Sizzling Solutions: Accelerating Heat Mitigation – Policies, Programs, and Design Dynamics!

March 27, 2024

CRRC COOL ROOF RATING COUNCIL ®

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Speakers

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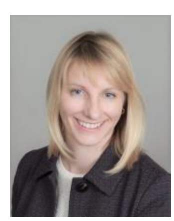

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Agenda

1. Introduction
2. Cool surface basics
3. Cool roof design best practices
4. Extreme Heat/UHI in Code
5. Policy implementation at the local level

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Efficiency delivered.

We advance best practices, codes, and policies through market leadership, research, guidance, and technical advocacy toward a built environment that equitably delivers community benefits and climate solutions.

This webinar is possible thanks to the support of Barr Foundation and the Clean Cooling Collaborative, an initiative of ClimateWorks Foundation.

Clean Cooling COLLABORATIVE An initiative of ClimateWorks Foundation

Barr Foundation

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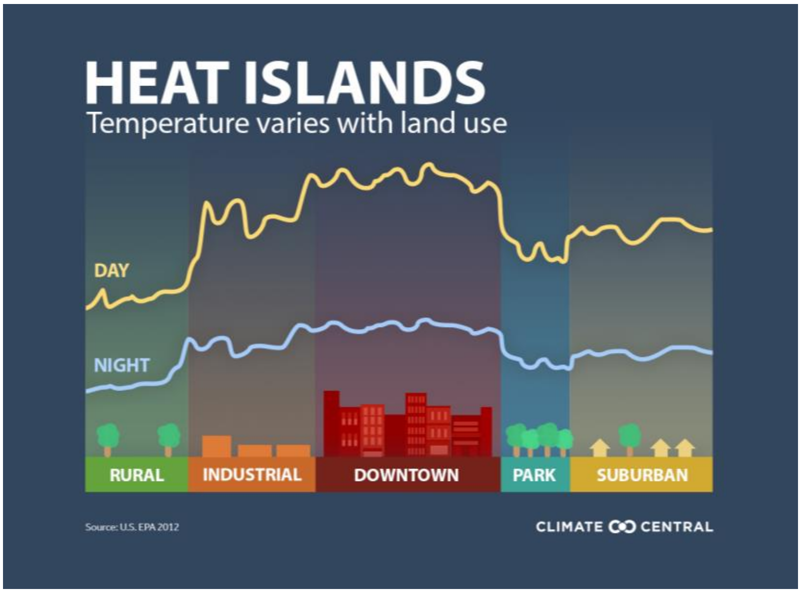

Urban areas are on average 5-9°F higher than surrounding rural areas.

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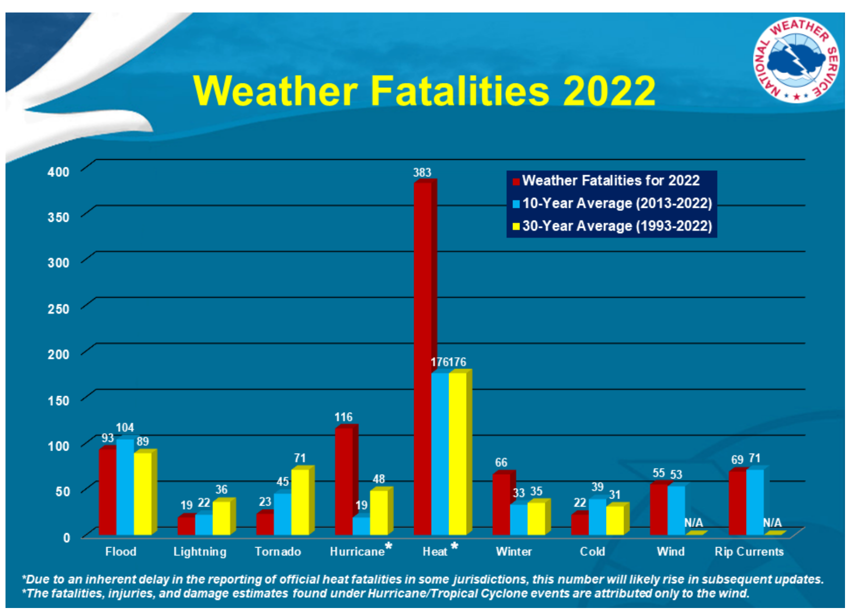
Heat is the most fatal weather event.



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Health impacts of Extreme Heat

- Many common medications reduce body's ability to cool off
- Some medications are less effective at high heat
- High temps can exacerbate mental health problems and increase violence

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Other impacts of UHIs and Extreme heat

- Increased smog/air pollution
- Increased energy use, greenhouse gas emissions, and energy bills
- Increased wear and tear of building surfaces and pavements from higher temperature fluctuations

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Extreme heat / UHI Mitigation Strategies

- Cool and Green Roofs
- Cool Walls
- Cool and/or Permeable Pavements
- Shading
- Trees/Vegetation
- Maximum temperature setpoint

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Introduction to Cool Roofs and Walls

Audrey McGarrell
Cool Roof Rating Council

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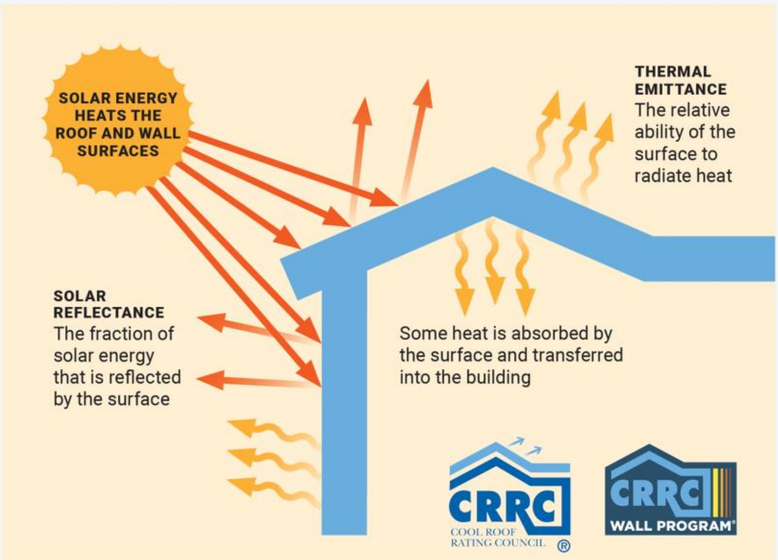

Cool roofs and walls highly reflect sunlight and emit absorbed heat

Image credit: Cool Roof Rating Council

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Solar Reflectance Index combines SR and TE into one calculated value

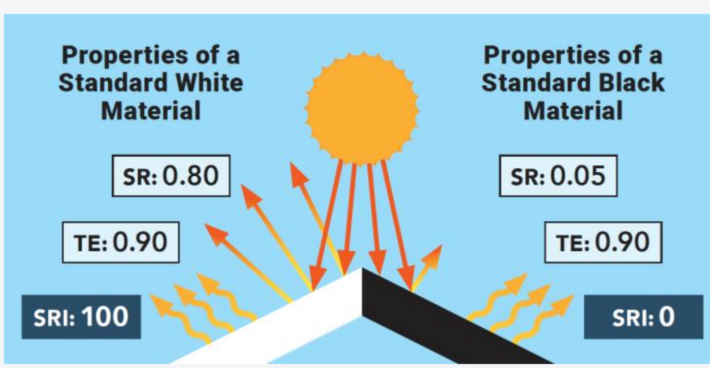

Image credit: Cool Roof Rating Council

- Typically between 0 and 100, but can be >100 for particularly cool surfaces
- Only applicable to roofs (not walls)

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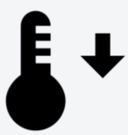
Impacts on Individual Buildings

- In many climate zones, cool roofs and walls can reduce the cooling load of the building during hot weather, which helps:
  - Decrease A/C use and lower utility bills
  - Increase occupant comfort and safety
  - Extend the life of HVAC equipment
- Overall impacts may vary depending on climate zone, time of year, energy use patterns, and proper installation



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Impacts on Communities

- Cool roofs and walls and the associated reduction of air conditioning use can help:
  - Improve grid stability during peak times of day and peak seasons
  - Improve air quality
  - Reduce the urban heat island (UHI) effect and associated public health risks from heat waves and increased building temperature

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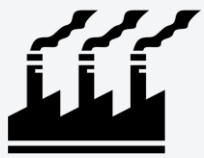
Global Impacts

- Cool roofs and walls can help:
  - Address climate change by lowering CO_2 and other emissions associated with fossil fuel-generated electricity used for A/C
  - Raise the global albedo, thereby reducing global warming



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Radiative properties are measured following industry-vetted test methods

- Solar Reflectance Standards
  - ASTM C1549
  - ASTM E903
  - ASTM E1918
  - 410-Solar Test Method*
- Thermal Emittance Standards
  - ASTM C1371
  - Slide Method*

D&S Solar Spectrum Reflectometer

Image Source: Devices and Services

D&S AE1 Emissometer

Image Source: Devices and Services

SOC 410-Solar Reflectometer

Image Source: Surface Optics Corporation

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*Not an ASTM Method

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Natural weathering is crucial for understanding radiative performance over time


Image Source: Atlas Weathering Services

Image Source: Atlas Weathering Services

Image Source: Lawrence Berkeley National Laboratory

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Laboratory aging available for roof products

- Based on ASTM D7897
- Roof products only



Image Source: Heat Island Group, Lawrence Berkeley National Laboratory

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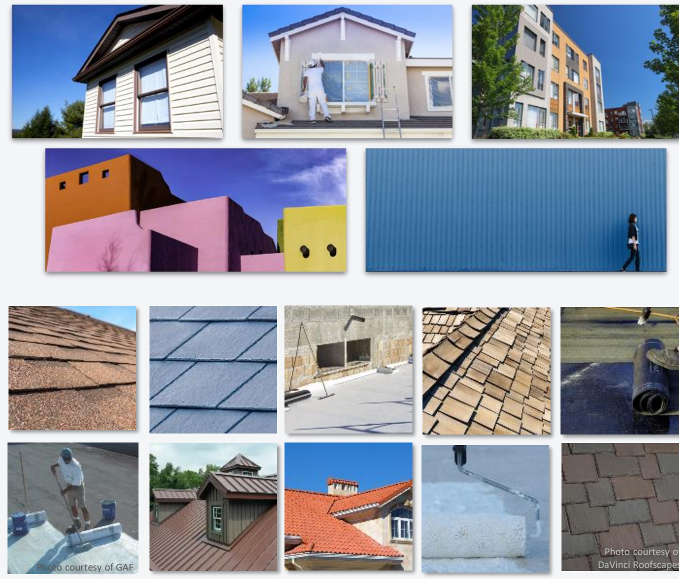
Cool products come in many materials, shapes, and colors



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Cool Colors

Cool-colored products look like conventional colors but reflect more infrared radiation

Cool Colors

Conventional Colors

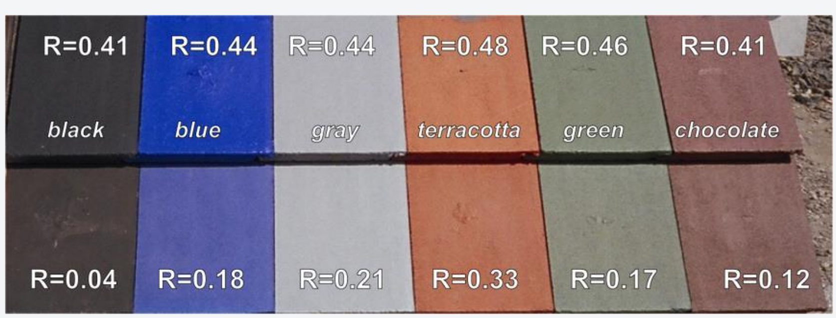

Photo courtesy of: American Rooftile Coatings

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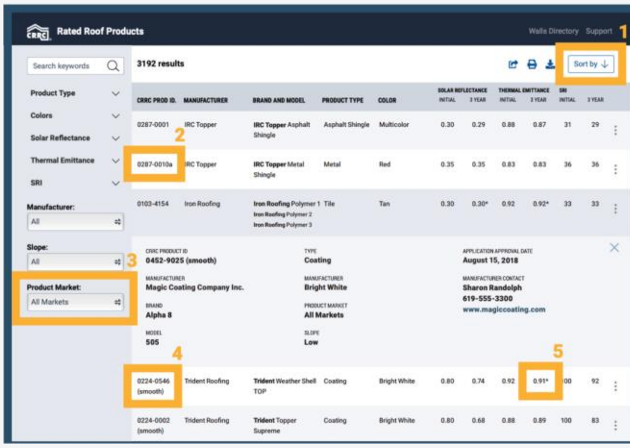
Easily find radiative property data on the CRRC Rated Products Directories



RESULTS ARE DISPLAYED IN A SORTABLE TABLE:

1 Use the [Sort by] button to sort and reorder products

2 A letter after the CRRC Product ID means the product is a reformulation of a previously rated product

3 Indicates if the product is sold to other roofing manufacturers, end-use customers, or both

4 Indicates if the coating was tested over a smooth or rough substrate, as defined in the CRRC-1 Product Rating Program Manual

5 An asterisk indicates the product obtained a Rapid Rating, which will be replaced by three-year aged values once the weathering period is complete

https://coolroofs.org/directory

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Third-party ratings have an important role in policy and program development, compliance, and enforcement

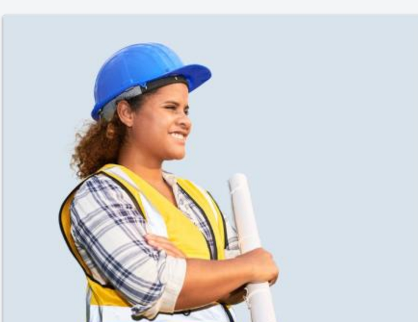

Image Source: iStock

- Informs consumers about product's ability to reduce heat gain
- Helps consumers ID higher performing/compliant products
- Gives assurance of unbiased and verified data
  - Provides validity to marketing claims
  - Supports programs and policies

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Concepts for Resilient Design + Roof Systems

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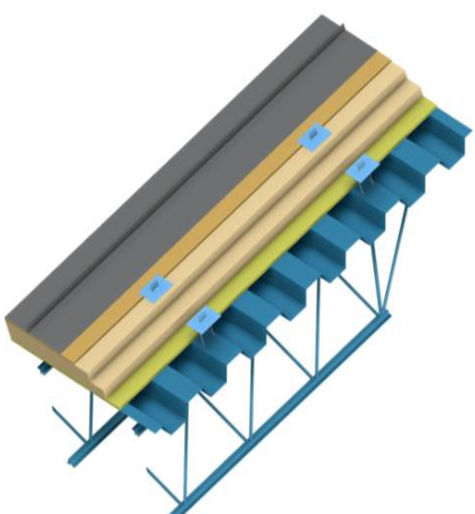

Good Roof…. Good Building.

- Less thermal expansion of structural components
- Less movement and reduced risk of cracking finishes
- Lower risk of condensation
- Roof systems that keep the building dry result in durable buildings that last a long time.

Photo: MH

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Common Roof Assemblies

Better performing roof systems protect the structural elements from heat and moisture:

-Waterproofing component(s)

-Insulation (typically staggered rigid layers)

-Air/vapor control layers

-Components are secured and selected to manage local wind uplift, hail, and other weather events.

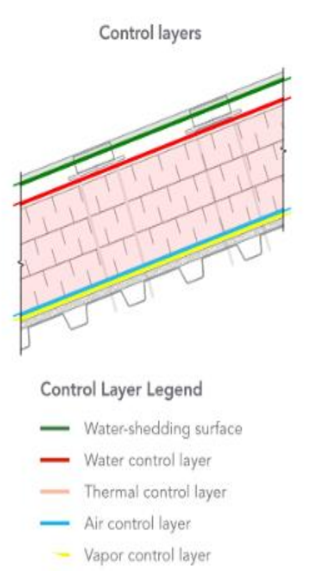

Photo: Vaprosheild

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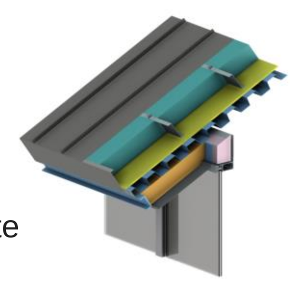
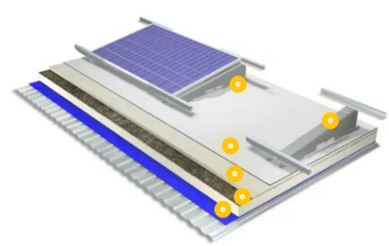
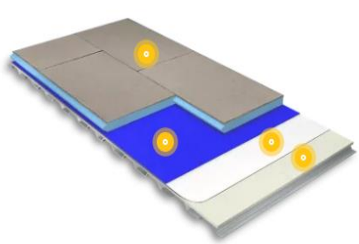
Best Practices:

- Sloped
- Multi-Layer
- Primary Protected
- Flexible and Accommodate Movement
- Reduced Wear & Tear
- Maintainable







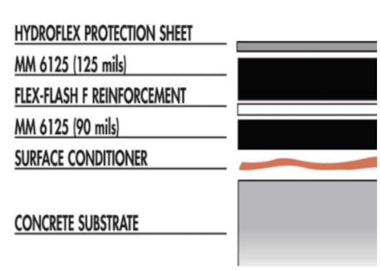


Photo credit: Sika Hydrotech

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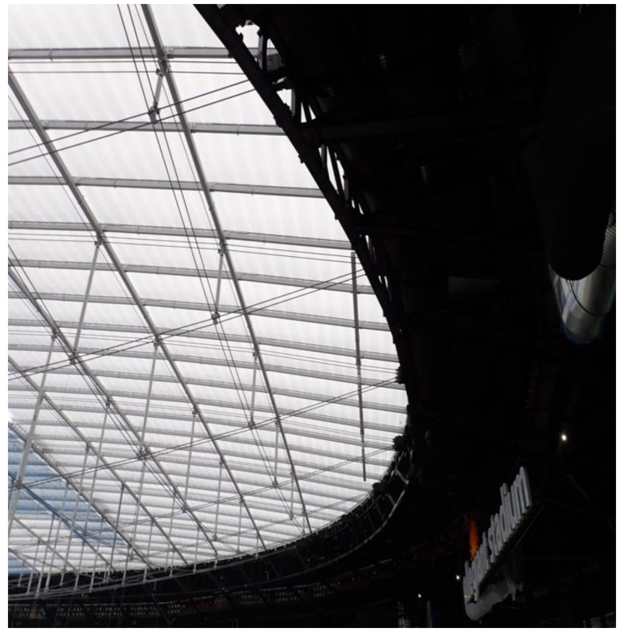
Urban Heat Island and Roof Systems

Roof designers select systems that account for solar reflectance and emissivity of the exposed materials, typically based on an industry standard of measurement: the **solar reflective index (SRI):**

- Material Index ranges between 0-100
- IECC C4.02.3
- LEED Sustainable Sites
- Membranes
- Metal components
- Finish materials
- Roof top amenities (pavers, pool, energy generation)
- Plants (discounted in code requirements)



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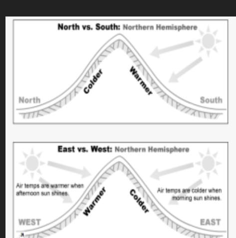
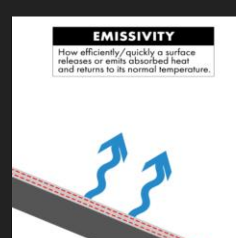
Roof Selection & SRI



Exposure

Shade vs Sun
Sloping Face Direction

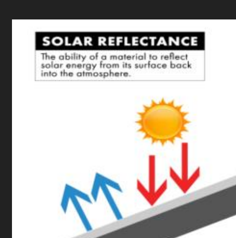


Emissivity

Ability of a material to emit heat instead of absorb. it

Climate

Latitude
Solar exposure
Local Climate



Solar Reflectance

Ability of a material to reflect light and heat in lieu of transmit it into the building materials.

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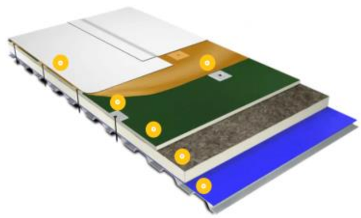
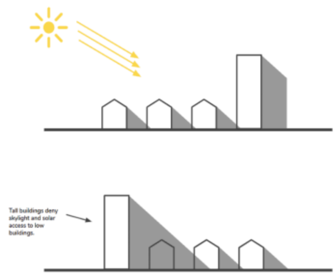
Cool Roof Design Approaches

- High SRI Surface (aggregate, membrane)
- Planted

A High SRI material may not always be required or desired….

- Shaded roof areas
- Photovoltaics/Thermal H.W.
- Greenhouses
- Cold climates?





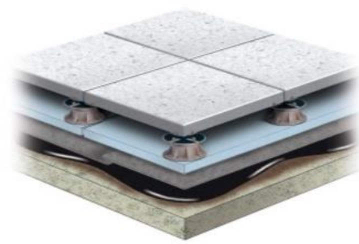


Photo Credit: Sika Sarnafil, American Hydrotech, Planlux

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Roof Color Selection Matters

Estimated Cumulative Potential Energy Savings Due to the Use of White Sarnafil S 327 Membrane Compared With a Black Roof:

Total Primary Energy Consumption [MJ/1,000m²]

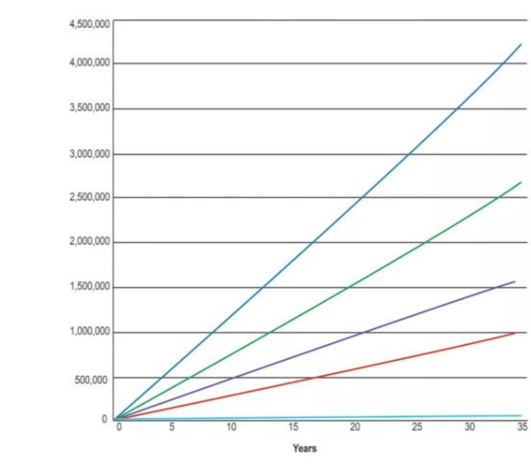

PHOTO CREDIT: SIKA SARNAFIL, AMERICAN HYDROTECH, PLANLUX

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SRI

Roof system designers select systems that account for solar reflectance and emissivity of the exposed materials, typically based on an industry standard of measurement: the solar reflective index (SRI):

- Range between 0-100
- Membranes
- Metal components
- Finish materials
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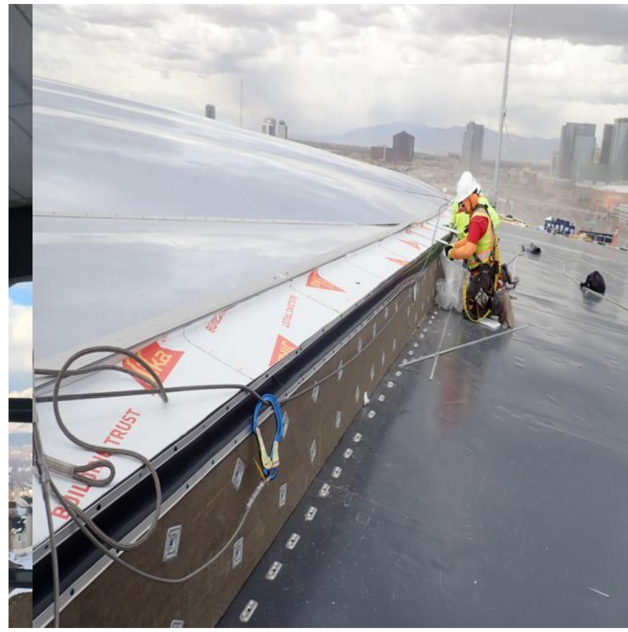

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Planted Roofs

Pros:

- Transpire Water
- Limit UV and wind exposure to roof materials and structure
- Reduce heat island
- Requires care and access

Cons:

- Require water
- Need maintenance and care
- Can cost more upfront
- Protection from roof migration
- Leaks may be hard to find

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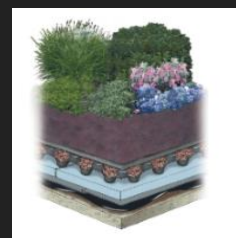
Plant Selection

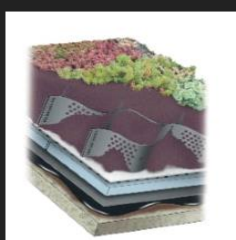
Climate

Hardiness Zone
Rainfall
Wind



Site

Sun/shade
Biodiversity
Vegetation Size
Visibility



Maintenance

Year round?
Invasive Species
Weeding and Care

Access

Safety
Equity

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Air Leakage is Costly:

Parapets
Penetrations
Skylights
Drains
Transitions

Morrisonhershfield.com

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Addressing Thermal Bridging:

Walls and Planters

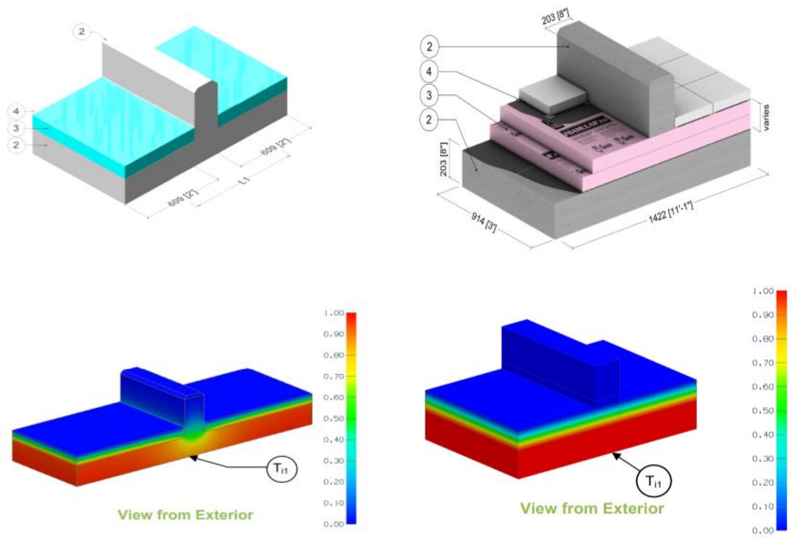

Photo credit: Thermalenvelope.ca

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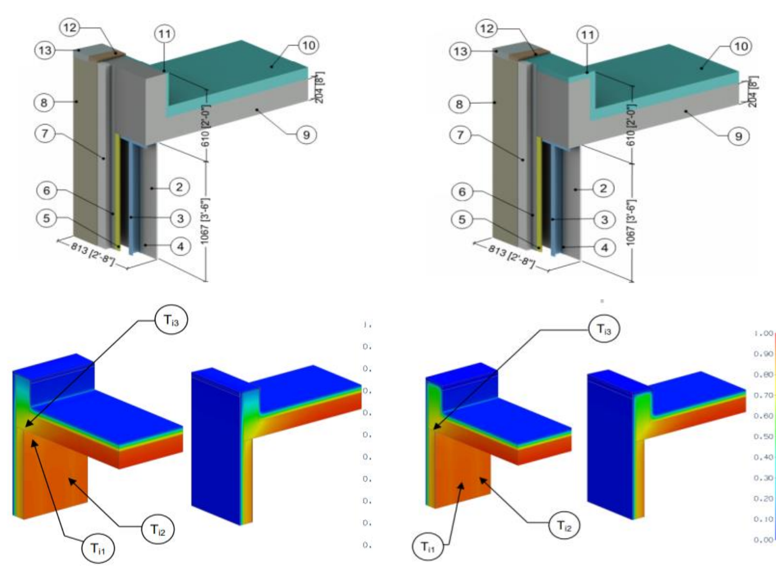
Addressing Thermal Bridging:

Parapets



Thermalenvelope.ca

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Questions?

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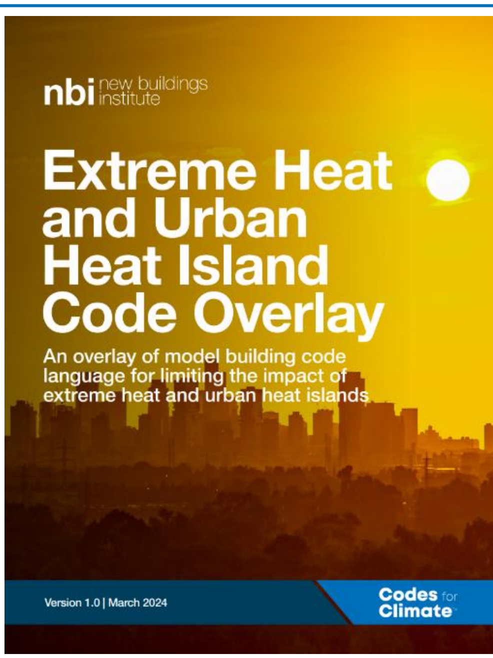

NBI's Extreme Heat & UHI Code Overlay

NBI's Extreme Heat & UHI Code Overlay provides language for jurisdictions to implement cool roofs/walls, cool/permeable pavement, trees/vegetation, and a maximum temperature setpoint.

Link to report:
Extreme Heat and Urban Heat Island Code Overlay - New Buildings Institute

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Summary of Code Language Changes

Codes	• Language for Energy codes, Green codes, and Building codes
Climate Zones	• Expanded cool roofs to Climate Zone 5
Solar Reflectance	• Added solar reflectance requirements for steep roofs and residential
Cool Walls	• Expanded cool walls to Climate Zone 4 (currently only in CZ 0, which is outside of U.S.)
Indoor Temp	• Added a maximum indoor temperature setpoint

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Codes & UHI Strategies

ASHRAE 90.1	IECC	189.1/IgCC	International Building Code	International Residential Code	International Mechanical Code
• Cool Roofs • Cool Walls	• Cool Roofs • Cool Walls	• Cool Roofs • Cool Walls • Cool/Permeable Pavement • Trees/Vegetation	• Cool Roofs • Cool Walls • Max Temp Setpoint	• Cool Roofs • Cool Walls • Max Temp Setpoint	• Max Temp Setpoint

Energy Codes (ASHRAE 90.1, IECC) — Green Code (189.1/IgCC) — Building Codes (International Building Code, International Residential Code, International Mechanical Code)

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Example Energy Code Language

Code Section → **5.4.4.2. Wall Solar Reflectance and Thermal Emittance.** For Climate Zone 0 through 4, *above-grade*

Subject → *east-, south-,* and *west-oriented walls* shall comply with subparagraph (a) or (b):

Require Scope → a. A minimum of 75% of the *opaque wall* area shall have a minimum area-weighted initial solar reflectance of 0.30 when tested in accordance with ASTM C1549 with AM1.5GV output, or ASTM E903 with the AM1.5GV output, or determined in accordance with *generally accepted engineering standards*, and a minimum *emittance* or emissivity of 0.75 when tested in accordance with ASTM C835, C1371, E408, or determined in accordance with *generally accepted engineering standards*. For the portion of the *opaque wall* that is glass spandrel area, a minimum solar reflectance of 0.29, determined in accordance with NFRC 300 or ISO 9050, shall be permitted. Area-weighting is permitted only between the *south-, east-,* and *west-oriented walls* and only between *walls* of the same *space conditioning category*.

Includes: percentage, scope, SRI value, Standard to comply with, and options.

OR

Scope → b. A minimum of 30% of the *above-grade wall* area shall be shaded through the use of human-made *structures*, *existing buildings*, hillsides, permanent *building* projections, *on-site renewable energy systems*, or a combination of these. Shade coverage shall be calculated by projecting the shading surface downward on the *wall* at an angle of 45 degrees.

New code language

This addition moves the cool roof and cool wall requirements from the prescriptive compliance path into the mandatory requirements. The language above adds a cool roof requirement for steep-sloped roofs; currently, 90.1-2022 does not include steep-sloped roofs in their cool roof requirements. In addition, an existing exception for the cool roof requirement for higher insulation levels is removed because studies show that well-insulated buildings still stand to benefit from cool surfaces. [12] *Cool roofs are currently required in the prescriptive path of ASHRAE 90.1 in Climate Zones 0 to 3. The overlay language extends the cool roof requirements to include climate zones 4 and 5* [7] *and extends cool wall requirements to include climate zones 1, 2, 3, and 4* [8] [9] [10]. *Cool walls are currently only required in the prescriptive path of ASHRAE 90.1 in Climate Zone 0, which is located outside of the U.S.*

Explanation

Italic = defined in the code   Underlined = new code

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Examples of Heat Mitigation Strategies

Potential Policy Pathways: Zoning Code, Housing Code, Energy Code, Building Code, Incentive Program…

- **D.C. Housing Code** – requires space cooling from May 15 to Sep 15, with indoor temp at 78°F, or at least 15°F less than the outside temperature.
- **Baltimore Building Code** – requires cool roofs on low-sloped commercial buildings.
- **Sacramento Zoning Code -** requires 50% of parking lots to be shaded by trees.
- **Hawaii Energy Code** – provides a wall insulation exception for cool walls.
- **Phoenix, AZ Cool Pavement Program**– Phoenix has implemented a cool pavement program, increasing solar reflectivity on 118 miles of roads.

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Thank you!

You can contact me at Liepa@newbuildings.org.

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KING COUNTY EXTREME HEAT MITIGATION STRATEGY

Daaniya Iyaz, Extreme Heat Mitigation Strategy Specialist

SIZZLING SOLUTIONS WEBINAR

27 MARCH 2024

King County

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AGENDA

1) Heat Strategy Background
2) Strategy Action Areas
3) Wrap Up

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HEAT STRATEGY BACKGROUD

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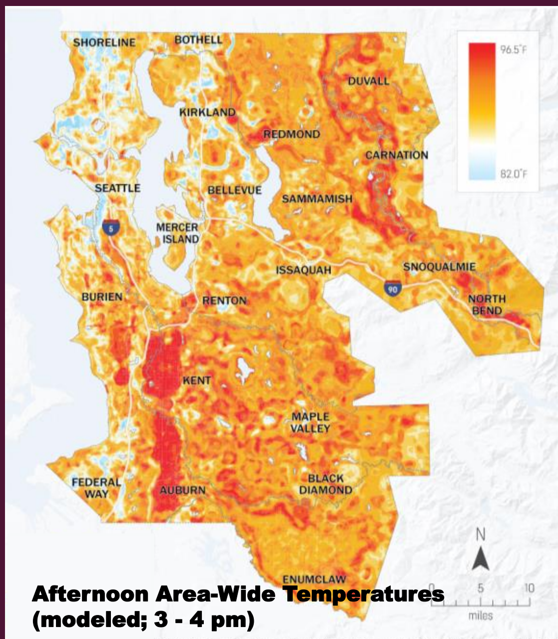
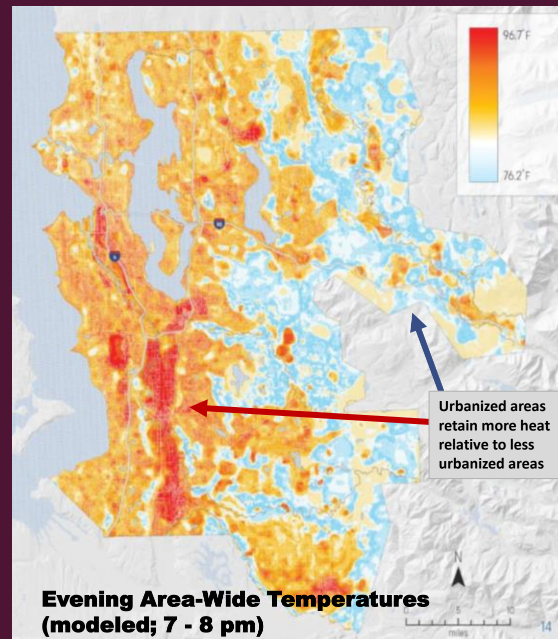
2020 URBAN HEAT ISLAND MAPPING PROJECT





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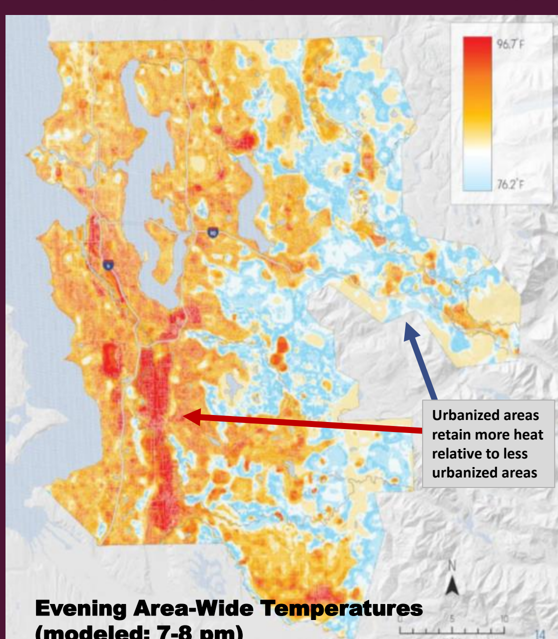
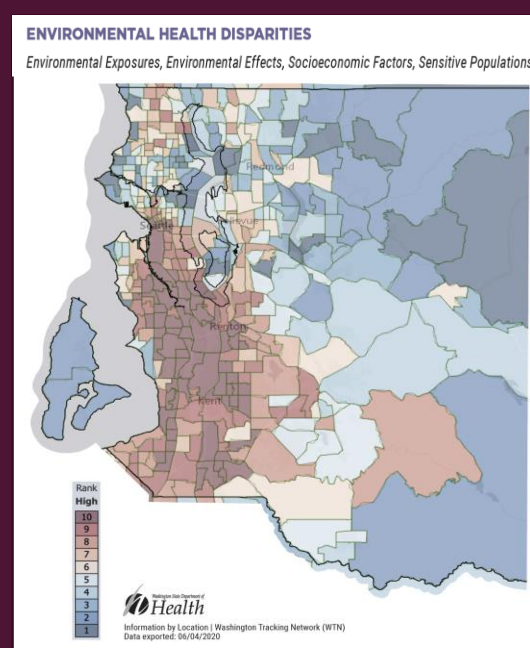
2020 URBAN HEAT ISLAND MAPPING PROJECT





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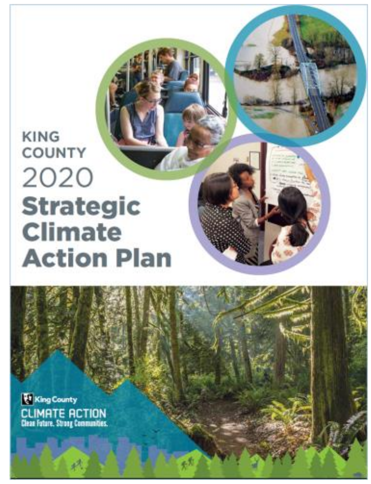
KING COUNTY'S FIRST EXTREME HEAT MITIGATION STRATEGY

- **Context**: Priority action in King County Strategic Climate Action Plan; Supported by FEMA grant & King County funding
- **Audience**: King County, local jurisdictions, community organizations
- **Focus**:
  - Short-term actions (emergency management, communications, etc.)
  - Long-term actions (urban tree canopy management, building codes, etc.)
- **Completion date**: Summer 2024



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STRATEGY DRAFT GOAL STATEMENT

The goal of the King County Heat Mitigation Strategy is to equitably address and reduce the harmful effects of extreme heat on people and places in King County by:

- Effectively preparing for and responding to heat events when they occur,
- Expanding the use of built and nature-based solutions that reduce extreme heat impacts,
- Strengthening the resilience of communities most affected by extreme heat.

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ACTION AREAS

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HEAT ACTION CATEGORIES

1. **Help People Stay Cool & Safe Indoors** ←
2. **Help People Stay Cool & Safe Outdoors**
3. **Cool Our Neighborhoods**
4. **Design for Heat** ←
5. **Expand & Enhance Heat Safety Communications & Trainings**
6. **Support Action Implementation & Continued Learning on Heat**

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DESIGN FOR HEAT: RELEVANT ACTIONS

- Develop and support local adoption of a King County building code package for heat mitigation. This could include…
  - Increasing use of high albedo materials in new construction and retrofits.
  - Recommending and/or incentivizing cool roofs and shade coverage.
  - Promoting best practices in passive cooling.

https://archinect.com/news/article/143997037/cool-roofs-substantially-reduce-temperatures-during-a-heat-wave-according-to-new-study

https://gordonswindowdecor.com/

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HELP PEOPLE STAY COOL & SAFE INDOORS: RELEVANT ACTIONS

- Increase access to home cooling for low-income residents and other vulnerable populations.
  - Distribute cooling resources and technologies, such as window films.
  - Expand heat pump installation programs.
- Expand access to energy efficient repairs, upgrades, and utility bill assistance.
  - Increase access to weatherization and home repair programs for existing housing.

ENERGIZE SKYWAY & WHITE CENTER

https://www.energizekingcounty.org/

https://www.energy.gov/scep/wap/whole-house-weatherization

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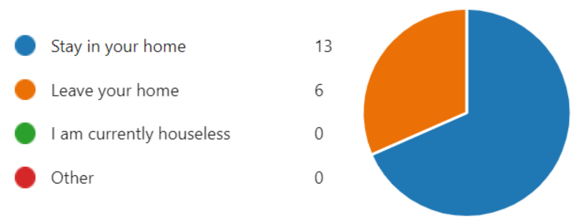
WHY ARE BUILT ENVIRONMENT SOLUTIONS IMPORTANT?

Highlights from community outreach events:

- People prefer to stay home during heat events but feel too hot in their homes.
- Major barriers to cooling at home:
  - Cost
  - Difficulty/confusion with cooling options
  - Medical/mobility limitations
  - Power outages
- Strong interest from community organizations in increasing cooling capacity of homes and buildings.

When it is hot outside, are you and your family more likely to stay in your home or leave your home?



Survey response from our community focus group in Kent, WA.

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WRAP UP

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KEY TAKEAWAYS

1. People prefer to stay home during heat events.
2. Cost and complex technology are some of the most prevalent barriers for cooling.
3. We need a mixture of solutions that involve code amendments, passive/active cooling retrofits, integration with existing systems, and community outreach.

Thank you for your time!

If you have any questions or would like to discuss further, please contact me at daiyaz@kingcounty.gov.

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Thank you!

CRRC COOL ROOF RATING COUNCIL

Coolroofs.org

nbi new buildings institute

www.newbuildings.org

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