Heat island reduction

SS7 | Possible point

Glossary

Intent

To reduce heat islands[1] to minimize impacts on microclimates and human and wildlife habitats.

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To reduce heat islands[1] to minimize impacts on microclimates and human and wildlife habitats.

To reduce heat islands to minimize effects on the microclimate and human and wildlife habitat.

Reduce heat islands (thermal gradient differences between developed and undeveloped areas) to minimize impact on microclimate and human and wildlife habitat.

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To minimize effects on microclimates and human and wildlife habitats by reducing heat islands.

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To minimize effects on microclimates and human and wildlife habitats by reducing heat islands.

To reduce heat islands[8] to minimize impacts on microclimates and human and wildlife habitats.

To reduce heat islands[11] to minimize impacts on microclimates and human and wildlife habitats.

Requirements

Option 1

Use any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots):

- Provide shade from the existing tree canopy or within 5 years of landscape installation. Landscaping (trees)
  must be in place at the time of occupancy.
- Provide shade from structures covered by solar panels that produce energy used to offset some nonrenewable resource use.
- Provide shade from architectural devices or structures that have a solar reflectance index[2] (SRI) of at least 29.
- Use hardscape materials with an SRI of at least 29.
- Use an open-grid pavement system (at least 50% pervious).

OR

Option 2

Place a minimum of 50% of parking spaces under cover[3]. Any roof used to shade or cover parking must have an SRI of at least 29, be a vegetated green roof or be covered by solar panels that produce energy used to offset some nonrenewable resource use.

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[1] Heat islands are defined as thermal gradient differences between developed and underdeveloped areas.
[2] The solar reflectance index (SRI) is a measure of the constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standardblack surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. to calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E408 or ASTM C 1371.
[3] For the purposes of this credit, under cover parking is defined as parking underground, under desk, under roof, or under a building.

Option 1

Use roofing materials with a solar reflectance index[2] (SRI)equal to or greater than the values in the table below for a minimum of 75% of the roof surface.

Roofing materials having a lower SRI value than those listed below may be used if the weighted rooftop SRI average meets the following criteria:

$$\frac{\text{Area Roof Meeting Minimum SRI}}{\text{Total Roof Area}} \times \frac{\text{SRI of Installed Roof}}{\text{Required SRI}} \geq 75\%$$

Alternatively, the following equation may be used to calculate compliance:

$$\frac{\left[\text{Area of Roof A} \times \frac{\text{SRI of Roof A}}{\text{Required SRI}}\right] + \left[\text{Area of Roof B} \times \frac{\text{SRI of Roof B}}{\text{Required SRI}}\right] + \ldots}{\text{Total Roof Area}} \geq 0.75$$

Roof Type	Slope	SRI
Low-sloped roof	≤ 2:12	78
Steep-sloped roof	> 2:12	29

OR

Option 2

Install a vegetated roof that covers at least 50% of the roof area.

Option 3

Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:

$$\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$$

Roof Type	Slope	SRI
Low-sloped roof	≤ 2:12	78
Steep-sloped roof	> 2:12	29

Alternatively, a weighted approach may be used to calculate compliance for multiple materials:

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[1] Heat islands are defined as thermal gradient differences between developed and underdeveloped areas.
[2] The solar reflectance index (SRI) is a measure of the constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standardblack surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. to calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E408 or ASTM C 1371.
[3] For the purposes of this credit, under cover parking is defined as parking underground, under desk, under roof, or under a building.

Choose 1 of the following options:

Option 1

Use any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots):

- Provide shade from the existing tree canopy or within 5 years of landscape installation; landscaping (trees) must be in place at the time of certification application.

- Provide shade from structures covered by solar panels that produce energy used to offset some nonrenewable resource use.
- Provide shade from architectural devices or structures that have a solar reflectance index (SRI)[2] of at least 29. Implement a maintenance program that ensures these surfaces are cleaned at least every 2 years to maintain good reflectance.
- Use hardscape materials with an SRI of at least 29 and implement a maintenance program that ensures these surfaces are cleaned at least every 2 years to maintain good reflectance.
- Use an open-grid pavement system (at least 50% pervious).

OR

Option 2

Place a minimum of 50% of parking spaces under cover[3]. Any roof used to shade or cover parking must have an SRI of at least 29, be a vegetated roof or be covered by solar panels that produce energy used to offset some nonrenewable resource use. Implement a maintenance program that ensures all SRI surfaces are cleaned at least every 2 years to maintain good reflectance. The top parking level of a multilevel parking structure is included in the total parking spaces calculation but is not considered a roof and is not required to be an SRI surface.

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[1] Heat islands are defined as thermal gradient differences between developed and underdeveloped areas.
[2] The solar reflectance index (SRI) is a measure of the constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standardblack surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. to calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E408 or ASTM C 1371.
[3] For the purposes of this credit, under cover parking is defined as parking underground, under desk, under roof, or under a building.

Credit substitution available
You may use the LEED v4 version of this credit on v2009 projects. For more information check out this article.

Option 1

Use roofing materials with a solar reflectance index (SRI)[2] equal to or greater than the values in the table below for a minimum of 75% of the roof surface.

Roofing materials having a lower SIR value than those listed below ay be used if the weighted rooftop SRI average meets the following:

Area Roof Meeting Minimum SRI / Total Roof Area	x	SRI of Installed Roof / Required SRI	≥	75%

Implement a maintenance program that ensures all SRI surfaces are cleaned at least every 2 years to maintain good reflectance.

OR

Option 2

Install and maintain a vegetated roof that covers at least 50% of the roof area.

Option 3

Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:

Area Roof Meeting Minimum SRI / 0.75	+	Area of Vegetated Roof / 0.5	≥	Total Roof Area

Roof Type	Slope	SRI
Low-sloped roof	≤ 2:12	78
Steep-sloped roof	> 2:12	29

Alternatively, a weighted approach may be used to calculate compliance for multiple materials:

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[1] Heat islands are defined as thermal gradient differences between developed and underdeveloped areas.
[2] The solar reflectance index (SRI) is a measure of the constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standardblack surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. to calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E408 or ASTM C 1371.
[3] For the purposes of this credit, under cover parking is defined as parking underground, under desk, under roof, or under a building.

Credit substitution available
You may use the LEED v4 version of this credit on v2009 projects. For more information check out this article.

Option 1

Use any combination of the following strategies for 25% or 50% of the site hardscape (including roads, sidewalks, courtyards, and parking lots):

- Provide shade from the existing tree canopy or within 5 years of landscape installation. Landscaping (trees) must be in place at the time of occupancy.

- Provide shade from structures covered by solar panels that produce energy used to offset some nonrenewable resource use.
- Provide shade from architectural devices or structures that have a solar reflectance index (SRI)[2] of at least 29.
- Use hardscape materials with an SRI of at least 29.
- Use an open-grid pavement system (at least 50% pervious).

OR

Option 2

Place a minimum of 25% or 50% of parking spaces under cover.[2] Any roof used to shade or cover parking must have an SRI of at least 29, be a vegetated green roof, or be covered by solar panels that produce energy used to offset some nonrenewable resource use.

Project teams earn points by achieving the following percentages of site hardscape or parking under cover:

Percentage	Points
25%	1
50%	2

[2] For the purposes of this credit, under cover parking is defined as parking underground, under desk, under roof, or under a building.

Option 1. Nonroof measures

Use any combination of the following strategies for 50% of the nonroof site hardscape (including roads, sidewalks, courtyards, parking lots, parking structures, and driveways):

a. Provide shade from open structures, such as those supporting solar photovoltaic panels, canopied walkways, and vine pergolas, all with a solar reflectance index (SRI) of at least 29.
b. Use paving materials with an SRI of at least 29.
c. Install an open-grid pavement system that is at least 50% pervious.
d. Provide shade from tree canopy (within ten years of landscape installation).

OR

Option 2. High-reflectance and vegetated roofs

Use roofing materials that have an SRI equal to or greater than the values in Table 1 for a minimum of 75% of the roof area of all new buildings within the project; or install a vegetated ("green") roof for at least 50% of the roof area of all new buildings within the project. Combinations of SRI-compliant and vegetated roofs can be used provided they satisfy the equation in Option 3.

Table 1. Minimum solar reflectance index value, by roof slope

Roof slope	SRI
Low (≤ 2:12)	78
Steep (> 2:12)	29

Option 3. Mixed nonroof and roof measures

Use any of the strategies listed under Options 1 and 2 that in combination meet the following criterion:

Area of Nonroof Measures / 0.5	+	Area of SRI Roof / 0.75	+	Area of Vegetated Roof / 0.5	≥	Total Site Hardscape Area	+	Total Roof Area

Option 1

Provide any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots):

- Shade (within 5 years of occupancy)
- Paving materials with a Solar Reflectance Index (SRI) of at least 29
- Open grid pavement system

OR

Option 2

Place a minimum of 50% of parking spaces under cover (defined as under ground, under deck, under roof, or under a building). Any roof used to shade or cover parking must have an SRI of at least 29.

Option 1

Use roofing materials having a Solar Reflectance Index (SRI) equal to or greater than the values in the table below for a minimum of 75% of the roof surface.

OR

Option 2

Install a vegetated roof for at least 50% of the roof area.

OR

Option 3

Install high albedo and vegetated roof surfaces that, in combination, meet the following criteria:
(Area of SRI Roof / 0.75) + (Area of vegetated roof / 0.5) >= Total Roof Area

[INSERT TABLE HERE]

Choose one of the following options:

Option A

Use any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots):

- Provide shade from existing tree canopy or within five years of landscape installation; landscaping (trees) must be in place at the time of certification application.
- Provide shade from structures fully covered by solar photovoltaic panels.
- Provide shade from architectural devices or structures that have a solar reflectance index (SRI) of at least 29. Implement a maintenance program that ensures these surfaces are cleaned at least every two years to maintain good reflectance.
- Have paving materials with an SRI of at least 29 and implement a maintenance program that ensures these surfaces are cleaned at least every two years to maintain good reflectance.
- Have an open-grid pavement system (at least 50% pervious).

Option B

Place a minimum of 50% of parking spaces under cover (defined as underground, under deck, under roof or under a building). Any roof used to shade or cover parking must have an SRI of at least 29. Implement a maintenance program that ensures all SRI surfaces are cleaned at least every two years to maintain good reflectance. The top parking level of a multilevel parking structure is included in the total parking spaces calculation but is not considered a roof and is not required to be an SRI surface.

Choose one of the following options:

Option A

Use roofing materials having a solar reflectance index (SRI) equal to or greater than the values in the table below for a minimum of 75% of the roof area. If more than 75% of the roof area is covered with the SRI material, the SRI value may be lower than the required value if the resulting area-weighted equivalent SRI performance is at least as high as having the required value on 75% of the area.

Implement a maintenance program that ensures all SRI surfaces are cleaned at least every two years to maintain good reflectance.

Option B

Install and maintain a vegetated roof covering at least 50% of the roof area.

Option C

Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:
(Area of SRI Roof / 0.75) + (Area of Vegetated Roof / 0.5) >= Total Roof Area
[INSERT TABLE HERE]

Choose one of the following options:

Option A

- Provide (from existing canopy or within five years of landscape installation) shade on at least 30% of non-roof impervious surfaces on the site, including parking lots, walkways, plazas, etc.

Option B

- Use/maintain light-colored/high-albedo materials (reflectance of at least 0.3) for 30% of the site's nonroof impervious surfaces on the site, including parking lots, walkways, plazas, etc.

Option C

- Place/maintain a minimum of 50% of parking space underground.

Option D

- Use/maintain an open-grid pavement system (net impervious area of LESS than 50%) for a minimum of 50% of the parking lot area.

Option A

- Have in place over the performance period ENERGY STAR®–compliant, high-reflectance and high emissivity roofing material that has a minimum emissivity of 0.9 when tested in accordance with ASTM 408 for a minimum of 75% of the roof surface.
- Provide records and results of quarterly inspections over the performance period to determine that these features are being maintained.

Option B

- Install/maintain a "green" (vegetated) roof for at least 50% of the roof area.
- Provide records and results of quarterly inspections over the performance period to determine that these features are being maintained.

Combinations of roofing materials that meet the requirements of Option A and Option B can be used providing they collectively cover the designated area. See the LEED for Existing Buildings Reference Guide for guidance on calculating achievement of credit requirements based on using a combination of Option A and B roofing materials.

Option 1

Provide any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots):

- Shade (within 5 years of occupancy)
- Paving materials with a Solar Reflectance Index (SRI) of at least 29
- Open grid pavement system

OR

Option 2

Place a minimum of 50% of parking spaces under cover (defined as under ground, under deck, under roof, or under a building). Any roof used to shade or cover parking must have an SRI of at least 29.

Option 1

Use roofing materials having a Solar Reflectance Index (SRI) equal to or greater than the values in the table below for a minimum of 75% of the roof surface.

OR

Option 2

Install a vegetated roof for at least 50% of the roof area.

OR

Option 3

Install high albedo and vegetated roof surfaces that, in combination, meet the following criteria:
(Area of SRI Roof / 0.75) + (Area of vegetated roof / 0.5) >= Total Roof Area

[INSERT TABLE HERE]

Option 1

Provide any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots):

- Shade (within 5 years of occupancy)
- Paving materials with a Solar Reflectance Index (SRI) of at least 29
- Open grid pavement system

OR

Option 2

Place a minimum of 50% of parking spaces under cover (defined as under ground, under deck, under roof, or under a building). Any roof used to shade or cover parking must have an SRI of at least 29.

Option 1

Use roofing materials having a Solar Reflectance Index (SRI) equal to or greater than the values in the table below for a minimum of 75% of the roof surface.

OR

Option 2

Install a vegetated roof for at least 50% of the roof area.

OR

Option 3

Install high albedo and vegetated roof surfaces that, in combination, meet the following criteria:
(Area of SRI Roof / 0.75) + (Area of vegetated roof / 0.5) >= Total Roof Area

[INSERT TABLE HERE]

Provide shade (within 5 years) and/or use light-colored/high-albedo materials (reflectance of at least 0.3) and/or open grid pavement for at least 30% of the site's non-roof impervious surfaces, including parking lots, walkways, plazas, etc.; OR place a minimum of 50% of parking spaces underground or covered by structured parking; OR use an open-grid pavement system (less than 50% impervious) for a minimum of 50% of the parking lot area.

Use ENERGY STAR® compliant (highly reflective) AND high emissivity roofing (emissivity of at least 0.9 when tested in accordance with ASTM 408) for a minimum of 75% of the roof surface; OR install a "green" (vegetated) roof for at least 50% of the roof area. Combinations of high albedo and vegetated roof can be used providing they collectively cover 75% of the roof area.

Provide shade (within 5 years) on at least 30% of non-roof impervious surface on the site, including parking lots, walkways, plazas, etc., OR, use light-colored/high-albedo materials (reflectance of at least 0.3) for 30% of the site's non-roof impervious surfaces, OR place a minimum of 50% of parking space underground OR use open-grid pavement system (net impervious area of LESS than 50%) for a minimum of 50% of the parking lot area.

Use ENERGY STAR Roof-compliant, high-reflectance AND high emissivity roofing (initial reflectance of at least 0.65 and three-year-aged reflectance of at least 0.5 when tested in accordance with ASTM E903 and emissivity of at least 0.9 when tested in accordance with ASTM 408) for a minimum of 75% of the roof surface; OR, install a "green" (vegetated) roof for at least 50% of the roof area.

Choose one of the following options:

Option 1. nonroof and roof (2 points except Healthcare, 1 point Healthcare)

Meet the following criterion:

Area of Nonroof Measures		Area of High-Reflectance Roof		Area of Vegetated Roof		Total Site Paving Area		Total Roof Area
———————	+	———————	+	———————	≥		+	
0.5		0.75		0.75				

Alternatively, an SRI and SR weighted average approach may be used to calculate compliance.

Use any combination of the following strategies.

Nonroof measures

- Use the existing plant material or install plants that provide shade over paving areas (including playgrounds) on the site within 10 years of planting. Install vegetated planters. Plants must be in place at the time of occupancy permit and cannot include artificial turf.
- Provide shade with structures covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines.
- Provide shade with architectural devices or structures that have a three-year aged solar reflectance

(SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation.

- Provide shade with vegetated structures.
- Use paving materials with a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation.
- Use an open-grid pavement system (at least 50% unbound).

High-reflectance roof

Use roofing materials that have an SRI equal to or greater than the values in Table 1. Meet the three-year aged SRI value. If three-year aged value information is not available, use materials that meet the initial SRI value.

Table 1. Minimum solar reflectance index value, by roof slope

	Slope	Initial SRI	OR	3-year aged SRI
Low-sloped roof	≤ 2:12	82		64
Steep-sloped roof	> 2:12	39		32

Vegetated roof

Install a vegetated roof.

OR

Option 2. parking under cover (1 point)

Place a minimum of 75% of parking spaces under cover. Any roof used to shade or cover parking must (1) have a three-year aged SRI of at least 32 (if three-year aged value information is not available, use materials with an initial SRI of at least 39 at installation), (2) be a vegetated roof, or (3) be covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines.

Choose one of the following options:

Option 1. nonroof (1 point)

Establishment

Use any combination of the following strategies for a minimum of 50% of the site paving.

- Use the existing plant material or install plants that provide shade over paving areas (including playgrounds) on the site within 10 years of planting. Plants must be in place at the time of certification application.
- Install vegetated planters. Plants must be in place at the time of occupancy permit and cannot include artificial turf.
- Provide shade with structures covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines,
- Provide shade with architectural devices or structures that have a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation,
- Provide shade with vegetated structures.
- Use paving materials with a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation.
- Use an open-grid pavement system (at least 50% unbound).

Performance

Implement a maintenance program that ensures all high-reflectance paving surfaces are cleaned at least every three years to maintain good reflectance.

OR

Option 2. roof (1 point)

Use either roofing materials with a SRI equal to or greater than the values in Table 1 for a minimum of 75% of the roof area, or a vegetated roof for a minimum of 50% of the roof area, or both. If using both high-reflectance and vegetated roof surfaces, meet the following criterion:

Area of High-Reflectance Roof		Area of Vegetated Roof		
———————	+	———————	≥	Total Roof Area
0.75		0.5		

Alternatively, an SRI and SR weighted average approach may be used to calculate compliance.

Implement a maintenance program that ensures all high-reflectance roof surfaces are cleaned at least every three years to maintain good reflectance, and all vegetated roofs are maintained for plant health and good structural condition.

Option 3. nonroof and roof (2 points)

Meet the following criterion:

Area of Nonroof Measures		Area of High-Reflectance Roof		Area of Vegetated Roof				
———————	+	———————	+	———————	≥	Total Site Paving Area	+	Total Roof Area
0.5		0.75		0.50				

Alternatively, an SRI and SR weighted average approach may be used to calculate compliance.

Use any combination of the following strategies.

Nonroof measures
Use the measures listed in Option 1. Plant material must be in place at time of certification application.

High-reflectance roof
Use roofing materials that have an SRI equal to or greater than the values in Table 1. Meet the three-year aged SRI value. If three-year aged value information is not available, use materials that meet the initial SRI value.

Table 1. Minimum solar reflectance index value, by roof slope

	Slope	Initial SRI	OR	3-year aged SRI
Low-sloped roof	≤ 2:12	82		64
Steep-sloped roof	> 2:12	39		32

Vegetated roof
Install a vegetated roof.

Implement a maintenance program that ensures all high-reflectance surfaces are cleaned at least every three years to maintain good reflectance, and all vegetated roofs are maintained for plant health and good structural condition.

Option 4. Parking under cover (1 point)

Place at least 50% of parking spaces under cover. Any roof used to shade or cover parking must (1) have a three-year aged SRI of at least 32 (if three-year aged value information is not available, use materials with an initial SRI of at least 39 at installation), (2) be a vegetated roof, or (3) be covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines.

Implement a maintenance program that ensures all SRI surfaces are cleaned at least every three years to maintain good reflectance, and all vegetated roofs are maintained for plant health and good structural condition.

Option 1. Nonroof (1 point)

Use any combination of the following strategies for 50% of the nonroof site paving (including roads, sidewalks, courtyards, parking lots, parking structures, and driveways).

- Use the existing plant material or install plants that provide shade over the paving areas on the site within 10 years of plant material installation.
- Install and plant planters, either at grade or raised. Plant material cannot include artificial turf.
- Provide shade with structures covered by energy generation systems, such as solar thermal collectors , photovoltaics, and wind turbines, that produce energy used to offset some nonrenewable resource use.
- Provide shade with architectural devices or structures that have a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation,
- Provide shade with vegetated structures.
- Use paving materials with a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation.
- Use an open-grid pavement system (at least 50% unbound).

OR

Option 2. High-reflectance and vegetated roofs (1 point)

Use roofing materials that have an SRI equal to or greater than the values in Table 1.Meet the three-year aged SRI value (if three-year aged value information is not available, use materials that meet the initial SRI value) for a minimum of 75% of the roof area of all new buildings within the project, or install a vegetated (“green”) roof for at least 75% of the roof area of all new buildings within the project. Combinations of SRI-compliant and vegetated roofs can be used, provided they satisfy the equation in Option 3.

Table 1. Minimum solar reflectance index value, by roof slope

	Slope	Initial SRI	OR	3-year aged SRI
Low-sloped roof	≤ 2:12	82		64
Steep-sloped roof	> 2:12	39		32

Option 3. Mixed nonroof and roof measures (1 point)

Use any of the strategies listed under Options 1 and 2 that in combination meet the following criterion:

Area of Nonroof Measures		Area of High-Reflectance Roof		Area of Vegetated Roof		Total Site Paving Area		Total Roof Area
———————	+	———————	+	———————	≥		+	
0.5		0.75		0.75				

Alternatively, an SRI and SR weighted average approach may be used to calculate compliance.

Choose one of the following options:

Option 1. nonroof and roof (2 points except Healthcare, 1 point Healthcare)

Meet the following criterion:

Area of Nonroof Measures		Area of High-Reflectance Roof		Area of Vegetated Roof		Total Site Paving Area		Total Roof Area
———————	+	———————	+	———————	≥		+	

0.5		0.75		0.75				

Alternatively, an SRI and SR weighted average approach may be used to calculate compliance.

Use any combination of the following strategies.

Nonroof measures

- Use the existing plant material or install plants that provide shade over paving areas (including playgrounds) on the site within 10 years of planting. Install vegetated planters. Plants must be in place at the time of occupancy permit and cannot include artificial turf.
- Provide shade with structures covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines.
- Provide shade with architectural devices or structures that have a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation.
- Provide shade with vegetated structures.
- Use paving materials with a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation.
- Use an open-grid pavement system (at least 50% unbound).

High-reflectance roof

Use roofing materials that have an SRI equal to or greater than the values in Table 1. Meet the three-year aged SRI value. If three-year aged value information is not available, use materials that meet the initial SRI value.

Table 1. Minimum solar reflectance index value, by roof slope

	Slope	Initial SRI	OR	3-year aged SRI
Low-sloped roof	≤ 2:12	82		64
Steep-sloped roof	> 2:12	39		32

Vegetated roof

Install a vegetated roof.

OR

Option 2. parking under cover (1 point)

Place a minimum of 75% of parking spaces under cover. Any roof used to shade or cover parking must (1) have a three-year aged SRI of at least 32 (if three-year aged value information is not available, use materials with an initial SRI of at least 39 at installation), (2) be a vegetated roof, or (3) be covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines.

NOTE:

For each option below, if SRI information is not available for the specified product, demonstrate compliance using the SRI calculator in California's Energy Efficiency Standards for Residential and Nonresidential Buildings (California Code of Regulations, Title 24, Part 6; available at http://www.energy.ca.gov/title24/2008standards/sri_calculator/SRI_Calcul...). This calculator uses solar reflectance and thermal emittance to determine the SRI of roofing materials.

OPTION 1

Use any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots):

- Provide shade from the existing tree canopy or within 5 years of landscape installation. Landscaping (trees) must be in place at the time of occupancy.
- Provide shade from structures covered by solar panels that produce energy used to offset some nonrenewable resource use.
- Provide shade from architectural devices or structures that have a solar reflectance index[9] (SRI) of at least 29.
- Use hardscape materials with an SRI of at least 29.
- Use an open-grid pavement system (at least 50% pervious).

OR

OPTION 2

Place a minimum of 50% of parking spaces under cover[10]. Any roof used to shade or cover parking must have an SRI of at least 29, be a vegetated green roof or be covered by solar panels that produce energy used to offset some nonrenewable resource use.

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[8] Heat islands are defined as thermal gradient differences between developed and undeveloped areas.
[9] The solar reflectance index (SRI) is a measure of the constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. To calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371.
[10] For the purposes of this credit, under cover parking is defined as parking underground, under deck, under roof, or under a building.

NOTE:

For each option below, if SRI information is not available for the specified product, demonstrate compliance using the SRI calculator in California's Energy Efficiency Standards for Residential and Nonresidential Buildings (California Code of Regulations, Title 24, Part 6; available at http://www.energy.ca.gov/title24/2008standards/sri_calculator/SRI_Calcul...). This calculator uses solar reflectance and thermal emittance to determine the SRI of roofing materials.

OPTION 1

Use roofing materials with a solar reflectance index[12] (SRI) equal to or greater than the values in the table below for a minimum of 75% of the roof surface.

Roofing materials having a lower SRI value than those listed below may be used if the weighted rooftop SRI average meets the following criteria:

$$\frac{\text{Area of Roof Meeting Minimum SRI}}{\text{Total Roof Area}} \times \frac{\text{SRI of Installed Roof}}{\text{Required SRI}} \geq 75\%$$

Roof Type	Slope	SRI
Low-sloped roof	≤ 2:12 (15%)	78
Steep-sloped roof	> 2:12 (15%)	29

OR

OPTION 2

Install a vegetated roof that covers at least 50% of the roof area.

OR

OPTION 3

Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:

$$\frac{\text{Area of Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} > \text{Total Roof Area}$$

Roof Type	Slope	SRI
Low-sloped roof	≤ 2:12 (15%)	78
Steep-sloped roof	> 2:12 (15%)	29

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[11] Heat islands are defined as thermal gradient differences between developed and undeveloped areas.

[12] The solar reflectance index (SRI) is a measure of the constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. To calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918 or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371.