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Cool Roof Feasibility and Site Analysis for Public Sector Facilities

RESEARCH AND LITERATURE REVIEW

PREPARED FOR
South Bay Cities Council of Governments (SBCCOG)

SUBMITTED BY

AESC, a Franklin Energy Company

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1. Executive Summary

This report provides a comprehensive overview of cool roof technologies, examining their functionality, benefits, and applicability, particularly within the territory of the South Bay Cities Council of Governments (SBCCOG) in the Southern California region. Cool roofs are designed to reflect more sunlight and absorb less heat than standard roofs, which lowers roof temperatures and reduces energy consumption for cooling. Beyond direct building-level advantages such as improved indoor comfort and energy savings, cool roofs also contribute to broader environmental benefits, including mitigation of the Urban Heat Island (UHI) effect.

The report evaluates various cool roof technologies, rating systems, and installation logistics across different roof types and materials, along with associated costs, maintenance needs, and payback periods. A comparative analysis with alternatives like green roofs is included to assess feasibility and cost-effectiveness. The report includes a regional assessment of SBCCOG's unique climate zones (CZ), policy landscape, and funding opportunities, offering tailored recommendations for public agencies and stakeholders aiming to implement sustainable roofing solutions in both coastal and inland communities.

The report finds that cool roof retrofits can effectively provide energy savings in buildings with HVAC systems in warm climates such as in California. Energy savings vary based on several factors including original roof reflectivity, HVAC efficiency, insulation, and climate. Summarized results of several case studies in California are included to provide examples of potential savings. There are tools available to estimate energy savings based upon the factors that can be used on a case-by-case basis. In buildings without HVAC, there cannot be measurable savings, but the thermal comfort can be improved inside the building.

2. Introduction

2.1 Cool Roof Definition

Cool roofs are named for their ability to lower rooftop temperatures and are defined by two measured material properties: solar reflectance (SR) and thermal emittance (TE). SR is the ability of the surface to reflect sunlight. TE is the ability of the surface to radiate absorbed heat from the sunlight. Both properties are measured on a scale of 0 to 1 where a higher value indicates a “cooler” roof. The Solar Reflectance Index (SRI) is a calculated metric that was created to combine SR and TE into a single parameter used to compare cool roof products. SRI values are typically from 0 to 100, where 0 is comparable to a standard black material and 100 is comparable to a standard white material (CRRC, 2024). Figure 1 shows a visualization of the important properties related to cool roofs. It is possible to have SRI values that are outside of the typical range due to how the standard black and white materials are defined. Figure 2 shows the SR and TE values that are used to calculate SRI = 100 and SRI = 0. It is possible to have a more reflective and/or higher emittance material than the standard white roof, leading to an SRI value greater than 100. It is also possible to have a less reflective and/or lower emittance material than the standard black material, leading to a negative SRI value.

Roofs consist of many layers including structural beams, decking, insulation, waterproofing layers, and roof covering/coating. This report will primarily focus on the topmost layer, the roof covering or coating. This layer has the most effect on how much solar energy is reflected or absorbed.

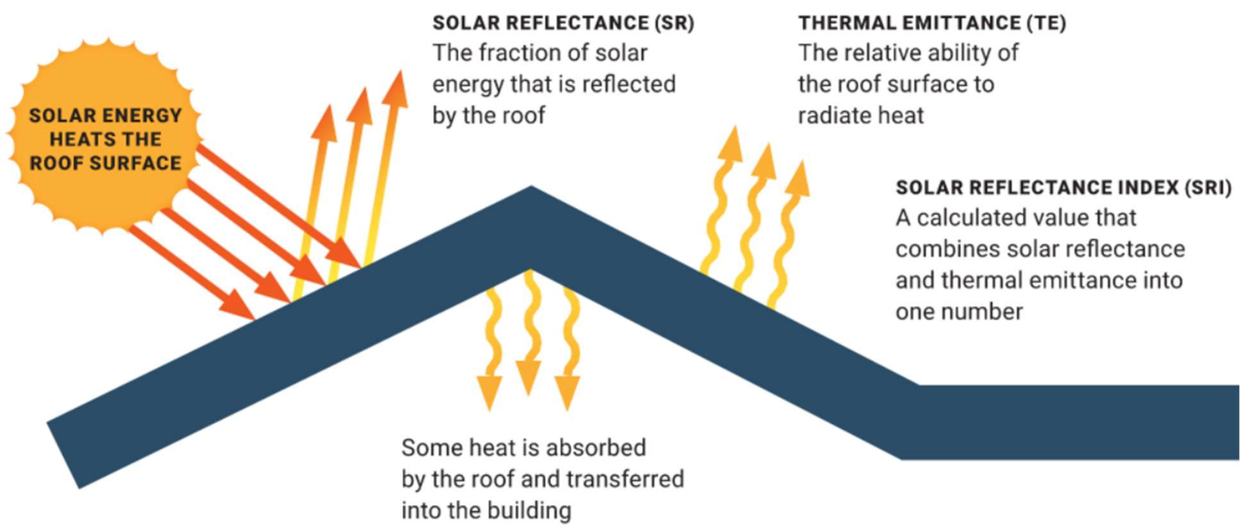


Figure 1: Material properties that define cool roofs.
Source: (CRRC, 2024)

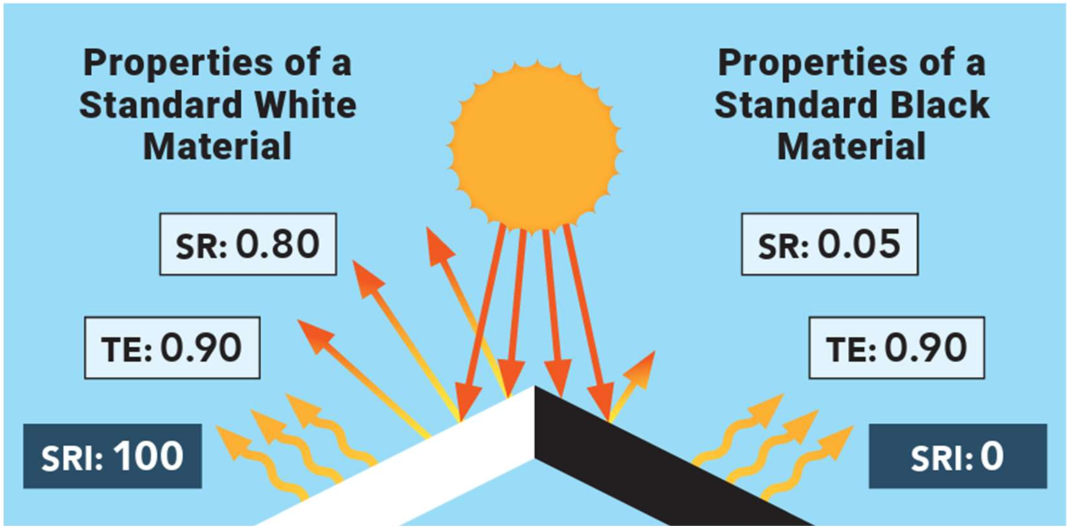


Figure 2: SRI Values
Source: (CRRC, 2024)

2.2 Benefits of Cool Roofs

Cool roofs provide benefits both to the building itself and the surrounding community. The roof is a major source of heat entering the building envelope. A roof with a higher SRI allows less heat to enter the building, which lessens the cooling load. This can create energy savings during the summer months, as heating, ventilation, and air conditioning (HVAC) equipment can run with lower energy input to cool the building. This is particularly beneficial for older or undersized HVAC units. It can also increase the thermal comfort inside buildings without HVAC systems (US DOE, n.d.). Energy savings can vary depending on many factors including building type, roof type, amount of insulation, building location, and climate. This report examined some of these factors and provided tools for estimating energy savings in Section 4.2.

Beyond individual buildings, cool roofs contribute to mitigating the UHI effect, a phenomenon where urban areas experience higher temperatures than surrounding rural regions. In the US, roofs and pavements typically make up about 60% of the surface area in a city and are often dark-colored, absorbing a lot of heat from the sun. Consequences of the UHI effect include increased energy consumption to cool buildings, air pollution, and frequency of heat-related and respiratory illnesses (Berkeley Lab, n.d.). Increasing the adoption of cool roof materials in cities will reflect more sunlight from these areas, therefore reducing urban temperatures and improving public health.

One potential drawback is the “heating penalty.” The roof will absorb less heat in the winter as well, which can increase the heating load. However, in warmer climates, the summer energy savings typically outweigh the additional winter heating costs.

3. Available Cool Roof Technologies

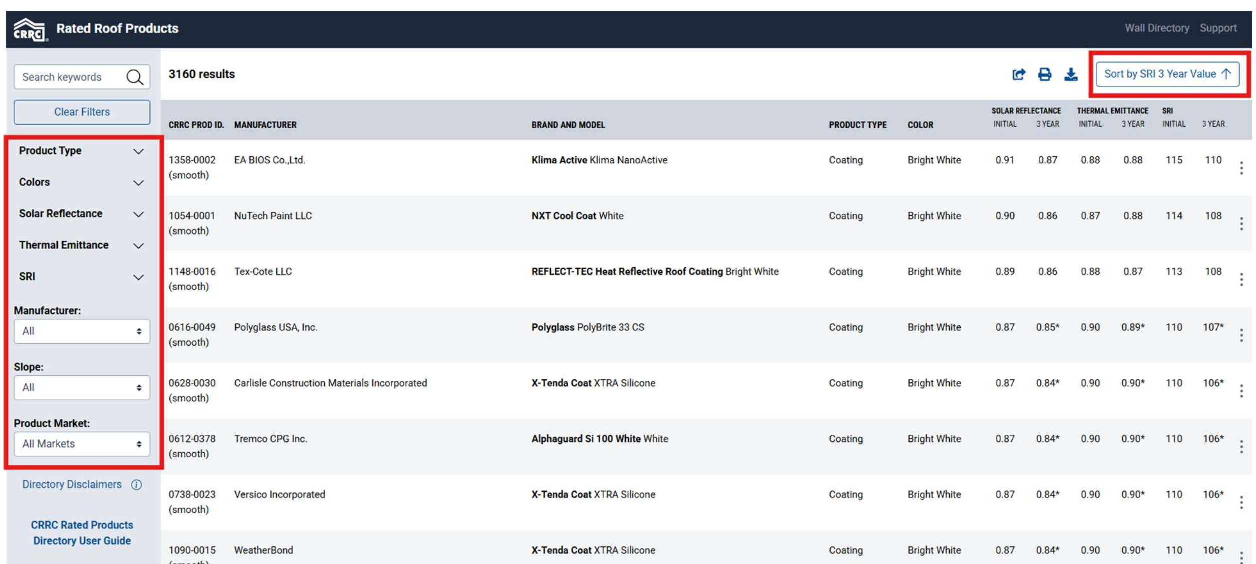
3.1 Rating Cool Roof Products

As discussed in Section 2.1, the criteria for comparison of cool roof products are the SR, TE, and SRI values. SRI is the easiest for comparison since it is a single metric that represents the combined effect of SR and TE.

The Cool Roof Rating Council (CRRC) is an organization that provides product rating programs for manufacturers to certify their roof and wall products and have them listed in the CRRC's free online databases (CRRC, n.d.). The CRRC Rated Roof Products directory compiles listed products for cool roof retrofits and provides initial and 3-year values for the SR, TE, and SRI values. The 3-year values are measured after a 3-year weathering test of the product in different representative US climates: Ohio (cool/temperate), Arizona (hot/dry), and Florida (hot/humid) (CRRC, 2022). It is important to consider the 3-year SRI value because products can lose their effectiveness when exposed to the elements.

Figure 3 shows an example of using the CRRC database to select cool roof products. Information available includes Manufacturer, Brand, Model, Product Type, Color, and values for Initial and 3-Year SR, TE, and SRI. It is recommended to work with the roofing contractor to ensure a rated product is chosen. The "Sort By" button at the top right can be used to sort the list as desired, and the Filter list at the left side can be used to filter products as desired.

See database here: https://coolroofs.org/directory/roof



CRRC PROD ID.	MANUFACTURER	BRAND AND MODEL	PRODUCT TYPE	COLOR	SOLAR REFLECTANCE INITIAL	SOLAR REFLECTANCE 3 YEAR	THERMAL EMITTANCE INITIAL	THERMAL EMITTANCE 3 YEAR	SRI INITIAL	SRI 3 YEAR
1358-0002 (smooth)	EA BIOS Co.,Ltd.	**Klima Active** Klima NanoActive	Coating	Bright White	0.91	0.87	0.88	0.88	115	110
1054-0001 (smooth)	NuTech Paint LLC	**NXT Cool Coat** White	Coating	Bright White	0.90	0.86	0.87	0.88	114	108
1148-0016 (smooth)	Tex-Cote LLC	**REFLECT-TEC Heat Reflective Roof Coating** Bright White	Coating	Bright White	0.89	0.86	0.88	0.87	113	108
0616-0049 (smooth)	Polyglass USA, Inc.	**Polyglass** PolyBrite 33 CS	Coating	Bright White	0.87	0.85*	0.90	0.89*	110	107*
0628-0030 (smooth)	Carlisle Construction Materials Incorporated	**X-Tenda Coat** XTRA Silicone	Coating	Bright White	0.87	0.84*	0.90	0.90*	110	106*
0612-0378 (smooth)	Tremco CPG Inc.	**Alphaguard Si 100 White** White	Coating	Bright White	0.87	0.84*	0.90	0.90*	110	106*
0738-0023 (smooth)	Versico Incorporated	**X-Tenda Coat** XTRA Silicone	Coating	Bright White	0.87	0.84*	0.90	0.90*	110	106*
1090-0015 (smooth)	WeatherBond	**X-Tenda Coat** XTRA Silicone	Coating	Bright White	0.87	0.84*	0.90	0.90*	110	106*

Figure 3: Screenshot of CRRC Rated Roof Products Directory.
Source: (CRRC, 2025)

3.2 Relevant Codes and Standards

3.2.1 Overview

There are several codes and standards with cool roof requirements that are applicable to the SBCCOG territory. See below for a summary of which codes are applicable to which cities in the region.

1. California Title 24, Part 6: Building Energy Efficiency Standards
    - Applicable to the entire SBCCOG territory.
2. Los Angeles County Title 31: Green Building Standards Code
    - Applicable to the unincorporated County of Los Angeles.
3. Municipal Codes
    - City of Los Angeles Chapter IX, Article 9: Green Building Code
        1. Applicable to Los Angeles (District 15).
    - City of Rolling Hills Title 15, Chapter 15.22: Green Building Standards Code
        1. Applicable to Rolling Hills.
    - City of Rolling Hills Estates Title 15, Chapter 15.04: Building Code
        1. Applicable to Rolling Hills Estates.

3.2.2 California Title 24, Part 6: Building Energy Efficiency Standards, 2022

Also known as the California Energy Code, this standard applies to projects in the state of California. Most Authority Having Jurisdictions (AHJs) are currently implementing the 2022 edition. The requirements vary based on whether a project is considered New Construction, Addition, or Alteration. For this report, the focus is on cool roof requirements for nonresidential buildings undergoing an Alteration (i.e., existing building retrofits that do not increase the square footage of the building).

Relevant Definitions (Ace Resources, 2024):

1. **Nonresidential Building**: defined by Occupancy Group. Includes Occupancies A (Assembly), B (Business), E (Educational Facilities), F (Factories), H (High Hazard Facilities), R-1 (Hotel & Motel), I-2 (Institutional), M (Mercantile), S (Storage), and U (Utility).
2. **Alteration**: any change to a building that does not increase the conditioned floor area and conditioned volume.
3. **Roof Recoat**: not defined in the code. In the roofing industry, typically is when a new layer is applied to the outer surface of the existing roof material for renewal or maintenance, and the existing roofing material is not replaced and recovered.
4. **Roof Recover**: installation of a roof covering over an existing roof covering without removing the existing roof covering.
5. **Roof Replacement**: removal of existing roof covering, repair of any damage, and installation of a new roof covering.

6. **Low-Sloped**: roof pitch of <2:12 (9.5 degrees).
7. **Steep-Sloped**: roof pitch of >= 2:12 (9.5 degrees).

The California Energy Code requires the usage of CRRC rated products to meet the requirements (Ace Resources, 2024).

According to the California Energy Code, when more than 50% or 2,000 ft^2 of roofing material is recovered, replaced, or recoated, cool roof requirements are triggered. Table 1 can be used to determine the roofing material requirements based on whether the roof is low-sloped or steep-sloped. The selected product must either comply with both the SR and TE requirements, or only the SRI requirement. According to the Nonresidential Compliance Manual developed by the CEC, there are stricter requirements for low-sloped roofs because they receive more solar radiation during the summer than steep-sloped roofs (CEC, 2023). It is anticipated that the majority of SBCCOG cities' buildings will be required to comply with the California Energy Code if it is decided to move forward with the cool roof upgrades.

Table 1: Prescriptive Roofing Material Requirements for Nonresidential Building Alterations – California Energy Code

Roof Style	Building Type	Climate Zones	EITHER 3-Year SR	AND TE	OR SRI
Low-Sloped	Nonresidential	1-16	≥ 0.63	≥ 0.75	≥ 75
Steep-Sloped	Nonresidential	2, 4-16	≥ 0.25	≥ 0.80	≥ 23

Source: (Ace Resources, 2024)

3.2.3 Los Angeles County Title 31: Green Building Standards Code

This code applies only to the portion of SBCCOG territory that is unincorporated and falls under the jurisdiction of the County of Los Angeles. The County of Los Angeles code accepts the majority of the California Energy Code but has adopted several additional ordinances that are more stringent than California's requirements. One of these ordinances includes changes to Table 1 in Section 3.2.2.

Table 2 below shows the changes to Table 1 that are applicable in the County of Los Angeles. The required SR, TE, and SRI values are slightly increased from those in the California Energy Code.

Table 2: Prescriptive Roofing Material Requirements for Nonresidential Building Alterations – County of Los Angeles

Roof Style	EITHER 3-Year SR	AND TE	OR SRI
Low-Sloped	≥ 0.68	≥ 0.85	≥ 82
Steep-Sloped	≥ 0.28	≥ 0.85	≥ 27

Source: (County of Los Angeles, 2025)

3.2.4 Municipal Codes

Most of the cities in the SBCCOG territory adopt the California Energy Code as written, or without any changes to the cool roof requirements.

Only the cities of Los Angeles, Rolling Hills, and Rolling Hills Estates have stricter cool roof requirements. These cities adopt the same modification as the County of Los Angeles, either through an ordinance or by adopting the entire Los Angeles County Title 31. Table 2 also applies in these areas (American Legal Publishing, 2025), (Municode, 2025), (Municode, 2024).

3.3 Technologies Available for Different Roof Types

3.3.1 Roof Coverings

There are different cool roof products available based on the roof covering. Roof covering types are typically divided into Low-Sloped or Steep-Sloped (see definitions in Section 3.2.1). This is primarily because of how roof pitch affects water drainage. Steep-sloped buildings rely on gravity to shed water and do not require additional drainage. Common steep-sloped roof coverings such as shingles and tiles are layered to allow water to flow downward without obstruction. Conversely, low-sloped roofs lack sufficient pitch for gravity-based drainage alone. These roofs have drains installed with subtle pitch lines to guide water toward drainage points and prevent ponding. As a result, low-sloped roofs typically use sheet-like materials installed with uniform thickness (American Quality Remodeling, 2024).

The SBCCOG cities' building list includes both low-sloped and steep-sloped roofs. Table 3 and Table 4 below include common roof covering types for low- and steep-sloped roofs and information about the material, typical colors, and identifying features.

Table 3: Common Roof Covering Types for Steep-Sloped Roofs

Type	Material	Color	Features/Description
Asphalt/Composition Shingle	Mix of granules, tar, and fiberglass	Ranges from dark gray to light tan or white	• Most cost-effective for steep-sloped roofs • Wide variety of colors
Concrete Tile	Concrete	Dark to light gray	• Durable • Long lifetime • Different tile shapes available
Clay Tile	Clay	Red/orange	• Fragile and appear more decorative • More expensive than concrete tiles
Metal Roof	Metal sheets with interlocking seams to keep out water	Dark colored	• Durable • Long lifetime
Wood Shake	Wood	Dark colored	• Older roofing material • Less common

Source: (CRRC, n.d.), (CeDUR, n.d.)

Table 4: Common Roof Covering Types for Low-Sloped Roofs

Type	Sub-Type	Material	Color	Features/Description
Single-Ply Membrane	EPDM	Synthetic rubber	Black or White	• High elasticity
Single-Ply Membrane	TPO (Thermoplastic Polyolefin)	Vinyl / thermoplastic	White	• Highly reflective • UV resistant
Single-Ply Membrane	PVC (Polyvinyl Chloride)	Vinyl / thermoplastic	White	• Highly reflective • UV resistant
Built-Up Roofing (BUR)		Multi-layer system; felt/fiberglass, tar, and top layer of gravel	Dark colored	• One of the oldest types of roofing • Durable and long-lasting • Heavy because of the many layers and gravel
Modified Bitumen	APP (Atactic Polypropylene)	Asphalt membrane with plastic and fiberglass	Varies from dark to light	• Designed to improve upon BUR • Two or more layers • More UV protection
Modified Bitumen	SBS (Styrene-Butadiene-Styrene)	Asphalt membrane with rubber and fiberglass	Varies from dark to light	• Designed to improve upon BUR • Two or more layers • More elasticity
Metal Roof		Metal sheets with interlocking seams to keep out water	Dark colored	• Durable • Long lifetime
Spray Polyurethane Foam (SPF)		Spray Foam	White	• Sprays onto the roof as a liquid, then expands into foam and hardens • Also has insulative properties
Roof Coating	Acrylic Coating	Water-based Acrylic	White	• Applied to top of flat roof types • Can increase lifespan of roof without replacing the covering • Ineffective against ponding water • Highly reflective
Roof Coating	Silicone Coating	Silicone	White	• Applied to top of flat roof types • Can increase lifespan of roof without replacing the covering • Highly reflective • More costly than acrylic • Can withstand ponding water
Roof Coating	Polyurethane Coating	Polyurethane	White	• Applied to top of flat roof types • Can increase lifespan of roof without replacing the covering • Durable • Can withstand ponding water • Compatible with TPO, PVC, or modified bitumen
Roof Coating	Butyl Coating	Butyl	White	• Applied to top of flat roof types • Can increase lifespan of roof without replacing the covering • High elasticity

				• Compatible with BUR and modified bitumen • Less commonly used

Source: (Colony Roofers, 2023), (Best Roofing, 2025), (D'Annunzio, n.d.), (Colony Roofers, 2023)

Table 3 and Table 4 are primarily intended to provide some background information on the types of roof coverings that may be encountered on existing buildings. The type of roof covering for an existing building can be determined by reviewing the record drawings or previous roof maintenance records for the building, or by working with a licensed roofing contractor. Low-sloped roofs can be more challenging to identify, as many of them have a similar appearance. During research for this section, some conflicting information was found regarding the advantages and disadvantages of different roofing types. This is likely because many available resources are written by roofing contractors who may emphasize the benefits of the products they offer.

After the type of roof covering is identified, then a compatible cool roof retrofit can be chosen. Table 5 shows examples of cool roof retrofits and expected cost. The expected cost relates to material cost only, and labor cost will need to be considered.

Table 5: Cool Roof Product Options for Different Roof Covering Types

Roof Type	Roof Slope	Conventional Roof		Cool Roof			EUL** (yrs)
		Roof Option	SR	Roof Option	SR	Material Cost*	
Asphalt Shingle	Steep	Black/dark brown with conventional pigments	0.05 – 0.15	Light gray	0.20 – 0.30	$	15 - 30
				Medium gray/brown with cool pigments	0.20 – 0.30		
Concrete Tile	Steep	Dark color with conventional pigments	0.05 – 0.35	Color with cool pigments	0.40 – 0.60	$ - $$$	50+
				White	0.70		
Clay Tile	Steep	Terracotta (unglazed red tile)	0.40 – 0.50	Color with cool pigments	0.40 – 0.60	$$ - $$$	50+
				White	0.70		
Wood Shake	Steep	Painted dark color with conventional pigments	0.05 – 0.35	Bare	0.40 – 0.55	$	15 - 30
Metal Roof	Steep or Low	Unpainted, corrugated	0.30 – 0.50	Color with cool pigments	0.40 – 0.70	$$	20 - 50+
		Dark painted, corrugated	0.05 – 0.10	White painted	0.60 – 0.70		
Liquid Applied Coating	Steep or Low	Smooth black	0.05	Smooth white	0.60 – 0.90	$	10
Built-Up Roof	Low	With dark gravel	0.05 – 0.15	With white gravel	0.30 – 0.50	$ - $$	10 - 30
		With aluminum coating	0.10 – 0.15	Smooth with white roof coating	0.75 – 0.85		
Modified Bitumen	Low	With mineral surface capsheet (SBS, APP)	0.10 – 0.20	White coating over mineral surface	0.60 – 0.75	$	10 – 30
Single-Ply Membrane	Low	Black (PVC or EDPM)	0.05	White (PVC or TPO)	0.70 – 0.85	$	10 – 20
				Color with cool pigments	0.40 – 0.60		

*Material Cost: $ = $0 - $2 / ft², $$ = $2 - $4 / ft², $$$ = $4 - $6 / ft².
**EUL: Expected Useful Life
Source: (CoolCalifornia, n.d.)

Table 5 shows that the cost can vary greatly based on the type of roof covering. However, since a cool roof retrofit generates energy savings in buildings with HVAC, the cost of the retrofit can be offset within a certain number of years. One example of this is a case study done by the Southwest Energy Efficiency Project (SWEEP) at the Thomas O. Price Service Center, an office building in Tucson, Arizona. The building's 28,000 ft^2 roof was originally a dark colored metal roof which was coated with a white elastomeric coating in 2001. The payback period for this retrofit was approximately six years with a 16% return on investment (CRRC, 2009). Furthermore, recovering or coating the roof surface increases the longevity of the roof. It provides a new top layer that seals any damage or wear on the roof surface, and the reduced temperature at the roof surface slows future wear.

3.3.2 Initial Recommendations Based on Roof Covering

In general, low sloped roofs are more ideal candidates because there are more product options with high SRI. There are also less expensive installation options such as the application of a roof coating to the existing roof layers. Low-sloped roofs have higher cool roof requirements per the California Energy Code, most likely due to a greater availability of cool roof products.

Less Feasible for Cool Roof Retrofit

- Asphalt/Composition Shingle and Wood Shake: when reviewing available products in the CRRC Directory, the maximum values for SR and SRI are 0.30 and 33, respectively (CRRC, 2025). These roof types will likely not generate significant energy savings.
- Concrete Tile and Clay Tile: the tiles have a long lifetime (50+ years), and to replace them with cooler colored or white tiles would be more expensive comparatively. It would be considered only if the building has a significant number of cracked/damaged tiles and needs tile replacement anyway. There may be compatible coatings that can be considered instead of tile replacement.
- TPO and PVC: these roof membranes are typically already white and with high solar reflectance (CRRC, 2025). These are already considered cool roofs and could likely not achieve additional energy savings.

More Feasible for Cool Roof Retrofit

- Built-Up Roof: the CRRC Directory has several options for high SRI gravel that could be used to replace the top gravel layer, or a white roof coating could be applied.
- Metal Roof: a white coating can be applied to the metal to increase reflectivity.
- Single Ply Membrane, dark colored: a white roof coating can be applied which has high reflectivity.
- Modified Bitumen: a white roof coating can be applied which has high reflectivity.

3.3.3 Impact of Building Insulation

It is important to consider building insulation when estimating the effectiveness of cool roof retrofits. There are three types of heat transfer: conduction (transfer through direct contact of materials), convection (transfer through movement of liquids and gases), and radiation (transfer through electromagnetic waves). Insulation provides a physical barrier that slows conductive and convective heat transfer through the roof (US DOE, n.d.). Cool roofs are the most beneficial for buildings with low to moderate insulation levels. In highly insulated buildings, the heat flow into the building is already limited by the insulation, so adding roof reflectivity will not generate as significant of energy savings.

Insulation is rated by R-value, which represents the material's resistance to conductive heat flow. A higher R-value indicates greater resistance to heat transfer, resulting in better insulative performance. R-value is determined by the type, thickness, and density of the insulation, and can also be affected by aging and moisture accumulation. The R-values of a multilayered system are additive, determining the overall R-value of the insulation (US DOE, n.d.).

Another important parameter is the U-factor, which represents the overall transmittance of heat through a part of the building assembly such as a roof or wall. The California Energy Code includes requirements for U-factor of the roof and attic for New Construction and Additions (Ace Resources, 2024).

The first edition of the California Energy Code came into effect in 1978. According to the California Air Resources Board, more than 75% of existing residential and nonresidential buildings were built before 1978 (CARB, n.d.). It is likely that many of the buildings in the SBCCOG territory have low or even no insulation if they have not been modified significantly since initial construction. Building record drawings can be used to determine what type and how much insulation is installed in an existing building, or a roofing contractor can determine this information through a visual inspection.

3.4 Comparison with Alternatives

There are three main options for roof alterations with the purpose of achieving energy savings: cool roofs, green roofs, and rooftop solar photovoltaic (PV). This section provides a brief overview of the other options and offers a comparison to cool roofs.

A green roof has a vegetative layer over the roof surface. Green roofs are either extensive or intensive. An extensive green roof is the simpler and more cost-effective option, featuring a minimal layer (two to four inches) of vegetation and growing medium applied to the rooftop. The goal is to achieve the benefits of roof coverage while minimizing cost, weight, and required maintenance. An intensive green roof is a more complex system, commonly designed with a focus on aesthetics to look like a rooftop garden or park. Intensive green roofs are often installed when part of the intent is to provide a rooftop space for people to enjoy. Due to their increased complexity, they tend to be more expensive, heavier, and require more maintenance.

Additional structural support may also be required for the building to support the roof (EPA, 2025).

Green roofs provide many of the same benefits as cool roofs. For example, the plants reduce the surface temperature of the roof and generate similar energy savings from reduction in HVAC activity inside the building. The difference is that the reduction in temperature comes from the evaporation of water into the air by the plants instead of from solar reflectivity like cool roofs. Green roofs also contribute to the reduction of the UHI effect. Furthermore, green roofs offer other benefits that are beyond the capability of cool roofs. Vegetation on green roofs contributes to improved air quality by sequestering atmospheric CO_2 through photosynthesis and filtering airborne pollutants. Additionally, green roofs help with regulating stormwater runoff, which is a major problem in Los Angeles County. Most land in cities is paved, which cannot soak up water when it rains. Rainfall is instead converted to runoff and swept into storm drains, picking up trash, oil, waste, bacteria, and pathogens present on the ground along the way. This is a major source of pollution for nearby lakes, rivers, and beaches where the storm drains lead to. Plants absorb rainwater, use some of it, and release the rest slowly, which reduces the chance of the water carrying debris and pollutants into the drains (Garrison, Horowitz, & Lunghino, 2012). Green roofs are a helpful increase in natural land in urban environments.

While green roofs can be very beneficial to communities, they are more expensive and require more maintenance than cool roofs. There is also the risk of roof leaks from having living plants and water on the roof surface. In Southern California, since most rainfall in the area is from November to March, the green roofs may require additional irrigation to survive during the summer (Garrison, Horowitz, & Lunghino, 2012). Additional irrigation is an important consideration, as minimizing water consumption is a consistent objective in Southern California due to water scarcity and resource management.

The third option for utilizing rooftop space is rooftop solar PV systems. Solar PV actively produces electricity from the sunlight; therefore, the energy savings for the building are more significant than either cool or green roofs. The energy produced can offset any load in the building instead of only the HVAC system. On low-sloped roofs, the solar panels are typically installed at a tilt and shade the roof, therefore providing a similar cooling effect to the building as cool roofs without having to recover the roof (Garrison, Horowitz, & Lunghino, 2012). When installed together, one study done in 2021 that modeled low-sloped roofs showed that the annual solar energy yield was increased by an average of 3.4% when installed on a cool roof, compared to a conventional roof (Cavadini & Cook, 2021). However, solar panels have the highest upfront cost and building-specific financial analysis is recommended to determine if the small increase in solar production is worth the added cost of roof recovering. Solar panels have a life expectancy of about 30 to 35 years (DOE, n.d.).

By comparison to the other two options, cool roofs are a simpler and more feasible retrofit. However, a combination of green, cool, and solar roofs in an urban environment can work together to benefit the area as a whole.

4. The South Bay Approach

4.1 Description of South Bay Sub-Region

The South Bay Sub-Region overseen by the SBCCOG includes Carson, El Segundo, Gardena, Hawthorne, Hermosa Beach, Inglewood, Lawndale, Lomita, Manhattan Beach, Palos Verdes Estates, Rancho Palos Verdes, Redondo Beach, Rolling Hills, Rolling Hills Estates, Torrance, part of the City of Los Angeles (District 15), and part of unincorporated Los Angeles County (Districts 2 & 4) (SBCCOG, 2013). The Appendix includes a map of the territory.

The region, except for the City of LA, is served by Southern California Edison (SCE) as the electric utility. The City of LA area is served by the Los Angeles Department of Water and Power (LADWP) as the electric utility (SCE, n.d.). There is also a Community Choice Aggregation (CCA) in the area, the Clean Power Alliance (CPA), that serves Carson, Hawthorne, Manhattan Beach, Hermosa Beach, Redondo Beach, and Rolling Hills Estates. CPA provides generation from clean and renewable energy sources while SCE still provides transmission and distribution (CPA, n.d.).

California has 16 CZs defined by the California Energy Commission (CEC) and are used in the California Energy Code discussed in Section 3.2.2. The SBCCOG territory falls into CZ 6 and CZ 8. The boundary between these two zones is the 405 freeway (CEC). West and south of the 405 along the coast is in CZ 6, and east and north of the 405 freeway is in CZ 8.

The CEC provides weather data files for typical weather in each zone, based on a representative city. The representative city for CZ 6 is Torrance and the representative city for CZ 8 is Fullerton. Table 6 shows a summary of the weather data for each relevant zone, based on the CZ2025 data downloaded from the California Measurement Advisory Council website (CALMAC, 2025). It can be seen from the data that CZ 8 has more hours with higher temperatures than CZ 6. This indicates that buildings in CZ 8 are likely to have higher annual cooling loads and therefore have more potential energy savings from lowering cooling equipment usage and therefore are likely to be better candidates for cool roof retrofits.

Table 6: Weather Data Summary for CZ 6 and CZ 8

Temperature Range (°F)	CZ 6: Number of Hours (Torrance Data)	CZ 8: Number of Hours (Fullerton Data)
30 – 40	30	17
40 – 50	678	617
50 – 60	2509	2100
60 – 70	3609	3491
70 – 80	1582	1597
80 – 90	314	796
90 – 100	34	116
100 – 110	4	26

Source: (CALMAC, 2025)

4.2 Expected Energy Savings

Energy savings from cool roof retrofits are primarily realized through reductions in a building's cooling equipment usage. When the cool roof reflects more solar energy on a hot summer day, which leads to less heat conduction through the roof into the building envelope, then the amount of work the air conditioning must do to cool the space is reduced. Thus, energy savings and dollar savings are measurable through the reduction in energy usage, and the resulting cheaper electricity bill.

4.2.1 Buildings Without HVAC

If the building does not have an HVAC system, there will not be any direct energy or dollar savings. However, there is still potential value in installing cool roof retrofits on buildings without HVAC, given that the average summer temperature in California has increased about 3°F since 1896. Temperatures will likely continue to rise by an additional 2°F by 2040 and over 4°F by 2070 (UCSD, n.d.). As temperatures rise, buildings that historically were able to maintain thermal comfort without HVAC may have to consider undergoing costly HVAC upgrades. A cool roof retrofit can lower internal building temperatures, therefore extending that timeline or potentially preventing the need for HVAC upgrades at all.

4.2.2 Buildings with HVAC

For buildings with HVAC, savings are impacted by several factors discussed previously in this report, including how much the roof SRI was increased, amount of roof/attic insulation, and climate. Studies on this topic vary widely, showing that the energy savings from cool roofs can range from 10% to 43% of a building's cooling load (Garrison, Horowitz, & Lunghino, 2012). Building-specific analysis should be done when considering a cool roof retrofit to achieve a more accurate estimate of energy savings. Roof space that is used for HVAC equipment takes away from available area for cool roof retrofits but is typically negligible compared to total roof area.

One tool that can be employed is an online calculator developed by the US Department of Energy's Oak Ridge National Laboratory (ORNL, n.d.). Inputs to the calculator include building location, R-value of insulation, SR and TE of the proposed roof covering, and HVAC efficiency. The outputs to the tool include the expected energy and dollar savings from the cool roof retrofit.

See calculator: https://coolroof.ornl.gov/

4.2.3 Relevant Case Studies

Several case studies were reviewed and can help inform expected energy savings for cool roof retrofits in the SBCCOG territory. However, it can be seen from the referenced studies that energy savings vary from building to building due to the factors discussed in this report. All the evaluated buildings did experience some amount of savings, suggesting that cool roof retrofits will reliably produce savings for a wide variety of building types in California.

Monitoring the energy-use effects of cool roofs on California commercial buildings (Akbari, Levinson, & Rainer, 2005)

Buildings Evaluated:

- One retail store in Sacramento
- One elementary school in San Marcos (near San Diego)
- Four cold storage buildings in Fresno

The measured data and simulations were used to estimate energy savings for similar buildings installing cool roof retrofits in the 16 California CZs.

Findings:

- Building Specific:
    - The daily maximum roof surface temperature of each building was reduced by 60 – 75°F.
    - Retail store: 52% reduction in average air conditioning energy use
    - School building: 17 – 18% reduction in average air conditioning energy use
    - Cold storage building: 3 – 4% reduction in average air conditioning energy use
- Generalized results from computer simulation:
    - Typical retail store: Estimated energy savings of 500 – 1,400 kWh/year per 1,000 ft^2 of conditioned area
    - Typical school building: Estimated energy savings of 300 – 600 kWh/year per 1,000 ft^2 of conditioned area
    - Typical cold storage building: Estimated energy savings of 400 – 700 kWh/year per 1,000 ft^2 of conditioned area

Measured temperature reductions and energy savings from a cool tile roof on a central California home (Rosado, Faulkner, Sullivan, & Levinson, 2014)

Buildings Evaluated:

Two single family homes adjacent to each other in Fresno, CA

- "Cool" house: reflective concrete tile roof with SR = 0.51
- "Standard" house: dark-colored asphalt shingle roof with SR = 0.07

Findings:

- Energy savings of 0.26 kWh / ft^2 / year
- 26% reduction in cooling energy use

Summary of Cool Roof Monitoring and Analysis at Three Sites (Architectural Energy Corporation, 2002)

Buildings Evaluated:

- Site A: manufacturing facility in El Cajon, CA.
- Site B: two office buildings in Oceanside, CA.
- Site C: retail store in La Mesa, CA.

Findings:

- Site A: Estimated energy savings of 0.415 kWh / ft^2 / year and cost savings of $0.067 / ft^2 / year. Simple payback period of 29 years.
    - The report concludes that this site had the lowest savings due to good roof insulation.
- Site B: Estimated energy savings of 0.618 kWh / ft^2 / year and cost savings of $0.071 / ft^2 / year. Simple payback period of 20 years.
- Site C: Estimated energy savings of 0.64 kWh / ft^2 / year and cost savings of $0.10 / ft^2 / year. Simple payback period of 5 years.
    - The report concludes that this site had the most energy savings due to less efficient roof insulation and low cost from the contractor to do the retrofit.

4.3 Potential Funding Sources for Public Agencies

The Cool Roof Rating Council provides a list of programs that include incentives for cool roof upgrades (CRRC, n.d.). See listed below the relevant programs.

LADWP: Business Offerings for Sustainable Solutions (BOSS) (LADWP, n.d.)

Eligibility: LADWP non-residential electric customers in good standing. (This will only apply to the City of LA area)

Program Description: Provides incentives for implementing energy efficiency measures. Cool roof upgrades fall into the “Building Envelope” category, which pays $0.30-0.65 per KWH saved from the impacted HVAC system.

CEC: Energy Conservation Assistance Act – Low Interest Loans (CEC, n.d.)

Eligibility: Cities, Counties, Special Districts, and other public sector entities in CA.

Program Description: Loans with 1% interest rates are available for projects with proven energy or demand savings. The maximum loan amount is $3 million and must be paid back within 20 years.

SCE: Measured Savings Program (AESC, n.d.)

Eligibility: Specific NAICS Code commercial properties within the SCE service territory

Program Description: Incentives offered for savings in Total System Benefit (TSB) through energy efficiency equipment installations such as HVAC systems, lighting, and insulation. A Normalized Metered Energy Consumption (NMEC) program that provides incentives based upon actual energy savings calculated from the utility meter in relation to predetermined granular profiles for a specific energy cohort.

SoCal REN: Public Agency Program (SoCalREN, 2025)

Eligibility: Qualifying Local Government, State and Federal Agencies, and Tribal Nations within the greater Los Angeles area

Program Description: Rate-payer funded program that offers full program benefits such as on-site assessments, installation of energy-saving equipment, financial support, and more.

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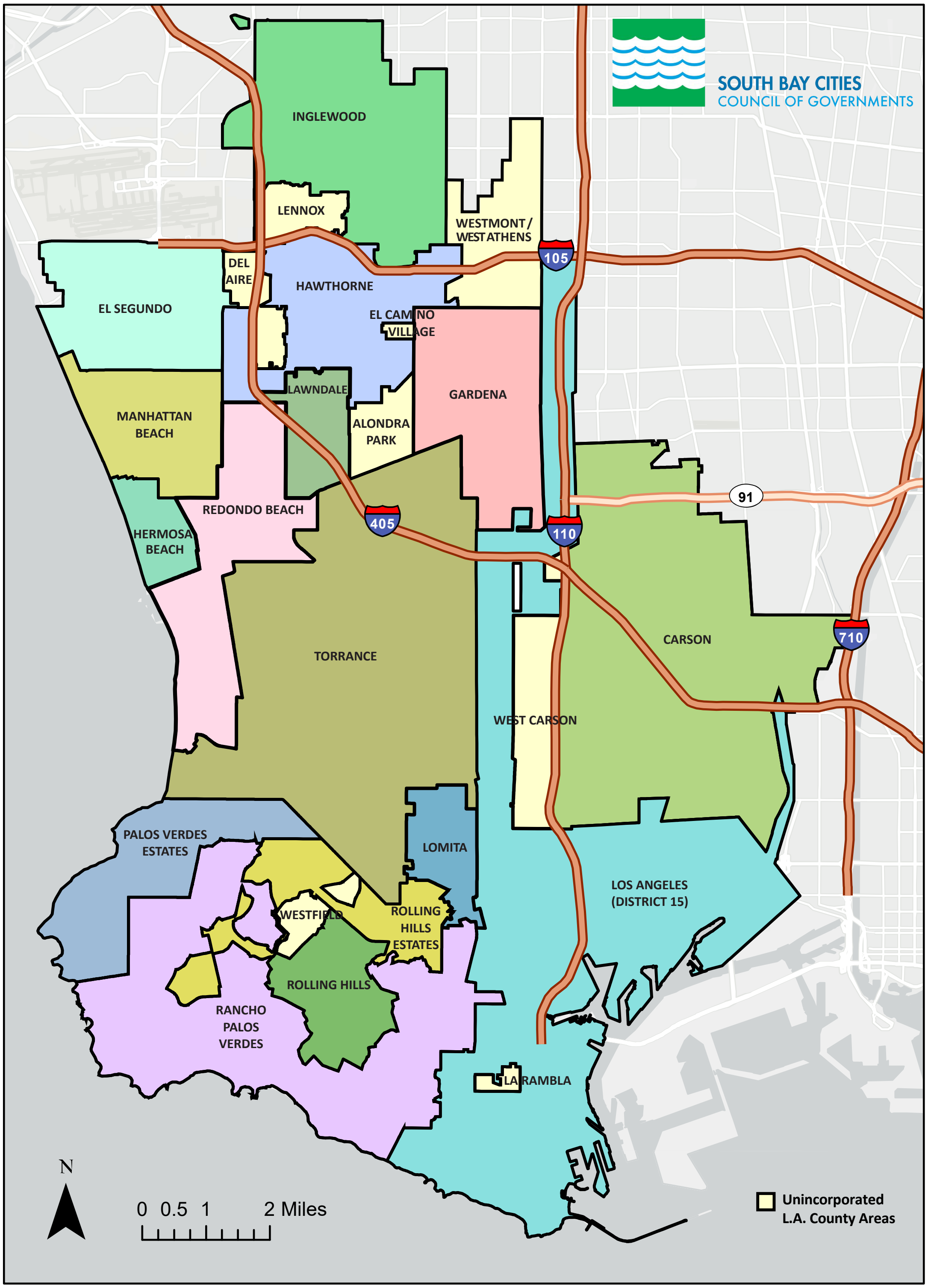
6. Appendix

6.1 Map of SBCCOG Territory



The South Bay Cities Council of Governments (SBCCOG) is a joint powers authority of 16 cities and the County of Los Angeles that share the goal of maximizing the quality of life and productivity of the South Bay region. Our members are Carson, El Segundo, Gardena, Hawthorne, Hermosa Beach, Inglewood, Lawndale, Lomita, Manhattan Beach, Palos Verdes Estates, Rancho Palos Verdes, Redondo Beach, Rolling Hills, Rolling Hills Estates, Torrance, and the Harbor City/San Pedro/Wilmington communities of the City of Los Angeles, along with the unincorporated areas of the County of Los Angeles District 2 and 4.