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Introduction

This Extreme Heat Toolkit was developed for the Western Adaptation Alliance (WAA), a knowledge exchange consortium of 15 cities in the intermountain southwestern United States. The information below complements information contained in the Extreme Heat Toolkit spreadsheet. As specified in the project proposal, it includes references from literature on the topic, websites, resources (i.e., overall approaches and plans, tools, partnering opportunities, funding ideas, promising practices). Where feasible, the materials are accompanied by descriptions.

The Table of Contents above is hyperlinked, allowing easy movement within the document by holding the ctrl key and clicking on the heading you to which you wish to move. The documents listed can be found in the Extreme Heat Toolkit Resources folder, within the corresponding folder.

Strategies and Promising Practices

Cool Policies for Cool Cities

- http://aceee.org/sites/default/files/publications/researchreports/u1405.pdf
- http://www.georgetownclimate.org/resources/cool-policies-for-cool-cities-best-practices-for-mitigating-urban-heat-islands-in-north-am

Hewitt, V., E. Mackres, and K. Schickman. 2014. Cool Policies for Cool Cities: Best Practices for Mitigating Urban Heat Islands in North American Cities. Report Number U1405. Washington, DC, American Council for an Energy-Efficient Economy and Global Cool Cities Alliance, 53 pp.

Comment: This is a ***substantial resource*** on the Urban Heat Island (UHI). The authors garnered information and surveyed professionals and practitioners in 26 cities, including WAA cities (Denver, Las Vegas, Phoenix). It has a strong orientation toward practical information for urban planning professionals. ***The Appendices are an amazing source for Promising Practices and Policies***: they include rich information on UHI planning documents and websites (Appendix B); City goals and approaches to the UHI (Appendix D-1); a list of implementing agencies, funding sources, and demonstrated impacts (effectiveness) of UHI mitigation (Appendix D-2), Procurement Policies (Appendix D-3), Voluntary policies and programs in place (Appendix D-4), Mandatory policies (Appendix D-5), and UHI Indicators tracked by cities (Appendix D-6).

Excerpt from the Executive Summary:
This report describes UHIs and discusses the ways in which some North American cities mitigate heat and its impacts. Cities experience UHIs differently, so their approaches to tackling UHI-related problems vary. After conducting a literature review, we distributed a questionnaire to local government contacts in 26 North American cities to gather information on their UHI mitigation activities. Their responses constitute a bank of policies, programs, and practices. This report profiles the causes, impacts, mitigation strategies, and social and institutional context of city action.

Heat-mitigation actions are embedded in a broad set of strategies and agency activities. None of the surveyed cities has a plan dedicated specifically to mitigating the urban heat island effect, but each has at least one heat-mitigation strategy integrated into other initiatives. Sometimes such strategies are hidden in plain sight. For example, stormwater management, street tree programs, and green building codes work to mitigate urban heat islands whether or not that is the city's actual intention.

Most cities are implementing both voluntary programs and mandatory policies to reduce excess heat. All but two of the cities we surveyed have established at least one voluntary policy or program for private construction, and three-quarters of the cities have established at least one mandatory private construction policy**. *Rebates are the most popular voluntary policy mechanism; codes or ordinances for cool or green roofs are the most prevalent mandatory policy.***

From the Funding & Budgeting Section (p. 21):
Many of our respondents indicated that the city did not track mitigation expenditures, or that they were so tightly interwoven into other city projects that funding for UHI mitigation within the city budget was not quantifiable.

Local governments are not the only entities funding UHI mitigation programs. Nineteen cities indicated that funding is available from non-city sources such as nonprofit groups, local utilities, philanthropic foundations, or local universities. Many cities partner with groups or foundations dedicated to specific environmental causes. For example, Portland partners with Friends of Trees, Dallas with Texas Trees Foundation, and Los Angeles with CityPlants. Philadelphia's TreePhilly partners with the Tookany/Tacony Frankford Watershed Partnership for tree planting and maintenance programs.

Cities reported additional funding sources. Some cities fund programs with state financial assistance. For example, Pennsylvania state PENNVEST loans funded a $30 million green streets project in Philadelphia. Many cities are served by energy or water utility programs that include funding for UHI mitigation measures. Georgia Power, for instance, offers rebates for reflective roofs. In Baltimore, funds from the Exelon purchase of Constellation Energy funded the construction of 22 cool roofs in 2013.

Sample Figures:

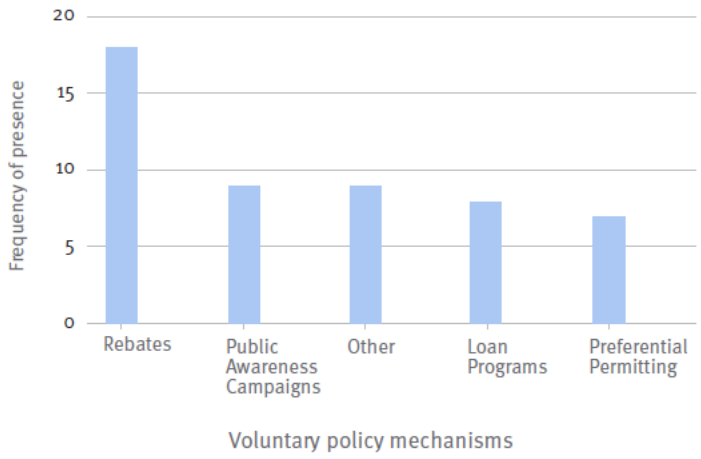
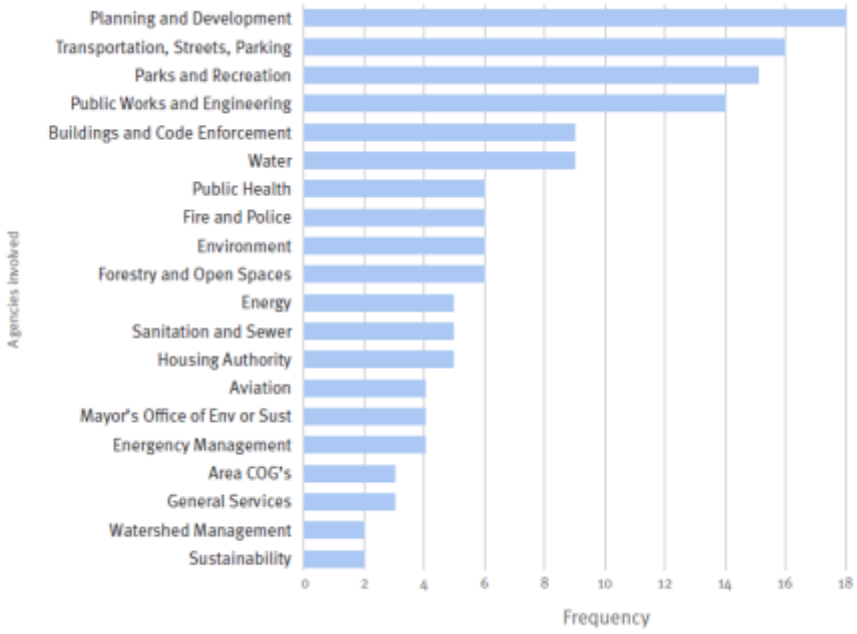


Figure 10: Voluntary policy mechanisms for private construction in surveyed cities (n=26)

Figure 12: Frequency of planning or implementing agencies across all studied cities



Tracked Urban Heat Trends	Cities
Temperature Variation	7
Change in Vegetation	6
Hospital Visits	3
Environmental Public Health	2
Precipitation Rates	2
NAAQS Non-Attainment Days	1
Carbon Emissions	1
Change in Albedo	1

Table 4: Urban heat trends tracked by cities (n=26)

California cool pavements

- http://www.georgetownclimate.org/resources/ca-cool-pavements-research-and-implementation-act-ab-296-2012
- http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120AB296

Assembly Bill 296, the "Cool Pavements Research and Implementation Act," was approved by California Governor Jerry Brown on September 27, 2012. AB 296 calls upon the California Environmental Protection Agency (CalEPA) and the California Department of Transportation (Caltrans) to develop a standard specification for sustainable or "cool" pavements that can be used to mitigate urban heat islands.

Cool pavements absorb less sunlight than conventional pavements, helping reduce surface and air temperatures in cities. Recent research shows that lighter-colored roofs and pavements can reduce smog, cut energy consumption, cool urban areas, and mitigate the impacts of climate change.

The bill requires CalEPA to develop heat reduction strategies with the CA Climate Action Team, and to pursue cool pavement technologies with CalTrans. CalEPA is directed to develop a definition for the term urban heat island effect inclusive of an effect index, and upon completion of an index, develop a standard specification for sustainable or cool pavements.

The specifications for cool pavements will complement and support the existing voluntary standards for cool pavements in the California Green Building Code.

According to a U.S. Environmental Protect Agency (U.S. EPA), a report regarding urban heat islands notes that on a hot summer day, the sun can heat dry, exposed urban surfaces, such as roofs and pavements, to temperatures 50 - 90 degrees hotter than air, while shaded or moist surfaces (often in more rural surroundings) remain close to air temperatures. The report notes that heat island impacts include increased energy consumption, elevated emissions of air pollutants and greenhouse gases, compromised human health and comfort, and impaired water quality. Reducing the heat island effect can includes four measures: increasing tree and vegetative cover, creating green roofs, installing cool (mainly reflective) roofs, and using cool pavements.

Related Organizations:
California Department of Transportation (Caltrans)
California Environmental Protection Agency (CalEPA)
California Climate Action Team (CAT)

Publication Date: September 27, 2012

San Francisco Climate Change

- http://www.georgetownclimate.org/resources/climate-change-hits-home-adaptation-strategies-for-the-san-francisco-bay-area
- http://www.spur.org/sites/default/files/publications_pdfs/SPUR_ClimateChangeHitsHome.pdf

This San Francisco Planning and Urban Research Association (SPUR) report describes the expected impacts of climate change in the Bay Area and recommends planning strategies for local governments and other agencies to adapt to these threats.

To develop this report, SPUR convened a climate change adaptation task force in May 2009 that met for nine months and included different agency and utility stakeholders in San Francisco and the Bay Area, along with engineering, planning and environmental experts. They also conducted focused workshops throughout 2010 to vet strategies and recommendations. This report first presents an overview of the major climate threats to the region and then follows with vulnerability concerns and suggested strategies for local government planning in six areas: public safety and health, transportation, energy, ecosystems and biodiversity, water management and sea level rise.

The report concludes with an action plan, outlining more than 30 strategies for local and regional agencies (e.g. for BCDC, Coastal Commission, MTC) to begin minimizing the region's vulnerabilities to these long-term, potentially catastrophic effects.

Related Organizations:

San Francisco Planning and Urban Research Association (SPUR)

Publication Date: May 2011

City of Philadelphia Cool Block Contest

- http://www.retrofitphilly.com/
- http://www.coolrooftoolkit.org/wp-content/uploads/2012/04/ContestFactSheet_Final.pdf

Approach: Public Participation Contest

Partnership: Dow Chemical (roofing materials)

Greenworks Philadelphia has set a goal of achieving energy efficiency retrofits in 15% of the city's existing housing stock. Philadelphia's historic row homes account for nearly 75% of all housing stock in the city, and many are in need of these services. New homes need them too! On December 17th, 2009, the City introduced legislation requiring that all new no- and low-slope roofs either have a reflective roof or a green roof.

Installation of the winning block's energy-efficiency upgrades have been ongoing since the city celebrated at the block party in June, 2010 – cool roof coatings were applied to all homes on the 1200 block of Wolf Street throughout the summer of 2010 and the insulation and air sealing installation is underway. The winter storms and snowfall Philadelphia has experienced so far in 2011 has slowed things down a bit, but we're still on track to complete all installation by spring.

Hoverter, S. P. 2012. Adapting to urban heat: a tool kit for local governments.
Washington, DC.: Georgetown Climate Center, 82 pp.

Website: http://www.law.georgetown.edu/academics/academic-programs/clinical-programs/our-clinics/HIP/upload/Urban-Heat-Toolkit_RD2.pdf
Website: http://www.georgetownclimate.org/adaptation-tool-kit-urban-heat

Comments: This document focuses on built-environment strategies, including lessening the Urban Heat Island, protecting public health, lowering energy consumption, and providing co-benefits for stormwater management and air quality. The main emphasis is mitigation. The document has *really excellent assessment* of the pros and cons of each mitigation strategy, including economic analysis. They evaluate each strategy in terms of outcome criteria and governance criteria, and this seems especially useful (see sample table, for pavement-based solutions, below).

"Adapting to Urban Heat: A Tool Kit for Local Governments" is designed to help local governments reduce the effects of increased heat on their communities and citizens. It provides an analytic tool for policy makers to consider a combination of four built-environment changes (cool roofs, green roofs, cool pavements, and urban forestry), providing clear criteria for selecting among these approaches. It also examines the roles government can play in pursuing these changes: shaping government's own operations, mandating or providing incentives for private choices, and engaging in public education.

Each of the four main chapters provides decision-making criteria and examples of mandates, incentives, public education programs, and government operations for each strategy. Each chapter also concludes with a set of "no-regrets" policies that local officials may undertake that provide multiple benefits, including public health, air quality, and energy efficiency, in addition to reducing urban heat impacts.

TABLE 15 *Decision-Making and Pavements: Traditional vs. Porous vs. Light-Colored*

Benefit	Traditional	Porous	Light-Colored
Reduce heat	!	+	+
Stormwater management	!	+	!
Upfront direct cost	+	~	~
Long-term maintenance costs	~	!	~
Roadway safety	~	+	~
Strength for heavy use	+	!	+
Use in cold climates	+	~	+
Access for utility work	!	~	!
Environmental concerns with production	~	~	~

Advantageous (+) The choice maximizes benefits and is feasible.
Neutral (~) The choice may present may present mixed advantages and disadvantages.
Disadvantageous (!) The choice maximizes benefits and is feasible.

McInnes, J. A. and J. E. Ibrahim. 2010. Minimising harm to older Victorians from heatwaves: A qualitative study of the role of community-based health profession and carer organisations. Australas J Ageing **29**:104-110.

Comment: This is an academic paper on state-level heatwave response, in Australia. It is worthwhile for the discussion section and Table 2. These make some key points about emergency preparedness and response, some of which is *highlighted*, below. These include the importance of training and annually orienting public organizations, limitations of cooling centers, and extra coordination needed for addressing issues with the homeless population.

The window of opportunity for effective public health interventions is very narrow once a heatwave has commenced. Mortality associated with heatwaves occurs very shortly after peaks in temperature, and heat-related illness can be rapidly fatal, particularly for those who live alone and are unable to seek help. Therefore, strategies for minimising the health burden of heatwaves will ideally include proactive as well as reactive components.

Proactive strategies reported elsewhere include:

- the development of databases of contact information for high-risk individuals,
- pre-summer training for health organisation personnel and the organisation of a network of volunteers to act as 'buddies' for isolated individuals when the hot weather arrives

Proactive measures conducted by Victorian health profession and carer organisations include:

- assessment of living conditions,
- advocacy for the installation of air-conditioners,
- provision of information and advice,
- referral of clients to other support services and
- the incorporation of heat health messages in pre-summer staff training programs.

The Delivered Meals volunteers provide a source of regular social contact, with this service contacting a large number of older people in the community each day. Victoria has the potential to develop registries of high-risk individuals that could be used to target health interventions to those in greatest need. Key issues to be considered before using registries include confidentiality, the development of useful screening tools and evidence that such an intervention is an effective way of reducing population morbidity and mortality.

Reactive strategies reported in use in heatwave plans elsewhere include:

- frequent checking on vulnerable individuals,
- opening of cooling centres and
- the operation of telephone help-lines to provide advice and a referral service.

Reactive measures described in this study only include monitoring of clients for deterioration of health status, and visiting clients more frequently if considered necessary.

The use of 'cooling centres' was considered problematic because many older people still need care while at these centres.

Significant gaps in capacity to minimise harm to the older people from heatwaves that were identified in this study include

- a paucity of outreach programs specifically targeting the homeless,
- difficulty in contacting General Practitioners after-hours and during holiday periods,
- a scarcity of free, publically accessible drinking water and
- a lack of provision of air-conditioning in public housing.
- A need to investigate where older people source information from was identified, and
- the importance of ensuring that information provided is accessible to those who need it most was emphasised.
- That only RDNS [*Royal District Nursing Service – perhaps no U.S. equivalent*] was found to have a program targeting the homeless is of concern because *homelessness is associated with a number of factors that increase vulnerability to heat-related illness including lack of access to shade, drinking water and air-conditioned shelter, limited access to sources of information, economic deprivation and social isolation*.

Adaptation, Operation, and Response Plans

Chula Vista Adaptation Plan

- http://www.georgetownclimate.org/resources/city-of-chula-vista-california-climate-adaptation-plan
- https://sphinx.chulavistaca.gov/clean/conservation/Climate/documents/ClimateAdaptationStrategiesPlans_FINAL_000.pdf?s=41E274A66DDF8D0DC3044C762DF1CF02BDF6AFDB

In 2010, the City of Chula Vista's Climate Change Working Group (CCWG) evaluated the potential impacts from climate change on municipal infrastructure and services, and recommended strategies to adapt to these potential impacts. In October 2010, the CCWG presented 11 recommended Climate Adaptation Strategies (see Appendix A) to the City Council to address climate change vulnerabilities and solutions related to energy and water supplies, public health, wildfires, biodiversity, coastal resources, and the local economy. At the City Council's direction, City staff developed more detailed implementation plans for each of the 11 strategies, which included steps, timelines, and costs. The plans were formally adopted by the City Council in May 2011.

The 11 strategies expand the city's urban forests, incorporate "cool" or reflective roofs, promote gray water and other water reuse, adjust open space management due to climate change and design future development and municipal projects to be resilient to the rise in sea level. Initial implementation of all 11 strategies is planned over a three-year period.

The report provides good examples of mainstreaming climate change adaptation into existing processes and plans. Strategies include updating existing plans such as the City's Emergency Response Plan and Multi-Jurisdictional Hazard Mitigation Plan to include extreme heat events and the appropriate response actions to mitigate the impacts from the events.

Pertaining to sea-level rise, the Climate Change Working Group recommended that Chula Vista amend its land development codes and CEQA guidelines to incorporate climate change related sea-level rise into future development and municipal infrastructure projects' design and review.

Related Organizations:
City of Chula Vista

Publication Date: May 2011

SA Health. 2013. Extreme Heat Operational Plan. Government of South Australia. Version 6.06. January 2013. 37 pp.
Operational Plan:
https://www.sahealth.sa.gov.au/wps/wcm/connect/f5a784004d2dc67da0e0f3f08cd2a4a7/ExtremeHeatOperationalPlan-phce-Jan2013.pdf?MOD=AJPERES&CACHEID=f5a784004d2dc67da0e0f3f08cd2a4a7

Extreme Heat Website:
http://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/protecting+public+health/emergency+management/extreme+heat

Comment: The South Australia Extreme Heat Operational Plan is a state-level plan, with much integration to the municipal level, through reference to the capital city, Adelaide. While some aspects of the plan will not be germane to the United States, due to differences in national and state policy, the document provides a template for coordinated extreme heat planning. Potentially of interest to WAA cities are: coordination mechanisms (e.g., Critical Incident Team, p. 6), a migrant health service (p. 7), integration with ambulance services, explicit temperature triggers for action, adaptive strategies (p. 16-17), summary of local health research needs (p. 19), preparedness measures—including a communication plan and list of fact sheets (p. 22-23), and an Action Plan (p. 31-36). Note, too that there is a companion document, made for public awareness, called the *South Australia Extreme Heat Guide*.

Guidance on critical planning and outreach activities
The following activities are those which the health sector should lead or participate:

- public education, including in health care settings (doctor's waiting rooms and hospital clinics;
- preventative programs;
- provision of health care (especially mental health promotion and primary care) for communities affected by environmental adversity (e.g. drying conditions in rural communities);
- surveillance of disease;
- forecasting future health risks from projected climate change;
- health sector workforce training to attune to climate-related health risks.

In addition to adaptive strategies for the health sector, the *Climate Change Health Check 2020* report also identifies capacity building measures that extend beyond the formal health sector for other agencies and individuals to pursue. These are:

- community education and mass media campaigns to reduce and prevent weather-related health risks;
- disaster preparedness across sectors (and including the 'surge capacity' of the health system);
- early-warning systems for impending weather extremes (e.g. heatwaves, storms);
- neighbourhood support watch schemes to protect those who are most vulnerable;

- enhanced urban planning – green spaces, shade and reduction of the 'heat island' effect;
- climate-proofed housing design (shade, insulation, ventilation); and
- improved water catchments in water-deprived regions.

Health Fact Sheets

Additional information has been developed in the form of fact sheets focusing on specific topics, or for specific audiences. The following fact sheets are available for download from the SA Health website.

- Advice for older people
- Being active in the heat
- Caring for babies and young children in extreme heat
- Caring for older people
- Caring for pets
- Preventing Heat Related Illness – keeping healthy in the heat
- Safe food handling in extreme heat
- Clothing for the heat
- Older children and teenagers
- Physical activity during the heat
- Pregnancy advice during the heat
- Sleeping when it's hot

San Francisco Department of Public Health (SFDPH). 2013. Extreme Heat Response Plan. An Annex to the SFDPH Emergency Operations Plan. San Francisco, CA: SFDPH, 16 pp.

Comments: This document contains a well-articulated plan of action for multiple stages of heat emergency. For WAA cities, aside from the template provided in the operational plan (p. 7-9), some relevant and potentially useful sections include: response and partner agencies (p. 10-11; note: American Red Cross is a key partner), a checklist of Department Operations Center phased activities (p. 13), roles and responsibilities (p. 14-15), and a resource checklist (p. 16).

Additional resource: Populations and Risk Factor Maps for Adverse Health Outcomes from Extreme Heat. This is a 25-page resource of GIS maps of various neighborhood-level heat-health indicators, such as Percentage of Residents Without Access to Regional Transportation, Tree Density per Census Block, Percentage of Residents Without Park Access, Linguistic Isolation, Social Isolation, Residents Living in Nursing Homes, and so on.

Houston Advanced Research Center (HARC), 2004. Cool Houston! A Plan for Cooling the Region. For clean air & quality of life benefits. July 2004. The Woodlands, TX: HARC, 46 pp. http://www.harc.edu/coolhouston

- Ancillary site - http://www.coolrooftoolkit.org/knowledgebase/city-of-houston-code-enforcement-cool-roof-code/

Comment: While it may not seem that a city in a hot, humid environment, like Houston, would have practices and ideas suitable for WAA cities, this plan has much to offer, by way of thorough information on cooling strategies, examples of municipal codes, incentive programs, and partnerships.

*"The **Cool Houston Plan** sets forth actions that will literally change the surface of the region.* While this would appear to be a daunting task, experience and research over the past 10 years has helped define how to make this happen. First, the Plan recognizes that many rooftop and paving surfaces are replaced or resurfaced every year; and that there are specific decision points when the new surface is selected. The Plan targets these decision points and the people likely to make these decisions. Second, the Plan targets those surfaces most likely to change, rather than all surfaces. Residential streets and driveways, for example, are rarely resurfaced. Parking lots, however, are resurfaced or coated fairly often. Building owners and managers generally make these decisions with input from contractors. These decisions can be affected by (1) incentives, (2) regulations, and/ or (3) new information."

"Third, the Plan proposes actions that are economically justified and that provide an additional stream of benefits to the property owner and community. Whether it is new trees or a new roof, the cool technologies in this report are affordable and provide multiple benefits. Trees, for example, not only cool the region, but improve property values, lower air conditioning costs, reduce stress, and help prevent flooding. While this sounds like a paid commercial for a miracle product, trees indeed provide a miraculous set of benefits and services for us."

Goals/Strategies

The document articulates, in great detail, multiple and integrated strategies for addressing the urban heat island effect, through active and passive measures, including the following:

- Cool paving
- Cool roofing
- Cool trees
- Air quality
- Quality of life
- Water

Each section includes descriptive information on

- each kind of solution (e.g., multiple pavement and roofing types, tree height and species types and planting among different land surfaces),
- recommended uses,
- advantages and disadvantages,
- lifecycle,
- reflectance, and

- cost (c. 2004).

The aforementioned information section has language that might be useful for development of documentation for WAA city plans, codes, and outreach to citizens.

There is also an ***implementation plan***, with discussions of incentives, municipal codes, partnerships, and outreach to building owners, managers, and the public.

Contacts and Resources

US Department of Labor Occupational Safety & Health Administration

Website: https://www.osha.gov/SLTC/heatillness/index.html

Comment: This is a fantastic set of resources for informing outdoor workers and others about heat risks. While OSHA may not play well in red states, one can easily adapt the messages in the OSHA resources for other audiences. The employer guides can be adapted for use by businesses in WAA cities. The resources are available in Spanish and, in selected cases, other languages.

The online materials include:

- Educational Resources
- Training Resources
- Using the Heat Index: A Guide for Employers
- Smartphone App
- Translations into Spanish
- Training resources for employers and workers
- Online toolkit, social media toolkit

Additional Resources for Workers and Employers

- OSHA Fact Sheet: Protecting Workers from the Effects of Heat Fact Sheet (PDF*)
- OSHA-NIOSH Heat Illness Info Sheet: Protecting Workers from Heat Illness (PDF*)
- OSHA Safety and Health Topics Page: Occupational Heat Exposure
- National Institute for Occupational Safety and Health (NIOSH) Fast Facts: Protecting Yourself From Heat Stress(2010, April)
- National Institute for Occupational Safety and Health (NIOSH) Workplace Safety and Health Topic: Heat Stress
- Centers for Disease Control and Prevention (CDC) Frequently Asked Questions (FAQs) about Extreme Heat
- National Oceanic & Atmospheric Administration's (NOAA) National Weather Service Heat Index

OSHA Training Resources

OSHA Heat Illness Prevention Training Guide

- *Guide to carry out heat safety training, with lesson plans (tailgate or toolbox talks).*
    - Available in English (PDF*) and en español (PDF*)

Other Training Resources

- Cal/OSHA Heat Safety Training Kit for Employers**

  - Resources available in English, Spanish, Hmong, Punjabi
- Cal/OSHA DVD: Water, Rest, Shade: The Work Can't Get Done Without Them**
  - *DVD available in English, Spanish, Hmong, Punjabi, Mixteco*
- Washington State Department of Labor and Industries Outdoor Heat Exposure (OHE, Heat Stress)**
  - *Resources available in English and many in Spanish*
- ADOSH- Staying Safe while Working in Extreme Heat (Video)
  - Arizona Division of Occupational Safety and Health
- Guide for tailgate training: Heat Hazards in Agriculture (PDF)
  - Labor Occupational Health Program's (University of California, Berkeley, 2008)
  - *Also available en español (PDF)*
- Script for Instructors: Dangers of Heat Stress
  - Farm Safety Association, Inc. (2003)
  - *Also available in en français and en español*
- eLearning Course: Heat Stress Awareness for Construction & General Industry
  - Kentucky Labor Cabinet, Office of Occupational Safety & Health
- Extension Training Module: Heat Stress
  - Ohio State University
    - *Also available en español*
- Fact Sheet: Heat Stress (PDF)
  - Texas Department of Insurance
  - *Also available en español* (PDF)

The following resources are linked beyond the Training Resources page:

- Cal/OSHA Webpage: California Campaign to Protect Outdoor Workers From Heat Illness***
- Cal/OSHA, Division of Occupational Safety and Health (DOSH) Webpage: Heat Illness Prevention***
- Cal/OSHA Heat Illness Prevention eTool***
- Oregon OSHA's Quick Facts for Employees (PDF) (English and Spanish)
- Washington State Department of Labor and Industries Webpage: Outdoor Heat Exposure (OHE, Heat Stress)***
- National Council on Skin Cancer Prevention (NCSCP) Website and "Don't Fry Day"
- Centers for Disease Control (CDC) Sun Safety

California

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Promising practices:

- In the L.A. metro area, they have formed an Inter-county "Healthy Design Work Group" which works on sidewalks, access to green space, low-impact development. Health is the unifying message for this group.
- Dr. Rhoades mentioned that a County Climate Committee (interdepartmental group) has been effective, because many departments (listed below) did not regularly meet or know what each department was already doing. She mentioned that coordination across departments is critical to public health outreach success—a finding that is supported in the literature from various countries, states and cities that have developed explicit heat-health emergency plans. She mentioned that the group is action oriented, and that their inaugural program addresses the Urban Heat Island, through frequently cited measures, such as shade tree plantings, cool roofs and pavements, coordinated emergency response.
    - Departments:
        - Public Health
        - Parks & Recreation
        - Fire Department
        - Beaches & Harbors
        - Internal Services
        - Regional Planning
        - Public Works (responsible for:)
            - Street trees
            - Pavements
            - County buildings
            - Permits for roofs
- *Funding*. Dr. Rhoades also mentioned that the City receives supplemental human resources support through the Americorps Civics Work program. The program funds college grads to work in local government on sustainability issues.
- *Partnership strategy*. The County Climate Committee partners with member departments first. Once the department partnerships are firmly established, they plan to take the program to potential stakeholder organizations, who will then work with community groups.
- *Mitigation-side program*. City of Los Angeles cool roofs ordinance. A non-profit, Climate Resolve, helped pass the cool roofs ordinance. The City worked with industry on developing cool pavements. The City has their own asphalt plants; they are aiming to go to the use of a cool pavement slurry.
- *Key public health messaging*. Hotter temperatures produce more smog, which exacerbates the direct impacts of extreme temperatures. Dr. Rhoades stressed that the Air Quality connection is important.

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Comment: Based on a telephone interview, Dr. Drechsler referred us to multiple websites and publication resources for California.

Websites
Sacramento County: These pages include emergency preparedness manuals. The first page is devoted to heat tips for citizens, and contains links to many resources. http://www.sacramentoready.org/Emergencies/Pages/Heat.aspx The second webpage includes "Are You Prepared? A Guide to Emergency Preparedness for Sacramento County," which has two pages on how citizens can protect against heat-related illnesses (p. 31-32). http://www.dhhs.saccounty.net/PUB/Emergency-Preparedness/Documents/AYP-2011-WEB-English.pdf

Los Angeles: Extreme heat preparedness tips (recognize heat stroke signs, drink lots of water, etc.) and information for citizens. http://www.readyla.org/index2.php?lang=en&cat=disaster_awareness&text=aware_extreme_heat

California (state): http://www.climatechange.ca.gov/climate_action_team/reports/Preparing_California_for_Extreme_Heat.pdf

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Office of Environmental Health Hazard Assessment

Dr. Basu mentioned California's *Preparing for Heat* guidelines. Preparing for Heat is an ongoing work in progress. The fundamental tenets of California policy, as practiced by the state and cities, are: using green infrastructure (LID, cool roofs, green buildings and pavements, shade trees) to help reduce exposure to heat, and identifying and reaching out to vulnerable populations. She, and others at CalEPA, have written extensively on California public health responses to heat waves, such as the ones that occurred in 2006 and 2011. She provided us with her book chapter on Heat Related Disorders, which chronicles the 2006 California heat wave.

Basu, R. 2015. Heat-Related Disorders (draft of "Disorders Related to Heat Waves" p. 87-96).*in* B. Levy and J. Patz, editors, Climate Change and Public Health. New York: Oxford University Press.

Comment: This is an academic book chapter, that gives an overview of illnesses and deaths related heat waves, including direct and indirect causes of heat-related deaths and illnesses.

Perhaps the most valuable information is in statistics related to numbers of deaths and the costs associated with heat waves. Dr. Basu devotes part of this book chapter to vulnerable populations, including farm workers, pregnant farmworkers, and athletes. I have included, below, an excerpt related to public health measures for addressing heat wavers.

Some short-term solutions that have proven to be successful during a heat wave include checking on elderly individuals, especially those living alone, providing information on cooling centers, and providing transportation to them as needed. Longer-term goals may consist of establishing heat wave warning systems, making cool environments available (through air conditioning, shaded dwellings, or other means), public education, planting trees and other vegetation in well-placed areas, modifying the built environment to provide proper ventilation, and using materials and lighter colors that reduce heat build-up and optimize thermal comfort.

Arizona

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Comment: Dr. Manos has developed a fact sheet, entitled "The Heat is On: June's Our Hottest Month and the Most Dangerous for Heat Emergencies," for public information in southern Arizona. In plain language, the fact sheet covers basic facts about emergency room visits and deaths, it emphasizes June, the deadliest month, and it covers key points on how people can stay safe as summer temperatures rise.

Key practices mentioned in the document include: frequent hydration, interactions between prescription medicines or alcohol and dehydration, the special case of automobiles as death traps, and the necessity of checking on neighbors, friends, family, and those with limited mobility.

Dr. Manos is in the midst of conducting substantial research on climate-related public health risks in southern Arizona, and developing a public health climate adaptation plan for Pima County.

Matthew Roach, Ph.D.

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Arizona Department of Health Services Public Health Resources.

This includes a heat surveillance report, heat emergency response plan, heat safety resource guide, brochures, cooling center maps and more.
http://www.azdhs.gov/phs/oeh/extreme/heat/illness.php

Effectiveness of Public Health Actions:
Evaluation of cooling centers in Maricopa County, AZ. This is a joint project with Arizona State University and Maricopa County Department of Public Health (lead agency). Presentations regarding this work:

- American Meteorological Society - https://ams.confex.com/ams/95Annual/webprogram/Paper266065.html
- Additional promising practices in Arizona can be found here : https://ams.confex.com/ams/95Annual/webprogram/6HEALTH.html

Climate and Health Profile for Arizona. This includes key references, partnerships, and current practices. The work involved in this report builds on CDC's Building Resilience Against Climate Effects Framework. More reports about the framework are going to be published over the next few years for Arizona. https://sustainability.asu.edu/news/archive/new-report-details-effects-of-changing-climate-on-arizonans-health.

Other references:
Association of State & Territorial Health Officials – EPHT Fellowship Page 12:
http://www.astho.org/Environmental-Health/Tracking-Environmental-Health-Hazards/Tracking-Progress-Improving-Health-Electronic-Report/

American Public Health Association – Adaptation in Action: Grantee Success Stories from CDC's Climate and Health Program
https://www.apha.org/~/media/files/pdf/topics/environment/adapt_in_action.ashx

Publications

American Public Health Association (APHA). 2015. Adaptation in Action: Grantee Success Stories from CDC's Climate and Health Program. March 2015. Washington, DC: APHA, 16 pp.

Website: http://www.cdc.gov/climateandhealth/pubs/adaptation-in-action.pdf

Comment: This document briefly outlines state and city public health initiatives from CDC's BRACE (Building Resilience Against Climate Effects) grant program. For WAA cities, there are links to city-based programs (San Francisco and New York City), and highlights of the Arizona program, including reference to Arizona's statewide heat emergency communication plan. A notable achievement of the San Francisco initiative is the development of a city-specific heat vulnerability index, which pinpoints risks on a neighborhood-by-neighborhood basis.

This website has documents related to San Francisco's heat health plan - http://www.sfhealthequity.org/component/jdownloads/viewcategory/42-climate-change?Itemid=62

Useful documents include GIS maps with heat risk indicators, vulnerability assessments, and planning documents.

Arizona

Chuang, W-C., A. Karner, N. Selover, D. Hondula, N.Chhetri, A. Middel, M. Roach and B.Dufour. 2015. Arizona Extreme Weather, Climate and Health Profile Report. A report prepared for Arizona Department of Health Services and the United States Centers for Disease Control and Prevention Climate-Ready States and Cities Initiative. http://www.azdhs.gov/phs/oeh/documents/arizona-extreme-weather-climate-and-health-profile-report-2015-executive-summary.pdf

Comment: This document reports on Arizona's participation in the U.S. Centers for Disease Control and Prevention BRACE (Building Resilience Against Climate Effects) program. The report has valuable information on vulnerabilities to climate factors, with an emphasis on extreme heat. The report also contains detailed information regarding projections of future climate and changes in heat risk factors. Particularly useful are: Table 3, a detailed list of indicators of heat vulnerabilities, and Table 6, a list of collaborators. The vulnerability analysis does a great job of illustrating connections between climate and specific health outcomes, and the analysis highlights vulnerable places and populations in Arizona.

Excerpt from the Vulnerability Analysis: Vulnerability to extreme heat events - Human vulnerability to extreme or excessive heat events (EHEs) involves more than physical exposure. It also involves individual and population sensitivity to EHEs and adaptive capacity. Sensitivity depends on the underlying characteristics of a population, such as age and ethnicity, while

adaptive capacity reflects the capability of a system, population, or individual to cope with changes. The interdisciplinary team has identified the characteristics that make populations vulnerable to heat, as well as the locations (i.e., the places in which vulnerable populations congregate) where interventions are most needed. Reviews of this work show that low-income groups, African Americans, Latino Americans, Hispanic Americans, Native Americans, people with weak social ties, infants, the elderly, and those without access to air conditioning, are among the groups that usually suffer the effects of heat stress at rates that exceed those found in the general population.

Promising Practices

Heat safety toolkits

Arizona Department of Health Services (ADHS) has developed Heat & Outdoor Worker Heat Safety Toolkits targeted at three populations susceptible to heat illness (older adults, children, and outdoor workers) in partnership with the Arizona Division of Occupational Safety and Health. A Heat & Older Adult Heat Safety Toolkit also has been developed in partnership with the Arizona Governor's Office on Aging; and a Heat & School- Age Children Safety Toolkit has been created in partnership with Safe Kids Arizona.

Excerpt on Heat Risk Factors of Particular Importance to Arizona

A particular challenge facing Arizona is that, in many parts of the state, *extreme heat occurs as a chronic, rather than episodic, hazard with dangerously high temperatures persisting throughout the warm season (Harlan et al. 2014). Continual high nighttime lows do not allow the body to recover from the daytime heat, if no access to cooling is available.* Vulnerable populations are at particular risk when nighttime temperatures remain high, as they typically do for several consecutive days in the summer in Arizona. The worst impacts of EHEs will likely be felt in urban areas, where large numbers of vulnerable people reside, urban heat island effects exist, and air quality is more likely to be poor (Revi et al. 2014).

Specifically, Latinos became increasingly vulnerable to heat stress while the number of vulnerable whites decreased because of both demographic shifts and intensified UHI effects in traditionally minority neighborhoods.

Physicians for Social Responsibility. 2015. Citizen's Guide for Readiness for Climate Extremes in the Desert Southwest. Contributors: B.H. Warren, D. Schaller, D. Branch-Gilby, K. Altman, CSSW "Building Resilient Neighborhoods" Work Group, Good Neighbor Ventures. 55 pp. http://www.psr.org/azclimate

Comment: This guide book is aimed at neighborhood-level preparedness and response to heat-health emergencies. The section on "Assess and Assure Your Readiness" (pp. 14-19) includes assessment resources for developing a plan. "Building a Resilient Home and Neighborhood" (pp. 20-29) includes public health information for individuals and households. The guide is readymade for the low desert parts of Arizona, and provides a good template for a neighborhood level resource.

Australia

Price Waterhouse Coopers. 2011. Protecting human health and safety during severe and extreme heat events: A national framework. Department of Climate Change, Commonwealth Government (Australia).

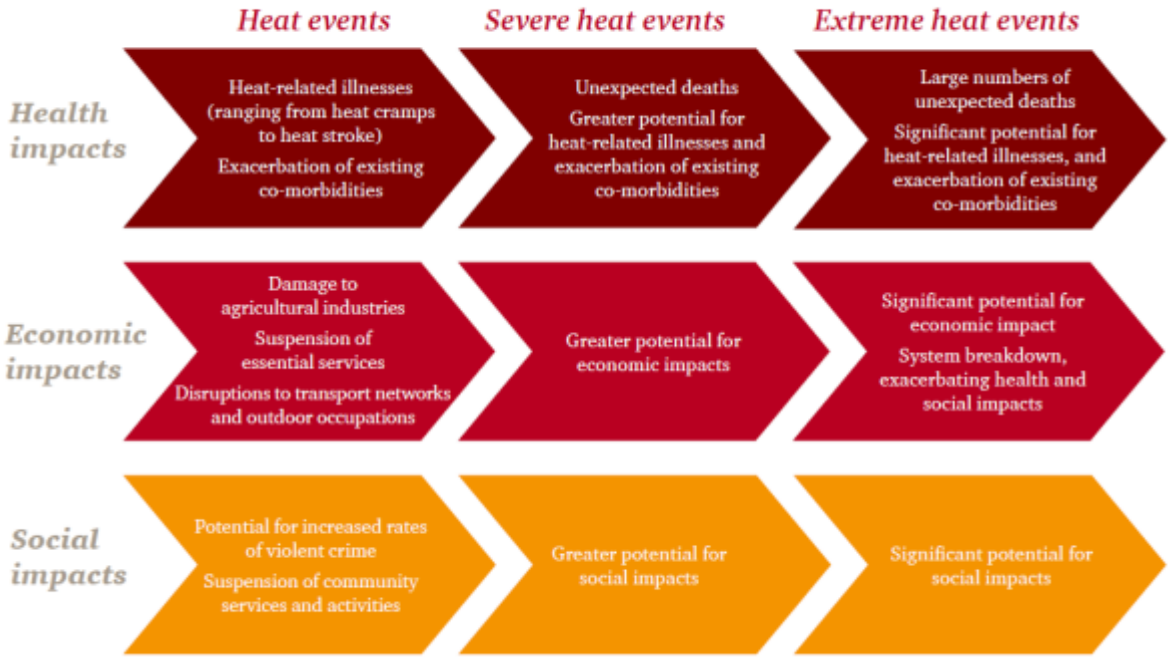
Comment: This Australian national planning document is valuable for its broad overview of a comprehensive extreme heat-health plan. It includes examples from public health, economic assessment, social impacts, and the cascading and intersecting impacts of extreme heat, power infrastructure, water management, and public health. The document also includes examples of measures to mitigate extreme heat (e.g., green roofs, use of highly reflective building and paving materials, etc.). We have included some sample tables and figures, to illustrate parts of the document.

Good Practice Summary

- *A statewide (or jurisdiction-wide) focus*
- *The nomination of a 'hazard leader' (responsible agency)*
- *Real-time surveillance of heat-health impacts*
- *Recognition of regional differences (even within a city)*
- *Focusing on those most at risk (vulnerable populations)*
- *Provision of technical guidance (in-house departmental guidance, in-house education, public education and outreach)*

Illustration of the multiple and intersecting impacts of extreme heat events

Figure 4: Continuum of heat events and their impacts



Indirect impacts that severe heat events can have on human health and safety include:

- *Infrastructure failures* – heat events can disrupt electricity supply and public transport networks, impeding the ability of individuals to manage prolonged high temperatures. As the Victorian Government notes, 'power outages will impact on people's ability to run air conditioners and public transport disruptions will hinder people's ability to reach a cooler location.'
- *Reduced community capacity to respond to heat events* – during periods of high temperatures, there is increased demand for ambulance and hospital emergency services. 'As a heatwave continues the capacity of these services to meet such high demand is often seriously compromised, potentially resulting in extended response times, overstretched or even non-existent services.'
- *Health and wellbeing of support services* – it is important to recognize that, during heat events, a number of basic public services still need to be provided. Indeed, demand for some services – such as health and emergency care and emergency track work (i.e., replacing buckled rail lines) – is likely to increase due to a heat event. Staff providing these services may face a range of adverse health effects caused by prolonged exposure to high temperatures. The relevant organizations also face challenges in ensuring they have sufficient occupational health and safety procedures in place to uphold the health and wellbeing of their workforce, while continuing to provide an appropriate level of necessary services.

Social impacts: Heat events can have a range of social impacts. Unfortunately, researchers have not examined these impacts to the same level of detail as health and safety impacts. Social impacts that the literature and stakeholders have highlighted include:

- There is considerable evidence to suggest there is a link between heat and crime, although the topic is still subject to debate. It has been suggested that there is an increase in aggressive crimes in hot weather, such as: rioting and civil unrest; higher levels of street violence, attacks and homicide; road rage; and domestic violence. Simister and Cooper suggest that unusually hot days trigger an increase in the production of stress hormones (particularly adrenaline). This can result in aggression, leading to observed increases in violent crime.
- Home and work security has the potential to be compromised, as people leave windows open in an attempt to cool their houses and workplaces.
- Some stakeholders have noted a potential for the closure of community social activities as a result of high temperatures, although literature on this topic is sparse. Stakeholders have also suggested the potential for business closures, with resultant knock-on effects for owners and employees, especially in low-income areas. Low-income households that rely on air conditioning might suffer economic hardship because of large energy bills.

Note the following tables, as they may be particularly useful for public health outreach, and city planning for public health emergencies

- Table 6: Physiological factors that can affect an individual's vulnerability to heat events
- Table 7: Contextual factors that can affect an individual's vulnerability to extreme heat events

- Table 13: Key mitigation areas identified and the respective priority areas
- Table 14: Design aspects to decrease exposure to high temperatures

Public Health Emergency Planning Lessons:

- Developing a register of at-risk individuals and developing methods to 'check-up' on their health status appears to be an effective tool to mitigate adverse impacts during heat events.
- Consideration should be given, however, to managing the costs of establishing and maintaining a register and the privacy of at-risk individuals. Some jurisdictions, for example, may wish to create a centralized register while others may prefer to use existing arrangements at the local level.
- Consideration should also be given to ensuring phone check-in services are coordinated and avoid unnecessary overlap. Stakeholders highlighted that, in some cases, phone check-in services can become counter-productive if at-risk individuals are contacted too much by different agencies/individuals.
- Opportunities exist to explore innovative adaptations of such phone systems through advanced technology.

California

Bedsworth, L. 2008. Climate Change and California's Public Health Institutions. November 2008. San Francisco, CA:Public Policy Institute of California, 24 pp.
http://www.ppic.org/content/pubs/report/R_1108LB3R.pdf

Comment: This 2008 publication is valuable, because it discusses four major climate challenges for the public health sector: heat, air pollution, infectious disease, and wildfires. In each section, the author includes primary adaptation measures. There is a section on "constraints on state and local public health agencies." ***For WAA cities****, perhaps the most important section of this document is* ***Table 2****, which shows the phases of* ***San Diego County's Excessive Heat Response Plan, triggers associated with each phase, associated actions, and responsible institutions***.

Primary Adaptation Measures for extreme heat: "For public agencies, the primary adaptation measure to deal with extreme heat is a heat emergency plan and accompanying outreach and assistance for vulnerable populations. Such plans are typically prepared by local government agencies, and they have been shown to be effective in reducing mortality due to extreme heat (Ebi et al., 2004). Heat emergency plans are also implemented at the local level, but involve coordination with state agencies and other non-profit groups."

Brown Jr, E. G., M. Rodriquez, and R. Chapman. 2013. ***Preparing California for Extreme Heat.***

http://climatechange.ca.gov/climate_action_team/reports/Preparing_California_for_Extreme_Heat.pdf

Comment: This is a state-level document, which may not seem to have applications suitable for municipalities. However, the document illustrates government partnerships and program coordination needed to develop an effective, integrated strategy for adapting to extreme heat.

Climate Action Team's Public Health Workgroup convened the Heat Adaptation Workgroup

- Co-chaired by California Department of Public Health, and California Environmental Protection Agency, it includes staff from multiple agencies
    - They obtained temperature data from Cal-Adapt (http://cal-adapt.org/) a web-based adaptation planning tool developed by California Natural Resources Agency, the California Energy Commission, and the UC Berkeley Geospatial Innovation Facility
    - Agencies – *Note the comprehensive coordination*
        - Business, Transportation and Housing Agency (BTH)
        - California Air Resources Board (CARB)
        - California Department of Forestry and Fire Protection (CAL FIRE)
        - California Department of Public Health (CDPH)
        - California Department of Transportation (Caltrans)
        - California Governor's Office of Emergency Services (Cal OES)
        - California Energy Commission (CEC)
        - California Environmental Protection Agency (Cal/EPA)
        - California Natural Resources Agency (CNRA)
        - California Public Utilities Commission (CPUC)
        - Department of Community Services and Development (CSD)
        - Department of Water Resources (DWR), Office of the State Climatologist
        - Division of Occupational Safety and Health (Cal/OSHA)
        - Governor's Office of Planning and Research (OPR)
        - Lawrence Berkeley National Laboratory (LBNL), Urban Heat Island Group
        - National Weather Service (NWS), Sacramento Weather Forecasting
        - Office and Western Region Headquarters, Salt Lake City
        - Office of Environmental Health Hazard Assessment (OEHHA)

Section on Climate Change and Projections of Future Temperature

- Includes a description of the characteristics of extreme heat waves
- Projections for temperatures, extreme heat days
- UHI and the built environment, which specifically mentions
    - Shading
    - Green building standards
    - Cool roofing
    - Energy efficient measures for houses and small commercial buildings
    - Management and restoration of parks and riparian zones in urban areas
    - Cool pavements

Section on Health Effects from Heat

- Illnesses
- Populations at risk

- Air conditioning: a dilemma
    - AC – energy demand/energy grid trade-offs
    - Cost of air conditioning and unequal access to AC
    - *Energy emergency alerts (from CA Public Utility Commission – used during heat waves and wildfires threaten energy grid conditions) request that public set their thermostats to 78°F or higher, during peak periods, but public health officials encourage vulnerable populations to use and seek protection of AC*
    - Air Quality and Heat Exposure

Recommendations

- These are mostly generalized recommendations, but some refer to specific codes, and they identify the responsible agencies, local or regional governments, and stakeholders for implementing the recommendations. They also specify *lead agencies*. Recommendation sections include:
    - ***Heat Resilient and Cooler Communities***. This section includes recommendations for
        - updating building energy efficiency standards,
        - indoor air quality, urban pavement specifications,
        - tree planting and vegetation management.
        - Also development of an urban heat island effect index *"that would allow the cities to set quantifiable goals for heat reduction, including means to measure heat and GHG reduction benefits of various cool or sustainable materials strategies."*
    - ***Preparedness and Response to Extreme Heat Events***. This section includes recommendations for
        - assessing and updating state, regional and local hazard mitigation plans,
        - improving heat-health alert warnings (in coordination with the National Weather Service),
        - improving community resilience (e.g., improving social infrastructure with "places and organizations that foster social cohesion and support"), and
        - improve outreach strategies for communicating risks,
        - various energy system assurance measures,
        - improving access to indoor cooling strategies (e.g., by coordinating with the energy emergency alert program to create a unified message).
    - ***Public Health and Health Care Sector Readiness***. This section includes recommendations for
        - increasing the health care system's extreme heat preparedness and resiliency,
        - improving heat-related illness and death surveillance (i.e., to improve understanding, monitoring and improving early warning).
        - Also, *"[c]ontinue discussions with state public health department personnel and the national Council of State and Territorial Epidemiologists regarding making heat death and/or illness a reportable condition,"* which would aid in surveillance measures, evaluation of interventions, and garnering support.

- ***Measures to Protect Workers at Risk of Extreme Heat***. This section includes recommendations for
  - evaluating the effectiveness of regulations on heat illness prevention standards,
  - augment worker training in outdoor work industries (e.g., to include assurance of adequate water, shade, breaks), and
  - evaluate effectiveness of engineering and administrative controls to mediate employee exposures to high heat.
- ***Research Needs***. This section includes recommendations for research on
  - identifying characteristics of vulnerable populations,
  - adaptation strategies, occupational health risks,
  - *"strategies that could provide protection against heat and air pollution to vulnerable populations that are not based on energy intensive air conditioning,"*
  - urban heat island quantification,
  - heat warning systems,
  - urban tree canopy analysis.

Sacramento County Department of Health and Human Services. 2011. Are You Prepared? A guide to emergency preparedness for Sacramento County. May 2011. Sacramento: Sacramento County Public Health, 48 pp.

Comment: This document is a generic guide to emergency preparedness. The pages on heat-related illness (pp. 31-32), have checklists for protecting against heat-related illness, the special vulnerability of older people, and how to help someone with heat-related illness. These are written in an easy-to-read manner. They include a brief sidebar on "protecting your pets from heat," which may seem trivial, but concern about pets often precludes individuals from seeking extreme heat relief at public cooling shelter facilities. Also, generic information on community and workplace preparedness (pp. 10-11) may be useful for helping personnel in a WAA city from reinventing the wheel as they write preparedness documents.

Michigan

Cameron, L., M. Stanbury, R. Wahl, and S. Manente. 2011. Michigan Climate and Health Adaptation Plan (MICHAP). 2010-2015 Strategic Plan. Michigan Department of Community Health, Division of Environmental Health.
http://www.michigan.gov/documents/mdch/MDCH_climate_change_strategicPlan_final_1-24-2011__343856_7.pdf

Comment: The Michigan Department of Community Health has assembled an impressive array of public health materials, based on projects funded by the Association of State and Territorial Health Officials (ASTHO), and the Centers for Disease Control and Prevention. Two very useful aspects are the extensive description of their strategic planning process to develop an adaptation

plan, and the section of the plan related to extreme heat events. In addition, the State of Michigan has developed extensive related materials, including an evaluation of implementation of the plan, a facilitator's guide for heat-health workshops, a report on public health climate change indictors, a public information brochure on extreme heat, and other documents. Michigan, like Arizona, is one of the CDC BRACE pilot project states.

Excerpts from the Climate and Health Adaptation Plan
A set of collective **core beliefs** emerged from participants in the two planning sessions; these underlie the group's goals and strategies expressed in the final strategic plan:

1. Actions must be sustainable within each organization's resources and within their community resources.
2. Work must acknowledge the need for environmental justice, recognizing that the most vulnerable populations experience the greatest impacts from environmental and health events.
3. Coordinated efforts on all levels of government, social services and research must occur for any long-term success in managing the effects of climate change on human health.
4. Land, water and air misuse impact human health.
5. By addressing climate change we are protecting human health.

Three plan **goals** followed from these core beliefs:

1. Climate change is recognized as a public health issue & integrated into public health practice. (Currently, climate change and its public health impacts are not understood or appreciated.)
2. Public health agencies will have the tools, resources, and activities to respond to climate change impacts within existing programs. (Public health programs currently deal with many of these health impacts, but lack resources to respond adequately).
3. Vulnerable populations are to be explicitly considered in programs and policies addressing climate change impacts. (Public health systems are not sufficiently prepared to identify and respond to disproportionate impacts on vulnerable populations).

Theme 3: Organize, plan and implement a response, (focused on improving emergency planning for ***Heat Events***):

1. Revise heat action levels and improve early warning systems and communications.
2. Incorporate heat events in public health response plans, including establishment of cooling centers, transportation to centers, and provision of air conditioning and emergency power.
3. Conduct surveillance for heat related illness in Michigan.
4. Emergency planning for heat and other events should also addressing ongoing emergency needs of those who are especially vulnerable due to chronic diseases.

Minnesota

Minnesota Department of Health (MDH). 2012. Minnesota Extreme Heat Toolkit.
Minnesota Climate and Health Program. Environmental Impacts Analysis Unit. June 2012. St.

Paul, MN: Minnesota Department of Public Health, 43 pp.
http://www.health.state.mn.us/divs/climatechange/

Comment: This is a superb, comprehensive resource on extreme heat and public health risks. Even though it was developed for Minnesota, a state with a vastly different climate than that of WAA cities, the information in the Minnesota Extreme Heat Toolkit is extremely relevant, except for some specifics pertaining to the weather and climate of Minnesota (Chapter 1). The document is accompanied by 11 Appendices, many of which could be valuable to WAA cities and stakeholders – e.g., Draft language for heat response plan (D-1), Exteme heat tip sheet for individuals (E-1), Mapping 101: Joining census data for beginning GIS users (G-1). Within the Minnesota Extreme Heat Toolkit document, some potentially useful sections include:

- Table 1 – National Weather Service Definitions of heat watch, advisor, and warning;
- Table 2 – Heat illnesses and their symptoms;
- Chapter 2 – the section on Characteristics that increase the risk of heat-related illness;
- Chapter 3 – Preparing for Minnesota Extreme Heat Events, including Key Steps for Planning for and Responding to an Extreme Heat Event, Developing a heat response plan, Additional strategies to prevent heat-related illnesses (see Table 4 - Checklist of response plan elements and strategies implemented by Olmsted County and the City of Minneapolis).

In addition, the Minnesota Department of Health website has a Powerpoint presentation that is a good model for communicating about extreme heat warning, planning, and risk management.

Table 3: Characteristics that increase the risk of heat-related illness

Demographic characteristics, social/behavioral factors, and geography/location may affect the ability of an individual to maintain normal body temperature and stay hydrated.

Demographic characteristics

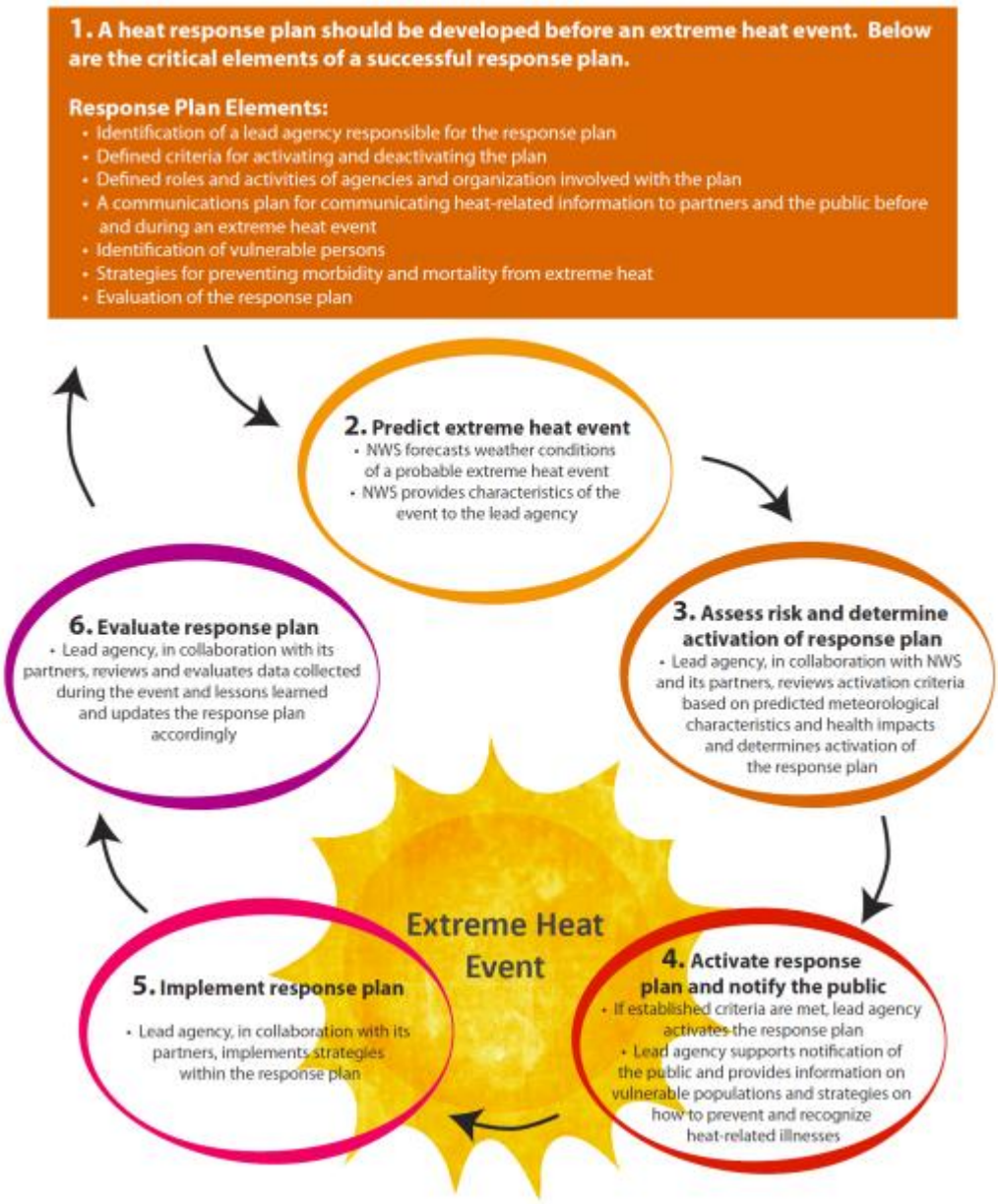
- Age-Older adults: persons 65 years old or older
- Age-Children: children ages five years and younger (including infants)
- Economic constraints: persons living at or below poverty line
- Persons with pre-existing diseases or mental health conditions
- Persons on certain medications

Social/Behavioral factors

- Social isolation: persons living alone, especially the elderly
- Prolonged exposure to the sun
- Use of alcohol

Geographic/location factors

- Living in urban areas
- Lack of air conditioners
- Living in top floor apartments
- Living in nursing homes/bedridden



Key Steps for Planning for and Responding to an Extreme Heat Event (detailed description is available in the document)

1. Create a heat response plan
2. Predict extreme heat event and transfer information to lead agency
3. Assess risk and determine activation of response plan
4. Activate response plan and notify the public
5. Implement response plan
6. Evaluate response plan

The document has excellent step-by-step advice for developing a heat response plan. For a quick overview, see the checklist in Table 4.

Oregon

Ready for Change: Preparing Public Health Agencies for the Impacts of Climate Change. A Climate Masters Guide for the Public Health Sector. May 2010. 43 pp.

Comment: The guidance on extreme heat in this document (pp. 17-20) contains a stripped-down version of steps that public health officials can take to minimize risk of heat stress among employees and the public, and a bulleted-list of elements for a heat-health response plan.

Texas

Houston Advanced Research Center (HARC). 2009. Dallas Urban Heat Island. Dallas Sustainable Skylines Initiative. Prepared by Houston Advanced Research Center. Prepared for U.S. Environmental Protection Agency. The Woodlands, TX: HARC, 80 pp.

Comment: This report focuses on Urban Heat Island mitigation. Of possible interest to WAA cities is the information on funding, incentives, public outreach and education, policies, and regulations.

The Dallas Urban Heat Island report articulates the city's urban heat island situation, and strategies for addressing the UHI, including:

- Expanded use of trees and vegetation (p. 30)
- Cool and green roofs (p. 50)
- A combination of paving strategies, LEED standards, and stormwater management (p. 71)

Utah

Resource Contact (recommended by Matt Roach, Arizona Department of Health Services): Victor Alaves is interested in heat preparedness work. Victor is an Environmental Quality and IH Program Administrator with the Environmental Health Division at the Salt Lake County Health Department. (VAlaves@slco.org)

World Health Organization (WHO). 2008. Heat-Health Action Plans Guidance. F. Matthies, G. Bickler, N. Cardeñosa Marin, and S. Hales (eds.). Copenhagen: WHO Regional Office for Europe, 45 pp.

Comment: The WHO Heat-Health Action Plans Guidance document is another superb resource for developing or co-developing preparedness plans in conjunction with public health agencies

and other collaborators. The publication begins with an easy-to-read background on extreme heat medical risks and vulnerable populations. ***Chapter 3***, a key resource for WAA sustainability directors, lays out the steps for developing heat-health action plans, from heat-health warning (which depends chiefly on coordination between meteorological forecasts [e.g., National Weather Service] and public health officials) to preparedness of various agencies and individuals, to urban design factors to mitigate heat, to evaluation and improvement of heat-health plans and processes. This brief document is rich in content; it covers slightly different ground than the 2015 WMO-WHO *Heatwaves and Health: Guidance on Warning-System Development*, which focuses a lot on the warning system sub-part of heat-health planning.

Some key points:

1. Vulnerable population groups include the commonly referred to elderly, people with chronic diseases, and people whose socioeconomic status makes them more vulnerable. This document reminds us that those who work outdoors are also at risk. The document also highlights the interaction between heat and air pollution, which may increase health risks.
2. Among the excellent list of general principles applicable to heat-health action plans (section 3.1) are:
    - Use existing emergency warning systems and response arrangements
    - Be broad – use a multi-agency, multi-sector approach
    - Communicate effectively, which includes having a risk communication plan, fostering dialogue (rather than one-way communication), understanding public perceptions, developing trust with the public, building capacity, and monitoring and evaluating communication.
    - Ensure that responses to heatwaves do not exacerbate other risks
    - Evaluate the effectiveness and appropriateness of the plan
3. The document contains 10 appendices, which have excellent heatwave public health response information.

Core elements of heat-health action plans:

1. **agreement on a lead body** (to coordinate a multi- purpose collaborative mechanism between bodies and institutions and to direct the response if an emergency occurs);
2. **accurate and timely alert systems** (heat–health warning systems trigger warnings, determine the threshold for action and communicate the risks);
3. **a heat-related health information plan** (about what is communicated, to whom and when);
4. **a reduction in indoor heat exposure (medium- and short-term strategies)** (advice on how to keep indoor temperatures low during heat episodes);
5. **particular care for vulnerable population groups**;
6. **preparedness of the health and social care system** (staff training and planning, appropriate health care and the physical environment);
7. **long-term urban planning** (to address building design and energy and transport policies that will ultimately reduce heat exposure);
8. **real-time surveillance and evaluation**.

The document goes into great detail about these eight core elements, with good examples highlighted within the content.

The extensive evaluation section (3.2.9, p. 24-29) gives excellent information on the core elements of both process and outcome evaluation, minimum standards for these evaluations, and the challenges of evaluation.

- Process evaluation looks at whether messages were timed well and reached key populations, as well as the degree to which participating organizations found the plan to be helpful.
- Outcome evaluations look at public health outcomes (illness, death) and non-health outcomes, such as public work productivity or absence during a heatwave, and changes in health behavior.

World Meteorological Organization and World Health Organization (WMO/WHO). 2015. Heatwaves and Health: Guidance on Warning-System Development. G.R. McGregor, P. Bessemoulin, K. Ebi and B. Menne, (eds.). WMO-No. 1142. Geneva: WMO, 96 pp.

Comment: This is a really excellent, comprehensive and detailed resource for developing a Heat-Health Warning System. The only problem with the document may be the level of technical detail (e.g., Chapter 3 – Assessment of Heat Stress, some parts of Chapter 4 – Heat-Health Warning Systems: Definition and Methodology). For WAA urban sustainability directors, the key chapters include:

- Chapter 5: Communicating heat–health warnings and heat-related information to stakeholders and the public
- Chapter 6: Intervention strategies
- Chapter 7: Evaluation of health warnings and health-protection measures
- Chapter 8: Planning for heat events at the intraseasonal-to seasonal scale

In particular, the following sections seem most useful in planning for extreme heat events:

Chapter 2, which contains an introduction to heat and health, describing risks, illnesses, and impacts. Table 2 is useful, but Table 2 in the Minnesota Extreme Heat Toolkit contains very similar information in standard English.
Chapter 4, sections 4.1 and 4.2, which describe general characteristics of developing heat-health warning systems (see Figure 2).
Chapter 5, which contains excellent information on communication of heat-health messaging. In particular, the sections on the content of a warning, coordination with media, development of a community of practice, and public education have worthwhile advice.
Chapter 6, in particular the "boxes" which have information on actions that individuals can take to prepare for and respond to heat illness, specific groups to coordinate and advise, an example of warning coordination from Philadelphia, responses, intervention elements, and strategies – specifically, boxes 2, 3, 4, and tables 6 and 7.
Chapter 7, which covers evaluation of plans; for a good quick overview, see Table 8.

Chapter 8, particularly the parts on developing Heat-Health Action Plans (see Box 9), and the examples from various cities and countries.

Box 9. Core elements of Heat–Health Action Plans

1. Agreement on a lead body (to coordinate a multi-purpose collaborative mechanism between bodies and institutions and to direct the response if an emergency occurs)
2. Accurate and timely alert systems (HHWS)
3. A heat-related health information plan (about what is communicated, to whom and when)
4. A reduction in indoor heat exposure, including medium- and short-term strategies and advice on how to keep indoor temperatures low during heat episodes
5. Particular care for vulnerable population groups
6. Preparedness of the health- and social-care system (staff training and planning, appropriate health care and the physical environment)
7. Long-term urban planning (to address building design and energy and transport policies that will ultimately reduce heat exposure)
8. Real-time surveillance and evaluation

Source: adapted from WHO, 2008

Literature References *(see below for selected summaries)*

Organization: Extreme Heat Mitigation references and summaries first, followed by Public Health Adaptation references and summaries.

Extreme Heat Mitigation

Gagliano, A., M. Detommaso, F. Nocera, and G. Evola. 2015. A multi-criteria methodology for comparing the energy and environmental behavior of cool, green and traditional roofs. Building and Environment **90**:71-81

Golden, J. S., J. Carlson, K. E. Kaloush, and P. Phelan. 2007. A comparative study of the thermal and radiative impacts of photovoltaic canopies on pavement surface temperatures. Solar Energy **81**:872-883.

Hewitt, V., E. Mackres, and K. Schickman. 2014. Cool Policies for Cool Cities: Best Practices for Mitigating Urban Heat Islands in North American Cities. Report Number U1405. Washington, DC, American Council for an Energy-Efficient Economy and Global Cool Cities Alliance, 53 pp.

Middel, A., N. Chhetri, and R. Quay. 2015. Urban forestry and cool roofs: Assessment of heat mitigation strategies in Phoenix residential neighborhoods. Urban Forestry & Urban Greening **14**:178-186.

Middel, A., K. Häb, A. J. Brazel, C. A. Martin, and S. Guhathakurta. 2014. Impact of urban form and design on mid-afternoon microclimate in Phoenix Local Climate Zones. Landscape and Urban Planning **122**:16-28.

Yang, J., Z.-H. Wang, and K. E. Kaloush. 2015. Environmental impacts of reflective materials: Is high albedo a 'silver bullet' for mitigating urban heat island? Renewable and Sustainable Energy Reviews **47**:830-843.

Golden, J. S., J. Carlson, K. E. Kaloush, and P. Phelan. 2007. A comparative study of the thermal and radiative impacts of photovoltaic canopies on pavement surface temperatures. Solar Energy **81**:872-883.

In the United States, the Environmental Protection Agency has developed a three-prong approach of (1) cool pavements, (2) urban forestry and (3) cool roofs to mitigate the UHI. Researchers undertook an examination of micro scale benefits of the utilization of photovoltaic panels to reduce the thermal impacts to surface temperatures of pavements in comparison to urban forestry. ***The results of the research indicate that photovoltaic panels provide a greater thermal reduction benefit during the diurnal cycle in comparison to urban forestry while also providing the additional benefits of supporting peak energy demand, conserving water resources and utilizing a renewable energy source***.

Middel, A., K. Häb, A. J. Brazel, C. A. Martin, and S. Guhathakurta. 2014. Impact of urban form and design on mid-afternoon microclimate in Phoenix Local Climate Zones. Landscape and Urban Planning **122**:16-28.

Comment: This modeling study, from researchers at Arizona State University, uses Phoenix, AZ as a test case. The authors looked at the effects of different neighborhood designs, building types and landscaping on local outdoor hot spots and cool spots. The most important points are:

cooling is not only a function of vegetation and surface materials, but also dependent on the form and spatial arrangement of urban features, and, at the microscale, urban form has a larger impact on daytime temperatures than landscaping.

Abstract
This study investigates the impact of urban form and landscaping type on the mid-afternoon microclimate in semi-arid Phoenix, Arizona. The goal is to find effective urban form and design strategies to ameliorate temperatures during the summer months. We simulated near-ground air temperatures for typical residential neighborhoods in Phoenix using the three-dimensional microclimate model ENVI-met. The model was validated using weather observations from the North Desert Village (NDV) landscape experiment, located on the Arizona State University's Polytechnic campus. The NDV is an ideal site to determine the model's input parameters, since it is a controlled environment recreating three prevailing residential landscape types in the Phoenix metropolitan area (mesic, oasis, and xeric). After validation, we designed five neighborhoods with different urban forms that represent a realistic cross-section of typical residential neighborhoods in Phoenix. The scenarios follow the Local Climate Zone (LCZ) classification scheme after Stewart and Oke. We then combined the neighborhoods with three landscape designs and, using ENVI-met, simulated microclimate conditions for these neighborhoods for a typical summer day. Results were analyzed in terms of mid-afternoon air temperature distribution and variation, ventilation, surface temperatures, and shading. Findings show that advection is important for the distribution of within design temperatures and that spatial differences in cooling are strongly related to solar radiation and local shading patterns. In mid-afternoon, dense urban forms can create local cool islands. Our approach suggests that the LCZ concept is useful for planning and design purposes.

Key points:

- Cooling is not only a function of vegetation and surface materials, but also dependent on the form and spatial arrangement of urban features.
- At the microscale, urban form has a larger impact on daytime temperatures than landscaping.
- In mid-afternoon, dense urban forms can create local cool islands.
- Spatial differences in cooling are strongly related to solar radiation and local shading patterns.
- The LCZ classification scheme is a useful concept for integrating local climate knowledge into urban planning and design practices.

Middel, A., N. Chhetri, and R. Quay. 2015. Urban forestry and cool roofs: Assessment of heat mitigation strategies in Phoenix residential neighborhoods. Urban Forestry & Urban Greening **14**:178-186.

Comment: This modeling study, from researchers at Arizona State University, uses Phoenix, AZ as a test case. The authors looked at the effects of different tree planting and landscaping scenarios and found that tree planting was highly effective in cooling daytime high temperatures at a residential neighborhood level, and *they quantified the amount of cooling*. They found that residential cool roofs were not as effective at reducing residential neighborhood temperatures,

but they note that *cool roofs have benefits that extend beyond their impact on ambient temperatures*.

Abstract
The City of Phoenix (Arizona, USA) developed a Tree and Shade Master Plan and a Cool Roofs initiative to ameliorate extreme heat during the summer months in their arid city. This study investigates the impact of the City's heat mitigation strategies on daytime microclimate for a pre-monsoon summer day under current climate conditions and two climate change scenarios. We assessed the cooling effect of trees and cool roofs in a Phoenix residential neighborhood using the microclimate model ENVI-met. First, using xeric landscaping as a base, we created eight tree planting scenarios (from 0% canopy cover to 30% canopy cover) for the neighborhood to characterize the relationship between canopy cover and daytime cooling benefit of trees. In a second set of simulations, we ran ENVI-met for nine combined tree planting and landscaping scenarios (mesic, oasis, and xeric) with regular roofs and cool roofs under current cli mate conditions and two climate change projections. For each of the 54 scenarios, we compared average neighborhood mid-afternoon air temperatures and assessed the benefits of each heat mitigation measure under current and projected climate conditions. Findings suggest that the relationship between percent canopy cover and air temperature reduction is linear, with 0.14°C (0.25°F) cooling per percent increase in tree cover for the neighborhood under investigation. An increase in tree canopy cover from the current 10% to a targeted 25% resulted in an average daytime cooling benefit of up to 2.0°C (3.60°F) in residential neighborhoods at the local scale. Cool roofs reduced neighborhood air temperatures by 0.3°C (0.54°F) when implemented on residential homes. The results from this city-specific mitigation project will inform messaging campaigns aimed at engaging the city decision makers, industry, and the public in the green building and urban forestry initiatives.

Major conclusions: First, our model results show that increased tree coverage in Phoenix neighborhoods reduces air temperatures, but the magnitude of this impact, even at a 25% tree canopy cover, may not be sufficient to offset increased temperatures due to climate change. However, trees can be one component of a climate adaptation strategy. Second, further research is needed to quantify the cooling, social, economic, and environmental benefits; the promotion and management costs; and water use implications of a tree program in a comprehensive economic assessment. Finally, the benefit of cool roofs for heat mitigation and climate change adaptation needs to be further investigated for the entire Phoenix region. Cool roofs have benefits that extend beyond their impact on ambient temperatures. To assess their role in UHI mitigation and climate change adaptation, a comprehensive analysis of implementation and maintenance costs, property values, building energy savings, and thermal comfort implications is needed.

Public Health Adaptation

Bittner, M. I., E. F. Matthies, D. Dalbokova, and B. Menne. 2014. Are European countries prepared for the next big heat-wave? *Eur J Public Health* **24**:615-619.

Chuang, W-C., A. Karner, N. Selover, D. Hondula, N.Chhetri, A. Middel, M. Roach and B. Dufour. 2015. *Arizona Extreme Weather, Climate and Health Profile Report.* A report prepared for Arizona Department of Health Services and the United States Centers for Disease Control and Prevention Climate-Ready States and Cities Initiative. 66 pp.

Heaton, M. J., S. R. Sain, A. J. Monaghan, O. V. Wilhelmi, and M. H. Hayden. 2015. An Analysis of an Incomplete Marked Point Pattern of Heat-Related 911 Calls. Journal of the American Statistical Association **110**:123-135.

Huang, C., A. G. Barnett, Z. Xu, C. Chu, X. Wang, L. R. Turner, and S. Tong. 2013. Managing the health effects of temperature in response to climate change: challenges ahead. *Environmental Health Perspectives* **121**:415.

Knowlton, K., M. Rotkin-Ellman, G. King, H. G. Margolis, D. Smith, G. Solomon, R. Trent, and P. English. 2009. The 2006 California heat wave: impacts on hospitalizations and emergency department visits. *Environ Health Perspect*. **117**:61-67.

Madrigano, J., K. Ito, J. S., P. L. Kinney, and T. Matte. 2015. A Case-Only Study of Vulnerability to Heat Wave-Related Mortality in New York City (2000-2011). *Environ Health Perspect.*

McInnes, J. A. and J. E. Ibrahim. 2010. Minimising harm to older Victorians from heatwaves: A qualitative study of the role of community-based health profession and carer organisations. *Australas J Ageing* **29**:104-110.

Ostro, B., S. Rauch, and S. Green. 2011. Quantifying the health impacts of future changes in temperature in California. *Environmental Research* **111**:1258-1264.

Price, K., S. Perron, and N. King. 2013. Implementation of the Montreal heat response plan during the 2010 heat wave. *Can J Public Health* **104**:96-100.

SA Health. 2013. Extreme Heat Operational Plan. Government of South Australia. Version 6.06. January 2013. 37 pp. https://www.sahealth.sa.gov.au/wps/wcm/connect/f5a784004d2dc67da0e0f3f08cd2a4a7/ExtremeHeatOperationalPlan-phce-Jan2013.pdf?MOD=AJPERES&CACHEID=f5a784004d2dc67da0e0f3f08cd2a4a7

San Francisco Department of Public Health (SFDPH). 2013. Extreme Heat Response Plan. An Annex to the SFDPH Emergency Operations Plan. San Francisco, CA: SFDPH, 16 pp.

Smoyer-Tomic, K. E. and D. G. Rainham. 2001. Beating the heat: development and evaluation of a Canadian hot weather health-response plan. *Environ Health Perspect*. **109**:1241-1248.

White-Newsome, J. L., B. Ekwurzel, M. Baer-Schultz, K. L. Ebi, M. S. O'Neill, and G. B. Anderson. 2014. Survey of county-level heat preparedness and response to the 2011 summer heat in 30 US States. *Environmental Health Perspectives* **122**:573-579.

Williams, S., P. Bi, J. Newbury, G. Robinson, D. Pisaniello, A. Saniotis, and A. Hansen. 2013. Extreme heat and health: Perspectives from health service providers in rural and remote communities in South Australia. *International Journal of Environmental Research and Public Health* **10**:5565-5583.

Bedsworth, L. 2009. Preparing for climate change: A perspective from local public health officers in California. *Environmental Health Perspectives* **117**:617-623.

Comment: This academic publication covers a number of climate change health related issues. The information was gleaned from interviews with local public health officers from cities and counties. For WAA cities, the relevant information includes Table 2 (below)—which outlines San Diego's heat health plan, and conclusions (below) about *gaps in public health preparedness and responses to heat emergencies*—especially with respect to cooling centers.

Table 2. Phases of San Diego County's Excessive Heat Response Plan (County of San Diego Health and Human Services Agency 2006).

Phase	Description	Institutions
I. Seasonal readiness	Begin monitoring of heat indicators on a daily basis	Public Health Services Administration
	Announce opening and location of cooling centers, distribute fans and bus passes, if needed	Aging and Independence Services
	Develop and revise materials for agencies working with vulnerable populations	Office of Media and Public Affairs
	Convene Heat Plan Task Force	Emergency Medical Services
II. Increased readiness	Triggered by credible prediction of prolonged heat or power outages during warmer than normal conditions	Public Health Services Administration
	Release heat advisory press releases	Aging and Independence Services
	Monitor 911 calls, ambulance response, and emergency department visits and fatalities that indicate heat-related symptoms	Office of Media and Public Affairs
	Continue to monitor heat indicators	Public Health Services Emergency Medical Services Branch
	Notify all agency partners to provide outreach to vulnerable populations	
III. Heat alert	Triggered by excessive hot weather, night temperatures of ≥ 75°F for ≤ 3 days	Public Health Services Administration
	Continue public outreach	Aging and Independence Services
	National Weather Service advisories of excessive heat for ≤ 3 days, or high heat accompanied by blackouts	Public Health Services Emergency Medical Services Branch
	Enhance monitoring of 911 and other indicators and outreach to vulnerable populations	Office of Media and Public Affairs
	Institute daily calls among all involved agencies	
	Twice-daily check-ins with National Weather Service heat index	
IV. Heat emergency	Triggered by ≥ 3 days with a heat index[a] > 105°F, National Weather Service heat advisories or warnings for ≥ 3 days, abnormal medical emergencies and mortality due to extreme heat	Public Health Services Administration
	Issue regular media releases and brief public officials	Sherriff Department
	Consider declaring a public health emergency	Governor's OES
	Activate Emergency Operation Center and Medical Operation Center	Public Health Services Emergency Medical Services Branch
	Send out Emergency Medical Alert Network notification to enrolled medical professionals and county staff	Aging and Independence Services
	Twice-daily check-ins with National Weather Service heat index	Office of Media and Public Affairs
	Enhance outreach to vulnerable populations and encourage cancelation of school-sponsored sporting events	
	Activate reverse 911 system[b] to notify vulnerable populations	
	Continue to monitor 911 calls and other indicators and daily calls among all involved agencies	

[a]Determines how hot it feels based on temperature and relative humidity. [b]Reverse 911 is a system that can place calls to populations to provide emergency information (phone numbers must be preentered).

However, there are also some clear gaps. *In particular, very few respondents to the survey indicated that their agency provided transportation to cooling centers (32%), and even fewer provided financial assistance to low-income residents to help with additional cooling costs (12%).*

Huang, C., A. G. Barnett, Z. Xu, C. Chu, X. Wang, L. R. Turner, and S. Tong. 2013. Managing the health effects of temperature in response to climate change: challenges ahead. *Environmental Health Perspectives* **121**:415.

Comment: This brief academic paper includes a valuable synopsis of heat-health planning needs and lessons learned from implementation of heat-health plans, and it articulates trade-offs. The authors note the importance the following adaptation measures: reducing heat exposure; access to cooling (including financial assistance to low-income or elderly citizens, so they can afford to use air conditioning during an emergency); cool building design; urban planning to reduce exposure to heat; public health data surveillance and early warning; preparedness of public health agencies (including the need to add staff and increase rotation during hot weather, because workers may be reluctant report to work if their family is at risk, or because many may be on vacation); and appropriate messaging (e.g., messages specially targeted to the elderly or high-risk occupational groups). ***The paper also includes some economic estimates of the costs of heat-related emergencies*** (including deaths).

Knowlton, K., M. Rotkin-Ellman, G. King, H. G. Margolis, D. Smith, G. Solomon, R. Trent, and P. English. 2009. The 2006 California heat wave: impacts on hospitalizations and emergency department visits. *Environ Health Perspect*. **117**:61-67.

Comment: The key WAA-relevant result from this epidemiological study is that acclimatization to extreme heat and the adaptive capacity of individuals and communities are critical factors contributing to risk of illness and death. Acclimatizing to extreme heat, even in cities where people are used to high temperatures, is important for those who do not prepare adequately for outdoor activities requiring exertion.

In this study we investigated whether any age or race/ethnicity groups experienced increased hospitalizations and emergency department (ED) visits overall or for selected illnesses during the 2006 California heat wave. During the heat wave, 16,166 excess ED visits and 1,182 excess hospitalizations occurred statewide. ED visits for heat-related causes increased across the state [RR = 6.30; 95% confidence interval (CI), 5.67-7.01], especially in the Central Coast region, which includes San Francisco. Children (0-4 years of age) and the elderly (> or = 65 years of age) were at greatest risk. ED visits also showed significant increases for acute renal failure, cardiovascular diseases, diabetes, electrolyte imbalance, and nephritis. The 2006 California heat wave had a substantial effect on morbidity, including regions with relatively modest temperatures. This suggests that population acclimatization and adaptive capacity influenced risk. By better understanding these impacts and population vulnerabilities, local communities can improve heat wave preparedness to cope with a globally warming future.

Ostro, B., S. Rauch, and S. Green. 2011. Quantifying the health impacts of future changes in temperature in California. *Environmental Research* **111**:1258-1264.

Comment: Highly technical public health research paper. Only important if you need to quote statistics (from California, and some comparisons with other world cities) about expected changes in number of temperature-related mortalities, given future climate changes.

White-Newsome, J. L., B. Ekwurzel, M. Baer-Schultz, K. L. Ebi, M. S. O'Neill, and G. B. Anderson. 2014. Survey of county-level heat preparedness and response to the 2011 summer heat in 30 US States. *Environmental Health Perspectives* **122**:573-579. http://dx.doi.org/10.1289/ehp.1306693 and http://ehp.niehs.nih.gov/1306693/

Comment: This academic paper points out lessons about implementing heat preparedness plans. The paper evaluates the type and effectiveness of communication to various populations, using a variety of media. The paper also mentions promising practices and collaborations used by counties in the U.S. The authors note "Heat plans may be critical to ensure the effectiveness of specific heat responses. For example, *although heat wave early warning systems can save lives, their success can be limited by not having clear decision-making protocols among the relevant institutions and end users or their advocates* (Kovats and Ebi 2006); such protocols could be established through heat planning."

Promising Communication and Outreach Practices:
Communication Practices:

- Websites
- Public service announcements
- Hotlines
- Social media
- Door-to-door campaigns

Key Collaborations:

- Medical professionals
- Social and civic organizations
    - Departments of Social Services
    - American Red Cross
    - United Way
    - Salvation Army
    - Meals on Wheels
    - Rotary
    - local shelters
    - local libraries
- Fire departments
- Police departments

Important and effective actions to ensure public safety during heat emergencies:

- Activating heat plans
- Opening cooling centers
- Assisting with relocation during electrical outages
- Providing financial assistance
- Providing transportation
- Hiring new staff in response

Outreach and education characteristics for U.S. Counties:

- Mostly:
    - People working with the elderly
    - With certain medical conditions
    - Low incomes
    - Health care providers
- Less often
    - Mobility challenged
    - People working with the homeless
    - Living in high-rise apartment buildings
    - People with nervous disorders
- Even less often
    - Children, through schools and child care centers
    - People working outdoors
    - Agencies serving the mentally ill

Excerpt on Communication and Outreach:
The most common methods of communication about heat risks were public service announcements (53%) and websites (48%). Several counties also reported communicating about heat through social media (30%), flyers and posters (18%), and email messages (17%). Few counties reported communicating through joint events with other groups (8%), telephone hotlines (6%), door-to-door campaigns (4%), or telephone calls (1%).

Of counties responding (n = 177), many reported providing outreach or education to people working with the elderly (37%), people with certain medical conditions (37%), people with low incomes (29%), and health care providers (25%). Fewer counties reported providing outreach to people who are mobility challenged (15%), people working with the homeless (12%), people living in high-rise apartment buildings (10%), and people with nervous system disorders (9%). Some counties wrote in other forms of education or outreach, including outreach geared toward children through schools and child care centers; outreach to people working outdoors; and outreach to agencies serving the mentally ill.

Table 1. Summaries of county-level preparedness and response to the extreme heat of 2011 in 30 U.S. states.

Preparedness or response action	Percent of responding counties that responded "yes"	No. of counties responding "yes"/no. of counties responding
Preparedness for heat in 2011		
Existing heat plan in 2011	40	76/188
Existing heat wave definition in 2011	30	56/185
Response to heat in 2011		
Communicated about heat risks	73	132/180
Provided outreach/education on heat to public	64	113/177
Collaborated with other organizations	46	66/145
Opened cooling centers	40	61/152
Activated heat plan	24	46/188
Assisted with relocation during electrical outages	4	7/177
Provided financial assistance	3	6/177
Provided transportation	2	4/179
Hired new staff in response to heat	1	1/167

Each row gives both the percent of counties responding "yes" of all counties with nonmissing responses for the factor as well as the absolute number of counties responding "yes" and responding with any nonmissing answer.