

Overview of Climate Change and the Effects on Worker Health

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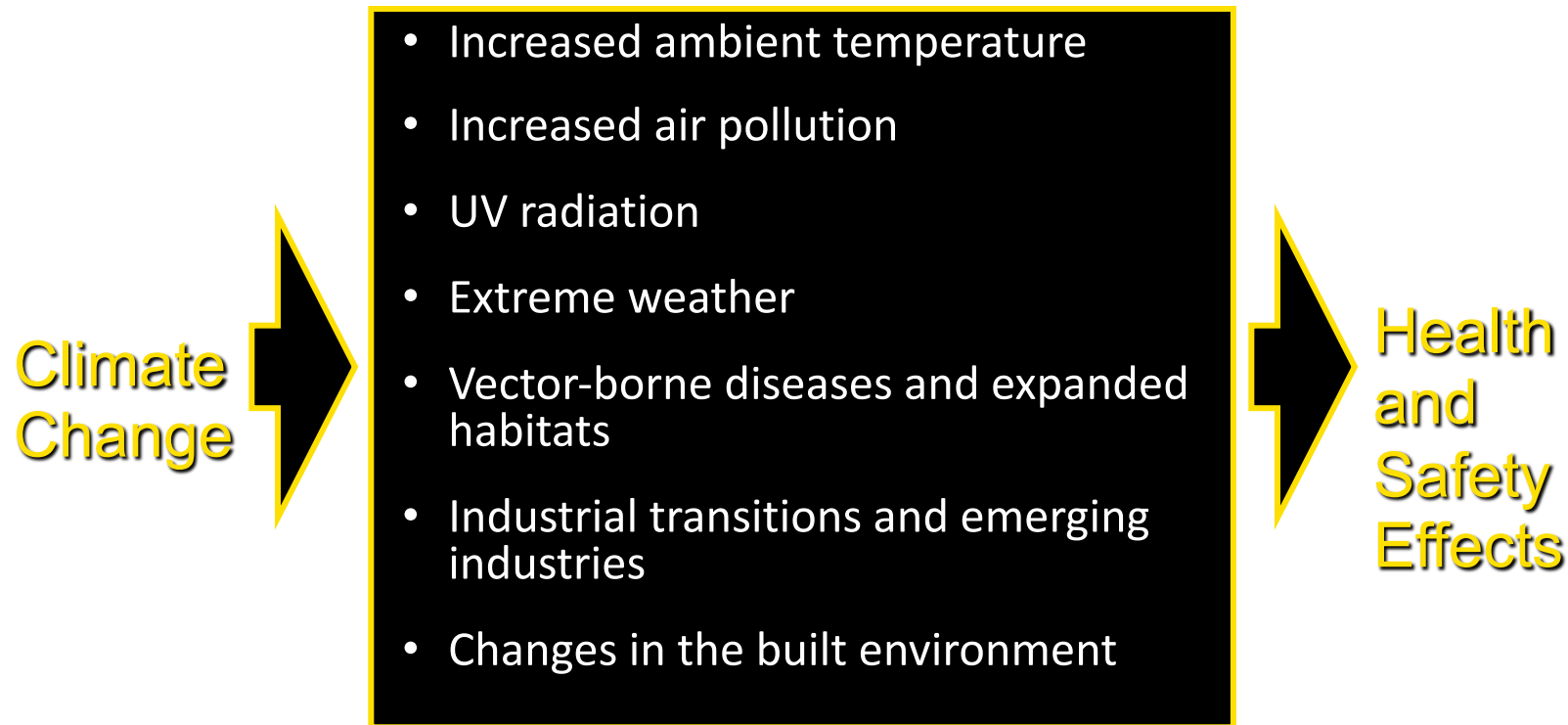
Disclaimer: The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health.



- ❑ Prior to 2009, the relationship between climate change and occupational safety and health generally had not been comprehensively characterized
- ❑ There was a range of literature on individual hazards
- ❑ Broad overviews were lacking

Links between Climate Change and Occupational Safety and Health Effects

Occupational Hazards/Exposures



(Schulte and Chun 2009)

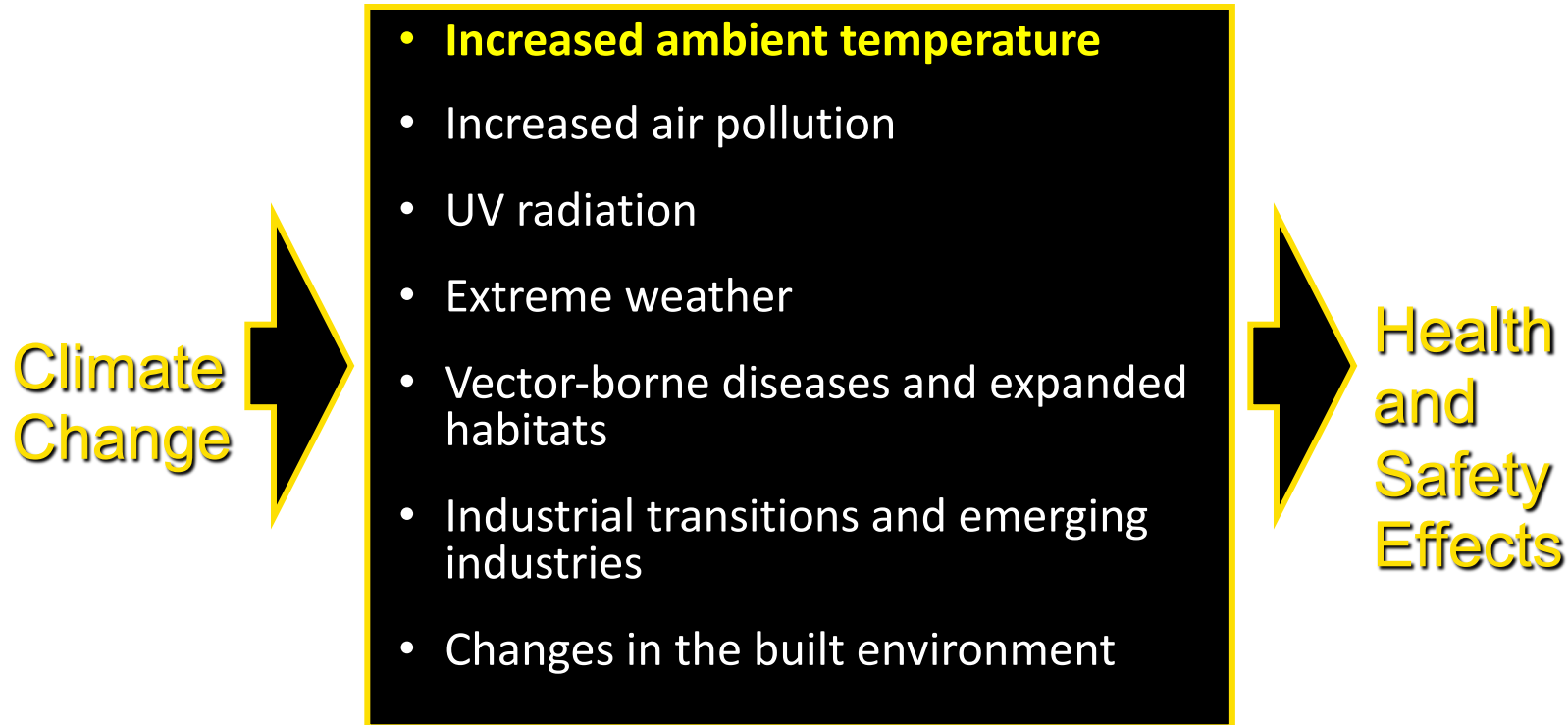
Why are workers at risk of occupational safety and health effects from climate change?

- ❑ Likely to have more and greater exposure than general public
- ❑ Employers may not be sufficiently informed or prepared to institute adequate risk management
- ❑ Workers are not a specific part of states' climate change action plans

Hazards to Workers

Links between Climate Change and Occupational Safety and Health Effects

Occupational Hazards/Exposures

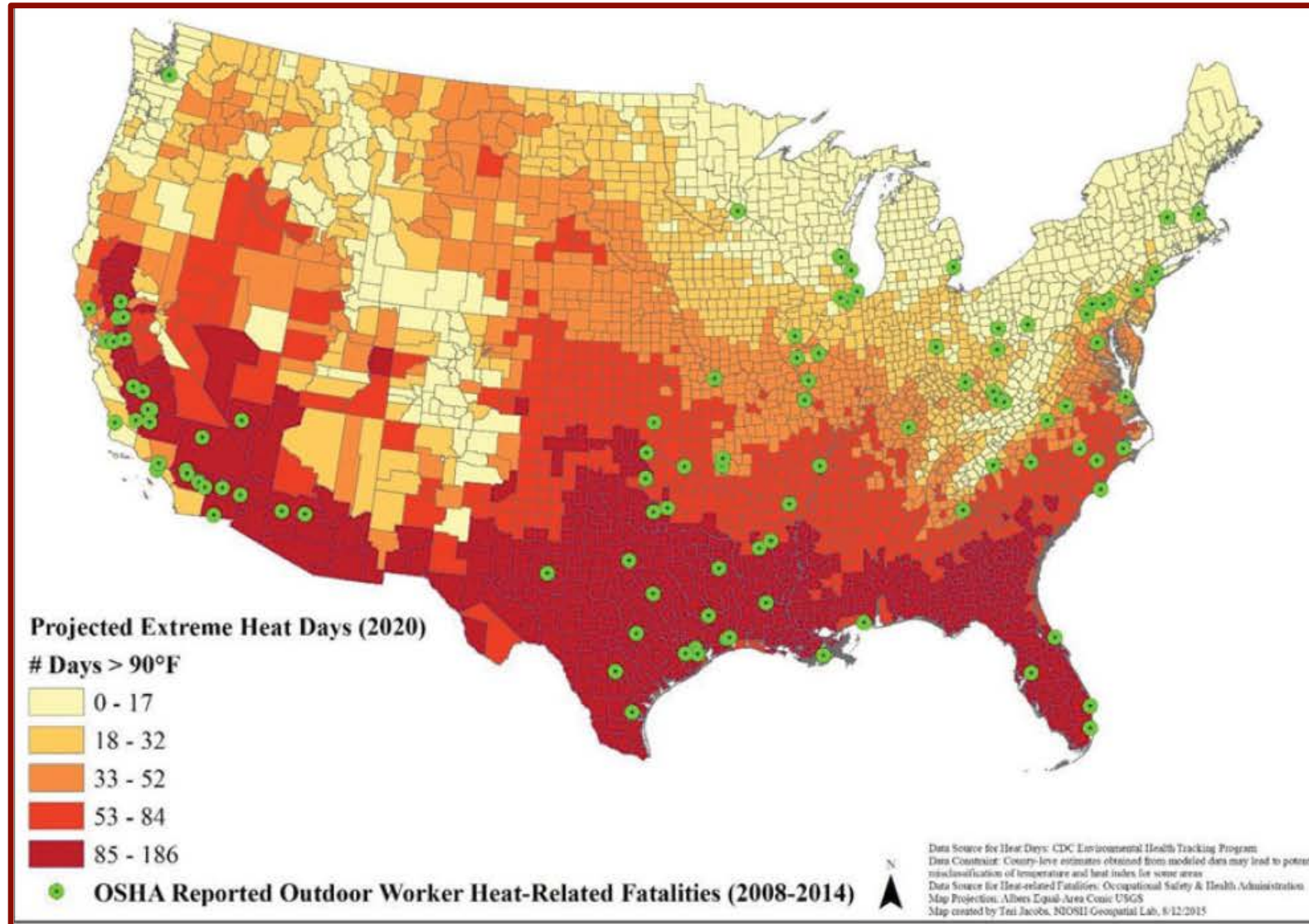


(Schulte and Chun 2009)

Increased Ambient Temperature

- ❑ Global mean surface air temperature increased in the last 100 years

Individual Outdoor Heat-related Fatalities 2008-2014 on Projection of Number Days > 90°F in 2020



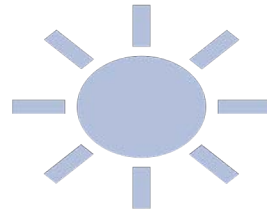
Definition of Heat Stress

The net heat load to which a worker is exposed from the combined contributions of



Metabolic Heat

- Level of exertion
- Length of time



Environmental Factors

- Temperature
- Humidity
- Air flow



Clothing & PPE

- Long sleeves
- Long pants
- Hard hats
- Respirators
- Gloves

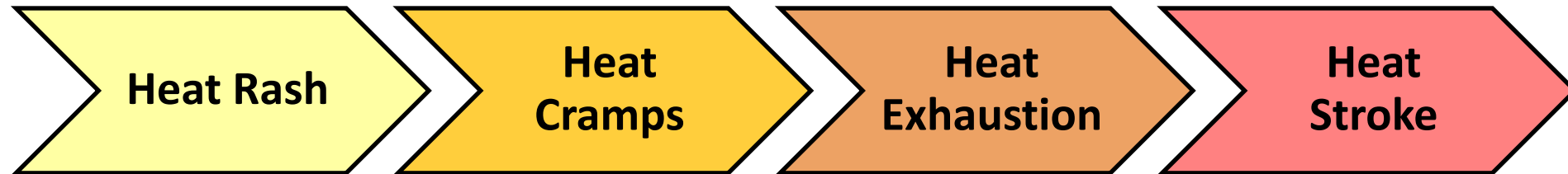
which results in an increase in heat storage in the body.



Health Effects Heat-related Illnesses

SEVERITY

Less Severe ----- More Severe



Discomfort ----- Death

SYMPTOMS/OUTCOMES

Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health



NIOSH

Heat Stroke: Classical vs. Exertional

Characteristic	Classical Heat Stroke	Exertional Heat Stroke
Age	Young children or elderly	15-45 years
Health	Chronic illness common	Usually healthy
Activity	Sedentary	Strenuous exercise
Sweating	Usually absent	Often present
Prevailing weather	Frequent in prolonged heat waves	Variable
Rhabdomyolysis	Seldom severe	Common, may be severe
Acute renal failure	Fairly rare	Common

Adapted from Heat Stress Control and Heat Casualty Management [DOD 2003].

Number of HRIs, Injuries, & Deaths

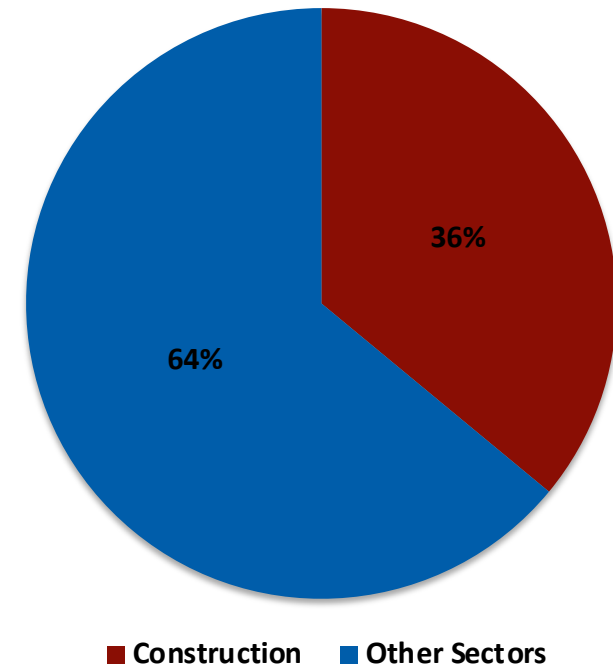
From 1992-2016, work-related environmental heat was responsible for:

69,374 HRIs & Injuries

783 Deaths

(BLS 2019)

Heat-related Deaths
(1992-2016)



Heat Stress & Toxicology

- Changes to core temperature can alter the absorption, distribution, metabolism, & excretion of toxicants (e.g., pesticides).

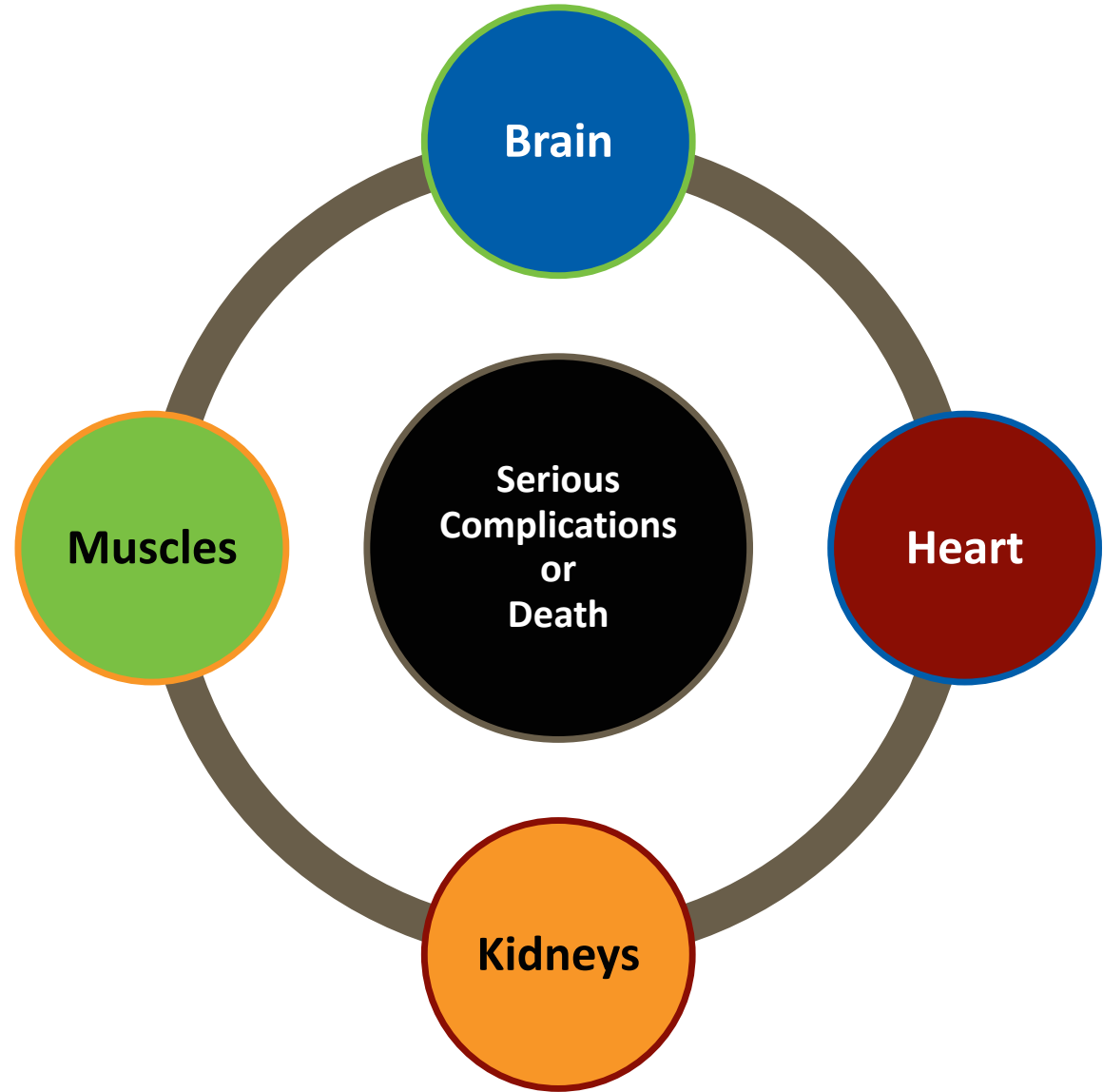


- High temperatures may accelerate dispersion & increase the density of airborne particles.
- Less likely to use or correctly use PPE because of discomfort from the heat.
- Other airborne pollutants may put additional strain or have exacerbated health effects in hot environments.

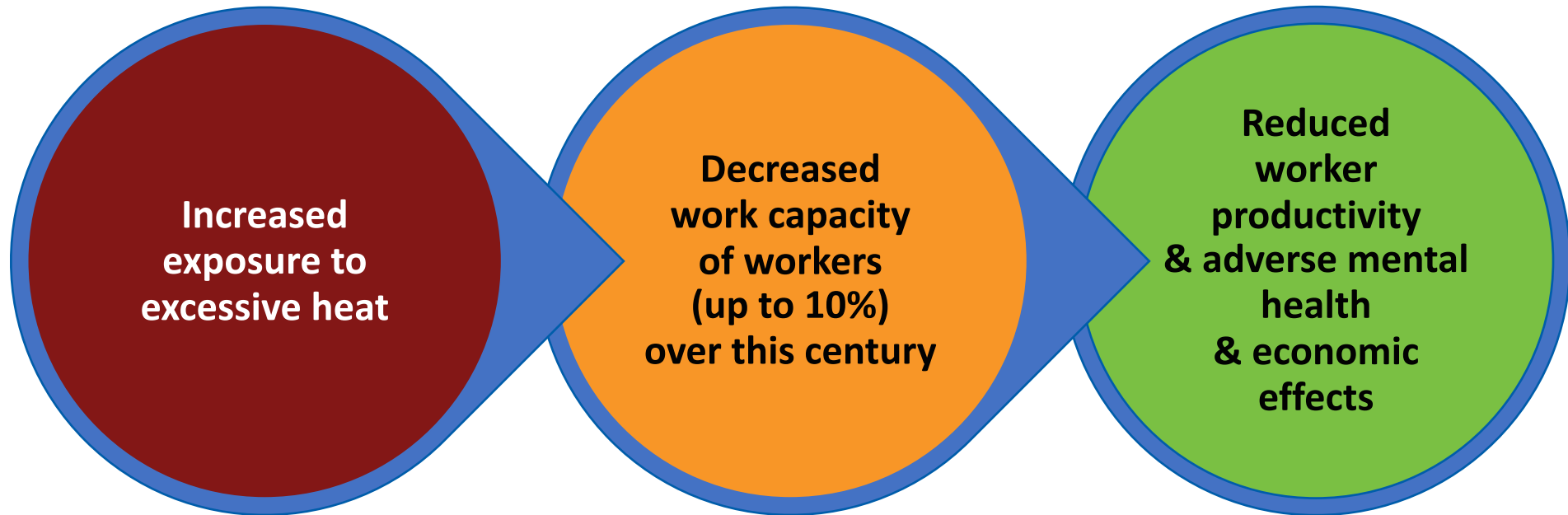
Severity of Heat Stress

**With delayed treatment,
the mortality rate
may be as high as 80%.**

**In 2015, 2830 cases of
occupational HRI resulted in at
least 1 day of lost work, with
214 hospitalizations and 37
fatalities.**

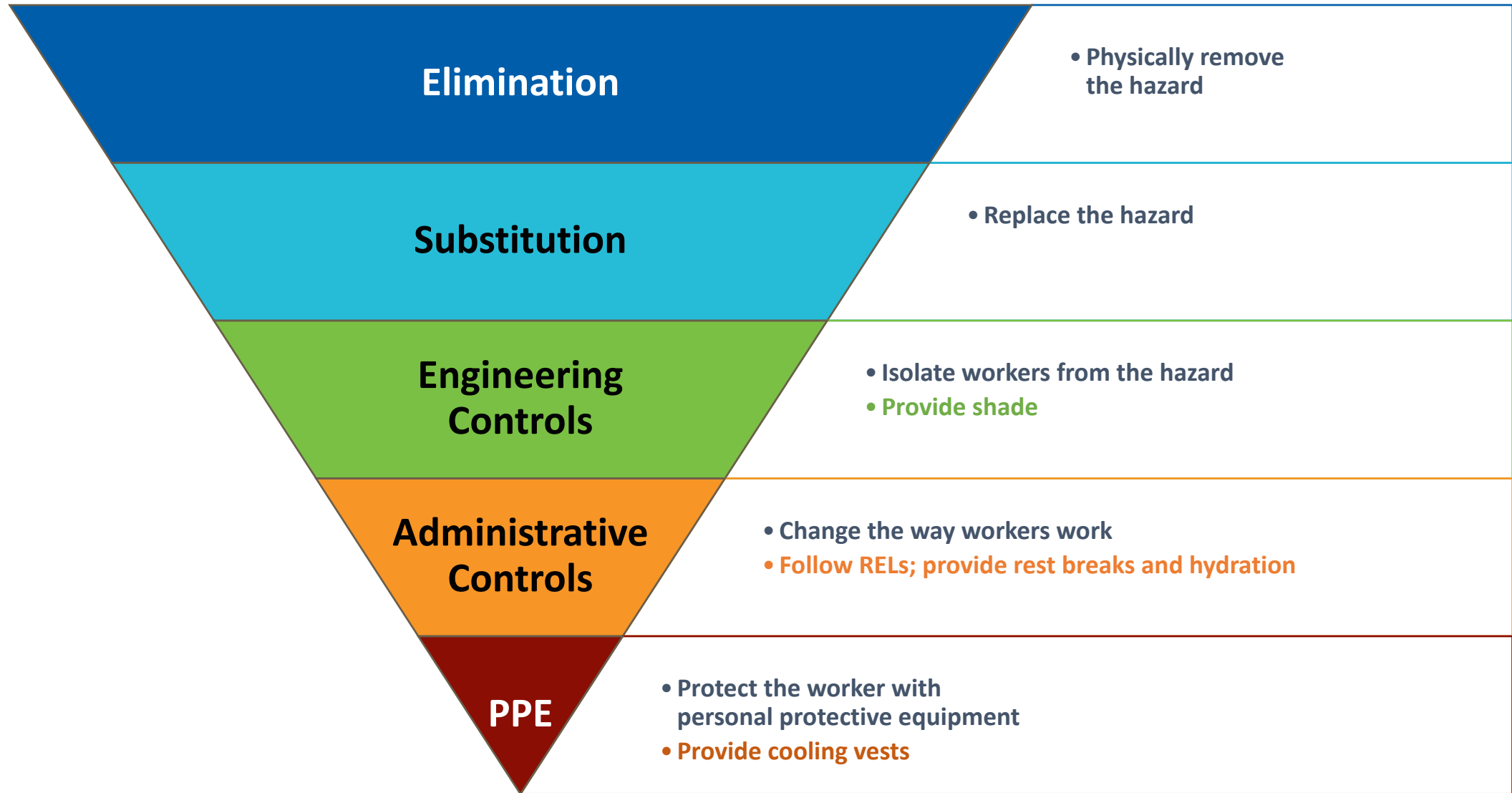


Cost of Increasing Heat Exposures

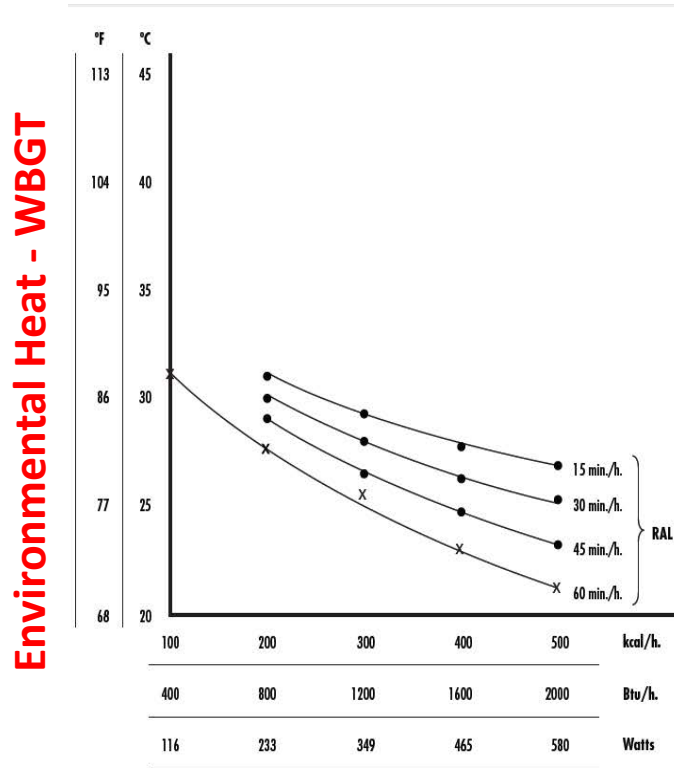


Estimated global net costs of heat-related reductions in work productivity are \$2.4 trillion by 2030.

Hierarchy of Controls for Heat Hazards

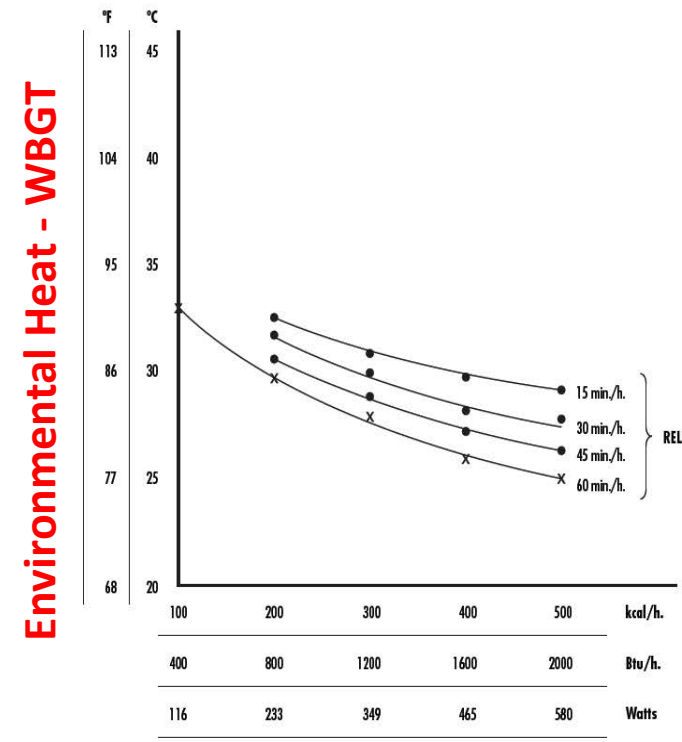


NIOSH Recommended Limits



Recommended Alert Limit (RAL)

For Unacclimatized Workers



Recommended Exposure Limit (REL)

For Acclimatized Workers

Administrative Controls

- Limit time in heat and/or increase rest time in a cool environment
- Increase the number of workers per task
- Implement a heat alert program when a heat wave is likely
- Require workers to conduct self-monitoring
- Implement a buddy system

Set up a buddy system

Check your workers routinely to make sure...

- ☒ they make use of readily available water and shade.
- ☒ they don't have heat-related symptoms.



Training for Workers & Supervisors

- Recognize symptoms of HRI
- First aid
- HRI risk factors
- Importance of acclimatization
- Importance of reporting HRI symptoms



Be aware that protective clothing or **personal protective equipment** may increase the risk of heat stress.



Additional Training for Supervisors

- Implementation of an acclimatization plan
- Procedures for when HRI symptoms are present
- Monitoring weather reports & responding to advisories
- Monitoring & encouraging adequate hydration/rest breaks

Acclimatization

Result of beneficial physiological adaptations that occur after gradual increased exposure to a hot environment.

Acclimatization for New Workers

Closely supervise new employees for the first 14 days.

Acclimatization for Returning Workers with Previous Experience

Acclimatization can be maintained for a few days of non-heat exposure.



The infographic features three tips for heat acclimatization, each with a title in a brown box. The background includes a stylized illustration of a construction site with a crane, a dump truck, and workers. The text is in a clean, sans-serif font, with percentages highlighted in red.

TIP 1
Gradually increase the time spent in hot environmental conditions over a 7–14 day period.

TIP 2
For new workers, the schedule should be no more than 20% exposure to heat on day 1 and an increase of no more than 20% exposure on each additional day.

TIP 3
For workers who have had previous experience with the job, the acclimatization schedule should be no more than:

DAY 1	DAY 2	DAY 3	DAY 4
50%	60%	80%	100%
EXPOSURE	EXPOSURE	EXPOSURE	EXPOSURE

Hydration

Employers should provide appropriate hydration

- Water should be cool and near the work area
- Provide individual drinking cups
- Encourage workers to hydrate

Drink an Appropriate Amount to Stay Hydrated.

If you are:

Drink:

In the heat < 2 hours & involved in moderate work activities

1 cup (8 oz.) of water every 15-20 minutes

Experiencing prolonged sweating lasting several hours

Sports drinks containing balanced electrolytes

Rest Breaks

- Ensure and encourage rest and hydration breaks.
- Permit breaks when a workers feels discomfort.
- Assign new workers lighter work and longer, more frequent breaks.
- Shorten work and increase rest periods:
 - As temperature, humidity, and sunshine increase
 - When there is no air movement
 - If protective clothing or PPE is worn
 - For heavier work

Communication Efforts

Employers

Need to understand the importance

OSH Professionals

Need accurate recommendations

Workers

Need plain language & visuals



OSHA-NIOSH Heat Safety Tool App

- Calculates heat index using location
- Precautions based on heat index level
- Hourly heat index forecast
- Symptoms & first aid
- Risk factors
- Training recommendations
- ***NEW for 2020***
User programmable hydration & rest reminders



App Store Search: niosh heat

Thermal stress: a common hazard in these workplaces



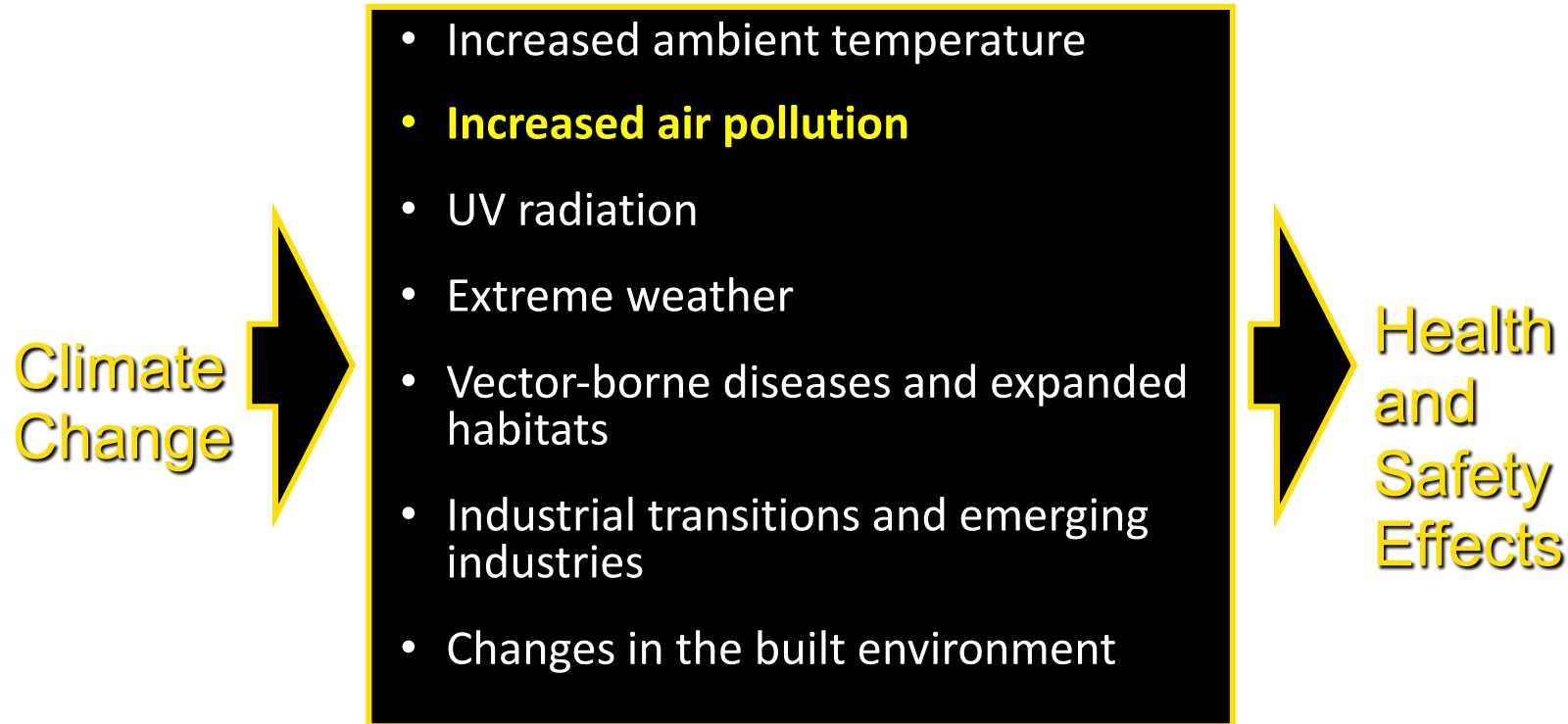
Sugar cane cutting, Nicaragua

Chronic Kidney Disease (CKDu)

- ❑ First major epidemic which may be due to climate change
- ❑ 2nd leading cause of death among men in El Salvador
- ❑ Young men of working age: 20,000 dead
- ❑ Farmers and sugar cane workers, construction workers, corn and rice farmers, cotton plantation workers, and miners
- ❑ Affected countries include: Sri Lanka, India, Saudi Arabia, Bangladesh, Egypt, Mexico, Costa Rica, El Salvador, Nicaragua, Honduras, Thailand
- ❑ Dehydration and heat stress
 - Heat stress → dehydration → higher concentrations of toxicants in serum and kidney

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Occupational Hazards/Exposures



(Schulte and Chun 2009)

Increased Air Pollution

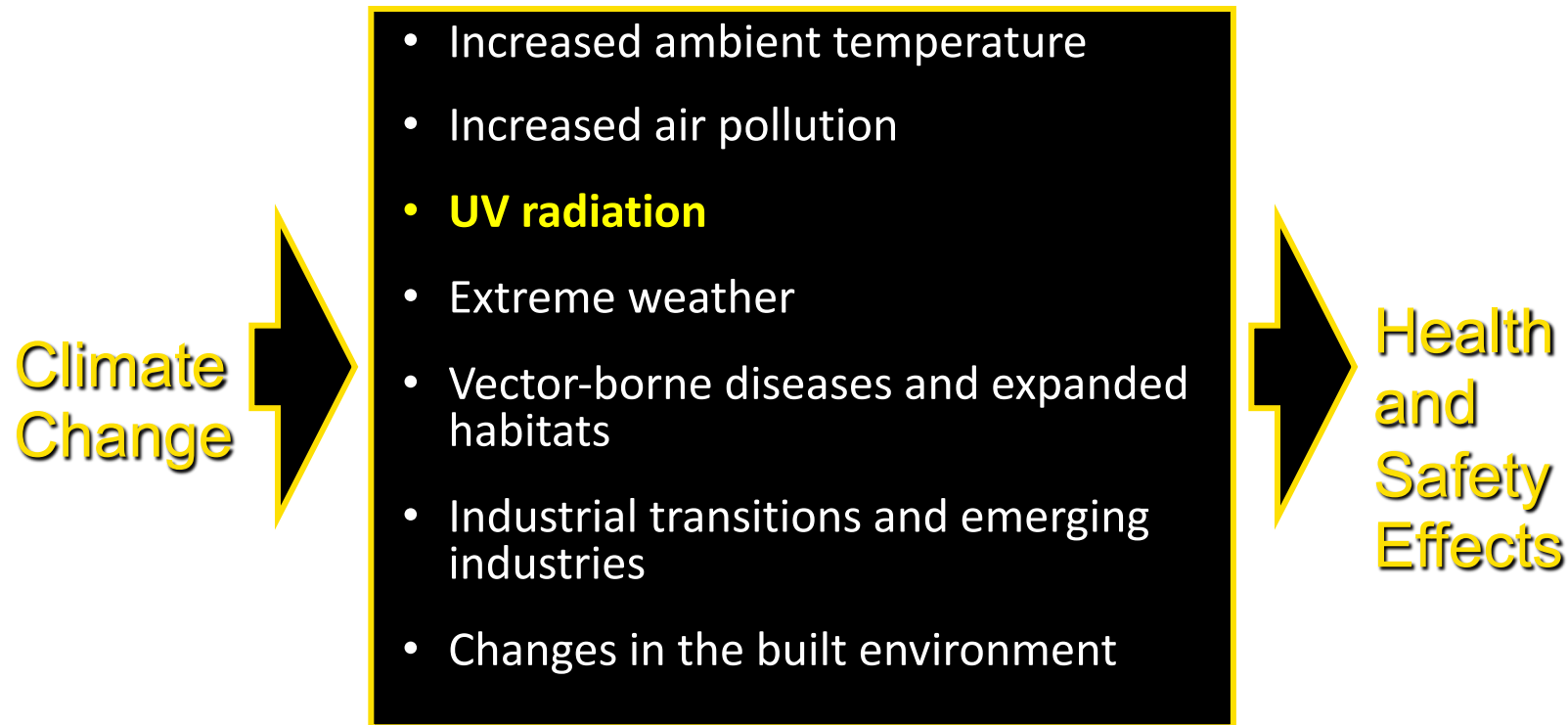
- ❑ Air pollution and climate change have complex reciprocal relationship
 - Various air pollutants increase global warming
 - Global warming leads to formation of various pollutants
- ❑ Ground level ozone created by chemical reactions (oxides of nitrogen and volatile organic compounds) plus rising temperatures
 - Trigger variety of health problems; reduces lung function; exacerbates asthma and risk of premature mortality
 - 2-8 ppb increases in summer time
- ❑ Increase in length and severity of pollen season

Impact on Workers of Air Pollution

- ❑ Not assessed comprehensively
- ❑ Still being assessed
 - Generally air pollution increases respiratory and cardiovascular mortality
 - Can infer risks to workers in geographical areas
 - Combustion a main source
 - Increased frequency of wildland fires
- ❑ Policy makers face challenge in developing optimal control strategies presented by changing climate base lines (Kinney 2008)

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(Schulte and Chun 2009)

Ultraviolet Radiation Exposure

- ❑ Complex interaction of green-house gases, climate change and stratospheric ozone depletion



Increase UV radiation

- ❑ Affects all people (60,000 premature deaths globally in 2000) but particularly outdoor workers
- ❑ Results in skin cancer, eye damage, immune suppression

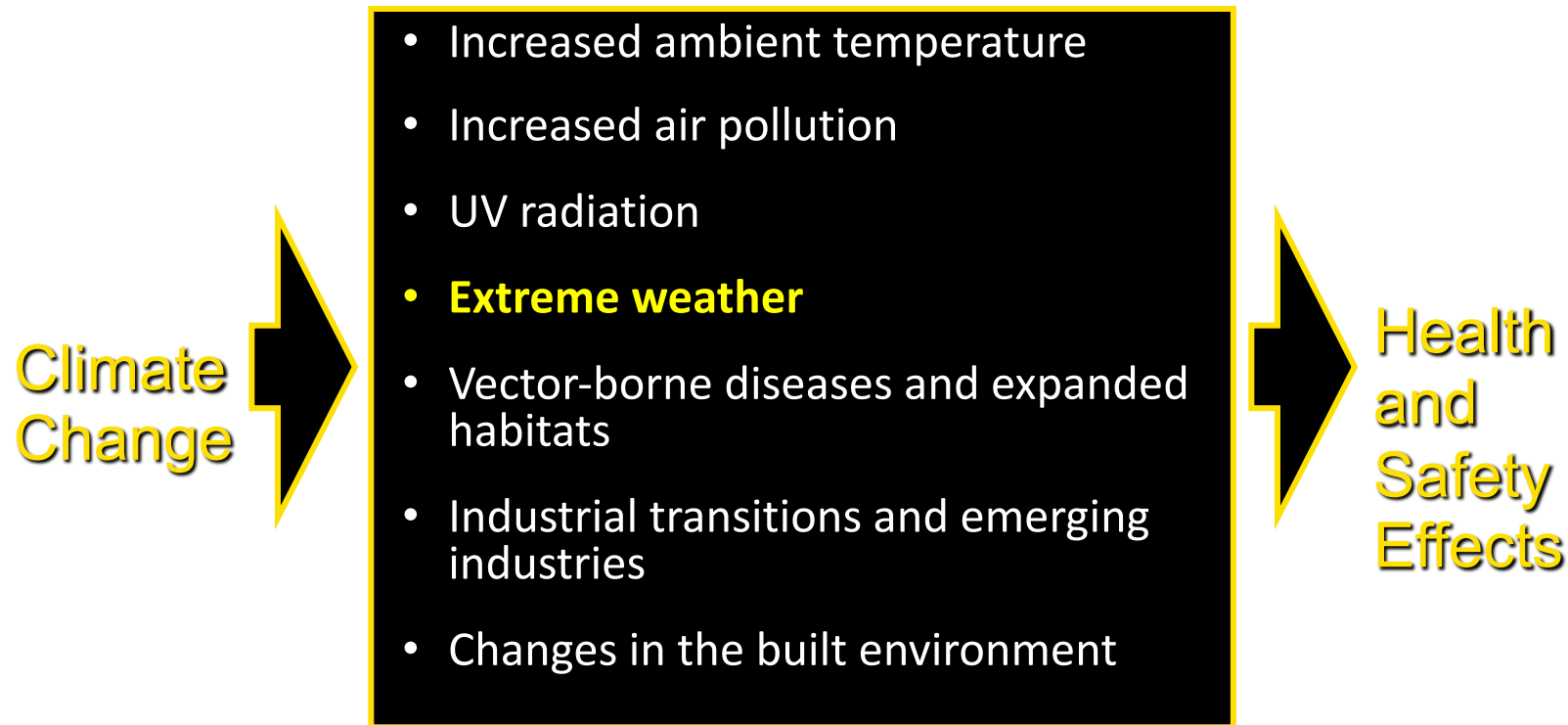
Ultraviolet Radiation Exposure (cont)

- ❑ Also airline pilots are at risk
 - No standard for optical transmission properties of aircraft windshields
 - UV radiation at 10,000 ft 2-3 times what it is at the ground

- ❑ At present UV levels are still increased relative to the 1960's but terrestrial UV radiation is projected to decrease
- ❑ Although the Montreal protocol is reducing ozone-depleting gases
 - Will take time
 - Longer in northern latitudes (Arctic workers)
- ❑ Recovery may take longer in Arctic
 - Increased number of workers predicted
 - More at-risk of UV health effects

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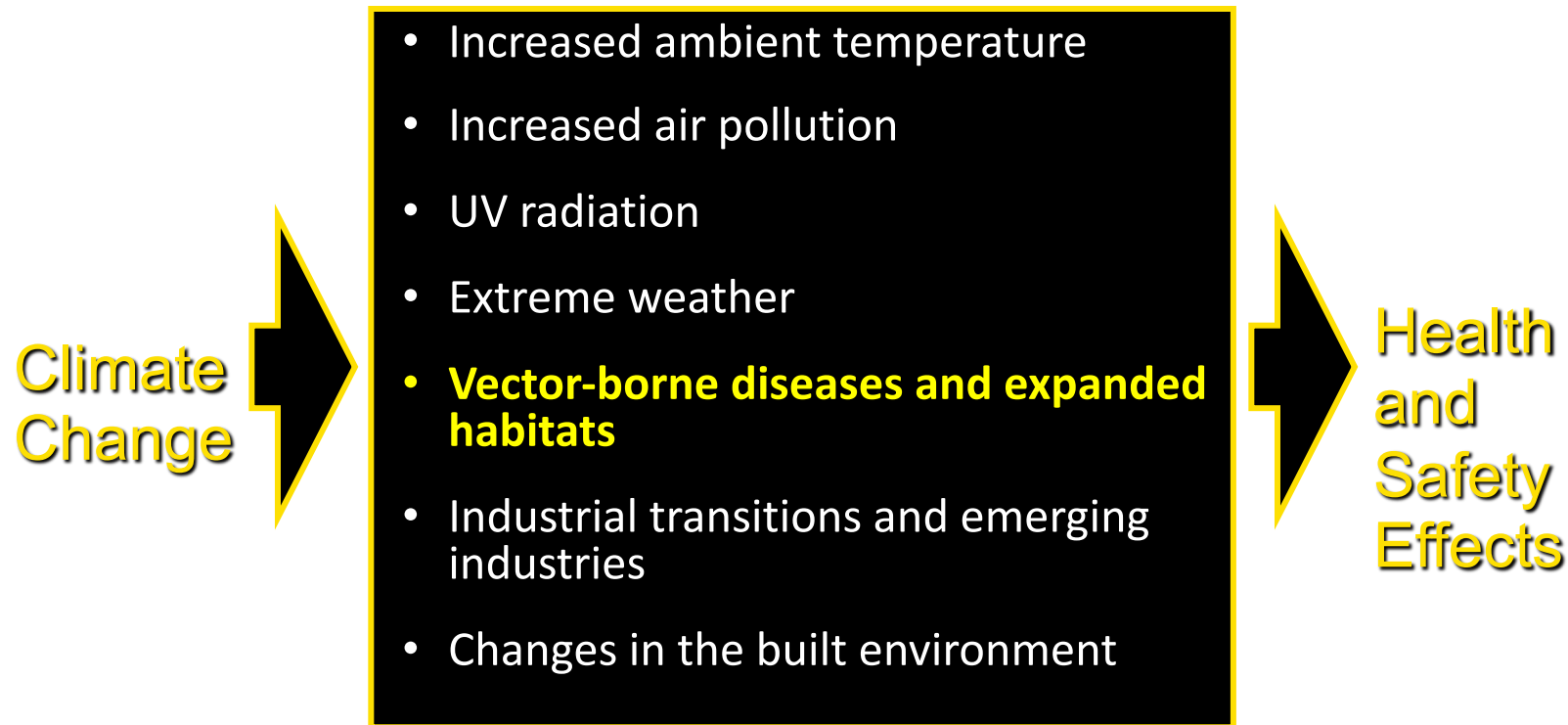
(Schulte and Chun 2009)

Extreme Weather

- ❑ Increasingly extreme weather events are more frequent and intense
 - storms, floods, landslides, droughts, wildfires
 - hazard to outdoor workers and emergency responders
- ❑ 1992-2006: 307 workers died from natural disasters
- ❑ Hazard depends on the disaster
- ❑ Damage to infrastructure and destruction of service networks pose hazards to workers
- ❑ Model predicts lightning strikes in the US at 50% greater frequency over 21st Century
- ❑ Physical fatigue—long work hours
- ❑ Mental stress and fatigue

Links between Climate Change and Occupational Safety and Health Effects

Occupational Hazards/Exposures



(Schulte and Chun 2009)

Vector-borne diseases/expanded habits

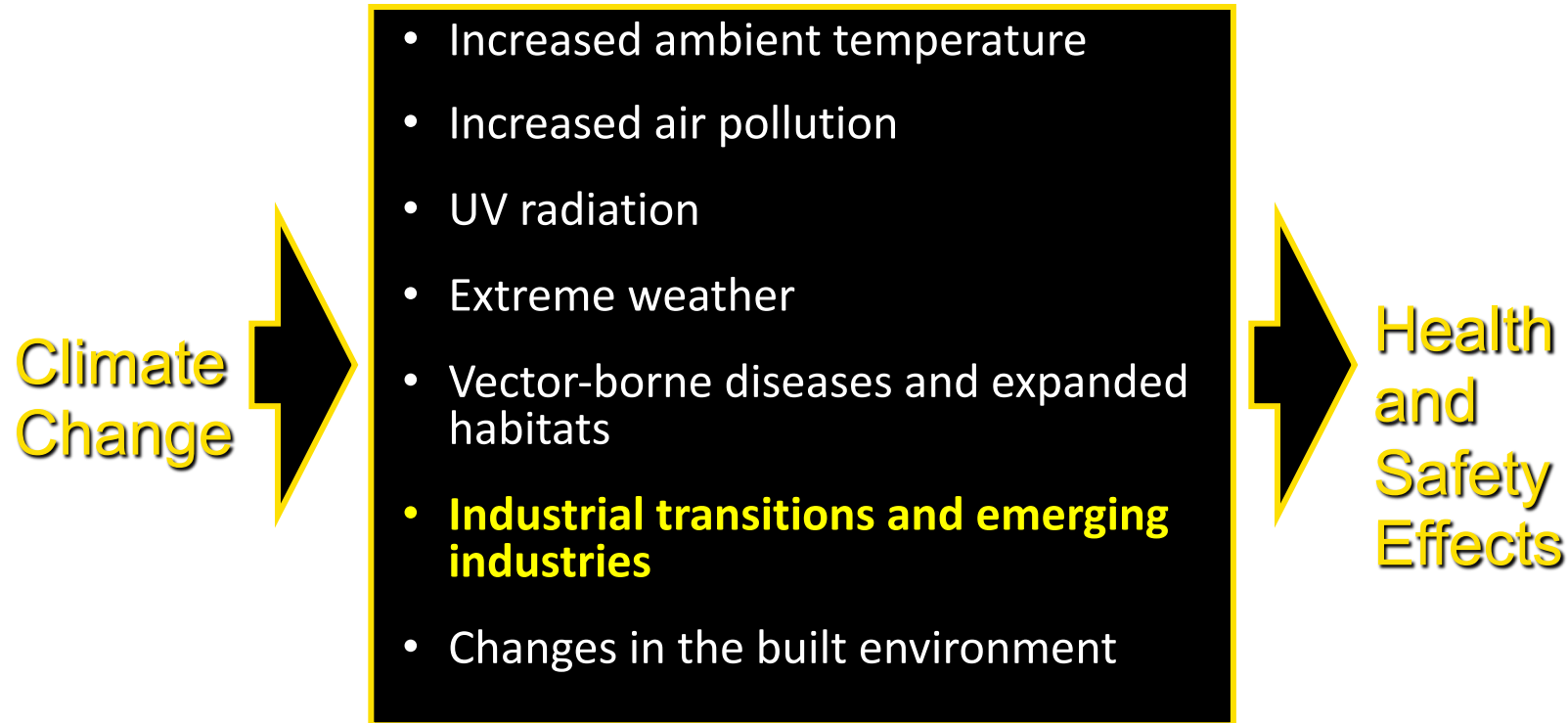
- ❑ Vector habitats are expanding:
 - Insects
 - Lyme disease, Chikungunya, West Nile Virus, Zika
 - Number of counties high-risk for Lyme disease increased 320% in last 20 years
- ❑ Non-vector borne expansion
 - Airborne allergens/molds
 - Poisonous plants
 - Reptiles

Vector-borne diseases/expanded habits

- ❑ Impacted length and severity of pollen season
 - Warmer conditions favor airborne allergens
 - Rise in prevalence and severity of allergic disorders
- ❑ Increased pesticide and herbicide use

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(Schulte and Chun 2009)

Industrial Transitions and Emerging Industries

- Climate change may result in extensive shifts in industrial investments
- Some industries will deteriorate
 - Job insecurity
- Emerging industries
 - Solar
 - Wind
 - Biodiesel
 - Nuclear
- Recycling
- Green jobs

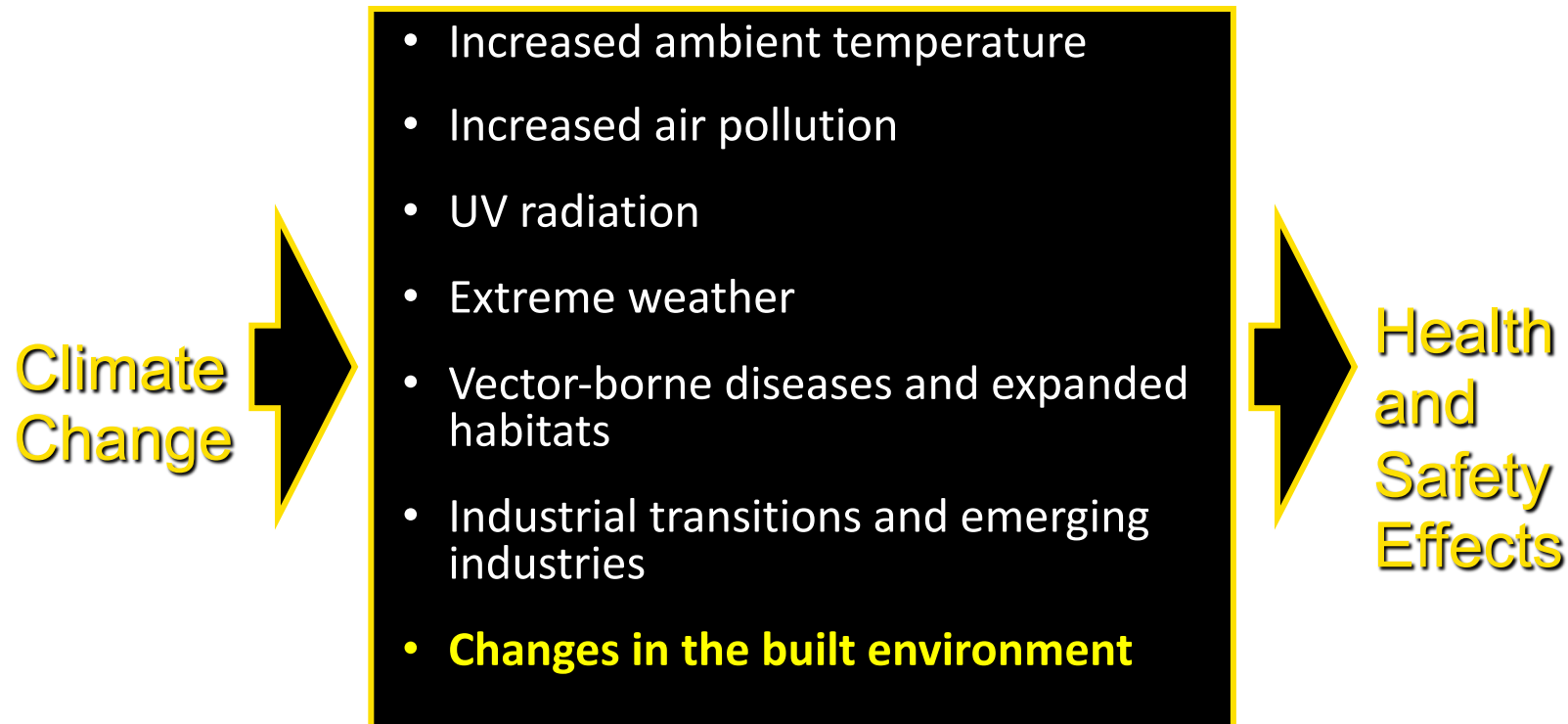
Unintended consequences

- ❑ 1-Bromopropane was selected as alternative to ozone-depleting solvents
- ❑ 1-Bromopropane
 - Neurologic effects in workers
 - Carcinogenic and reproductive hazard



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(Schulte and Chun 2009)

Changes in the Built Environment

- ❑ High temperatures increase need for tighter climate-controlled buildings
 - Tight building syndrome
 - Radon
- ❑ Construction of hard structures in coastal areas
 - New settings
- ❑ Leadership in Energy and Environmental Design (LEED)
 - Incorporate worker protection standards in LEED Criteria

Mental Health Effects of Climate-Related Occupational Hazards

- ❑ Post-Traumatic Stress Disorder
- ❑ Depression
- ❑ Combined psychological effects
 - With other hazards, e.g., heat
 - With personal loss

Priorities for Action

- ☐ Research
- ☐ Surveillance
- ☐ Risk Assessment
- ☐ Risk Management

Research

- ❑ Identify indicators of climate change effects on workers
- ❑ Determine interactions between climate change and work hazards and other factors
- ❑ Investigate effectiveness of mitigation strategies and hazard controls
- ❑ Identify most vulnerable workers and address health inequities

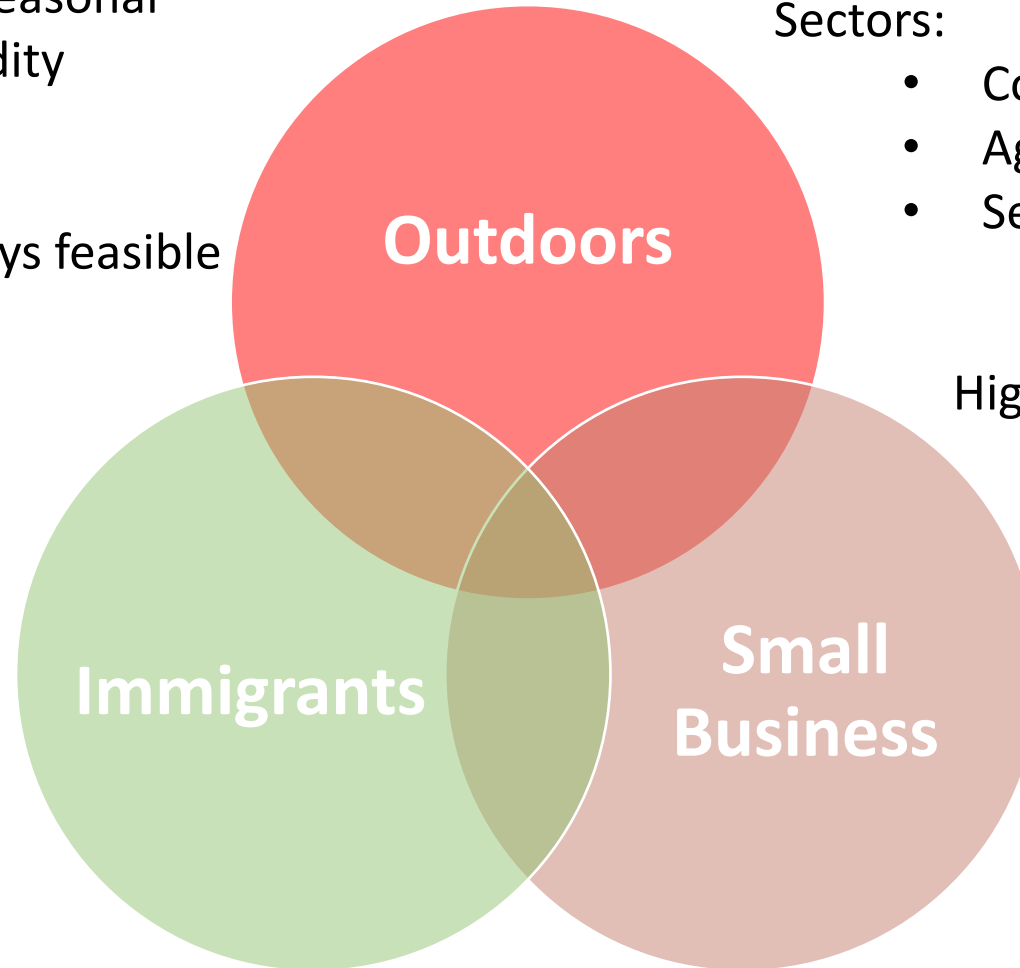
Health Equity: An Important Issue in Climate Change and Occupational Safety & Health

Millions exposed to seasonal temperature & humidity extremes

Controls are not always feasible

Sectors:

- Construction
- Agricultural
- Services (e.g., landscaping)



Increased HRI susceptibility:

- Lack of knowledge
- Lack of training
- Poverty
- Seasonality
- Language barriers
- Cultural differences

Higher injury & fatality rates:

- OSH not a priority
- Lack of resources
- Greater manager time demands
- Lack of management commitment to safety
- Fewer employees to engage in activities

Surveillance

- ❑ Determine risk by hazard, occupation, and location
- ❑ Enhance sentinel event/early warning systems
- ❑ Modify existing surveillance systems

Hazards related to climate change

	Current conditions	New conditions
Known hazards		
New hazards		

Risk Assessment

- ❑ Identify new models
- ❑ Integrate OSH, climate data, and vulnerability data
- ❑ Consider how to address uncertainties
- ❑ Incorporate consideration of worker risks into planning

Risk Management and Policy Development

- ❑ Develop adaptive response/control guidance
- ❑ Develop employer and worker guidance
- ❑ Integrate occupational safety and health with public health efforts
- ❑ Enhance preparedness

Thank you!

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