, public health, and environmental science are necessary to understand the multifaceted impacts of extreme heat.
9. The collaborative approach of co-producing or co-developing heat resilience data, strategies, and plans ensures that extreme heat is not only scientifically sound but also socially and economically viable (McNie et al., 2016). It fosters the development of

actionable, context-specific solutions that are more likely to be effective and equitable in addressing extreme heat and its impacts (Schneider et al., 2024).

Goals, Objectives, and Actions

The specific goals, objectives, and actions a community chooses to prioritize should be tailored to the local context. The following offer broad examples of the kinds of goals and objectives that can be addressed within the scope of climate modeling & microscale climate modeling, along with activities that could be undertaken to achieve them.

Climate Modeling & Microscale Climate Modeling: Goals, Objectives, and Actions

Goals	<ul style="list-style-type: none"> ● Understand how extreme heat conditions vary geographically and over time, especially in the context of a changing climate. ● Understand how observations, models, and scenarios can inform heat mitigation and adaptation planning. ● Bridge the gap between scientific research and practical implementation, which is crucial for effective and sustainable action on urban climate governance and extreme heat (Keith et al., 2021; Schneider et al., 2024). ● Understand associations between heat and health outcomes. ● Understand the impacts of the urban heat island effect (which neighborhoods in a city are hotter than others). ● Prioritize heat mitigation actions to cool neighborhoods and the city. ● Estimate future extreme heat conditions and develop adaptation and resilience-building strategies.
Objectives	<ul style="list-style-type: none"> ● Assess projected changes in extreme heat. ● Assess changes to warm-season average temperatures. ● Assess the number of hot days and warm nights. ● Assess frequency, intensity, and duration of locally defined extreme heat events. ● Assess other climatologically meaningful indicators of heat hazard and exposure.
Actions	<ul style="list-style-type: none"> ● Determine which types of climate data are appropriate for a community’s resilience goals. ● Identify relevant heat indicators, how to use them in GIS, and how to interpret the findings ● Identify relevant and usable climate data and information spanning scales from human and neighborhood to community and regional. ● Identify locally-relevant heat indicators and thresholds. ● Compile available climate data and information sources.

Climate Modeling & Microscale Climate Modeling: Tiered Approach

Tier 1	Tier 2	Tier 3
<p><i>Understanding Heat Exposure</i></p> <p>Assess climate variability and change using interactive web-based tools that include common climate and heat indicators.</p> <p>Visualize maps, time-series graphs, and charts.</p> <p>Scale maps, time series graphs, and charts based on microclimate to regional climate needs.</p>	<p><i>Visualizing Heat Exposure</i></p> <p>Download available climate data and climate change projections in a GIS or CSV format.</p> <p>Visualize and interpret this information in the context of risk and resilience.</p> <p>Visualize and interpret this information in the context of risk and resilience.</p>	<p><i>Modeling Local Microclimates</i></p> <p>Create locally relevant extreme heat and climate indicators at locally relevant time scales and spatial aggregations.</p> <p>Train ambassadors and communities on the use of microclimate modeling tools, such as <u>EnviMet</u> and <u>SOLWEIG</u>, and microclimate observations.</p>

Climate Modeling & Microscale Climate Modeling: Key Terms

- Anomaly:** Difference between future climate and present-day climate.
- Climate:** Average (typically over more than thirty years) weather in a place.
- Climate Change:** Changes in average weather conditions that persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature, as well as shifts in precipitation, changes in frequency and location of severe weather events, and changes to other features of the climate system ([cite](#)). Climate change is increasing the likelihood of many extreme weather events, contributing to greater climate variability.
- Climate model:** A numerical representation of the climate system based on the physical, chemical, and biological properties of its components, their interactions, and feedback processes. Climate models can be used to study and simulate long-term (decadal or longer) climate projections and to produce shorter-term (seasonal, annual, interannual) projections. Related term: Earth system model.
- Climate projections:** The simulated response of the climate system to a scenario of future emissions or

concentrations of greenhouse gases and aerosols, generally derived using climate models. Climate projections depend on the emissions, concentration, or radiative forcing scenario used, which, in turn, is based on assumptions concerning, for example, future socioeconomic and technological developments.

6. **Climate variability:** The way aspects of climate (such as temperature and precipitation) differ from an average.
7. **Extreme heat:** In common usage, “Extreme heat” typically refers to temperatures much hotter and/or more humid than average. Because some places are hotter than others, this depends on what is considered average for a particular location at that time of year.⁴² Extreme heat is considered an invisible and silent threat, which is one of the factors that separates heat from other climate risks such as flooding or wildfires (Keith et al., 2019).
8. **Global climate:** A description of the climate of a planet as a whole, averaged across regions.
9. **Heat:** Refers to a transfer of energy
10. **Heat exposure assessment:** Scientists study how people feel heat in different city areas, focusing on sunlight, wind, and surfaces like pavement. They measure how much heat our bodies absorb and how shade from trees or buildings can reduce it. This research helps understand how to make cities more comfortable and safer during hot weather.
11. **Microscale climate modeling:** Scientists use highly detailed computer models to study how climate affects very small areas within cities, such as individual buildings, streets, or neighborhoods. These models reveal how local features, such as trees or tall buildings, create unique weather patterns at very small scales, explaining why some parts of a city are hotter.
12. **Personal Heat Exposure:** Individual experience of heat is referred to as personal heat exposure. It encompasses environmental exposures such as climate and site conditions, demographic and health factors, activity level, and access to cooling.
13. **Regional climate:** The climate in a community’s surrounding area is called its regional climate. Regional climate depends on factors such as the amount of sunlight it receives, its elevation, the land’s shape, and its proximity to large bodies of water.
14. **Scenario:** A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Scenarios are neither projections nor forecasts but are used to provide a view of the implications of developments and actions.
15. **Urban climate:** Urban areas have a unique climate shaped by various processes within the city. This differs from rural climates due to factors such as buildings, human activities, and changes in natural landscapes, leading to effects such as the **urban heat island**, altered wind patterns,

and altered precipitation (Oke et al., 2017).

cloudiness, visibility, wind) at a specific place and time.

16. **Weather:** state of the atmosphere (temperature, humidity, precipitation,

Climate Modeling & Microscale Climate Modeling: Recommended Readings and Resources

1. Boehnert, J., & Wilhelmi, O. (2023, May 4). *The power of GIS*. ArcGIS StoryMaps. <https://storymaps.arcgis.com/stories/ed58d3649a9642b7b645b561fc21dfc6>
2. Climate Resilience Information System (CRIS) includes data and interactive web portals such as the NCA5 Interactive Atlas (U.S. Global Change Research Program 2023a) and Climate Mapping for Resilience and Adaptation (CMRA; U.S. Global Change Research Program 2023b). Communities can use this information to explore changes in extreme heat at the county or census tract scale.

U.S. Global Change Research Program. (2023a). *Climate Mapping for Resilience and Adaptation (CMRA) assessment tool*. <https://livingatlas.arcgis.com/assessment-tool/home/>

U.S. Global Change Research Program. (2023b). *NCA5 interactive atlas*. <https://atlas.globalchange.gov>
3. McNie, E., Parris, A., & Sarewitz, D. (2016). Improving the public value of science: A typology to inform discussion, design and implementation of research. *Research Policy*, 45(4), 884–895. <https://doi.org/10.1016/j.respol.2016.01.004>
4. Stebbins, J. F. (1987). Identification of multiple structural species in silicate glasses by ²⁹Si NMR. *Nature*, 330, 465–467. <https://doi.org/10.1038/330465a0>
5. The Fifth National Climate Assessment (NCA5) is the most comprehensive and current report by the US government on climate change impacts, risks and responses (USGCRP 2023). The report highlights changes in extreme heat across U.S. regions and implications for sectors and communities.

Crimmins, A. R., Avery, C. W., Easterling, D. R., Kunkel, K. E., Stewart, B. C., & Maycock, T. K. (Eds.). (2023). *Fifth National Climate Assessment*. U.S. Global Change Research Program. <https://doi.org/10.7930/NCA5.2023>
6. Vano, J. A., Arnold, J. R., Nijssen, B., Clark, M. P., Wood, A. W., Gutmann, E. D., Addor, N., Hamman, J., & Lehner, F. (2018). DOs and DON'Ts for using climate change information for water resource planning and management: Guidelines for study design. *Climate Services*, 12, 1–13.

Heat Exposure Settings

Lead Author: Kelly Turner, Ph.D.

Conceptual Overview

Heat Exposure Settings are the places that people spend time and become vulnerable to heat. They are the everyday places where life is carried out, such as homes, workplaces, schools, transportation systems, public spaces, and other sites for routine activities. Each Heat Exposure Setting encompasses a unique combination of:

- (1) **Context-dependent heat exposure pathways and cooling requirements**, shaped by who uses the place, for what purposes, and during which times of day or year; and
- (2) **Institutions and actors that govern the setting**, jointly influencing how heat is mitigated and managed for the individuals, activities, and periods of use associated with that place.

Both components are necessary because effective heat governance requires alignment with how heat is experienced and how change can realistically be implemented.

Heat exposure and its health consequences are personal and context-dependent. An individual's heat-health risk is a function of "the three Ps": personal health, physical activity, and place-specific environmental conditions. Personal health factors that amplify risk, such as age, medical conditions, and medication use, limit your body's ability to cool itself. Physical activities that involve high exertion, long duration, occur in hot conditions, or involve equipment may increase the work your body has to do to cool down. Places that are fully exposed to weather elements, generate heat inside or outdoors through design or mechanical operations, or generally lack cooling, also put people at higher heat-health risk. By examining the specific mix of personal, activity, and place-specific environmental risk, communities can identify the dominant vectors of heat risk in a given Heat Exposure Setting and develop place-specific strategies that are both responsive and scalable.

The Heat Exposure Settings concept was initially developed by the UCLA Luskin Center for Innovation for a policy-gap analysis prepared for the State of California (De Shazo, Lim, & Pierce, 2021). That report argued that a place-based approach could improve the delivery of heat action by tailoring solutions to specific settings and aligning them with discrete areas under the regulatory authority and monitoring responsibilities of affiliated state agencies. The report used the American Time Use Survey and a literature review of heat-vulnerable populations to develop an initial list of settings: homes, workplaces, schools and childcare facilities, carceral facilities, parks and recreational facilities, and public transit stops. The authors then conducted policy analysis to audit the gap between heat-protection policy needs and existing California policies. Subsequent reports identified pathways to bridge policy gaps in homes and schools.

Taking a place-based approach is especially helpful for addressing heat because its governance is typically fragmented across institutions. Heat is not typically governed by a central statute that is carried out by one clear institutional authority. Instead, heat governance is carried out across a patchwork of policies operating across sectors and jurisdictions.

The most frequently occurring form of heat governance is emergency management of extreme heat events, sited in hazard and public health institutions, followed by urban heat mitigation, sited in land-use and environmental institutions. Most communities rightly engage public health, emergency services, land-use, natural resources, urban forestry, climate, sustainability, and resilience offices in heat-resilience planning. What these institutions do not fully address is the range of statutes, agencies, and officers that influence facilities, operations, personnel, and clients and partners that are responsible for the daily functioning of everyday life. Each setting entails distinct sets of institutions and actors that are frequently overlooked in heat resilience efforts because they are place-specific rather than heat-centric. Conversely, these institutions and actors may overlook their important role in heat resilience efforts because they are charged with delivering a range of services that may appear independent of heat. This gap in conceptualizing relevance to heat resilience can inadvertently prevent effective heat mitigation and management when rules conflict.

The Luskin Center for Innovation at UCLA used the Heat Exposure Framework to examine K-12 public schools in California (UCLA Luskin Center for Innovation 2023). School-aged children are a heat-vulnerable population. Key heat-impacted activities and hot facilities include outdoor recreation on sun-exposed playgrounds and indoor learning environments that lack mechanical cooling. Cooling school facilities entails engaging the Department of Education, which has authority to set standards for safe and educationally appropriate facilities; the Department of General Services; and the Division of the State Architect, which has authority to approve building designs and determine compliance with safety codes, among others. These entities, jointly with the Department of Justice and Office for Civil Rights, oversee compliance with the Americans with Disabilities Act (ADA). Federal and California ADA law requirements added a 40% funding match for any outdoor facilities upgrades, creating an additional fiscal burden for local school districts seeking to install shade structures on playgrounds; and frequently, the most resource-constrained schools were also the most heat-vulnerable. In response, legislation was introduced to limit ADA matches to 20% (SB515). This example highlights how an Exposure Settings Framework can reveal unintended conflicts by engaging institutions such as the ADA that fall outside conventional heat resilience framings.

Many heat exposure settings are universally important across communities, including homes, schools, workplaces, and transit. Others may be very specific to your community. For example, cultural heritage sites, military bases, and agricultural worksites.

Exposure Settings: Best and Leading Practices

1. **Start by identifying the dominant heat exposure pathways in a given setting to tailor intervention selection.** Avoid prescribing cooling interventions simply because they are preferred or conventional.
2. **Align cooling interventions with institutional authority.** Identify which institutions govern facilities, operations, personnel, funding, and other standards in the setting.
3. **Design solutions around existing rules-in-use.** Determine which rules facilitate, constrain, or could be amended to achieve cooling goals.

4. **Create a “menu” of options that provide multiple institutional pathways for implementing solutions in a given setting.** Draw from this menu when policy windows open. Avoid one-size-fits-all solutions across settings.
5. **Be mindful of ways existing rules entrench inequities.** Avoid doubling down on rules-in-use that historically have created disparities in heat exposure or its management.
6. **Track implementation and adapt over time.** Assess effectiveness, monitor rule changes, and identify innovations in site-specific implementation. Update rules as institutional or climate conditions change.

Heat Exposure Settings: Goals, Objectives, and Actions

The specific goals, objectives, and actions a community chooses to prioritize should be tailored to the local context. The following offer broad examples of the kinds of goals and objectives that can be addressed within the scope of heat exposure setting assessment, along with activities that could be undertaken to achieve them.

Heat Exposure Settings: Goals, Objectives, and Actions

Goals	<ul style="list-style-type: none"> • Identify and prioritize action in the “settings” where people spend the most time exposed to hot conditions • Make connections between the sites, sectors, and stakeholders impacted and able to enact changes
Objectives	<ul style="list-style-type: none"> • Create an exhaustive list of heat exposure settings, including settings that are unique to the community • Determine what activities people engage in when they are in those settings • Assess heat vulnerability across the settings and sectors that are most affected • Determine what sectors (e.g., housing, education, transportation) and actors (e.g., Department of Transportation) influence facilities and operations in those settings
Actions	<ul style="list-style-type: none"> • Complete the Heat Exposure Settings Worksheet

Heat Exposure Settings: Tiered Approach to Workbook Activities

Tier 1	Tier 2	Tier 3
<i>Heat Exposure Settings Identification</i>	<i>Proposed; No Workbook Activity</i>	<i>Proposed; No Workbook Activity</i>

<p>Identify and prioritize key exposure settings. Identify heat exposure pathways in each setting and the responsible institutional actors.</p> <p>Brainstorm potential interventions and discuss feasibility.</p>	<p>Identify which institutions govern facilities, operations, personnel, and funding.</p> <p>Review relevant statutes, requirements, and operational rules.</p> <p>Develop a menu of options for amending existing rules to facilitate cooling goals.</p>	<p>Engage relevant agencies and decision-makers to further understand institutional rules and potential changes.</p> <p>Develop a targeted plan to adjust rules, including appropriate vehicles of change (e.g., policy, plans, etc.).</p> <p>Create a monitoring and evaluation plan.</p>
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Heat Exposure Settings: Key Terms

1. **Exposure Pathways:** The processes through which people experience heat. These pathways are conditioned by personal health, physical activity, and environmental conditions in particular places.
2. **Exposure Settings:** The environments where people regularly spend time and are exposed to heat, including homes, workplaces, schools, transportation, and public spaces. Each setting features distinct heat exposure pathways, cooling needs, and governing institutions.
3. **Institutions:** The formal and informal rules-in-use that shape what is permitted, allowed, required, or forbidden (Ostrom, 2005).
4. **Institutional Alignment:** The process of coordinating agencies, statutes, funding mechanisms, and operational practices to support effective heat mitigation and management in a setting.
5. **Place-based Approach:** A planning strategy that organizes action around specific activity sites rather than abstract geographic zones or sectors.
6. **Setting-Specific Intervention:** A cooling strategy tailored to the populations, activities, facilities and institutional context of a particular exposure setting.

Heat Exposure Settings: Recommended Readings and Resources

1. DeShazo, J. R., Lim, L., & Pierce, G. (2021). *Adapting to extreme heat in California: Assessing gaps in state-level policies and funding opportunities*. Luskin Center for

Innovation, University of California Los Angeles.

<https://innovation.luskin.ucla.edu/wp-content/uploads/2021/10/Adapting-to-Extreme-Heat-in-California.pdf>

2. Callahan, C., Dunlap, L., Gallarza, M., Spriggs, R., & Turner, V. K. (2022). *Protecting Californians with heat resilient homes*. Luskin Center for Innovation, University of California Los Angeles.
innovation.luskin.ucla.edu/wp-content/uploads/2022/07/Protecting-Californians-with-Heat-Resilient-Homes.pdf .
3. Callahan, C., Dunlap, L., Gallarza, M., Spriggs, R., & Turner, V. K. (2023). *Protecting Californians with heat resilient schools*. Luskin Center for Innovation, University of California Los Angeles.
<https://innovation.luskin.ucla.edu/wp-content/uploads/2023/05/Protecting-Californians-with-Heat-Resilient-Schools.pdf>
4. Ostrom, E. (2005). *Understanding institutional diversity*. Princeton, NJ: Princeton University Press.

Heat Vulnerability

Lead Author: Sara Meerow, Ph.D.

Conceptual Overview

Heat risks are not evenly distributed. Heat vulnerability reflects the degree to which people, places, or systems are likely to be negatively affected by heat. Vulnerability is shaped by 1) heat exposure, the weather and climate conditions that together with the built environment determine a person, place, or system's thermal settings; 2) sensitivity, or the extent to which a person, place, or system is negatively affected by exposure to heat; and 3) adaptive capacity, or ability to respond to heat in order to minimize negative effects. These components vary by individual, household, neighborhood, and community, so it is important to understand the local context. This complexity makes it challenging to assess heat vulnerability, but doing so is important in order to efficiently and equitably target heat resilience efforts. There is likely no one-size-fits-all approach to measuring heat vulnerability. Most heat vulnerability assessments integrate a number of physical and social indicators, for example, in a spatial heat vulnerability index (HVI). Research suggests that heat-specific, localized indices may more accurately capture relative risks than generic ones.

Heat Vulnerability: Best and Leading Practices

1. **Develop a locally relevant definition of heat vulnerability** that considers the most important factors related to physical heat exposure, sociodemographic sensitivity, and adaptive capacity.
2. **Consider developing a community heat vulnerability index (HVI)** that integrates multiple spatial indicators of vulnerability, but make sure to carefully consider which indicators are most relevant to the community, the modeling approach, and the statistical and geospatial choices.
3. Use information on heat vulnerability, such as an HVI, to **identify priority areas** for resilience strategies.

Heat Vulnerability: Goals, Objectives, and Actions

The specific goals, objectives, and actions a community chooses to prioritize should be tailored to the local context. The following offer broad examples of the kinds of goals and objectives that can be addressed within the scope of heat vulnerability assessment, along with activities that could be undertaken to achieve them.

Heat Vulnerability: Goals, Objectives, and Actions

Goals	<ul style="list-style-type: none"> • Set goals to reduce specific components of the community's heat vulnerability. Consider exposure, sensitivity, and adaptive capacity • Aim to prioritize heat resilience strategies in more vulnerable areas of the community
Objectives	<ul style="list-style-type: none"> • Plan to assess heat vulnerability across the community (e.g., develop a community-specific heat vulnerability index) • Set specific targets related to indicators of heat vulnerability that the community wants to improve in a particular timeframe
Actions	<ul style="list-style-type: none"> • Use existing indicators or a social vulnerability index to identify more socially vulnerable areas in the community • Develop a localized heat vulnerability index • Use the heat vulnerability assessment to identify priority areas for heat resilience strategies

Heat Vulnerability: Tiered Approach to Workbook Activities

Tier 1	Tier 2	Tier 3
<i>Understanding Heat Vulnerability</i>	<i>Building Your Own Social Vulnerability Viewer</i>	<i>Creating a Social Vulnerability Index for Heat</i>
<p>Use existing datasets to examine multiple dimensions of heat vulnerability in your community.</p> <p>Learn how to assess what a particular index or method for measuring vulnerability captures and does not capture.</p>	<p>Use online Geospatial Information System (GIS) tools to build a dynamic web map depicting social vulnerabilities to heat in your community.</p>	<p>Develop a unique social vulnerability index for your community using locally relevant indicators.</p>

Heat Vulnerability: Key Terms

1. **Vulnerability:** “The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.” (IPCC 2022)

2. **Exposure:** “The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected [by heat]” (adapted from IPCC 2022).
3. **Sensitivity:** “The degree to which a system or species is affected, either adversely or beneficially [by heat]. The effect may be direct or indirect” (adapted from IPCC 2022).
4. **Adaptive capacity:** “The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities or to respond to consequences [of heat]” (adapted from IPCC 2022).

Heat Vulnerability: Recommended Readings and Resources

1. Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards. *Social Science Quarterly*, 84(2), 242–261. <http://www.jstor.org/stable/42955868>
2. Hamstead, Z. A., & Sauer, J. (2021). Mapping vulnerability to weather extremes: Heat and flood assessment approaches. In Z. A. Hamstead, D. M. Iwaniec, T. McPhearson, M. Berbés-Blázquez, E. M. Cook, & T. A. Muñoz-Erickson (Eds.), *Resilient urban futures* (The Urban Book Series). Springer Nature. https://doi.org/10.1007/978-3-030-63131-4_4
3. Karanja, J., Vanos, J., Georgescu, M., Frazier, A. E., & Hondula, D. (2025). The imperative for hazard- and place-specific assessment of heat vulnerability. *Environmental Health Perspectives*, 133(5), 055003. <https://doi.org/10.1289/ehp14801>
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5. Wilhelmi, O. V., & Hayden, M. H. (2010). Connecting people and place: A new framework for reducing urban vulnerability to extreme heat. *Environmental Research Letters*, 5(1), 014021. <http://dx.doi.org/10.1088/1748-9326/5/1/014021>

Social, Cultural, and Equity Considerations for Heat Resilience

Lead Author: Trace Lane

Conceptual Overview

Social and cultural considerations of heat resilience describe the potential disruption, loss, or alteration of community events, cultural practices, and essential daily tasks that may result from increasing chronic and acute heat. Exploring the social and cultural, or *sociocultural*, impacts and risks of heat is important because it reveals how heat can pose a safety threat when communities engage in activities that maintain local lifeways and social cohesion within communities, tribes, and cultural groups. The disruption of these sociocultural activities matters because it can weaken the societal bonds that make communities more resilient to disasters, disconnect us from our cultural identities, make it dangerous to perform necessary daily tasks, and impose a barrier to heat-safe civic engagement. Understanding the sociocultural risks of heat can empower a community to proactively mitigate potential impacts through heat resilience planning, species monitoring and preservation plans, cooling intervention strategies, and other adaptation measures.

Sociocultural considerations can, and should, include a richly diverse range of interpretations. Ultimately, the conclusions about what is important to a community are determined by the community, even if the rationale does not fit an existing sociocultural model. Here, the goal is to provide a process for assessing the sociocultural risks posed by heat to a community. Conclusions derived from this process should be vetted by a diverse representation of community members. Planning efforts should address the risks deemed highest priority by the community.

We organize sociocultural considerations of heat into four areas of actionable practice:

1. Heat-Safe Community Events
2. Heat-Resilient Cultural Practices
3. Heat Resilience for Daily Life
4. Equity Considerations

Heat-Safe Community Events

Social connections, like those facilitated at community events, are a foundational element of community resilience (Tamasiga et al, 2024). Community events can include any gathering that takes place in your city, town, or neighborhood. Examples include food festivals, community bike rides, marathons, flea markets, art walks, concerts, and seasonal sports. Safe and enjoyable community events are an integral component of resilient communities because they offer the opportunity to build relationships, exchange knowledge, increase social cohesion, share resources, provide an outlet for local commerce, organize, and increase quality of life (among many other benefits) (Ludin et al, 2019).

However, as heat increases, so does the risk of heat exposure at outdoor events during the heat season, particularly for heat-sensitive attendees. In the Sociocultural worksheets, communities can identify events that may pose a health and safety risk to attendees - those which occur during heat season, are held outdoors, and lack a heat mitigation or management plan. Once events are identified, planning efforts can address these needs.

Heat-Resilient Cultural Practices

Plant and animal species that are irreplaceable, integral components of cultural practices are called cultural keystone species (Cristancho and Vining, 2004). Characteristics of cultural keystone species can include the generation of local, traditional, or indigenous knowledge; representation in cultural stories; use in traditional cuisine or medicine; and support of local economies by producing traditional products. In parallel with the concept of a keystone species in ecology, a cultural keystone species is a cornerstone of a culture (Mills et al., 1993). Just as the loss of an ecological keystone species can cause significant disruption or damage to an ecosystem, the loss of a cultural keystone species can disrupt or damage a culture.

Resources

- [What is a Cultural Keystone Species?](#)
- [National Congress of American Indians \(NCAI\)](#)
- [Seventh Sovereign Tribal Engagement Tips](#)
- [NOAA Cultural Resources Toolkit](#)
- [NOAA Tribal Consultation Handbook](#)

Learn About Cultural Keystone Species

- [Sweet Grass](#)
- [Elderberry](#)
- [Totora Reed](#)

Heat poses a risk to cultural practices when temperatures exceed the biological threshold for survival of cultural keystone species (Wahid et al., 2007). Cultural keystone species that are pushed beyond their temperature threshold for survival are at risk of extinction, species decline, migratory shifts, or other shifts in species assemblages (Seifert et al., 2015). If the cultural keystone species on which a cultural practice depends

disappears or becomes inaccessible, so too will the cultural practice itself. This area of the sociocultural heat practice is made actionable in the worksheets. Communities can identify relevant cultural keystone species, their biological heat thresholds, and the potential for those thresholds to be exceeded.

Heat Resilience for Daily Life

As chronic and acute heat increase, new risks associated with heat are emerging in the necessary tasks of daily life. What might once have been a low-risk activity, such as waiting for the bus, may require an adapted approach to remain safe in the context of rising heat. Heat-sensitive pedestrians may need to shift to shaded routes to avoid sun exposure during the heat of the day. Caregivers for young children or elderly people may need to adjust activity

schedules, have a cooling strategy in case of emergencies, and learn to recognize the signs of heat-related illness. Pet owners may need to adjust outdoor schedules to avoid heat stroke or other heat-related injuries.

To respond to these emerging risks, communities must understand their lived experiences of heat exposure: when, where, and how people are exposed to heat while carrying out their daily tasks (also see Heat Exposure Settings). One way to understand the lived experiences of heat is through qualitative data collection that generates detailed, context-specific accounts of how heat is impacting the daily lives of community members. With this information, a community can better understand the heat challenges it is experiencing. These results can inform a community survey to determine the pervasiveness of the challenges and ultimately inform heat planning.

Qualitative data collection approaches can include:

- interviews
- multi-model storytelling opportunities (visual, oral, written)
- focus groups or group discussions
- other culturally appropriate ways of transferring community-held knowledge

For an example of qualitative data collection about lived experiences of heat, refer to the Resource Spotlight “[Melting Metropolis](#)”.

Equity Considerations

Equity considerations of heat resilience address key questions: who bears the greatest burdens of heat, who benefits from cooling solutions, who has a voice in decision-making, and what information and perspectives are considered valid. These equity questions address the commonly referred to “pillars of equity”. The pillars, or key categories, include recognitional, distributive, procedural, and epistemological equity. The definitions of these terms evolve as collective understanding shifts, and there can be overlap between the pillars. The utility of the pillars of equity lies in their offering a framework for thinking through crucial equity issues.

Recognitional equity is a key part of equitable heat resilience planning because it invites recognition of the social categories and structures that have historically increased burdens while decreasing access to benefits for some groups compared to others. For example, historical practices of redlining communities led to chronic disinvestment in some communities compared to others. This is illustrated by disparities in tree canopy coverage and freeway proximity, both of which affect the lived experience of heat in a community.

Distributive equity considerations are an integral component of heat resilience planning. Understanding which community members are likely to be most impacted by extreme and chronic heat informs prioritization of cooling interventions (benefits). Exploring the distribution of cooling benefits in your community that are associated with the availability of shade structures, tree canopy, and other cooling infrastructure can further inform priorities.

Procedural equity refers to the fairness in a process, or equitable access to participation in the process of defining problems and adopting solutions (Schlosberg, 2007; Wenta et al., 2018; Van den Berg and Keenan, 2019). This is made actionable by considering who can participate in the planning process, if they are participating as an empowered decision maker or how their perspectives will be integrated into decision making (Wenta et al., 2018). Meaningful and ongoing participation of community members and trusted representatives can foster collaborative relationships and effective implementation of cooling solutions that work best for specific communities.

Epistemological equity refers to an equitable approach to the kinds of knowledge considered valid, in which perspectives from any one system of knowledge are not deemed more valuable than those from another. Epistemological equity is especially important in resilience planning. In practice, incorporating epistemological equity means that community-held knowledge, experiential knowledge, embodied knowledge, Traditional Ecological Knowledge, and other forms of knowledge are equally important to scientific knowledge. Related to procedural equity, this principle is made actionable by including and integrating community-held knowledge about priorities and preferences into decisions. For example, community-held knowledge can be a way to ground-truth scientific data about cooling priorities by informing planners about which pedestrian routes are preferred by the community and why, and therefore should be prioritized for cooling interventions.

Social, Cultural, and Equity Considerations: Best and Leading Practices

1. The definition of problems and appropriate solutions should be community-informed and community-led, informed by community-defined values.
2. Consider positionality, the history of relationships, and power dynamics when engaging with communities. Build trust slowly and authentically.
3. Before engaging with a tribe, indigenous organization, or front-line community, read historical accounts about that group that are written from their perspective(s). But remember that one person does not represent all perspectives for an entire group.
4. Understand and respect various forms of refusal to participate, including silence.
5. Ask yourself, “Who is this for, why are we doing this, and who will it benefit?”, and be transparent about the answer with all parties (Smith, 2019).
6. Utilize a trauma-informed approach when engaging with communities that have suffered injustice.

Goals, Objectives, and Actions

The specific goals, objectives, and actions a community chooses to prioritize should be tailored to the local context. The following offer broad examples of the kinds of goals and objectives that

can be addressed within the scope of social, cultural, and equity considerations, along with activities that could be undertaken to achieve them.

Social, Cultural, and Equity Considerations: Goals, Objectives, and Actions

Goals	<ul style="list-style-type: none"> • Understand the potential risks that heat might pose to your community’s social cohesion, community lifeways, cultural identity, and necessary daily tasks through an equity-centered lens. • Adopt heat resilience plans that include actions to address social, cultural, and equity risks.
Objectives	<ul style="list-style-type: none"> • Assess potential heat risks to community gatherings and events. • Assess potential heat risks to cultural keystone species. • Assess potential heat risk posed to the necessary daily tasks of community members. • Assess the process of defining problems and solutions through the key pillars of equity.
Actions	<ul style="list-style-type: none"> • Complete the <u>community events worksheet</u>. • Complete the <u>cultural keystone species worksheet</u>. • Consult the <u>Melting Metropolis case study</u> for guidance on qualitative assessment. • Utilize the equity scorecard resource. • Connect the results from these risk assessments to planning efforts.

Social, Cultural, and Equity Considerations: Tiered Approach

Tier 1	Tier 2	Tier 3
<i>SOCIOcultural Events Heat Risk Assessment</i>	<i>Sociocultural Resource Identification</i>	<i>Sociocultural Resource Risk Assessment</i>
Utilizing the method developed by SOCIO, Tier 1 activities guide communities in the process of identifying events that take place during heat season and might pose a safety threat to heat-sensitive attendees. Planning efforts can address these needs through event-specific cooling interventions, reconsidering event timing	Utilizing the method developed by SOCIO, Tier 2 worksheets guide communities in the identification of sociocultural resources and keystone species that are relevant to the community and at risk of crossing their biological survival threshold for heat. Planning efforts can then address this need through	Utilizing the method developed by SOCIO, Tier 3 worksheets support communities in determining if sociocultural resources and cultural keystone plant species are at risk of crossing their biological survival threshold for heat. Planning efforts can then address this need through cultural keystone species monitoring

<p>when appropriate, providing safety information for attendees, offering free hydration at events, deploying heat-informed medical response teams at events, or other solutions.</p>	<p>cultural keystone species monitoring and preservation plans, as deemed appropriate by the community, group, or tribe in a cultural relationship with the species.</p>	<p>and preservation plans, as deemed appropriate by the community, group, or tribe in a cultural relationship with the species.</p>
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Social, Cultural, and Equity Considerations: Key Terms

- Cultural keystone species:** Plant and animal species whose existence and symbolic value are essential to the stability of a cultural group, and perform functions that are so important for the culture that their withdrawal from the culture’s context would cause significant cultural disruptions (Cristancho and Vining, 2004).
- Epistemological equity:** refers to an equitable approach to the kinds of knowledge that are considered valid, wherein perspectives from any one system of knowledge are not considered more valuable than perspectives from another.
- Keystone species:** Species that “exert influences on the associated assemblage, often including numerous indirect effects, out of proportion to the keystone’s abundance or biomass” (Paine 1995, 962).
- Positionality:** Considerations of a researcher or practitioner’s influence on the processes, outcomes, or people involved in a project that result from current or historical power dynamics, gender, age, culture and ethnicity, social class, and shared experiences (Manohar et al, 2017).
- Procedural equity:** Refers to the fairness in a process, or equitable access to participation in the process of defining problems and adopting solutions (Schlosberg, 2007; Wenta et al., 2018; van den Berg and Keenan, 2019).
- Recognitional equity:** The recognition of structural vulnerability and intergenerational disadvantaged positions of minority groups, in terms of their cultural, socioeconomic, and political rights or access to the political system. Meerow et al. (2019) assert that recognitional equity includes: (1) acknowledging community members’ different intersecting identities (e.g., race, gender, social class, and age), (2) recognising that these identities are shaped by historical injustices that

can affect individual vulnerability to shocks and stresses, the ability to access re- sources, and the capacity to participate in decision-making, and (3) promoting respect for different groups.

injustice, then identifying the offenders and victims, and finally considering the types of compensation and other repairs that can be made and sustained (Robinson and Carlson, 2021).

7. **Distributive equity:** This concept addresses how burdens and benefits are distributed among groups in society.
8. **Restorative Justice:** Measures associated with restorative justice can be used to redress negative impacts of climate change, by first acknowledging harm that has occurred, the existence of an
9. **Social and cultural considerations of heat:** The disruption, loss, or alteration of community events or spaces, social infrastructure, and cultural practices that maintain local lifeways and social cohesion of communities, tribes, and cultural groups in response to chronic or extreme heat.

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Heat Governance, Maturity Assessment, Stress Testing, & Tabletop Exercises

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Conceptual Overview

Maturity describes a system's readiness to respond to a problem, such as extreme heat. We use the idea of assessing the *maturity* of a community's capacity to respond to heat to identify areas to prioritize for improvement. Capacities can be assessed in a Maturity Assessment for their level of sophistication in three overarching dimensions: (a) Institutions, including authority, funding, preparedness and response, and evaluation and accountability; (b) Partnerships and Networks, including coordination, inclusivity, and public communication, and (c) Assets of physical and natural infrastructure and application of technical knowledge (A Maturity Model for Heat Governance (June 2024), NOAA).

Stress testing is a method for assessing a system's readiness to respond to a problem, such as a community, government, institution, or agency. The problem is often posed as an emergency or extreme event, thereby stressing the system beyond its normal operating range. Stress testing can be a tool to identify capacity gaps and develop new, longer-term, equitable strategies to address them in the future. Stress testing for extreme heat involves working through the process of preparing for and responding to an extreme heat event in order to assess heat governance maturity. Stress testing is used to help partners evaluate their *capacities*, access to resources, funding, staff, partnerships, and other assets needed during an extreme heat event. Stress testing can involve conducting *tabletop exercises* in which participants, including individuals, organizations, and agencies, discuss how they would respond to an extreme heat event. Through this process, gaps in capacity can be identified and targeted for redress, thereby becoming better positioned to respond to actual extreme heat events.

Governance (contrasted with government) recognizes that response to heat within communities may involve not just formal state actors, but also nonprofit organizations, schools, healthcare systems and providers, and individual residents. Extreme heat preparedness and response require coordinating information and resources among diverse partners. Partners may include multiple government agencies and entities across jurisdictions and scales (e.g., municipal, rural, regional, and tribal agencies); community partners and non-governmental entities (e.g., schools, hospitals, and community- and faith-based organizations); and individual residents. Stress testing can help identify partners needed for extreme heat preparation and response.

It is crucial to tailor approaches to evaluating heat readiness to reflect communities' diverse needs. For example, an urban area may be data-rich and have well-defined government jurisdictions, readily accessible medical care to support increased needs during heat events, and

established cooling centers accessible by public transit, but lack accessible green space options and strong partnerships between government and non-governmental organizations. A rural or unincorporated area may have greater access to green spaces, but less clear jurisdictional boundaries, a lack of relevant heat data or monitoring equipment, and limited access to medical care or cooling centers.

Stress testing and maturity modeling will play a key role in assessing the capacity to respond to heat. Communities will assess their current capacities for responding to extreme heat and identify gaps. Based on the partners and specific needs identified by the maturity modeling and stress testing, communities will be directed to a tailored suite of recommended tools, resources, partnerships, and evaluation metrics.

Stress Testing: Best and Leading Practices

1. Organize a tabletop exercise with a diverse group of participants, even if there are limited heat adaptation plans or policies developed, as doing so can identify the most salient priorities for next steps (for example: Charleston)
2. Continue to engage stress testing activities to improve multi-sectoral and multi-jurisdictional response, even when initial heat adaptation plans have been completed, in recognition that building heat resilience is a continual process of improvement (for example: Phoenix)
3. Focus on specific subpopulations that may be particularly vulnerable to extreme heat, specifically engaging organizations that serve these populations (for example: Las Vegas)
4. Before the Stress Testing exercise, review and connect with local and regional heat governance plans, initiatives, heat-focused community organizations, and existing heat-related data and models, and consider conducting an initial Maturity Assessment.
5. After the Stress Testing exercise, immediately assign actions on the ideas generated, empower individuals and agencies to act upon them, and establish a timeline to re-evaluate progress.

Stress Testing: Key Decision Points

1. Communities must learn about tabletop exercises, including the range of objectives they can be designed to stress-test
2. Communities must decide the appropriate partners and assemble a planning committee to spearhead a tabletop exercise. This team will need to create objectives, prepare materials, design the scenario, and coordinate logistics of the event
3. Communities must decide how to integrate the findings of the tabletop exercise into the next steps to increase resilience for their communities (usually also included in the After Action Report)

Stress Testing: Goals, Objectives, and Actions

The specific goals, objectives, and actions a community chooses to prioritize should be tailored to the local context. The following offer broad examples of the kinds of goals and objectives that can be addressed within the scope of stress testing and maturity assessment, along with activities that could be undertaken to achieve them.

Stress Testing: Goals, Objectives, and Actions

Goals	<ul style="list-style-type: none"> • Achieve an understanding of the governmental and non-governmental capacity needed to support heat resilience and planning. • Identify current capacities and gaps in existing heat resilience initiatives to respond to an extreme heat event. • Identify a suite of tools, resources, partnerships, and evaluation metrics that will support communities in further strengthening their heat-ready governance.
Objectives	<ul style="list-style-type: none"> • Evaluate “maturity” (i.e., self-identify the communities’ existing capacities, funding, resources, etc., for heat resilience planning and governance). • Recommend the next resources/tools to move to the next level of readiness or a tabletop exercise.
Actions	<ul style="list-style-type: none"> • In conversation with key partners, review the ‘Stress-Test A’ checklist and indicate what capacities and resources the community currently has for heat resilience planning and governance.

Governance Capacity Assessment: Tiered Approach to Workbook Activities

Tier 1	Tier 2	Tier 3
<p><i>Self Assessment (Stress Test A)</i></p> <p>Complete a comprehensive heat management resource assessment checklist and answer questions about local capacities and gaps.</p>	<p><i>Maturity Model (Stress Test B)</i></p> <p>Connect answers from Stress Test A to key capacity areas in the NOAA Maturity Model for Heat Governance.</p> <p>Form a list of relevant and willing stakeholders, existing planning documents, and key data points that will be useful for planning a future tabletop exercise.</p>	<p><i>Proposed; No Workbook Activity. Tabletop Exercise</i></p> <p>Use data collected in previous tiers and NOAA’s Introduction to Heat Tabletop Planning and Coordination to develop a heat-specific tabletop exercise.</p>

Stress Testing: Key Terms

1. **Adaptive capacity:** “The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities or to respond to consequences [of heat]” (adapted from IPCC 2022).
2. **Capacity:** A community’s ability to provide services to residents, which is influenced by structural and cultural factors.
3. **Direct resident involvement:** The ability of residents and communities, including capacity to organize around shared needs and advocate for community benefits.
4. **Government capacity:** Public agencies’ ability to provide services to residents. Factors influencing government capacity include: financial stresses, staff turnover, collaborative capacity, and procurement rules changes.
5. **Heat Governance:** the actors, institutions, strategies, and processes for managing/mitigating risks associated with heat (Keith et al 2021). *Governance* recognizes roles of formal state actors (government), as well as non-state actors (hospital systems, school districts, nonprofits, community-based organizations, businesses, etc).
6. **Maturity:** A community’s existing capacities, funding, resources, etc., for heat resilience planning and governance. Maturity can evolve as a community’s capacities, resources, knowledge, and efforts change.
7. **Maturity Model:** A tool to assess a community’s current capacities, funding, and resources to successfully manage heat risk (i.e., the community ‘maturity’) and to identify the gaps and needs to improve heat resilience. For example, see the [NOAA NIHHS Maturity Model Planning Guide](#). (resource no longer available)
8. **Nongovernmental capacity:** The ability of non-governmental actors, including: hospital systems, school districts, nonprofits or community based organizations, and businesses, to provide services to residents. Compared with government capacity, capacity from nongovernmental organizations can be more flexible, direct, leverage social networks and more/different material resources.
9. **Stress testing:** Methods to identify the needs and capacities of government and community entities to implement heat resilience governance and community-led initiatives (Miller & Muñoz-Erickson 2018).
10. **Table-top exercise:** A collaborative planning tool that simulates emergency situations in an informal environment. A facilitator guides exercise participants through a hypothetical emergency scenario to explore preparedness and response strategies and build equitable long-term resilience. For example, see the NOAA NIHHS Introduction to Heat TableTop Coordination and Planning Guide.

Stress Testing: Recommended Readings and Resources

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Heat Action Planning

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Conceptual Overview

New environmental challenges require systems to respond in new ways. Climate action, sustainability, adaptation, and resilience plans are comprehensive strategic documents that outline specific actions communities should undertake to address emerging environmental challenges. These types of plans offer a framework for identifying, measuring, and tracking progress towards goals designed to mitigate and manage the impacts of extreme weather events.

Heat action planning is the process by which a community outlines comprehensive goals, metrics, and actions to mitigate and manage heat. Heat action plans (HAPs) are the resulting “written documents that help manage actions across multiple organizations to reduce adverse health effects from extreme heat. HAPs broadly contain strategies such as performing surveillance, providing risk communication, supporting social and health care, establishing cooling centers, distributing water bottles and fans, and creating energy assistance programs.” (Randazza et al. 2023). They can also outline strategies that cool communities, such as urban greening and designing buildings to maximize shade and ventilation. Heat action plans can thus include “a portfolio of assessments and actions to respond to and reduce heat-related impacts” (Arsht Rock).

Heat action planning encompasses two distinct areas: heat mitigation and heat management. *Heat mitigation* emphasizes design and planning strategies to reduce the contribution of the built environment to urban heat, such as green infrastructure, shade planning, or cool roofs (Keith & Meerow 2022).

Heat management is focused on response strategies for extreme heat the domain of emergency management (Keith & Meerow, 2022). Heat strategies can include heat warning public transportation to cooling centers heat events.

Key Decision Point:
Communities must decide whether to integrate heat resilience into existing plans and/or develop a stand-alone heat action plan.

preparation and events, often within or public health management systems or free during extreme

A foundational step in heat action planning is an initial evaluation of existing plans and policies, or the *network of plans*, that address extreme weather hazards, climate change, and sustainability. Evaluating the existing network of plans ensures awareness of current plans, how they are (or are not) connected to extreme heat, and potential co-benefits and conflicts among them. An evaluation of the existing network of plans provides

communities with an opportunity to analyse how heat mitigation policies are integrated across plans and to better target policies in high heat-risk areas.

A subsequent step in the heat action planning process is conducting a *plan quality evaluation*. This process assesses the quality of existing heat plans to ensure they include key elements such as goals, fact base, implementation and monitoring, coordination, public participation, and uncertainty. If a heat action plan already exists within a community, it can be improved or adjusted based on the results of the Plan Quality Evaluation for Heat Resilience. If communities want to go deeper to assess how planned land use changes and future developments could affect heat resilience, they may also conduct a Plan Integration for Resilience Scorecard™ (PIRS™) for Heat.

Heat action planning guidance will support communities by integrating heat goals, a fact base, strategies, and implementation measures across relevant local plans and within a dedicated heat action plan.

Heat Action Planning: Best and Leading Practices

1. Set clear goals and associated metrics for success.
 2. Build a comprehensive “fact base” of information on heat risks.
 3. Develop a diverse portfolio of heat mitigation and management strategies.
 4. Develop a strategy for managing uncertainty.
 5. Coordinate across planning efforts.
 6. Ensure inclusive participation in planning processes.
 7. Ensure effective implementation, monitoring, and evaluation.
- [“Planning for Urban Heat Resilience.” PAS Report, Apr. 2022, planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/PAS-Report-600-r1.pdf.](https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/PAS-Report-600-r1.pdf)

Goals, Objectives, and Actions

The specific goals, objectives, and actions a community chooses to prioritize should be tailored to the local context. The following offer broad examples of the kinds of goals and objectives that can be addressed within the scope of heat action planning, along with activities that could be undertaken to achieve them.

Heat Action Planning: Goals, Objectives, and Actions

Goals	<ul style="list-style-type: none"> ● Develop or update a dedicated Heat Action Plan, or ● Integrate a heat action component into an existing plan.
Objectives	<ul style="list-style-type: none"> ● Evaluate existing plans and policies across urban planning, hazard mitigation planning, public health, and emergency management to support communities in equitably addressing heat mitigation and management.
Actions	<ul style="list-style-type: none"> ● Complete the Plan Quality Evaluation for Heat Resilience or PIRS™ for

	<p>Heat.</p> <ul style="list-style-type: none"> • Cohort participants will be trained to conduct plan assessments in their communities. • Utilize the 7 Principles of Strong Climate Change Planning to develop or update a dedicated Heat Action Plan.
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Heat Action Planning: Tiered Approach to Workbook Activities

Tier 1	Tier 2	Tier 3
<i>Planning Capacity Assessment Workshop</i>	<i>Plan Quality Evaluation for Heat Resilience</i>	<i>Plan Integration for Resilience Scorecard (PIRS) for Heat</i>
Conduct a workshop to select a network of plans, qualitative assessment of focus across plans on heat (e.g., fact base, goals, strategies, implementation)	Complete Tier 1 plus conduct Plan Quality Evaluation for Heat Resilience	Complete Tier 1 and 2, plus conduct PIRS™ for Heat

Heat Action Planning: Key Terms

1. **Heat action planning:** The process by which a community outlines comprehensive goals, metrics, and actions for mitigating and managing heat. Heat action plans (HAPs) are “written documents that help manage actions across multiple organizations to reduce adverse health effects from extreme heat. HAPs broadly contain strategies such as performing surveillance, providing risk communication, supporting social and health care, establishing cooling centers, distributing water bottles and fans, and creating energy assistance programs.” (Randazza et al. 2023). Heat action plans include “a portfolio of assessments and actions to respond to and reduce heat-related impacts” (Arsht Rock)
2. **Urban Heat mitigation:** “Design and planning strategies to reduce the contribution of the built environment to urban heat” (Keith & Meerow 2022)
3. **Heat management:** “Preparation and response strategies for extreme heat events, often within the domain of emergency management or public health” (Keith & Meerow, 2022)
4. **Heat resilience:** “Proactively managing and mitigating heat across the many systems and sectors it affects.” (Meerow & Keith 2022)
5. **Heat equity:** “The development of practices and policies to mitigate and

manage heat with a focus on reducing the inequitable distribution of risk across different groups within the same community” (Keith & Meerow, 2022)

6. **Heat governance:** “the actors, strategies, processes, and institutions that can mitigate and manage this hazard” (Keith et al. 2021, Nature)
7. **Network of plans:** “collection of community plans that shape the built environment” including comprehensive plans, hazard mitigation plans, and climate action (Keith et al. 2023).
8. **Plan quality evaluation:** “an established method for evaluating the content of plans to see whether they contain elements that are widely believed to be critical to the plan’s effectiveness in achieving community goals” (Meerow et al. 2024).
9. **Plan Integration for Resilience Scorecard™ for Heat:** A methodology for analyzing the land use policies, or action items, across community plans that would affect urban heat and comparing spatial patterns in policy attention with indicators of vulnerability (Keith et al. 2023).

Heat Action Planning: Recommended Readings and Resources

Readings on current state of heat planning research and practice:

1. Keith, L., Meerow, S., Turner, V. K., & Hondula, D. M., Arnott, J. C. (2021). Deploy heat officers, policies and metrics: Cities need heat governance to plan for extreme temperatures and protect those most at risk. *Nature*, 598, 29–31. <https://doi.org/10.1038/d41586-021-02677-2>
2. Keith, L., Gabbe, C. J., & Schmidt, E. (2023). Urban heat governance: Examining the role of urban planning. *Journal of Environmental Policy & Planning*, 25(5), 642–662. <https://doi.org/10.1080/1523908X.2023.2244446>
3. Keith, L., Meerow, S., & Wagner, T. (2020). Planning for extreme heat: A review. *Journal of Extreme Events*, 6, 1–27. <https://doi.org/10.1142/S2345737620500037>
4. Turner, V. K., French, E. M., Dialesandro, J., Middel, A., Hondula, D. M., Weiss, G. B., & Abdellati, H. (2022). How are cities planning for heat? Analysis of United States municipal plans. *Environmental Research Letters*, 17, 064054. <https://doi.org/10.1088/1748-9326/ac73a9>
5. Gabbe, C. J., Pierce, G., Petermann, E., & Marecek, A. (2024). Why and How Do Cities Plan for Extreme Heat? *Journal of Planning Education and Research*, 44(3), 1316-1330. <https://doi.org/10.1177/0739456X211053654>

Readings on evaluating heat planning

1. Meerow, S., Keith, L., Roy, M., & Trego, S. (2024). Plan evaluation for heat resilience: Complementary methods to comprehensively assess heat planning in Tempe and Tucson, Arizona. *Environmental Research Letters*. <https://doi.org/10.1088/1748-9326/ad5d05>
2. Meerow, S., & Woodruff, S. (2020, July). 7 principles of strong climate change planning. American Planning Association. <https://www.planning.org/planning/2020/jul/tools-japa-takeaway/>

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4. Malecha, M., Masterson, J. H., Yu, S., & Berke, P. (2019). *Plan Integration for Resilience Scorecard guidebook: Spatially evaluating networks of plans to reduce hazard vulnerability – Version 2.0*. College Station, TX: Institute for Sustainable Communities, College of Architecture, Texas A&M University. <https://planintegration.com>
5. Trego, S., Meerow, S., & Keith, L. (2023). Heat planning in small and medium-sized cities: A collaborative application of PIRS™ for heat in Kent, WA, USA. *Socio-Ecological Practice Research*, 5, 409–422. <https://doi.org/10.1007/s42532-023-00166-6>

Readings on heat action planning

1. Keith, L., & Meerow, S. (2022). *PAS Report 600: Planning for urban heat resilience*. American Planning Association. <https://www.planning.org/publications/report/9245695/>
2. Guardaro, M. (2023). Strengthening heat action plans in the United States. *American Journal of Public Health*, 113, 465–467. <https://doi.org/10.2105/AJPH.2023.307260>
3. Randazza, J. M., Hess, J. J., Bostrom, A., Hartwell, C., Adams, Q. H., Nori-Sarma, A., Spangler, K. R., Sun, Y., Weinberger, K. R., Wellenius, G. A., & Errett, N. A. (2023). Planning to reduce the health impacts of extreme heat: A content analysis of heat action plans in local United States jurisdictions. *American Journal of Public Health*, 113, 559–567. <https://doi.org/10.2105/AJPH.2022.307217>
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8. McGregor, G. R., Bessemoulin, P., Ebi, K., & Menne, B. (Eds.). (2015). *Heatwaves and health: Guidance on warning-system development*. World Meteorological Organization & World Health Organization. <https://climate-adapt.eea.europa.eu/en/metadata/guidances/heatwaves-and-health-guidance-on-warning-system-development>
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Stakeholder Engagement

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Conceptual Overview

Engagement refers to processes through which stakeholders become involved in heat resilience preparations in order to shape and enhance outcomes. This core concept focuses on approaches that enable three overarching engagement activities: meaningful engagement with impacted communities, strategic engagement with decision-makers, and media outreach to the public at large.

Engagement is a crucial component for understanding the impacts of heat in a community, identifying which heat intervention strategies are a good fit, and implementing the adopted strategies effectively. Heat resilience strategies are more robust when they include the voices of impacted communities and decision-makers' expertise; more effective when they include buy-in from key stakeholder groups; and more durable when they are supported by stakeholders, rules, and resources.

Thoughtful, meaningful, and strategic engagement for heat resilience planning can ensure community interests and concerns inform heat actions; increase the likelihood that heat actions can be implemented effectively through supportive legislation, regulation, funding, and guidelines; and create greater awareness of heat issues and actions among the public-at-large, indirectly influencing policy through community concern. Early, ongoing, and iterative interactions are a precursor to meaningful engagement that is relationship-based, built on trust, and willing to acknowledge a range of stakeholder priorities. This is a key component of heat resilience planning because heat is a cross-cutting problem that necessitates collaboration among communities, organizations, Tribal Nations, and city departments.

Engagement occurs on a spectrum ranging from one-way communication (least robust) to collaborative partnerships (more robust). At a minimum, engagement entails one-way communication between community leaders and an audience. This level of engagement could include posting National Weather Service heat alerts on social media, running a heat education campaign through community communication channels, or developing communications and media to illustrate disproportionate urban heat exposure.

Key Decision Point:

Identifying communities affected by urban heat-related inequities requires community engagement.

Recommendation:

Engage with community leaders to learn about the resident experience of heat-related inequities and associated health disparities.

Most heat resilience action goals will benefit from a more robust engagement strategy. A more robust engagement approach includes two-way communication, wherein a community or stakeholder group provides insight and feedback that is integrated into plans and decisions. This type of engagement must happen early in a project so that the feedback can be integrated at crucial planning junctures, rather than after plans are finalized.

A more robust approach to engagement will include longer-term initiatives that support an authentic relationship among the community(ies) of impact, other stakeholders, and the project team. Goals of this level of

in-depth engagement can include empowering community leaders through existing community channels and organizations to lead community outreach or engaging decision-makers during multiple phases of the policy cycle to develop relationships and align agendas.

Some forms of engagement will include working with city or Tribal agencies, departments, or bureaus to gather information and operate within administrative protocols. For example, to conduct a benefit-cost analysis of tree canopy expansion as a cooling intervention strategy, one city department might engage another to obtain cost data. To ensure the project's success, it will be important to consider how expanding tree canopy might affect operations across other city departments (such as tree maintenance) and which administrative protocols are relevant when seeking information.

Key Decision Point:

Introducing resources within a community, particularly those that are policy-based, often necessitates support from decision makers.

Recommendation:

Engage residents and allies in power mapping to identify spheres of influence and how they can be leveraged to reach resident goals.

Other forms of engagement will be focused on communities of impact - residents, community organizations, and other community stakeholders. Engaging with community leaders and trusted messengers is a key part of understanding how heat impacts community members' lives and which proposed intervention strategies would have community support. Without community support, it is much less likely that an intervention strategy will succeed in addressing the intended problem. This is because the data available to researchers about heat in a given location is not intended to provide contextual details. These contextualizing details can only be learned through engagement with community members and relevant city departments. Absent meaningful engagement at impactful junctures in the planning process, interventions might be off-target or pose additional problems for the community.

Stakeholder Engagement: Best and Leading Practices

1. Identify communities affected by urban heat
2. Create an engagement strategy, map, and tracker to stay organized.
3. Ask community leaders for advice on when, where, who, and how to engage.
4. Demonstrate respect for diverse priorities, approaches, languages, cultures, and knowledge.
5. Ensure appropriate access to urban heat-related resources and information.
6. Meet community residents where they are (e.g., door-to-door, house meetings).
7. When appropriate, compensate community members for their time (e.g., for participation in door-knocking and data collection).
8. Offer childcare for in-person events.
9. Research the work of the person/s with whom you are engaging prior to meeting.
10. Invest time in listening to the people you are engaging with.
11. Prioritize communities that have been historically underrepresented in decisions, planning, and distribution of benefits.
12. Follow up and report back: demonstrate how you integrated the feedback you received.

Goals, Objectives, and Actions

The specific goals, objectives, and actions a community chooses to prioritize should be tailored to the local context. The following offer broad examples of the kinds of goals and objectives that can be addressed within the scope of engagement, along with activities that could be undertaken to achieve them.

Stakeholder Engagement: Goals, Objectives, and Actions

Goals	<p>Community</p> <ul style="list-style-type: none"> ● meaningful engagement with impacted communities <p>Decision-Makers</p> <ul style="list-style-type: none"> ● strategic engagement with decision-makers <p>Media</p> <ul style="list-style-type: none"> ● media outreach to the public at large
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<p>Objectives</p>	<p>Community</p> <ul style="list-style-type: none"> ● Identify resident interests in heat resilience. <ul style="list-style-type: none"> ■ Identify community heat-related challenges and needs. ■ Identify community assets concerning heat adaptation, mitigation, and management. ■ Identify community-specific policy and governing challenges. ● Identify community heat-related adaptation, mitigation, and adaptation goals. <ul style="list-style-type: none"> ■ Identify effective mechanisms for circulating heat/health alerts. <p>Decision-Makers</p> <ul style="list-style-type: none"> ● Identify the policy and governing challenges. ● What are the policy levers and legislative vehicles available to make changes? ● Take the current policy temperature. What type of rules are open for change in the current policy cycle? ● Create specific action goals. <p>Media</p> <ul style="list-style-type: none"> ● Determine the intention of engaging the media. ● Determine the vehicle best suited for that type of engagement (e.g., OpEds, news, social media). ● Create media content and a dissemination strategy.
<p>Actions</p>	<p>Community</p> <ul style="list-style-type: none"> ● Build community leaders ● Expand the community base ● Build community coalitions ● Voter education and mobilization ● Communications and media ● Engage decision-makers <p>Decision-Makers</p> <ul style="list-style-type: none"> ● Review existing rules and proposed new rules being considered that pertain to extreme heat at the appropriate jurisdictional scale. ● Develop a full policy brief on specific key issues that are priority areas for the community and are aligned with stakeholder goals/well-positioned to move forward. ● Develop relationships with key decision-makers such as legislative staff of bill authors, agencies and departments, advocates, etc., to better understand their heat-related concerns and goals, and to provide review

	of policy brief materials prior to the start of the new bill deadline if possible.
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Stakeholder Engagement: Tiered Approach to Workbook Activities

Tier 1	Tier 2	Tier 3
<p>Community: <i>Build Community Leaders</i></p> <p>Train leaders to hold community workshops with community groups.</p> <p>Policy: <i>Policy Landscape Analysis</i></p> <p>Create an issue statement, map key stakeholders, locate your issue in the policy cycle, and identify policy pathways toward change.</p> <p>Media: <i>The Media Quadrant</i></p> <p>Prepare to respond to media inquiries.</p>	<p>Community: <i>Build Community Coalitions</i></p> <p>Build community coalitions to support community advocacy.</p> <p>Policy: <i>Tracking Policy</i></p> <p>Building on the policy landscape analysis, track policy vehicles relevant to your issue statement to inform response. Develop policy-facing materials and deliver them at key convenings and through one-on-one meetings.</p> <p>Media: <i>Proposed; No Workbook Activity.</i></p> <p>Develop a message and proactively reach out to the media, drafting OpEds, etc.</p>	<p>Community: <i>Co-Develop Heat Action Goals</i></p> <p>Co-develop heat action goals, strategies, tactics, etc., with communities through collaborative partnerships with community groups.</p> <p>Policy: <i>Proposed; No Workbook Activity.</i></p> <p>Co-design and guide policies through one-on-one relationships with decision-makers and their staff.</p> <p>Media: <i>Proposed; No Workbook Activity.</i></p> <p>Develop media campaigns, complete with toolkits and partners to deploy.</p>

Stakeholder Engagement: Key Terms

- | | |
|--|---|
| <p>1. Impacted Communities:
Communities experiencing urban heat impacts.</p> <p>2. Environmental Justice Communities: Underserved,</p> | <p>low-income communities and communities of color experiencing disproportionate environmental exposures, such as urban heat impacts.</p> |
|--|---|

3. **Community Leaders:** Central actors in environmental change initiatives, formally or informally recognized as environmental justice, public health, or community organizing experts.
4. **Decision-makers:** Individuals with legal authority to enact and enforce rules, or individuals informally recognized as authorities via large influence over particular groups.
5. **Policy Cycle:** Stages in the process of the policy development stream, including agenda setting, formation, implementation, and review, to which engagement should be tailored.
6. **Policy Landscape Analysis:** Map of the key players, institutions, and leaders that impact a policy or research issue.
7. **Media:** Means of mass communication encompassing traditional formats such as print, radio, television, and online publications, as well as new media such as social media, podcasts, and blogs.
8. **Heat Alerts:** Tools used to communicate heat risk and encourage protective actions, such as advisories, watches, and warnings used by the National Weather Service ([Hondula et al. 2022](#)).
9. **Heat Risk Management System:** The suite of tactics and tools, and supporting institutions and infrastructure, used to evaluate and reduce harm to groups and individuals that may become exposed to high temperatures that affect community health and well-being.
10. **Heat Actions:** An action involving heat-related community organizing, outreach, education, adaptation and mitigation strategies, policy analysis and development, etc.

Stakeholder Engagement: Recommended Readings and Resources

1. Callahan, C., Coffee, D., DeShazo, J.R., & González, S.R. (2021). *Justice40 and climate equity: Final report*. Luskin Center for Innovation, University of California Los Angeles. <https://innovation.luskin.ucla.edu/wp-content/uploads/2021/10/luskin-justice40-final-web-1.pdf>
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8. California Coalition for Health Equity. (n.d.). *Coalition building*.
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13. The Praxis Project. (n.d.). *Planning for media advocacy*.
<https://www.scribd.com/document/44610766/PraxisMedia>
14. National Democratic Institute. (n.d.). *Developing a decision maker engagement plan (English)*.
<https://www.ndi.org/sites/default/files/Developing%20A%20Decision%20Maker%20Engagement%20Plan%20%28English%29.pdf>

Indicators of Heat Resilience

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Conceptual Overview

An indicator is a value that can be observed and measured to communicate the presence or absence of a phenomenon. When an indicator is tracked over time, the measurements can communicate increases or decreases in the phenomenon of interest. This type of observation and measurement can be used to identify the presence of a problem, gauge likely resilience to it, track progress towards goals, and evaluate the impact of solutions.

Challenges to Anticipate:

1. Key data sources may be missing or difficult to access.
2. Collecting data for indicators often requires collaboration across multiple agencies and sectors.

Identifying appropriate indicators at the community scale will play a key role in advancing heat resilience. Accessible, reliable, and valid indicators can empower communities to communicate the extent of extreme heat exposure and its impact on their communities.

Understanding a community's exposure to extreme heat is a critical step toward making the case to address the associated challenges. Indicators that describe the historical and current *heat burden*, or the amount of heat a community is exposed to, offer insight into the scale and severity of the extreme heat people in a particular place experience.

To gauge how communities are likely to be impacted by their exposure to extreme heat, indicators in key areas of community well-being that are known to contribute to **heat resilience**, or the ability to withstand and recover from extreme heat experiences, can be identified for measurement. Key indicators should acknowledge past and current heat burden, the surrounding natural and built environment, overall health and economic levels, social and demographic connections, local grid security, and social factors that might influence heat risk or resilience.

Key Decision Points:

1. Communities must determine which indicators they would like to prioritize in the short and long-term.
2. Communities must decide to either use existing data/databases or begin collecting their own data.

Indicators are crucial for describing a community's heat burden, tracking progress towards heat resilience goals, and assessing the impact of heat resilience strategies. Indicators provide evidence to support reducing exposure to heat hazards, reducing overall vulnerability (such as enhancing emergency response capacity, increasing access to cooling centers, or expanding green infrastructure), and increasing communities' ability to respond to heat hazards. As communities determine their heat resilience goals, indicators allow them to track progress towards these goals in ways that are meaningful, measurable, specific, time-based, and applicable to their unique community context.

Indicators of Heat Resilience: Best and Leading Practices

1. Indicators must be observable, measurable over time, and actionable.
2. Community needs and priorities, informed by historical experiences and vulnerabilities, should inform the indicators of heat burden and heat resilience.
3. Ensure indicators are quantifiable with available data; if data are not available, ensure it can be collected or provided by the community or team.
4. Provide flexibility in the wording and application of the indicator to meet community needs.
5. Indicators are useful for both identifying heat risk and tracking progress to lessen that risk (or increase resilience) over time.
6. Indicators will have different themes depending on the goal. For example, health goals need health indicators, economic goals need economic indicators, and so on.
7. Effective indicators must be both evidence-based and accepted by the community as relevant in their given context.
8. Include community members in the process of defining indicators and deciding which indicators are meaningful.
9. Choose your indicators with awareness that members of impacted communities may not be visible in the same ways as members of more affluent communities, and might not be accurately represented in counts or frequencies.
10. Ensure that your indicators can track whether communities that have historically shouldered a disproportionately high share of the heat burden have access to the benefits of heat resilience solutions.
11. The indicators should be iteratively and adaptively updated to reflect learning from the design, implementation, and evaluation of heat adaptations.
12. When possible, indicators should align with existing urban planning, public health, climate adaptation, and emergency management frameworks.

Goals, Objectives, and Actions

The specific goals, objectives, and actions a community chooses to prioritize should be tailored to the local context. The following offer broad examples of the kinds of goals and objectives that can be addressed within the scope of resilience indicators, along with activities that could be undertaken to achieve them.

Indicators of Heat Resilience: Goals, Objectives, and Actions

Goals	Understand the change in heat impacts and progress towards heat resilience.
Objectives	Track indicators of heat impacts and heat resilience over time.
Actions	Identify appropriate indicators through which to track heat impacts and heat resilience.

Indicators of Heat Resilience: Tiered Approach to Workbook Activities

Tier 1	Tier 2	Tier 3
<p><i>Develop Resilience Indicators</i></p> <p>Decide which heat burdens you want to track to describe and monitor the problem.</p> <p>Decide which type of heat resilience you want to track to monitor progress towards it.</p> <p>Identify and compile a list of potential indicators of heat burden and heat resilience for your community based on research.</p>	<p style="color: red;"><i>Proposed; No Workbook Activity</i></p> <p>Prioritize the potential indicators list based on community importance and feasibility, determined through community and stakeholder engagement.</p> <p>Refine and prioritize the list of indicators for short and long-term goals based on assessed capacity.</p> <p>Identify sources of data needed to track your chosen indicators, and engage with knowledge holders as needed to develop a plan for data sharing.</p>	<p style="color: red;"><i>Proposed; No Workbook Activity</i></p> <p>Start to track indicators of implementation or success.</p> <p>Monitor the indicators over time.</p> <p>Report changes/no changes for each indicator on a regular schedule to monitor heat burden and progress towards heat resilience.</p> <p>Communicate changes/no changes in indicators to stakeholders.</p>

Indicators of Heat Resilience: Key Terms

- Community:** FEMA defines community as: 1. A group of people living in the same locality and under the same government, or a political subdivision of a state or other authority that has zoning and building code jurisdiction over a particular area. 2. A political entity that has the authority to adopt and enforce floodplain ordinances for the area under its jurisdiction. 3. A network of individuals and families, businesses, governmental and nongovernmental organizations, and other civic organizations that reside or operate within a shared geographical boundary and may be represented by a common political leadership at a regional, county, municipal, or neighborhood level. 4. Any State, or area or political subdivision thereof, or any Indian tribe or authorized Tribal organization or Alaska Native village or authorized native organization, which has authority to adopt and enforce floodplain management regulations for the areas within its jurisdiction.
- Heat-caused death:** A loss of life where heat exposure is listed as a direct cause of death on the death certificate (Maricopa County Dept of Public Health).
- Heat risk:** The danger to health or infrastructure due to heat as a function of exposure, sensitivity, and the ability to adapt.
- Heat-related health data:** Health outcomes data that describe illness, injury, disability, or death that is either directly caused by heat or deaths where heat was a contributing factor.
- Heat-contributed death:** A loss of life where heat exposure is listed as a contributing factor on the death certificate (Maricopa County Dept of Public Health).
- Indicator:** A measurement or value that can be tracked over time to communicate the state of heat risk (or heat resilience) in a given area over a period of time.

Indicators of Heat Resilience: Recommended Readings and Resources

- Keith, L. & Meerow, S. (2022). *Planning for urban heat resilience (PAS Report 600)*. American Planning Association. <https://www.planning.org/publications/report/9245695/>
- National Oceanic and Atmospheric Administration. (2024). *A maturity model for heat governance*. https://cpo.noaa.gov/wp-content/uploads/2025/02/Heat-Governance-Maturity-Model_V1.pdf
- HeatReady Schools

- a. Shortridge, A., Walker VI, W., White, D. D., Guardaro, M. M., Hondula, D. M., & Vanos, J. K. (2022). HeatReady schools: A novel approach to enhance adaptive capacity to heat through school community experiences, risks, and perceptions. *Climate Risk Management*, 36, 100437. <https://doi.org/10.1016/j.crm.2022.100437>
 - b. Arizona State University. (n.d.). *HeatReady schools*. <https://globalfutures.asu.edu/heatready/schools/about/>
4. HeatReady Neighborhoods
 - a. Guardaro, M., Gastelum, A., Winkle, R., Munoz Encinas, M., Vanos, J., Bassett, S., & Hondula, D. (2025). HeatReady Neighborhoods: A Planning Rubric for Extreme Heat. *Journal of the American Planning Association*, 91(2), 177–191. <https://doi.org/10.1080/01944363.2024.2396923>
 - b. Arizona State University. (n.d.). *HeatReady neighborhoods*. <https://globalfutures.asu.edu/heatready/neighborhoods/about/>
5. Miami-Dade County. (2021). *Miami-Dade County extreme heat action plan*. <https://www.miamidade.gov/global/economy/environment/extreme-heat-action-plan.page>
6. New York State. (2024). *Extreme heat in New York State. Summary of impacts and vulnerabilities*. <https://dec.ny.gov/sites/default/files/2024-06/extremeheatsummaryimpactsreport.pdf>
7. North Carolina Office of Recovery and Resiliency. (2024). *North Carolina heat action plan toolkit*. <https://www.deq.nc.gov/energy-climate/state-resilience-office/resilience-resources-local-communities/heat-action-plan-toolkit>
8. San Francisco Department of Public Health. (2003). *Heat and air quality resilience plan*. https://media.api.sf.gov/documents/HAQR-2305221_0.pdf
9. City of Phoenix. (n.d.). *City of Phoenix heat response plan*. <https://www.phoenix.gov/administration/departments/heat/heat-response-programs/heat-response-plan.html>
10. State of Arizona. (2024). *Arizona extreme heat response plan*. <https://resilient.az.gov/sites/default/files/2024-07/extreme-heat-preparedness-plan-2024-03-1.pdf>
11. Murage, P., Hajat, S., Macintyre, H. L., Leonardi, G. S., Ratwatte, P., Wehling, H., ... Kovats, S. (2023). Indicators to support local public health to reduce the impacts of heat on health. *Environment International*, 183, 108391. <https://doi.org/10.1016/j.envint.2023.108391>

Benefit-Cost Analysis

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Conceptual Overview

Benefit-cost analysis is the process of identifying, quantifying, and monetizing expected benefits and costs of investments, actions, or policies to determine which alternative yields the highest net benefits, and deciding which solutions are the most appropriate economic fit for your community (for a primer on the general use of benefit-cost analysis in a policy context, see [OMB Circular A-4](#)).

Benefit-cost analysis is a useful tool for selecting among possible actions a community might take to improve heat resilience. These assessments empower communities to identify and, where possible, quantify benefits (e.g., reduced mortality, reduced emergency room visits, improved worker productivity, improved student test scores, increased property values, improved stormwater management). To the extent that the benefits of a specific action can be assigned a monetary value, they can be compared to the action's costs to calculate net benefits. Communities can then compare the net benefits of alternative policy actions. Importantly, however, while useful, a simple comparison of net benefits should not be the only factor determining the suitability of a given heat resilience action.

Benefit-cost analysis is a key part of understanding and describing the economic impacts of extreme heat across various aspects of human welfare, such as health, education, worker productivity, infrastructure, and government operations.

Analyzing Benefits of Extreme Heat Intervention Strategies

The benefits of heat interventions can potentially span economic, social, and environmental benefit categories, each with different kinds of data. For example, expanding tree canopy not only provides economic benefits (avoided labor costs, reduced governance operations, lower healthcare costs associated with higher temperatures, and lower energy costs) but also ecosystem benefits, such as increased biodiversity, improved stormwater management, and carbon sequestration. In addition, trees provide social benefits that are not always appropriate to monetize but should still be included, such as the ability to gather in cool spaces during extreme heat, a sense of place, identity, and psychological well-being. Adding to the nuance, trees provide different benefits at different points in their lifespan, so benefit timescales must be informed by the tree's growth cycles (a one-year-old tree provides less benefit than a ten-year-old

Key Decision Point:

Communities must decide which cooling intervention(s) to analyze.

Recommendation:

Choose an existing intervention that the community is considering expanding or a new intervention that is likely to have co-benefits beyond heat.

tree). However, in order for the benefits of a tree to be realized, the analysis must assume appropriate maintenance, including its associated costs.

Analyzing Costs of Extreme Heat Interventions

Economic analyses, including benefit-cost analysis, empower communities to identify and, where possible, monetize resource costs and the costs of financing them. The costs of an intervention strategy are analyzed by quantifying labor, materials, land, maintenance, and other relevant costs associated with procuring, implementing, and maintaining the intervention. For example, costs for a shade structure might include the labor of architects and engineers to design the structure, the procurement of materials, construction, any electrical work needed to comply with lighting codes, and ongoing maintenance.

Comparing Different Alternatives

Benefit-cost analysis empowers communities to compare interventions with each other and with a “business as usual” scenario. Business-as-usual may mean continuing on the existing trajectory across a range of future climate scenarios. Alternatives analysis is a key component of analyzing the benefits and costs of potential heat interventions, selecting the most advantageous interventions, and making compelling arguments to decision-makers and potential funders.

Benefit-Cost Analysis: Best and Leading Practices

1. BCAs are widely used to evaluate whether resources should be allocated to environmental improvements in general, and increasingly to climate adaptation.
2. Heat resilience is a relatively new context for applying BCA.
3. The most valuable part of conducting a BCA is the systematic thinking process it can inform, rather than the “final number” itself.
4. Incorporate equity in the analysis through an inclusive community engagement process and by incorporating perspectives of historically marginalized groups into the analysis, including BCA results disaggregated by socio-demographic groups.
5. BCA should be viewed as an opportunity to engage the public at different points, including in defining the problem, prioritizing interventions to analyze, and assessing results.
6. Use locally calibrated data when available. The question of how much local data to collect is important because, in some circumstances, local data collection would be feasible and practical, while in others it could be extremely time-consuming and yield small benefits relative to using regional or national data.
7. For heat-related interventions, consider broader co-benefits (urban ecosystem benefits, social benefits, SCOPE emissions costs).
8. For interventions that don’t directly relate to heat, consider if there are any heat-related benefits and costs.
9. Costs represent the foregone value of the alternative use of resources committed to the project; thus, labor (or jobs) are typically a cost, not a benefit, in a BCA.
10. Analysis monetizes a stream of expected future benefits and costs for projects and identifies which additional benefits and costs could be quantified but not monetized, and which could be identified but not quantified.

11. Include benefits and costs for communities that have been historically marginalized and excluded from past analyses, including communities of color, low-income communities, unhoused residents, and others.
12. Check whether historically marginalized groups receive a proportional share of net benefits.
13. Ensure that members of impacted communities have a voice in identifying benefits and costs and in shaping decisions and planning processes. Planning processes should be accessible to diverse linguistic preferences, cultural approaches, schedules, and abilities.
14. Consider benefits and costs beyond those that can be quantified or monetized and hold other kinds of value for community members.

Goals, Objectives, and Actions

The specific goals, objectives, and actions a community chooses to prioritize should be tailored to the local context. The following offer broad examples of the kinds of goals and objectives that can be addressed within the scope of benefit-cost analysis, along with activities that could be undertaken to achieve them.

Benefit-Cost Analysis: Goals, Objectives, and Actions

Goals	<ul style="list-style-type: none"> ● Gain an understanding of the benefits and costs associated with heat resilience interventions to support the selection of strategies that will advance heat resilience goals. ● Help public agencies and community organizations select among possible heat interventions and make compelling arguments to decision-makers and potential funders. ● Build capacity to conduct BCAs using peer-reviewed evidence, publicly available datasets, and established analytical frameworks. ● Facilitate effective community engagement around BCA. ● Provide frameworks for different types of analyses, tailored to community needs and capacity. ● Increase the likelihood of project financing.
Objectives	<ul style="list-style-type: none"> ● Conduct a benefits-cost analysis of heat-resilience interventions, including urban forestry, green infrastructure, cool roofs, and cooling centers.
Actions	<ul style="list-style-type: none"> ● Define the scope of the analysis in collaboration with community stakeholders and decision-makers. ● Choose intervention(s) of interest for analysis from a limited menu of options (e.g., urban forestry, green infrastructure, cool roofs, cooling centers) ● Identify key outcomes to be measured.

	<ul style="list-style-type: none"> • Develop a detailed project timeline, including phases for community engagement, data collection, tool application, analysis, and reporting. • Define baseline and potential alternatives. • Collect local data from public agencies, community-based organizations, and other sources. Use national datasets when local data are unavailable or not feasible to collect. • Apply tools and models to estimate the benefits and costs of selected intervention(s). • Summarize potential benefits and costs of intervention(s). The summary could be presented as a slide deck or a policy brief. • Present summary to decision makers in public meetings (e.g., Planning Commission, City Council) and post online for the broader community.
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Benefit-Cost Analysis: Tiered Approach to Workbook Activities

Tier 1	Tier 2	Tier 3
<p><i>Apply the Heat Action Platform</i></p> <p>Assessment is qualitative and descriptive.</p> <p>No quantitative analysis, but does identify potential benefits and costs based on existing national/international evidence.</p> <p><i>Proposed; No Workbook Activity.</i></p> <p>One-way community engagement only (agency or organization provides the public with information but does not solicit feedback).</p> <p>Share a summary presentation of the evidence base.</p>	<p><i>Apply the C40 Heat Resilient Cities Tool</i></p> <p>Quantification of some direct project outcomes.</p> <p>Monetization of benefits and costs using at least one potential intervention using external publicly available data (e.g., from academic or gray literature).</p> <p><i>Proposed; No Workbook Activity.</i></p> <p>Some community outreach prior to BCA and/or following initial analysis.</p>	<p><i>Proposed; No Workbook Activity.</i></p> <p>Robust community engagement prior to and following the BCA analysis.</p> <p>Identify local cost, implementation, and maintenance data from the relevant department or organization.</p> <p>Conduct a complete BCA associated with at least one heat-related intervention, using community-specific data.</p>

Benefit-Cost Analysis: Key Terms

1. **Benefit-cost analysis:** identifying, quantifying, and monetizing expected benefits and costs of investments, actions, or policies to determine which alternative yields the highest net benefits. (OMB Circular A-4)
2. **Willingness to Pay:** estimate of the monetary value to a representative individual of a beneficial outcome that does not have a market price (such as a reduction in mortality risk).(EPA Guidelines for Preparing Economic Analyses)
3. **Opportunity Cost:** monetary benefit foregone to society by using a resource for an investment, action, or policy rather than for its highest valued alternative use (such as real estate being used for commercial activity rather than green space). (EPA Guidelines for Preparing Economic Analyses)

Benefit-Cost Analysis: Recommended Readings and Resources

BCA examples from local governments

1. Autocase. (2021). *Cost-benefit analysis of key climate ready strategies: Executive summary* (City of San Antonio). <https://www.sanantonio.gov/Portals/0/Files/Sustainability/News/Cost-Benefit-Analysis-of-Key-Climate-Ready-Strategies.pdf>
2. AECOM, & The Nature Conservancy. (2021). *Economic assessment of heat in the Phoenix metro area*. The Nature Conservancy. https://www.nature.org/content/dam/tnc/nature/en/documents/TNC_EcoHeatAssesment_AZ_Report.pdf
3. Autocase. (2018). *Triple bottom line cost-benefit analysis of green infrastructure/low impact development (GI/LID) in Phoenix, AZ*. Prepared by Autocase, Stantec, and Watershed Management Group. <https://www.phoenix.gov/content/dam/phoenix/pddsit/documents/pz/tbl-cba%20autocase%20features%20and%20projects%20evaluation.pdf>

BCA and community engagement resources from government agencies and NGOs

1. Federal Emergency Management Agency. (n.d.). *Benefit-cost analysis toolkit*. U.S. Department of Homeland Security.
2. <https://www.fema.gov/grants/tools/benefit-cost-analysis>
3. U.S. Environmental Protection Agency. (n.d.). *Green infrastructure cost-benefit resources*. https://19january2021snapshot.epa.gov/green-infrastructure/green-infrastructure-cost-benefit-resources_.html
4. U.S. Environmental Protection Agency. (2024). *Guidelines for preparing economic analyses*. U.S. Environmental Protection Agency. <https://www.epa.gov/environmental-economics/guidelines-preparing-economic-analyses-3rd-edition>

5. Office of Management and Budget. (2003). *Circular No. A-4: Regulatory analysis*. Executive Office of the President.
https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4
6. Robinson, L. A., Hammitt, J. K., Cecchini, M., Chalkidou, K., Claxton, K., Cropper, M., Eozenou, P.H., de Ferranti, D., Deolalikar, A.B., Guanais, F., Jamison, D.t., Kwon, S., Lauer, J.A., O’Keeffe, L., Walker, D., Whittington, D., Wilkinson, T., Wilson, D., & Wong, B. (2019). *Reference case guidelines for benefit-cost analysis in global health and development*. Bill & Melinda Gates Foundation.
https://media.repository.chds.hsph.harvard.edu/static/filer_public/16/3c/163c0d02-1837-4e9b-b88b-d646bbea857c/2019_robinson_ref_case_guidelin_bca_proj_r_126.pdf
7. European Commission. (2014). *Guide to cost-benefit analysis of investment projects: Economic appraisal tool for cohesion policy 2014–2020*. European Commission Directorate-General for Regional and Urban Policy.
https://ec.europa.eu/regional_policy/en/information/publications/guides/2014/guide-to-cost-benefit-analysis-of-investment-projects-for-cohesion-policy-2014-2020#:~:text=The%20Commission%20with%20help%20of,case%20studies%20for%20the%20Guide.
8. National Oceanic and Atmospheric Administration. (2025). *A checklist for writing grant proposals that encourage meaningful community engagement*.
<https://coast.noaa.gov/data/digitalcoast/pdf/grant-proposal-checklist-community-engagement.pdf>

Key scholarship about the health benefits of heat interventions

1. Hondula, D. M., Balling, R. C., Vanos, J. K., & Georgescu, M. (2015). Rising temperatures, human health, and the role of adaptation. *Current Climate Change Reports*, 1(3), 144–154.
<https://doi.org/10.1007/s40641-015-0016-4>
2. Kovats, R. S., & Hajat, S. (2008). Heat stress and public health: A critical review. *Annual Review of Public Health*, 29, 41–55.
<https://doi.org/10.1146/annurev.publhealth.29.020907.090843>

Key scholarship related to the economic analysis of heat interventions

1. Johnson, D., See, L., Oswald, S. M., Prokop, G., & Krisztin, T. (2021). A cost–benefit analysis of implementing urban heat island adaptation measures in small- and medium-sized cities in Austria. *Environment and Planning B: Urban Analytics and City Science*, 48(8), 2326–2345. <https://doi.org/10.1177/2399808320974689>
2. Teotónio, I., Silva, C. M., & Cruz, C. O. (2018). Eco-solutions for urban environments regeneration: The economic value of green roofs. *Journal of Cleaner Production*, 199, 121–135. <https://doi.org/10.1016/j.jclepro.2018.07.084>



Roadmap Workbook

Introduction

The Roadmap Workbook (the Workbook) is a toolkit that will empower communities to put the Framework into action. It includes downloadable worksheets, templates, and other resources to help communities collect key data points for local planning processes. The Workbook includes new, tailored resources created by the Center’s team of experts to support action in each content area introduced in the Framework. The Workbook also offers a curated collection of existing resources recommended by the Center for Heat Resilient Communities team.

The Workbook is a supplement to the local planning process

Each community will have their own decision making processes. These resources are intended to support these processes with data relevant to evaluating the merits of heat action strategies.

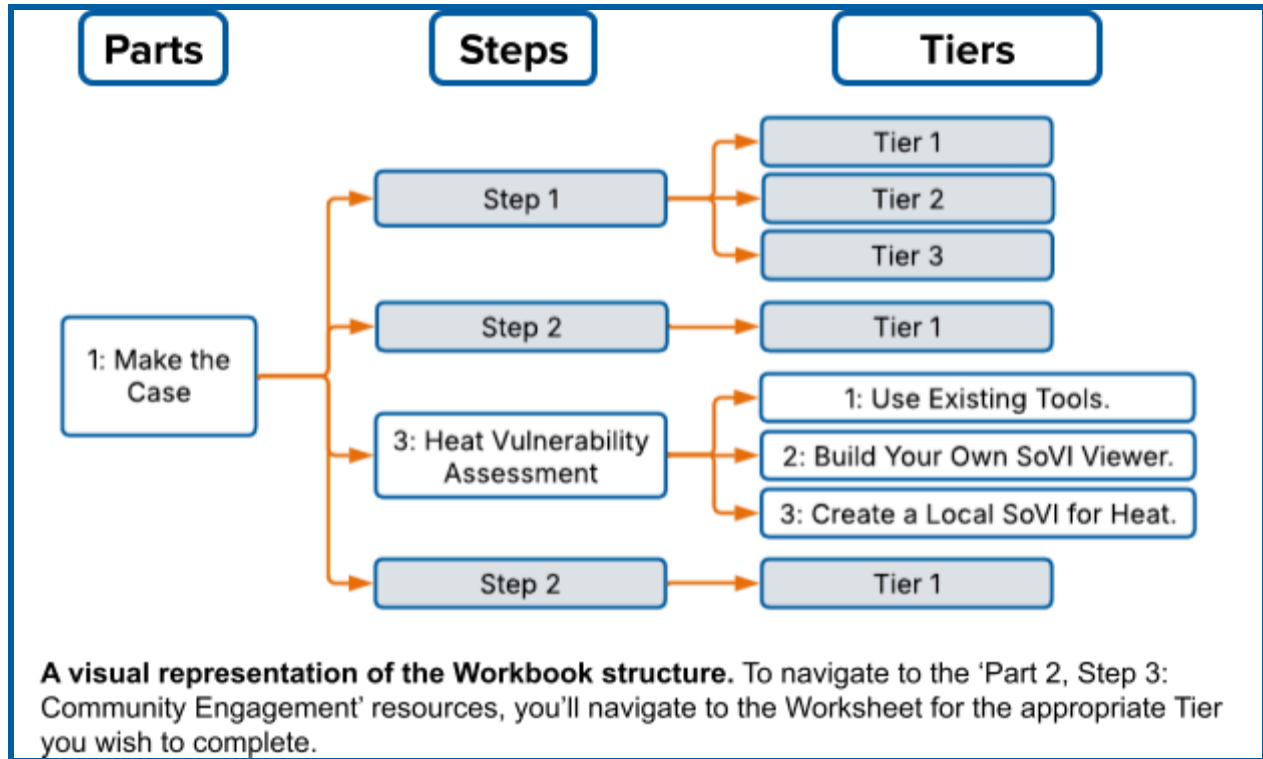
Recognizing that each community will have its own decision-making process, the Workbook is not a prescription for how to conduct planning and decision-making. Rather, the Workbook activities will guide users in identifying, collecting, and organizing the data needed to inform planning and decision-making.

Each part of the Workbook is centered around addressing the foundational considerations introduced in the Framework, articulated as “Guiding Questions”. Taken together, the answers to these questions provide a basis for local, data-informed decision-making. The activities can also serve as documentation for potential funding applications.

Part 1: *Make the Case* guides users in collecting and organizing relevant data to define the problem of heat in their local context. Part 2: *Assess Capacity to Respond* supports communities in identifying existing capacities to address the problems defined in Part 1. Part 3: *Prioritizing Action* asks users to generate a list of exposure setting-specific strategies and qualitatively evaluate them using data collected in Parts 1 and 2. Part 4: *Make Goals and Strategies Actionable* builds on the identified strategies and guides users in collecting and organizing data to evaluate the effectiveness and feasibility of potential heat action strategies. Part 5: *Putting it all Together* supports users in prioritizing strategies identified in Part 3, using the evidence base developed across all Workbook activities.

The five ‘parts’ of the Workbook are designed to be engaged linearly, though you may choose to complete activities according to your community’s needs and where you are in the decision-making process. Each part contains ‘steps’. Each step represents a specific type of data or action useful to the heat action planning process. Each step may contain up to three different activities, organized into three ‘tiers’. Tier 1 activities require the least lift, while Tier 3 activities require the most time and resources.

Each tiered activity within a step contains a “worksheet” with instructions and guidance on how to use each embedded resource. Embedded resources may include input data, shapefiles (geospatial boundaries for analysis), additional readings, and interactive tables to organize data collected during the activity. Additional resources, such as case studies and examples, are also offered.



Part 1: Make the Case for Action

The guidance in Part 1, Make the Case for Action, is focused on understanding the impacts of extreme heat on communities and the health, well-being, and livelihoods of community members. Completion of Part 1 will empower communities with the information needed to make the case for heat resilience action to decision makers, residents, and potential funders in the local heat action planning process. Part 1 will also provide data to aid decision-making, set priorities, and allocate resources. It supports community understanding of current and future extreme heat impacts in the absence of heat resilience action. Part 1 is organized into 4 steps and draws from the following sections of the Framework: Climate Modeling & Microscale Climate Modeling; Exposure Settings; and Social, Cultural, & Participation Considerations.

Part 1, Step 1

Guiding Question: What is my community's current and future heat exposure?

Heat Exposure Assessment will provide guidance on accessing, interpreting, and collecting the modeling-based information that communities need to assess and respond to projected changes in extreme heat, including changes to warm season average temperatures; number of hot days and warm night; frequency, intensity, and duration of locally defined extreme heat events; and other climatologically meaningful indicators of heat hazard and exposure.

Part 1, Step 2

Guiding Question: *Where in my community are people commonly exposed to heat?*

Heat Exposure Settings will provide guidance on employing the heat exposure settings framework. This framework is based on the idea that each location, or setting, where people are exposed to heat encompasses a universe of institutions that jointly determine the physical design of spaces and rules about ownership, access, and use - all of which impact the selection of appropriate heat mitigation strategies. To make effective changes, the full universe of institutions should be audited in each setting to fully understand the context of heat exposure and feasible intervention pathways.

Part 1, Step 3

Guiding Question: *Who in my community is most vulnerable to heat?*

The Social Vulnerability Assessment will provide guidance on accessing, interpreting, and visualizing spatialized information that communities need to assess and respond to uneven susceptibility to heat-related harm. Understanding how social vulnerability informs overall heat vulnerability, how it is measured, and how to interpret this data will help communities make data-informed heat action and policy decisions that recognize inequitable distribution of heat burdens.

Part 1, Step 4

Guiding Question: *Which social and cultural assets in my community are at risk due to heat?*

Social, Cultural, and Equity Considerations will provide guidance on assessing and managing heat-induced disruption, loss, or alteration of community events or spaces, social infrastructure, and community practices, and cultural heritage practices that maintain local lifeways and social cohesion of communities, tribes, and other groups. These considerations make visible how the day-to-day lives of community members may become unsafe as heat becomes more extreme.

In the table below, you will find links to each of the worksheet activities and additional resources needed to complete Part 1 of the Workbook.

Workbook Part 1: Make the Case for Action

	Step	Worksheets	Resources
	Step 1: Heat Exposure Assessment	1	Understanding Heat Exposure using Existing Tools
		2	Visualizing Heat Exposure Data
		3	Modeling Local Microclimates with ENVI-met
			Case Study: Evaluating Local Micro-Climates (MaRTy)

Part 1: Make the Case for Action	Step 2: Heat Exposure Settings	1	Identifying Heat Exposure Settings	
	Step 3: Heat Vulnerability Assessment	1	Understanding Heat Vulnerability Data using Existing Tools	
		2	Building Your Own Social Vulnerability Viewer	Case Study: Creating Decision Support Tools for Heat Health
		3	Creating a Local Social Vulnerability Index for Heat	
	Step 4: Social, Cultural, & Equity Considerations	1	SOCIOcultural Heat Risk Assessment	Case Study: Melting Metropolis Art Walk
				Resource Spotlight: iSeeChange

Part 2: Assess Capacity to Respond

The guidance in Part 2, Assess Capacity to Respond, supports communities in identifying key resources, assessing capacity gaps, and engaging them in responding to the challenges identified in Part 1. Completion of Part 2 will empower communities to design appropriately scaled approaches to heat resilience that are aligned with current capacities and community-identified needs. It will also help them communicate capacity and resource needs to decision makers, residents, and potential funders in local planning and decision-making processes. Part 2 is organized into 3 steps and draws on the following sections of the Framework: Heat Governance, Maturity Assessment, Stress Testing & Tabletop Exercises, Heat Action Planning, and Engagement.

Part 2, Step 1

Guiding Question: *Are our government and civic institutions prepared to respond to acute and chronic heat?*

Governance Capacity Assessment will help you assess your community's capacity to respond to heat events. Provided resources will help you i) survey and synthesize your existing capacities to respond to acute events into priority action areas and ii) apply this information to a Maturity Model for Heat Governance. The outcomes from these activities will prepare you for a future tabletop exercise. This includes identifying key documents, stakeholders, and policies to consider as you plan to increase your heat action capacity.

Part 2, Step 2

Guiding Question: *Do our existing planning activities support heat resilience?*

Planning Capacity Assessment will provide guidance on assessing the breadth, quality, and spatial distribution of policies and strategies in existing community plans. Provided resources will also help you identify opportunities to improve plan integration with heat resilience and policy goals. **The guidance provided in this Step may be useful in completing 'Part 2, Step 1: Governance Capacity Assessment'.

Part 2, Step 3

Guiding Question: *How can we engage relevant stakeholders to improve heat resilience?*

Community Engagement provides direction and guidance on completing exercises with community leaders and stakeholders to build trust and support knowledge co-production. These resources are intended to help you co-develop heat action goals with stakeholders from impacted communities, leading to more durable and effective solutions.

In the following table, you will find links to each of the worksheet activities and additional resources needed to complete Part 2 of the Workbook.

Workbook Part 2: Assess Capacity to Respond

Part 2: Assess Capacity to Respond	Step	Worksheets		Resources	
	Step 1: Governance Capacity Assessment	1	Performing a Simple Stress Test		
		2	Applying the Maturity Model for Heat Governance		Resource Spotlight: NOAA Maturity Model
					Resource Spotlight: NOAA Tabletop Exercises
	Step 2: Community Plan Assessment	1	Planning Capacity Assessment Workshop		
		2	Plan Quality for Heat Resilience Assessment		Cohort only: Completed Plan Quality Evaluations
		3	Plan Integration for Resilience Scorecard (PIRS) for Heat		
	Step 3: Build Community Engagement Capacity	1	Building Community Leaders Workshop		
		2	Building Community Coalitions Workshop		
		3	Co-Developing Heat Action Goals Workshop		

Part 3: Prioritizing Action

In Part 3, communities will use the information they’ve collected thus far on baseline heat impacts and governance capacity to generate a preliminary list of goals and strategies to address various dimensions of each goal. These goals may come from existing plans or community initiatives or represent new opportunities identified through previous Workbook activities. Using the Exposure Settings framework, users will then qualitatively assess how well each strategy addresses known heat impacts and whether existing capacities are sufficient for implementation. Provided resources guide users in comparing strategies based on their relevance to known heat impacts in high-impact exposure settings and their feasibility, leading to a priority list of strategies for further examination.

Workbook Part 3: Prioritizing Action

Part 2:	Step	Worksheets		Resources
Assess Capacity to Respond	Step 1: Governance Capacity Assessment	1	Listing and Ranking Goals and Strategies	

Part 4: Make Goals and Strategies Actionable

The guidance in Part 4 focuses on developing pathways to implement the goals and strategies identified in the local planning process. Completion of Part 4 will empower communities with the information needed to prioritize and evaluate the effectiveness of potential heat action strategies and communicate these data points to potential funders and stakeholders engaged in local planning processes. Workbook activities support communities in tracking and communicating progress toward heat resilience, evaluating the benefits of heat resilience action, and addressing policy needs. Part 4 is organized into 5 steps and draws from the following sections of the Framework: Benefit-Cost Analysis, Engagement, and Indicators of Heat Resilience.

Part 3, Step 1

Guiding Question: How can we articulate the economic benefits of reducing heat impacts?

Benefit-Cost Analysis provides a primer to conducting benefit-cost analysis for heat, including key steps and considerations. Included resources will introduce available tools for conducting heat-specific benefit-cost analysis of common interventions.

Part 3, Step 2

Guiding Question: Which policies support local heat action priorities?

Policy Analysis will provide a suite of exercises and tools to analyze the policy landscape, putting your community in a position to gain local and extra-local support for heat action. This includes guidance on conducting desk research and directly engaging policymakers to advocate for and design effective local heat action strategies that are more likely to be actionable in your specific policy environment.

Part 3, Step 3

Guiding Question: How can we communicate effectively with the public to support heat goals?

Media Communication will provide guidance on creating and delivering compelling messaging when communicating across media platforms. Provided resources will help you prepare talking points to deliver strategic messaging to local media who can use their coverage of extreme heat to further local goals and generate support for heat action.

Part 3, Step 4: Proposed; not completed prior to funding termination.

Part 3, Step 5

Guiding Question: How can we track heat impacts and progress toward goals?

Resilience Indicator Selection will help communities identify and collect data on locally relevant, evidence-based heat risk indicators. This information can be used to determine past and present heat risk and evaluate progress towards enhancing heat resilience moving forward. These data

will strengthen your ability to make the case for the provision of resources and for funding applications.

In the following table, you will find links to each of the worksheet activities and resources needed to complete Part 3 of the Workbook.

Workbook Part 4: Make Goals & Strategies Actionable

	Step	Worksheets		Resources
	Part 43: Make Goals & Strategies Actionable	Step 1: Benefit-Cost Analysis	1	Apply the Arsht-Rockefeller Heat Action Platform Policy Tool
2			Apply the C40 Heat Resilient Cities Tool	Resource Spotlight: FEMA's Benefit-Cost Analysis Tool
Step 2: Policy Analysis		1	Policy Landscape Analysis	
		2	Tracking Policy Activity	
Step 3: Media Communication		3	Apply the Media Quadrant to Your Issue	
Step 4: Heat Alert Development		1	Proposed; not completed prior to funding termination.	Resource Spotlight: LARC Heat Campaign
Step 5: Resilience Indicator Selection		2	Putting it All Together	Resource Spotlight: Heat Ready Schools

Part 5: Putting it All Together

In Part 5, users will return to their priority strategies identified in Part 3 and attach evaluation metrics, simple cost-benefit information, policy levers, and communications considerations. Considering relevance to high-impact exposure settings, feasibility, and implementation complexity, users will have an evidence-based list of priority strategies to use as appropriate in local decision-making. A template is provided to transfer priority strategies into a Heat Action Blueprint to orient local coordination and to communicate with impacted community members and decision-makers.

Workbook Part 5: Putting it All Together

Part 5:	Step	Worksheets		Resources
Putting it All Together	Step 1: Refine and Present Your Priority Strategies	1	Listing and Ranking Goals and Strategies	

Appendices

Glossary of Key Terms

1. **Adaptive capacity:** “The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities or to respond to consequences [of heat]” (adapted from IPCC 2022).
2. **Anomaly:** difference between future climate and present day climate.
3. **Benefit-cost analysis:** identifying, quantifying, and monetizing expected benefits and costs of investments, actions, or policies to determine which alternative yields the highest net benefits. ([OMB Circular A-4](#))
4. **Built shade:** Manufactured shade structure designed for pedestrian use, which can be either attached to a building or freestanding.
5. **Capacity:** ability to provide services to residents, which is influenced by structural and cultural factors
6. **Climate:** is the average weather in a place, typically over more than thirty years.
7. **Climate Change:** Changes in average weather conditions that persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature, as well as shifts in precipitation, changes in frequency and location of severe weather events, and changes to other features of the climate system.² Climate variability is often natural, however climate change is causing an increase in the probability of many extreme weather events, and those events contribute to climate variability.
8. **Climate model:** A numerical representation of the climate system based on the physical, chemical, and biological properties of its components, their interactions, and feedback processes and accounting for some of its known properties. Climate models are applied as a research tool to study and simulate long-term climate projections (decadal or longer) and operationally used to create shorter climate predictions (seasonal, annual, interannual).^{1,2} Related term: [Earth system model](#).
9. **Climate projections:** The simulated response of the climate system to a scenario of future emissions or concentrations of greenhouse gasses and aerosols, generally derived using

climate models. Climate projections depend on the emissions, concentration, or radiative forcing scenario used, which, in turn, is based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized.

10. **Climate variability:** The way aspects of climate (such as temperature and precipitation) differ from an average.
11. **Community Leaders:** Central actors in environmental change initiatives formally or informally recognized as environmental justice, public health, or community organizing experts.
12. **Cooling centers:** Publicly available air-conditioned or otherwise mechanically cooled facilities that provide spaces for residents to cool off and find protection from heat on very hot days.
13. **Decision-makers:** Individuals with legally instantiated authority to enact and enforce rules, or individuals informally recognized as authorities via large influence over particular groups.
14. **Direct resident involvement:** the ability of residents and communities, including capacity to organize around shared needs and advocate for community benefit
15. **Environmental Justice Communities:** Underserved, low-income communities and communities of color experiencing disproportionate environmental exposures, such as urban heat impacts
16. **Exposure:** “The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected [by heat]” (adapted from IPCC 2022).
17. **Exposure Pathways:** The processes through which people experience heat. These pathways are conditioned by personal health, physical activity, and then environmental conditions in particular places.
18. **Exposure Settings:** The environments where people regularly spend time and are exposed to heat, including homes, workplaces, schools, transportation, and public spaces. Each setting features distinct heat exposure pathways, cooling needs, and governing institutions.
19. **Extreme heat:** Temperatures that are much hotter and/or humid than average. Because some places are hotter than others, this depends on what is considered average for a particular location at that time of year
20. **Global climate:** A description of the climate of a planet as a whole, with all the regional differences averaged.

21. **Governance** - recognizes that response to heat within communities may involve not just formal state actors, but also nonprofit organizations, schools, healthcare systems and providers, and individual residents.
22. **Government capacity**: public agencies' ability to provide services to residents. Factors influencing government capacity include: financial stresses, staff turnover, collaborative capacity, and procurement rules changes.
23. **Heat Actions**: An action involving heat-related community organizing, outreach, education, adaptation and mitigation strategies, policy analysis and development, etc.
24. **Heat action plans (HAPs)**: "written documents that help manage actions across multiple organizations to reduce adverse health effects from extreme heat. HAPs broadly contain strategies such as performing surveillance, providing risk communication, supporting social and health care, establishing cooling centers, distributing water bottles and fans, and creating energy assistance programs." (Randazza et al. 2023). Heat action plans include "a portfolio of assessments and actions to respond to and reduce heat-related impacts" (Arsht Rock)
25. **Heat action planning**: The process by which a community outlines comprehensive goals, metrics, and actions for mitigating and managing heat.
26. **Heat Alerts**: Tools used to communicate heat risk and encourage protective actions such as advisories, watches, and warnings used by the National Weather Service ([Hondula et al. 2022](#)).
27. **Heat-caused death**: A loss of life where heat exposure is listed as a direct cause of death on the death certificate ([Maricopa County Dept of Public Health](#)).
28. **Heat-contributed death**: A loss of life where heat exposure is listed as a contributing factor on the death certificate ([Maricopa County Dept of Public Health](#))
29. **Heat equity**: "The development of practices and policies to mitigate and manage heat with a focus on reducing the inequitable distribution of risk across different groups within the same community" (Keith & Meerow 2022)
30. **Heat exposure assessment**: Scientists study how people feel heat in different city areas, focusing on sunlight, wind, and surfaces like pavement. They measure how much heat our bodies absorb and how shade from trees or buildings can reduce it. This research helps understand how to make cities more comfortable and safer during hot weather.
31. **Heat governance**: "the actors, strategies, processes, and institutions that can mitigate and manage this hazard" (Keith et al. 2021, Nature)

32. **Heat management:** "Preparation and response strategies for extreme heat events, often within the domain of emergency management or public health" (Keith, Meerow, and Wagner 2020)
33. **Heat mitigation:** "Design and planning strategies to reduce the contribution of the built environment to urban heat" (Keith, Meerow, and Wagner 2020)
34. **Heat resilience:** "Proactively managing and mitigating heat across the many systems and sectors it affects." (Meerow et al. 2016, Keith et al. 2020)
35. **Heat-related health data:** health outcomes data that describe illness or death that is either caused by heat or attributed to heat.
36. **Heat resilient building codes:** The use of building codes to codify the above strategies and others into new construction and remodeling subject to local land use policies.
37. **Heat risk:** the danger to health or infrastructure due to heat as a function of vulnerability and total exposure.
38. **Heat Risk Management System:** The suite of tactics and tools, and supporting institutions and infrastructure, used to evaluate and reduce harm to groups and individuals that may become too exposed to high surface temperatures that affect community health and well-being.
39. **Home retrofits / weatherization:** Provision encouraging or requiring new development and/or existing buildings to improve structural resilience to heat through weatherization projects.
40. **Impacted Communities:** Communities experiencing urban heat impacts.
41. **Indicator:** a measurement or value that can be tracked overtime to communicate the state of heat risk (or heat resilience) in a given area over a period of time.
42. **Indoor cooling subsidies:** Financial incentives to help residents and businesses acquire, maintain, or operate mechanical cooling systems such as air conditioning, heat pumps, or other technologies
43. **Institutional Alignment:** The process of coordinating agencies, statutes, funding mechanisms, and operational practices to support effective heat mitigation and management in a setting.
44. **Maturity:** describes the level of readiness of the system to respond to a problem, such as extreme heat

45. **Maturity Model:** A tool to assess a community’s current capacities, funding, and resources to successfully manage heat risk (i.e., the community ‘maturity’) and to identify the gaps and needs to improve heat resilience.
46. **Microscale climate modeling:** Scientists use highly detailed computer models to study how climate affects very small areas within cities, such as individual buildings, streets, or neighborhoods. These models reveal how local features like trees or tall buildings create unique weather patterns on a very small scale, explaining why some parts of a city are hotter, known as the "urban heat island" effect.
47. **Media:** Means of mass communication encompassing traditional formats such as print, radio, television, and online publications, as well as new media such as social media, podcasts, and blogs.
48. **Nongovernmental capacity:** the ability of non-governmental actors, including: hospital systems, school districts, nonprofits or community based organizations, and businesses, to provide services to residents. Compared with government capacity, capacity from nongovernmental organizations can be more flexible, direct, leverage social networks and more/different material resources
49. **Network of plans:** “collection of community plans that shape the built environment” including comprehensive plans, hazard mitigation plans, and climate action (Keith et al. 2023).
50. **Opportunity Cost:** monetary benefit foregone to society by using a resource for an investment, action, or policy rather than for its highest valued alternative use (such as real estate being used for commercial activity rather than green space). ([EPA Guidelines for Preparing Economic Analyses](#))
51. **Place-based Approach:** A planning strategy that organizes action around specific activity sites rather than abstract geographic zones or sectors.
52. **Plan Integration for Resilience Scorecard™ for Heat:** A methodology for analyzing the land use policies, or action items, across community plans that would affect urban heat and comparing spatial patterns in policy attention with indicators of vulnerability (Keith et al. 2023).
53. **Plan quality evaluation:** “an established method for evaluating the content of plans to see whether they contain elements that are widely believed to be critical to the plan’s effectiveness in achieving community goals” (Meerow et al. 2024).
54. **Policy Cycle:** Stages in the process of the policy development stream including agenda setting, formation, implementation, and review, to which engagement should be tailored.

55. **Policy Landscape Analysis:** Map of the key players, institutions, and leaders that impact a policy or research issue.
56. **Procedural equity:** Refers to the fairness in a process, or equitable access to participation in the process of defining problems and adopting solutions (Schlosberg, 2007; Wenta et al., 2018; van den Berg and Keenan, 2019).
57. **Public communication campaigns:** Information campaigns intended to inform the public of extreme heat events and protective actions for both chronic heat and extreme heat events.
58. **Reflective (Cool) surfaces:** Horizontal and vertical surfaces that deliver higher reflectance and absorb lower amounts of solar radiation compared to conventional materials to reduce surface, air, and radiant temperatures i.e. high albedo surfaces.
59. **Regional climate:** The climate of where your community is located is called a regional climate. Regional climate can be described by the temperatures over the seasons, how windy it is, and how much rain or snow falls. The climate of a region depends on many factors including the amount of sunlight it receives, its height above sea level, the shape of the land, and how close it is to oceans.
60. **Scenario:** A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts but are used to provide a view of the implications of developments and actions.6
61. **Sensitivity:** “The degree to which a system or species is affected, either adversely or beneficially [by heat]. The effect may be direct or indirect” (adapted from IPCC 2022).
62. **Setting-Specific Intervention:** A cooling strategy tailored to the populations, activities, facilities and institutional context of a particular exposure setting.
63. **Stress testing:** a group of methods to explore and identify the needs and capacities of government and community entities to implement heat resilience governance and community-led initiatives (Miller & Muñoz-Erickson 2018).
64. **Urban climate:** Urban areas have a unique climate shaped by various processes within the city. This differs from rural climates due to factors like buildings, human activities, and changes in natural landscapes, leading to effects like the urban heat island, altered wind patterns, and modified precipitation (Oke et al., 2017).
65. **Urban forestry:** The planting, maintenance, care, and protection of tree populations, such as shade trees, in urban settings. Urban forestry can be found in parks, gardens, landscaped boulevards, greenways, and street-side tree boxes.

66. **Vegetative infrastructure:** Using vegetation and green space to reduce outdoor and indoor temperatures. Examples include green walls and roofs, provision of outdoor green spaces, and reduction of impervious surfaces (e.g. depaving).
67. **Vulnerability:** “The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.” (IPCC 2022)
68. **Willingness to Pay:** estimate of the monetary value to a representative individual of a beneficial outcome that does not have a market price (such as a reduction in mortality risk).([EPA Guidelines for Preparing Economic Analyses](#))
69. **Weather:** the state of the atmosphere at a particular place and point in time with respect to temperature, humidity, precipitation, cloudiness, visibility, and wind.

Recommended Readings & Resources

Climate Modeling & Microscale Climate Modeling

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2. Climate Resilience Information System (CRIS) includes data and interactive web portals such as the NCA5 Interactive Atlas (U.S. Global Change Research Program 2023a) and Climate Mapping for Resilience and Adaptation (CMRA; U.S. Global Change Research Program 2023b). Communities can use this information to explore changes in extreme heat at the county or census tract scale.

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- Callahan, C., Dunlap, L., Gallarza, M., Spriggs, R., & Turner, V. K. (2022). *Protecting Californians with heat resilient homes*. Luskin Center for Innovation, University of California Los Angeles. innovation.luskin.ucla.edu/wp-content/uploads/2022/07/Protecting-Californians-with-Heat-Resilient-Homes.pdf .
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Heat Action Planning: Recommended Readings and Resources

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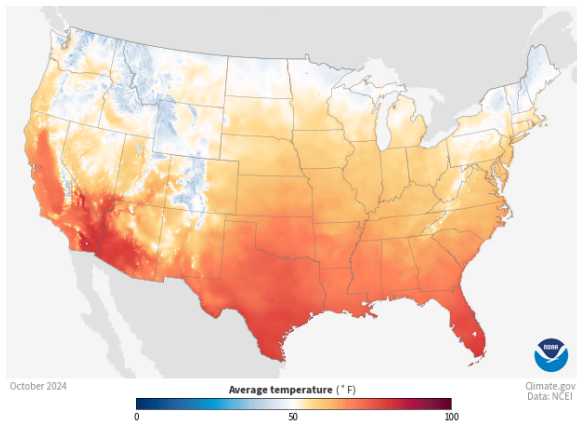
Center for Heat Resilient Communities Workbook

Part 1: Make the Case for Action		
Step 1: Heat Exposure Assessment	T1	Understanding Heat Exposure Data using Existing Tools
	T2	Visualizing Heat Exposure Data
	T3	Modeling Local Micro-Climates with ENVI-Met
Step 2: Exposure Settings Identification	T1	Identifying Heat Exposure Settings
Step 3: Heat Vulnerability Assessment	T1	Understanding Heat Vulnerability Data using Existing Tools
	T2	Building Your Own Social Vulnerability Viewer
	T3	Creating a Local Social Vulnerability Index for Heat
Step 4: Sociocultural Impacts Assessment	T1	Sociocultural Impacts Assessment: Keystone Species & Events
Part 2: Assess Capacity to Respond		
Step 1: Governance Capacity Assessment	T1	Performing a Simple Stress Test
	T2	Applying the Maturity Model for Heat Governance
Step 2: Community Plan Assessment	T1	Planning Capacity Assessment Workshop
	T2	Plan Quality for Heat Resilience Assessment
	T3	Plan Integration for Resilience Scorecard (PIRS) for Heat
Step 3: Build Community Engagement Capacity	T1	Building Community Leaders Workshop
	T2	Building Community Coalitions Workshop
	T3	Co-Developing Heat Action Goals Workshop
Part 3: Prioritizing Action		
Organize Your Data into Priority Strategies	Listing and Ranking Goals and Strategies	
Part 4: Make Goals and Strategies Actionable		
Step 1: Benefit-Cost Analysis	T1	Apply the Arsh-Rockefeller Heat Action Platform Policy Tool
	T2	Apply the C40 Heat Resilient Cities Tool
Step 2: Policy Analysis	T1	Policy Landscape Analysis
	T2	Tracking Policy Activity

Step 3: Media Communication	T1	Apply the Media Quadrant to Your Issue
Step 4: Heat Alert Development	T1	{Proposed. Not completed prior to funding termination}
Step 5: Resilience Indicator Selection	T1	Develop Resilience Indicators
Part 5: Develop a Heat Action Blueprint		
Refine and Present Your Priority Strategies		Putting it all Together Activity

Part 1 Workbook Activities

Understanding Heat Exposure



Part/Step: Part 1: Make the Case, Step 1: Heat Exposure Assessment

Tier: 1

MOTIVATION

The Understanding Heat Exposure activity will empower you to leverage web-based tools to visualize maps and create time-series charts depicting how heat varies geographically and over time. This activity will also provide insight into future risks and health outcomes associated

with extreme heat and the urban heat island effect.

OBJECTIVES

In this activity, you will:

- Utilize existing web-based tools to examine geographical differences in heat using climate models.
- Create time-series charts analyzing changes in heat over time.
- Utilize existing tools to understand future impacts of heat.

RESOURCES

- Understanding Heat Exposure Tables

UNDERSTANDING HEAT EXPOSURE WORKSHEET

Activity: Follow the question prompts and links, and use the ‘Understanding Heat Exposure Tables’ tool to gather data from existing resources on extreme heat exposure using existing data. Please use the Understanding Heat Exposure tables to guide your responses to the questions.

The NWS defines [excessive heat](#) as high heat - significantly above normal - and humidity such that the human body cannot maintain proper internal temperatures and may experience heat stroke. The [NWS issues](#) “outlooks” when conditions could potentially lead to excessive heat in the next 3-7 days, “watches” when conditions are favorable for an excessive heat event in the next 24 to 72 hours (generally, temperatures expected to be 100 F or higher for at least 2 days and nighttime temperatures not dropping below 75F), “advisories” when extreme heat conditions are imminent in the next 12 hours, and “warnings” within 12 hours of the onset of extremely dangerous heat conditions (generally, a heat index of 105F or higher for 2 days and nighttime temperatures not dropping below 75F). The decision to issue an excessive heat warning is made in conjunction with one of the 122 [local NWS Weather Forecast Offices](#) (WFOs) to account for variations in regional preparedness for different levels of heat. **Note:** each local NWS website is structured differently and definitions of extreme heat are located in different sections of the sites.

Question 1: What constitutes extreme heat in our community? What entity defines extreme heat? Provide a link referencing your definition.

Use the NWS NOWData tool to record baseline temperatures: After you have your definition, open the [NWS national map](#) of severe weather and click on your region. This will take you to your local WFO website. Next, navigate to “climate and past weather” and find the 1991-2020 temperature normals. This data will be presented differently depending on your local NWS’s web content. After clicking on your community, navigate to NOWData (some localities may open this automatically if you select ‘next’).

Select Monthly summarized data, enter the correct year range, select ‘Avg temp’ from the drop-down, and summarize by ‘Mean’. Use the resulting table to fill in the ‘Q1-3’ sheet in the ‘Understanding Heat Exposure Tables’ tool.

Return to the NOWData page. Select ‘Monthly summarized data’, enter the correct year range, select ‘Max temp’ from the drop-down, and summarize by ‘Number of days’. Input the temperature threshold identified in your community’s extreme heat definition. Use the resulting table to answer Questions 2 and 3 below.

Question 2: Historically, how many extreme heat days did our community experience (here, defined as total # of extreme heat days from 1991 to 2020)?

Question 3: How many extreme heat days does our community experience annually (here, defined as mean annual # of extreme heat days)?

Create a Time Series: Navigate to NOAA's [Climate at a Glance City Time Series](#). Select Maximum Temperature as the parameter and enter 1991 as the start year. Make a time series for each of the months of June, July, and August. Record these time series graphs in the 'Q4' sheet of the 'Understanding Heat Exposure Tables'.

Question 4: How have Summer temperatures changed over time?

Capture visual documentation of local Urban Heat Islands: Navigate to the Trust for Public Land and ESRI's interactive [Urban Heat Island Severity Map](#). Zoom into your community. Record this visual in the 'Q5' sheet of the 'Understanding Heat Exposure Tables' tool.

Question 5: Where are the hottest areas in our community?

Collect climate projection data: The [Climate Mapping for Resilience and Adaptation \(CMRA\) Assessment Tool](#) lets users explore scenarios based on current and projected climate conditions in locations across the United States. CMRA can be used to learn how to prioritize resilience-building actions and find programs that offer compatible funding. CMRA provides links to federal funding resources, federal climate policies, and proven solutions from other communities. The portal also displays a curated collection of open datasets related to extreme heat, drought, wildfires, flooding, and coastal inundation. Users can combine this data with local geospatial data or incorporate it into their assessment tools to configure new maps and apps that address local needs. To start exploring CMRA, follow the link and select "Launch the CMRA Assessment Tool" in the middle of the page (scroll down). Enter your community, a zip code, or find your area on the map. Explore the results under the 'Extreme Heat' tab. Use the 'Q6' sheet to capture the data for your community.

Question 6: If no action is taken, how hot will it be in the early century, midcentury, and late century? How would that change for your community with mitigation efforts?

Explore shade throughout the day during your heat season: Use the two tools below to document the shadiest and least shady times of day in different parts of your community.

1. Navigate to the American Forests [Tree Equity Score](#) tool {*May not be available for all communities}. Zoom into your community. Find the 'Layers' dropdown menu at the bottom of the left panel. From there, find the 'Other' section at the bottom of the panel and toggle between the Shade layers for Noon, 3pm, and 6pm.

To filter for Census Tracts with low or high shade values, find the 'Filters' dropdown menu at the bottom of the left panel and use the 'Shade' filter at the bottom of the panel to explore low- and high-shade Census Tracts in your community.

Record areas / Census Tracts of interest and their percent shade cover in the 'Q7' sheet.

2. Navigate to [ShadeMap's viewer](#). Zoom into your Census Tracts of interest and explore shade distributions throughout the day using the sliding tool on the bottom of the screen. Make sure that the date is set to a day relevant to the heat season in your community. Take note of the apparent land use types in this area and whether pedestrian areas receive shade from buildings or vegetation at Noon, 3pm, and 6pm for your identified areas / Census Tracts of interest in the 'Q7' sheet.

Question 7: What are the shadiest and least shady times of day in different parts of our community where and when it is needed? Where in our community is there not enough shade when it's needed to keep people safe outdoors?

Question 8: Looking across the temperature metrics in this worksheet, how would they be useful for different purposes? Are there any areas that are consistently hotter across all metrics? Are there any areas of concern in your community that these metrics do not capture?

Visualizing Heat Exposure Data

MOTIVATION

The Customizing Heat Exposure Data Activity will equip you with the tools to access and manipulate climate data to assess heat exposure in your community. After accessing and understanding the data, you will construct a web map or a series of static maps to facilitate data visualization and highlight specific vulnerabilities.

OBJECTIVES

In this activity, you will:

- Learn to locate, download, and process data in GIS format.
- Use online GIS tools to build a dynamic web map depicting heat vulnerabilities throughout your community, or utilize open-source GIS software to create a series of static maps depicting heat vulnerabilities throughout your community
- Derive data-driven insights to inform heat action and policy

RESOURCES

Input Data

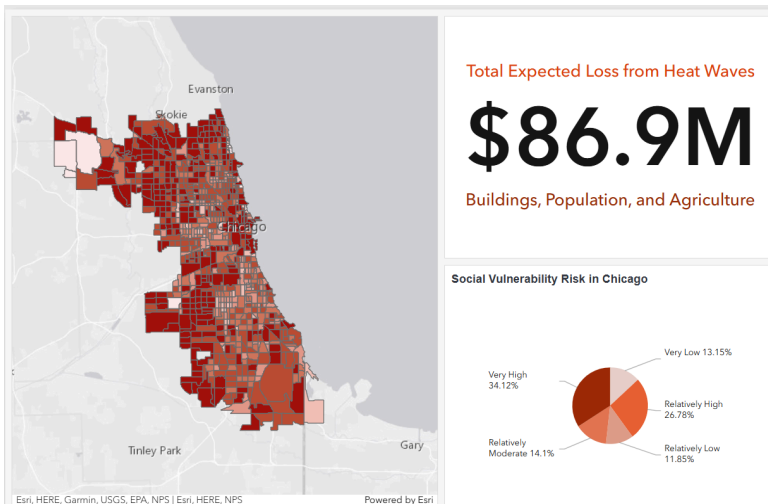
- National Risk Index dataset
- U.S. Department of Health & Human Service boundary layers

Examples

- [Example of completed webmap](#)
- [Example of completed dashboard](#)
- [Example of completed pdf ma](#)

Part/Step: Part 1: Make the Case, Step 1: Heat Exposure Assessment

Tier: 2



SPATIALLY VISUALIZING HEAT VULNERABILITY WORKSHEET

This activity will guide you through the steps of downloading and cleaning GIS data, selecting the appropriate data for your goals, and creating a dynamic web map displaying your results.

NOTE: This activity can take two paths:

- 1) Building a web map and data dashboard with ArcGIS Online software, which requires a basic (or above) license, or
- 2) Creating a series of static pdf maps using open-source GIS software.

The first section provides steps for the web map. The second section provides steps for the static open-source map series. Complete one of these sections depending on your community's capacity and license availability.

OPTION 1: BUILDING A WEB MAP AND DASHBOARD

[Example of completed web map](#)

[Example of completed dashboard](#)

Exploring the Data

This activity uses data from the [National Risk Index](#), a vulnerability assessment data layer managed by FEMA which measures risk for various natural disasters and social vulnerabilities. Their data can be explored through their series of web maps. Take a look through their National Risk Index data, which shows a composite score for each census tract taking all risk indicators into account. Navigate to their [web map](#) page, select "Open in Map Viewer," and zoom into your community. Click on a census tract to activate a popup window.

1. At the general risk level, what patterns emerge?
2. What information is included in the popup? What information would be useful to your community which is not included at this general level?

Downloading and Understanding the Data.

For the purposes of this activity, do not download the entire NRI dataset. Instead, download the Core 5 Tier 2 NRI dataset, which includes attributes related to social vulnerability, assets, and heat wave risk.

Unzip the file. Inside, you will find a shapefile and supporting files as well as an Excel file called NRI_DataDictionary. The data dictionary explains what each field in the data depicts. Open it and read through, paying special attention to the Field Alias column.

3. What data fields do you think will be especially helpful to your community? Do any address specific gaps you identified in question 2?

Cleaning the Data in ArcPro

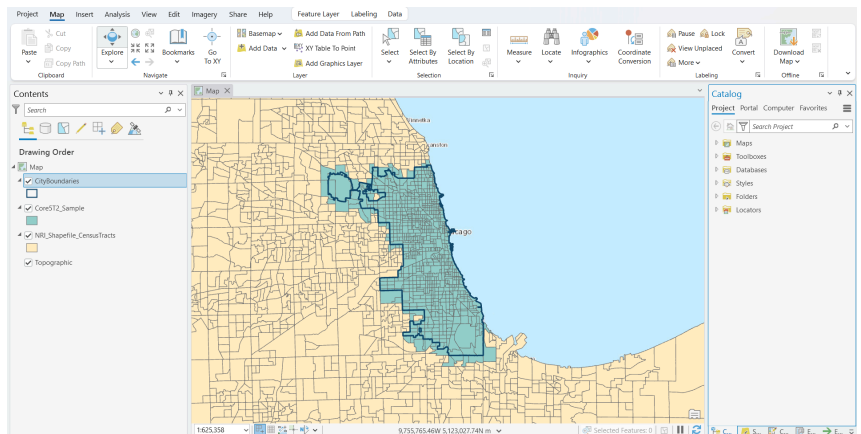
Opening the Data

Open ArcPro and ensure that you are logged in with your ArcGIS Organizational Account (upper right corner). Drag and drop the NRI shapefile (.shp) into your map viewer.

Selecting the Tracts in your Study Area

Zoom into your community. You want the tracts relevant to your study area. There are several options to do so, depending on the complexity and size of your study area.

1. Use the select tool and select the tracts individually by clicking on them while holding the shift key.
2. Use the select tool and drag a rectangle over your study area.
3. For exact boundaries, use a City Boundary GIS layer such as [this one](#) from the U.S. Department of Health & Human Service or a boundary layer hosted by your local government. Load the city boundary shapefile using the same steps as above. Right-click on the layer, in the contents pane, select “Properties,” select “New Definition Query,” and enter a query singling out the name of your city. Navigate to “Select by Location” in the upper ribbon. Enter the NRI tracts as the input features, select “Intersect” as the relationship, and select the City Boundaries layer as the Selecting Features. Click apply. This will select



only the tracts in your chosen boundary.

After you have selected your tracts of interest using one of the methods above, right-click on the tract layer in the contents pane, select “Data”, then “Export Features,” and export a layer of your chosen tracts.

Stylizing the Data

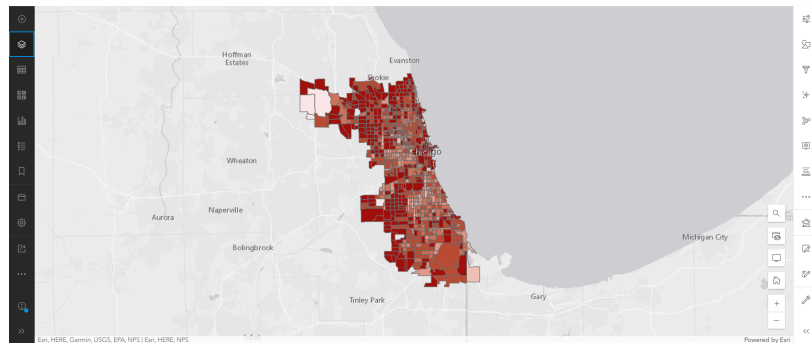
Now that you have narrowed down the data to your study area, right-click on the new layer in the contents pane and open the attribute table. Reacquaint yourself with the data, using the data dictionary if necessary. Select the field you wish to display in your web map. Navigate to the symbology pane. Select ‘Graduated Colors’ along with the selected field. Feel free to explore different fields and symbology types. Also, feel free to change the basemap in the upper ribbon.

Exporting to Webmap

When you are satisfied with your map, select “Share” in the upper ribbon. Name your item, add appropriate tags and summaries, and ensure the sharing level is set to organization. Also, ensure that all the processing layers have been removed; otherwise, they will end up in your final web map. Select “Analyze” and resolve all errors using the three-dot button that appears next to each one. Click share.

Finalizing Your Web Map

Navigate to ArcGIS online on a browser and log into your ArcOnline organizational account. Navigate to Content. Your web map will be there. Click on it, then select “Open in Map Viewer”. Customize your web map! You can change the popups (the information that appears when you select a tract) by choosing the popups button on the right-hand ribbon. You can change the field names to be more user-friendly using the “fields” button and referencing the data dictionary. When satisfied, make sure to save your work.



Creating a Dashboard

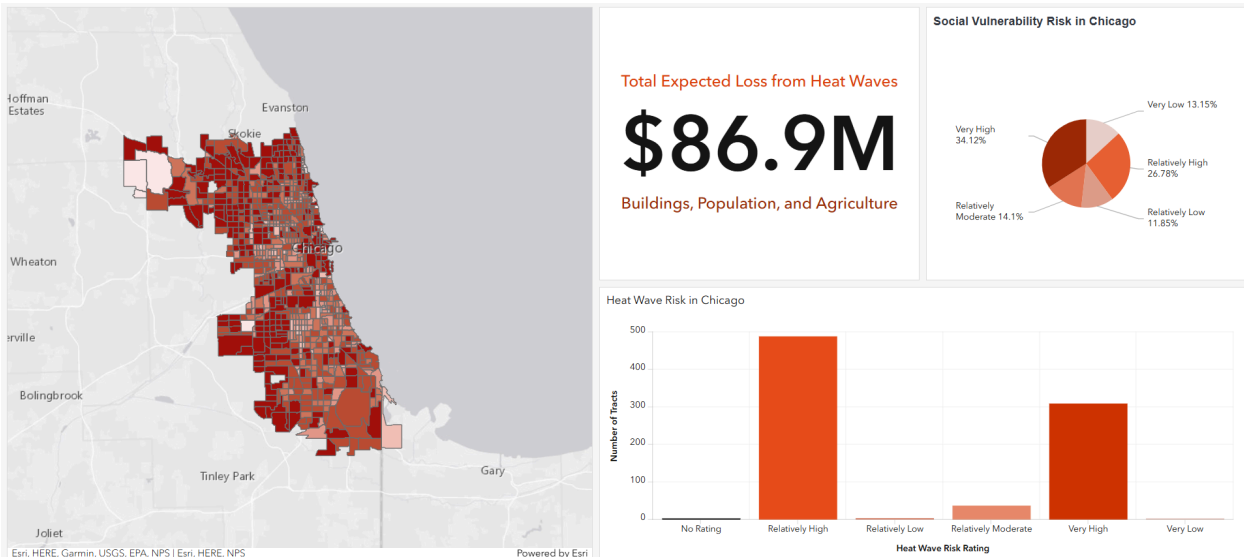
If several fields interest you, a dashboard is a perfect way to display multiple pieces of information. Navigate to Content and select “Create app” in the upper left corner. Click Dashboard. Name your dashboard and add the appropriate tags and summary.

Customizing Your Dashboard

Click the + symbol and add your web map.

To add other elements, click the + symbol again and select where you want the new element to be located. Include the following elements:

1. **Serial Chart:** These function like bar charts. Select the data layer in your web map as the source data. Ensure “Categories from” is set to “Grouped values” and set the category field to HWAV_RISKR, or the heatwave risk rating. Leave the statistic as “Count” and “FID”: this essentially counts the unique ID numbers within each category. Navigate to “Category Axis” and title the axis “Heat Wave Risk Rating.” Title your value axis “Number of Tracts.” Title your chart “Heat Wave Risk in [COMMUNITY NAME]” in the “General” tab. Stylize the chart in the series tab.
2. **Pie Chart:** Select the data layer in your web map as the source data. Ensure “Categories from” is set to “Grouped values” and set the category field to SOVI_RATNG, or the social vulnerability risk rating. Leave the statistic as “Count” and “FID”: this essentially counts the unique ID numbers within each category. Navigate to the “Slices” tab and colorize the slices as appropriate. In the “General” tab, add the title “Social Vulnerability Risk in [COMMUNITY NAME].”
3. **Indicator:** These function as large callout numbers. Select Sum and HWAVEALT. This shows the total expected annual loss of all buildings, population, and agricultural value for all tracts combined. In the “Indicator” tab, add the title “Total Expected Loss from Heat Waves” to the top text, add “\$” to the middle text, and “Buildings, Population, and Agriculture” to the bottom text.
4. Get creative, and explore the other options for displaying data! Feel free to add and display the fields you found most pertinent to your community.



Share Your Dashboard

When your dashboard is completed, navigate to the content and ensure that all components (your layer, your web map, and your dashboard) have the appropriate share setting. All components must

have the same share setting. Use these icons to understand sharing settings. Click on the icon to change:



Only you can see these items.



Only members of your ArcGIS Online Organization can see these items.



Everyone, even folks without an ArcGIS Login, can view these items.

After setting the share setting, click on your dashboard, click “Open Dashboard,” and use the resulting URL to share your result!

OPTION 2: USING OPEN-SOURCE QGIS TO CREATE A STATIC MAP SERIES

[Link to an example print map](#)

Exploring the Data

This activity uses data from the [National Risk Index](#), a vulnerability assessment data layer managed by FEMA which measures risk for various natural disasters and social vulnerabilities. Their data can be explored through their series of web maps. Take a look through their National Risk Index data, which shows a composite score for each census tract taking all risk indicators into account. Navigate to their [web map](#) page, select “Open in Map Viewer,” and zoom into your community. Click on a census tract to activate a popup window.

1. At the general risk level, what patterns emerge?
2. What information is included in the popup? What information would be useful to your community which is not included at this general level?

Downloading and Understanding the Data

For the purposes of this activity, do not download the entire NRI dataset. Instead, download the Core 5 Tier 2 NRI dataset, which includes attributes related to social vulnerability, assets, and heat wave risk.

Unzip the file. Inside, you will find a shapefile and supporting files as well as an Excel file called NRI_DataDictionary. The data dictionary explains what each field in the data depicts. Open it and read through, paying special attention to the Field Alias column.

3. What data fields do you think will be especially helpful to your community? Do any address specific gaps you identified in question 2?

Downloading QGIS

QGIS is free GIS software that allows users to create visuals, examine data, and conduct complex analyses. If you do not have access to an ESRI ArcGIS software license, navigate to the QGIS download page and download the most recent version of the software to your computer.

Adding the data to your map

Once downloaded, open a new empty project. Save and name your project. Drag and drop the NRI shapefile (.shp) into your map viewer.

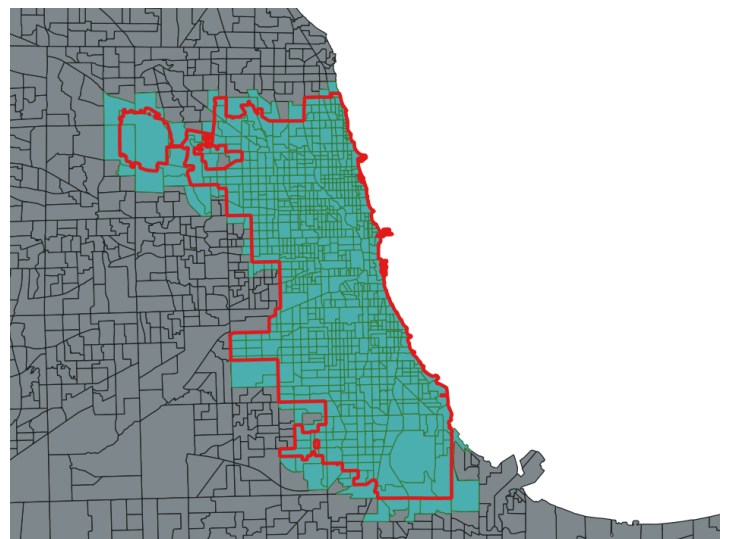
Adding a Basemap

Navigate to View > Panels > Browser. Ensure this box is checked. In the browser pane on the left-hand side, find "XYZ Tiles" and expand the XYZ Tiles section. Right-click on OpenStreetMap and select Add Layer to Project. Drag it to the bottom of your layer list.

Selecting the Tracts in your Study Area

Zoom into your community. You want the tracts relevant to your study area. There are several options to do so, depending on the complexity and size of your study area:

4. Use the select tool and select the tracts individually by clicking on them while holding the shift key.
5. Use the select tool and drag a rectangle over your study area.
6. For exact boundaries, use a City Boundary GIS layer such as [this one](#) from



the U.S. Department of Health & Human Service or a boundary layer hosted by your local government. Load the city boundary shapefile using the same steps as above. Right-click on the layer in the contents pane and select “Filter.” Enter a query singling out the name of your city (EX: "NAME" = 'Chicago'). Navigate to “Select by Location” in the upper ribbon. Enter the NRI tracts as the input features, select “Intersect” as the relationship, and select the City Boundaries layer as the Selecting Features. Click apply. This will select only the tracts in your chosen boundary.

After you have selected your tracts of interest using one of the methods above, right-click on the tract layer in the contents pane, select “Export”, then ‘Export Selected Features As,’ and export a layer of your chosen tracts.

Stylying the Data

Now that you have narrowed down the data to your study area, right-click on the new layer in the contents pane and open the attribute table. Reacquaint yourself with the data, using the data dictionary if necessary. Select the field you wish to display in your web map. Double-click the layer to open properties and navigate to the symbology pane. Select ‘Graduated Colors’ along with the selected field. Click “Classify” to apply the color ramp. Feel free to explore different fields and symbology types.

Turn off the layers that are no longer necessary.


Creating a Print Layout

Once you are satisfied with your data stylization, click “New Print Layout” (



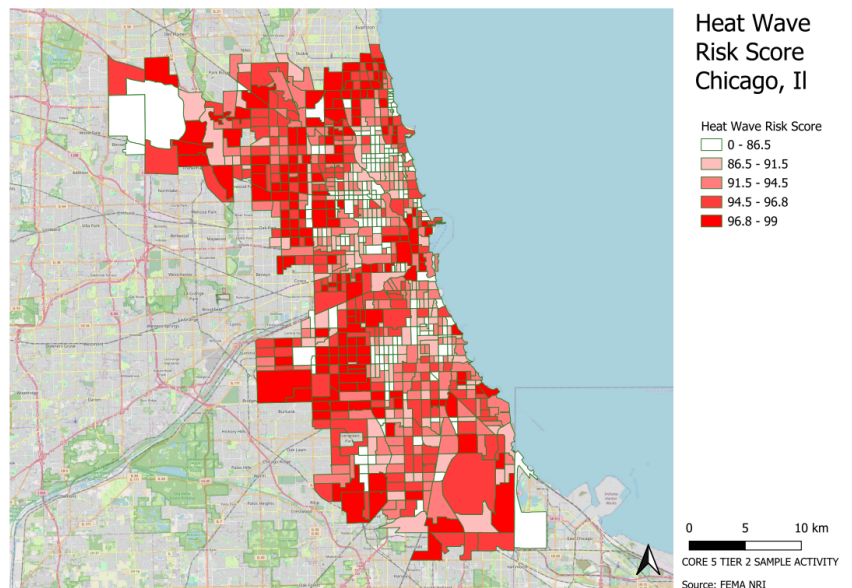
) in the upper left-hand corner.

This will open a layout editing

window. Click “Add Map” () on the left-hand side. Your stylized map will appear.

Use the tools along the right-hand pane to add a title (using add text), a legend, a scale bar, source information, and a north arrow.

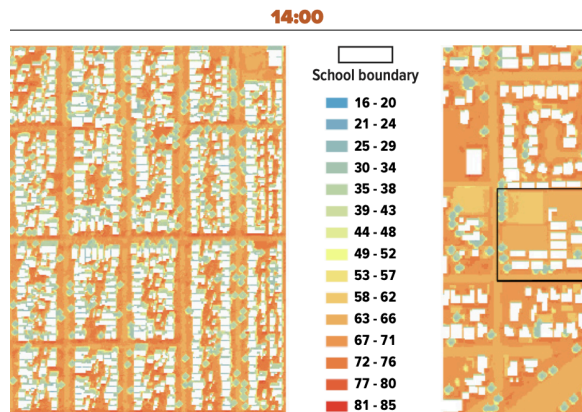
Open the “Items” pane on the right to edit titles in the legend, edit text, change the scale of your map, interactively edit and zoom through your map, and apply different fonts and styles.



Creating a Map Book

Recreate the above steps to create a PDF book of the fields most pertinent to your community.

MODELING LOCAL MICRO- CLIMATES WITH ENVI-MET WORKSHEET



Mean radiant temperature simulation results for a residential neighborhood in Pacoima and Fernangeles Elementary School

Part/Step: Part 1: Make the Case, Step 1: Heat Exposure Assessment

Tier: 3

MOTIVATION

Extreme heat is a growing threat in many cities, and not all temperature metrics equally capture how people actually experience that heat. While widely available data such as Land Surface Temperature (LST) from remote sensing and Air Temperature (AT) from weather stations are commonly used in planning, these metrics do not fully reflect the range of conditions that influence heat exposure at the human scale (Turner et al., 2022). How a person experiences heat at a specific site depends on multiple factors, including humidity, wind speed, and heat radiating from nearby surfaces, with shade being the most important moderator of outdoor thermal comfort (Middel and Krayenhoff, 2019). Mean Radiant Temperature (MRT) is a composite measure that captures these influences and offers a more accurate approximation of human thermal burden than LST or AT alone (UCLA Luskin Center for Innovation, 2022). Because MRT requires fine-scale, site-specific measurements, it is not as widely available. Fortunately, it can be modeled. ENVI-met is one such modeling tool (Bruse and Fler, 1998). It allows users to simulate microclimate conditions by incorporating detailed representations of buildings, vegetation, and surface materials. In this activity, you will use ENVI-met to explore microclimate conditions at a chosen site and test how design interventions such as adding trees or shade structures can reduce MRT and improve thermal conditions at the human-scale.

References:

1. Turner et al. 2022:
<https://www.tandfonline.com/doi/full/10.1080/1747423X.2021.2015003#abstract>

2. Middel and Krayenhoff, 2019:
<https://www.sciencedirect.com/science/article/pii/S0048969719326531>
3. UCLA Luskin Center for Innovation, 2022:
<https://innovation.luskin.ucla.edu/wp-content/uploads/2022/10/Urban-Heat-and-Cool-Design-Facts.pdf>
4. Bruse and Fleer, 1998:
<https://www.sciencedirect.com/science/article/abs/pii/S1364815298000425?via%3Dihub>

Activity: Follow the prompts and links, and use the Modeling Local Microclimates Tables to record your responses and insights from microclimate modeling. All tutorial videos referenced are located at <https://envi-met.com/tutorials-overview/getting-started/>

Note: You will need access to a Windows Machine to download the free version of the ENVI-met software. You can download a free trial version of ENVI-met here: <https://envi-met.com/microclimate-simulation-software/>

OBJECTIVES

In this activity, you will:

- Use ENVI-met to simulate microclimate conditions in a selected area
- Test a cool design scenario for the selected area using ENVI-met
- Interpret simulation results to make evidence-based recommendations

Resources:

- [ENVI-met Tutorials](#)
- [ENVI-met Forum](#)

DEVELOPING MICROCLIMATE MODEL

Activity: Follow the question prompts and links, and use the [Modeling Local Microclimates Tables](#) as you work through the steps.

1. Exploring ENVI-met & Setting Up Your Workspace

1.1 Watch Introductory Tutorials: Begin by watching the [ENVI-met tutorial “Exploring the ENVI-met Workflow #1”](#) to familiarize yourself with the key tools and the overall microclimate modeling process. Then, watch [“Designing Your Ideal Workspace #2”](#) for step-by-step instructions on setting up your project workspace.

1.2 Optional Tutorials: For this activity, it is not necessary to watch [“Understanding Database Logic #3”](#) or [“Using the Database Manager #4.”](#) However, if you are interested in creating custom attributes

(e.g., modeling a native plant species or a specific building material not found in the default database), you may find those tutorials helpful.

2. Choose a Site

Select a site within your community of interest no larger than 100 x 100 meters, or approximately 325 feet x 325 feet. Possible locations include a schoolyard, residential block, park, or transit stop.

- Open Google Earth and zoom into your chosen location.
- Use the measurement tool to outline a site area no larger than 100 x 100 meters.
- Take a screenshot of your selected site and insert it into Tab 1: “Q1” of your interactive workbook.
- Then, respond to the following questions:
 - 1a: Why did you choose this location?
 - 1b: What are your questions or concerns about its microclimate?

Note: The LITE version of ENVI-met (free for non-commercial use) is limited to 50 x 50 grid cells. Setting your grid resolution to 2 meters allows for a maximum model area of 100 x 100 meters. Be sure to select a site that fits within these constraints.

3. Create model input file

3.1 Watch the Tutorial: Start by watching the ENVI-met tutorial “[Digitization Essentials with SPACES #5.](#)”

3.2 Prepare Your Base Image: Take the screen capture of your site and convert it to a .BMP file. You can use free online tools such as CloudConvert, Convertio, or FreeConvert. You’ll need a .BMP file to import your site image into ENVI-met Spaces for digitization.

3.3 Digitize in ENVI-met Spaces: Open ENVI-met Spaces, import your BMP file, and follow the steps outlined in the tutorial to digitize your site. Remember to select location – the default is Essen, Germany, so you must change it. Add all relevant features, including: Buildings, Vegetation (trees, shrubs, grass, etc.), and Surface cover types (e.g., asphalt, concrete, soil). Be as precise as possible—details like the number and placement of trees can significantly influence microclimate results.

3.4 Save Your Model: Once you finish digitizing, save your model file. It will be saved with a .INX extension, which you will need later for the simulation step. Also, take a screen capture of the model and put it in the tab “Q1” in the column “Screen Capture of Site (Baseline Model Image From Spaces)” in the interactive worksheet linked above.

4. Initiating Setup and Simulation

4.1 Watch Tutorial: Begin by watching the ENVI-met tutorial video “[Initiating Setup and Simulation #6](#)” to familiarize yourself with the process. For this activity, we recommend using Simple Forcing instead of Full Forcing for meteorological input.

4.2 Create Your Simulation File (.SIMX):

- Open ENVI-guide to set up your .SIMX file, which will store the simulation settings.
- Enter the day, start time, and total simulation time for your model.
- Import your .INX file (created in Spaces) to define the model area.

4.3 Simulation Settings:

- If you are using a licensed version than you may select Multi-Core Parallel for faster simulation or if you prefer to limit CPU usage, select Single Core instead
- If you are using the LITE version of ENVI met the default will be Single Core
- Under the Meteorology section, choose “Use Simple Forcing.”

4.4 Find Local Weather Data for Simple Forcing:

- Go to wunderground.com and enter your site location (e.g., Los Angeles).
- Beneath the location, you will see the name of the weather station currently selected. Click “CHANGE” to open a map and choose the weather station closest to your site.
- Then, click the “History” tab and enter the date you intend to model.
- Record the air temperature and humidity values, which you will enter in the Simple Forcing section.

4.5 Save and Run the Simulation:

- Save your .SIMX file once all parameters are set.
- Open ENVI-core and load your .SIMX file.
- Start the simulation.

Note: Simulation run time will vary depending on the size of your model area and your computer’s processing power.

VISUALIZING & INTERPRETING RESULTS

5. Visualize and Interpret Your Simulation Results

5.1 Watch the Tutorial: Begin by watching the ENVI-met tutorial “[Analyzing Data Using Leonardo #7.](#)” This video will walk you through how to load and analyze simulation results using Leonardo, the ENVI-met visualization tool.

5.2 Explore Mean Radiant Temperature Patterns:

- After watching the tutorial, open Leonardo and navigate to the Data Navigator on the right-hand side.

- Load the .EDT atmosphere file from your output project folder. For each of the following times, visualize the Mean Radiant Temperature (MRT): 8:00 AM, 10:00 AM, 12:00 PM, 2:00 PM, 4:00 PM, and 6:00 PM
- In the data selection panel, choose “Mean Radiant Temperature” as your primary variable.
- Select “Windspeed” for contours.
- Set the Position of View Plane to 3.
- Click “Extract Data 2D” to generate your visual output for each time.
- Take screen captures of each time and input them into your interactive worksheet tab “Q2-4”

5.3 Answer the following questions based on your visualizations and input your answers in the tab “Q2-4”:

- Temporal patterns:
 - 2a: At what time of day is mean radiant temperature the highest across your site?
 - 2b: How does it change throughout the day? Are there noticeable shifts in hotspot locations?
- Spatial patterns:
 - 3a: Which areas in your site appear to retain more heat?
 - 3b: Are there any areas that remain consistently cooler throughout the day?
- Design implications:
 - 4a: What features in the landscape might be contributing to higher or lower MRT (e.g., shade from trees, materials types, building orientation)?
 - 4b: How might you address the identified hotspots through a cool design intervention (e.g. adding trees, a shade sail) and where would you locate it on your site?

DEVELOPING COOL DESIGN SCENARIO MICROCLIMATE MODEL

6. Develop Your Cool Design Scenario

Now that you’ve identified areas of heat burden and proposed a possible intervention, such as planting trees, adding a shade sail, or installing reflective pavement, it’s time to bring that idea to life by modifying your ENVI-met model.

6.1 Duplicate Your Model Files

- Make a copy of your original .INX model file (this is your baseline model).
- Rename it to reflect that it’s your cool design scenario (e.g., yourfilename_CoolDesign.INX).

6.2 Edit the Model in ENVI-met Spaces

- Open the duplicated .INX file in ENVI-met Spaces.
- Add your proposed cool design intervention (e.g., trees, shade structures) in the location you identified in Step 5, Question 4b.

- Once complete, take a screenshot of your updated model and paste the screenshot into the “Q1” tab of your interactive workbook for reference in the column “Screen Capture of Site (Cool Scenario Model Image from Spaces)”.

6.3 Update Your Simulation File

- Make a copy of your original .SIMX simulation file.
- Rename it to match your scenario (e.g., yourfilename_CoolDesign.SIMX).
- Open the copied .SIMX file in ENVI-guide and replace the model input file with your updated .INX file (the one with your cool design intervention).
- Keep all other simulation settings the same and save your cool design .SIMX file.

6.4 Run Cool Design Simulation

- Open ENVI-core and load your updated .SIMX file for the cool design scenario
- Start your simulation

COMPARATIVE ANALYSIS

7. Compare the Baseline and Cool Design Scenarios

Now that you’ve run your cool design simulation, it’s time to compare the results to your baseline to evaluate the effectiveness of your intervention.

7.1 Repeat the Mean Radiant Temperature Visualization for the Cool Design Scenario used in Step 5.2, but this time using the results from your cool design simulation:

- Open Leonardo and navigate to the Data Navigator on the right.
- Load the .EDT atmosphere file from your output project folder. For each of the following times, visualize the Mean Radiant Temperature (MRT): 8:00 AM, 10:00 AM, 12:00 PM, 2:00 PM, 4:00 PM, and 6:00 PM
- In the data selection panel, choose “Mean Radiant Temperature” as your primary variable.
- Select “Windspeed” for contours.
- Set the Position of View Plane to 3.
- Click “Extract Data 2D” to generate your visual output for each time.
- Take screen captures of each time and input them into your interactive worksheet tab “Q5-7”

7.2 Answer the following questions based on a comparison of the visualizations of your baseline and cool design scenarios and input your answers in the tab “Q5-7”:

- Temporal Patterns:
 - 5a: In which areas do you see a noticeable reduction in Mean Radiant Temperature compared to the baseline?
 - 5b: At what times of day is the cooling effect most apparent?

- Effectiveness of Design Intervention:
 - 6a: How effectively was your intervention addressing the hotspots you identified in Step 6?
 - 6b: Did the cooling extend beyond the immediate area of the intervention?
- Unintended Effects:
 - 7a: Did any areas experience increased temperatures or new hotspots in your cool design model?
 - 7b: What might explain these changes?

Heat Exposure Settings



Section: Part 1: Make the Case, Step 2: Heat Exposure Settings Identification

Tier: 1

MOTIVATION

A heat exposure setting is a place where exposure to heat occurs. We often think about “where it’s hot” in our communities in geographic terms - through maps that tell us the latitude and longitude of hot sites. But “where it’s hot” can be thought of in terms of the specific places that people spend most of their time, and how conditions in those sites contribute to the amount of heat exposure they experience. Thinking about “where it’s hot” in the latter terms helps us get specific about where heat exposure occurs, and what solutions are appropriate for a given exposure setting.

OBJECTIVES

In this activity you will:

- Generate a list of key exposure settings in your community
- Brainstorm who is impacted and how
- Brainstorm solutions and consider how effective or implementable they are
- Use this information to reflect upon your priorities for actions

RESOURCES

Included in this worksheet you will find:

- Heat Exposure Settings Tables
- Questions designed to help make sense of the challenges/solutions brainstormed

HEAT EXPOSURE SETTING WORKSHEET

IDENTIFYING HEAT IMPACTED COMMUNITIES AND SITES

Activity: Use the first tab in the ‘Heat Exposure Settings Tables’ to brainstorm the types of places that different groups of people in your community become heat exposed, the ways that exposure impacts their daily lives, and strategies for reducing exposure. Then, sort your identified exposure settings by level of priority.

Key Settings: Which exposure settings impact the most people in your community? (Use columns E and F). Make a note of which sites are unique or are key features of your community (Use column C).

- 1.
- 2.
- 3.
- 4.
- 5.

Key Populations: Which exposure settings have the most negative consequences for impacted communities in this exposure site? (Use columns G and H)

- 1.
- 2.
- 3.
- 4.
- 5.

Interventions: What interventions will be most effective at reducing heat exposure for impacted communities in this exposure site? (Use columns I and J)

Use your best judgement to brainstorm interventions. You will have opportunities later in the workbook to refine your intervention strategies based on new or already-existing data.

- 1.
- 2.
- 3.
- 4.
- 5.

Implementation: Which interventions will be easiest to implement? (Use column K)

Use your best judgement to determine the feasibility of identified strategies for this brainstorming activity. Later activities will help you collect and produce new data on existing capacities to implement identified strategies.

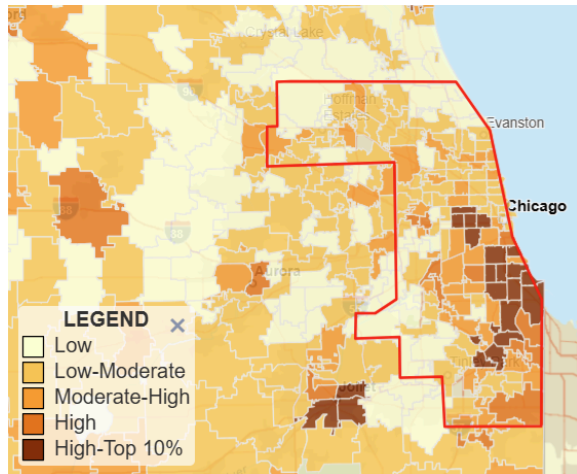
- 1.
- 2.
- 3.
- 4.
- 5.

Reflection Question: Based on your responses above and your knowledge of your community, which sites should be top priorities for heat action in your planning efforts? **(Use column L)**

Level of priority is a subjective assessment based on your community or organization's stated goals and values. For example, you may place a greater weight on the presence of high-risk population groups, the severity of heat impacts in each site, or the proportion of the population that uses the site.

Column L contains four rankings ('high', 'medium', 'low', and 'not a priority'), though you are welcome to tailor the number and titles of dropdown options to suit your needs.

Understanding Heat Vulnerability



Part/Step: Part 1: Make the Case, Step 3: Heat Vulnerability Assessment

Tier: 1

MOTIVATION

This activity will introduce you to Heat Vulnerability and how it is assessed. You will use existing web tools to spatially explore social and heat vulnerability in your community.

OBJECTIVES

List the tangible outputs:

- An understanding of social vulnerability and how this informs heat vulnerability.
- An understanding of how heat vulnerability is measured.
- An understanding of the spatial distribution of heat vulnerability in your community.

RESOURCES

Interactive Table

- [Understanding Heat Vulnerability Tables](#)

Links to interactive dashboards

- [ATSDR](#)
- [CHAT](#)
- [NRI](#) (Some gaps in coverage)

UNDERSTANDING HEAT VULNERABILITY

Activity: Use these ‘Understanding Heat Vulnerability Tables’ to help gather data to answer the following questions.

Learn about social vulnerability: To learn about social vulnerability, navigate to the [CDC’s Social Vulnerability Index Interactive Map](#). In the upper left hand corner, select ‘Census Tracts’ from the “Geographic Unit” dropdown (you may need to zoom in to a finer scale before you are able to select the Census Tract view). Navigate to your community. Toggle between dimensions of social vulnerability using the “Overall SVI” dropdown.

Record Census Tracts with a High ‘Overall SVI’ score in the ‘Q2’ sheet. To learn more about the index and these dimensions, navigate to the [CDC’s Social Vulnerability Index webpage](#).

Question 1: What metrics are included in the CDC’s Social Vulnerability Index?

Question 2: How does social vulnerability, as mapped out by the CDC, differ throughout your community?

Learn about heat vulnerability: To learn about Heat Vulnerability, navigate to the [CDC’s Heat and Health index](#). To learn more about the index, download the factsheet under the ‘snapshot’ section. To begin exploring, click the ‘Explore the HHI with the NCEH Heat and Health Tracker’ link. Enter your zip code or county. Scroll through the content, paying close attention to the time change chart, the Heat Health Index Data Explorer map, and the population characteristics section.

Question 3: What metrics are included in the CDC’s Heat and Health Index? (See, [About the data](#))

Question 4: What is your community’s heat vulnerability level according to the CDC’s Heat and Health index? Where is heat burden highest with respect to:

- (a) Overall Heat Health Index
- (b) Historical Heat Burden
- (c) Natural and Built Environment Percentile Rank
- (d) Sensitivity Percent Rank
- (e) Sociodemographic Percent Rank
- (f) Key points of interest (ex. Daycare centers, fire and ems stations)

Explore FEMA’s National Risk Index: Now, navigate to [FEMA’s National Risk Index](#). From the ‘Risk Index’ dropdown, select ‘Heat Wave’ and toggle to the census track view. Use the ‘Q6’ sheet to

document Census Tracts with a high heat risk score according to this tool or are otherwise of interest (for example, Census Tracts identified in Question 2).

For each identified Census Tract, populate the 'Q6' sheet with its Expected Annual Loss value (Column D), Social Vulnerability Score (Column E), and Community Resilience Score (Column F). To access the Expected Annual Loss value from heat, select 'Heat Wave' from the "Expected Annual Loss" dropdown. The Social Vulnerability Score provided in the 'Social Vulnerability' tab uses data from the CDC's SVI and is the same as that identified in Question 2.

Next, use [this recreation](#)⁴ of FEMA's Future Risk Index tool to document Expected Annual Loss for Mid- and Late-Century under low- and high-emissions pathways. These data are only available at the County scale. Navigate to your County and make the following selections at the top of the page:

- Under the "Rating" dropdown, select 'Projected Annual Loss'.
- Under the "Hazard" dropdown, select 'Extreme Heat'.
- Under the "Scenario" dropdown, toggle between the two time periods and two emissions scenarios to populate columns.
- Under the "Datasource" dropdown, toggle between 'LOCA 95th' to populate columns H - J and 'LOCA 99th' to populate columns K - M in the 'Q6' sheet.

Question 5: What metrics are included in FEMA's National Risk Index? (See [Learn More](#) and [Determining Risk](#))

Question 6: Where is heat risk highest in your community according to FEMA's National Risk Index? How does heat risk compare to overall risk? How might extreme heat impact your economy now and in the future?

Explore Local Tools:

Question 7: Describe heat risk using a local tool if available. For instance, California's [CHAT](#) tool.

Make Sense of the Data:

Question 8: Compare the three vulnerability indices, and your local index if available. What areas are vulnerable on all three? What areas show different vulnerability across the tools? What is contributing to the high vulnerability scores?

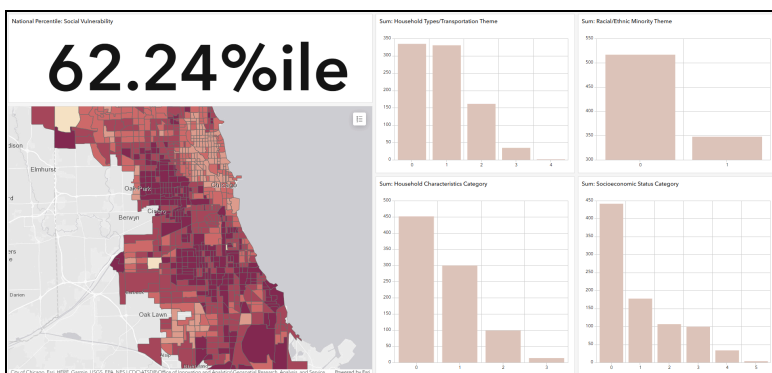
⁴ FEMA's Future Risk tool was live from mid-Dec 2024 to mid-Feb 2025. [Fulton Ring](#) has recreated the tool using the same data.

Question 9: For whom would a heat vulnerability tool be useful in your community/local government?

Question 10: What grant funding (ex. FEMA) is tied to heat vulnerability. Is your community's vulnerability supporting eligibility for funding?

Question 11: What information are these tools missing, which would be useful to your community?

Building Your Own Social Vulnerability Viewer



Part/Step: Part 1: Make the Case, Step 3: Heat Vulnerability Assessment

Tier: 2

MOTIVATION

This activity will equip you with the ability to build your own data-driven social vulnerability viewer. After accessing and understanding the data, you will construct a web map or series of static maps to facilitate data visualization and highlight specific vulnerabilities.

OBJECTIVES

In this activity, you will:

- Develop an understanding of social vulnerability and how this informs heat vulnerability.
- Develop an understanding of how heat vulnerability is measured.
- Use online GIS tools to build a dynamic web map depicting social vulnerabilities throughout your community or utilize open source GIS software to create a series of static maps depicting social vulnerabilities throughout your community.
- Derive data-driven insights to inform heat action and policy.

RESOURCES

Social vulnerability web tools

- [CHAT](#), for the state of CA
- [NRI](#)

Examples from this activity

- [Completed webmap](#)
- [Completed dashboard](#)
- [Example print map](#)

SPATIALLY VISUALIZING SOCIAL VULNERABILITY WORKSHEET

This activity will guide you through the steps of downloading and cleaning GIS data, selecting the appropriate data for your goals, and creating a dynamic webmap displaying your result. This activity follows steps similar to Part 1, Step 1, Tier 2: Customizing Heat Exposure Data.

NOTE: This activity can take two paths:

- 1) Building a web map and data dashboard with ArcGIS Online software, which requires a basic (or above) license, or
- 2) Creating a series of static pdf maps using open-source GIS software.

The first section provides steps for the web map. The second section provides steps for the static open-source map series. Complete one of these sections depending on your community’s capacity and license availability.

OPTION 1: BUILDING A WEBMAP AND DASHBOARD

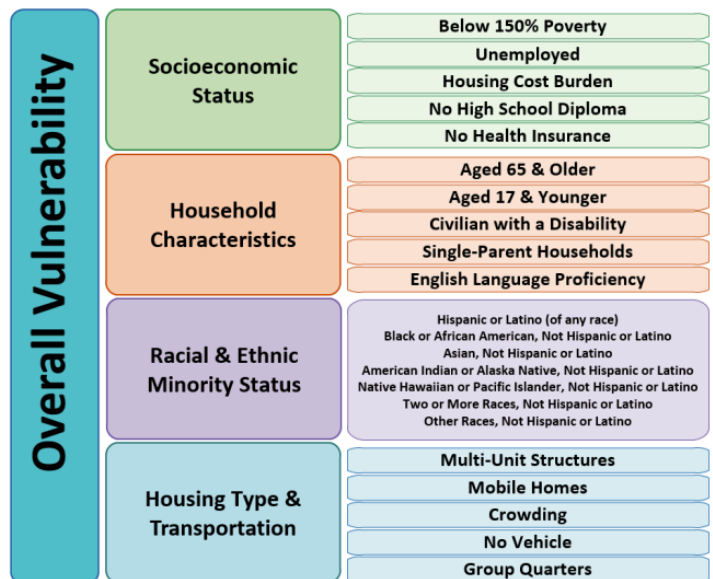
Example of [Completed webmap](#)

Example of [Completed dashboard](#)

Exploring the Data

This activity uses data from the [National Risk Index](#), a vulnerability assessment data layer managed by FEMA which measures risk for various natural disasters and social vulnerabilities. Their data can be explored through their series of web maps. Take a look through their National Risk Index data, which shows a composite score for each census tract taking all risk indicators into account. Navigate to their [page](#), select “Social Vulnerability”, and zoom into your community. Make sure the “Census Tract” option is selected. Click on a census tract to activate a popup window.

1. At the general level, what patterns emerge?
2. What areas have higher social vulnerability within your community?



What kind of range do you see between tracts with high and low vulnerability?

3. Social Vulnerability is calculated using the data displayed in the ‘Overall Vulnerability’ graphic. These data come from the US census. Are any indicators specifically relevant to your community?

Downloading and Understanding the Data.

Download the 2020 SVI dataset. Unzip the file. Inside, you will find a geodatabase.

Cleaning the Data in ArcPro

Opening the Data

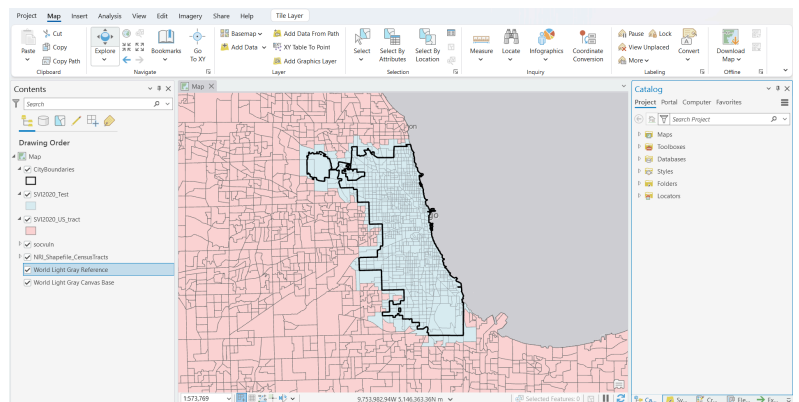
Open ArcPro and ensure that you are logged in with your ArcGIS Organizational Account (upper right corner). Add the Geodatabase to an ArcPro project. Add the layer ‘SVI2020_US_tract’. Right click on the layer and open the attribute table.

4. What data fields do you think will be especially helpful to your community? Do any address specific gaps you identified in question 3?

Selecting the Tracts in your Study Area

Zoom into your community. You want the tracts relevant to your study area. There are several options to do so, depending on the complexity and size of your study area.

1. Use the select tool and select the tracts individually by clicking on them while holding the shift key.
2. Use the select tool and drag a rectangle over your study area.
3. For exact boundaries, use a City Boundary GIS layer such as [this one](#) from the U.S. Department of Health & Human Service or a boundary layer hosted by your local government. Load the city boundary shapefile using the same steps as above. Right click on the layer, in the contents pane select “Properties”, select ‘New Definition Query’, and enter a query singling out the name of your city. Navigate to “Select by Location” in the upper ribbon. Enter the SVI tracts as the



input features, select “Intersect” as the relationship, and select the City Boundaries layer as the Selecting Features. Click apply. This will select only the tracts in your chosen boundary.

After you have selected your tracts of interest using one of the methods above, right click on the tract layer in the contents pane, select “Data”, then “Export Features”, and export a layer of your chosen tracts.

Stylizing the Data

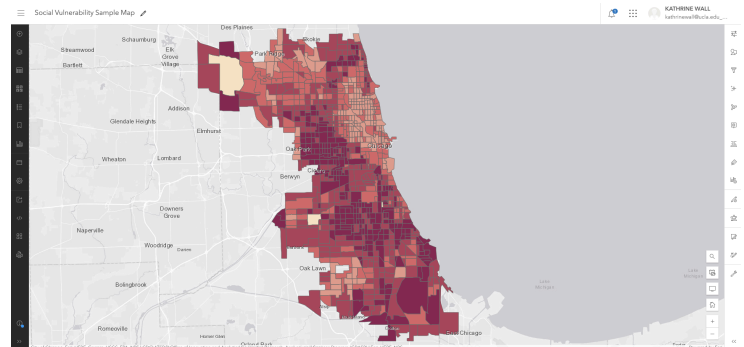
Now that you have narrowed down the data to your study area, right click on the new layer in the contents pane and open the attribute table. Reacquaint yourself with the data, using the attribute table is necessary. Select the field you wish to display in your webmap; F_total, or ‘Sum of the four themes’ is the cumulative social vulnerability score and a good place to start. Navigate to the symbology pane. Select ‘Graduated Colors’ along with the selected field. Feel free to explore different fields and symbology types. Also feel free to change the basemap in the upper ribbon.

Exporting to Webmap

When you are satisfied with your map, select “Share” in the upper ribbon. Name your item, add appropriate tags and summaries, and ensure the sharing level is set to organization. Also ensure that all the processing layers have been removed; otherwise, they will end up in your final webmap. Select “Analyze” and resolve all errors using the three-dot button that appears next to each one. Click share.

Finalizing Your Webmap

Navigate to ArcGIS online on a browser and log into your ArcOnline organizational account. Navigate to Content. Your webmap will be there. Click on it, then select “Open in Map Viewer”. Customize your webmap! You can change the popups (the information that appears when you select a tract) by selecting the popups button on the right hand ribbon. You can change the field names to be more user-friendly using the “fields” button and referencing the data dictionary. When satisfied, make sure to save your work.



Creating a Dashboard

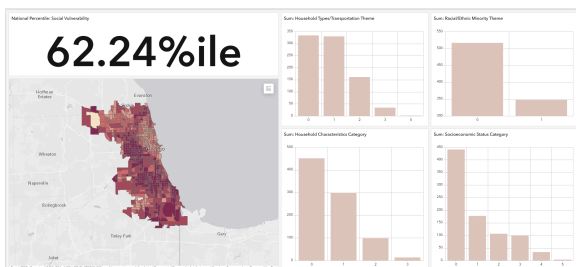
If several fields interest you, a dashboard is a perfect way to display multiple pieces of information. Navigate to Content and select “Create app” in the upper left corner. Click Dashboard. Name your dashboard and add the appropriate tags and summary.

Customizing your Your Dashboard

Click the + symbol and add your web map.

To add other elements, click the + symbol again and select where you want the new element to be located. Include the following elements:

1. Indicator: These function as large callout numbers or percentiles. Select Average and ‘Overall percentile ranking’. This shows the national percentile ranking for your community with regards to social vulnerability. In the “Indicator” tab, click on Value formatting, select percent, and add two decimal places. Add a title in the General tab.
2. Serial Chart: These function like bar charts. Select the data layer in your webmap as the source data. Ensure “Categories from” is set to “Grouped values” and set the category field to F_THEME2, or the sum of characteristics for the household characteristics theme. Add a filter, F_THEME2 is between 0 and 5, to eliminate error values. Leave the statistic as “Count” and “FID”: this is essentially counting the unique id numbers within each category. Navigate to the General title and add a title “Sum: Household Characteristics Category”. Do the same for the other themes: F_THEME1 (socioeconomic status), F_THEME3 (racial/ethnic minority), and F_THEME4 (housing types/transportation).
3. Get creative, and explore the other options for displaying data! Feel free to add and display the fields you found most pertinent to your community.



Share Your Dashboard

When your dashboard is completed, navigate to content and ensure that all components: your layer, your webmap, and your dashboard, have been the appropriate share setting. All components must have the same share setting. Use these icons to understand sharing settings. Click on the icon to change:



Only you can see these items.



Only members of your ArcGIS Online Organization can see these items.



Everyone, even folks without an ArcGIS Login, can view these items.

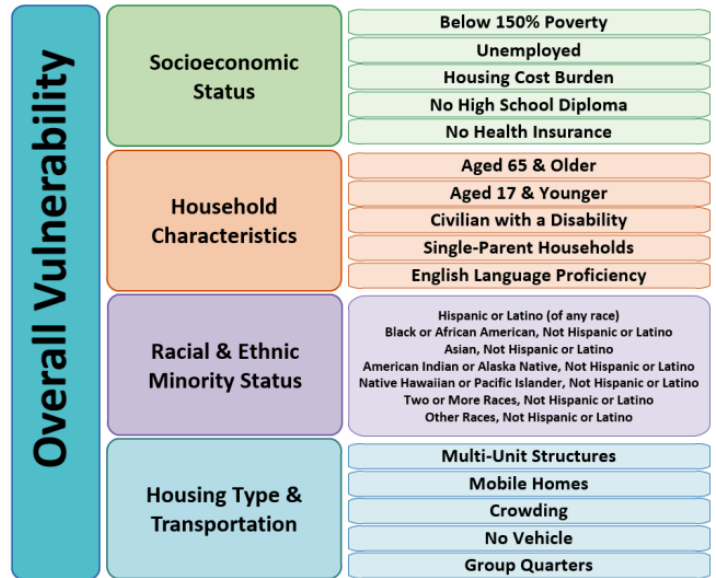
After setting the share setting, click on your dashboard, click “Open Dashboard”, and use the resulting URL to share your result!

OPTION 2: USING OPEN SOURCE QGIS TO CREATE A STATIC MAP SERIES

[Link to an example print map](#)

Exploring the Data

This activity uses data from the [National Risk Index](#), a vulnerability assessment data layer managed by FEMA which measures risk for various natural disasters and social vulnerabilities. Their data can be explored through their series of web maps. Take a look through their National Risk Index data, which shows a composite score for each census tract taking all risk indicators into account. Navigate to their [page](#), select “Social Vulnerability”, and zoom into your community. Make sure the “Census Tract” option is selected. Click on a census tract to activate a popup window.



1. At the general level, what patterns emerge?
2. What areas have higher social vulnerability within your community? What kind of range do you see between tracts with high and low vulnerability?
3. Social Vulnerability is calculated using the data displayed in the ‘Overall Vulnerability’ graphic. These data come from the US census. Are any indicators specifically relevant to your community?

Downloading and Understanding the Data

Download the 2020 SVI dataset. Unzip the file. Inside, you will find a geodatabase.

Downloading QGIS

QGIS is free GIS software that allows users to create visuals, examine data, and conduct complex analyses. If you do not have access to an ESRI ArcGIS software license, navigate to the QGIS download page and download the most recent version of the software to your computer.

Adding the data to your map

Once downloaded, open a new empty project. Save and name your project. Drag and drop the SVI geodatabase (gdb) into your map viewer. Right click on the data and open the attribute table.

1. What data fields do you think will be especially helpful to your community? Do any address specific gaps you identified in question 2?

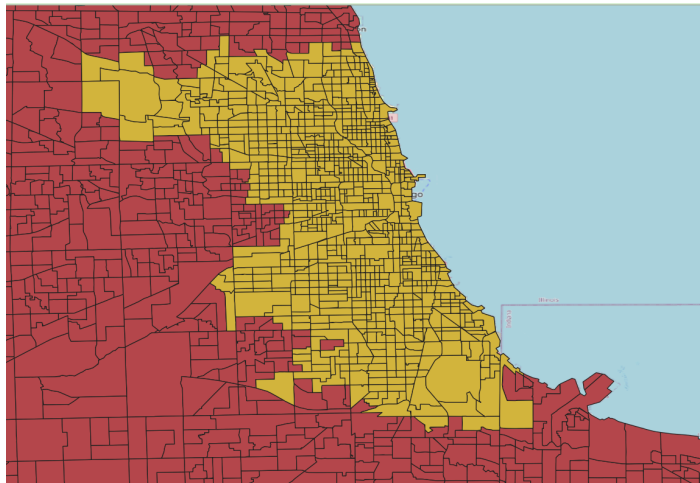
Adding a Basemap

Navigate to View > Panels > Browser. Ensure this box is checked. In the browser pane on the left hand side, find "XYZ Tiles" and expand the XYZ Tiles section. Right-click on OpenStreetMap and select Add Layer to Project. Drag it to the bottom of your layer list.

Selecting the Tracts in your Study Area

Zoom into your community. You want the tracts relevant to your study area. There are several options to do so, depending on the complexity and size of your study area:

1. Use the select tool and select the tracts individually by clicking on them while holding the shift key.
2. Use the select tool and drag a rectangle over your study area.
3. For exact boundaries, use a City Boundary GIS layer such as [this one](#) from the U.S. Department of Health & Human Service or a boundary layer hosted by your local government. Load the city boundary shapefile using the same steps as above. Right click on the layer in the contents pane and select "Filter". Enter a query singling out the name of your city (EX: "NAME" = 'Chicago'). Navigate to "Select by Location" in the upper ribbon. Enter the SVI tracts as the input features, select "Intersect" as the relationship, and select the City Boundaries layer as the Selecting Features. Click apply. This will select only the tracts in your chosen boundary.





After you have selected your tracts of interest using one of the methods above, right click on the tract layer in the contents pane, select “Export”, then ‘Export Selected Features As”, and export a layer of your chosen tracts.

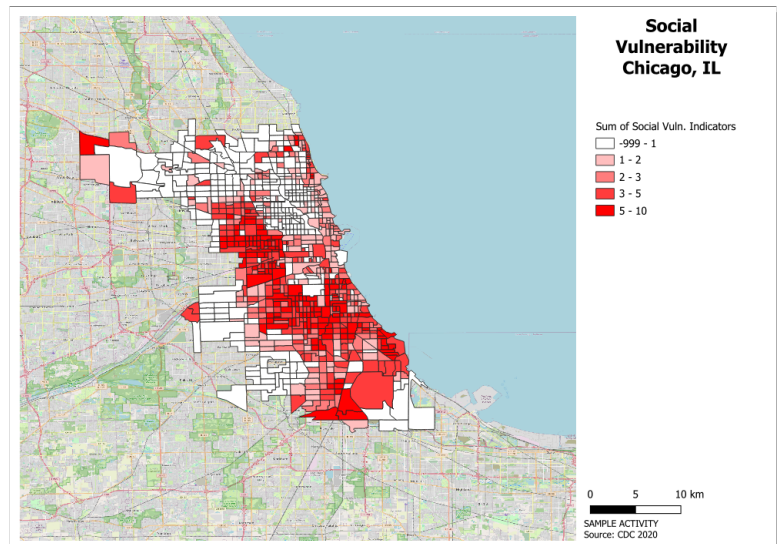
Stylizing the Data

Now that you have narrowed down the data to your study area, right click on the new layer in the contents pane and open the attribute table. Reacquaint yourself with the data, using the data dictionary if necessary. Select the field you wish to display in your print map. A good field to start with is F_total, or ‘Sum of the four themes’. This is the cumulative social vulnerability score. Double click the layer to open properties and navigate to the symbology pane. Select ‘Graduated Colors’ along with the selected field. Click “Classify” to apply the color ramp. Feel free to explore different fields and symbology types.

Creating a Print Layout

Once you are satisfied with your data stylization, click “New Print Layout” () in the upper left hand corner. This will open a layout editing window. Click “Add Map” () on the left hand side. Your stylized map will appear.

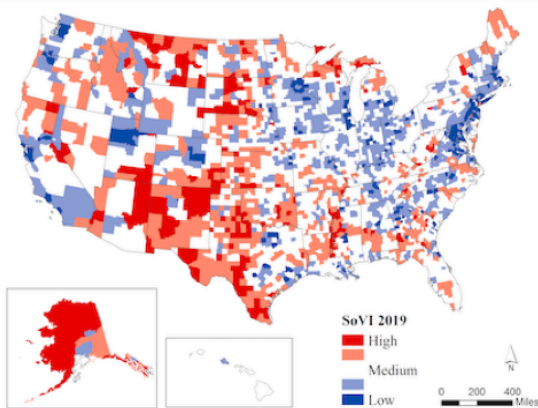
Use the tools along the right hand pane to add a title (using add text), a legend, a scale bar, source information, and a north arrow. Open the “Items” pane on the right to edit titles in the legend, edit text, change the scale of your map, interactively edit and zoom through your map, and apply different fonts and styles.



Creating a Map Book

Recreate the above steps to create a pdf book of the fields most pertinent to your community.

Creating a Social Vulnerability Index for Heat



Part/Step: Part 1: Make the Case, Step 3: Heat Vulnerability Assessment

Tier: 3

MOTIVATION

The Social Vulnerability Index (SoVI[®]), constructed using a statistical procedure called a principal components analysis, allows analysts to assess areas within their community that may be especially sensitive to heat events. This activity allows participants to build their own SoVI[®], selecting the input metrics that are most relevant to their communities.

OBJECTIVES

In this activity, you will:

- A customized SoVI[®] specifically utilizing selected metrics most relevant to your community.

RESOURCES

List of the content that communities will engage with:

Background reading

- [HVRI's SoVI reference tool](#)

Additional Reading

- [Do social vulnerability indices correlate with extreme heat health outcomes?](#)
- [Smartphone locations reveal patterns of cooling center use as a heat mitigation strategy](#)

CREATING A SoVI

SoVI[®] is a valuable tool for policy makers and practitioners because it graphically illustrates the geographic variation in social vulnerability. It shows where there is uneven capacity for preparedness and response and where resources might be used most effectively to reduce the pre-existing vulnerability. SoVI[®] also is useful as an indicator in determining the differential recovery from disasters using empirically-based information.

Learn About Social Vulnerability

Social Vulnerability Indices (SVI) are used to assess communities' ability to prepare for, respond to, and recover from external stressors such as natural and environmental hazards. It does so by examining collectively social, economic, and demographic factors such as socioeconomic status, racial composition, and language proficiency. To explore an existing SVI, navigate to the [California Heat Assessment Tool \(CHAT\)](#) and click the tab under 'Social Vulnerability'.

1. What factors are included in CHAT's assessment of social vulnerability?
2. What variables would be useful for an assessment of social vulnerability in your community?

Learn About SoVI

The Social Vulnerability Index (SoVI[®]) is a Social Vulnerability Index that is constructed using a statistical procedure called a principal component analysis. The factors generated are labeled and assigned a cardinality based on their influence on social vulnerability and then put into an additive model to generate a total SoVI[®] score. The results are mapped using standard deviations from the mean. Learn more about the [SoVI[®] recipe](#).

Collect Input Variables

SoVI[®] variables are derived primarily from the US Census Bureau using the [Census Data Engine](#) with some ancillary data from the Geographic Names Information System (GNIS). If your community utilizes city and/or county data, that could be used as well.

Download data for your community for the variables that you have selected as useful for your community. Use census tracts for geographical units to ensure an appropriate level of granularity. For inspiration, view the [29 variables SoVI[®] uses](#).

3. What variables from the 29 used in SoVI[®] are most relevant to your community?

Normalize All Variables

Normalize all variables as either percentages, per capita values, or density functions (i.e. 'per square mile').

Verify Accuracy and Clean Data

Verify accuracy of the dataset using descriptive statistics (i.e. min/max, mean, standard deviation). Missing values can be replaced by substituting the variable's mean value for each enumeration unit. The statistical procedure will not run properly with missing values. Census units with population values of zero should be omitted.

Standardise Input Variables

Standardize the input variables using z-score standardization: $z = \frac{x - \mu}{\sigma}$. This generates variables with a mean of 0 and a standard deviation of 1.

Principal Components Analysis

For statistical analysis, SPSS is recommended, but R or a similar program works as well. Perform the principal components analysis (PCA) using a varimax rotation (100 iterations) and Kaiser criterion (100 iterations) for component selection. This rotation reduces the tendency for a variable to load highly on more than one factor. Next set parameters for the extraction of factors. This can be aided by the examination of a scree plot for significant drops in Eigenvalue as the number of components included in the analysis increases. While some disjoints in the scree are anticipated (such as those that occur between the first few components) subsequent decreases in Eigenvalue indicate appropriate thresholds for factor extraction.

Resulting Factors

Examine the resulting factors. Determine the broad representation and influence on (i.e. increase or decrease) social vulnerability for each factor by scrutinizing the factor loadings (i.e. correlation between the individual variable and the entire factor) for each variable in each factor.

Factors are named via the choosing of variables with significant factor loadings (or correlation coefficients) - usually greater than .700 or less than -.700, but in some instances we also examine factor loading from greater than .500 and less than -.500 to help identify the dimension. Next, a directional adjustment (or cardinality) is applied to an entire factor to ensure that the signs of the subsequent defining variables are appropriately describing the tendency of the phenomena to increase or decrease vulnerability. For example a factor could be an indicator of wealth, which decreases vulnerability, if it includes variables such as median house value, percentage of rich households, median

rent. Therefore it will have a negative cardinality. The important variables (median house value, percentage rich, median rent) have a positive correlation, so the factor scores on this dimension must be inverted. To adjust the sign of this factor so that those variables appropriately represent their tendency to decrease social vulnerability, a negative cardinality is applied, and the factor is multiplied by -1. Another factor could be labeled race and social status, has four dominant variables (percentage black, percentage female headed household percentage living in poverty, and percent of children not living in a 2-parent household) all of which increase vulnerability (positive cardinality), so Factor 2 is entered into the equation as + Factor 2.

Save the component scores as a separate file.

Calculating SoVI Variable

Calculate a new variable named “SoVI” by placing all the components with their directional (+,-) adjustments into an additive model to generate the overall SoVI[®] score for the place.

Mapping SoVI

Join your SoVI[®] score data to geographical data likely Census Tracts in a GIS program like ArcGIS pro, ArcGIS Online, or QGIS.

Map SoVI[®] scores using an objective classification (i.e. quantiles or standard deviations) with 3 or 5 divergent classes to illustrate areas of high, medium, and low social vulnerability. Normally 1.5-2 standard deviations from the mean are used. The map can be exported as a pdf or converted into a webmap/dashboard (see tier 2 for guidelines to do this).

Reflect

Reflect on your community map.

4. Do any areas stand out? What factors do you think lead to an increased vulnerability in these areas?
5. Compare your results with the heat vulnerability exercise from Core 5. Do any areas experience heightened social vulnerability and heat vulnerability? What factors are contributing to these differences?
6. What state, FEMA, and NGO grants could this SoVI[®] support?

SOCIOcultural Heat Risk Assessment

Part/Step: Part 1: Make the Case, Step 4:
Sociocultural Impacts Assessment



MOTIVATION

The SOCIOcultural worksheets will support communities and tribes in the identification of culturally - significant resources and practices that could be impacted by chronic or acute heat events, providing a foundation for collaborative resilience planning efforts.

OBJECTIVES

Tangible outputs:

- Identification of sociocultural resources and events
 - Assessment of sociocultural heat risks
-

RESOURCES

General Reading and Guides

- [What is a Cultural Keystone Species?](#)
- [National Congress of American Indians \(NCAI\)](#)
- [Seventh Sovereign Tribal Engagement Tips](#)
- [NOAA Cultural Resources Toolkit](#)
- [NOAA Tribal Consultation Handbook](#)



SOCIOCULTURAL RISK ASSESSMENT WORKSHEET

HOW WILL HEAT IMPACT SOCIOCULTURAL RESOURCES?

Sociocultural Resources

Sociocultural resources are plants, animals, or insects that play a special role in tribal or a community's cultural heritage, and therefore contribute to their identity. This special role might include an influence on traditional cuisine, ceremonies, harvests, crafts, economies, or creation stories. Sociocultural resources can also be called cultural keystone species. Learn more about sociocultural resources and cultural keystone species [here](#) and [here](#).

Protecting sociocultural resources is a vital component of heat resilience, because the extinction of these species will fundamentally alter the collective identities of tribes and communities and their access to their cultural heritage practices. When conducting a sociocultural risk assessment, it is imperative to utilize recommended best practices for respectful, anti-colonial engagement.



The first step to incorporating sociocultural considerations into heat resilience planning is to identify sociocultural resources that could be impacted by heat. Then, conduct a sociocultural resources risk assessment. Next, conduct a sociocultural events heat risk assessment. Finally, describe the results of these risk assessments and integrate into planning efforts.

These activities will guide communities through sociocultural risk assessments.

Activities:

Part 1: Identify sociocultural resources in your community using this [SOCIOcultural Resource Identification Guide](#)

Part 2: Assess heat risk to the sociocultural resources you identified using this [SOCIOcultural Resources Heat Risk Assessment worksheet](#)

Part 3: Identify community and cultural events that occur during heat season using this [SOCIOcultural Events Heat Risk Assessment worksheet](#)

After filling out the worksheets, utilize the following questions to guide your next steps:

1. Are tribal / community representatives included in your sociocultural risk assessment and planning process? If not, invite them and share what you have discovered in your sociocultural risk assessment.

2. How will increasing acute and chronic heat affect the sociocultural resources, events, or practices you have identified?
3. What, if any, efforts currently address heat risk to these resources, events, or practices?
4. Use the information gathered to inform decisions about heat resilience planning for sociocultural resources, events, and practices.

Part 2 Workbook Activities

Stress Test A



Part/Step: Part 2: Assess Capacity to Respond,
Step 1: Governance Capacity Assessment

Tier: 1

MOTIVATION

Stress testing the capacity to respond during heat events is a critical first step in identifying strengths, weaknesses, and your community's management ability. Stress tests can take many forms, but at the core, it involves surveying your existing capacities. This activity was designed as a baseline assessment.

OBJECTIVES

In this activity you will:

- Discuss guidelines questions to frame your stress test assessment.
- Complete a comprehensive heat management resource assessment checklist.
- Answer questions about capacities and gaps.

RESOURCES

- Guiding questions
- Stress Test A Activity checklist
- Reflection questions

STRESS TEST

A CHECKLIST TO DETERMINE CAPACITY

Step 1: Discuss Challenges Discuss the main challenges that your community faces pertaining to heat and jot them down here. Some may be included in the provided list, some may not. If not, you may want to add these challenges to your final list. Additionally, not all checklist items will be relevant, but it doesn't hurt to check.

Step 2: Guiding Questions Review the guiding questions and return to them after completing the checklist activity.

Guiding Question 1: How do you perceive the risk of extreme heat in your community/your organization?

Guiding Question 2: What are the biggest challenges you face in dealing with extreme heat?

Guiding Question 3: What population do you think need the most assistance with extreme heat?

Step 3: Basic Information Enter some basic information about your community and/or organization.

Name of Locality or Organization:

Scale (region, state, county, local, organization):

Type of Organization (if applicable, e.g., school, hospital, faith-based organization):

Your Role:

Step 4: Checklist Activity Complete the 'Stress Test A Activity checklist' spreadsheet, which focuses on five key areas: (1) Heat Resilience Plan, (2) Heat Related Data, (3) Heat Mitigation, (4) Heat Management, and (5) Engagement and Communication.

Step 5: Answer Guiding Questions (See step 2)

Applying the Maturity Model for Heat Governance to my Community



Part/Step: Part 2: Assess Capacity to Respond,
Step 1: Governance Capacity Assessment

Tier: 2

Estimated Time Commitment: Likely days to weeks to identify stakeholders and gather information, if not already started.

MOTIVATION

The overarching goal of this activity is to guide communities in the application of the NOAA document, “[A Maturity Model for Heat Governance](#)” v1 (2024). Application of the Maturity Model in this case is intended to lead to subsequent planning actions to implement a tabletop exercise for the community (e.g. developing a Situation Manual, and identifying relevant stakeholders), for example as described in the NOAA document “[Introduction to Heat Tabletop Planning and Coordination](#)” v1 (2024).

OBJECTIVES

- Communities will connect their answers from the previous activity (Stress Test A) to key capacity areas in the Maturity Model for Heat Governance.
- Form a list of relevant and willing stakeholders (specific names, affiliations, and contact information) who may form a Planning Committee for a tabletop exercise for the community.
- Form a list of relevant existing documents (plans, policies, and reports) and data sources that will be a useful starting point for the Planning Committee to understand baseline conditions and begin to form a plan to develop a Situation Manual (SitMan) for a future tabletop exercise.

RESOURCES

Interactive Activity Tables:

- Maturity Model Activity Tables

Background reading:

- [“A Maturity Model for Heat Governance”](#) v1 (2024)
- [“Introduction to Heat Tabletop Planning and Coordination”](#) v1 (2024)

Case Studies

- Optional: After Action Reports from four previous NOAA pilot communities participating in tabletop exercises:
 - [Withering Daisy](#)
 - [The Pressure Cooker](#)
 - [Lowcountry Boil](#)
 - [Magic City Meltdown](#)

Applying the Maturity Model for Heat Governance to my Community WORKSHEET

LINKING OUR BASELINE CAPACITIES TO A FUTURE TABLETOP EXERCISE

Question 1: Read through the Maturity Model for Heat Governance document developed by NOAA. Assign scores to each of 10 dimensions in the Maturity Model for Heat Governance and create spider diagrams for each of three dimension groupings: Institutions, Partnerships and Networks, and Assets. Please download the 'Maturity Model Activity table' (see the Resources section above) and enter in your scores (tab: "Maturity Model Spider Diagrams"), referring to the scoring rubric in the Maturity Model for Heat Governance v1 (2024), on pages 16 - 18. In determining what scores your community should get for each dimension, it may be useful to refer to your answers to the previous exercise (Stress Test A).

Question 2: Completing the above rubric will require you to search for plans, policies, and reports that already exist in your community. Keep track of the existing documents that you come across in the Google Sheet (tab: "Plans, Policies, and Reports"). Key excerpts and figures from these documents may be useful in the development of a future Situation Manual (SitMan) for a tabletop exercise (see NOAA's 2024 "Introduction to Heat Tabletop Planning and Coordination" document to understand what a SitMan might include, on p 8). Use the 'Notes' column to keep track of why each document you list has pertinent information to consider.

Question 3: Completing the above rubric and searching for existing plans, policies, and reports will likely generate people and organizations that will be relevant to include in the future planning of a tabletop exercise for your community. Some of these people and organizations may have the capacity to be involved on the planning committee for a future tabletop exercise (see NOAA's 2024 "Introduction to Heat Tabletop Planning and Coordination" document, pp 2- 7 for ideas of what pre-planning and planning will entail).

Heat Planning Assessment



Part/Step: Part 2: Assess Capacity to Respond,

Step 2: Community Plan Assessment

Tier: 1

MOTIVATION

The Heat Planning Assessment will help you assess the extent to which your current plans may advance heat resilience and identify opportunities to better integrate plans and incorporate heat-related goals, information, and strategies into future plan updates. To facilitate the process, you will want to convene officials responsible for key community plans (general or comprehensive plans, hazard mitigation plans, climate action plans, sustainability plans, etc).

OBJECTIVES

In this activity, you will:

- Evaluate your network of plans.
- Assess how plans address heat resilience.
- Identify opportunities to better integrate plans for heat resilience.

RESOURCES

Included in this worksheet you will find:

- Plan assessment worksheet
- Discussion facilitation guide

PLAN ASSESSMENT WORKSHEET

Activity: Fill out this worksheet for each existing community plan that could be relevant for heat resilience. This includes plans that shape the future of the built environment, guide development, policies, or programs. This could include your general or comprehensive land use plans, heat action plan, hazard mitigation plan, climate action plan, parks and recreation plan, infrastructure plans (e.g., transportation), or public health plan. Focus on the most recent version of plans that are actively being used by the community.

PLAN INFORMATION

Plan name	Institution/organization responsible for plan	Date of adoption

HEAT-RELATED CONTENT

Goals: List any stated goals related to heat resilience.

You may wish to customize the table below to the information provided in your plan related to each goal e.g. some plans may include funding mechanisms or evaluation metrics.

Page #	Stated Goal	Timeline

Fact base: List any heat-related information provided to frame the issue.

{You may wish to use bullet points or create a table to organize your data based on the information available.}

Strategies: Specific planned actions in the plans that can help to achieve heat resilience goals

➤ **Heat mitigation strategies:** List planned actions that can help to reduce heat from the built environment.

You may wish to customize the table below to the information provided in your plan related to each strategy e.g. some plans may include funding mechanisms or evaluation metrics.

Page #	Stated Strategy	Timeline

➤ **Heat management strategies:** Planned actions to prepare for and respond to chronic and acute heat

You may wish to customize the table below to the information provided in your plan related to each strategy e.g. some plans may include funding mechanisms or evaluation metrics.

Page #	Stated Strategy	Timeline

➤ **Heat governance strategies:** Planned actions to improve processes, better coordinate between relevant actors, or develop institutions related to heat resilience

You may wish to customize the table below to the information provided in your plan related to each strategy e.g. some plans may include funding mechanisms or evaluation metrics.

Page #	Stated Strategy	Timeline

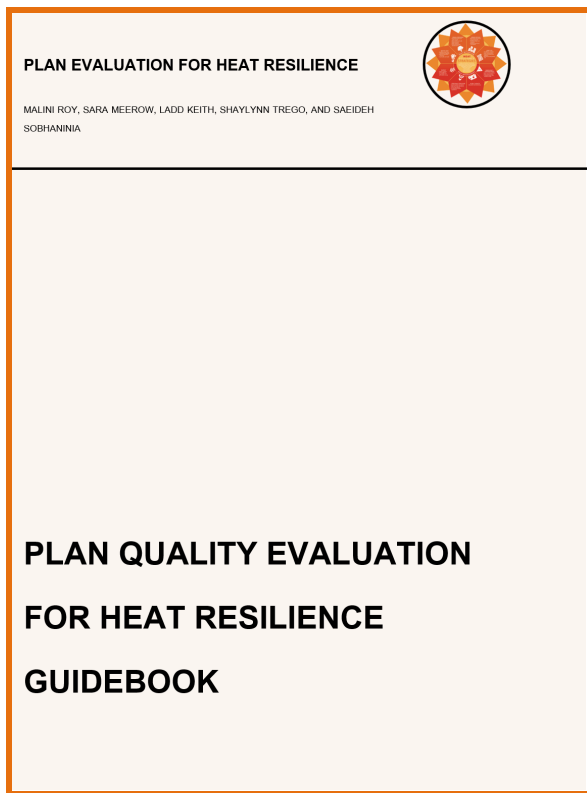
FACILITATION DISCUSSION GUIDE

Activity: Once the Plan Assessment Worksheet has been completed for the relevant network of plans, bring relevant departments together to discuss their findings. Use the facilitation questions below to help guide the conversation.

Discussion Prompts

1. What are the overall results from the plan’s goals, information sources, and strategies?
2. Which plans in the network of plans are most central to heat planning currently?
3. Are any plans/organizations missing?
4. Are any heat-related goals, information, or strategies missing?
5. How was public participation used during the plan development?
6. How well do the plans address heat (in)equity?
7. Are the plans aligned for heat resilience? If not, who is responsible for future coordination efforts?
8. What actions can be taken to address heat resilience gaps or misalignment between plans?

Plan Quality Evaluation for Heat Resilience



Part/Step: Part 2: Assess Capacity to Respond,
Step 2: Community Plan Assessment

Tier: 2

MOTIVATION

The Plan Quality Evaluation for Heat Resilience is an approach that communities can use to systematically evaluate the quality of their relevant plans, based on established criteria for high-quality plans, and identify specific heat mitigation and management strategies. The plan quality evaluation results can inform future plan development and updates.

OBJECTIVES

In this activity, you will:

- Systematically code relevant plans identified in Tier 1 for quality principles and heat mitigation and management strategies.
- Visualize and interpret plan quality and heat strategy results.
- Identify opportunities to improve plan quality and heat mitigation and management strategy selection.

RESOURCES

Included in this worksheet, you will find:

- Plan Quality Evaluation for Heat Resilience Guidebook
- Plan Quality Evaluation for Heat Resilience Excel Worksheet

Activity: To apply the Plan Quality Evaluation for Heat in your community you should follow the steps in the [Plan Quality Evaluation for Heat Resilience Guidebook](#) and use the pre-formatted Plan Quality Evaluation for Heat Resilience [Excel Worksheets](#) as your template for conducting your plan quality assessment.

When you are finished, answer the following questions:

Quality Principles: What principles and associated criteria did your plans do particularly well on?

Quality Principles: What principles and associated criteria could your plans improve upon?

Heat Strategies: What heat mitigation and management strategies did your plans contain?

Heat Strategies: What heat mitigation and management strategies were potentially missing from your plans?

Future Planning: How will you use this information in future plans or plan updates?

Plan Integration for Resilience Scorecard™ (PIRS™) for Heat



Part/Step: Part 2: Assess Capacity to Respond,
Step 2: Community Plan Assessment

Tier: 3

MOTIVATION

The Plan Integration for Resilience Scorecard™ (PIRS™) for Heat is an approach that communities can use to analyze how heat mitigation policies are integrated into different plans and to identify opportunities to better target heat mitigation policies in high heat risk areas. PIRS™ for Heat will provide you with specific, actionable information about how current plans would affect heat resilience.

OBJECTIVES

In this activity, you will:

- Create a comprehensive list of actions in existing community plans that would affect heat resilience through the physical built environment.
- Categorize planned actions by policy tool, heat resilience strategy type, and likely effect on heat risks.
- Map planned policies to identify what parts of the city are being targeted for heat mitigation in current plans.
- Compare mapped and scored policies with heat vulnerability data to assess policy alignment with spatial heat risks and to identify opportunities for more targeted urban heat resilience planning.

RESOURCES

Along with this worksheet, you will need:

- [PIRS™ for Heat Guidebook](#)
- [PIRS™ for Heat Excel Worksheet](#)

To apply the Plan Integration for Resilience Scorecard™ (PIRS™) for Heat in your community you should follow the steps in the [PIRS™ for Heat Guidebook](#) and use the preformatted spreadsheets in the [PIRS™ for Heat Excel Worksheet](#) as your template for conducting your own PIRS™ for Heat assessment. When you are finished, answer the following questions.

Policy Tools and Heat Mitigation Strategies: What policy tools and heat mitigation strategy categories do your plans focus on?

Policy Tools and Heat Mitigation Strategies: What policy tools and heat mitigation strategy categories could you add in future plans or plan updates?

Policy Scores: How did your policies score in terms of heat mitigation? Are they aligned with heat hazard exposure or vulnerability?

Policy Scores: Are your policies spatially aligned with your hottest and most vulnerable areas?

Future Planning: How will you use this information in future plans or plan updates?

Build Community Leaders



Photo Credit: Georgetown Climate

Part/Step: Part 2: Assess Capacity to Respond,
Step 3: Build Community Engagement Capacity

Tier: 1

MOTIVATION

Building community leaders is central to grassroots movements. In underserved communities across the US, where systemic inequities and racism lead to disproportionate environmental burdens, like Urban Heat Islands in Black and Brown neighborhoods, skilled community organizers can collaborate with residents to identify the most urgent social and environmental challenges. Together, they can develop solutions through collective action and policy changes that enhance community health and wellbeing. Leadership training ensures that those closest to the struggles are also the architects of the solutions, fostering power from the ground up. Real change can be realized when communities have leaders who know how to mobilize, advocate, and sustain movements.

OBJECTIVES

In this activity you will:

- Discuss and map urban heat challenges

RESOURCES

Included in this worksheet, you will find:

- Leadership training tools

BUILD COMMUNITY LEADERS WORKSHEET

BUILDING COMMUNITY LEADERS TO ADDRESS URBAN HEAT INEQUITIES

Activity: Mapping Heat and Building Solutions. This sheet is intended for leadership trainees.

Objective: Provide community leaders with the knowledge and tools to educate residents on urban heat, identify the locations with the highest surface temperatures in the neighborhood, and build collective solutions. Leadership trainees should be gathered at a table with a facilitator, who may also be a leadership trainee.

Materials Needed: Large neighborhood maps, markers, sticky notes, printed heat vulnerability maps (Core 5, Tiers 1 and 2), and an easy-to-read [fact sheet on urban heat impacts](#).

Steps:

1. Grounding the Issue – Discuss how urban heat affects our neighborhoods, especially in areas with little tree cover, lots of concrete, and limited access to cooling spaces. Make it real—how have folks in the room felt the impacts?
2. Mapping the Heat – Using neighborhood maps, mark places where heat is a serious issue—bus stops with no shade, schools with bare playgrounds, and apartment buildings without AC—layer in lived experiences with data where possible.
3. Community Stories – Share firsthand experiences about how extreme heat affects daily life. Pull from your own experiences or the experiences of those with whom you have worked. Who is struggling the most? What creative ways have people adapted? Stories make the issue tangible and help shape the message.
4. Building Solutions Together – In small groups, brainstorm ways to educate and mobilize neighbors. Maybe it's organizing tree-planting efforts, pushing for more cooling centers, or creating multilingual heat safety flyers. The goal is action rooted in community needs.
5. Practice & Messaging – Role-play conversations with residents, practicing how to break down the issue in clear, relatable ways that move people to action.

Outcome: Leaders walk away ready to engage their communities with real knowledge, strategies, and the confidence to push for solutions that protect and empower our neighborhoods.

*Timing for the activities above may be adjusted as needed.

Build Community Coalitions



Photo Credit: Georgetown Climate

Part/Step: Part 2: Assess Capacity to Respond,
Step 3: Build Community Engagement Capacity

Tier: 2

MOTIVATION

Most organizers know that bringing together a diverse mix of people strengthens a movement. They can list all the reasons why—there’s power in numbers, wisdom in different perspectives, and real value in a broad, inclusive coalition. But even with this understanding, many groups struggle to make it happen. Some say they don’t have the right connections to reach beyond their usual circles—whether that’s professional networks, faith communities, or racial and ethnic groups different from their own. Others hesitate out of fear—worried that conflicts will surface as people with different lived experiences learn to work together.

OBJECTIVES

In this activity you will:

- Assess community resources
- Identify and approach potential partners

RESOURCES

Included in this worksheet you will find:

- Community ally mapping tool

BUILD COMMUNITY COALITIONS WORKSHEET

BUILDING AN ALLIANCE OF ORGANIZATIONS WITH SHARED INTERESTS

Activity: More often than not, the reasons groups aren't working together today are tied to long histories that shaped those divides. A lack of diversity in any space usually reflects deeper patterns in the broader community. Shifting from how things "are" to what they "could be" means acknowledging the past tensions that got us here.

Objective: Use the guiding questions to map potential allies and build a coalition. This activity is intended for community leaders and community-based organizations.

Materials Needed: Butcher paper and markers.

Ask the following guiding questions and document responses on butcher paper:

1. How are resources distributed among the communities we want to work with?
 - a. Have there been conflicts over funding or support?
 - b. What caused those tensions, and who was involved?
2. Identify a potential ally and describe their past experience with collaboration.
 - a. Did it meet their needs? Was it positive or negative, and why?
3. What are the potential allies' attitudes toward collaboration?
 - a. Are there barriers, like mistrust or professional differences, that make it harder?
 - b. What concerns do they have about working together, and how can they be addressed?
4. Who are the key voices in the group?
 - a. Who's open to collaboration, and who's hesitant?
 - b. Do we—or someone we know—have connections with them? List names.
5. What does this group need from a partnership?
 - a. What can we offer, and what are they willing to contribute?
 - b. What risks do they see in joining forces?
6. What shared interests do we have?
 - a. Will this partnership yield tangible benefits for both parties?

Outcome: Organizations can use the answers to start shaping a recruitment plan. This plan should outline potential partners, their key concerns, and relevant background information to help build authentic relationships.

Co-Develop Heat Action Goals



Photo Credit: Georgetown Climate

Part/Step: Part 2: Assess Capacity to Respond,
Step 3: Build Community Engagement Capacity

Tier: 3

MOTIVATION

Fighting extreme heat is about developing grassroots solutions to protect our communities. Too often, decisions about our neighborhoods are made without us, leaving us with short-term fixes instead of lasting change. When we come together to set the agenda, we're building power, demanding investment in our communities, and ensuring the people most affected are the ones shaping the solutions.

OBJECTIVES

In this activity you will:

- Develop a shared vision for heat resilience

RESOURCES

Included in this worksheet you will find:

- Community ally mapping tool

CODEVELOPING HEAT ACTION GOALS WORKSHEET

COMMUNITY COALITIONS DEVELOPING HEAT ACTION GOALS

Activity: Heat Resilience in Action: Community-Led Solutions

Objective: Bring together multiple community groups to co-develop heat action goals, strategies, and tactics rooted in local needs and solutions. This activity ensures that those most impacted by extreme heat lead the response, building power through collaboration.

Materials Needed: Butcher paper, markers, sticky notes, printed neighborhood heat maps (for example, those documented in ‘Part 1, Step 1: Exposure Modeling’), and an outline of potential heat mitigation and adaptation strategies (e.g., tree planting, cooling centers, policy advocacy). If you do not have a ready-to-go proprietary list of strategies that are locally feasible, consider returning to the strategies identified in your network of plans in ‘Part 2, Step 2: Heat Action Planning’ or referring to the other content documented in previous RMWB activities to identify relevant potential mitigation and adaptation strategies. Or, you may wish to refer to the mitigation strategies (pp. 47 - 60) and management strategies (pp. 61 - 70) provided in the American Planning Association’s [Planning for Urban Heat Resilience](#) report.

Steps:

1. Setting the Stage – Start with a community grounding session.
 - a. What does extreme heat look like in our neighborhoods?
 - b. How does it impact different groups (seniors, outdoor workers, families, tenants)?
 - c. Invite representatives from different community organizations to share their perspectives.
2. Mapping the Challenges – Identify specific heat-related challenges from different community perspectives in mixed-group discussions.
 - a. Where are the most significant gaps in resources?
 - b. What barriers exist to staying cool? Write these down on sticky notes and place them on a shared board.
3. Co-Developing Goals – Each group defines key heat resilience goals based on identified challenges.
 - a. These could be short-term (e.g., increasing awareness about cooling centers) or long-term (e.g., pushing for city investment in tree equity).
 - b. Groups share out, and common themes are identified.
4. Building Collective Strategies – Shift the conversation to action.
 - a. What can we do together to advance these goals?
 - b. Break into groups to develop strategies and tactics, considering approaches like community education, direct action, policy advocacy, or mutual aid efforts.

5. Commitment to Action – Each group shares its top strategy and makes a commitment (e.g., launching a public campaign, organizing a cooling network, or meeting with local officials).
 - a. Create a shared action plan that outlines next steps and includes accountability check-ins.

Outcome: Community groups leave with a clear, shared vision for heat resilience and concrete next steps for working together to implement solutions. This process strengthens partnerships and ensures that heat action is led by those most affected.

*Timing for the activities above may be adjusted as needed.

Part 3 Workbook Activities

Listing and Ranking Goals and Strategies



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Part/Step: Part 3: Prioritize Action

MOTIVATION

Now that you have assessed your heat exposure and vulnerabilities and assessed the capacities to address them in your community, it is time to define the next steps. In this activity, you will define “goals”—big picture objects that will make your community more heat resilient. For each goal, you will then consider specific “strategies”—targeted actions you can take alone or in combination to achieve the goal. You will also consider the

context—exposure setting, timing, etc.—of each goal and strategy.

OBJECTIVES

In this activity, you will:

- Guidance on differentiating and defining Goals and Strategies
- Produce a list of goals and strategies for heat resilience in your community.
- Prioritize goals and strategies.
- Aggregate information from previous modules.

RESOURCES

- **Blueprint Activity: Putting it All Together.**
- **Reflection Questions.**

LISTING AND RANKING GOALS AND STRATEGIES WORKSHEET

Activity: Use the following instructions to populate the Blueprint Activity: Putting it All Together worksheet with possible intervention strategies using the data you have collected thus far to prioritize them based on relevance and feasibility.

Tip 1: The criteria for ranking strategies presented below is intended to serve as an exercise to help users organize their priorities and apply them to available strategies. This activity presents an evidence-based approach to decision making to complement local policy and planning processes. Use your best judgement and all available data to equip you with the best information to use in local decision making processes.

All resources from Parts 1 and 2 provide actionable information, but the following may be particularly useful for completing this exercise:

- Part 1: Make the Case, Step 2: Exposure Settings
 - Tier 1: Heat Exposure Settings. Column I asks users to list possible intervention strategies specific to identified sites of heat exposure.
- Part 2: Assess Capacity to Respond, Step 1: Governance Capacity
 - Tier 1: Stress Test A worksheet. Sections 3 and 4 of this worksheet list possible intervention strategies and considerations for each.
- Part 2: Assess Capacity to Respond, Step 2: Planning Capacity
 - All three Tiered activities will create a list of mitigation and management strategies identified in existing community plans.
- Part 2: Assess Capacity to Respond, Step 3: Build Community Engagement Capacity
 - Tier 3: Co-Develop Heat Action Goals. This worksheet required compiling a list of relevant and feasible mitigation and management strategies for community input.
- Resource Spotlight: Arshat-Rockefeller Heat Action Platform
 - This resource allows users to identify locally relevant strategies based on select community characteristics.
- There may be other local documents and community plans that were not previously engaged through Roadmap Workbook activities and that contain locally relevant strategies.
- The American Planning Association's Planning for Urban Heat Resilience report contains lists of mitigation (pp. 47-60) and management (pp. 61-70) strategies.

Tip: The “how” of strategy selection has major implications for procedural equity. To develop culturally resonant solutions and increase buy-in from community members who stand to benefit from interventions, it is best to involve impacted community members and their representatives at all stages of problem definition, solution ideation, implementation planning, and evaluation. Holistic guidance on procedural equity in climate resilience planning is beyond the scope of this Workbook, but the ‘Engagement’ Framework chapter and ‘Part 2, Step 3: Community Engagement’ Workbook activities provide a primer.

Step 1: Review the critical heat exposure settings (refer to your ‘Part 1: Make the Case, Step 2: Exposure Settings’ outputs) in your community, and brainstorm a list of goals to improve heat resilience in those settings. Goals should be general and require multiple strategies to address. Some goals will be specific to a heat exposure setting, while others will be crosscutting. As a target, try to come up with 5-10 goals. Give each goal a unique number for tracking (this is not a ranking) and add the number and goal to columns A and B.

Step 2: Next, brainstorm strategies (leveraging the resources listed above, if needed) to achieve parts of each goal. Strategies should be discrete actions or sets of actions that can be tracked. As a target, aim to develop 3-5 specific strategies for each goal. Give each strategy a unique number for tracking (this is not a ranking) and add the number and strategy to columns C and D.

Step 3: For each strategy, consider what heat exposure settings require an action to implement it (**Columns E - F**). Think about what category of action the strategy falls in (e.g., mitigation vs. management; **Column G**), if the strategy will be deployed inside/outside (**Column H**), and if it occurs on public/private land (**Column I**).

Step 4: For each strategy, think about how urgent the need is. Urgency is a subjective measure and is based on your community or organization’s stated goals and values. For example, you may define urgency based on shared expectations on when goals contained within community plans will be met, or by the scale of a specific indicator such as heat-related illnesses. You may wish to use data collected in Parts 1 and 2, or already available data, to determine the urgency for each strategy.

Whatever criteria you use to determine urgency, make sure it is consistently applied to each strategy. To ensure consistent application, collaborate with your project team to establish agreed-upon definitions for each category.

Value	Category	Description
3	Most urgent	Subjective; criteria determined by the community.
2	Urgent	Subjective; criteria determined by the community.
1	Not urgent	Subjective; criteria determined by the community.

Step 5: Referring to your own resources or the activities completed in Part 1: Make the Case, use the ‘Part 1: Making the Case’ sheet to rank how effective each strategy is at addressing heat resilience by reducing exposure, reducing vulnerability, improving sector-specific heat issues, and protecting/enhancing social and cultural resources.

Refer to the tables below as a reference for your rankings. These rankings refer to the direct outputs of activities in the Roadmap Workbook. You may wish to modify the category descriptions in these tables to suit your needs and other available data you may be using in your decision-making process.

<p>Reducing Exposure Score: How well does this strategy directly reduce experienced heat? Make your best estimation based on local data, existing pilots, case studies, or relevant literature.</p>		
Value	Category	Description
3	Directly Addresses	This strategy will directly reduce heat in high-exposure areas.
2	Indirectly Addresses	This strategy may reduce heat in high-exposure areas, but this is not the primary desired outcome.
1	Does not Address	This strategy will not reduce heat in high-exposure areas.
<p>Priority Exposure Setting Score: How well does this strategy address heat impacts in high-priority exposure settings? This may be achieved through improving on-site thermal comfort or providing resources to avoid negative health outcomes from on-site heat exposure.</p> <p>To help you complete this column, return to ‘Part 1, Step 2: Exposure Settings’, where users identify high-priority exposure settings based on usage rate, the presence of vulnerable users, time spent by users, and the relative severity of impacts in each setting.</p>		
Value	Category	Description
3	Directly Addresses	This strategy directly addresses heat impacts in one or more ‘ <u>high priority</u> ’ exposure settings.
2	Indirectly Addresses	This strategy may address heat impacts in one or more ‘ <u>high priority</u> ’ exposure settings, but this is not the primary desired outcome.
1	Does not Address	This strategy will not address heat impacts in a ‘ <u>high priority</u> ’ exposure setting.
<p>Heat Vulnerability Score: How well does this strategy decrease population vulnerability to heat? You may wish to refer to the materials in ‘Part 1, Step 3: Heat Vulnerability’ to guide your responses.</p>		
Value	Category	Description
3	Directly Addresses ≥2 Dimensions	This strategy directly addresses <u>two or more</u> dimensions of vulnerability (exposure, population sensitivity, and/or adaptive capacity).
2	Directly Addresses 1 Dimension	This strategy directly addresses <u>at least one</u> dimension of vulnerability and is likely to reduce expected adverse health outcomes.

1	Does not Address	This strategy will not reduce population vulnerability.
<p>Social and Cultural Impacts Score: How well does this strategy enhance/protect cultural resources and way of life?</p> <p>To help you complete this column, return to ‘Part 1, Step 4: Social and Cultural Considerations’, where users identify at-risk cultural resources, including keystone species and cultural events that may require heat resilience preparations.</p>		
Value	Category	Description
3	Directly Addresses	This strategy directly addresses heat impacts to a specific <u>at-high-risk</u> cultural resource (event or species) and will be highly effective in preventing adverse heat outcomes for people or other species.
2	Indirectly Addresses	This strategy is likely to address heat impacts to cultural resources (events or species), but it is not the primary desired outcome.
1	Does not Address	This strategy will not address heat impacts to cultural resources.

Step 6: Referring to your own resources or the activities completed in Part 2: Assess Capacity to Respond, use the ‘Part 2: Assess Capacity to Respond’ sheet to rank how prepared you are to implement each strategy in terms of governance, planning, and engagement.

Refer to the tables below as a reference for your rankings. These rankings refer to the direct outputs of activities in the Roadmap Workbook. You may wish to modify the category descriptions in these tables to suit your needs and other available data you may be using in your decision-making process.

<p>Governance Capacity Score: How prepared is our government (and related actors/ institutions) to respond?</p>		
Value	Category	Description
5	Highly prepared	We are ready to implement this action or are already implementing it.
4	Very prepared	We have identified relevant parties to implement the action and have a strategy for implementation in place, but have unfinalized details, e.g., lacking funding, have not yet conducted community engagement, have not yet achieved council approval, etc...
3	Prepared	We have some structures and relevant parties in place to implement this action, but considerable effort is required to mobilize action.

2	Somewhat prepared	We may have some structures and relevant parties in place to implement the action, but this strategy may not fall within their primary scope of work or interest.
1	Not prepared	We are not prepared to implement this strategy. This strategy is infeasible at this time.

Planning Capacity Score: How prepared are we across our network of plans?

Value	Category	Description
5	Highly prepared	This strategy is explicitly referenced in an adopted community plan, and the heat resilience benefits are clearly linked to it within the plan.
4	Very prepared	This strategy is explicitly referenced in an adopted community plan, but not clearly attached to heat resilience benefits, e.g., trees and green stormwater infrastructure in a flood prevention section of a climate action plan that will mitigate temperatures but may not be designed to maximize this outcome.
3	Prepared	This strategy could reasonably be included in or part of the implementation strategy for a broader strategy listed within a community plan, e.g., a landscaping code update in a city's comprehensive plan that does not reference heat-mitigating design, but could include it.
2	Somewhat prepared	This strategy is not referenced, but it would serve a stated goal or vision outlined in an adopted community plan.
1	Not prepared	This strategy is not relevant to the listed strategies, goals, or community visions contained in an adopted community plan.

Engagement Capacity Score: How prepared are we to engage community members on the desirability/need/implementation considerations for this strategy?

Value	Category	Description
5	Highly prepared	There are existing heat-dedicated spaces/communication channels to engage community members on this strategy, AND we have formal mechanisms to incorporate their feedback into implementation processes. Or we have already conducted community engagement for this strategy.
4	Very prepared	There are existing heat-dedicated spaces / communication channels to engage community members on this strategy, but no formal mechanisms exist to incorporate their feedback.

3	Prepared	There are existing non-heat-dedicated spaces/communication channels that we can leverage to engage community members on this strategy.
2	Somewhat prepared	There are no existing spaces/communication channels we can leverage to engage community members on this strategy, but we have existing relationships or have previously engaged groups that we could reach out to.
1	Not prepared	There are no existing spaces/communication channels to engage community members on this strategy, and we'd have to build relationships from scratch to deliver this engagement.

Step 7: In the 'Part 3: Prioritizing Action' sheet, transfer the normalized scores for effectiveness ('Part 1 Making the Case', Column N) and preparation ('Part 2: Assess Capacity to Respond', Column L) to columns K and L, respectively. Tally the scores for urgency ('Part 3: Prioritizing Action', Column J), effectiveness (Column K), and preparation (Column L). Considering these criteria, how much of a priority should each action be? **This is a subjective decision.** For instance, an action might rank highly for different reasons, including, but not limited to, effectiveness at cooling, your community's preparedness to do it, or the issue's urgency.

Part 4 Workbook Activities

Deploy the Heat Action Platform



Part/Step: Part 4: Make Goals and Strategies
Actionable, Step 1: Benefit-Cost Analysis

Tier: 1

Estimated Time Commitment: Tier 1 could be completed in an estimated 1-2 weeks.
(approximately 5-10 hours).

MOTIVATION

The Atlantic Council Climate Resilience Center's [Heat Action Platform Policy Tool](#) supports communities in evaluating local policy interventions to address heat resilience. The tool helps communities to identify and assess potential interventions based on their benefits and suitability for local contexts.

This tool is especially useful if your community:

- Has limited staff capacity to evaluate interventions.
- Has not previously integrated evidence-based heat interventions into planning or policymaking.
- Is deciding between multiple heat-related interventions.
- Seeks to establish a foundation for more detailed analyses, such as those in tier 2.

OBJECTIVES

This analysis is intended to help you:

- Bring descriptive evidence into heat-related decision-making.
- Explain and frame a local issue by applying evidence from similar contexts.

- Engage agency staff and decision makers (rather than the public or larger community).
- Lay the groundwork for more detailed future analyses.
- Conduct an analysis with a relatively limited time commitment due to using information summarized by this Framework and not incorporating any community engagement.

RESOURCES

- Benefit-Cost Analysis (BCA) Overview

TIER 1 BENEFIT-COST ANALYSIS WORKSHEET

APPLICATION OF THE CLIMATE RESILIENCE CENTER'S HEAT ACTION PLATFORM POLICY TOOL

Inputs

To use the tool, you'll first define three main inputs:

- Is the local **climate** Cold, Hot/Dry, Hot/Humid, or Temperate? ([Map from EIA](#))
- Is the local **density of development** Low, Medium, or High?
- What are “**trigger points**” for local action? Trigger points are [defined](#) as “Opportunities for municipalities to implement risk reduction and preparedness interventions based on the policy lever, building on the United Nations Environment Programme triggers used in the Beating the Heat handbook (2021).” Examples include city planning processes; land acquisition or sale evaluations; major infrastructure projects; and updates to zoning codes.

After you define these three inputs, the tool produces an initial list of interventions that may be appropriate for your community. You can further filter these interventions by type, policy lever, and sector.

Outputs

For each potential intervention, the tool provides a one-page summary, including:

- **Implementation guidance:** Scale, authority and governance, timeline, stakeholders, and funding sources.
- **Considerations for use:** Context-specific factors to keep in mind.
- **Case studies:** Examples from similar communities.
- **Impact and benefits:** High-level summary of the intervention's potential effectiveness.

The tool's outputs include several categories specifically related to benefits of the intervention:

- **Cost-benefit:** Ranked as low, medium, or high.
- **Public good:** Contribution to community well-being (low, medium, or high).
- **GHG reduction:** Potential to reduce greenhouse gas emissions (low, medium, or high).
- **Co-benefits:** Additional positive environmental, social, and economic outcomes from the intervention (beyond heat).

Apply the C40 Heat Resilient Cities Tool



Part/Step: Part 4: Make Goals and Strategies
Actionable, Step 1: Benefit-Cost Analysis

Tier: 2

Estimated Time Commitment: Tier 2 could be
completed in an estimated 8-12 weeks
(approximately 40-60 hours).

MOTIVATION

The [C40 Heat Resilient Cities Tool](#) assists planners and decision-makers to evaluate urban heat adaptation actions and quantify potential heat, health, and economic impacts. The tool can help communities identify the most effective actions and support community proposals for funding and implementation. This tool is a user-friendly spreadsheet that is based on scholarly evidence.

The C40 Heat Resilient Cities Tool is especially useful if your community:

- Is looking to “make the case” for heat-related actions.
- Needs guidance on prioritizing actions with the largest heat, health, and economic impacts.
- Is considering at least one of the three intervention types supported by the tool: urban parks, urban water, and cool and vegetated surfaces.

OBJECTIVES

This analysis is intended to help you:

- Bring quantitative evidence into heat-related decision-making.
- Compare the benefits and costs of intervention(s) with business as usual.
- Explain and frame a local issue by adapting publicly available data and existing tools to a specific decision making process.
- Engage agency staff, decision makers, and the community.

- Lay groundwork for future Tier 2 analyses.
- Identify existing heat disparities; focus analyses and decisions on increasing equity for communities of color, low-income communities, and others who have been historically marginalized.
- Use existing tool(s) that would meet local goals and objectives.
- Provide a process requiring a moderate time commitment. Staff would likely participate in training webinars, review materials, apply existing tools, and facilitate some public engagement.

RESOURCES

- Benefit-Cost Analysis (BCA) Overview

TIER 2 BENEFIT-COST ANALYSIS WORKSHEET

APPLICATION OF THE C40 HEAT RESILIENT CITIES TOOL

Inputs

To perform an analysis, users must input key community-specific and project-specific parameters, including:

- **Basic information:** City, climate zone, start and end years for the analysis, and social discount rate.
- **Action details:** Surface area of the action and broader city coverage targets.
- **Environmental inputs:** Minimum temperature threshold for mortalities, and climate scenarios
- **Social inputs:** Population density, population % by age, population growth, hospital admissions rates
- **Economic inputs:** Average cost of hospitalizations, Value of Statistical Life

The tool offers default values when local data are unavailable, though local inputs improve the accuracy of results.

Outputs

The tool provides detailed benefit estimates for selected urban heat adaptation actions. These outputs include:

- Heat impact (average temperatures, extreme heat days)
- Health impact (reduced mortality, reduced hospitalization)
- Economic impact (value of statistical life, hospital costs)

Policy Landscape Analysis



Part/Step: Part 4: Make Goals and Strategies
Actionable, Step 2: Policy Analysis

Tier: 1

Estimated Time Commitment: 60 minutes

MOTIVATION

Policy landscape analysis is a map of the key players, institutions, and leaders that impact your policy issue. To facilitate the process, it is helpful to craft a concise issue statement that has clear pathways to action and delineating the bounds of what that issue does and does not encompass. It is also helpful to have an understanding of where in the policy cycle your issues can be found in bills, bonds, regulation, etc. in order to develop strategies that are aligned with timing of decisions.

OBJECTIVES

In this activity you will:

- Draft a concise issue statement
- Map the key players involved
- Locate your issue in the policy cycle
- Identify policy pathways to change

RESOURCES

- Policy Landscape Analysis Tables.

Tips:

- Issue areas should be clearly defined and lend themselves to specific policy interventions, not just general programming. The scope of an issue area may be bound by geography, population, sector, or some other unit of analysis. Examples include:
 - Mitigating heat exposure for transit-dependent residents at bus stops.
 - Workplace protections for outdoor laborers in the landscaping industry.
 - Cooling access for unhoused community members during extreme heat events.
- You may want to perform this activity for multiple issue areas. Copy and paste the worksheet content for each issue area you intend to analyze prior to populating the template below.
- Familiarize yourself with the contents of the ‘Policy Landscape Analysis Tables’ before beginning the activity and make any desired modifications to suit local needs.

POLICY LANDSCAPE ANALYSIS WORKSHEET

IDENTIFYING KEY ACTORS AND INSTITUTIONS

Issue Area: Draft a one sentence description of your issue area that includes the specific problem and what needs to change.

{Draft your sentence here}

Activity: Use ‘Policy Landscape Analysis Tables’ to determine who the key stakeholders for your issue area are and brainstorm how they currently or potentially could influence it, whether they support or oppose the issue, and why. Then, sort your responses to compile a key list of stakeholders and institutions in response to the questions below.

Key Leaders: Which individuals are influencing your issue?

- 1.
- 2.
- 3.
- 4.
- 5.

Objectors/Obstructors: Who might oppose or slow down the policy change you are looking to create?

- 1.
- 2.
- 3.
- 4.
- 5.

Key Institutions: Which institutions hold the power on your issue?

- 1.
- 2.
- 3.
- 4.
- 5.

Supporters: Who might support your issue?

- 1.
- 2.
- 3.
- 4.
- 5.

Tracking Policy



Part/Step: Part 4: Make Goals and Strategies
Actionable, Step 2: Policy Analysis

Tier: 2

Estimated Time Commitment: 10-15 hours

OBJECTIVES

In this activity, you will:

- Create a database of existing and proposed laws and programs.
- Create a database of existing funding allocations.
- Identify which laws, programs, and allocations are salient to your community's heat action goals.

MOTIVATION

The heat policy landscape is rapidly emerging. Understanding what laws exist, who is responsible for executing them, and how budgets and programs allocate funds is important for thinking outside the box to plan and implement heat action projects. For instance, you might think of local, state, and federal environmental laws and agencies as you plan heat action in your community, but soon find synergies or barriers in unlikely places like Department of Defense Building Codes or Department of Education Tax Credits. Digging into how funds are allocated across the obvious and not-so-obvious programs puts your community in a position of power to position projects for support. And when no law or funding program exists, tracking which new local, state, and federal bills are being considered and how they fare will help your community meaningfully engage decision-makers to nudge the policy landscape in directions that better support heat action.

RESOURCES

Included in this worksheet, you will find:

- An introductory reading describing policy, regulatory, and funding vehicles across scales and links to resources.
- Tracking Policy Tables.

TRACKING POLICY WORKSHEET

Policy and Funding Vehicle Primer

While cities, counties, and other local jurisdictions have the power to create ordinances (local laws and codes), these laws cannot conflict with state and federal laws. In the event of a conflict, the “higher” jurisdiction’s law prevails. In some states, “home rule” may allow local jurisdictions greater autonomy to create local laws, though what is permitted under home rule varies by state. Regardless, local environmental managers, partners, and advocates should be aware of laws and other policy initiatives at higher scales that may impact local operations and opportunities.

FEDERAL & STATE POLICY LEVERS

Legislation: Highly durable policies that are introduced by the federal or state legislative branch and go through a law-making process.

- [Existing U.S. Code of Laws](#) (by subject)
- [Existing U.S. Statute Compilations](#) (not appearing in the U.S. Code of Laws)
- [Existing U.S. Laws At Large](#) (chronological)
- [Existing Public and Private Laws](#) (recently enacted “slip” laws)
- [Federal Bills Introduced by Congress](#) (House of Representatives and Senate)

Regulations: Less durable policies that are created by federal or state government agencies in the executive branch and go through a public comment and decision process.

Current Agency Regulatory Authority: <https://www.federalregister.gov/agencies>

Federal Regulations Under Review: <https://www.reginfo.gov/public/jsp/EO/eoDashboard.myjsp>

Federal Regulation Public Comment Website: <https://www.regulations.gov/>

Federal Fund and Awards for Spending by Agencies: <https://www.usaspending.gov/agency>

Grants and Programs: Varied federal or state agencies provide grants and other resources to support legislative and agency priorities. In addition to heat or climate mitigation or adaptation-specific grants and programs, there may be less obvious grants or programs that include heat resilience strategies within their allowable projects. Tracking proposed and recently passed federal and state legislation may give some indication of future grants and programs that can finance local heat resilience strategies.

Executive Order: Policies introduced by the President using constitutional or statutory authority; more reversible than legislation but capable of substantial and rapid change to federal operations and

priorities. Current and Past Executive Orders:

<https://www.federalregister.gov/presidential-documents/executive-orders>

Judicial: Judicial decisions can affect regulatory authority and agency interpretation of laws. Find information on supreme court decisions here:

https://www.supremecourt.gov/about/faq_documents.aspx

Appropriations: Funding can be a difference maker. Track how much has been appropriated to different federal actions to different states here:

<https://crsreports.congress.gov/AppropriationsStatusTable>

STATE & LOCAL POLICY LEVERS

State Legislation and Regulations: Most states provide similar resources to the federal government, publishing existing laws and proposed bills in an analog fashion. The National Conference of State Legislatures also compiles a searchable database:

- [NCSL 50-State Searchable Bill Tracking Databases](#)

How to Find Relevant State and Local Rules:

State and Local Government Websites: Many cities and states post their heat-related ordinances, building codes, and emergency response plans online.

OSHA and State-level OSHA Websites: For worker protection rules, visit the websites for individual states' OSHA programs, which may have specific heat safety regulations.

Energy Regulatory Bodies: Visit state energy commissions to learn about energy-related regulations that affect cooling access and affordability.

Local Ordinances: Check local government websites or municipal codes for ordinances related to cooling centers, building codes, and other local heat adaptation efforts.

Plan Updates: Both states and local jurisdictions publish and update various plan types that outline the issuing body's vision, goals, and policies for a specific domain or issue area. In some instances, federal or state law requires updating a plan according to specific intervals around which there may be established rules to vet revisions and additions. These update processes provide opportunities to advocate for and embed heat resilience objectives into authoritative documents. Relevant plan types may include:

- State and local heat-specific plans
- State and local climate action plans

- State and local hazard mitigation plans
- State and local land use and zoning codes

Model Heat Action Plans: A handful of states and an increasing number of local communities have published heat action plans that can serve as a starting point. Some have made toolkits available, see: [North Carolina’s Heat Action Plan Toolkit](#).

Bonds: Bond measures allow state or local governments to borrow money to fund projects they believe will benefit the public. A bond measure may or may not require voter approval (a referendum), depending on the type of bond and the state's laws where the city is located. Designing and passing planned or proposed bond measures is an opportunity to gather community and stakeholder input that may lead to the inclusion of heat resilience-promoting projects in funded projects.

Local Ordinance: An ordinance is a law enacted by a local government that addresses an issue within its regulatory authority, as determined by its state constitution or legislative body. Local ordinances are typically drafted by a city or county agency or official and approved by the local governing legislative body, such as a city council or county board of supervisors. This often involves holding public hearings and debates. Local ordinances are typically organized into a (now digital) directory, often referred to as the “municipal code.” These codes include laws and regulations pertaining to land use, safety, public health, and a range of other topics that govern day-to-day life within the jurisdiction.

- **Code Updates:** Local governments monitor state and federal legislative changes and judicial decisions to ensure their code remains in compliance. They may also conduct formal code updates to reflect the evolving needs of the community and to comply with goals in locally adopted plans or other authoritative documents.
- **Tax Measures:** Local governments may propose and pass issue-dedicated tax measures through voter approval (a referendum). Such laws can be effective in funding local priorities, such as financing heat mitigation measures like urban forestry.

While there is no national database of U.S. municipalities and counties, you may find publicly searchable databases of Codes of Ordinances, City Charter Documents, etc., through City and County Clerk’s Offices and through educational institutions, non-profit, and advocacy groups.

TRACKING POLICY WORKSHEET

Activity: For each issue area you identified in the ‘Tier 1: Policy Landscape Analysis’ worksheet, use the ‘Tracking Policy Tables’ to generate a list of existing laws, regulations, executive orders, etc. on your topic and answer the following questions.

Tips:

- You may want to perform this activity for multiple issue areas. Copy and paste the worksheet content for each issue area you intend to analyze prior to populating the template below.
- Familiarize yourself with the contents of the 'Tracking Policy Tables' before beginning the activity and make any desired modifications to suit local needs.

Once you have compiled your list, answer the questions below.

Existing Policy Levers: What are the existing laws and regulations, grants and programs, plan updates, and ordinances that are most central to your issue? Note any laws, regulations, programs, etc. that have been repealed, defunded, or weakened that may require new local action.

- 1.
- 2.
- 3.
- 4.
- 5.

Proposed Policy Levers: What new laws and regulations, grants and programs, plan updates, and ordinances are being proposed that are most central to your issue?

- 1.
- 2.
- 3.
- 4.
- 5.

Policy Leaders: Which legislators, managers, and/or other decision makers are leading the charge on your issue? List those most applicable to your identified priority heat actions and feasible implementation pathways in your jurisdiction.

- 1.
- 2.
- 3.
- 4.
- 5.

Agencies: Which agencies, departments, or groups have what authority over your issue?

- 1.
- 2.
- 3.

- 4.
- 5.

Funding: What funds are allocated toward your issue?

- 1.
- 2.
- 3.
- 4.
- 5.

Gaps: What aspects of your issue are not addressed by existing or proposed policy levers or may require policy change?

- 1.
- 2.
- 3.
- 4.
- 5.

The Media Quadrant



Part/Step: Part 4: Make Goals and Strategies
Actionable, Step 3: Media Communication

Tier: 1

MOTIVATION

Being able to deliver a clear, concise, and compelling message is key when communicating across all media platforms and channels. Doing so can be difficult, especially when problems like extreme heat and its impacts are complicated and nuanced. The Media Quadrant is a simple exercise that you can use to prepare talking points to deliver a message that the media can use in their coverage of extreme heat.

OBJECTIVES

In this activity you will:

- Become familiar with the media quadrant.
- Select a heat-related issue that you would like to be covered in the media.
- Create a series of talking points using the media quadrant questions.

RESOURCES

- Guiding questions

THE MEDIA QUADRANT

DEVELOPING CLEAR, CONCISE, AND COMPELLING MESSAGES

Activity: In this activity you will consider one heat-related issue that you would like to appear in the news. Answer the following questions and then practice responding to them, ideally with a colleague.

Question 1: What is the problem?

Response:

Question 2: What is a compelling data point or story that highlights the severity of the problem or creates a hook to draw in the audience?

Response:

Question 3: What is the solution to the problem?

Response:

Question 4: How will you contribute to the solutions?

Response:

Reflection: What was most/least compelling about your message and why?

Response:

Part 5 Workbook Activities

Putting it All Together



Part/Step: Part 5: Putting it All Together.

MOTIVATION

Now that you have engaged key implementation considerations, including how to track the progress of and evaluate the effectiveness and feasibility of heat actions, you are ready to develop a roadmap for implementing priority strategies. In this activity, you will define key implementation considerations for the strategies you identified in Part 3 of the Roadmap Workbook. You will then develop a prose document (“Heat Action Blueprint”) that you can use to communicate the new information, goals, and strategies you’ve developed to internal and/or external stakeholders.

OBJECTIVES

In this activity, you will:

- Aggregate information from previous modules.
- Attach evaluation metrics, simple benefit-cost information, policy levers, and communication considerations to strategies identified in Part 3: Prioritize Action.
- Transfer the information collected in the ‘Blueprint Activity: Putting it All Together’ document to your Heat Action Blueprint.

RESOURCES

- Utilize the same 'Blueprint Activity: Putting it All Together' Google Sheet you used in Part 3: Prioritize Action.
- Heat Action Blueprint template.

PUTTING IT ALL TOGETHER

Activity: Use the following instructions to

1. Populate the ‘Blueprint Activity: Putting it All Together’ tables with key implementation considerations for your priority strategies using the data you have collected from Part 4 of the Roadmap Workbook.
2. Then, use the ‘Heat Action Blueprint’ template to transfer your data to a shareable prose document

ADD IMPLEMENTATION CONSIDERATIONS TO PRIORITY STRATEGIES

Step 1: Return to the ‘Heat Action Strategies’ sheet of the ‘Blueprint Activity: Putting it All Together’ tables and consider your subjective Priority Level rankings in Column N. Make any necessary adjustments based on data you’ve gained since completing this list in Part 3: Prioritize Action of the Roadmap Workbook.

Step 2: Use the ‘Part 4: Making Goals and Strategies Actionable’ sheet in the Blueprint Activity tables to add the following to each priority strategy:

- From **Part 4, Step 1:** Indicators for tracking the progress of identified strategies.
- From **Part 4, Step 2:** The costs of inaction and savings associated with each strategy.
- From **Part 4, Step 3:** Key actors, policies, codes, etc., that enable each strategy.
- From **Part 4, Step 4:** Considerations for a strategy-specific communications strategy.

Step 3: Considering heat action strategy-specific implementation pathways may add to your understanding of the effectiveness and feasibility of priority strategies. Return to the ‘Heat Action Strategies’ sheet of the Blueprint Activity: Putting it All Together and consider your subjective Priority Level rankings in Column N once more.

CREATE YOUR HEAT ACTION BLUEPRINT

Populate the Heat Action Blueprint with your priority strategies and relevant information for each to create a shareable strategy document and communication tool. The Heat Action Blueprint template includes a cover page where you can add your community's name, list project team collaborators, and include logos for participating organizations. It also contains a “How to Read Me” section with template language to explain how these strategies were derived from the CHRC Workbook process.

You may wish to revise both the cover page and “How to Read Me” section to reflect how you used the workbook alongside local decision-making processes and additional information that you may choose to include in your Heat Action Blueprint.

Step 1: After revising your cover page and “How to Read Me” page, copy and paste priority strategies from the Blueprint Activity: Putting it All Together into the Heat Action Blueprint using their corresponding goals as a superstructure for your document.

Step 2: For each included strategy, use the information you’ve compiled in the Blueprint Activity: Putting it All Together, relevant Workbook activities, and local sources you may have used alongside the Workbook to populate the following elements in the Heat Action Blueprint template:

Description and Rationale:

- Describe the strategy, including:
 - the problem or need it addresses,
 - where/how the problem or need was identified,
 - and who it will benefit.

Lead Stakeholder(s) and Partner(s):

- In the table, list the lead stakeholders and partners involved in implementation. These may correspond to organizations that have authority or operate in the exposure setting related to the strategy; existing governance structures, including plans, policies, and codes; or those already doing similar work.

Timeline:

- In the table, list a relevant timeline for execution. Depending on your community and your stage in planning for heat, you may already have identified timelines for some strategies. In the absence of already-identified timelines or local engagement processes to identify feasible timelines, you may want to create simple categories. For example, you may wish to categorize strategies as “short term (1-3 years)” and “long term (3+ years)” or some other permutation of mutually exclusive time scales.

Heat Resilience Benefits:

- Use your rankings in the Blueprint Activity: Putting it All Together to populate the following elements with your scores from Part 1: Exposure (Step 1), Priority Exposure Settings (Step 2), Vulnerability (Step 3), and Sociocultural Impacts (Step 4).
 - Copy and paste the symbol provided in the table or another symbol of your choosing in successive columns to correspond to the numeric score for each element.

Implementation Readiness:

- Use your rankings in the Blueprint Activity: Putting it All Together to populate the following elements with your scores from Part 2: Governance Capacity (Step 1), Planning Capacity (Step 2), and Community Engagement Capacity (Step 3).

Next Steps:

- List any identified next steps and who will do them. In many cases, this may be for Lead Stakeholders and Partners to create actionable next steps.
- Include implementation considerations from Part 4 of the CHRC Workbook, including:
 - benefit-cost information,
 - current and anticipated policy levers for implementation,
 - communications and/or engagement needs,
 - other information, as deemed applicable by the project team.

Proposed Indicators:

- List proposed indicators to track progress or measure effectiveness identified in Part 5, Step 5 of the CHRC workbook, and, if available, provide data sources.