HEAT ISLAND EFFECT REDUCTION THROUGH MATERIALS USAGE & DESIGN

Densely developed urban areas are often 2 to 9 degrees Fahrenheit warmer than they would be if left in an undeveloped condition, a phenomenon known as "urban heat island effect"(UHI). The extra heat comes from several sources: 1) paved areas (which can account for 1/3 or more of a city's land area) and dark-colored rooftops absorb more sunlight and re-emit more heat than would an area's native soils and vegetation; 2) motor vehicles, buildings and machinery produce waste heat that is not quickly removed from the area; and 3) loss of vegetation eliminates natural cooling from evapotranspiration and shading.

UHIs have the potential to directly influence the health and welfare of urban residents by exacerbating the effects of heat waves. Within the United States, an average of 1000 people die each year due to extreme heat. This is particularly a concern for poorer residents who do not have access to air conditioning.

In many areas, the result of the urban heat island effect is higher electricity demand from air conditioning and refrigeration. Since these additional electricity loads often come at peak periods, they may accelerate the need to build new power generating facilities or to activate standby facilities. Reducing the heat island effect will thus reduce this extra energy demand.

Proper materials usage and design standards, e.g., installing green and cool roofs, planting trees and vegetation, applying window coverings, using cool paving materials and narrowing street widths can create more comfortable conditions and reduce the excess energy demand caused by heat island effect. These techniques for lowering urban temperatures benefit individual home and building owners directly. Shading provided by trees and vegetation, for instance, can save consumers money on summertime cooling bills. These features help enhance the marketability of developments that integrate them. This is a plus factor for developers and builders to consider.

APPLICABLE NEW JERSEY GOALS AND TARGETS

Reduce projected energy use by 20% by 2020 and meet 20% of the State's electricity needs with Class 1 renewable energy source by 2020 (NJ Energy Master Plan).

Stabilize GHG emissions at 1990 levels by 2020/ Reduce emissions to 80% below 2006 levels by 2050 (E.O. 54; NJ Global Warming Response Act, P.L. 2007, c.112).

Related urban and community forestry objective to plant 100,000 trees in key cities and towns of NJ under the Urban Forest Energy Efficiency program.

SUGGESTED ACTIONS AND STRATEGIES

Redesign Rooftops as Cool and/or Green Roofs - Roofs can be designed and built as practical heat reflectors. Roofing materials that have a high solar reflectance are known as "cool roofs." This attribute decreases heat transfer to the indoor environment and can also improve the durability of roofs. Cool roofing materials may also possess the characteristic of high emittance, that is, releasing a large percentage of the solar energy they absorb.

Conventional roofing materials can reach maximum temperatures of 190°F (88°C) during hot sunny days. In contrast, cool roofs reach peak temperatures of 120°F (49°C). In buildings without air conditioning, cool roofs can raise indoor comfort by reducing top-floor temperatures. There are two types of cool roofs: (1) commercial (low-slope) — these are generally a smooth, bright white surface most often used in primarily commercial buildings; and (2) residential (steep-slope) — these are made of various colors (from special pigments) to reflect solar energy. The Energy Star® program features voluntary product specifications for both types. Low-slope roofs should have initial solar reflectance of 65% while steep-slope roofs should have 25% or more. Emittance is not a criterion for the Energy Star label although a high emittance value can further reduce energy costs.

A “green roof” or rooftop garden[1] presents another option to replace conventional roofing material. These alternative roofs reduce heat islands by replacing heat-absorbing surfaces with plants, shrubs, and small trees that cool the air through evapotranspirartion. Green roofs are composed of soil and vegetation planted over a waterproofing layer. These can either be *extensive* or *intensive* based on the amount of soil, vegetative cover and accessibility of the roof. Extensive green roofs require only 1 to 5 inches of growing medium, while the intensive ones need a minimum of 1 foot of growing medium for the plants, trees and shrubs.

Energy-conserving Tree Planting and Landscaping - Providing vegetative cover by planting trees, shrubs and other vegetation in a properly designed manner is a simple and effective way to reduce the heat island effect in new or remodeled developments. It is estimated that tree and vegetation shading can minimize a building’s cooling energy consumption by up to 25% per year. Apart from shading, vegetative cover also cools the air through evapotranspiration. Other benefits include enhanced stormwater management and reduced air pollution.

There are two basic considerations for effective tree planting and landscaping in a specific development site: (a) *Where to Plant* — trees should shade the east and west walls to maximize cooling effects and thus savings from reduced air conditioning costs; and (b) *What to Plant* — Deciduous trees are favored since they work well to balance the energy requirements over an annual period. The tree crown and foliage cool buildings by blocking solar radiation in the summers. When leaves are shed during winters, the sun’s energy passes through and helps to warm buildings. Consulting with certified urban foresters and landscape architects will be useful in developing a suitable and cost-effective design (NJDEP through its Forest Service maintains a directory of certified urban foresters). For further information, please see the fact sheet on *Urban and Community Forestry*, which is also included in this technical guide series.

Construct Roads with Cool Pavement - Paving materials that lower surface temperatures are available and can be used in establishing roads, streets, parking lots and other facilities that require paved surfaces. Cool pavement options are available for traditional materials like asphalt and concrete as well as unpaved surfaces. There are two cool pavement alternatives: (a) pavements with higher solar reflectance that are relatively cooler in the sun; and (b) porous, or permeable pavements that benefit from the cooling effect of evaporation. In order to ensure high-level performance, proper design and construction are essential in applying either cool pavement technique. As yet, there is no official or labeling program to designate cool paving materials.

[1] City of Chicago installed a 20,300 square foot intensive green roof in its city hall with an expected reduction in air conditioning costs of $4,000 annually (2004. EPA. Cooling Summertime Temperatures: Strategies to Reduce Urban Heat Islands).

STATE TECHNICAL/FINANCIAL ASSISTANCE

Technical and funding assistance is available from NJ DEP Forest Service on urban and community forestry, tree planting, and shade trees.

FURTHER INFORMATION

EPA Heat Island Reduction Initiative - www.epa.gov/heatisland
Cool Roof Rating Council - www.coolroofs.org
Green Roofs for Healthy Cities - www.greenroofs.org
Center for Green Roof research - http://hortweb.cas.psu.edu/research/greenroofcenter
ENERGY STAR Qualified Cool Roof Products - www.energystar.gov/products
NJDEP Forest Service- http://www.nj.gov/dep/parksandforests/forest/index.html
USDA Urban and Community Forestry Program - www.fs.fed.us/ucf
Cool Pavement Report - EPA Cool Pavements Study - Task 5
www.epa.gov/hiri/resources/pdf/CoolPavementReport_Former%20Guide_complete.pdf

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September 2007