

Increasing Heat Resilience in the Built Environment with Cool Roofs, Cool Walls, and Cool Pavements

RIISING TEMPERATURES THREATEN OUR COMMUNITIES

Heat negatively affects our health and well-being, productivity, energy use, school performance, and more. Low income communities and communities of color more frequently bear these challenges.¹

1. Hsu, A., Sheriff, G., Chakraborty, T. et al. Disproportionate exposure to urban heat island intensity across major US cities. *Nature Communications* 12, 2721 (2021). <https://doi.org/10.1038/s41467-021-22799-5>

CITIES ARE HOTTER THAN OUTLYING AREAS

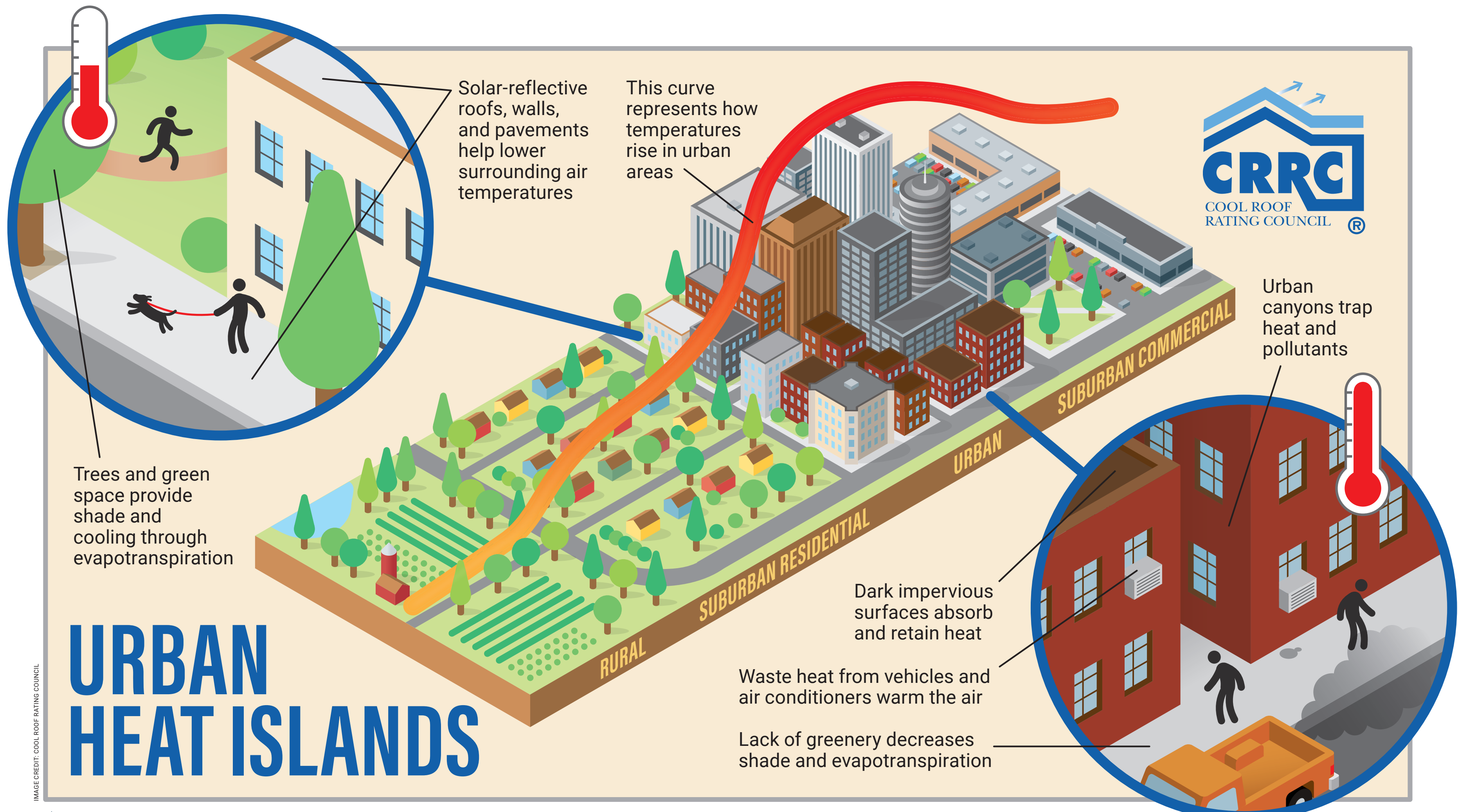
According to the U.S. Environmental Protection Agency (EPA), daytime temperatures in urban areas are about 1–7°F higher than temperatures in outlying areas, with nighttime temperatures about 2–5°F higher. This is due to the urban heat island (UHI) effect. An entire city or areas within a city can be a heat island.

THIRD-PARTY RATINGS

The Cool Roof Rating Council, a 501(c)(3) nonprofit established in 1998, implements third-party rating programs for roofing and exterior wall products. The ratings help inform consumers about the product's impact on a building's energy use and in combating the UHI effect. The CRRC lists product ratings in the online Rated Products Directories, which are available to the general public at no charge.



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URBAN HEAT ISLANDS

This illustration describes the factors that contribute to urban heat islands (UHI), as well as factors that help mitigate UHI. Urban heat islands occur when the temperature in urban environments is higher than surrounding areas. High surface temperatures lead to elevated air temperatures, especially at night. Heat islands increase heat-related discomfort, illness, and death. They also cause greater air conditioner use, which increases energy costs and air pollution. Urban heat has a disproportionate impact on disadvantaged communities. (Hsu et al., 2021; Hoffman et al., 2020; and Wilson, 2020).

HOW CAN WE MITIGATE URBAN HEAT ISLANDS?

Installing solar-reflective “cool” roofs, walls, and paved areas is one straightforward way to combat heat islands. These “cool” surfaces reflect more of the sun’s energy, rather than absorbing it as heat.

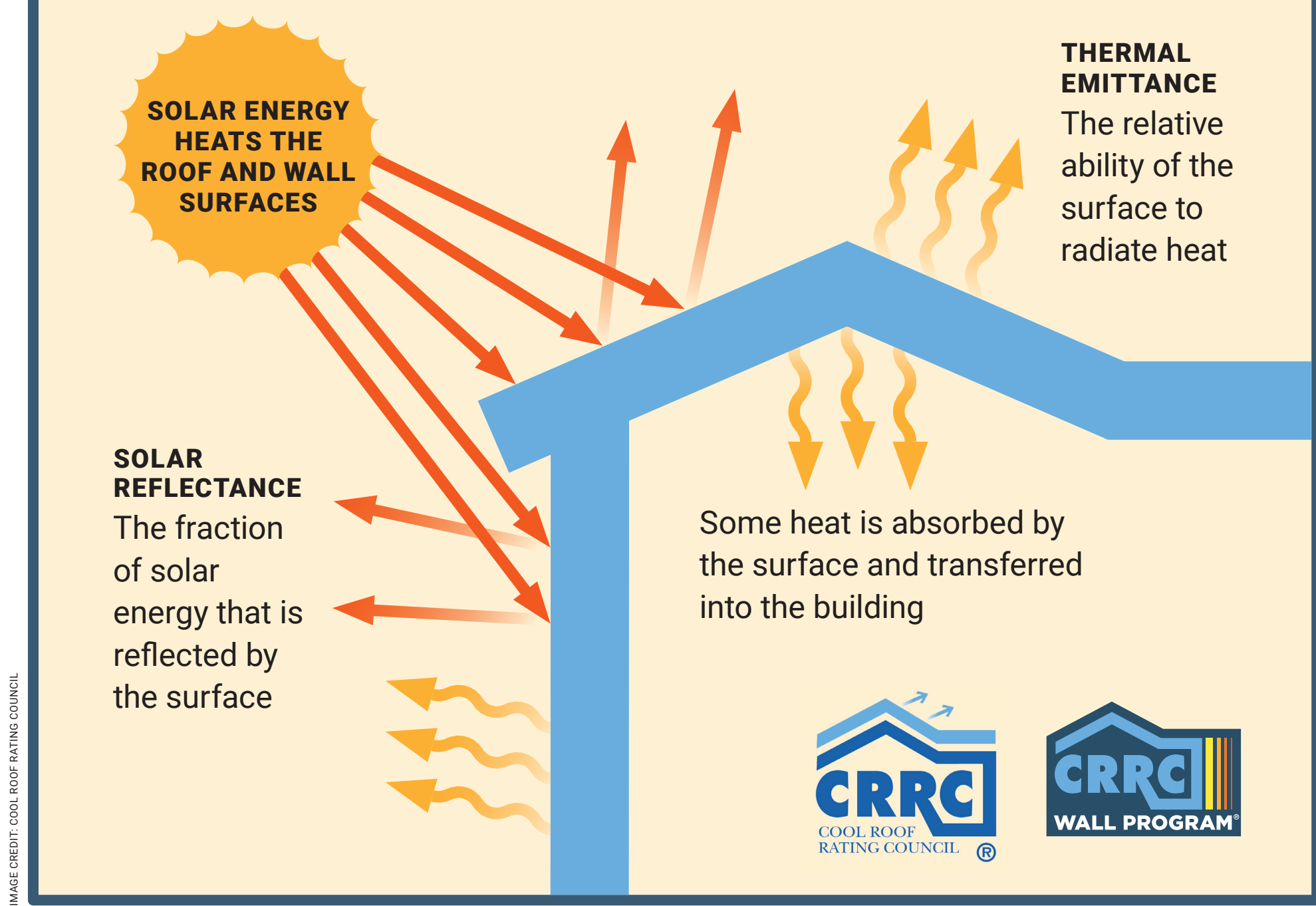
Increasing the albedo of our cities by 0.1 could result in an average surface temperature reduction of more than 10°F and a corresponding air temperature reduction of up to 1°F.¹ Each degree of cooling leads to increased comfort and economic benefits.

Investing in cool roofs, walls, and pavements presents an economic opportunity while cooling our communities. Reduced energy use helps lower utility bills, and home and building owners can use cool surfaces to qualify for financial incentives in some cities. At the community level, a cost-benefit analysis of UHI mitigation strategies for over 1,600 cities worldwide found that moderate use of cool roofs and pavements to mitigate UHI can yield up to a 12:1 benefit to cost ratio on these investments.²

1. Kravynoff, E. S., Broadbent, A. M., Zhao, L., et al. Cooling hot cities: a systematic and critical review of the numerical modeling literature. *Environ. Res. Lett.* 16, 053007 (2021). <https://doi.org/10.1088/1748-9326/abdcf1>

2. Estrada, F., Wouter Botzen, W. J., and Tol, R. S. J. A global economic assessment of city policies to reduce climate change impacts. *Nature Clim Change* 7, 403–406 (2017). <https://doi.org/10.1038/nclimate3301>

HOW DO COOL SURFACES WORK?



COOL SURFACE BENEFITS

- ✓ Reduce temperatures and increase comfort
- ✓ Lower A/C use and decrease energy costs
- ✓ Reduce energy demand and strain on electrical grid
- ✓ Decrease generation of greenhouse gas emissions
- ✓ Improve air quality by slowing smog formation
- ✓ Help keep people cooler during power outages

◀ This illustration describes the flow of radiant energy as heat between the sun, roof and wall surfaces, building interior, and surroundings. The higher the solar reflectance, the more solar energy is reflected away from the surface. Some of the solar energy is absorbed by the surface as heat. The higher the thermal emittance, the more absorbed heat is radiated away from the surface.

COOL EFFORTS IN ACTION!

BALTIMORE SMART SURFACES

The City of Baltimore worked with the Smart Surfaces Coalition (SSC) to understand and quantify the costs and benefits of “smart surfaces”—green, porous, and reflective surfaces, trees, and solar PV—adoption city-wide to help meet major Baltimore objectives, including reducing summer heat, redressing structural inequality, and improving livability and health of all citizens. Funded by the Abell Foundation and with guidance from local organizations and city leaders, the SSC conducted an in-depth analysis of the costs and benefits of city-wide adoption of smart surfaces by Baltimore. According to the analysis, city-wide adoption of 12 smart surfaces strategies over 20 years in Baltimore would cut peak summer downtown temperature by over 4°F, reduce city CO2e emissions by more than 10%, and have a benefit-cost ratio of about 10:1.

The city also proposed a cool roof ordinance in October 2021 (Council Bill 21-0160) that requires cool roofs on low-slope roofs on newly constructed buildings and roof replacements.



HEAT ISLAND REDUCTION PROGRAM

U.S. EPA's Heat Island Reduction Program works with local officials, community groups, researchers, and other stakeholders to identify opportunities to implement heat island mitigation policies that create healthy and sustainable communities, including cool surfaces. Key resources and activities include a compendium of strategies, social media toolkit, webinars, and technical information on heat islands and equity, climate change impacts, measuring heat islands, and more.



WHITE HOUSE INTERAGENCY WORKING GROUP ON EXTREME HEAT

The working group, formed by the White House Climate Policy Office in July 2021 and co-led by HHS, NOAA, and EPA aims to elevate, coordinate, and accelerate the federal government's efforts to increase the resilience of the nation to the impacts of extreme heat, with a focus on disadvantaged communities. A key priority was the launching of heat.gov in July 2022, a new one-stop shop to help the public and decision-makers understand and reduce the health risks of extreme heat.



COOL ROADWAYS PARTNERSHIP



pavement products that reduce surface and air temperatures and build resilience to rising heat. The participating jurisdictions, who together anticipate investing \$4.75 billion to add, maintain, or replace 70,000 lane-miles over the next 10 years, developed a comprehensive guide to existing cool pavement products and to foster dialogue between stakeholders.



HEAT ACTION PLATFORM

The Platform is a living, engagement-oriented tool for city officials, practitioners, and financial institutions to find guidance, both existing resources and tailor-made solutions, on reducing the human and economic impacts of extreme heat at the regional or municipal level. The Platform offers opportunities to engage with world-leading experts from a wide variety of organizations and across a diversity of disciplines to plan, fund, implement, and measure heat resilience actions that make sense given their specific local circumstances.

