Both types of green roofs can be used on residences, industrial facilities, offices, and other commercial property. Green roofs are widespread in Europe and Asia, and are becoming more common in the United States.

Cool Pavement

Pavements with low solar reflectance absorb large amounts of heat and can be up to 70˚ F (40˚ C) hotter in the sun than cooler alternatives.

Portland cement concrete and asphalt concrete – commonly called “concrete” and “asphalt,” respectively – are the most common paving materials for sidewalks and streets. Most new concrete has a solar reflectance, or albedo, of 35-40 percent; the solar reflectance of fresh asphalt is typically 5-10 percent.

Over time, the albedo of these pavements change. Concrete darkens from the build-up of tire residue, dirt, and oil, and asphalt lightens as the asphalt binder wears away to expose the underlying rock aggregate.

To maximize the albedo of both types of pavement, lighter-colored aggregate can be used in the pavement mix. Alternatively, asphalt pavements can be covered with high-albedo sealcoats, small rocks set in binder, or a thin layer of concrete. For concrete applications, using lighter-colored sand and cement can increase reflectivity.

Permeable, or porous, pavements allow water to percolate and evaporate, cooling the pavement surface and surrounding air. Permeable pavements can be constructed from anumber of materials including concrete, asphalt, and plastic lattice structures filled with soil, gravel, and grass.

Although there is no official standard or labeling program to designate cool paving materials, communities interested in reducing the heat island effect may consider surface reflectivity and permeability – along with other costs and benefits – when selecting a paving product.

What is EPA Doing to Reduce Heat Islands?

Through its Heat Island Reduction Initiative (HIRI), EPA works with community groups, public officials, industry representatives, researchers, and other stakeholders to identify opportunities to implement heat island reduction strategies and evaluate their impacts on energy demand, local meteorology, air quality, health, and other factors.

For More Information

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www.epa.gov/heatisland
EPA Global Warming Information
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ENERGY STAR Qualified Cool Roof Products
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High-albedo pervious pavement supports light traffic while mitigating the heat island effect and allowing stormwater to pass through.

The village of Fair Oaks in Sacramento, California installed a permeable portland cement concrete parking lot at a local park. It avoids the cost of a stormwater drainage system and helps reduce the heat island effect.

Cooling Summertime Temperatures

Strategies to Reduce Urban Heat Islands
What Is a Heat Island?

Commonly referred to as urban heat islands, this phenomenon can impact communities by increasing peak energy demand, air conditioning costs, air pollution levels, and heat-related illnesses and mortality. Fortunately, there are common-sense measures that can reduce the negative effects of heat islands.

What Causes Heat Islands?

Heat islands can occur year-round during the day and night. Urban-heat-island phenomenon occurs when temperatures in urban areas are typically higher than in surrounding rural and suburban areas. This is attributed to higher temperatures within urban areas, which are often characterized by higher levels of human activity, transportation, and manufacturing.

What Are the Effects of Heat Islands?

Heat islands may affect public health, the environment, and economic efficiency. Heat islands can increase peak electricity demand, affect water resources, and increase greenhouse gas emissions.

What Can Communities Do to Reduce the Heat Island Effect?

Several strategies can help reduce the impact of heat islands on communities. These strategies include:

- **Cool Roofs:** Using light-colored, reflective roofing materials can help reduce heat transfer to building interiors and reduce the need for air conditioning.
- **Shade Trees and Vegetation:** Trees and vegetation can help shade buildings, reduce summertime air conditioning demand, and improve air quality.
- **Green Roofs:** Installing green roofs can help reduce urban heat islands by providing additional surface area for vegetation and helping to absorb sunlight and heat.

These strategies can be implemented at various scales, from individual buildings to entire communities. By working together, communities can reduce the negative effects of heat islands and improve the overall health and well-being of their residents.
Both types of green roofs can be used on residences, industrial facilities, offices, and other commercial property. Green roofs are widespread in Europe and Asia, and are becoming more common in the United States.

Cool Pavement

Pavements with low albedo/reflectance absorb large amounts of heat and can be up to 10°F (5.6°C) hotter in the sun than cooler alternatives.

Portland cement concrete and asphalt concrete—commonly called “concrete” and “asphalt,” respectively—are the most common paving materials for sidewalks and streets. Most new concrete has a solar reflectance of 35-40 percent; the solar reflectance of fresh asphalt is typically 5-10 percent.

Over time, the albedo of these pavements changes. Concrete darkens from the build-up of tire residue, dirt, and oil, and asphalt lightens as the asphalt binder wears away to expose the underlying rock aggregate. To maximize the reflectance of both types of pavement, lighter-colored aggregate can be used in the pavement mix. Alternatively, asphalt pavements can be coated with high-albedo sealants, small rocks or “crushed” stone, or a thin layer of concrete. For concrete applications, using lighter-colored sand and cement can increase reflectivity.

Permeable, or porous, pavements allow water to percolate and evaporate, cooling the pavement surface and surrounding air. Permeable pavements can be constructed from a number of materials including concrete, asphalt, and plastic lattice structures with soil, gravel, and grass.

Although there is no official standard or labeling program to designate cool paving materials, communities interested in reducing the heat island effect may consider albedo, reflectivity, and permeability—along with other costs and benefits—when selecting a paving product.

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Cool Roof Rating Council
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U.S. Green Building Council
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Cooling Summertime Temperatures

Heat islands describe local scale temperature differences between urban and rural areas. In contrast, global warming refers to the gradual rise of worldwide average surface temperature.

The Difference between Heat Islands and Global Warming

Heat islands describe local scale temperature differences between urban and rural areas. In contrast, global warming refers to the gradual rise of worldwide average surface temperatures.

Cool Pavement in Action

The village of Fair Oaks in Sacramento, California installed a permeable Portland cement concrete parking lot at a local park. It avoids the cost of a stormwater drainage system and helps reduce the heat island effect.

Plastic lattice structures filled with soil, gravel, and grass.
Ozone (O₃)

Higher urban temperatures in the following ways:

- **Heat islands** are characterized by urban air and surface temperatures between them and reduce wind flow.
- **Cool Roofs** in action promote comfort and minimize health risks. As of April 2003, the Cool Homes Program had installed over 450 roofs.

**When Do Heat Islands Form?**

- Urban-heat islands can occur year-round during the day or night. Urban-heat differences are often larger during winter evenings. This is because rural areas cool off faster at night than urban areas.
- Heat islands can increase the demand for air conditioning, raising energy expenditures. For example, can save billions of dollars in energy expenditures, and reduce peak temperatures of 190°F (88°C). By comparison, cool roofs reach peak temperatures of 120°F (49°C).
- The term “cool roof” describes roofing materials that have a high solar reflectance and low thermal emittance.

**What Causes Heat Islands?**

- Rural-urban temperature differences are often largest during calm, clear evenings. This is because rural areas cool off faster at night than urban areas.

**What Is a Heat Island?**

Heat islands are characterized by higher air and surface temperatures than their non-urban surroundings. Urbanization can increase the amount of energy that consumers use for summertime cooling.

**How Do Heat Islands Affect Us?**

- Increased urban temperatures can affect public health, the environment, and the economic well-being of communities.

**Urban Heat Island Profile**

- **Public Health:** Heat stress can amplify extreme weather events, which can cause heat stroke and death. Heat waves reduce indoor comfort by lowering top-floor temperatures.

**Cool Roofs**

- The three “cool roof” descriptors that have a high solar reflectance and low thermal emittance:
  - **White Paint:** Reflects up to 90% of the solar energy that falls on it.
  - **Highly Reflective:** Reflects up to 80% of the solar energy that falls on it.
  - **Corrugated Roof:** Reflects up to 70% of the solar energy that falls on it.

**Energy Use**

- **Reduced energy use:** The solar reflectance of cool roofs can reduce energy use in commercial and residential buildings.

**What Can Communities Do to Reduce the Heat Island Effect?**

**Types of Cool Roofs**

- **Commercial (low slope):** Most cool roof applications are for low-slope, commercial buildings. The use of cool roofs can reduce the cooling load of buildings by as much as 15%.

**Benefits**

- **Solar Reflectance:** The albedo, or solar reflectance, of a surface in the percentage of incoming solar radiation that is reflected by that surface. Reflective coatings are rated in a scale of 0 to 1, where 0 is 0% and 1 is 100%.
- **Thermal Emittance:** The ability of a surface to absorb or reflect infrared radiation, measured as a value of 0 to 1.

**Softener, Solar Reflectance, and Emittance**

- Reflective surfaces can reduce urban temperatures, energy use, air pollution, and heat-related health impacts. Heat islands can increase the amount of energy that consumers use for summertime cooling.

**Rural and Urban Heat Island Profile**

- **Public Health:** Heat stress can amplify extreme weather events, which can cause heat stroke and death. Heat waves reduce indoor comfort by lowering top-floor temperatures.
What is a Heat Island?

Heat islands are characterized by higher air and surface temperatures than the surrounding rural areas. The greater the temperature difference, the greater the heat island. The heat island effect shows a city’s heat island. It is measured by temperature differences between urban and rural areas, and the warmed temperature is in downtown areas.

What Causes Heat Islands?

Heat islands can be caused by a variety of factors, including urbanization, reduced vegetation, and building materials. Urbanization increases the amount of impervious surface, such as concrete and asphalt, which absorb and retain heat. Reduced vegetation, such as trees and grass, reduces the amount of shading and evapotranspiration, which cools the environment. Building materials, such as concrete, also absorb and retain heat, contributing to the urban heat island effect.

What Does a Heat Island Do?

Heat islands can affect public health, the environment, and the economy. They can lead to increased energy use and costs, increased air pollution, and increased health risks, such as heat-related illnesses. Heat islands can also affect the environment by increasing the demand for water and energy, which can lead to the depletion of resources.

How Do We Reduce a Heat Island?

Cool roofs are a cost-effective and low-tech strategy to reduce the urban heat island effect. They work by reflecting solar radiation, which reduces the temperature of the roof and the surrounding area. Cool roofs are particularly effective in hot and sunny climates, where the sun’s energy is most intense.

Types of Cool Roofs

- **Reflective Roofs**: Reflective roofs are designed to reflect solar radiation away from the surface. They typically have a high solar reflectance, which means they reflect a large percentage of the sun’s energy. Reflective roofs are effective in areas with hot and sunny climates.
- **Non-Reflective Roofs**: Non-reflective roofs absorb solar radiation, which increases the temperature of the roof and the surrounding area. Non-reflective roofs are effective in areas with cooler and cloudy climates.
- **Cool Roofs**: Cool roofs are a combination of reflective and non-reflective roofs. They are designed to reflect solar radiation during the day and absorb solar radiation during the night, which helps to reduce the temperature of the roof and the surrounding area.

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Benefits of Cool Roofs

- **Energy savings**: Cool roofs can save energy by reducing the amount of heat that enters a building. This can reduce the energy required to cool the building, which can lead to lower energy bills.
- **Reduced air conditioning costs**: Cool roofs can reduce the need for air conditioning, which can lead to lower energy bills and lower emissions.
- **Reduced heat-related illnesses**: Cool roofs can reduce the temperature of the roof and the surrounding area, which can reduce the risk of heat-related illnesses.
- **Improved ecosystem**: Cool roofs can improve the ecosystem by reducing the temperature of the roof and the surrounding area, which can benefit local plants and animals.

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