



# Tighe&Bond

# Climate Impacts on Occupational Safety: Nature, Health, and Regulation



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# Discussion Outline

## ■ **Climate Change**

- Heat
- Fire, Wind, Water
- Flooding and Storm Systems

## ■ **Impacts on Health and Industry**

- Respiratory Impacts
- Outdoor Workers
- Construction Projects

## ■ **Policy and Regulation**

- Federal
- State
- Company

## ■ **Solutions**

- Safety Planning
- Administrative Tools
- Apps & Wearable Technologies

First, let's look at data, not conjecture.

# Climate Change - HEAT

The past eight years were the eight warmest years on record, and 2022 was the fifth-warmest on record globally, ([Freedman, 2023](#)).

Every month of 2022 ranked among the ten warmest for that month, despite the cooling influence from the La Niña climate pattern in the tropical Pacific, ([NOAA, 2023](#)).

It (2022) also marked the 46th-consecutive year (since 1977) global temperatures were above the 20th-century average. The 10-warmest years on record have all occurred since 2010, with the last nine years (2014-2022) among the 10-warmest years, ([NOAA, 2023](#)).

Climate change is making high temperatures more common and intensifying dryness that fuels catastrophic wildfires, ([Zhong et al, 2023](#)).

Several cities in the US are battling extreme heat and threat of wildfire smoke. Canada is facing its worst wildfire season on record causing hazy conditions and poor air quality. Experts warn scorching temperatures and toxic plumes from fires are hazardous to human health on their own, but together they create a dangerous combination, ([Kekatos, 2023](#)).

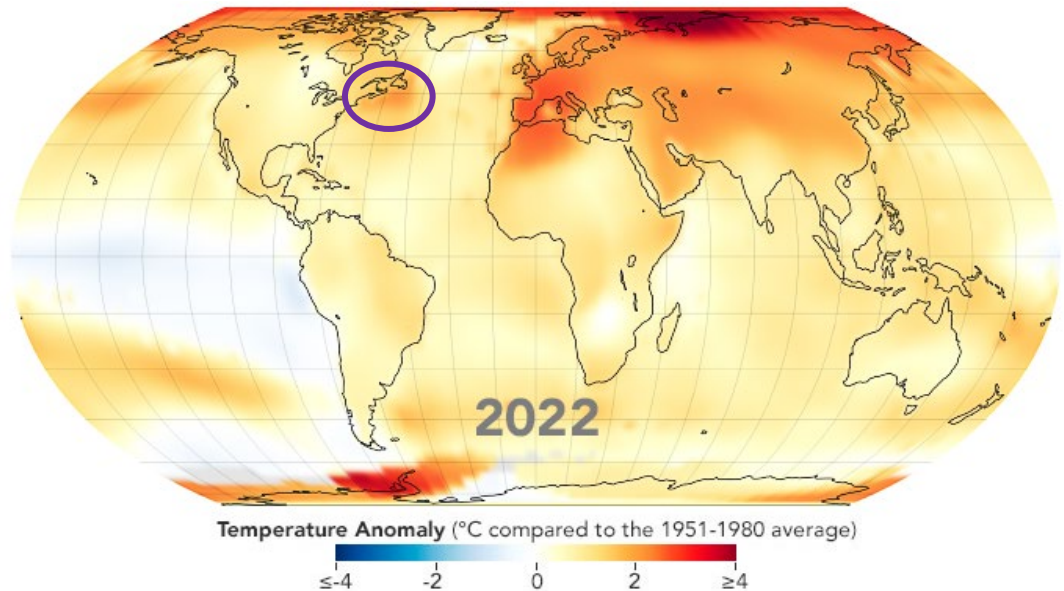
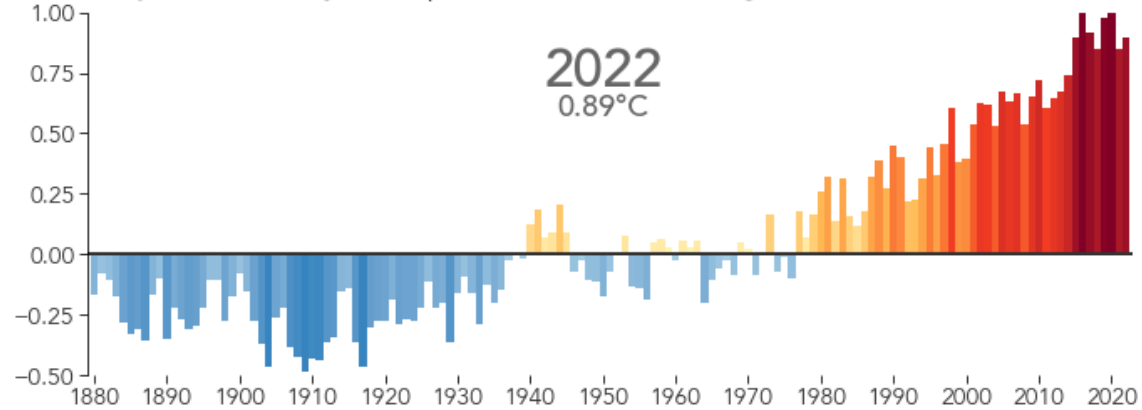
A consequence of climate change is that smoke in our skies is becoming more common in the summer months,” ([Cohen, 2023](#)).

Isn't all this data from hot countries and territories?

# Climate Change - HEAT

## Last 9 Years Warmest on Record

Global Temperature Anomaly (°C compared to the 1951-1980 average)



No, let's take New England as an example.

# Climate Change – HEAT (New England)

**Connecticut** has seen an approximate increase in temperature of 3.5 degrees Fahrenheit over the last 120 years. And as climate changes, this allows hurricanes to move further north up the coast

**Massachusetts** has warmed by approximately 3.5 degrees Fahrenheit since the beginning of the 20th century. The city of Boston finished out 2021 as its hottest year on record, and the state's number of hot days has been considerably above the long-term average since 2010.

**Rhode Island** has seen the highest rate of warming in New England – a nearly 4 degrees Fahrenheit since the early 1900s. According to the NOAA report, the state saw its greatest number of hot days and warm nights above the long-term average between 2015-2020.

**Vermont** has warmed about 3 degrees Fahrenheit over the last century-plus – the least of all six New England states considering its distance from the Atlantic Ocean.

SOURCE: [Barndollar, 2022](#)

# Climate Change – HEAT (New England)

**New Hampshire's** temperatures have warmed more than 3 degrees Fahrenheit over the last 120 or so years. Like Maine, most of the warming in New Hampshire has happened in the winter season – with an increase of more than 4 degrees Fahrenheit since 1900 – impacting snowfall and snow cover.

**Maine** has warmed by nearly 3.5 degrees Fahrenheit over the last century-plus. Since the mid-1990s, the amount of winter warming has been approximately double summer warming, the report says.

2% of total working hours are projected to be lost each year due to heat stress at work, representing more than \$4 trillion annually by 2030. When 100 million Americans are under a heat alert, that could mean up to one in three employees – or more, depending on your company's geography — are at risk at a given time, ([Varley, 2023](#)).

SOURCE: [Barndollar, 2022](#)

# Climate Change – Fire, Wind, Water

## Fire, Wind, Water

High temperatures, low humidity, little rainfall, dry vegetation, and fast winds. Wildfires depend on a combination of environmental conditions to start and spread. As global temperatures rise, research shows these conditions are appearing more intensely and frequently — escalating the risk of wildfires, ([Patel, 2021](#)).

Climate change enhances the drying of organic matter in forests (the material that burns and spreads wildfire) and has doubled the number of large fires between 1984 and 2015 in the western United States, ([C2Es](#)).

Particulate matter includes PM10, inhalable particles that are 10 micrometers and smaller in diameter, and PM2.5, inhalable particles with diameters of 2.5 micrometers and smaller. PM2.5 poses a greater health risk than PM10 as particles are so small (30 times smaller than the diameter of a human hair) and can get deep into the lungs and bloodstream.



# Climate Change – Fire, Wind, Water

## Fire, Wind, Water

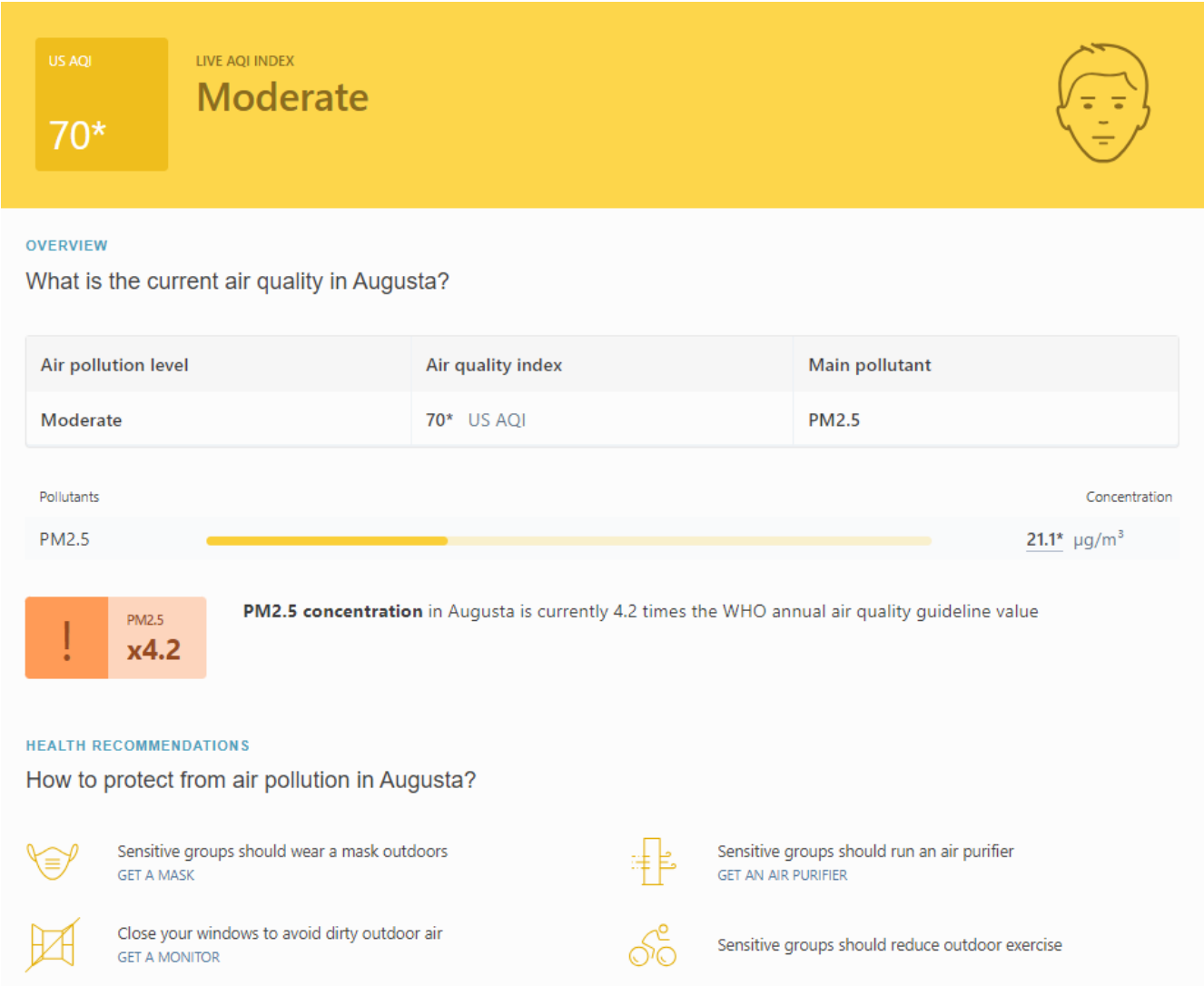
### Augusta Maine AQI

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 California	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.

# Climate Change – Fire, Wind, Water

## Fire, Wind, Water

### Augusta Maine AQI



Ok, I'll just buy more shorts, easy fix.

# Climate Change – Fire, Wind, Water

## Fire, Wind, Water

Hurricanes in the Atlantic Ocean, typhoons in the western Pacific Ocean, cyclones in the Indian Ocean, and strong tropical cyclones are an example of nature's fiercest fury. The warmer water temperatures, the more heat energy is available and the higher the potential for tropical cyclones to develop, ([Berardelli, 2019](#)).

Current climate models indicate that rising temperatures will intensify the Earth's water cycle, increasing evaporation. Increased evaporation will result in more frequent and intense storms, ([NASA](#)).

As global warming continues to exacerbate sea level rise and extreme weather, our nation's floodplains are expected to grow by approximately 45 percent, ([Denchak, 2019](#)).

That may help with the heat, but its more then that.

# Climate Change – Flooding and Storms

## Flooding and Storm Systems

The strong link between climate extremes and rising global average temperatures means continued global warming will mean more drought and rainstorms that are worse by many measures — more frequent, more severe, longer and larger, ([Science, 2023](#)).

Due to global warming, global climate models predict hurricanes will likely cause more intense rainfall and have an increased coastal flood risk due to higher storm surge caused by rising seas, ([Colbert](#)).

Extreme precipitation is expected to intensify with global warming as the concentration of atmospheric water vapor, which supplies the water for precipitation, increases in proportion to the saturation concentrations at a rate of about 6–7% per degree rise in temperature, ([Tabari, 2020](#)).

Humm, maybe it is getting rough out there.  
But how will it affect me.....

# Impacts on Health and Industry

## Respiratory Impacts

Outdoor air pollutants (ground-level ozone-particulate matter like dust from droughts and wildfire smoke) are expected to increase. All lead to respiratory illnesses, including asthma.

Earlier spring warming, precipitation changes, and rising temperatures and carbon dioxide concentrations can increase the length and severity of the pollen season, ([EPA](#)).

Research has linked the increased air pollution to acute health effects like coughing, eye irritation, and chronic health effects like heart disease, respiratory diseases, and allergic disorders, ([CDC](#)).

How much time you got?

# Impacts on Health and Industry

## Outdoor Workers

High heat leaved construction worker's 14 times more likely to die of a heat related injury or illness, ([Newsroom, 2022](#)).

A punishing mix of heat and humidity that makes outdoor labor difficult and dangerous is causing around 677 billion lost working hours a year around the world and over the past 40 years heat related labor losses have increased 9%, ([MacNamara, 2022](#)).

Workers are at greater risk of decreased productivity and disruptions from extreme heat and wildfire smoke threats which also shorten the construction season or cause work slowdowns, ([Pyzyk, 2022](#)).

(Minnesota) Construction and extraction are likely to be hit the hardest, with a projected loss of \$114 million due to extreme heat. Outdoor workers could lose up to 7 days of employment in some counties. ([Askari, 2021](#))

# Impacts on Health and Industry

## Construction Projects

Unpredictable weather affects both construction timelines and budgets. Climate is the biggest and most important factor in construction; it's what determines the materials used, the time frame for construction and the durability and longevity of the constructed building, ([Heigl, 2018](#)).

The estimated cost of weather-related delays in the United States alone approaches \$4 billion, ([Hegeman, 2019](#)).

Extreme weather events that result in severe flooding and drought, damaged buildings, and project disruptions. Additionally, unforeseen costs could arise, such as an increase in workers' compensation cases when employees are exposed to extreme weather conditions, ([Elissa, 2022](#))

Wow, so this will create human and industry risk. But *surely* the government has it under control.....

# Policy and Regulation - FEDERAL

The White House announced enhanced and expanded efforts OSHA is taking to address heat-related illnesses. OSHA is implementing an enforcement initiative on heat-related hazards, developing a [National Emphasis Program](#) on heat inspections, and launching a rulemaking process to develop a workplace heat standard. In addition, the agency is forming a National Advisory Committee on Occupational Safety and Health Heat Injury and Illness Prevention Work Group, ([OSHA, 2021](#)).

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**DIRECTIVE NUMBER:** CPL 03-00-024

**EFFECTIVE DATE:** April 8, 2022

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**SUBJECT:** National Emphasis Program – Outdoor and Indoor Heat-Related Hazards

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## **ABSTRACT**

### **Purpose:**

This Instruction describes policies and procedures for implementing a National Emphasis Program (NEP) to protect employees from heat-related hazards and resulting injuries and illnesses in outdoor and indoor workplaces. This NEP expands on the agency's ongoing heat-related illness prevention initiative and campaign by setting forth a targeted enforcement component and reiterating its compliance assistance and outreach efforts. This approach is intended to encourage early interventions by employers to prevent illnesses and deaths among workers during high heat conditions, such as working outdoors in a local area experiencing a heat wave, as announced by the National Weather Service. Early interventions include, but are not limited to, implementing water, rest, shade, training, and acclimatization procedures for new or returning employees.

### **Scope:**

This Instruction applies OSHA-wide.

No, not yet, and don't call me Shirley.



# Policy and Regulation - FEDERAL

## **Federal**

On October 27, 2021, OSHA published an Advance Notice of Proposed Rulemaking ([ANPRM](#)) for Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings in the Federal Register. With this publication, OSHA has begun the rulemaking process to consider a heat-specific workplace standard. The publication of this ANPRM has no impact on OSHA's current enforcement policies, ([OSHA](#)).

### **ACTION:**

Advance notice of proposed rulemaking (ANPRM).

### **SUMMARY:**

OSHA is initiating rulemaking to protect indoor and outdoor workers from hazardous heat and is interested in obtaining additional information about the extent and nature of hazardous heat in the workplace and the nature and effectiveness of interventions and controls used to prevent heat-related injury and illness. This ANPRM provides an overview of the problem of heat stress in the workplace and of measures that have been taken to prevent it. This ANPRM also seeks information on issues that OSHA can consider in developing the standard, including the scope of the standard and the types of controls that might be required.

# Policy and Regulation - FEDERAL

NEP Actions. OSHA Can Conduct Inspections on 80 degrees Fahrenheit+ Heat Index Days, (Birkholz, 2022).

Here are a few scenarios where OSHA could and would likely inspect for heat stress.

- Scenario 1: Facility has a reportable injury, such as an inpatient hospitalization because of employee heart attack, and the heat index was above 80 the day of the incident.
- Scenario 2: Employee complaint to OSHA about unsafe work conditions related to heat.
- Scenario 3: Pre-planned inspection for combined NEPs subject to the industry such as Forklift, Noise and Heat.

Know What OSHA Will Look For During an Inspection:

- Supply OSHA 300 Logs and 301 Incident reports (if required by that industry).
- Interview workers for symptoms of headache, dizziness, fainting, dehydration or other conditions that may indicate heat-related illnesses, including both new employees and any employees who have recently returned to work.
- Determine if the employer has a heat illness and injury program addressing heat exposure, and consider the following:

# Policy and Regulation - STATE

There are no federal or state standards that specifically protect workers from heat illness, and Texas cities and counties will soon be barred from making local rules with that purpose. Texas has recorded 42 heat-related deaths on the job since 2011 — more than any other state, according to U.S. Bureau of Labor Statistics data. ([Uranga, 2023](#)).

The federal government is in the midst of a years-long process to draft heat safety rules, and only six states have their own regulations that guarantee laborers access to water, rest and shade — the three elements that medical professionals say can protect workers from heat illness, ([Bogage et al, 2023](#)).

[California](#), [Oregon](#) and [Washington](#) — require heat breaks for outdoor workers. Minnesota has a rule that sets standards for indoor workers, and Colorado's heat regulations cover only farmworkers.

New York legislation that would have required worker protections died in committee and bipartisan efforts in Florida to set heat standards for worker safety have failed the past three years, ([Barrett, 2023](#)).

OK. Are there any solutions I can implement.....

# Policy and Regulation - COMPANY

The danger during extreme weather conditions is typically due to inadequate or insufficient precautionary and protection measures. If you think your jobsite is at risk for extreme weather conditions, it's time to act by involving all employees in safety meetings and plans, ([Elissa, 2022](#))

Under the Occupational Safety and Health Act, employers are responsible for providing workplaces free of known safety and health hazards. This includes protecting workers from heat-related hazards. ([OSHA](#))

Suggested Actions:

- 1) Create a heat illness prevention plan
- 2) Develop deliver training to workers
- 3) Understand heat illness first aid
- 4) Post / share educational publications

Of course!!

# Policy and Regulation - COMPANY

What are six actions to consider in navigating this challenge, ([Varley, 2023](#))

- 1) Take preventative actions
- 2) Know how hot is too hot – and for whom
- 3) Maximize indoor thermal comfort
- 4) Tailor to safety for outdoor workers
- 5) Practice acclimatization
- 6) Implement a long-term heat-health action plan

Employers should reduce workplace heat stress by using engineering and administrative (work practice) controls. An engineering control could be a change to the design of the workplace that reduces exposure to heat.

Administrative controls are changes to tasks or schedules to reduce heat stress, ([CDC](#)). Key steps:

- 1) Control
  1. Training
  2. Acclimatization
  3. Hydration
  4. Rest Breaks

# **Solutions - Administrative Tools**

Acclimatization: Allow sufficient time to accumulate prior full workload.

Work Duration: Shorten exposure time and use frequent rest breaks.

Rest Area: Provide cool (air-conditioning) rest-areas.

Water: Provide cool drinking water.

Pace of work: When possible, allow workers to set their own pace.

First Aid – Medical Care: Implement emergency procedures.

# Solutions – Wearable Tech

1. What is the device “actually” measuring? (skin temp, heart rate)
2. How well are the sensors within the device measuring what they are intended to measure?
3. Has the device been validated?
4. Does the instrument consider user variables?
5. What do we intend to do with the information provided by the device?  
Use the “right sensors used right” approach
6. Are we prepared for the reality of what this device will report?
7. How will our workforce react to our suggestion that the device be used?
8. How will we set and respond to alarms?

(Pizzani et al, 2023)

# Solutions - Proactive Monitoring

1. Monitor weather patterns
2. Use Apps to monitor or assess exposures
3. Build into safety plans heat controls / awareness plans
4. Establish a company culture or heat safety prevention
5. Understand individual heat tolerances

Suggested Actions and Impact Prevention		
WBGT(F)	Effects	Precautionary Actions
< 80		
80-85	Working or exercising in direct sunlight will stress your body after 45 minutes.	Take at least 15 minutes of breaks each hour if working or exercising in direct sunlight
85-88	Working or exercising in direct sunlight will stress your body after 30 minutes.	Take at least 30 minutes of breaks each hour if working or exercising in direct sunlight
88-90	Working or exercising in direct sunlight will stress your body after 20 minutes.	Take at least 40 minutes of breaks each hour if working or exercising in direct sunlight
>90	Working or exercising in direct sunlight will stress your body after 15 minutes.	Take at least 45 minutes of breaks each hour if working or exercising in direct sunlight



# Solutions - Proactive Monitoring (ACGIH)

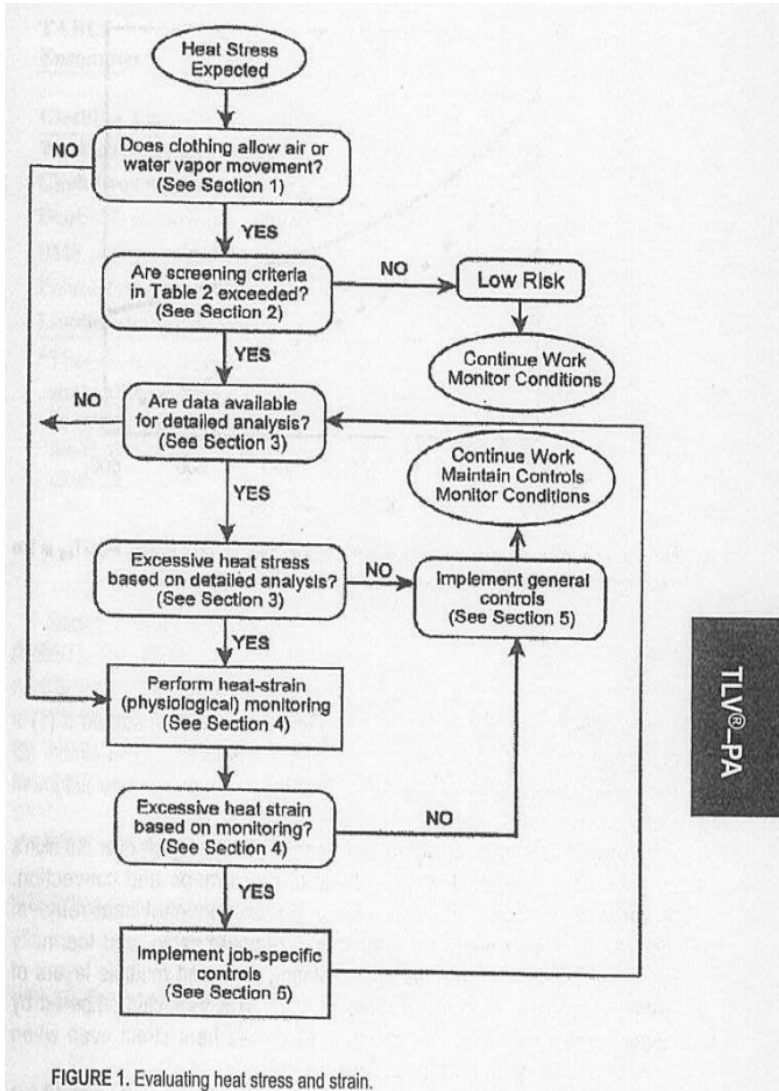


FIGURE 1. Evaluating heat stress and strain.

Image of Figure 1 – Evaluating heat stress and strain from the ACGIH 2019 TLV and BELs.

Acclimatization: Gradual physiological adaptation improves an individual's ability to tolerate heat stress. Requires physical activity under heat stress.

The TLV for heat stress and strain is based on maintaining body core temperature within 1 C of “normal.”

With a recent history of heat-stress exposures of at least 2 continuous hours a worker can be considered acclimatized for purposes of a TLV.

(5 of last 7 days to 10 to 14 days)

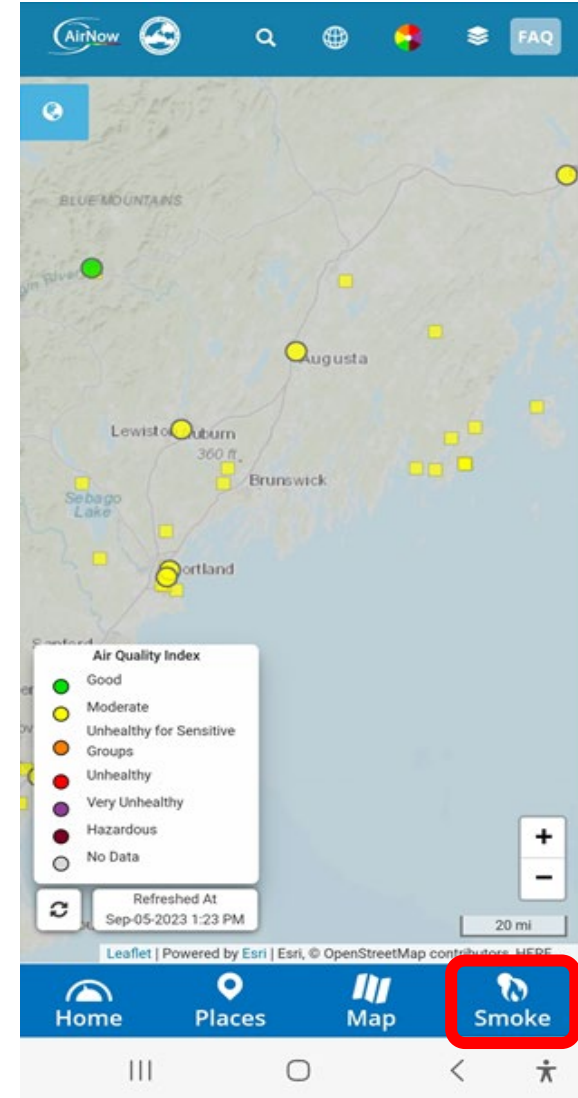
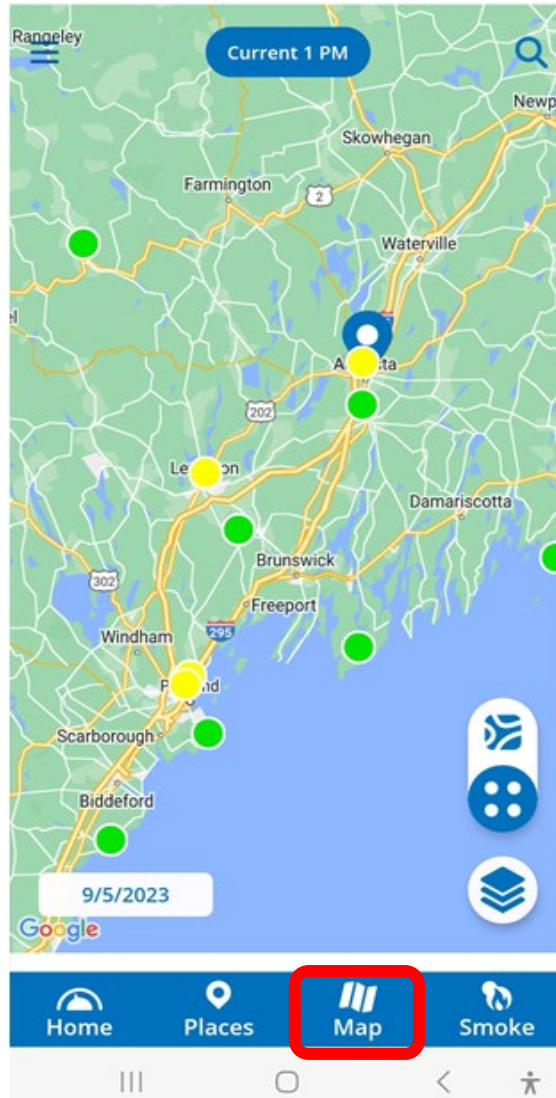
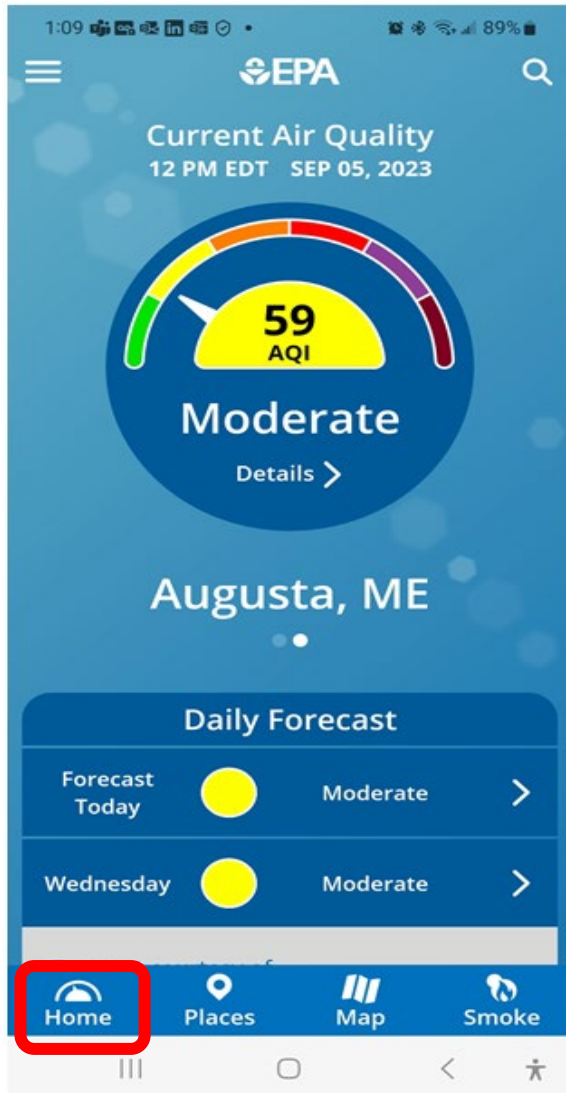
$$WBGT_{OUT} = 0.7 T_{nwb} + 0.2 T_g + 0.1 T_{db}$$

$$WBGT_{in} = 0.7 T_{nwb} + 0.3 T_g$$

(ACGIH, 2019)

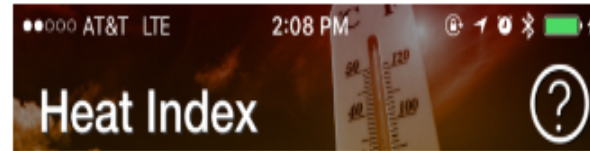
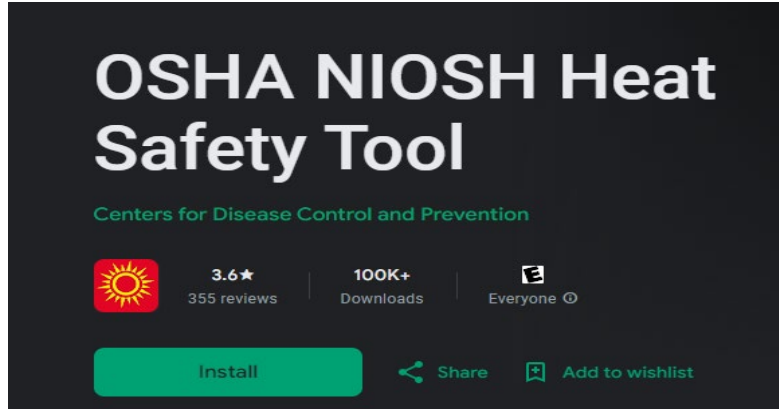
# Solutions – APPS (AQI)

AirNow (Android) and (iPhone)



# Solutions – APPS (HEAT)

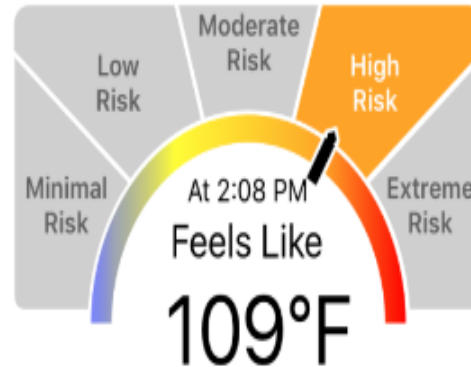
OSHA-NIOSH Heat Safety App ([Android](#) and [iPhone](#))



Calculated

95°F

55%



Precautions

Conditions are hazardous.



That was a lot of information. Can you summarize it, it's getting hot in here. Get it?!

# Summary

Data shows increased heat levels are real (for how long, we don't know)  
Increases in oceanic water temps increases latent heat energy – storms  
Injury metrics are showing increased risks to worker safety and wellbeing  
Increases in rainfall can result in safety concerns in construction environments

ACGIH guidelines and TLVs can provide support  
Federal standards are being developed to help control risks  
Some states are working against this regulatory approach and some for  
OSHA has outdoor and indoor heat-related- hazards as a National Emphasis Program

PM10 and 2.5 risks increased  
More warm days increases pollen risks  
Health Hazards: increases fire, winds, and drying of areas  
Wildfire generate heat and particulate which with minimal heat aloft, stays low

Use wearable tech if found appropriate  
Use administrative and work rest programs  
Encourage the use of app based real time monitoring tools  
Be proactive and implement heat and safety plans that include exposure limits

Yeah...funny.





# THANK YOU!

**CLIMATE AND OCCUPATIONAL SAFETY: HEAT, SMOKE, FLOODING**

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