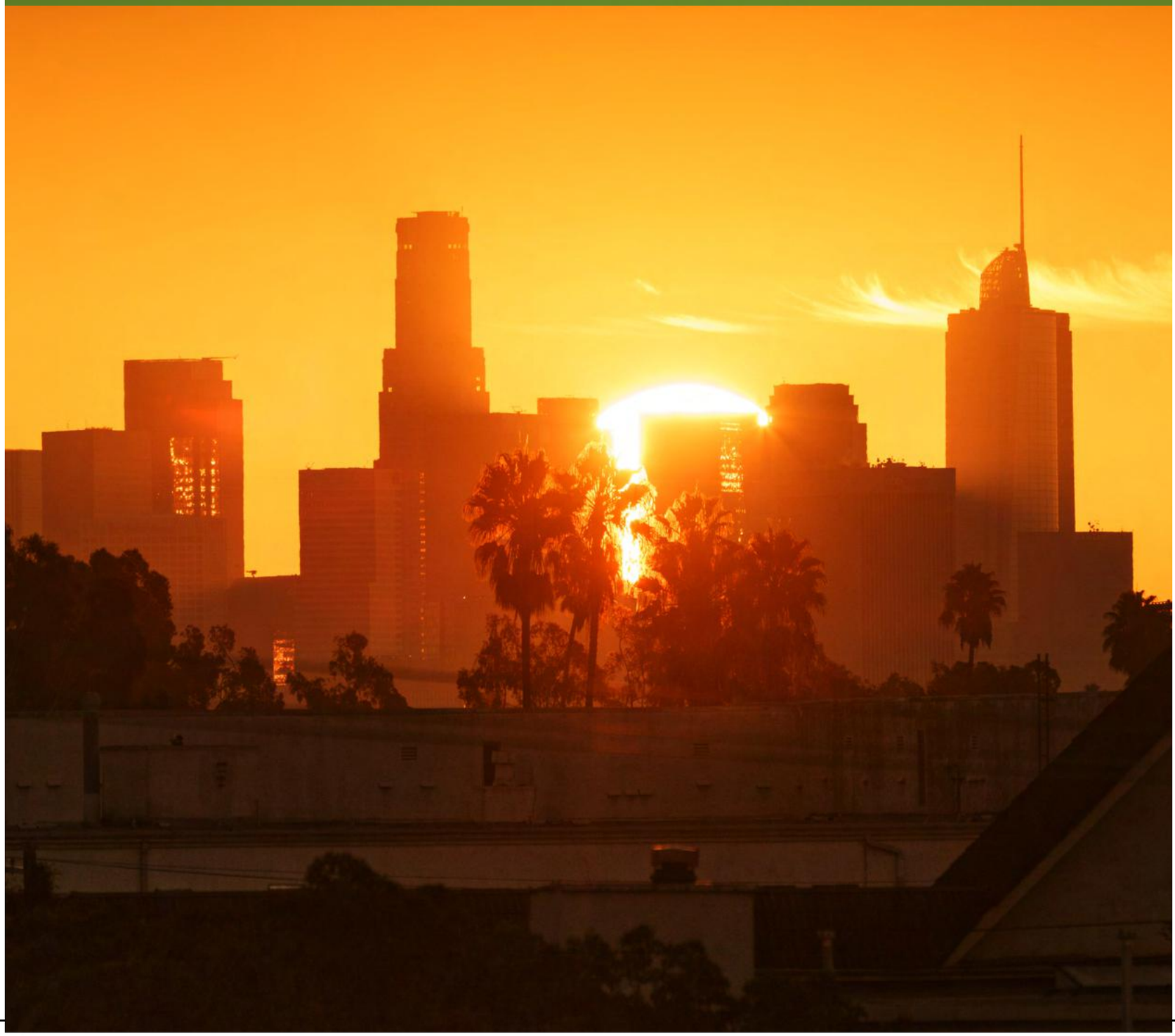
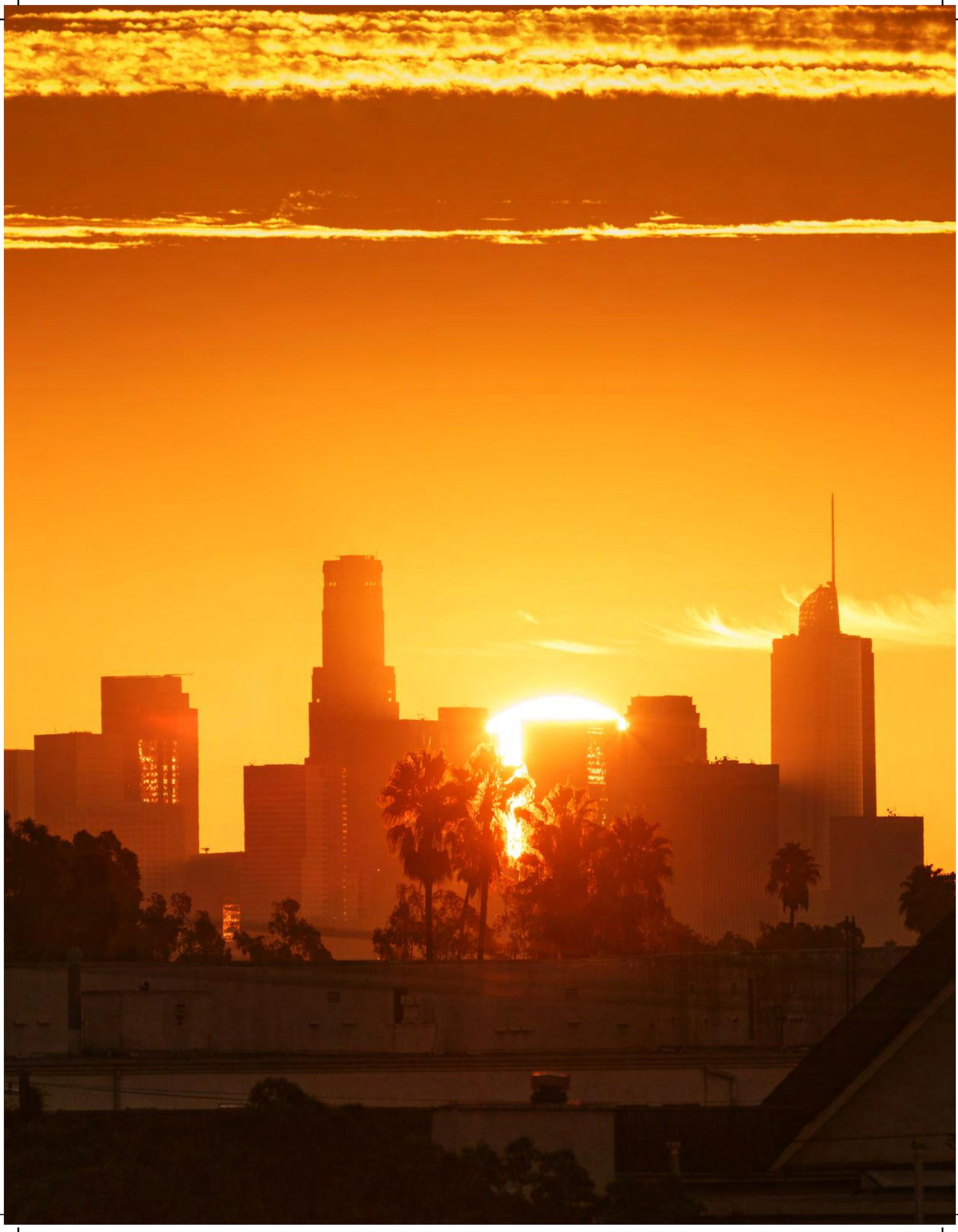
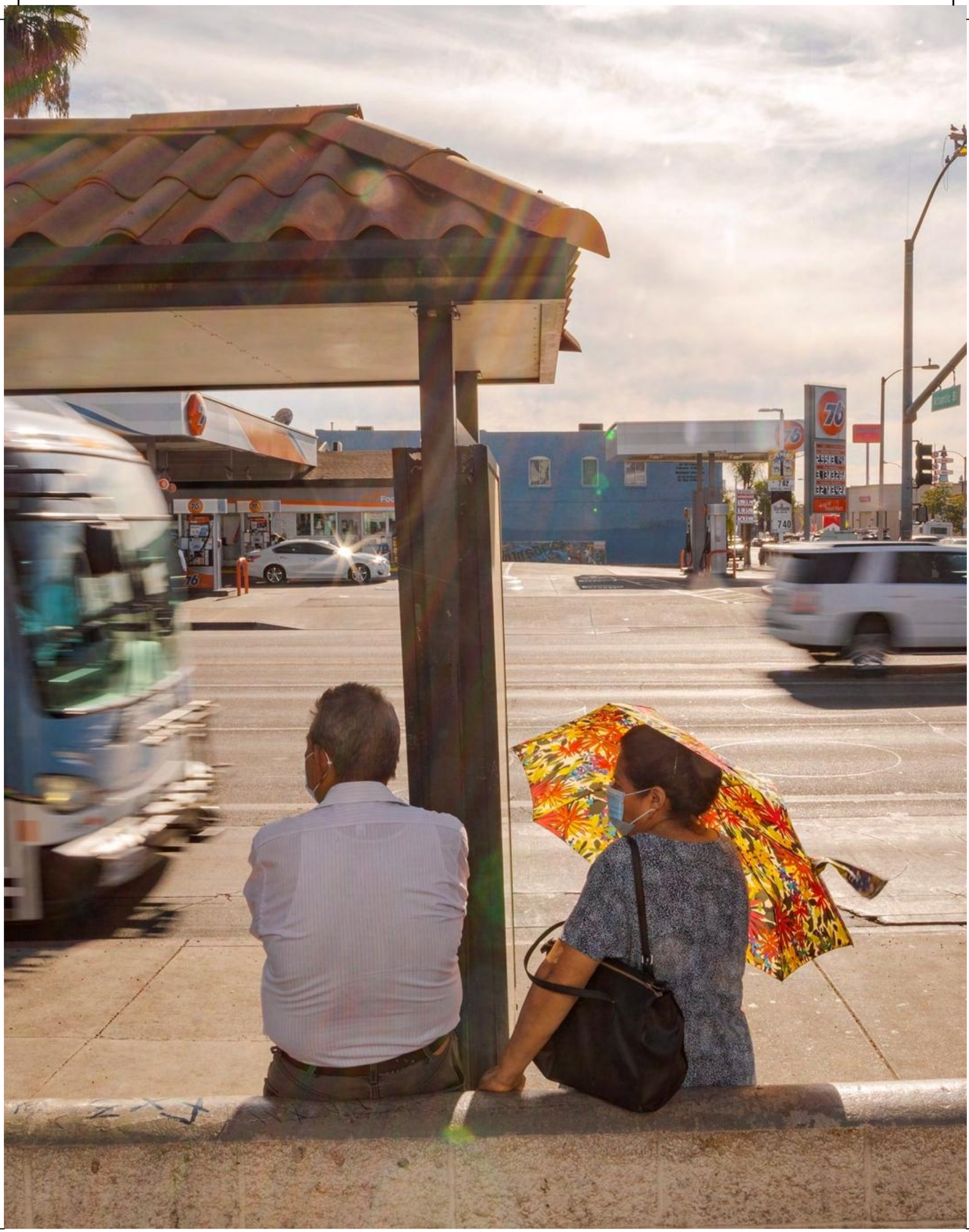
Chapter Five: Urban Heat, Trees, and Climate Change





Pre-Training Activity: Share Your Heat Story

What is your personal experience with extreme heat? Have you ever felt dizzy or or dehydrated during hot days? Have you witnessed anyone else experiencing heat stress symptoms?

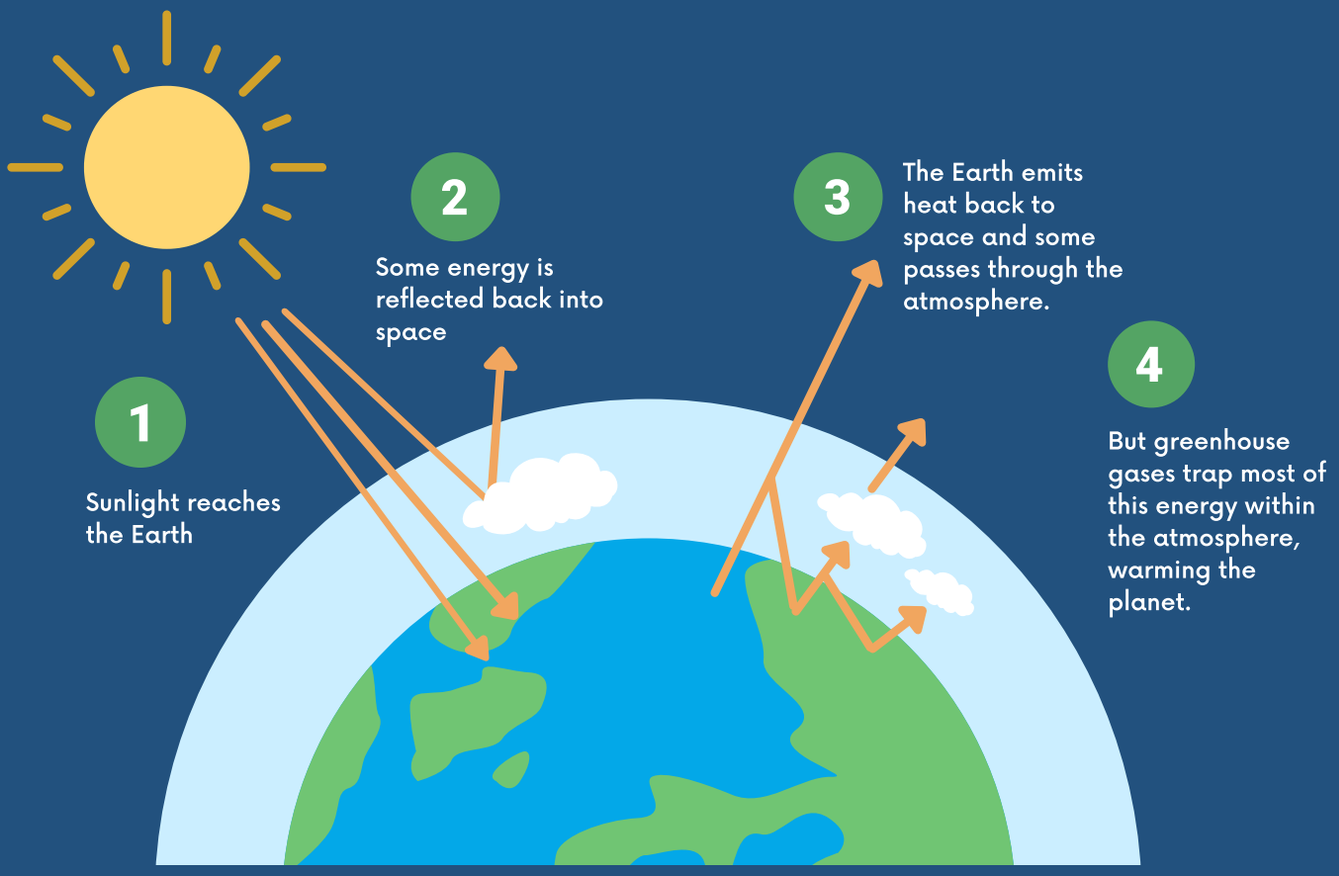


Climate Change

Climate change describes a change in the average conditions — such as temperature and rainfall — in a region over a long period of time. NASA scientists have observed Earth's surface is warming, and many of the warmest years on record have happened in the past 20 years.

There are many factors which contribute to Earth's climate, but scientists agree that the earth has been getting warmer in the past 50 to 100 years.

Greenhouse Gases



Certain gases in Earth's atmosphere block heat from escaping. This is called the greenhouse effect. These gases keep Earth warm like the glass in a greenhouse keeps plants warm.

Some greenhouse gases, like carbon dioxide (CO_2) and methane (CH_4), are naturally occurring and play an important role in Earth's climate. However, human activities — such as burning fossil fuels to power factories, cars, and planes — are causing an excessive amount of greenhouse gases to accumulate in the atmosphere.

This build up is causing the atmosphere to trap more heat, leading to a warmer planet.

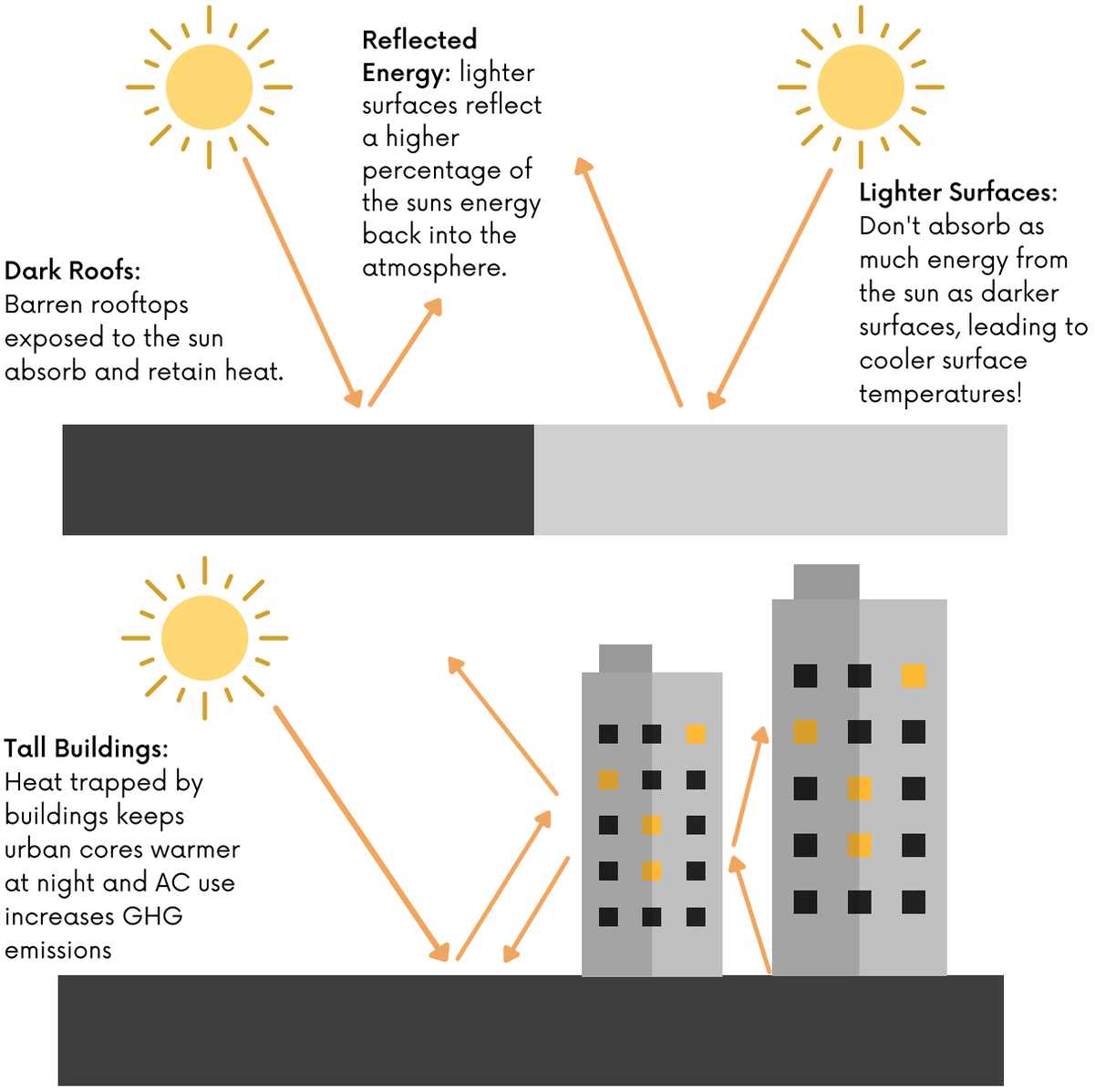
Urban Heat Islands

Being an Angeleno, you've most likely experienced heat waves and triple-digit temperatures. But did you know that urban areas experience higher temperatures than the surrounding rural and suburban neighborhoods? This phenomenon is called the Urban Heat Island Effect. Urban Heat Islands (UHI) are caused by the absorption and retention of solar radiation (in the form of heat) by surfaces like the asphalt roads, asphalt playgrounds, asphalt parking lots and asphalt roofing shingles. Other contributing factors to UHI are a lack of trees and other vegetation as well as "waste heat" produced by air conditioners, car-engines and industrial machinery.

This retention of heat leads to urban areas being upwards of 7°F hotter than surrounding rural areas during the day, and up to 22°F hotter at night.

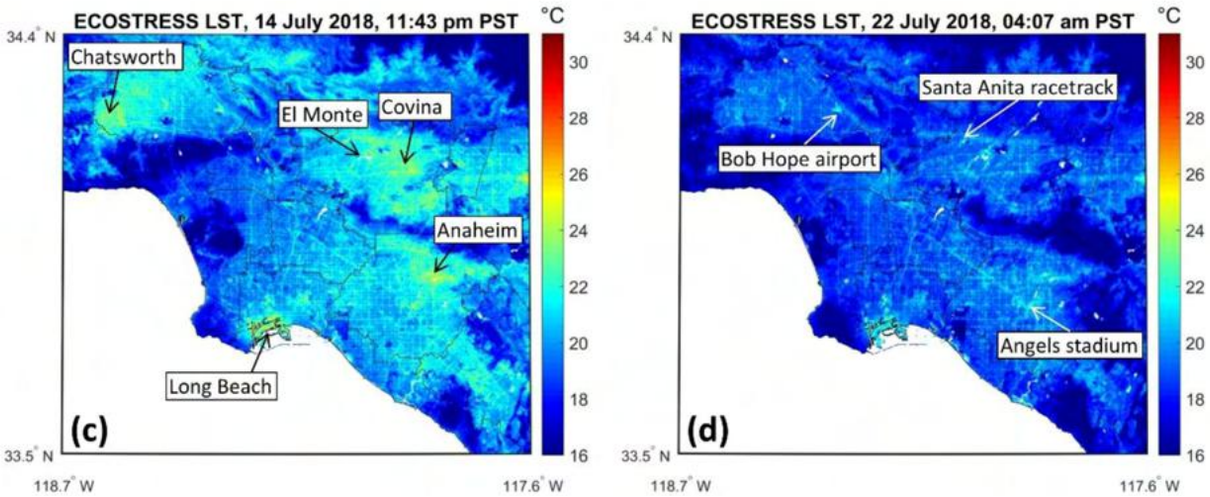
Heat-related illnesses and deaths are the most dangerous weather-related public health crisis in the US. Increased temperatures of one or two degrees exacerbate public health emergencies leading to an increase in heat-related deaths throughout the city. In this chapter, we are going to dive deep into the causes, public health crises, and the resulting disparity of Los Angeles' UHI and discuss potential solutions through the lens of urban greening.

The Albedo Effect



Asphalt has a low **albedo**, meaning dense urban centers are very good at trapping heat. Radiation which is meant to be reflected back into the atmosphere gets trapped by buildings and other built surfaces, retaining heat and raising both daytime and nighttime temperatures.

Nighttime Temperatures



ECOSTRESS captured surface temperature variations in Los Angeles, CA in the early morning hours of July 22. Hot areas are shown in red, warm areas in orange and yellow, and cooler areas in blue. **Credit: NASA/JPL-Caltech**

Cement, asphalt, and a multitude of other materials in the **built environment** contribute to our City's UHI. These materials tend to retain and reflect heat longer than natural surfaces such as grasses or soils. This retention of heat and energy increases nighttime temperatures when the city would typically be able to cool down, worsening public health outcomes and leading to heat-related illnesses and deaths. The absence of nighttime relief from the heat can increase health risk even more than high daytime temperatures, because the human body needs to rest and recover from daytime heat exposure. This leads to an increase in air conditioning usage, where available, which subsequently increases both **greenhouse gas emissions** and electricity bills. Those without AC must endure the heat and all of its related illnesses.

Built Environment: the human-made surroundings that provide the setting for human activity, ranging in scale from buildings and parks or green space to neighborhoods and cities that can often include their supporting infrastructure, such as water supply or energy networks.

PUBLIC HEALTH

Heat is the most dangerous natural disaster. Though extreme heat is a less visible menace than hurricanes or wildfires, it is climate change's most life-threatening impact, causing more deaths each year in the United States than any other weather-related problem, including all storms and floods combined (LA Times 2020)! In Los Angeles alone, high summer temperatures kill 60-70 Angelenos each year (Kalkstein 2017). Prolonged exposure to extreme heat causes our blood to rush to the surface of our skin as our bodies work to cool themselves. As a result, less blood reaches our brains, muscles, and other organs, interfering with both physical strength and mental capacity. The result of which can be seen through:

- General discomfort
- Increased irritability, violent crime, and workplace injury
- Heat cramps, exhaustion, and stroke
- Worsened heart and respiratory difficulties
- Heat related fatalities

As we begin to experience more extreme temperatures due to the climate crisis, cooling techniques and strategies can quite literally save lives. Research has shown that a single degree increase in temperature can drastically increase the rate of heat-related hospitalizations.

Heat vulnerability is not distributed equally across communities - what's a mild inconvenience for some might be a life-threatening event for others.

Communities with more privilege and access to resources are better able to insulate themselves from the negative impacts of extreme heat - literally. This is true both on the personal level, where they can more readily access cooling amenities like air conditioning, and on the community level, where they tend to live in cooler, more tree-lined neighborhoods.

By comparison, people with jobs that require them to be outside or in warehouses experience much longer and more intense exposure to urban heat, and the consequences can be devastating.

An occasional scan of local headlines may reveal the toll that extreme heat can take on people's lives. Some recent stories include...

- A 63-year-old Postal Service worker who was found unconscious in their mail truck;
- A 57-year-old jogger who passed after a morning jog in 90-degree weather;
- Babies and young children left in cars and people living in tents (Phillips et. al 2021).

The cases are everywhere. Chances are, you may have been impacted by extreme heat or know someone who has. For that reason, it's important to know the signs and symptoms of **heat illness**.

Heat vulnerability: Measures how likely a person or community is to be injured or harmed during periods of extreme heat. This index is determined by a number of factors, including a person's age, overall health, occupation, ability to access cooling amenities like air conditioning, and more.
Heat Illness: what happens when your body is s unable to dissipate heat effectively. This includes heat stroke, heat exhaustion, heat cramps, etc.

Heat Exhaustion

Faint or dizzy

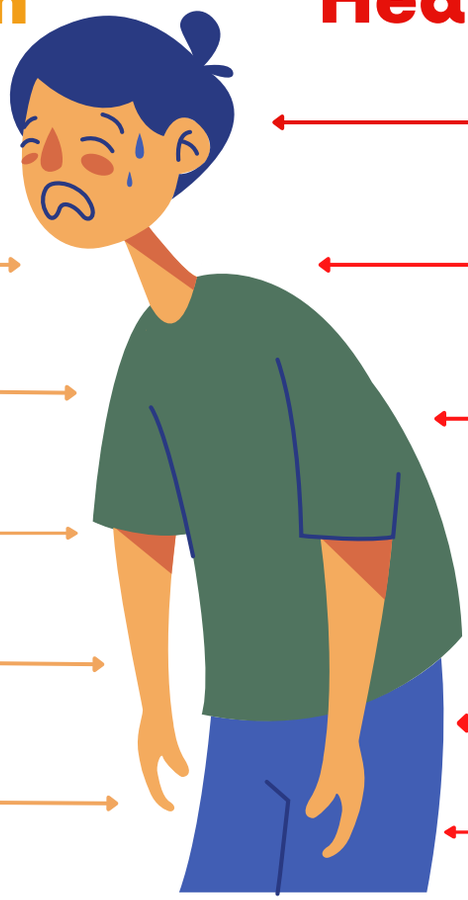
Excessive sweating

Cool, pale, clammy skin

Nausea or vomiting

Rapid, weak pulse

Muscle cramps



Heat Stroke

Throbbing headache

No sweating

Body temperature above 103 (red, hot, dry, skin)

Nausea or vomiting

Rapid, strong pulse

May lose consciousness

Prolonged exposure to heat can, directly and indirectly, create and worsen health complications. Of heat illnesses, heat exhaustion and heat stroke are the most serious.

If left untreated, heat exhaustion may progress to heat stroke. Heat stroke is a medical emergency and requires immediate medical attention.

TREATMENT

(Source: Mayo Clinic)

- Move to an air-conditioned space.
- Take a cold shower or using cold compresses.
- Drink plenty of fluids.
- Remove tight or extra clothing layers.

- Call 911 immediately.
- If possible, move the person to a cooler place.
- Use cold compresses to get their temperature down.
- Do not give them fluids.

Preventing Heat Illness

(Source: Mayo Clinic)

There are a number of steps you can take to prevent heat illnesses on extreme heat days.

Dress for success: Wear loose fitting, lightweight clothing to help your body cool properly

Drink plenty of fluids: Staying hydrated will help your body sweat and maintain its body temperature.

Get acclimated: Limit your time spent working or exercising in heat until you're used to it. People who are not used to hot weather are especially susceptible to heat-related illness.

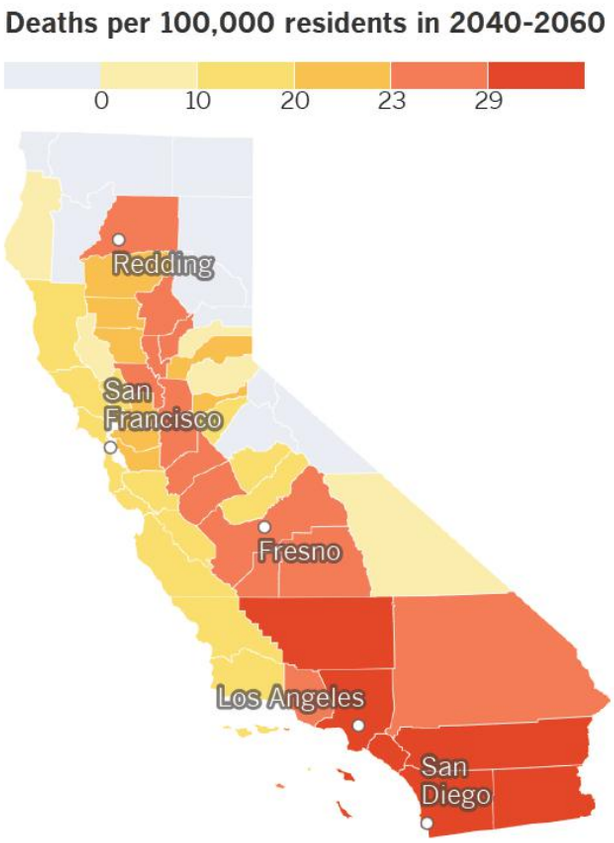
Protect against sunburns: sunburns affect your body's ability to cool itself. Wear hats, sunglasses, and apply sunscreen. Be sure to re-apply every 2 hours, or even more often if you're swimming or sweating.

For more heat illness prevention tips, check out the Mayo Clinic's page on heat illness.

Data on Extreme Heat

It is hard to determine the specific impacts that extreme heat is having on public health on a city and state level. Though official California records state there were 599 deaths related to heat exposure between 2010 and 2019, a recent Los Angeles Times investigation found that the **true toll is probably six times higher** (Phillips et. al. 2021).

We need to develop more a way to track heat deaths and hospitalizations in real-time to help make sure that we're responding to the problem effectively and equitably. This is becoming an especially pressing need with increasing temperatures each year.



Community Science

Community science is also a great way that we can track the impact that heat has on our neighborhoods and communities.

One recent example of this is a recent study published by UCLA, where researchers partnered with South and Southeast LA residents to track and better understand the impact that trees have on indoor temperatures. The collaboration allowed researchers to better understand a topic that is very under-researched.

Community Science: Collaboratively-led scientific investigation, exploration, and engagement in the entirety of the scientific process.

de Guzman, E. and A. Barreca. Evaluating the Impacts of Trees on Residential Thermal Conditions in Los Angeles Using Community Science. Y. Chen (Ed). TreePeople. 2021.

Phillips, Anna, Tony Barboza, Ruben Vives, and Sean Greene. "California Extreme Heat Deaths Show Climate Change Risks." Los Angeles Times, 7 2021.

Unhoused Communities

As we know from previous teachings, heat waves and extreme temperatures worsen health conditions and endanger public welfare. Despite Los Angeles' unprecedented housing crisis, houseless populations are oftentimes overlooked when discussing climate change and the policies put in place to protect our communities. Our houseless neighbors face greater risk of severe dehydration, heat stroke and other heat related conditions due to the inaccessibility of cooling resources such as air conditioning, readily available water, shelter and shade.

When it comes to heat related public health, we need to be having intersecting conversations about housing justice, urban planning and greening, ableism and mental health, and the influence of local governments.

Community care action items we can do today to support our neighbors in the face of urban heat:

- Check in with older and unhoused neighbors (especially those with health conditions)
- Distribute frozen water bottles
- Contribute to and upkeep community fridges
- Donate items which provide shade (such as tents and awnings)
- Offer rides or ride-share services to cooling centers and water stations
- Provide information and resources for cooling centers and shady community spaces
- Plant trees along your street and teach your friends, families and neighbors about the cooling effects of urban greening

SOLUTIONS TO THE URBA

Dark Roofs:
Barren rooftops exposed to the sun absorb and retain heat.

Tall Buildings:
Heat trapped by buildings keeps urban cores warmer at night and AC use increases GHG emissions.

Roads and Asphalt:
Dark roads and asphalt parking lots and playgrounds retain heat and reduce surface moisture.

BAN HEAT ISLAND EFFECT

Tree Cover:
Of all urban cooling strategies, planting and maintaining healthy trees has been shown to bring the most long-term health, environmental, and community benefits, while also combatting climate change by saving energy and water.

Shade Structures:
Structures like shade sails and shaded bus stops provide short-term relief from extreme heat in areas where there isn't room for trees.

Cooling Amenities:
Amenities like shaded bus shelters and water fountains are important short-term solutions for urban heat islands

Light-colored Pavement & Hardscape:
Reduce albedo and reflect light instead of absorbing it. This can cool surfaces by as much as 20°F.

Community:
Cooler temperatures welcome Angelenos to get outside and partake in community gatherings, active transportation, and other outdoor events!

Saving Energy

By deploying cooling measures, the people of Los Angeles can become more resilient. More resilient by staying cooler and healthier. And more resilient by reducing electrical demand on the grid, keeping the lights on and airconditoners operating.

As a City, we need to find a more sustainable fix to urban heat. Luckily, we have trees to break this cycle!

Thermodynamics

Conversation Starters:

Feeling the heat

Lets get outside: On a nice sunny day that's not too hot, grab a white and a black tee-shirt then find a sunny spot close to your home. Wearing your white shirt, spend five to ten minutes in the sun either reading a book, talking with a friend or just enjoying being outside. Make note of how you feel. After the time is up, go back inside to cool down for 30 min. Repeat this activity now in a black or darker colored shirt. Notice a difference?

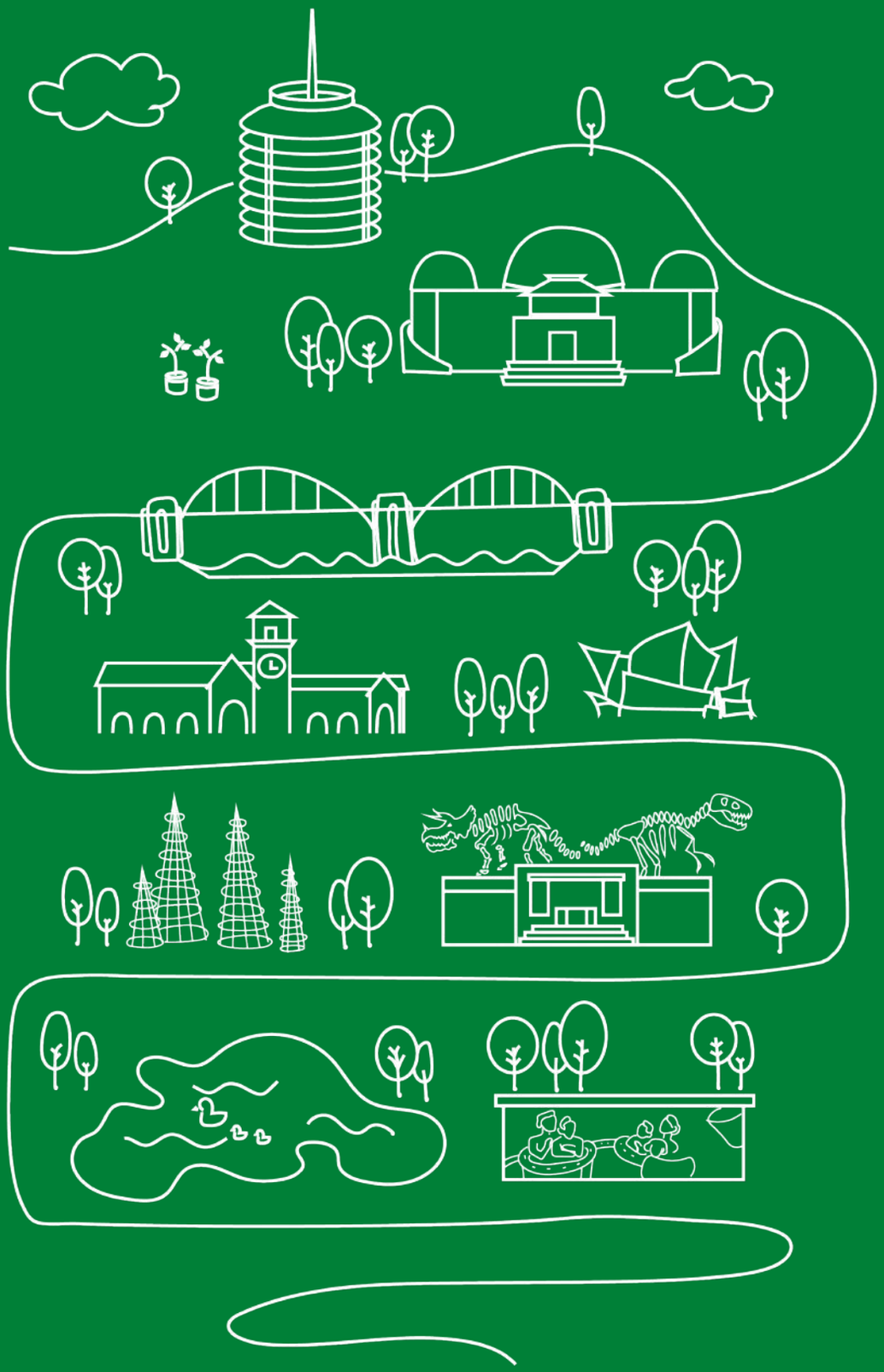
Start Thinking: Which shirt felt more comfortable? Which shirt felt hotter after ten minutes outside? The difference in heat you are experiencing is the effect of albedo at a micro-localized level. Imagine this effect across an entire city!

When speaking about the Urban Heat Island Effect, we need to take into consideration the **thermodynamics** of the city. Most importantly, we need to understand albedo. **Albedo** is the proportion of light or radiation reflected by a surface. Surfaces with high albedos reflect light and retain less heat whereas surfaces with low albedos absorb light and retain heat. Lighter colored surfaces tend to have higher albedo than darker colored surfaces. Imagine wearing a black tee-shirt compared to a white tee-shirt on a hot summer day. Which shirt would feel more comfortable? The difference in heat you are experiencing is the effect of albedo at a micro-localized level. Imagine this effect across an entire city!

Climate Change: Long-term changes in the average weather patterns that define Earth's local, regional, and global climates.
Albedo: The proportion of the incident light or radiation that is reflected by a surface, typically that of a planet or moon.

Post-Training Activity: Need for Shade

Where are the greatest needs for shade in your community? Thinking back on your neighborhood walks, conversations with neighbors, and experience as a member in your community. Where is there the greatest need for shade? How would cooler temperatures affect this part of your neighborhood? Are there opportunities for tree planting there?



Your city. Your voice.Your urban forest.
Tu voz. Tu ciudad. Tu bosque urbano.