

How to make bright choices about roofs, walls, and pavements

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Reflecting Sunlight: Albedo as a Means to Reduce the
Greenhouse Effect • Climate Resolve • 30 June 2022 (online)



Let's talk about the what, where, and how of **selecting solar-reflective "cool" surfaces**

- 1 What cool options are available for roofs, walls, and pavements?
- 2 Where should cool surfaces be used?
- 3 How can you find cool surface products?



Reflective roofs, wall, and pavement materials are **available in light, medium, and dark colors**



White roof membrane



White limestone roof



Cool-color roof tile



Cool-color roof shingle



White wall



Cool-color wall



White pavement coating

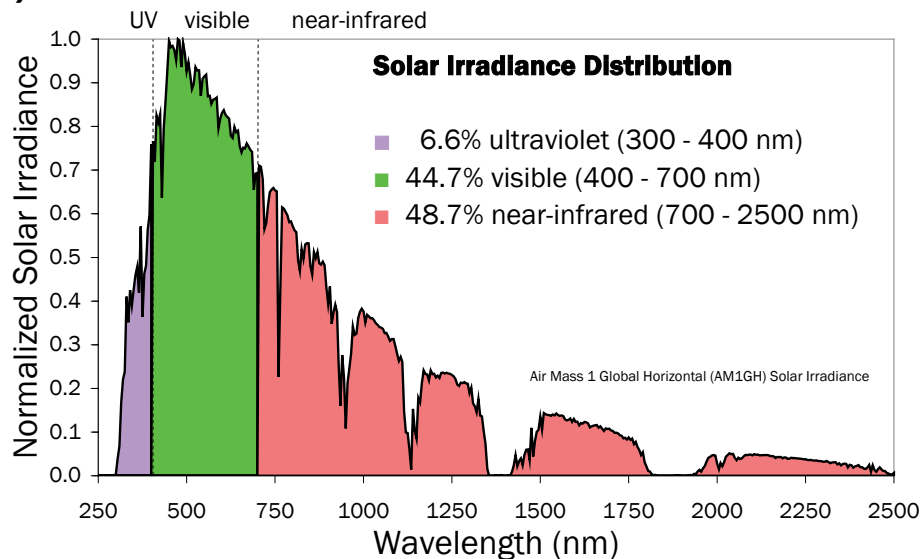


Cement concrete (right)

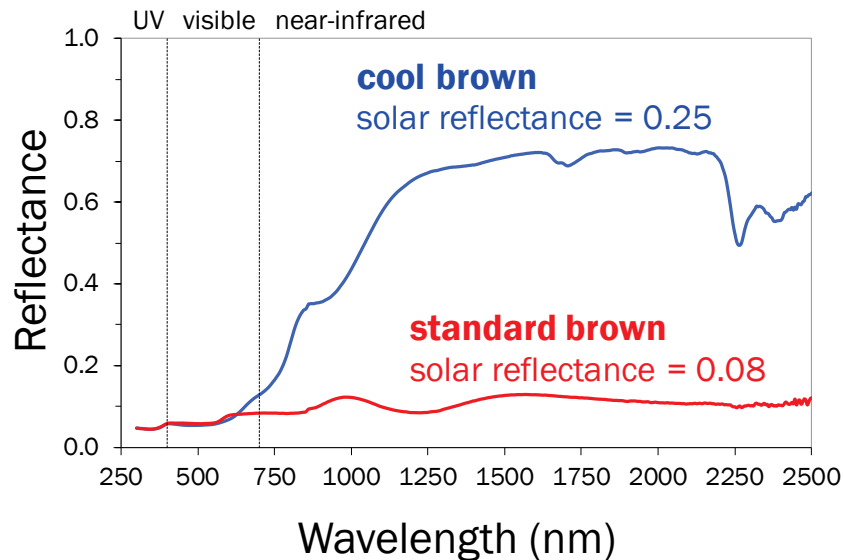


White is most reflective, but **colorful materials can stay cool** by reflecting the invisible "near infrared" half of sunlight

(a)



(b)

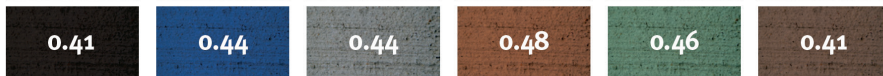


(c)

Standard Concrete Tiles (SR)



With Cool Coating Applied (SR)
























































Even a black surface can reflect >40% of sunlight!

Source: Adapted from data from American Rooftile Coatings. Solar reflectance (SR) = albedo.



Most cost effective & green path is to choose a cool roof product for new construction or end-of-service replacement (i/ii)

Common Roofing Materials and Cool Options*

Roof Type	Life Expectancy (years)	Roof Slope	Non-Cool Roof Options	Non-Cool Roof Solar Reflectance	Cool Roof Options	Cool Roof Solar Reflectance
 Asphalt Shingle	15 to 30 	steep-sloped 	black or dark brown with conventional pigments	0.05-0.15 	"white" (actually light gray) or cool color shingle	0.25 
 Built-Up Roof	10 to 30 	low-sloped 	with dark gravel with aluminum coating**	0.10-0.15 0.25-0.60  	with white gravel white smooth coating	0.30-0.50 0.75-0.85  
 Clay Tile	50+ 	steep-sloped 	dark color with conventional pigments	0.20 	terracotta (unglazed red tile) color with cool pigments white	0.40 0.40-0.60 0.70   
 Concrete Tile	30 to 50+ 	steep-sloped 	dark color with conventional pigments	0.05-0.35 	color with cool pigments white	0.30-0.50 0.70  
 Liquid Applied Coating	5 to 20 	low- or steep-sloped 	smooth black	0.05 	smooth white	0.70-0.85 
 Metal Roof Uncoated corrugated metal is typically less durable than coated metal	20 to 50+ 	low- or steep-sloped 	unpainted, corrugated** dark-painted corrugated	0.30-0.50 0.05-0.10  	white painted color with cool pigments	0.55-0.70 0.40-0.70  
 Modified Bitumen	10 to 30 	low-sloped 	with mineral surface capsheet (SBS, APP)	0.10-0.20 	white coating over a mineral surface (SBS, APP)	0.60-0.75 
 Single-Ply Membrane	10 to 20 	low-sloped 	black (polyvinyl chloride (PVC) or ethylene propylene diene monomer rubber (EPDM))	0.05 	white (PVC or EPDM) color with cool pigments	0.70-0.80 0.40-0.60  
 Wood Shake	15 to 30 	steep-sloped 	painted dark color with conventional pigments	0.35-0.50 	bare	0.40-0.55 

Source: Adapted from coolcalifornia.org roofing options table. Photos: Creative Commons and LBNL

* Spray polyurethane foam is not included in this chart because it is typically coated by a reflective liquid applied coating to minimize ultraviolet damage to the foam. ** Aluminum and metal have high solar reflectance but their low thermal emittances reduces their ability to stay cool.

Price Premiums for Cool Roofs on New Roofs (Premiums are the extra cost of installing the cool alternative)

Roof Materials	Typical Non-Cool Surface	Cool Alternative	Price Premium (US\$ per ft ²)
Built-Up Roof	Mineral aggregate embedded in flood coat	Light-colored aggregate, like marble chips, gray slag	0.00
	Asphaltic emulsion	Field-applied coating on top of emulsion	0.80-1.50
Metal	Mineral surfaced cap sheet	White mineral granules	0.50
	Unpainted metal	May already be cool	0.00
	Painted metal	Factory-applied white paint	0.20
Modified Bitumen	Mineral surface cap sheet	Factory-applied coating, white mineral granules	0.50
	Gravel surface in bitumen	Light colored gravel	0.00
	Metallic foil	May already be cool	0.00
	Asphalt coating	Field-applied coating on top of asphaltic coating	0.80-1.50
Shingles	Mineral granules	White granules	0.00
		Cool-colored granules	0.35-0.75
Sprayed Polyurethane Foam	Liquid applied coating	Most coatings are already cool to protect the foam	0.00
	Aggregate	Light colored aggregate	0.00
Thermoplastic Membranes	White, colored, or dark surface	Choose a white or light colored surface	0.00
Thermoset Membranes	Dark membrane, not ballasted (adhered or mechanically attached)	Cool EPDM formulation	0.10-0.15
Tiles		Factory cool ply or coating on dark EPDM	0.50
	Non-reflective colors	Clay, slate (naturally cool) Cool colored coatings	0.00 0.00

Source: Adapted from DOE Guidelines for Selecting Cool Roofs.



Most cost effective & green path is to **choose a cool roof product for new construction or end-of-service replacement** (ii/ii)

Example: Single-ply membranes

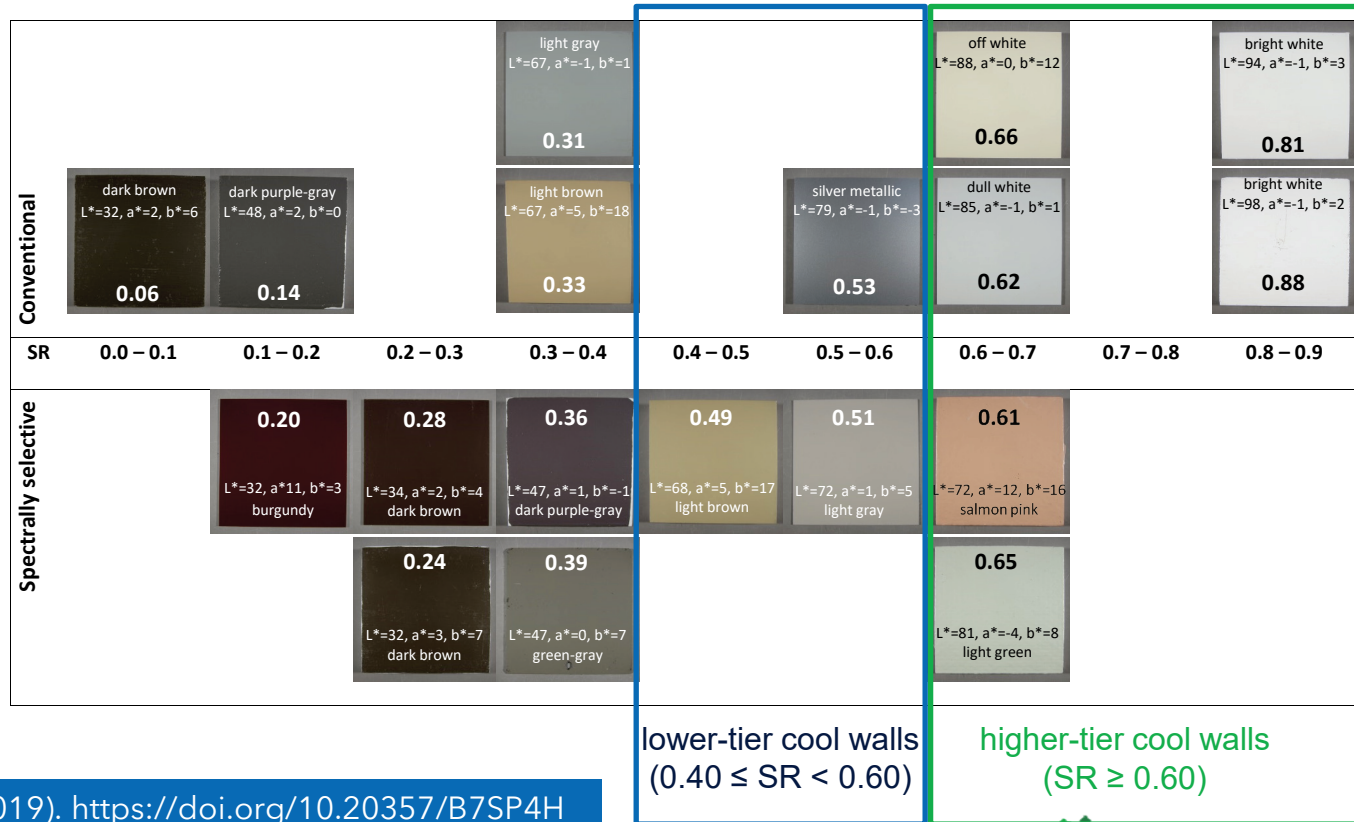
Common Roofing Materials and Cool Options*

Roof Type	Life Expectancy (years)	Roof Slope	Non-Cool Roof Options	Non-Cool Roof Solar Reflectance	Cool Roof Options	Cool Roof Solar Reflectance
 Single-Ply Membrane	10 to 20 	low-sloped 	black (polyvinyl chloride (PVC) or ethylene propylene diene monomer rubber (EPDM))	0.05 	white (PVC or EPDM)	0.70–0.80 
					color with cool pigments	0.40–0.60 

Price Premiums for Cool Roofs on New Roofs (Premiums are the extra cost of installing the cool alternative)

Roof Materials	Typical Non-Cool Surface	Cool Alternative	Price Premium (US\$ per ft ²)
Thermoplastic Membranes	White, colored, or dark surface	Choose a white or light colored surface	0.00

Cool-wall products with high solar reflectance (SR), or “albedo”, are sold today—though most are not yet marketed as such



Cement concrete **pavements**, or asphalt concrete pavements with a light- or cool-colored coating, **can be reflective**



White coating



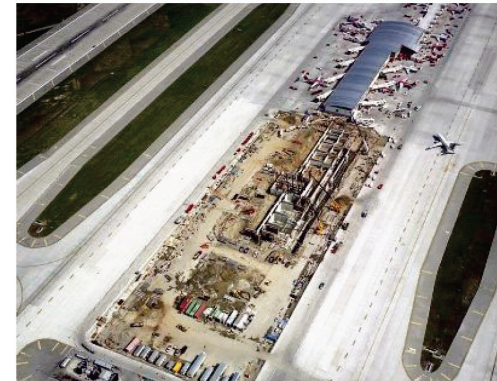
Cool-color coating



White pavers



Cement concrete sidewalk (top)

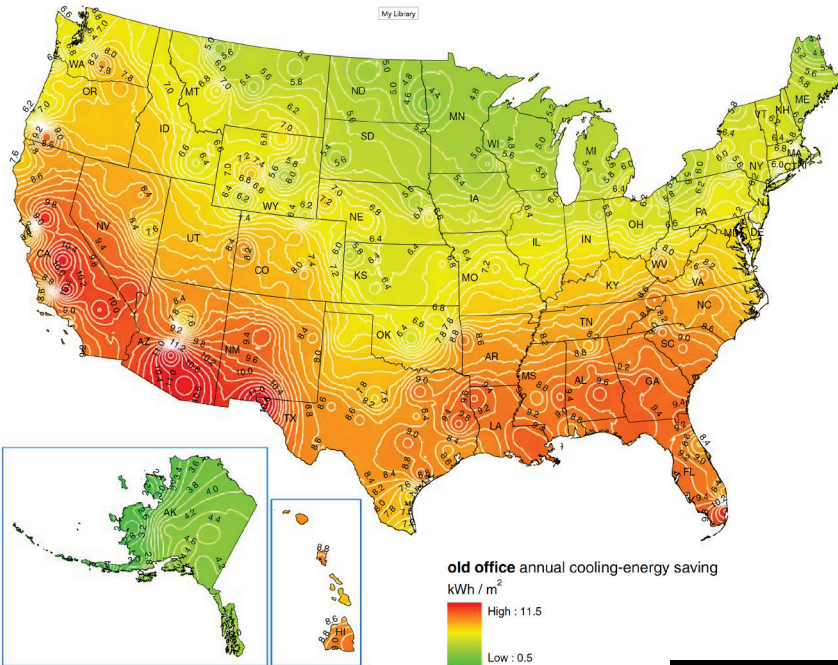


Slag cement concrete runway

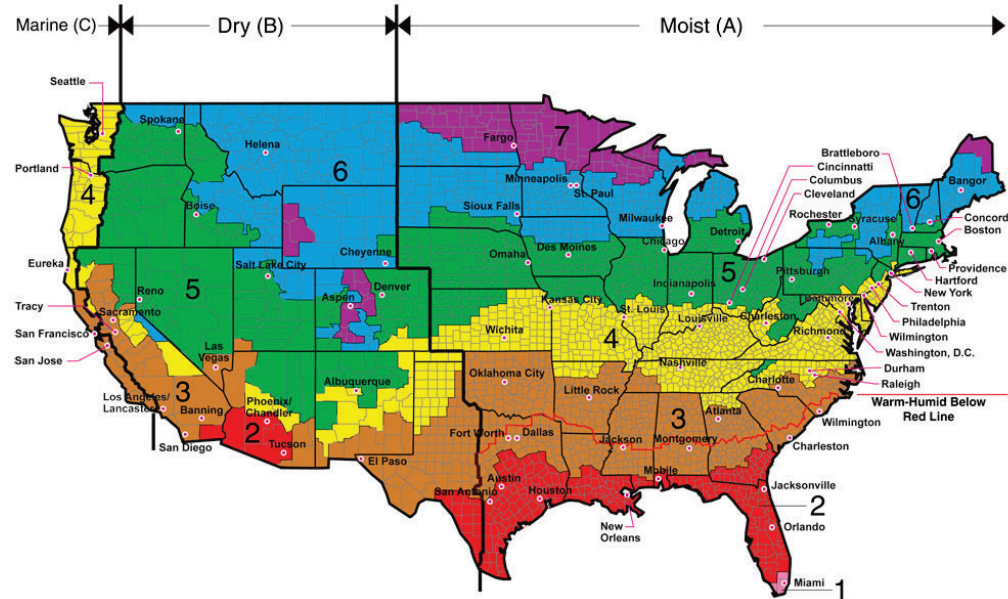


Cool roofs/walls can save energy + carbon across California, the southern half of the U.S. (ASHRAE climate zones 1 - 4), and beyond (roofs in climate zone 5)

(a) Cool-roof cooling energy savings



(b) ASHRAE climate zones



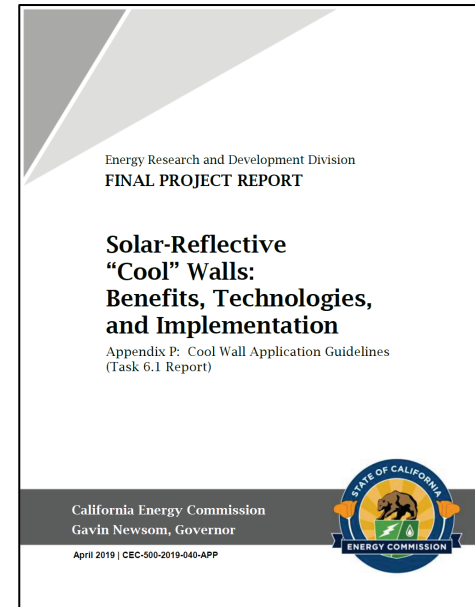
Reflective surfaces also provide global cooling anywhere.

LBNL's Cool Surface Savings Explorer estimates energy, emission, and cost savings from cool roofs and walls

Parameters	
Climate zone	CACZ_10
City	Riverside
State	California
Vintage year	pre1978
Vintage group	oldest
Building category	single-family home
Building orientation	mean
Modified surface(s)	N E S W
Base wall albedo	0.25
Albedo of modified wall(s)	0.6
Base roof albedo	0.1
Albedo of modified roof	NA

Results	
Annual cooling cost absolute savings intensity [\$/m ²]	1.161
Annual gas heating cost absolute savings intensity [\$/m ²]	-0.072
Annual electric heating cost absolute savings intensity [\$/m ²]	0
Annual combined heating cost absolute savings intensity [\$/m ²]	-0.072
Annual fan cost absolute savings intensity [\$/m ²]	0.23
Annual HVAC cost absolute savings intensity [\$/m ²]	1.318

Tool download link + instructions are in the Cool Wall Application Guidelines <https://doi.org/10.20357/B7SP4H>



You can find roof product ratings, incentives, and other resources on the **Cool Roof Rating Council's website** (CoolRoofs.org)

CRRC RATED PRODUCTS DIRECTORY USER GUIDE



What is the CRRC Rated Roof Products Directory?

- Free online tool at coolroofs.org/directory/roof
- Quick and convenient to use
- 3,000+ rated roofing products from all major product types
- New products added regularly
- Helpful job aid for contractors, architects, building managers, and more!

CRRC Rated Roof Products
Walls Directory Support 1

Search keywords 3192 results Sort by ↓

CRRC PROD ID.	MANUFACTURER	BRAND AND MODEL	PRODUCT TYPE	COLOR	SOLAR REFLECTANCE		THERMAL EMITTANCE		SRI	
					INITIAL	3 YEAR	INITIAL	3 YEAR	INITIAL	3 YEAR
0287-0001	IRC Topper	IRC Topper Asphalt Shingle	Asphalt Shingle	Multicolor	0.30	0.29	0.88	0.87	31	29
0287-0010a	IRC Topper	IRC Topper Metal Shingle	Metal	Red	0.35	0.35	0.83	0.83	36	36
0103-4154	Iron Roofing	Iron Roofing Polymer 1 Tile	Tile	Tan	0.30	0.30*	0.92	0.92*	33	33

CRRC PRODUCT ID: 0452-9025 (smooth) TYPE: Coating APPLICATION APPROVAL DATE: August 15, 2018

MANUFACTURER: Magic Coating Company Inc. MANUFACTURER CONTACT: Sharon Randolph 619-555-3300 www.magiccoating.com

BRAND: Alpha 8 PRODUCT MARKET: All Markets

MODEL: S05 SLOPE: Low

0224-0346 (smooth)	Trident Roofing	Trident Weather Shell TOP	Coating	Bright White	0.80	0.74	0.92	0.91*	90	92
0224-0002 (smooth)	Trident Roofing	Trident Topper Supreme	Coating	Bright White	0.80	0.68	0.88	0.89	100	83

- RESULTS ARE DISPLAYED IN A SORTABLE TABLE:**
- Use the **Sort by ↓** button to sort and reorder products
 - A letter after the CRRC Product ID means the product is a reformulation of a previously rated product
 - Indicates if the product is sold to other roofing manufacturers, end-use customers, or both
 - Indicates if the coating was tested over a smooth or rough substrate, as defined in the CRRC-1 Product Rating Program Manual
 - 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/roof>

RESOURCES For Home and Building Owners

A "cool" roof or wall reflects and emits the sun's heat back to the sky instead of transferring it to the building below. Generally lighter colored products are more reflective than darker colors, but color is not the only indicator of solar reflectance performance. Learn more by visiting "What is a Cool Roof?" and "What is a Solar-Reflective Wall?"

Save Money

[READ MORE](#)

Reduce Air Conditioner Use

[READ MORE](#)

Lower Indoor Air Temperature

[READ MORE](#)

Reduce Peak Energy and Improve Grid Stability

[READ MORE](#)

Combat Climate Change

[READ MORE](#)

Mitigate the Urban Heat Island

[READ MORE](#)

Reduce Smog

[READ MORE](#)

Improve Public Health

[READ MORE](#)

<https://coolroofs.org/resources/home-and-building-owners>

The Cool Roof Rating Council launched its Wall Rating Program in January – **wall product ratings will go live soon**



<https://coolroofs.org/programs/wall-rating-program>



The Global Cool Cities Alliance's Cool Roadways Partnership lists **cool pavement coatings from 10+ suppliers**



Key Initiatives

*Advancing efforts that build resilience to
with solar reflective urban surfaces is ar*

The Benefits

[Home](#) » [Cool Roadways Partnership](#)

Cool Roadways Partnership



Credit: LA Bureau of Street Services

Manufacturer Responses

ePave (ePave Cool Pavement Technology)

[ePAVE Cool Roadways Partnership Response to RFI](#)
[ePAVE White Paper](#)
[ePAVE Technical Bulletin](#)
[ePave SDS-2019](#) (Safety Data Sheet)

GAF (DuraShield)

[GAF RFI Response 3-17-21](#)
[GAF SDS 4040 STREETBOND DURASHIELD PART A – SOLAR GRAY](#) (Safety Data Sheet)
[GAF SDS 4016 STREETBOND DURASHIELD 2 PART B](#) (Safety Data Sheet)

GuardTop (CoolSeal)

[GuardTop RFI Response](#)
[GuardTop Brochure](#)
[GuardTop CoolSeal Facts](#)
[GuardTop CoolSeal RTU Specification](#)
[GuardTop CoolSeal ambient temp NASA data](#)
[GuardTop SDS CoolSeal](#) (Safety Data Sheet)

Lhoist (Lhoist Mineral Slurry)

[Lhoist LNA RFI Response](#)

National Concrete Pavement Technology Center (Concrete Overlays)

[NCPTC RFI Response](#)

Pavement Surface Coatings (Endurablend)

[PSC Endurablend RFI Response](#)
[PSC Friction test endurablend](#)
[PSC ENDURABLEND-DATASHEET](#)

Pavement Technology Inc. (PlusTI)

[PTI RFI Response](#)
[PTI Supporting Docs, Videos RFI](#)

Shepherd Color

[Cool Roadways Solutions_ShepherdColor](#)

ThermaCote (ThermaCote®)

[Thermacote RFI Response](#)
Thermacote E303 Thermacote Sharp
[ThermaCote LA Road Test](#)

TopShell – Submitted November 2021

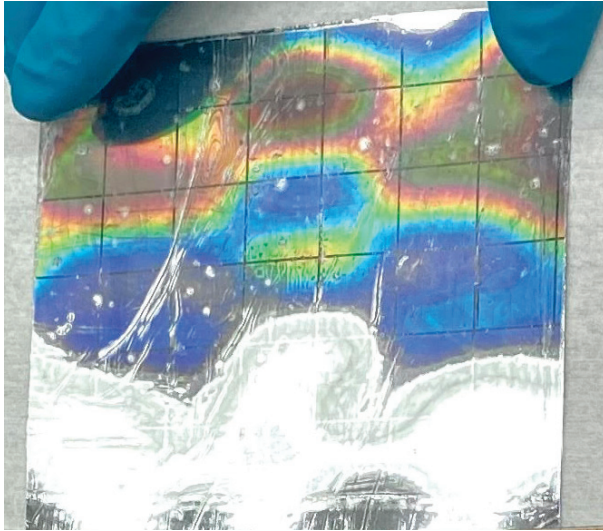
[TopShell Introduction](#)
[TopShell Technical Data Sheet 2021](#)
[TopShell Safety Data Sheet](#)
[TopShell LLC Cool Roadway Solutions RFI](#)
[TopShell Color List 2021](#)

Western Colloid (ArmorTop Stealth Grey)

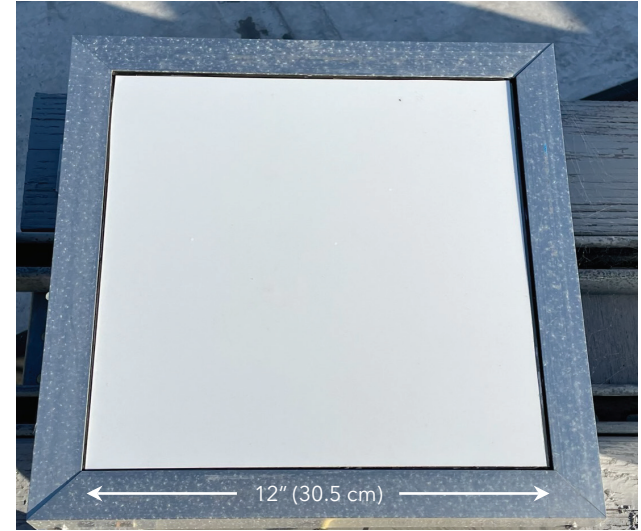
[Cool Roadways Solutions RFI – WesternColloid](#)

<https://globalcoolcities.org/cool-roadways-solutions-what-is-available-today>

Researchers continue to develop **exciting new cool surface materials**—here are just two of many prototypes



LBNL's **Temperature Adaptive Radiative Coating** (solar reflectance 75%) radiates heat when warm (thermal emittance 90% above 27 °C) but retains heat when cool (thermal emittance 20% below 22 °C)
<https://newscenter.lbl.gov/2021/12/16/roof-year-round-energy-savings>



3M's **Passive Radiative Cooling Film** provides high solar reflectance (93%) and thermal emittance (89%) in a thin polymer film
https://www.3m.com/3M/en_US/energy-conservation-us/applications/passive-radiative-cooling

Learn more about cool surface choices from the Global Cool Cities Alliance, Cool Roof Rating Council, and US EPA Heat Island Program



Overview

The simple act of switching from a dark to a light-colored surface has a number of benefits for buildings, cities, and the planet. Go to [Overview](#).



Saving Energy

As demand for cooling increases, so does electricity use, and costs for building owners and tenants. Go to [Saving Energy](#).



Saving Lives

Save lives during heat waves. Go to [Saving Lives](#).



Enhancing Human Comfort

Your cool surface helps turn down the temperature in your community. Go to [Enhancing Comfort](#).



Improving Health and Equity

Your cool surface makes your city healthier and happier. Go to [Improving Health and Equity](#).



Strengthening the Electric Grid

Your cool surface keeps the electric grid running on hot days. Go to [Strengthening the Electric Grid](#).



Promoting Cleaner Air

Your cool surface improves the air you and your neighbors breathe. Go to [Enabling Cleaner Air](#).



Cancelling Climate Change

Your cool surface makes a measurable impact on the warming caused by climate change. Go to [Cancelling Climate Change](#).



Growing Local Economies

The net economic benefits of reflective surfaces are two times greater than their cost. Go to [Growing Local Economies](#).

The screenshot shows the Cool Roof Rating Council (CRRC) website. The navigation bar includes: Cool Roof Rating Council, Rating Programs, Membership, Resources, About CRRC, and Product Directories. The main heading is "Resources" with the subtext "Find answers to your questions about cool roofing and solar-reflective exterior wall products." Below this are six content cards:

- What is a Cool Roof?** (LEARN MORE →)
- What is a Solar-Reflective Wall?** (LEARN MORE →)
- Looking for Codes, Programs or Standards?** (LEARN MORE →)
- Looking for Financial Incentives?** (LEARN MORE →)
- What is a Cool Roof?** (LEARN MORE →)
- What is a Solar-Reflective Wall?** (LEARN MORE →)

The screenshot shows the US EPA Heat Island Program website. It features the EPA logo, the text "United States Environmental Protection Agency", a "MENU" button, a search bar with "Search EPA.gov" and a magnifying glass icon, and a "CONTACT US" link.

Heat Island Effect

The graphic features a cityscape background with a dark blue overlay box containing the text:

Heat Island Mitigation Strategies

How to Keep Your Cool
Learn about the five strategies to reduce the heat island effect: trees and vegetation, green roofs, cool roofs, cool pavements, and smart growth. [Learn more>>>](#)

At the bottom, there are four numbered tabs: 1, 2, 3, and 4.

Heat islands are urbanized areas that experience higher temperatures than outlying areas. Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies. Urban areas, where these structures are highly concentrated and greenery is limited, become "islands" of higher temperatures relative to outlying areas. Daytime temperatures in urban areas are about 1-7°F higher than temperatures in outlying areas and nighttime temperatures are about 2-5°F higher. Find more information on the [Learn About Heat Islands](#) page.

Global Cool Cities Alliance
<https://GlobalCoolCities.org>

Cool Roof Rating Council
<https://CoolRoofs.org>

US EPA Heat Island Program
<https://www.epa.gov/heatislands>

Thank you!

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