



Heat Events and Indoor Air: Protecting Respiratory Health

Hosted by the U.S. Environmental Protection Agency (EPA)
August 6, 2026

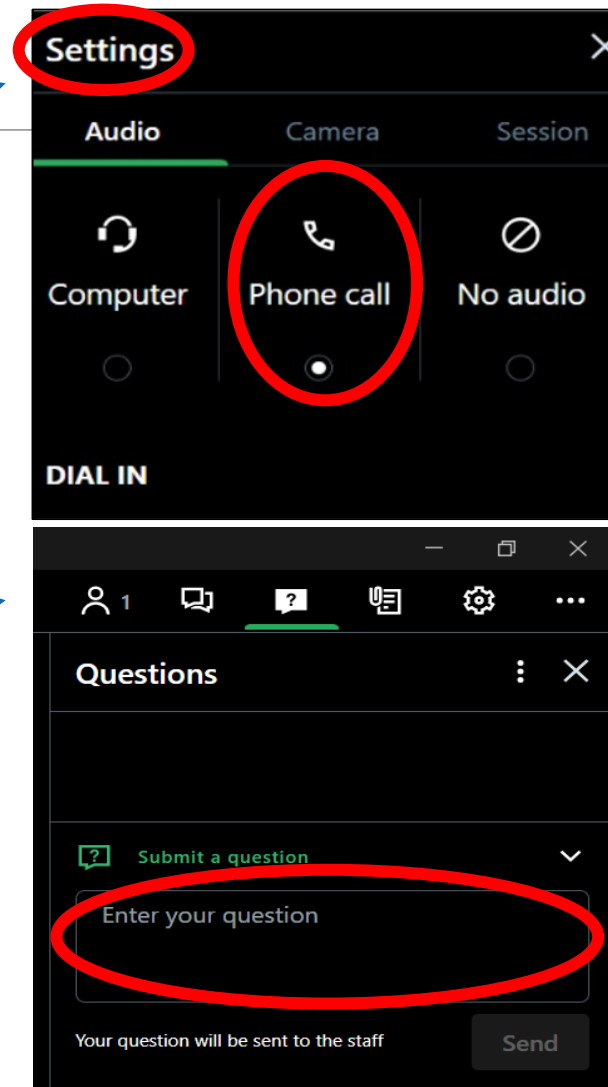
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Today's Host

Lauren Gentile, Ph.D., MELP

U.S. EPA

Office of Radiation and Indoor Air

Indoor Environments Division

Emergency Preparedness and Outreach Branch





Agenda

I. Welcome and Introductions 5 minutes

II. Framing the Webinar..... 20 minutes

A. Heat Events and Indoor Air: Protecting Respiratory Health

B. Indoor Environmental Solutions for Respiratory Health in Heat Events

III. EPA's Resources for Heat Events and Indoor Air 5 minutes

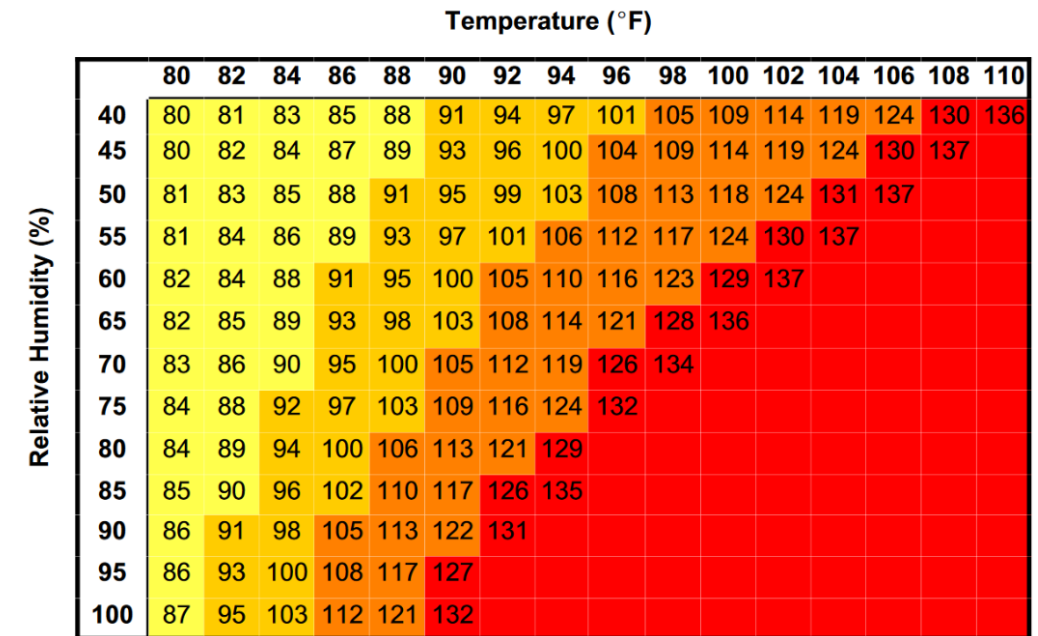
IV. Featured Speakers—Protecting Respiratory Health 20 minutes

V. Facilitated Expert Panel Discussion 40 minutes

Heat Events and Indoor Air: Protecting Respiratory Health

Framing the Webinar: From Outdoor Challenge to Indoor Protection

- When outdoor temperatures rise, indoor temperatures can also rise with it:
- Excessive heat outdoors and indoors is dangerous and can be deadly
 - Heat is the leading weather-related cause of death.
- Rising temperature is associated with reduced outdoor and indoor air quality, adversely impacting respiratory health.
- Moderating temperatures in indoor environments is the best defense during heat events.



Likelihood of Heat Disorders with Prolonged Exposure and/or Strenuous Activity

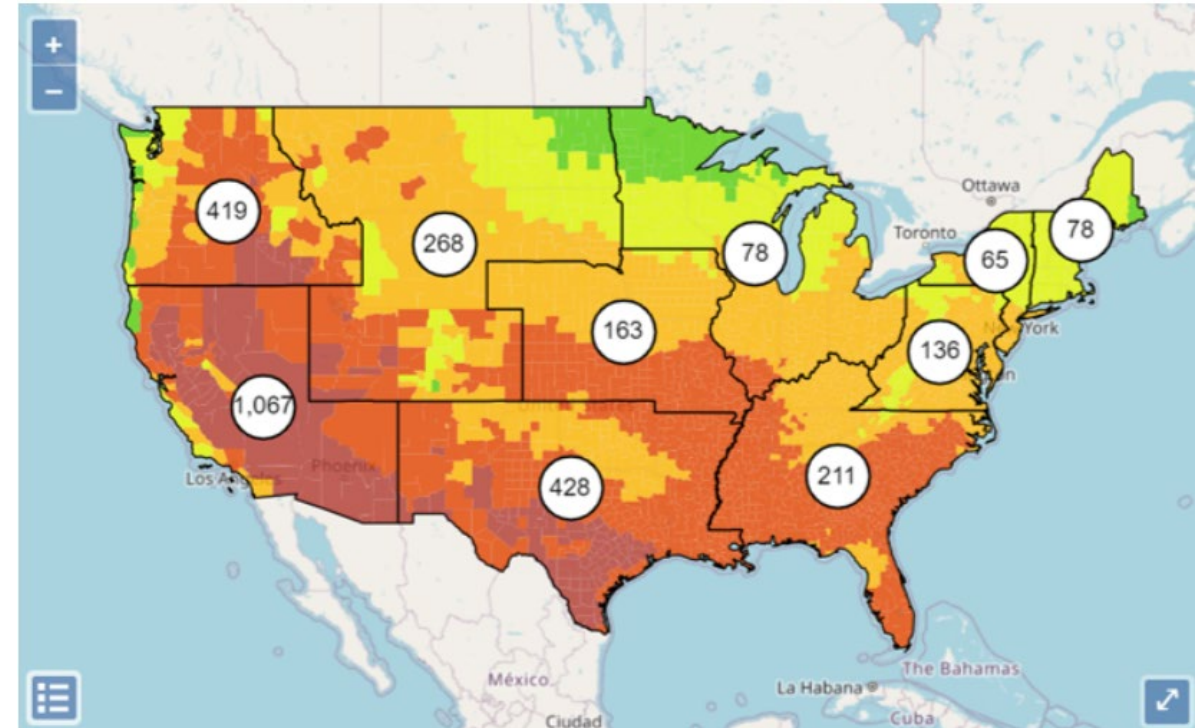
 Caution
 Extreme Caution
 Danger
 Extreme Danger

[Heat Index | National Oceanic and Atmospheric Administration](#)

Heat Events and Indoor Air: Protecting Respiratory Health

What is a Heat Event?

- Period of high heat and humidity, above 90°F, for 2-3 days, or
- Temperature much hotter and / or humid than average for a location.
- Heat waves are abnormally hot weather for two or more consecutive days.
- Heat is very taxing on the body (e.g., cardiovascular strain, dehydration, muscle cramping, exhaustion).



[Heat & Health Tracker | Centers for Disease Control and Prevention](#)

Heat Events and Indoor Air: Protecting Respiratory Health

Who Is at Risk During Heat Events?

- Extreme heat can be uncomfortable for everyone, but when paired with humidity, sun, or poor air quality, it becomes a serious health risk.
- At risk groups include:
 - Children
 - Older adults (age 65+)
 - People with chronic health conditions (e.g., asthma, COPD)
 - Pregnant women
 - Outdoor workers
 - Athletes

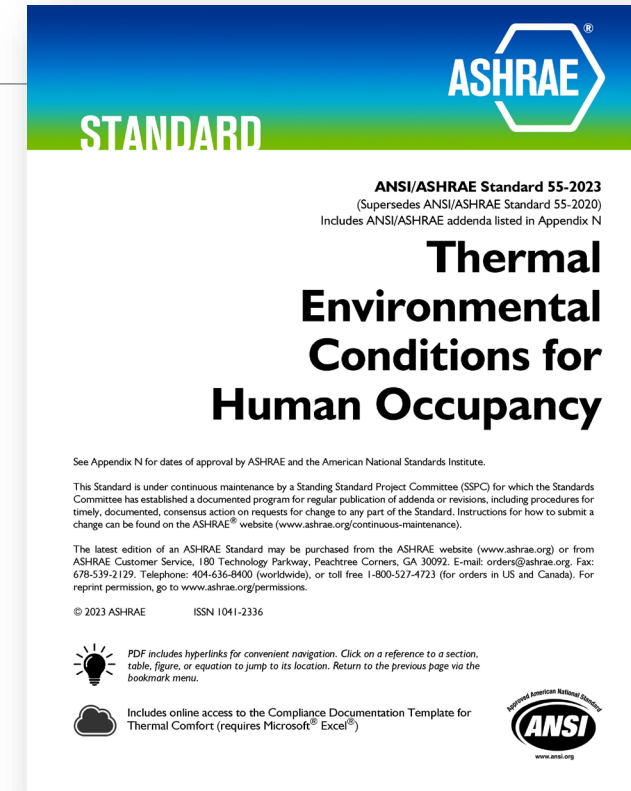


[Who is Most at Risk to Extreme Heat? | Heat.gov](https://www.epa.gov/heat)

Heat Events and Indoor Air: Protecting Respiratory Health

Indoor Heat Risk: Basics

- Not predicted by outdoor conditions alone.
- Humidity amplifies heat impacts indoors.
- Health risks increase rapidly in high **indoor wet bulb temperatures** (>80°F).
- Low air movement indoors worsens heat, humidity, and pollutant buildup.
- Multi-day exposures increase risks to health.
- Heat risks can persist overnight indoors.

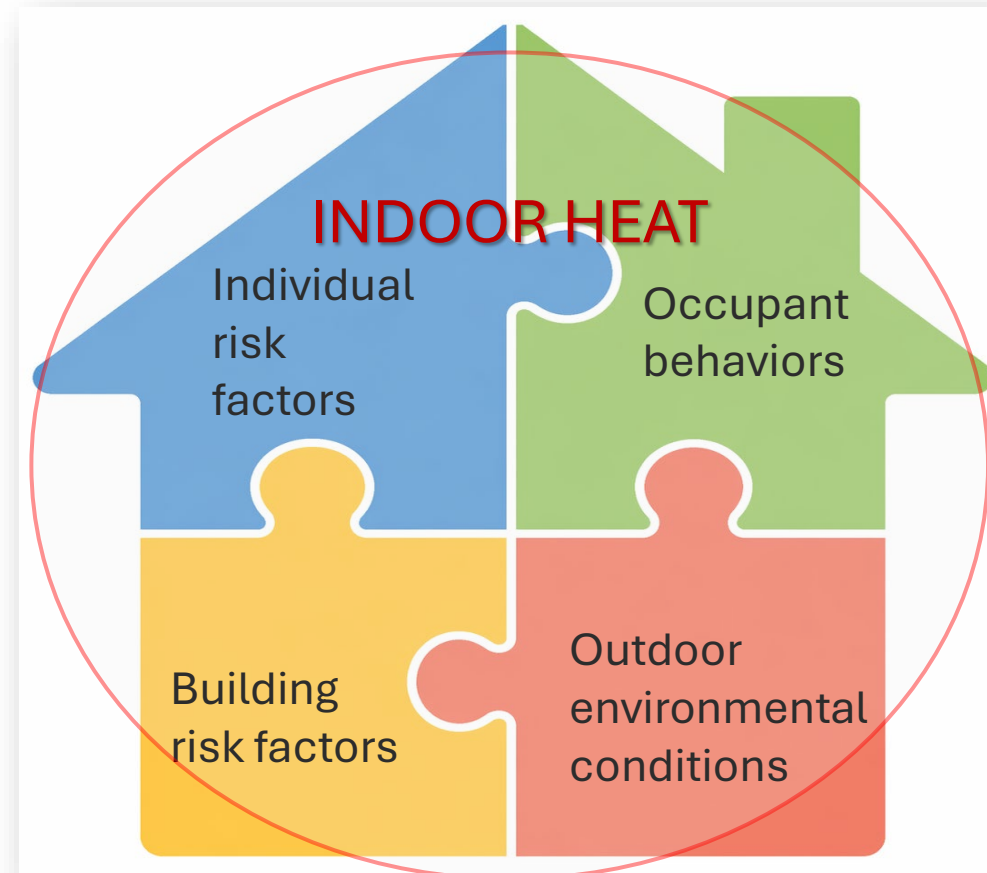


Standard 55 – Thermal Environmental Conditions for Human Occupancy

Heat Events and Indoor Air: Protecting Respiratory Health

Indoor Heat Risk: Interactions

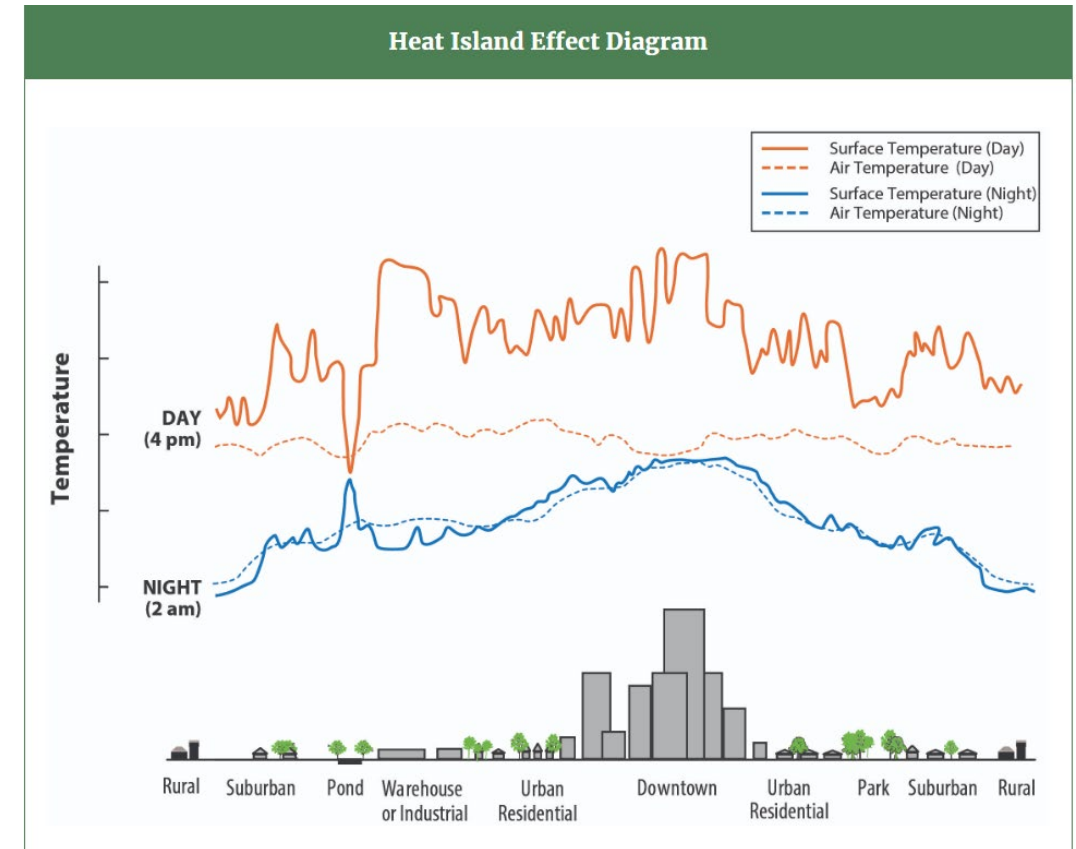
- Outdoor conditions: temperature, humidity, wind, and pollutant levels
- Building factors
- Occupant behaviors
- Individual health risks



Heat Events and Indoor Air: Protecting Respiratory Health

Indoor Heat Risk: Compounding Outdoor Environmental Risks

- Wildfire smoke
- High ground-level ozone and other outdoor pollutants
- Power outages
- Heat islands



[What Are Heat Islands? | US EPA](#)

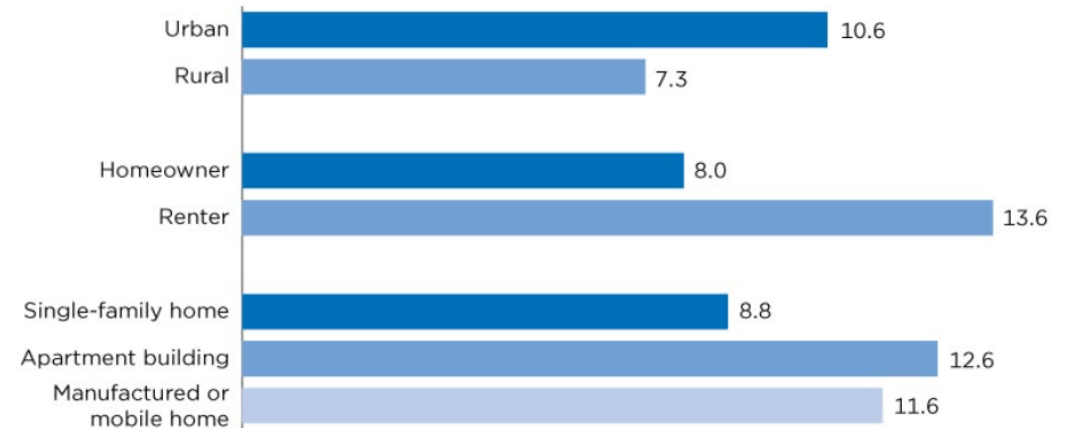


Heat Events and Indoor Air: Protecting Respiratory Health

Indoor Heat Risk: Compounding Building Risk Factors

- Lacking insulation
- Leaky windows, doors, walls
- Dark roofs (absorb heat)
- Top-floor units
- Manufactured and mobile homes
- Rental units
- Urban homes
- Lack of or broken air conditioning
- Cooling costs

Figure 1.
Share of U.S. Housing Units Uncomfortably Hot for 24+ Hours in Past 12 Months: 2023
(In percent)



Source: U.S. Census Bureau, 2023 American Housing Survey (sponsored by the U.S. Department of Housing and Urban Development), public-use file.

[Heat Risks and Cooling Problems in America's Households](#)

Heat Events and Indoor Air: Protecting Respiratory Health

Solutions: Indoor Environmental Heat Management

In preparation for and during heat events, manage indoor heat in homes, buildings and communities by:

- Reducing heat gain (passive)
- Removing heat (ventilation)
- Active cooling
- Protecting IAQ

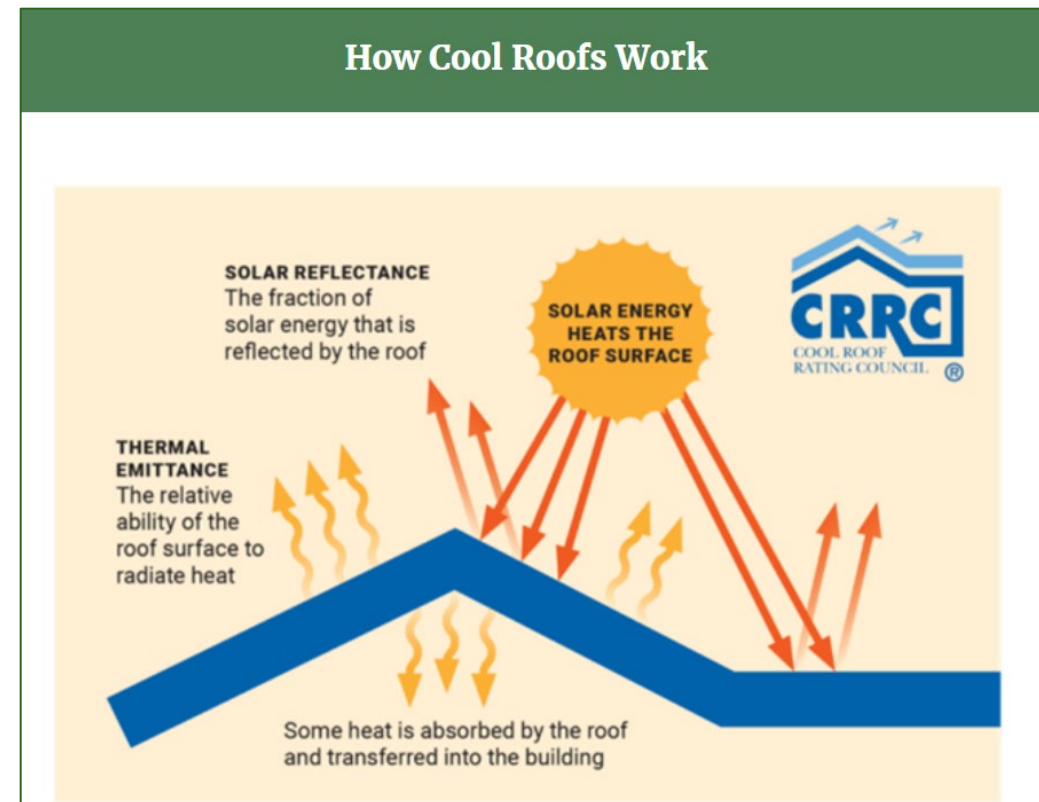


[Passive and Low-Energy Cooling | Building America Solution Center](#)

Heat Events and Indoor Air: Protecting Respiratory Health

Solutions: Indoor Environmental Heat Management

- Passive Cooling (High Impact)
 - Cool roofs
 - Insulation
 - Exterior shading
 - Window films

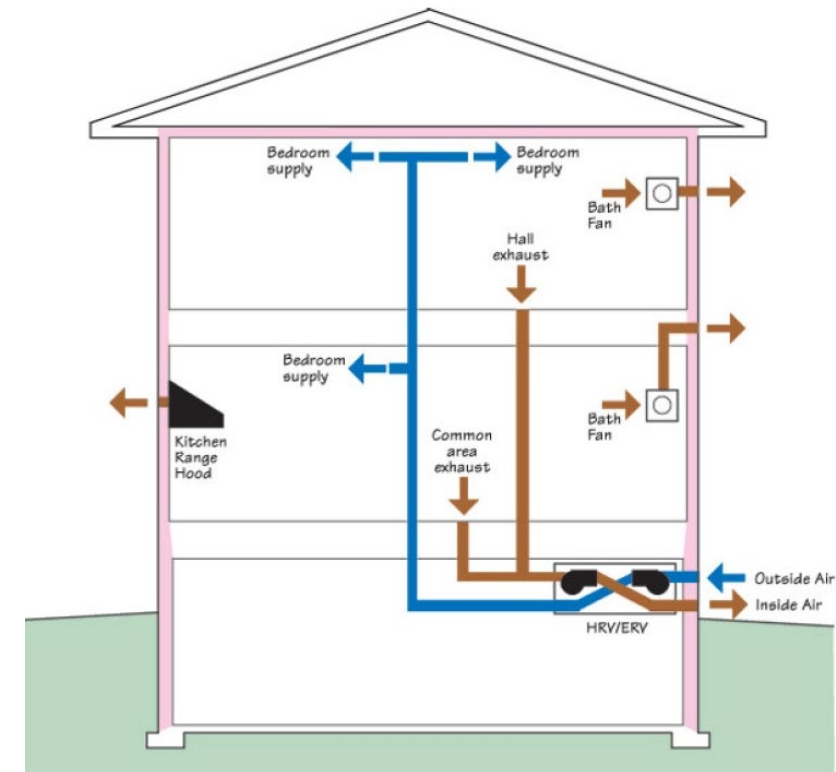


[Using Cool Roofs to Reduce Heat Islands | US EPA](#)

Heat Events and Indoor Air: Protecting Respiratory Health

Solutions: Indoor Environmental Heat Management

- Removing Heat
 - Night flushing
 - Cross-ventilation
 - Mechanical ventilation (HRV/ERV)
 - **Caution:** Do not draw unfiltered outdoor air inside when outdoor air quality is poor.

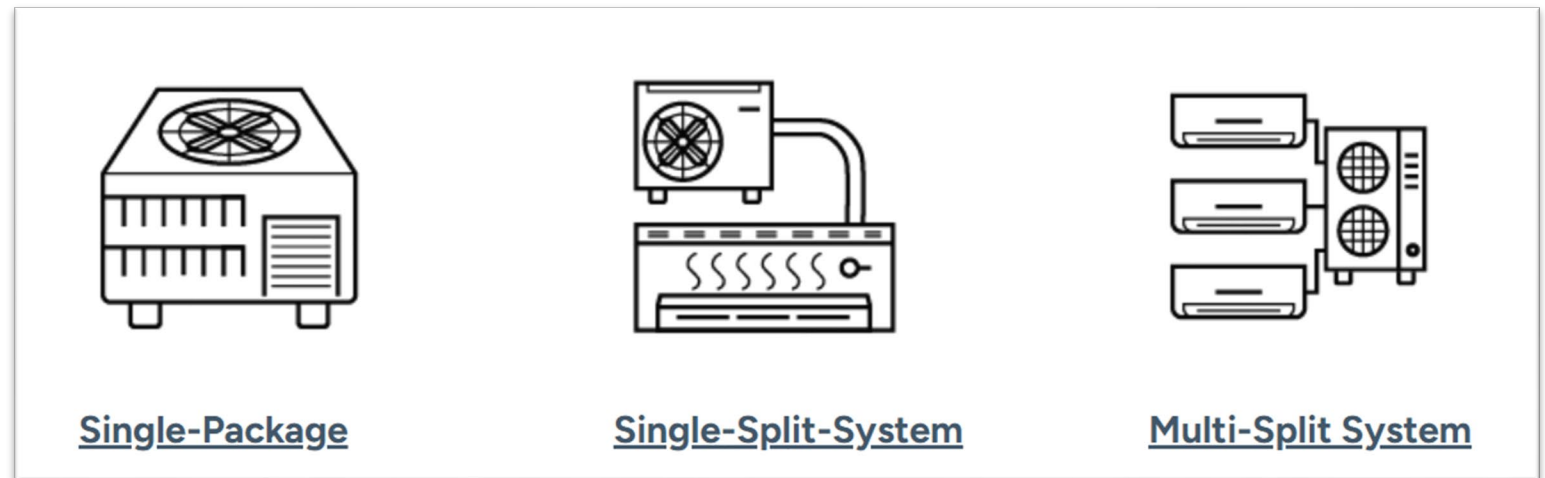


[Whole House Ventilation Strategies for Existing Homes | Building America Solution Center](#)

Heat Events and Indoor Air: Protecting Respiratory Health

Solutions: Indoor Environmental Heat Management

- Active Cooling
 - Air conditioning
 - Heat pumps
 - Mini-splits
 - Window units
 - Electric fans



[Product Look Up Tool \(U.S. Department of Energy\)](#)

Heat Events and Indoor Air: Protecting Respiratory Health

Solutions: Indoor Environmental Heat Management

Active Cooling With Fans:

- **Do not** rely on fans alone; they do not reduce body temperature.
- **Do not** use electric fans to cool if indoor temperatures are over 90 degrees.
- **Below 90 degrees**, move fans to blow hot air out and draw in cooler air.
- **Do not** use fans in closed rooms.



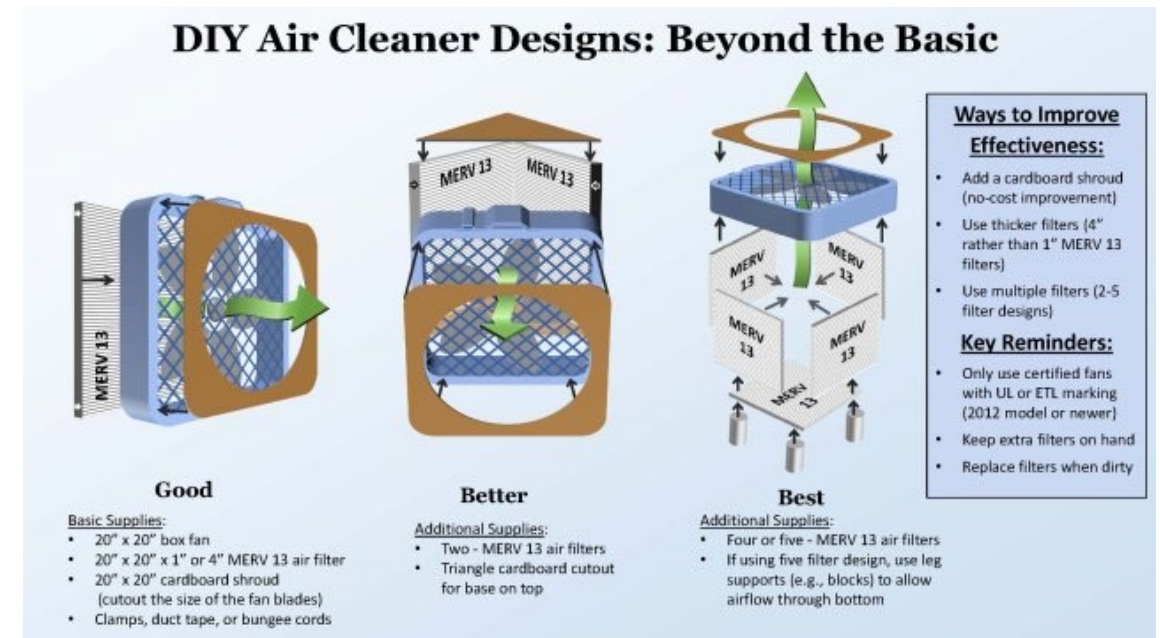
[Protecting Children and Maternal Health from Extreme Heat | US EPA](#)

Heat Events and Indoor Air: Protecting Respiratory Health

Solutions: Indoor Environmental Heat Management

Heat and air pollution often occur together. When heat and pollution levels are high, protect IAQ:

- **Avoid opening windows.**
- Ventilate only in cooler parts of the day.
- Avoid cooking and activities that create pollution until ventilation is safe.
- Use **heat- and humidity-resistant filters** in HVAC systems, or **filter with a portable air cleaner** that does not produce ozone.
- If portable air cleaners are not accessible, use a **do-it-yourself (DIY) air cleaner**.



[DIY Air Cleaner to Reduce Wildfire Smoke Indoors](#)

Heat Events and Indoor Air: Protecting Respiratory Health

Solutions: Indoor Environmental Heat Management in Schools

Schools influence IAQ:

- Aging infrastructure.
- High-density community centers.

Key IAQ steps for schools in heat events:

- Enhance HVAC with filtration.
- Adjust HVAC settings during events.
- Enhance building weatherization.
- Reduce indoor pollution sources.
- Monitor temperatures and indoor vs. outdoor air pollutants; manage ventilation to minimize exposures.





EPA's Heat Events and Indoor Air: Protecting Respiratory Health Resources



Emergencies and IAQ Webpage (EPA.gov/emergencies-iaq)

EPA Resources for Learning and Action

Keep Indoor Air Cool

EPA's website provides guidance on managing indoor air in the heat, preventing heat-related illness, and what to do if the power goes out during heat events.



United States
Environmental Protection
Agency

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Home / Emergencies IAQ

Emergencies IAQ

- [Indoor Air Quality Home Page](#)
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- [Floods](#) ▾
- [Extreme Heat](#)**
- [Power Outages](#) ▾
- [Winter Weather](#)
- [Resources About Emergencies and Indoor Air Quality](#) ▾

[Contact Us About Emergencies IAQ](#)

Extreme Heat and Indoor Air Quality

[Información disponible en español](#)

When indoor temperatures rise, people can suffer from potentially deadly illnesses, including heat exhaustion and heat stroke. It's important to be prepared whether or not you have air conditioning at home – a power outage could render cooling systems useless at just the wrong time. Follow the tips and safety precautions on this page to protect your family and your indoor air quality during extreme heat events.

On this page:

- [Keep Your Indoor Air Cool](#)
- [Prevent Heat-Related Illness](#)
- [What to Do if the Power Goes Out](#)
- [Additional Resources](#)

On other pages:

- [Emergencies and IAQ](#)
- [Extreme Heat](#)
- [Natural Disasters](#)

[Extreme Heat and Indoor Air Quality | US EPA](#)

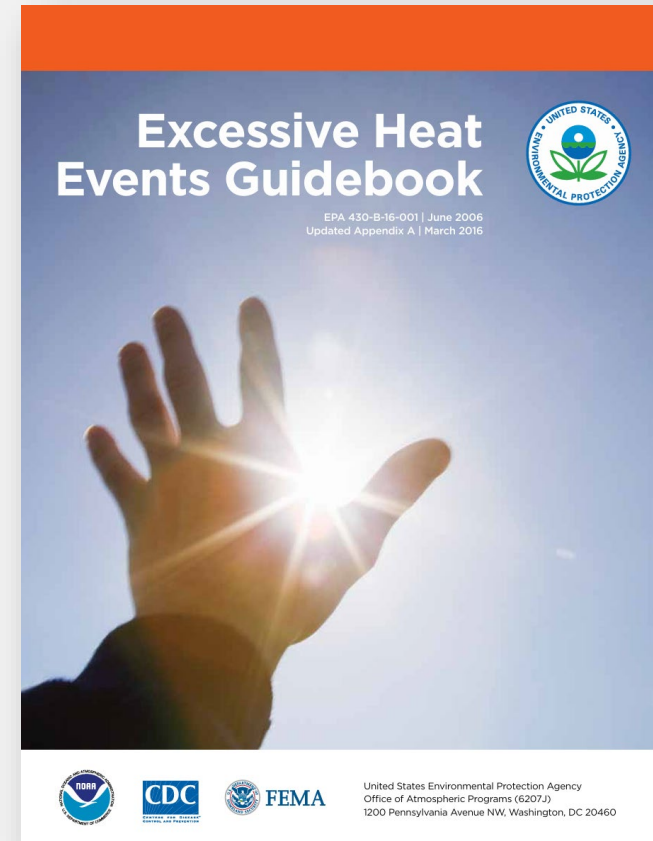


Excessive Heat Events Guidebook

EPA Resources for Learning and Action

Heat Guidebook

This guidebook provides public health officials with information on excessive heat events (EHE) risks and impacts to assess potential health risks from EHEs, and a menu of notification and response actions to consider for a local EHE program.



[Excessive Heat Events Guidebook](#)



Air Quality Index (AQI)

EPA Resources for Learning and Action

AirNow

EPA recommends checking the AQI daily and adjusting ventilation, outdoor air intake, air cleaning, and outdoor activity based on current conditions.

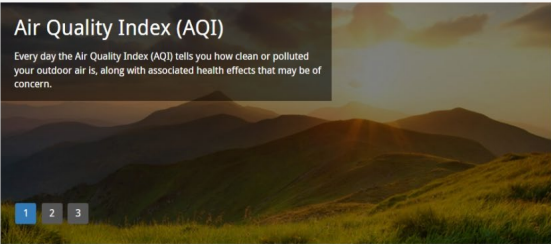


[AirNow](#)[AQI & Health](#)[Fires](#)[Maps & Data](#)[Education](#)[International](#)[Resources](#)[Español beta](#)

Get Current and Forecast Air Quality for Your Area

Air Quality Index (AQI)

Every day the Air Quality Index (AQI) tells you how clean or polluted your outdoor air is, along with associated health effects that may be of concern.



[1](#)[2](#)[3](#)

Air Quality Index (AQI) & Health

Millions of people live in areas where air pollution can cause serious health problems. Local air quality can affect our daily lives. Like the weather, it can change from day to day. EPA developed the Air Quality Index, or AQI, to make information available about the health effects of the five most common air pollutants, and how to avoid those effects.

Air Quality Index (AQI)

AQI Basics



- Air Quality Index Basics
- Activity Guides
- Using the Air Quality Index
- AQI Calculator
- Air Quality Index Publications

Pollutants



- EPA's Ozone Website
- EPA's Good vs. Bad Ozone
- Ozone Publications
- EPA's Particle Pollution Website
- Particle Pollution Publications
- EPA's Criteria Air Pollutants Website

Action Days



- What is an Action Day?
- List of Action Day Programs

AirNow.gov - Home of the U.S. Air Quality Index

Home | Site Map | Contact Us | Accessibility



Air Quality Index (AQI) Basics

What is the U.S. Air Quality Index (AQI)?

The U.S. AQI is EPA's index for reporting air quality.

How does the AQI work?

The U.S. Air Quality Index (AQI) is EPA's tool for communicating about outdoor air quality and health. The AQI includes six color-coded categories, each corresponding to a range of index values. The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 or below represents good air quality, while an AQI value over 300 represents hazardous air quality.

For each pollutant an AQI value of 100 generally corresponds to an ambient air concentration that equals the level of the short-term national ambient air quality standard for protection of public health. AQI values at or below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is unhealthy: at first for certain sensitive groups of people, then for everyone as AQI values get higher.

The AQI is divided into six categories. Each category corresponds to a different level of health concern. Each category also has a specific color. The color makes it easy for people to quickly determine whether air quality is reaching unhealthy levels in their communities.

AQI Basics for Ozone and Particle Pollution

Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

Air Quality Index

Air Quality Index Basics



Air Quality Flag Program

EPA Resources for Learning and Action

AirNow

The Flag Program helps schools and communities to use color-coded flags to communicate daily heat and air quality risks and to prompt actions like moving indoors when advised.

The screenshot shows the AirNow website interface. At the top is a blue navigation bar with the AirNow logo and links for AirNow, AQI & Health, Fires, Maps & Data, Education, International, Resources, and a Spanish Beta option. Below the navigation bar is a search bar with the text "Get Current and Forecast Air Quality for Your Area" and a field for "ZIP Code, City, or State". The main content area is divided into three columns: "Air Quality Classroom Curriculum", "Educational Resources", and "Additional Resources".

Air Quality Classroom Curriculum

- Coloring Page
- Activity Sheet (Grade K)
- Activity Sheet (Grades 1-2)
- Activity Sheet (Grades 3-5)
- Bird's Eye View Lesson Plan (Grades K-5)
- What's Up There Besides Air (Grade 5)
- Air Strips Lesson Plan (Grades 6-8)
- Particulate Pollution Paper Wad Game (Grades 6-8)
- Field Testing for Ozone Lesson Plan (Grades 9-12)
- Whirling Swirling Air Pollution 9-12 and Adult

Educational Resources

- Virtual Flag Display
- Morning Announcements
- Air Quality Animations and Games for Students
- Air Quality Resources For Teachers
- Why is Coco Orange? Book
- Poster for Schools
- Build Your Own Particle Sensor
- Generate: The Game of Energy Choices
- EnviroAtlas Interactive Educational Materials

Additional Resources

- Girl Scout Activity Booklet
- EPA's Environmental Education Center
- EPA: Protecting Children's Environmental Health

At the bottom of the page is a blue footer bar containing the text "AirNow.gov - Home of the U.S. Air Quality Index", a link to "Home | Site Map | Contact Us | Accessibility", and social media icons for Facebook, X, RSS, and Email.

[Air Quality Flag Program for Schools](#)

Air Cleaning Allies Infographic

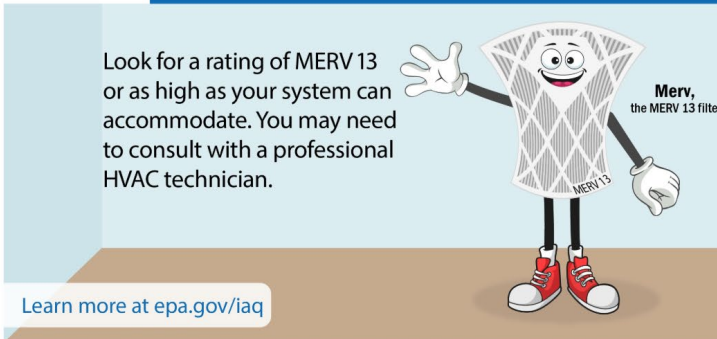
EPA Resources for Learning and Action



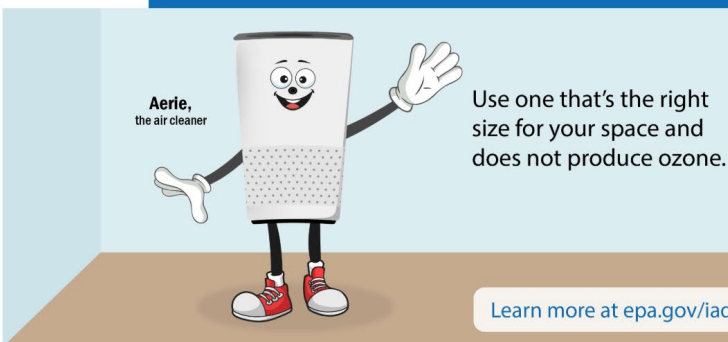
Meet Your Air Cleaning Allies!



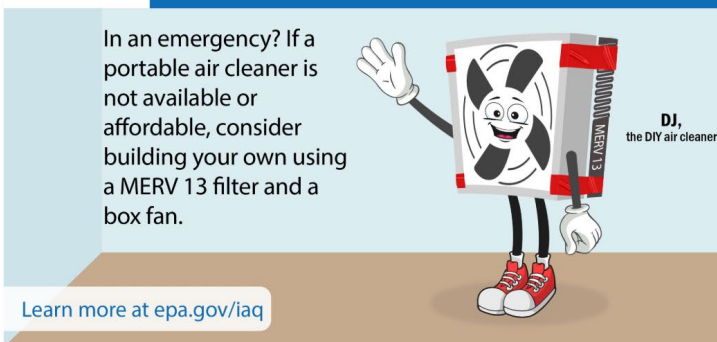
High-Efficiency HVAC Filters



Portable Air Cleaners



DIY Air Cleaners



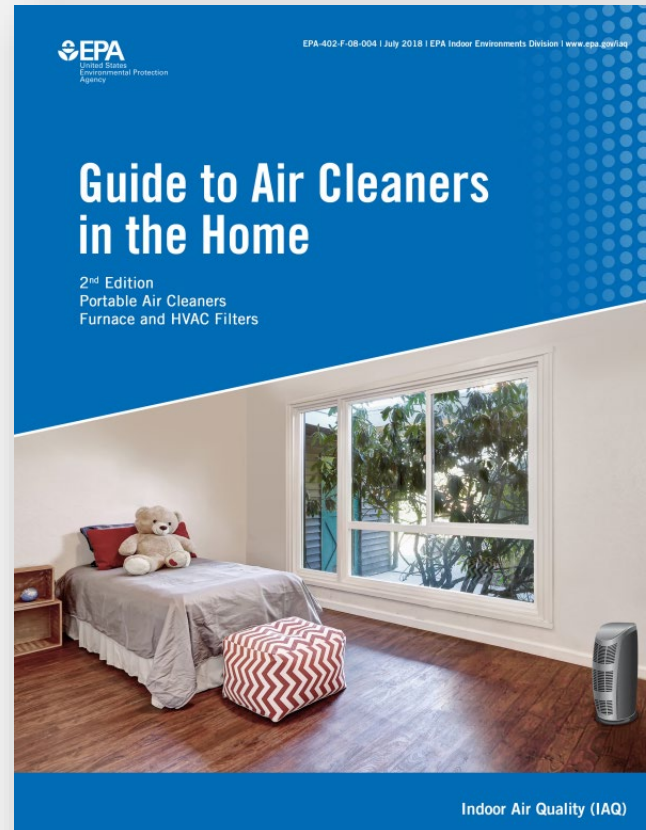


Guide to Air Cleaners in the Home (2nd Edition)

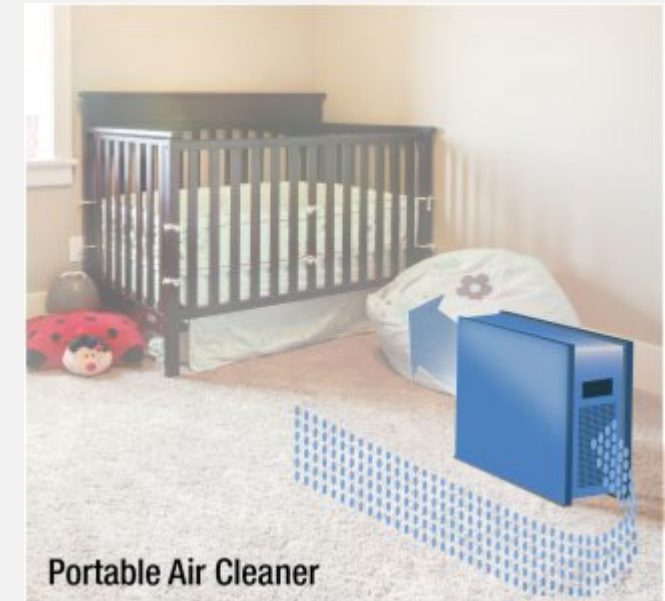
EPA Resources for Learning and Action

Air Cleaning Guide

This short consumer guide covers portable air cleaners and furnace or HVAC filters. It includes tips for selecting a portable air cleaner, furnace filter, or HVAC filter.



Tips For Selecting a Portable Air Cleaner, Furnace Filter, or HVAC Filter



[Guide to Air Cleaners in the Home | US EPA](#)



Ozone Generators Webpages

EPA Resources for Learning and Action

Webpages

EPA has webpages on ozone generators to avoid, reliable air cleaners, and steps to protect indoor environments for health. Find guidance for selecting air cleaners, monitoring outdoor air, and ventilating with filtration during high outdoor temperatures and air pollution events.

Learn more at: epa.gov/iaq

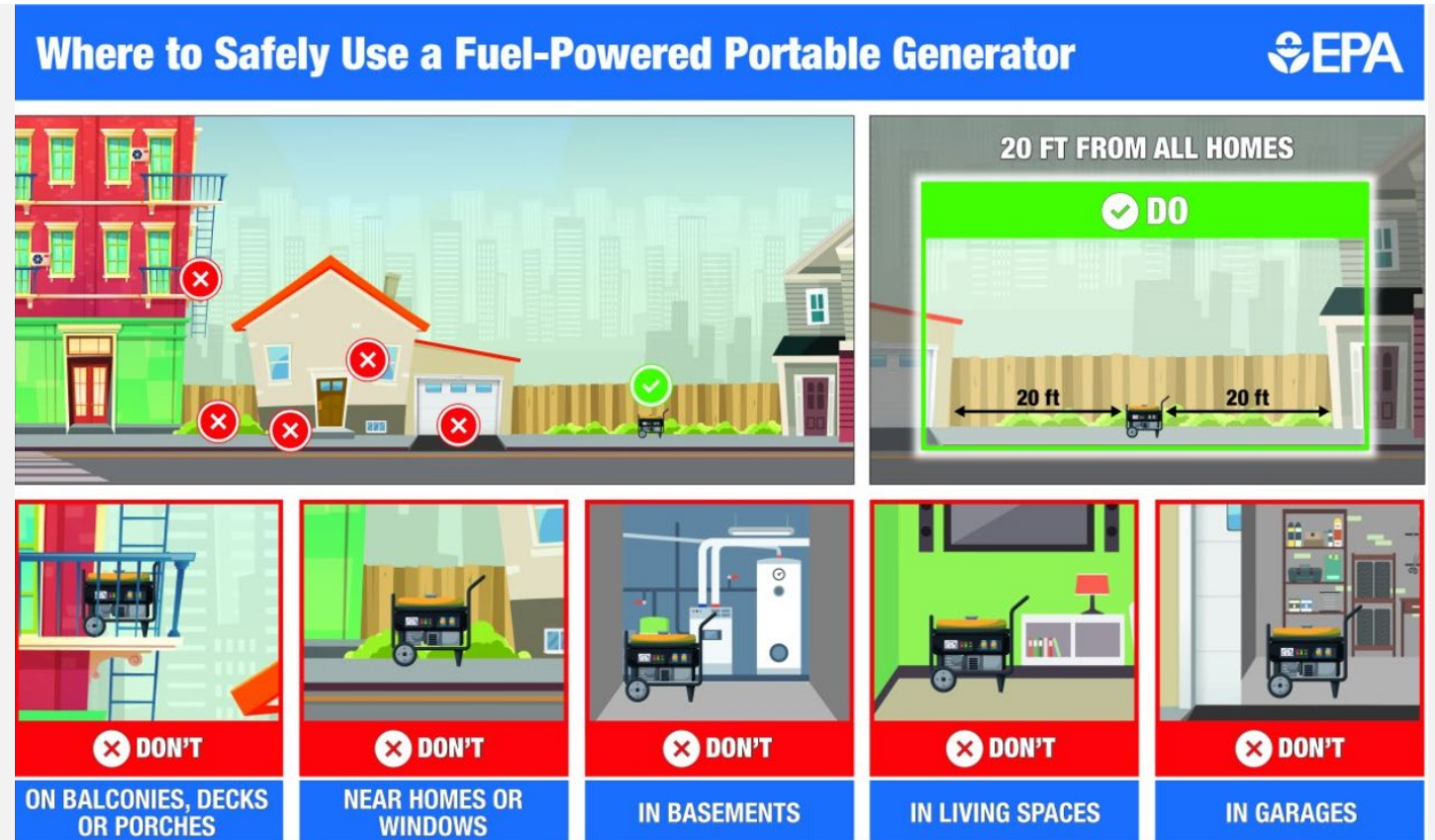
Portable Generators Webpages

EPA Resources for Learning and Action

Webpages

EPA has webpages on safe use of fuel-powered portable generators.

If the power goes out, safely provide power for cooling. Do not use fuel-powered portable generators indoors!



Learn more at epa.gov/iaq



Introducing Our Speaker-Panelists

Facilitated Expert Panel Discussion

Holly Samuelson, Ph.D.,
Associate Professor of Building Technology,
Massachusetts Institute of Technology



Barrak Alahmad, M.D., Ph.D., M.P.H.,
Senior Research Scientist, Department of
Environmental Health, Harvard T.H. Chan
School of Public Health



Vivek Shandas, Ph.D.,
Professor of Earth, Environment, and
Society, Portland State University



Heat & Buildings: How Buildings Mitigate Exposure

Holly Samuelson

Associate Professor | Building Technology Program

Department of Architecture | Massachusetts Institute of Technology

www.hollysamuelson.com

August 6, 2026

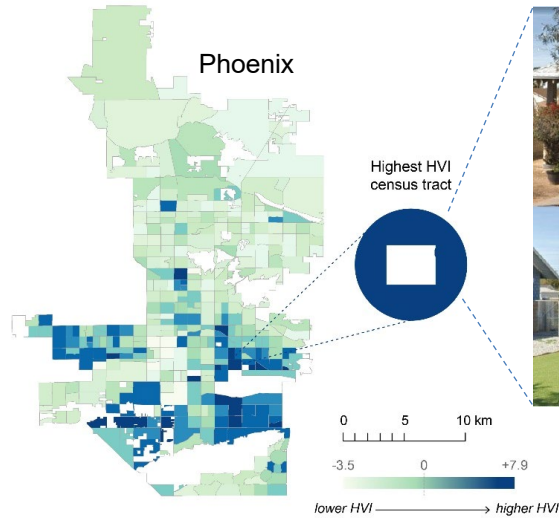


THE HUMAN LIMIT

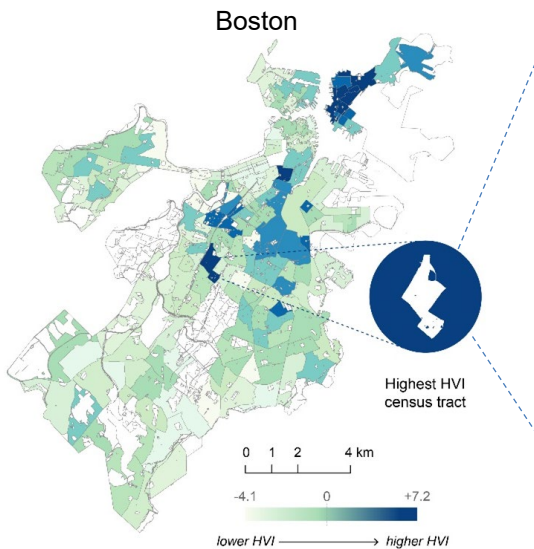


Housing Is a Critical Determinant of Heat Vulnerability

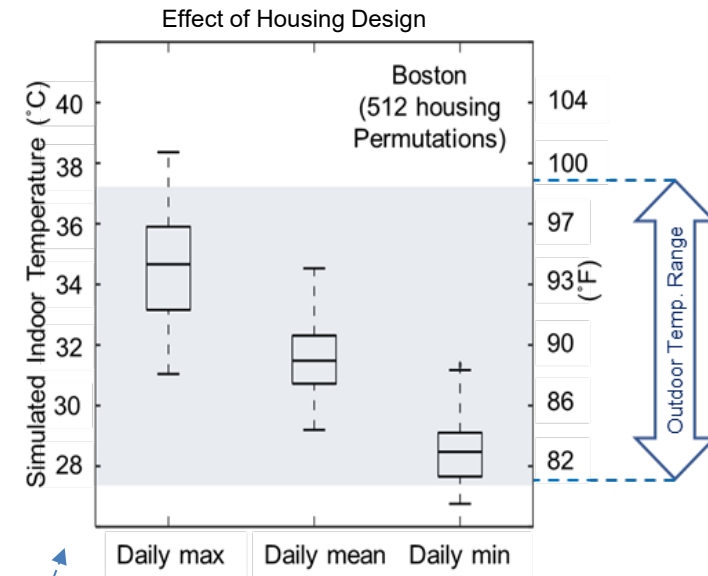
1. Developed and Applied a Heat Vulnerability Index (HVI)



2. Surveyed Existing Housing in Most Vulnerable Neighborhoods

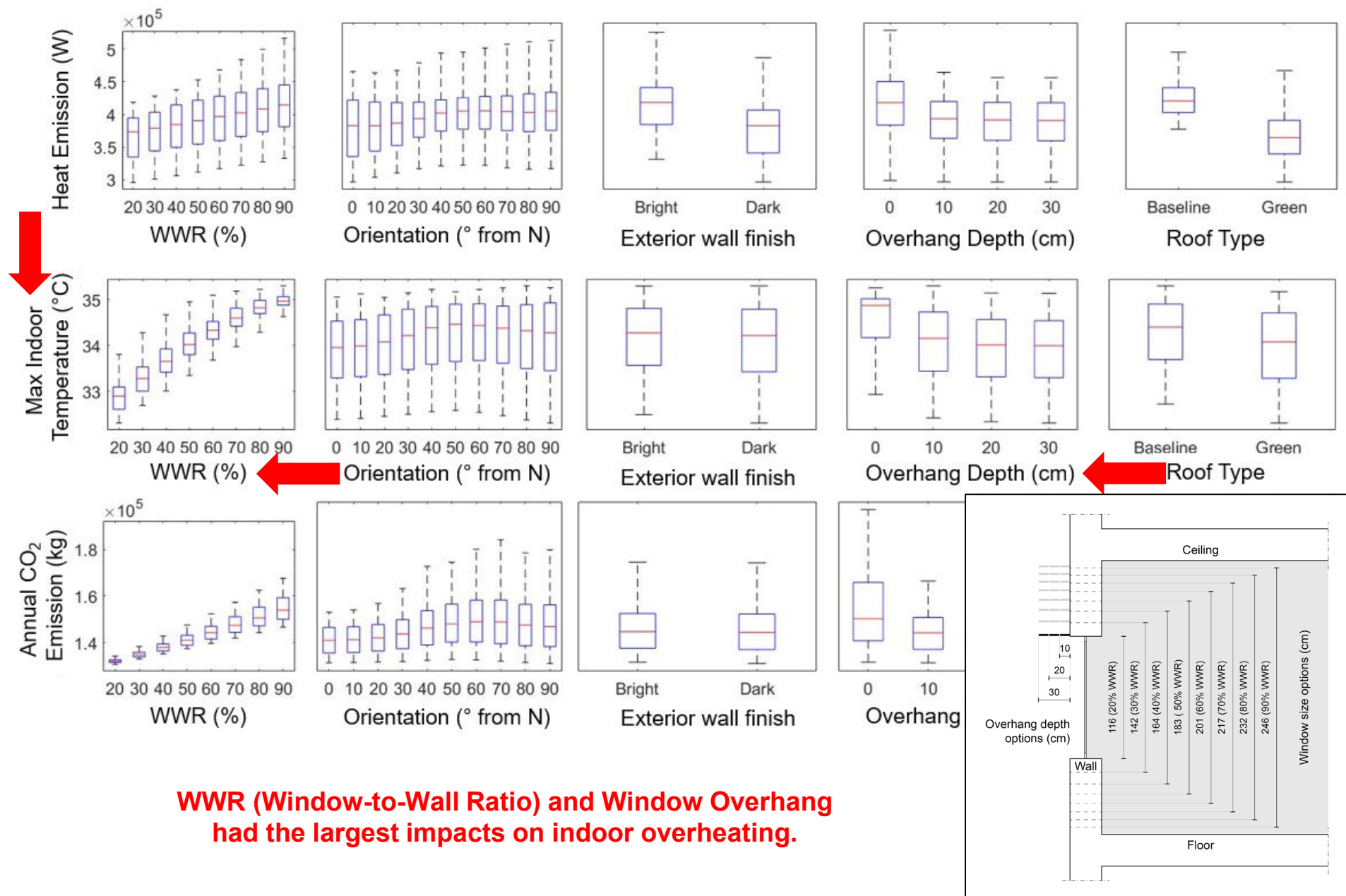


3. Simulated Indoor Temperatures Under Conservative Hot Weather Conditions



Housing matters! > 7°C variation attributable to housing characteristics within vulnerable neighborhoods.

New Building Design: Which Design Variables Matter Most to Heat Outcomes?

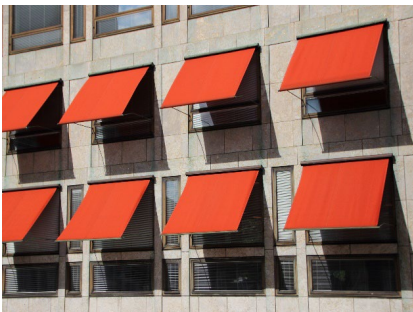
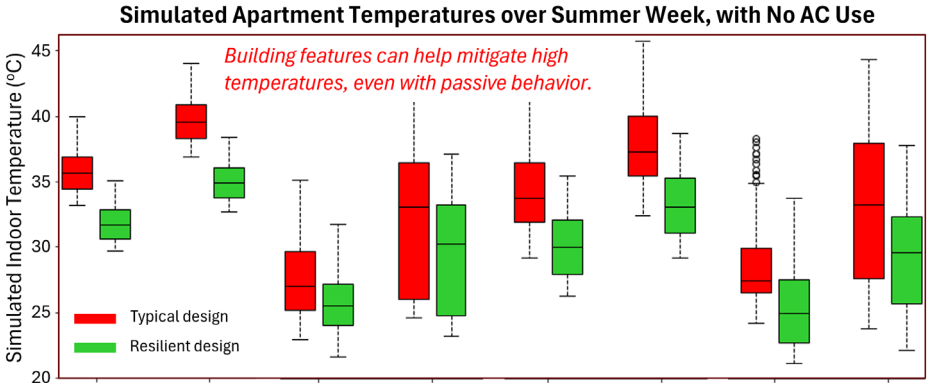
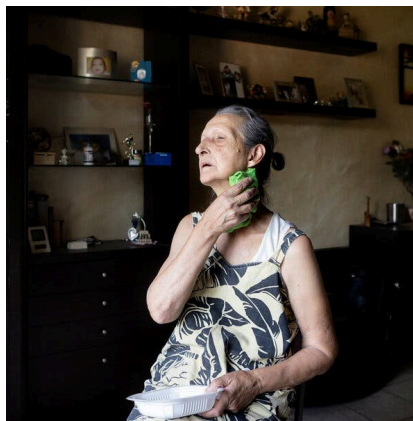
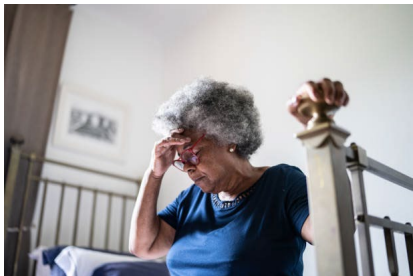


WWR (Window-to-Wall Ratio) and Window Overhang had the largest impacts on indoor overheating.

What about occupants who do not take adaptive actions to mitigate overheating?

Energy poverty, cognitive/physical impairment, inability to sense heat...

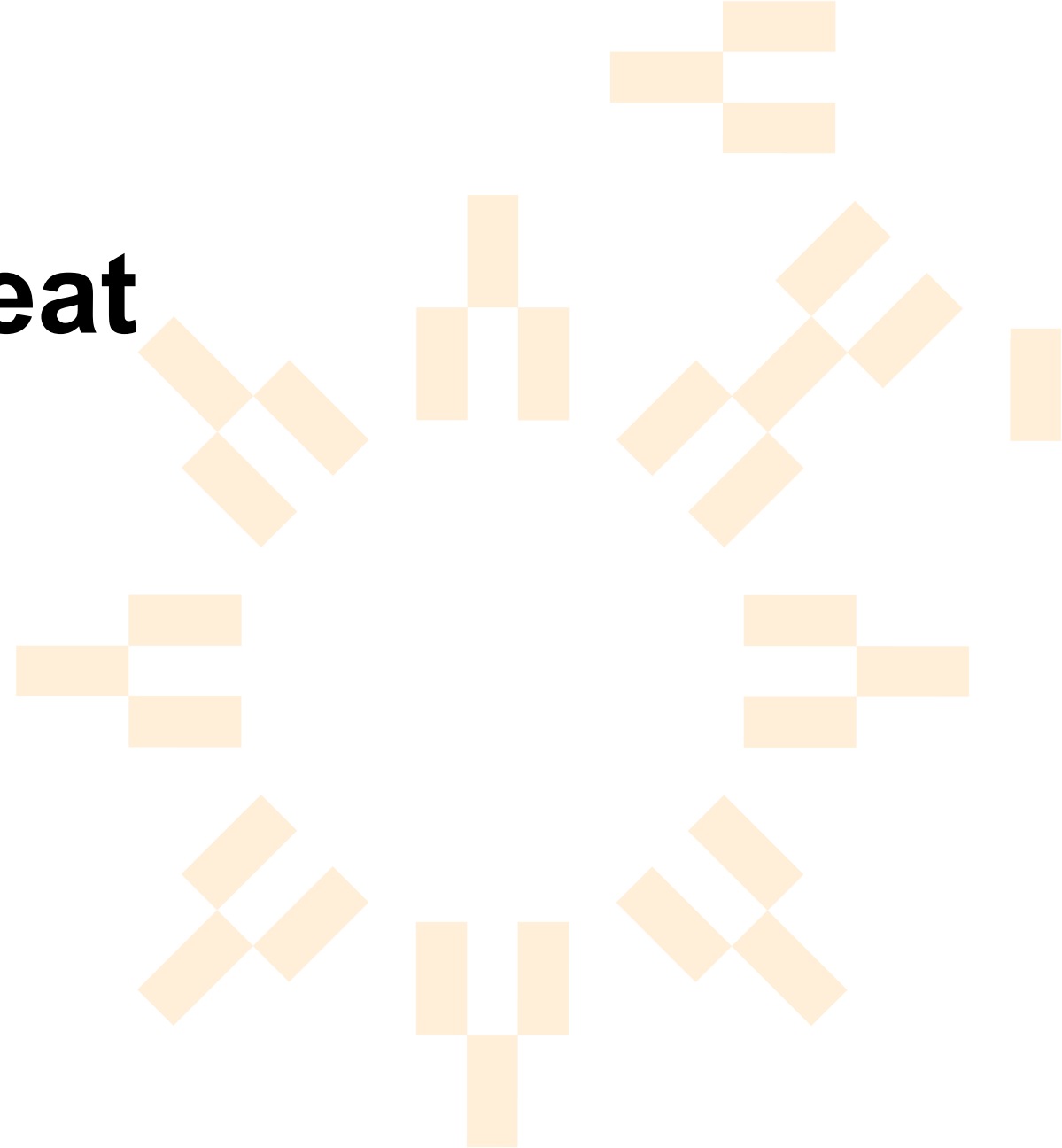
Can passive building design help? Yes.



AUG 6, 2026

Epidemiology of Heat

Barrak Alahmad, M.D., Ph.D., M.P.H.
Senior Research Scientist
Department of Environmental Health,
Harvard T.H. Chan School of Public Health
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Heatstroke

A fatal medical emergency defined by a core body temperature over 104°F (40°C)

Analyzing Death Certificates From 34 Countries

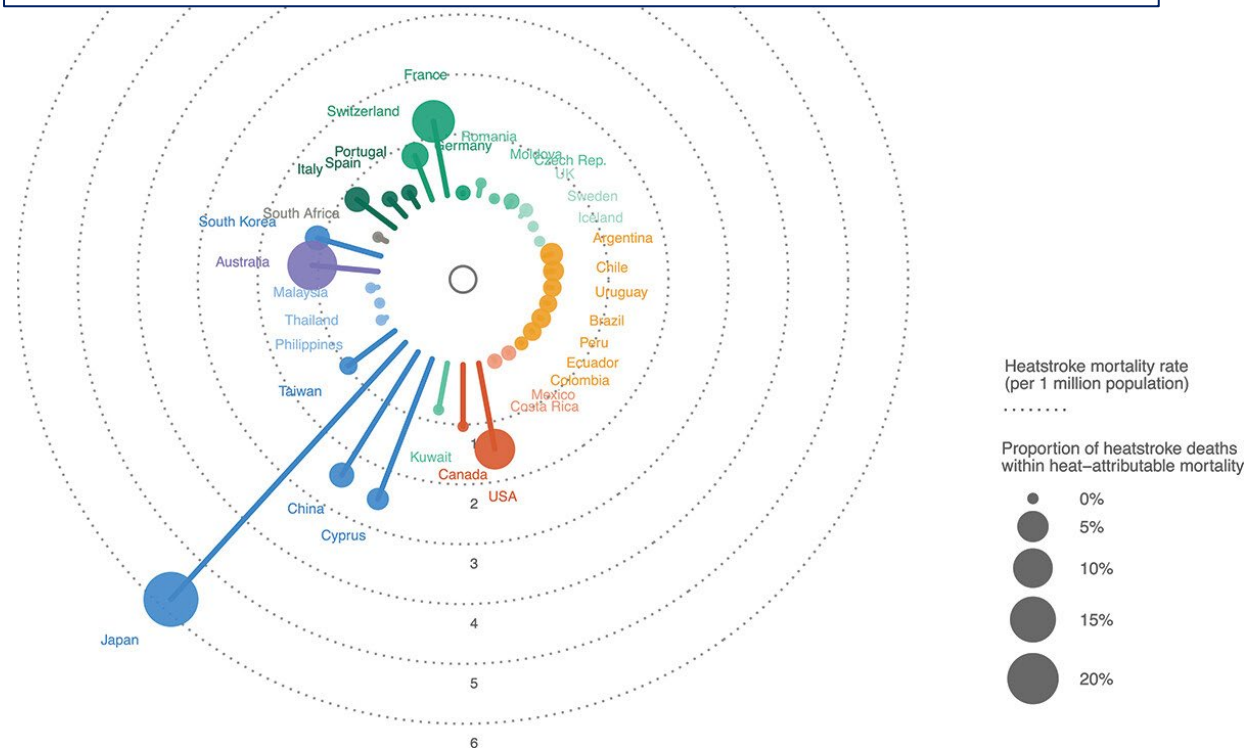
INTERNATIONAL FORM OF MEDICAL CERTIFICATE OF CAUSE OF DEATH

Cause of death		Approximate interval between onset and death
I Disease or condition directly leading to death*	(a)	Underlying (Primary) Cause of Death
	due to (or as a consequence of)	
Antecedent causes Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last	(b)	
	due to (or as a consequence of)	
	(c)	
	due to (or as a consequence of)	
	(d)	
II Other significant conditions contributing to the death, but not related to the disease or condition causing it		
		

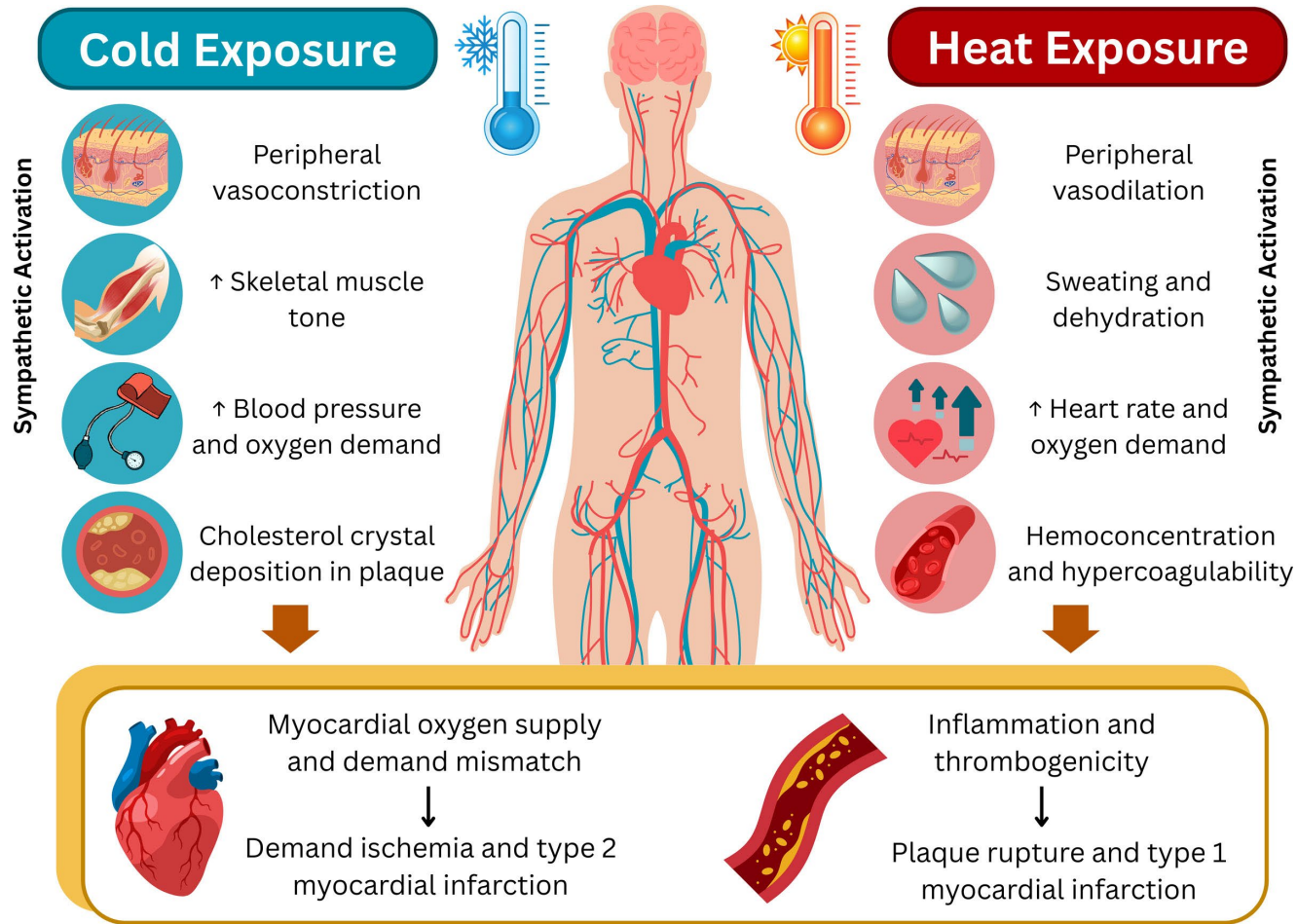
*This does not mean the mode of dying, e.g. heart failure, respiratory failure. It means the disease, injury, or complication that caused death.

Takeaways:

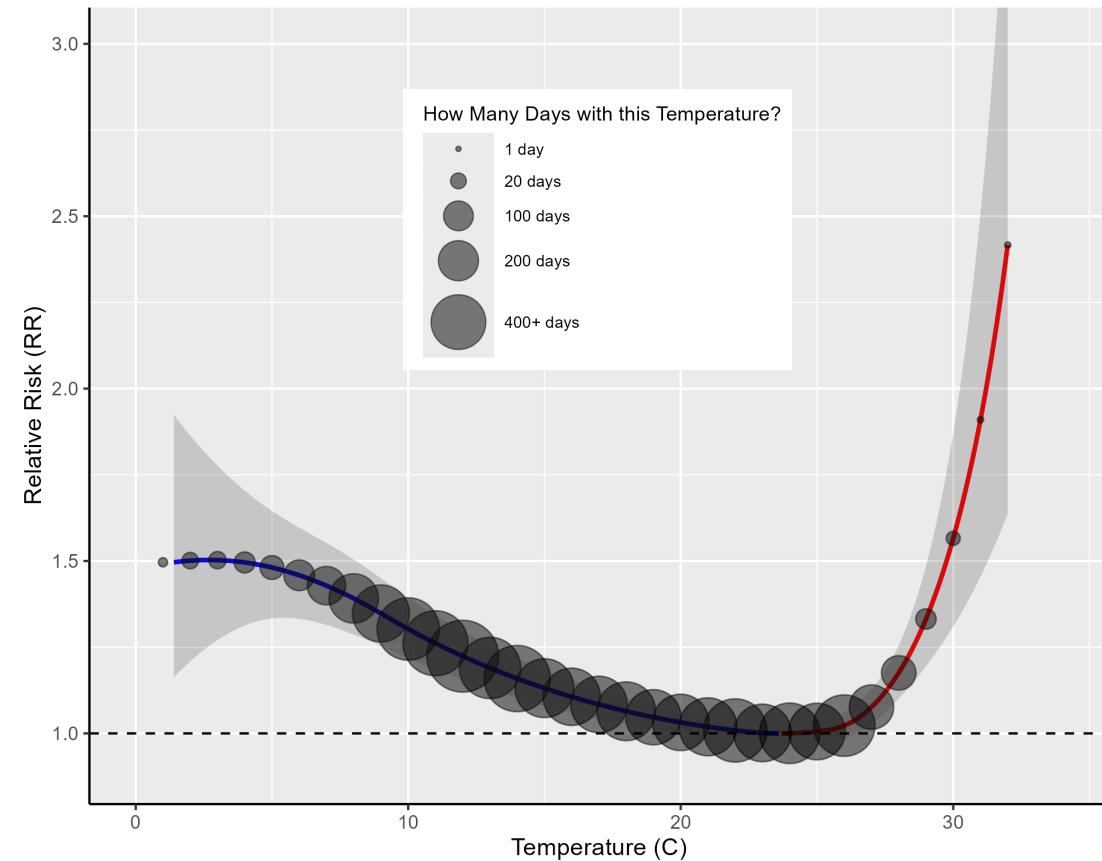
- Different reporting practices of heatstroke deaths
- Heatstroke deaths is a tiny fraction of heat's true health impact
- Heat can be a 'contributing' factor and not the 'primary'



Heat & the Heart



Cardiovascular Disease Mortality
Barcelona, Spain (2000-2018)



Hanneman et al. (2026) *Circulation*

Alahmad et al. (2025) *Lancet Planetary Health*

Heat & Cognitive Function Decline

Natural Experiment – College students:
24 in **AC** campus building
20 in **no-AC** campus building

Took two tests every day in July 2016

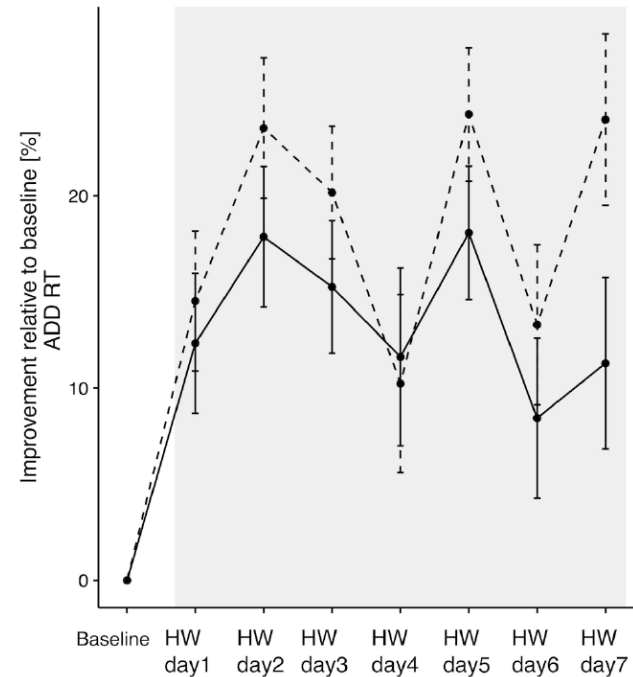
% improvement over time (diff-in-diff)

STROOP colored test

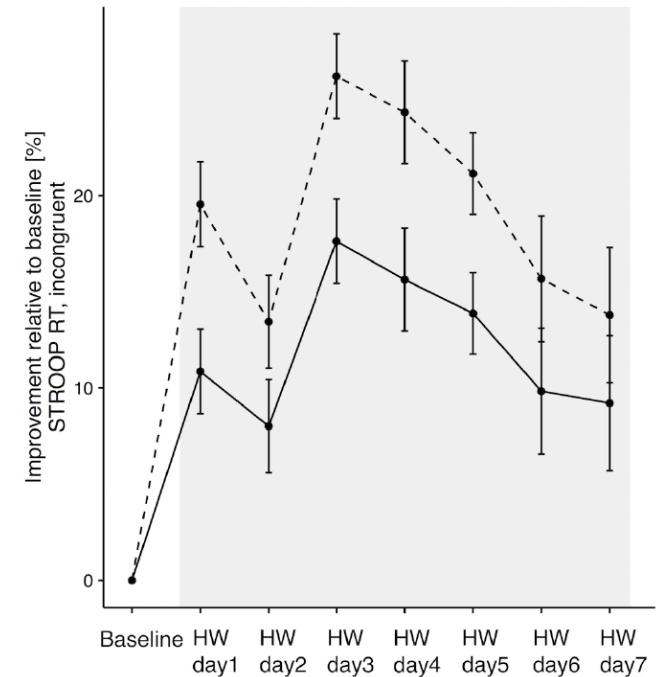
2-digit add & subtract

	Condition A	Condition B
Stimulus	GREEN	GREEN
Response	 fast response	 slow response

72	66	57	45
+ 21	+ 15	- 14	- 22
83	34	99	13
- 25	+ 54	- 65	+ 48
91	91	79	88
- 66	- 15	- 44	- 37
46	99	20	21
- 29	- 60	+ 24	+ 48



Addition/Subtraction test

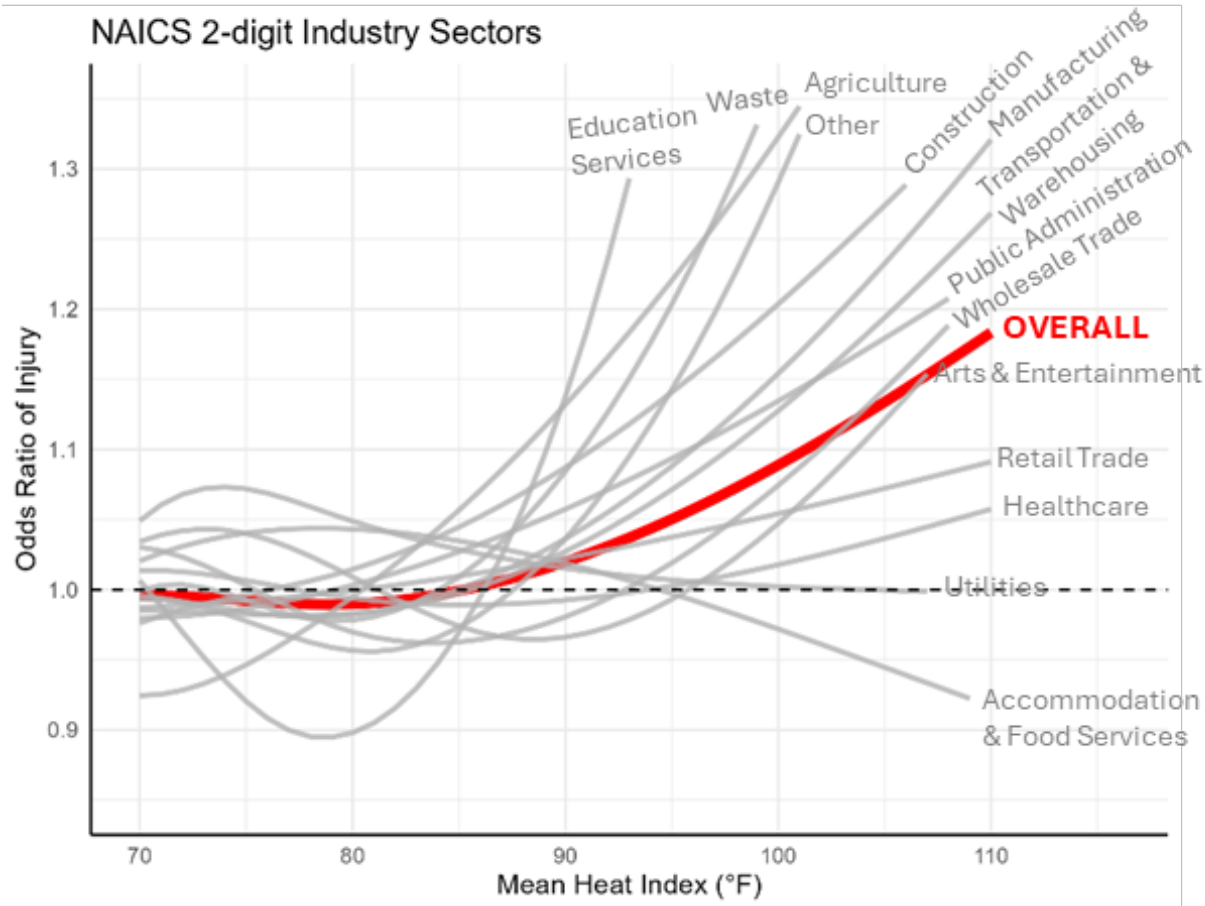


Stroop test

“...Students living in non-AC spaces experienced significant decrements on cognitive test performance.”

Heat & Accidents/Injuries

Is heat associated with increased accidents?



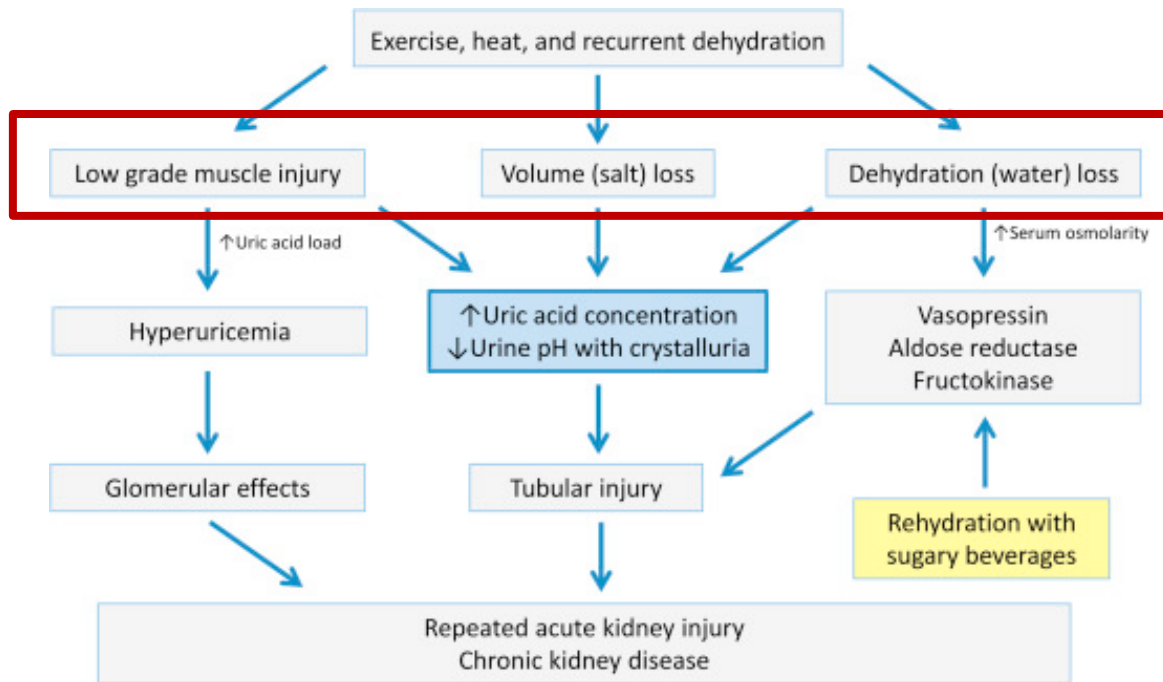
Analysis of ~850K work injuries in the United States in 2023 from any cause (e.g., falls, trips, slips)

OVERALL Dose-Response Relationship:

90F (vs. 80F) = **3%** increase
95F (vs. 80F) = **6%** increase
100F (vs. 80F) = **10%** increase
105F (vs. 80F) = **15%** increase
110F (vs. 80F) = **20%** increase

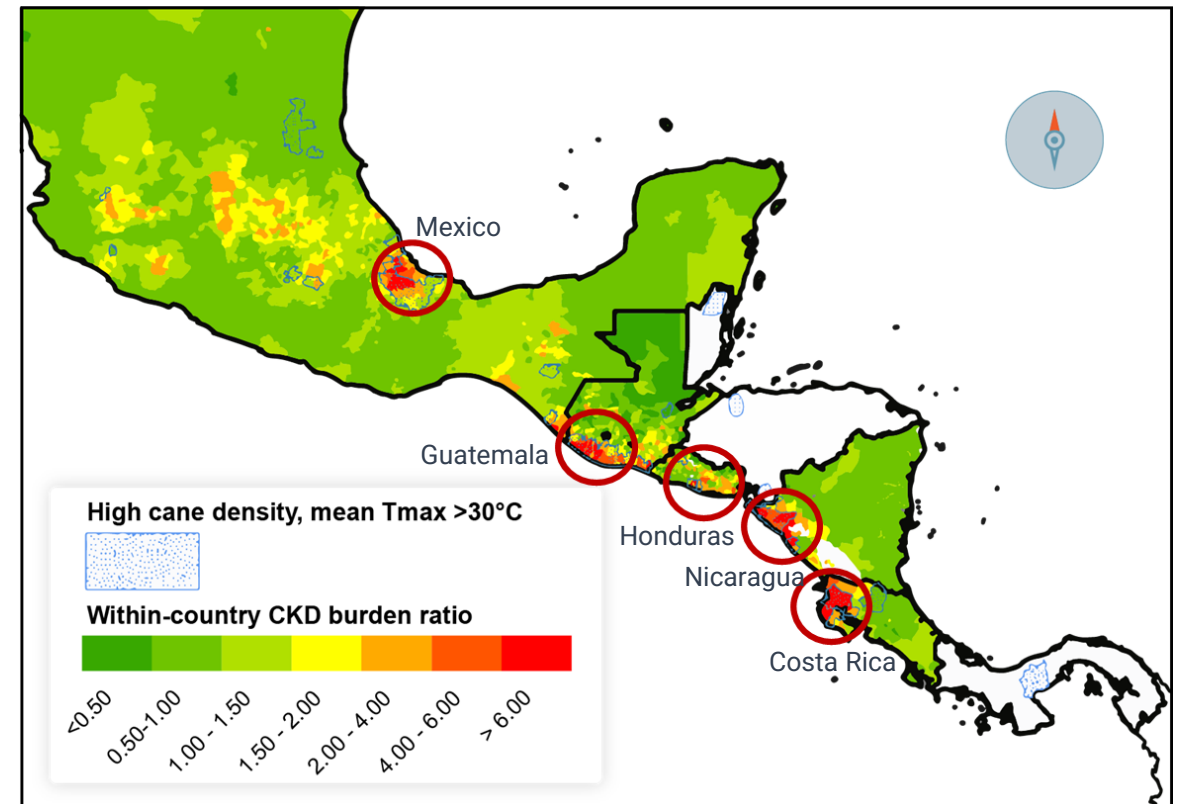
Heat & Kidney Disease

Repetitive insults to the kidneys:



Roncal-Jimenez et al (2016) *Am J Kidney Dis*

Clusters of chronic kidney failure among agriculture sugarcane communities:



Source: La Isla Network

‘Hot’ is not ‘Hot Everywhere’?

“A 95°F day in Vermont will have different implications for health than a 95°F day in Texas, and similarly, a 95°F day in May will have different implications than one in August.”

The U.S. Global Change Research Program
Report (2016)

95 ° F = 35 ° C

WHY?

- **INFRASTRUCTURE**

- (air conditioning, urban design, insulation)

- **BEHAVIOR ADAPTATION**

- (clothing, activity level, going out)

- **BIOLOGICAL/PHYSIOLOGICAL**

- (acclimatization, conditioning)

From Heat Maps to Heat Safety

Hyperlocal heat risk and local action

Vivek Shandas

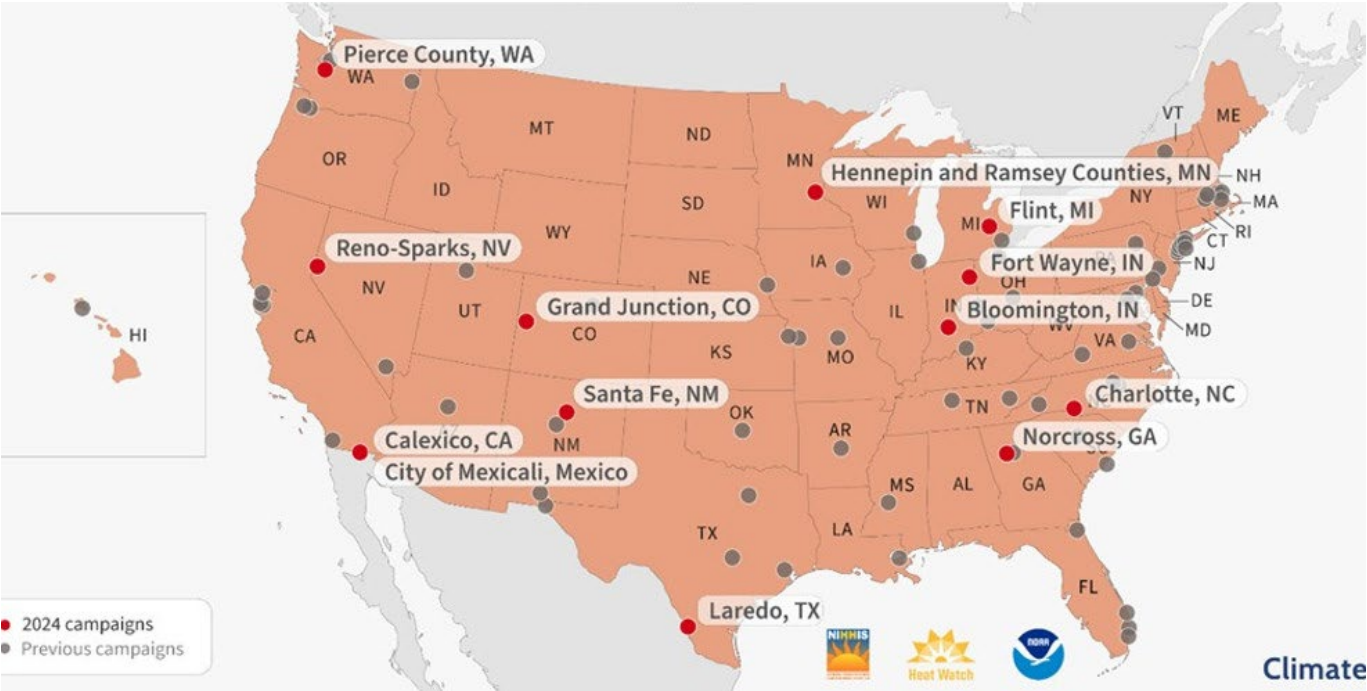


U.S. EPA Indoor Environments Division webinar
Heat Events and Indoor Air: Protecting Respiratory Health



The National Effort Has Created a New Local Evidence Base

Community science has moved heat mapping from a research exercise to a readiness tool



80+

U.S. communities supported

2017–2025

Campaign years shown on program maps

15 m

Granular modeled heat patterns for local action

What changed?

Cities now know where exposure concentrates by time of day, land cover, streetscape, and housing context—at a scale useful for emergency management and public health operations.

Neighborhood Heat Risk Is Where Exposure Meets Capacity

Heat risk is spatial, social, and operational

Detailed heat maps help communities ask a sharper question

Which blocks combine high heat exposure, respiratory vulnerability, limited cooling access, and low ability to act quickly?

Exposure

Hot streets, rooftops, parking lots, transit stops, schools, and homes that remain hot overnight.

Sensitivity

Older adults, children, pregnant people, outdoor workers, and people with asthma, COPD, or heart disease.

Adaptive capacity

AC access, utility affordability, mobility, language access, social connection, and trusted information.

Local Action: overlay maps with public health, housing, tree canopy, energy burden, and mobility data—then validate priorities with local knowledge.



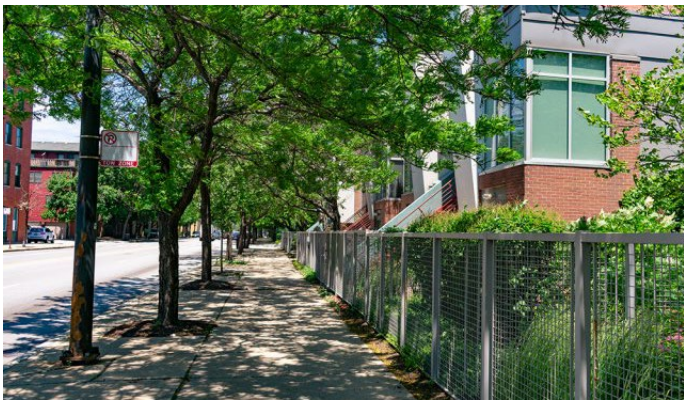
Evidence base: Voelkel & Shandas 2016; Voelkel et al. 2018; EPA Green Infrastructure image.

Feasible Interventions Now: Combine Material & Non-Material Actions

High-resolution heat information should guide both infrastructure and operations



Reflective / cool roofs



Shade + green infrastructure



Cooling + clean-air refuge

Material interventions

trees, shade structures, cool roofs, weatherization, heat pumps, filtration, public buildings, backup power

Non-material interventions

wellness checks, heat + AQI messaging, transportation plans, hours of operation, trusted messengers, tenant protections, after-action learning

A Community Heat-Safety Playbook

Before, during, and after heat events

BEFORE

- Map hot blocks + refuge locations
- Pre-position filters, fans, water, transportation
- Train trusted messengers and building managers
- Prioritize home visits for potentially impacted communities

DURING

- Activate wellness checks and cooling/clean-air spaces
- Pair heat alerts with AQI and ventilation guidance
- Extend hours for libraries, schools, and community sites
- Track unmet needs in real time

AFTER

- Review deaths, calls, EMS, shelter use, and outages
- Update vulnerable-resident lists and facility plans
- Target upgrades to the hottest blocks
- Fund durable improvements before next season

Closing point: The most useful heat map is the one that changes where resources go, who gets checked on, and what gets fixed before the next event.



Thank you for attending!