

California's Title 24 For Steep-Slope Roofs Building Energy Efficiency Standards



Updated March, 2020
(Supersedes July, 2014)

California's Title 24 for Steep-Slope Roofs Meeting the Code... Avoiding Hassles

About GAF

Founded in 1886, GAF has become North America's largest manufacturer of commercial and residential roofing. Our success in growing the company to nearly \$3 billion in sales has been based on our unique philosophy of:

- Helping property owners & architects to make their best roofing choices
- Helping support distributors and roofing contractors build their businesses and avoid hassles

GAF is your best choice! For more information, visit www.gaf.com.

About Title 24

The California Energy Commission (CEC) was created in 1974 through the Warren-Alquist State Energy Resources Conservation and Development Act to construct and periodically modify energy efficiency standards for residential and non-residential buildings. In 1978, all building codes and standards were combined under one umbrella called Title 24 Building Standards Code and Part 6 of this standard code has the requirements for energy efficiency while Part 1 has the administrative requirements. For more information or to download a copy of Title 24, visit www.energy.ca.gov/title24/

Why Title 24 Now?

- California has over 35 million people and from 1960 to 1974 when the CEC was created, they saw their energy consumption rise over 50% per capita, which means that not only as their population was increasing, the amount of energy each person was using was also increasing dramatically.
- California's building efficiency standards (along with those for energy efficient appliances) have saved more than \$56 billion in electricity and natural gas costs since 1978.
- The CEC's forecast data shows that 1/3 of the energy (natural gas and electricity) consumed in California is consumed by buildings.
- Strengthening the requirements of Title 24 has been a very key element in the state's climate change initiative.

Why Cool Roofs?

- Roof surface temperatures and attic temperatures can be reduced significantly.
- By lowering attic temperatures, air conditioning costs can be reduced by as much as 10-15% according to the Department of Energy's ENERGY STAR program.
- Reductions in air conditioning use help to reduce the "peak energy demand" on the power grid, reducing the need for new power plant construction.
- Cool roofs can reduce the effects of "Urban Heat Islands", where data shows that urban areas have higher ambient temperatures than surrounding rural areas because of their concentration of dark surfaces and the sparseness of vegetation (dark surfaces can be up to 70F hotter on a warm summer day than reflective, "cool" surfaces).

Do All Roofs Have “Cool Roof” Requirements in Title 24?

No. While Title 24 applies to all residential and non-residential buildings in the state, the specific requirements for roofs are dependent on geographic location, building use (residential, non-residential), type of construction (new construction, addition, or re-roofing), building type (low rise/high rise, low slope/high slope), etc. As this manual outlines, there are many instances where a “cool” roof is not required, and the CEC has been diligent in their requirements for “cool roofing” where it makes sense for property owners in the state. This is because in cooler climates, there can actually be a “penalty” for installing a roof with high reflectance.

When Did the 2019 Version of Title 24 Go Into Effect?

California's Building Energy Efficiency Standards are updated on an approximately three-year cycle. The 2019 Standards improves upon the current 2016 Standards for new construction of, and additions and alterations to, residential and nonresidential buildings. The 2019 Standards went into effect on January 1, 2020.

Glossary of Cool Roofing Terms

CRRC

Cool Roof Rating Council

The CRRC does not set requirements for solar reflectance (reflectivity) or thermal emittance; instead, they set the requirements for how to measure these properties and how to label products that have been measured. They also provide independent certification of a product’s reflectance and

ENERGY STAR

ENERGY STAR is a joint federal program of the U.S. Environmental Protection Agency and the U.S. Department of Energy that provides choices for energy efficient products and practices.

Note: The ENERGY STAR certified roof products program will be sunsetted on June 1, 2022.

Low Slope

Slopes up to and including 2:12

Solar Reflectance

The part of solar energy that is reflected by a surface, expressed as a percentage, e.g. a material with a 0.25 solar reflectance reflects 25% of solar energy. In Title 24, the term “aged reflectance” is used and refers to the reflectance of a material after 3 years of aging in the field.

SRI

Solar Reflectance Index

SRI combines reflectivity and emittance to measure a roof’s overall ability to reject solar heat. The calculation of this index is defined by ASTM E 1980-01 and is based on a mathematical formula that includes values for solar absorptance, solar flux, thermal emissivity, and various other coefficients.

Title 24 provides SRI alternatives to the solar reflectance and thermal emittance requirements.

Steep Slope

Slopes greater than 2:12

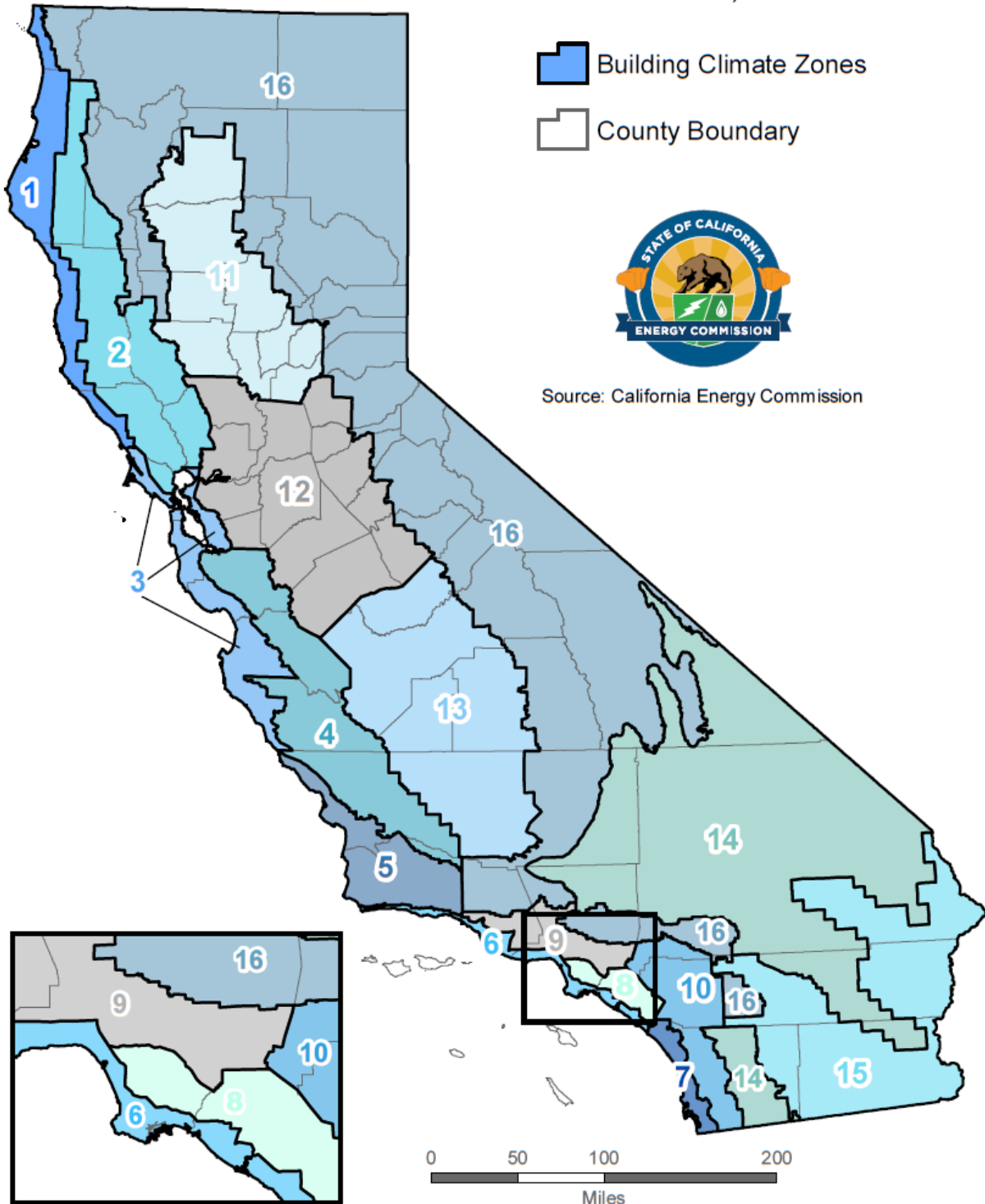
Thermal Emittance

The relative ability of a material to release absorbed heat gained from solar energy.

California's 16 Climate Zones

California has very distinct and differing climates which have been broken into 16 different "climate zones". These zones recognize that different climates have different energy demands and costs. The following map shows the 16 climate zones for the state:

Building Climate Zones California, 2017



Source: California Energy Commission

Complying With Title 24

There are 3 different ways to comply with the requirements for energy efficiency in Title 24

Prescriptive Approach

This is the simplest approach to meeting the requirements of Title 24, particularly for re-roofing because it defaults to installing a "cool roof" or other options (for re-roofing only). When the "cool roof" is installed, the prescribed requirements are met.

Overall Envelope Approach

This approach allows non-cool roofing to be installed if enough attic insulation is installed. While this trade-off makes sense, it must be accompanied by documentation that the amount of insulation used was adequate and meets the energy performance requirements for the building.

Performance Approach

The approach to meeting Title 24 requires detailed calculations using CEC software where the energy efficiency of the entire building is calculated and compared to a prescribed energy "budget". Using this method allows for trade-offs between different building envelope components and provides flexibility for designers; however, it is very difficult to comply with the standard when only making alterations to an existing building. Typically, an energy consultant is used when this approach is taken for compliance.

Understanding How Title 24 Classifies Buildings

In addition to knowing where the building is located so you can know what is required, you need to know how Title 24 classifies “buildings”.

“Low Rise Residential”... describes:

- All single family homes of any number of stories
- All duplexes of any number of stories
- All multi-family buildings up to 3 stories in height
- Garden apartments and other housing types up to 3 stories in height

“Nonresidential”... describes:

- Offices, retail and wholesale stores
- Grocery stores, restaurants, theaters
- Hotels and motels
- Industrial work buildings
- Commercial or industrial storage units
- Schools and churches
- Apartment and multi-family buildings with four or more stories
- Long-term care facilities
- Dormitories
- Private garages, carports, sheds and agricultural buildings

“High Rise Residential”... describes:

- All multi-family residential buildings with 4 or more habitable stories
- Garden apartments and other housing types with 4 or more habitable stories

For more information on building classifications, please refer to the actual Title 24, Part 6 standard.

Prescriptive Requirements for Photovoltaic System

All low-rise single family and multifamily buildings are required to have a PV systems installed unless the building qualifies for an exception. Chapter 7 describes the compliance requirements.

- 1. System Size.** The minimum size is based on the projected annual electrical usage as described in Section 150.1(c)14, Equation 7-1.
- 2. Orientation.** If a PV system is installed with a pitch greater than 2:12, the arrays must be oriented between 90 to 300 degrees from true north. If the pitch is less than 2:12, then it is considered low-slope (flat) installation.
- 3. Shading.** PV systems must not have any obstruction to the array. Obstructions may include: vent, chimney, neighboring terrain or structures, trees, and telephone poles that are closer than 30 feet from the nearest point of the array.

EXCEPTION 1: may apply if there is limited unshaded roof space. No PV is required if the effective annual solar access is restricted to less than 80 contiguous square feet by shading from existing permanent natural or manmade barriers external to the dwelling.

EXCEPTION 2: may apply to climate zone 15 and the required PV size may be reduced, if there is inadequate space on the roof to accommodate the PV size specified in Section 7.2.1. The PV size shall be the smaller of a size that can be accommodated by the Effective Annual Solar Access Roof Areas, or a PV size required by the equation above, but no less than 1.5 Watt DC per square foot of conditioned floor area.

EXCEPTION 3: may apply to two story residential building and the required PV size may be reduced if there is inadequate space on the roof to accommodate the PV size specified in Section 7.2.1. The PV size shall be the smaller of a size that can be accommodated by the Effective Annual Solar Access Roof Areas, or a PV size required by the Equation 150.1-C, but no less than 1.0 Watt DC per square foot of conditioned floor area

EXCEPTION 4: may apply to three stories or higher residential buildings and the required PV size may be reduced if there is inadequate space on the roof to accommodate the PV size specified in Section 7.2.1. In all climate zones, for low-rise residential dwellings with three habitable stories and single family dwellings with three or more habitable stories, the PV size shall be the smaller of a size that can be accommodated by the Effective Annual Solar Access Roof Areas, or a PV size required by the Equation 150.1-C, but no less than 0.8 Watt DC per square foot of conditioned floor area.

EXCEPTION 5: For a dwelling unit plan that is approved by the planning department prior to January 1, 2020 with available solar ready zone between 80 and 200 square feet, the PV size is limited to the lesser of the size that can be accommodated by the effective annual solar access or a size that is required by the Equation 150.1-C.

EXCEPTION 6: may apply to buildings with battery storage system. The required PV sizes from Equation 7-1 may be reduced by 25 percent if a battery storage system is installed. For single family building, the minimum capacity of the battery storage system must be at least 7.5 kWh. For multifamily buildings, the battery storage system must have a minimum total capacity equivalent to 7.5 kWh per dwelling. In all case the battery storage needs to meet the qualification requirements specified in Joint Appendix JA12 and be listed with CEC.

Mandatory Requirements for Solar Ready Buildings

Solar ready provisions are mandatory for newly constructed single-family homes and new low-rise multifamily residential buildings that do not have a PV system due to an exception in Section 150.1(c)14. This section allows the possibility for the requirements for photovoltaics on the site of the residential building to be fully or partially offset by Community Shared Solar Electric Generation. See Chapter 7 for additional information.

Prescriptive Envelope Requirements

(less than 5 lbs / ft²...e.g., Asphalt Shingles)

(greater than 5 lbs / ft²...e.g., Tile & Slate)

Nonresidential (including relocatable public schools)

Type of Construction	Climate Zones	Minimum Requirements
New Construction	1-16 (All climate zones)	Install Cool Roofing: 1. Aged Reflectance: ≥ 0.20 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 16
Re-roofing*	1-16 (All climate zones)	Install Cool Roofing: 1. Aged Reflectance: ≥ 0.20 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 16

*Re-roofing requirements must be met when more than 50% of the roof is recovered or replaced or the roof area is greater than 20 squares (2,000 sq.ft.)

Note: 1. There are **no** alternatives to using a cool roofing product for re-roofing.

High-Rise Residential & Hotels & Motels

Type of Construction	Climate Zones	Minimum Requirements
New Construction	2-15 (See map on page 3)	Install Cool Roofing: 1. Aged Reflectance: ≥ 0.20 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 16
Re-roofing*	2-15 (See map on page 3)	Install Cool Roofing (or see alternatives below): 1. Aged Reflectance: ≥ 0.20 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 16

* Re-roofing requirements must be met when more than 50% of the roof is recovered or replaced or the roof area is greater than 20 squares (2,000 sq.ft.)

Note: 1. There are **no** alternatives to using a cool roofing product for re-roofing.

Low-Rise Residential (typical single-family home)

Type of Construction	Climate Zones	Minimum Requirements
New Construction	10-15 (See map on page 3)	Install Cool Roofing: 1. Aged Reflectance: ≥ 0.20 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 16
Re-roofing*	10-15 (See map on page 3)	Install Cool Roofing (or see alternatives below): 1. Aged Reflectance: ≥ 0.20 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 16

* Re-roofing requirements must be met when more than 50% of the roof is recovered or replaced or the roof area is greater than 10 squares (1,000 sq.ft.)

Exceptions to using a cool roofing product for new construction and additions – any of the following can be implemented in lieu of using cool roofing products for low-rise residential buildings:

- EXCEPTION 1:** The roof area is covered by building-integrated photovoltaic panels of building-integrated solar thermal panels; or
- EXCEPTION 2:** Building has no ducts in the attic; or
- EXCEPTION 3:** Roof constructions that have a weight of at least 25 lb/ft²
- EXCEPTION 4:** Roof is an addition less than or equal to 300 sq. ft.

Exceptions to using a cool roofing product for re-roofing – any of the following can be implemented in lieu of using cool roofing products for low-rise residential buildings:




- EXCEPTION 1:** Air-space of 1.0 inch (25 mm) is provided between the top of the roof deck to the bottom of the roofing product; or
- EXCEPTION 2:** The installed roofing product has a profile ratio of rise to width of 1 to 5 for 50% or greater of the width of the roofing product; or
- EXCEPTION 3:** Existing ducts in the attic are insulated and sealed according to Section 150.1(c)9; or
- EXCEPTION 4:** Buildings with at least R-38 ceiling insulation; or
- EXCEPTION 5:** Buildings with a radiant barrier in the attic meeting the requirement of Section 150.1(c)2; or
- EXCEPTION 6:** Buildings that have no ducts in the attic; or
- EXCEPTION 7:** In Climate Zones 10-15, R-2 or greater insulation above the roof deck.

GAF Eligible Products

Product	Aged Reflectivity (≥0.20)	Initial Emissivity (≥0.75)	Aged SRI* (Title 24) (≥16)	Less than 5lbs. per sq. ft.
Asphalt Shingles				
Timberline HD®, Timberline® HDZ™, Timberline HD® Reflector Series™, and Timberline® HDZ™ RS (Golden Amber)	0.22	0.92	22	✓
Timberline HD®, Timberline HD® Reflector Series™, Timberline® HDZ™ RS, Timberline Ultra HD® Reflector Series™, and Timberline UHD® RS (Birchwood)	0.23	0.92	24	✓
Timberline® Cool Series and Timberline® CS (Cool Antique Slate)	0.26	0.92	28	✓
Timberline® Cool Series and Timberline® CS (Cool Barkwood)	0.26	0.90	27	✓
Royal Sovereign® Shingles (White)	0.27	0.91	28	✓
Timberline® Cool Series and Timberline® CS (Cool Weathered Wood)	0.27	0.92	29	✓
Timberline® Natural Shadow® and Timberline® NS (Artic White)	0.29	0.85	28	✓
Timberline HD® and Timberline® HDZ™ (White)	0.29	0.85	28	✓

*Aged SRI is based on Aged Reflectivity and Initial Emissivity per Title 24 requirements.

Common Questions & Answers...To Avoid Hassles

Question	Avoiding Hassles																						
<p>Are there labeling requirements to meet Title 24?</p>	<ul style="list-style-type: none"> Yes! If you are going to meet the prescriptive requirements and use a cool roofing product, it must not only meet the requirements of Title 24, but it must have a CRRC label that shows its solar reflectance and emittance. <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <table style="width: 100%; border-collapse: collapse;"> <tr> <td rowspan="2" style="text-align: center; vertical-align: middle;">  </td> <td style="text-align: center;"><u>Initial</u></td> <td style="text-align: center;"><u>Weathered</u></td> </tr> <tr> <td style="text-align: center;">Solar Reflectance</td> <td style="text-align: center;">0.00</td> <td style="text-align: center;">Pending</td> </tr> <tr> <td></td> <td style="text-align: center;">Thermal Emittance</td> <td style="text-align: center;">0.00</td> <td style="text-align: center;">Pending</td> </tr> <tr> <td colspan="3">Rated Product ID Number</td> <td style="text-align: center;">-----</td> </tr> <tr> <td colspan="3">Licensed Seller ID Number</td> <td style="text-align: center;">-----</td> </tr> <tr> <td colspan="2">Classification</td> <td colspan="2">Production Line</td> </tr> </table> <p style="font-size: small; margin-top: 5px;">Cool Roof Rating Council ratings are determined for a fixed set of conditions, and may not be appropriate for determining seasonal energy performance. The actual effect of solar reflectance and thermal emittance on building performance may vary.</p> <p style="font-size: x-small; margin-top: 5px;">Manufacturer of product stipulates that these ratings were determined in accordance with the applicable Cool Roof Rating Council procedures.</p> </div>		<u>Initial</u>	<u>Weathered</u>	Solar Reflectance	0.00	Pending		Thermal Emittance	0.00	Pending	Rated Product ID Number			-----	Licensed Seller ID Number			-----	Classification		Production Line	
	<u>Initial</u>		<u>Weathered</u>																				
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	Thermal Emittance	0.00	Pending																				
Rated Product ID Number			-----																				
Licensed Seller ID Number			-----																				
Classification		Production Line																					
<p>We've heard a lot about tax credits/exemptions... does installing cool roofing that meets Title 24 qualify for a tax credit?</p>	<ul style="list-style-type: none"> Not necessarily! The Federal Energy Policy Act of 2005 established tax credits of up to \$2,000 for builders of new energy-efficient homes. The tax credit is available for homes built/manufactured in the United States between January 1, 2018, and December 31, 2020. For further information about potential tax credits, click here. 																						
<p>If a product has an Energy Star rating mark, can it be used in California?</p>	<ul style="list-style-type: none"> Maybe... but if you have to use "cool roofing" to meet Title 24, then the product you use must also have a CRRC label. 																						
<p>If the CRRC label only has "as manufactured" values, can it be used under Title 24?</p>	<ul style="list-style-type: none"> Yes! Because Title 24 allows for a "calculation" of the 3 year aged value. 																						
<p>If a zone is not listed in the Prescriptive Requirements Tables, what do I have to do?</p>	<ul style="list-style-type: none"> You do NOT have to use a cool roofing product to be in compliance with Title 24. If a zone is not listed, there is not a requirement for cool roofing in that geographic area. 																						

Question	Avoiding Hassles
<p>Who will enforce Title 24? Is there a permitting process?</p>	<ul style="list-style-type: none"> • Enforcement to the Energy Efficiency Standards rests with your local building code official(s)... typically a city or county building code department. If you are in an area that will require “cool roofing”, you should contact the building code office in your city or county (whichever is applicable) and make sure that you understand what will be required to pull a building permit. California law requires building permits for both new construction and alterations and renovations, and your local office may adopt a “Certificate of Compliance” that will be used to verify compliance to Title 24.

Want to Learn More?

GAF Technical Services... can provide detail and answer questions on project specific conditions.

Contact Telephone... 1-800-766-3411.

For more information... about GAF’s commitment to sustainability and our full line of energy saving products, click [here](#).

Helpful Links...

www.gaf.com

www.energy.ca.gov/title24/

Title24@energy.ca.gov

www.coolroofs.org

www.energystar.gov

<http://gaf.ecoscorecard.com>

www.energystar.gov

www.DSIREusa.org

<http://cool.gaf.com>

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California’s Title 24 E-mail Hotline

Cool Roof Rating Council’s Home Page

Energy Star’s Home Page

GAF’s ecoScorecard

Federal Tax Credits

State Incentives for Renewables & Efficiency

Cool Roof Energy Savings Tool (CREST)