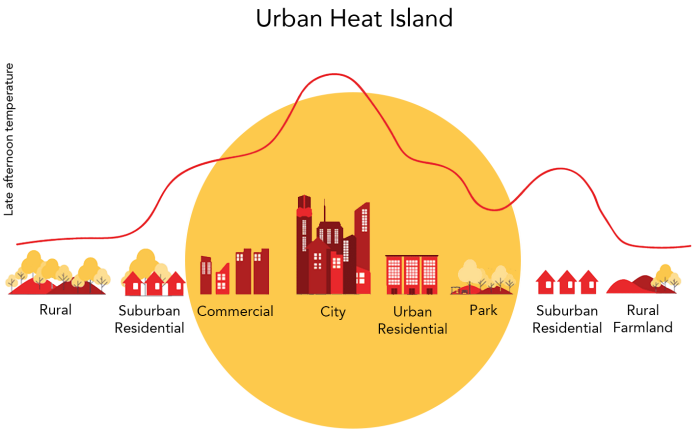
Cooling the Capital Region

Sacramento



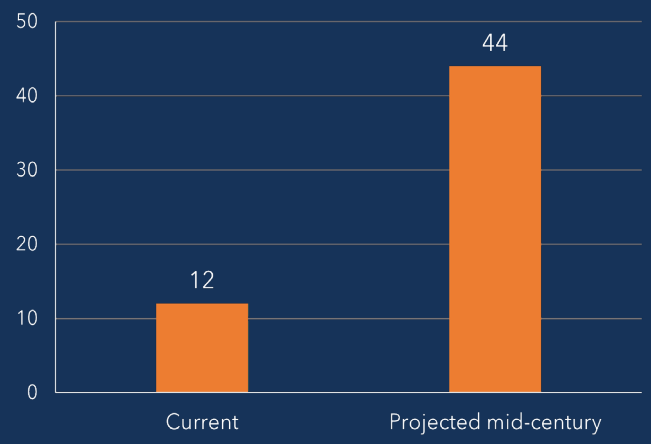
Extreme heat is a serious challenge for public health, safety, infrastructure, and the local economy every summer—and the urban heat island (UHI) effect only exacerbates the problem. The UHI effect refers to the higher temperatures experienced in urban and suburban areas in comparison to their surrounding rural areas. This temperature gap results from heat trapped and absorbed by the built environment—roads, pavements, buildings, and roofs—as well as waste heat released from engines and air conditioners. But we can reverse these effects and cool our neighborhoods through better planning and design changes to the built environment.

Extreme heat threatens everyone, but some populations are most at risk. Low-income communities, children, older people, pregnant people, people who are unhoused, people who work outside or in unconditioned spaces, and people with pre-existing health conditions are most vulnerable to extreme heat.

Why is this important?

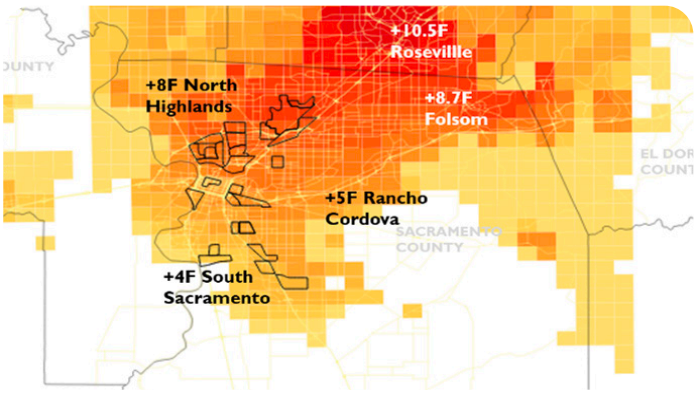
Number of days over 100°F in Sacramento per year

Historical average number of days over 100°F in Sacramento each year and projected average by mid-century (2035-2064)



The City of Sacramento has a high UHI effect of 8.7°F, meaning that developed areas in the City are about 8.7°F hotter than surrounding rural or agricultural areas. This is caused by development within Sacramento and throughout the region. The City of Sacramento should prioritize developing cooling solutions for the City's AB 617 communities—neighborhoods identified by the California Air Resources Board for priority air quality protection.

+8.7°F
UHII



Public Health

Extreme heat kills more people than any other weather-related disaster in the United States. Extreme heat leads to a wide range of health impacts, including cardiovascular and respiratory disease, heat exhaustion, and heat stroke, which can be fatal. Because extreme heat can trigger fatal outcomes from other chronic conditions (e.g., heart disease), heat is often overlooked as a cause of death. Extreme heat can have cascading impacts, such as lowered birth weights, premature births, increased mental health risks, and increased smog and ozone pollution. UCLA's How Heat Harms Health in Your Community project estimates that on an average heat day, Sacramento County experiences approximately 450 excess visits to the emergency room for heat-related health issues. South Sacramento communities experience particularly high excess visits to the emergency room.



Transportation Impacts

Pavements

On very hot days, roads, pavements, and airport runways can experience cracking, buckling, and rutting. This can increase roadway maintenance costs and decrease safety for drivers.



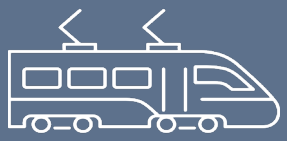
Rails

Rails can expand and warp when temperatures exceed the range within which they are designed to operate, risking derailments. Trains generally must slow their speeds to reduce rail stress.



Electrical Systems

Higher temperatures can cause electrical systems to overheat. Sacramento Regional Transit (SacRT) powers its light rail system with overhead catenary systems lines, which can stretch with heat and may lead to severing of the connection with the rail car. As mitigation, SacRT issues slow orders to reduce train speeds when temperatures are above 100°F, causing delays.



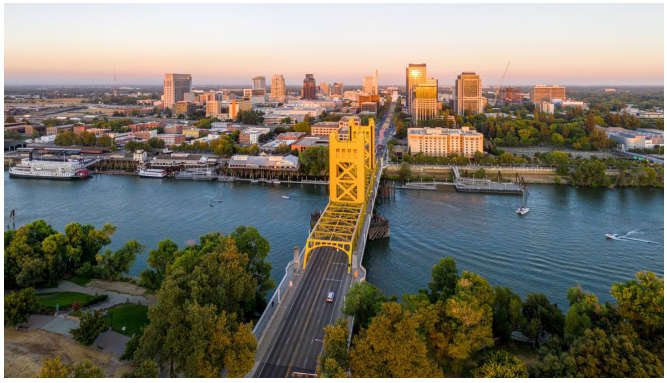
Decreased Transit Ridership and Active Transportation

A recent study from Fresno found that public transit use decreased as temperatures increased. Similarly, walking, biking, and other forms of active transportation are also likely to decrease during hot days. However, active transportation emits fewer greenhouse gases than driving and therefore reduces a person's contribution to the UHI effect.



Economic Impacts

Extreme heat can increase utility bills. During heat waves, high electricity demand for air-conditioning may lead to power shortages, potentially triggering blackouts and brownouts that may have widespread impacts for health as well as business operations and economic costs. Higher temperatures also reduce productivity, even for people working indoors, and affect students' learning ability. Some types of work, such as construction, landscaping, utility, and agricultural work, may need to be shifted earlier or later in the day. Extreme heat can also lead to more workplace accidents and injuries because of heat-related nausea, disorientation, dizziness, and faintness.





What can Sacramento do?

The most effective cooling strategy for Sacramento is to increase its tree canopy coverage while also transitioning to cool roofs and cool pavements. These strategies help lower temperatures during the afternoon, the hottest part of the day, and at night. Implementing these strategies across the region can help reduce ambient air temperatures and the number of dangerously hot days for everyone. **Independently, neighborhoods can reduce a large part of the UHI. But when neighborhoods act together to implement heat mitigation strategies, the cooling effect is much greater.**





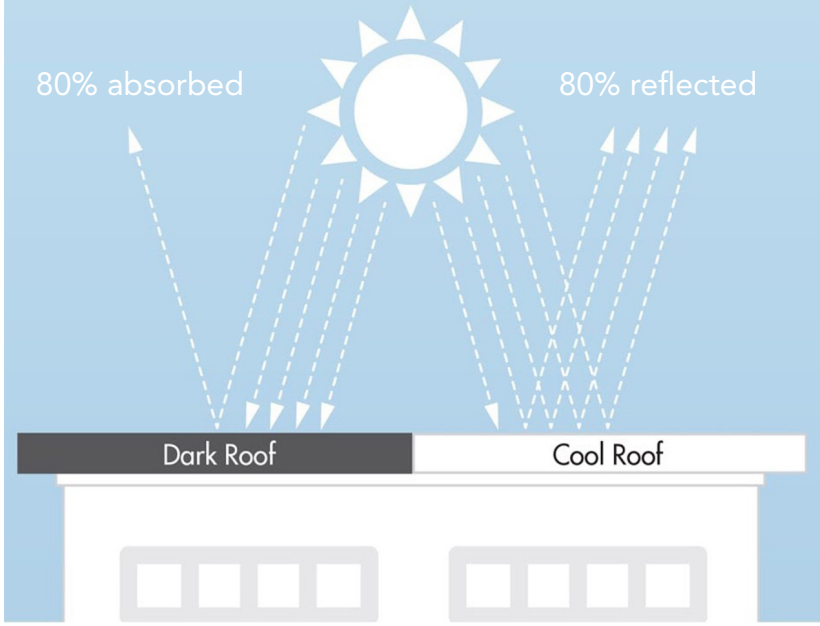


In Sacramento, using both cool roofs and pavements can reduce air temperatures by up to 9.4°F. This is a significant benefit, particularly for Oak Park, Natomas, and Del Paso Heights, and South Sacramento.

Increasing tree canopy cover can cool AB 617 communities in Sacramento by up to 2.5°F, with the biggest benefits for South Sacramento communities.

Albedo and Cool Roofs

Albedo is a ratio between 0 and 1 that describes the amount of sunlight that is reflected away by a surface. In general, a dark roof or pavement absorbs almost all heat, reflecting nearly zero heat, and thus is hotter and has an albedo closer to 0, whereas a lighter-colored surface repels heat, remains cooler and has an albedo closer to 1. A cool roof has a high albedo, generally over 0.63 for low-sloped roofs or 0.20 for steep-sloped roofs.



A standard roof absorbs heat and thus warms up the building interior, while cool roofs reflect heat away from buildings, keeping interiors cool. Cool roofing comes in a range of colors and materials, including tiles, shingles, or coatings, allowing broad applicability for different roof shapes and styles. Cool roofs help residents save significantly on electricity bills during the summer by reducing the amount of air conditioning needed to maintain comfortable temperatures. Although cool roofs cost the same or slightly more than a standard roof, they pay for themselves over time through electricity bill savings.






Research from Stockton indicates that if 70% of available roofs switch from conventional dark roofs to cool roofs, benefits would outweigh costs by 17 to 1. Benefits of cool roofs include ambient air cooling, savings from reduced energy usage, reduced greenhouse gas emissions, extended roof life, and improved public health by reducing heat-related health impacts. Considering its significant heat island effect, location, and meteorological conditions, Sacramento could experience the same or greater benefits.

Darker, absorbs heat 0  1 Lighter, reflects heat

Cool Pavements



Pavements make up 45% of the average city in the US. Conventional asphalt pavements can reach 120°F-150°F in the summer, radiating this excess heat into the surrounding air. Using cool pavements—or replacing pavements with vegetation—can help to lower temperatures with multiple benefits. There is a wide variety of cool pavements with different costs, applications, and maintenance considerations. A lighter-colored cool sealant or coating can be applied to existing pavements, reflecting heat away while extending pavement lifespan. Other cool pavements can be installed as part of a new road; for example, roller-compacted concrete can increase albedo while reducing maintenance costs. Porous or permeable pavements cool through evaporation and can support stormwater management.

Cool pavements can cool road surface temperatures in Sacramento by nearly 24°F in the afternoon during summer months. Additional benefits include reduced roadway maintenance costs, cooler stormwater runoff, and greater visibility at night (only for lighter-colored pavements and pavements with a solar reflectance of less than or equal to 0.35).



Existing roads already scheduled and budgeted for resurfacing present a significant opportunity to implement cool seals or cool surface treatments. The only additional associated costs would be for the reflective cool layer. According to the Smart Surfaces Coalition, reflective surface treatments cost about $0.32 per square foot for roads and $0.45 per square foot for parking lots. These treatments generate greater benefits, however, estimated at a $0.93 per square foot for roads and $1.05 for parking lots.



Using Stockton as a case study for a hot, dry California city, the Smart Surfaces Coalition estimates that implementing cool surface treatments for 50% of parking and 5% of roads would yield a benefit-cost ratio of 2.3:1—in other words, the total value of all benefits is more than double the installation costs. Benefits come from extended surface life of pavements, cooler air temperatures, reduced energy use, reduced greenhouse gas emissions, and a range of additional health and economic benefits.

Cool Pavement Options

Type	New/Maintenance	Albedo	Service Life	Application	Approximate Costs /sq. foot
Portland cement	New construction	0.4-0.7	15-35	Roads, sidewalks	$0.30-4.50
Asphalt with high albedo aggregate	New construction	0.05-0.2	7-20	Roads, parking lots	$0.10-1.50
Roller Compacted Concrete	New construction	0.35-0.7	20+	Varies by type	$75-115 per cubic yard
Colored asphalt	New & maintenance	0.1-0.8	5-10	Parking lots, bike lanes	$0.10
Chip seal	Maintenance	0.2-0.23	7-10	Roads, highways, parking lots	$0.10-0.15
Reflective coatings (cool seals/coatings)	New & maintenance	0.3-0.45	3-10	Low-traffic zones, parking lots, playgrounds, pedestrian areas	$0.83-1.60
Resin-based clear binder	New & maintenance	0.3-0.5	20	Sidewalks, trails, parking lots	$3-3.50
Microsurfacing with high albedo materials	Maintenance	0.35	7-10	Low- to medium-volume roads	$0.35-0.65

Vegetation



Trees and vegetation play important roles in combating heat. They absorb heat, provide shade, and even cool the surrounding air when water is evaporated from their leaves. They also beautify the environment, improve safety, support jobs, and provide mental and physical health benefits. Based on a Sacramento study, trees provide an estimated benefit of $120 per tree per year, including substantial benefits from air pollution reduction, energy savings, stormwater reduction, and property value improvements.

Increasing vegetation canopy cover by 12% in AB 617 communities can reduce UHI by up to 2.5°F and is the most effective strategy to reduce nighttime temperatures. Benefits from this scenario are greatest for South Sacramento. When combined with other strategies, such as cool roofs and cool pavements, it can be even more effective.

Zero-Emission Vehicles

Electric vehicles produce 80% less waste heat than standard combustion engine cars, which emit heat through exhaust. Traditional internal combustion engine vehicles lose 58% to 62% of fuel energy as waste heat, which contributes to the UHI effect in the surrounding environment. In contrast, zero-emission vehicles (ZEVs), including both electric vehicles and hydrogen vehicles, are far more efficient, losing only 20% of the total heat lost by conventional vehicles.

Cooler temperatures also optimize efficiency for ZEVs, as extreme heat degrades battery heath, which is an important consideration as the Capital Region and California strive to expand ZEVs.



If 25% of drivers in the area switch to electric or other zero-emissions cars, there can be up to a 4.3°F reduction in temperatures, particularly during rush hour and near major freeways and roads such as Highways 50 and 99.

Electric Vehicle Charging Stations



Designing public charging stations with passive cooling elements can help protect batteries as they charge and help reduce overall UHI effect impacts.

EV charging station solutions could include canopies, solar photovoltaic (PV) canopies, higher albedo pavements, permeable pavements, trees, and other vegetation. Shaded parking can reduce the internal temperature of a parked car during hot days, saving battery power for cooling the interior. An appropriately sized solar PV canopy can provide some of the electricity needed for EV charging. If designed well, greenery and urban vegetation can provide electric vehicle travelers both cooling and a desirable place to rest while waiting for their vehicles to recharge.

Solar Photovoltaic Parking Lots

When installed over a parking lot, solar PV structures can provide shade for parked vehicles while generating renewable energy. The shading can achieve multiple benefits: it reduces the UHI effect from pavements, reduces evaporation of volatile organic compounds (which contributes to ozone pollution and smog) from the fuel tanks of conventional vehicles, and cools the car interior, saving vehicle energy by lower air-conditioning needs.

Solar PV shading over parking lots can decrease temperatures by 2°F over a 24-hour period, and up to 4.4°F at peak periods. Notably, this has a greater cooling effect than rooftop solar PV, as parking lots tend to be darker than rooftops. Thus, for residential developments, a combination of cool roofs with solvar PV structures over nearby parking lots would deliver greater heat island reduction benefits.

Tree canopy shading over parking lots will generally deliver greater temperature reductions than solar PV structures over parking lots—about twice as much, assuming current solar efficiencies. Trees also help to reduce nighttime temperatures, critical to public health, while solar PV's cooling effects are limited to the daytime. However, some parking lots may not be suitable for tree planting (e.g., due to size or the presence of utility lines)—in these cases, solar PV shade structures may be ideal.

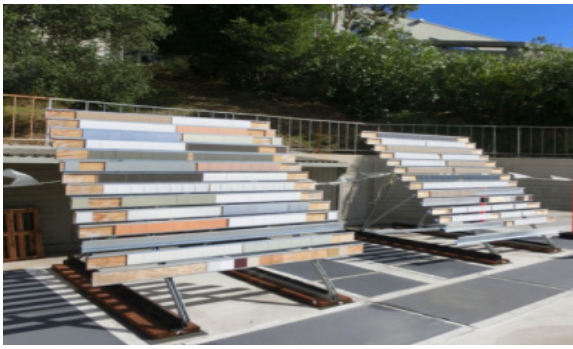




Cool Walls

Similar to cool pavements and cool roofs, cool walls typically use lighter-colored paints to reflect heat away from surfaces, keeping the building cool. Cool walls can be as simple as painting the exterior walls with a paint that has an albedo value around 0.35. Cool-colored paints come in a broad range of colors to match styles and preferences. The most effective paints are lighter in color, but specially designed, darker "cool" paints can also effectively reflect the sun's invisible infrared light. By installing cool walls, you can cut air-conditioning usage and lower utility bills. This cooling benefit is particularly helpful for older homes (pre-1980s), which were built with less insulation than homes today.





Infill Development

Infill development or a compact growth strategy—instead of greenfield development—can help to cool communities while supporting walkable, bikeable neighborhoods. Infill-oriented growth reduces the construction of new pavements and rooftops, reducing surfaces that would absorb heat and contribute to the UHI effect. It also helps to conserve agricultural or natural lands, which help to cool communities (and provide flood protection). An infill-oriented growth strategy, with 15 percent less new greenfield development, can reduce temperatures by an average of 3.6°F at night, and 2.4°F over 24 hours. Though these numbers may sound small, this strategy can also reduce dangerously high temperature extremes. In Sacramento, an infill strategy can reduce temperature spikes over 95°F by 20% and over 100°F by 40%.



Climate Resilience

Urban cooling strategies will help protect community members, particularly our most vulnerable neighbors, from extreme heat. This is especially important as the Sacramento region sees an increase in the number of very hot days due to climate change.

Consider greater action on climate mitigation and resilience, including tree planting, a cool roof policy, and support for public transit. Prioritize cooling strategy implementation in under-served communities, with direct consultation with community members. Ensure all residents have access to air-conditioned spaces, especially in affordable housing and in public spaces for unhoused neighbors. These changes can minimize the UHI effect and contribute to a safer environment for all.

Except where noted otherwise, the findings and data here are sourced from the Capital Region Urban Heat Island Mitigation Project. Find out more at:

- The project website: https://urbanheat-smaqmd.hub.arcgis.com/
- Technical Report: www.airquality.org/LandUseTransportation/Documents/Altostratus_Final_Report.pdf
- Summary Report: www.airquality.org/LandUseTransportation/Documents/UHI%20Project%20Summary%20Report.pdf

The full links to all external sources referenced in this document are listed below:

- UCLA's How Heat Harms Health in Your Community tool: https://experience.arcgis.com/experience/4c158842b-5c94857a06c3a85c7aa02de/
- Fresno Council of Governments' Extreme Heat and Shade Adaptation Plan: https://www.fresnocog.org/wp-content/uploads/2026/10/FresnoCoG_Draft093026.pdf
- Smart Surfaces Coalition's Achieving Urban Cooling, Enhanced Public Health and Equity, and Lower Climate Risk in Hot Dry Climates Through Smart Surfaces: An Indicative Case Study of Stockton, California: https://static1.squarespace.com/static/5b104d0b365f02ddb7b29576/t/6178291f730c615ed1a64ef0/1635264806952/Smart+Surfaces+Stockton.pdf
- City of Sacramento's Urban Forest Resource Analysis, 2018: https://www.cityofsacramento.gov/content/dam/portal/pw/Maintenance-Services/Urban-Forestry/Urban-Forest-Master-Plan/SacramentoCA_ResourceAnalysis_20180522pdf

Explore other heat resources:

- CRC's Urban Heat Pollution in the Capital Region website: climatereadiness.info/tools-resources/heat
- California Heat Assessment Tool (CHAT): www.cal-heat.org
- Cal-Adapt: cal-adapt.org/
- CalOES Summer Heat resources: news.caloes.ca.gov/cooling-centers-and-resources-4/
- EPA Heat Island website: www.epa.gov/heatislands
- CDC Extreme Heat website: https://www.cdc.gov/climate-health/php/resources/protect-yourself-from-the-dangers-of-extreme-heat.html

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

CAPITAL REGION CLIMATE READINESS COLLABORATIVE