United States Environmental Protection Agency

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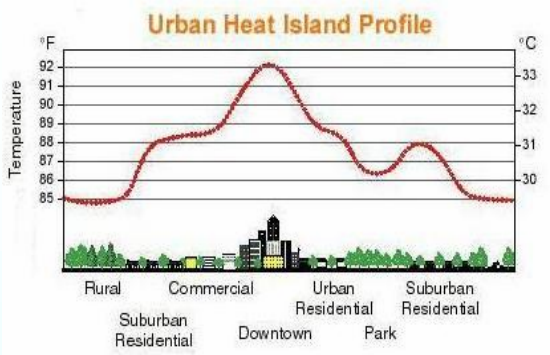
Smart Growth and Urban Heat Islands

Development patterns of the last 50 years have had both positive and negative impacts on communities across the country. One concern has been steadily increasing urban temperatures due to the effects of "urban heat islands." A heat island is an umbrella of air, often over a city or built-up area, that is warmer than the air surrounding it.

The urban heat island profile shown here demonstrates that heat islands are typically most intense over dense urban areas. The profile also shows how parks and other vegetated sections within a downtown area may help to reduce heat islands.

In general, summertime heat islands raise air conditioning demand, air pollution levels (particularly smog), and greenhouse gas emissions. They also increase the incidence of heat-related illness and mortality. In fact, in an average year, approximately 1,100 Americans die from extreme heat -- the leading weather-related killer in the United States. [2]

Heat islands augment this public health threat by directly increasing temperature and indirectly raising ground-level ozone concentrations. Those at significant risk from extreme heat and ozone exposure include the elderly, children, and individuals with pre-existing respiratory disease. Residents who live in homes with dark-colored roofs and no air conditioning may also be more vulnerable than the general population.



Source: EPA 1992 [1]

Because urban design plays a large role in heat island formation, smart growth development strategies provide an opportunity to reduce heat islands.

Smart growth is development that enhances both a community's economy and environment through strategies to help citizens make informed decisions about how and where they want to grow.

In addition to mitigating the heat island effect, smart growth provides a framework for increasing regional environmental protection, enhancing community character, and strengthening local economies. Here are four smart growth solutions that can achieve these goals:

- **Reducing off-street parking and using porous paving materials:** Surface parking lots replace natural vegetation with pavements that transfer heat to the surroundings. Providing on-street parking and planning compact, pedestrian-oriented development promotes transportation choices and can minimize the size and number of parking lots.
- **Planting, preserving, and maintaining trees and vegetation:** Trees and vegetation contribute to the beauty, distinctiveness, and material value of communities by incorporating the natural environment into the built environment. In addition, they cool surrounding areas by increasing evapotranspiration – a natural process that draws heat from the air to convert water in the leaf structure to water vapor. Planted adjacent to homes and buildings, trees provide shade, cool the interior, and reduce air conditioning energy demand. Trees and vegetation planted along medians and sidewalks can decrease evaporative emissions from cars and filter pollution from the air. Rooftop gardens, or green

Everyone wins. Residents get better homes, lower energy bills, and cooler neighborhoods with plenty of green space. Narrower streets and a shorter pipeline means lower installation costs, so the developer gets a subdivision that's cheaper to build. And the City ends up with less streets to maintain and a standard for future development that maintain the community's existing high quality of life.

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roofs, can also mitigate urban heat islands while increasing the energy efficiency and attractiveness of commercial and residential buildings.

- **Promoting infill and higher-density development:** Development within existing communities can preserve open space and help offset heat islands and their consequences. A 2001 report found that for every acre of brownfield redevelopment, 4.5 acres of open space is preserved. Additional research found that compact development contributes less heat energy to the surrounding air than low-density dispersed growth patterns.[3]

Case Study

Chicago is a leader in urban forestry and heat island mitigation. The city has adopted an ***open space impact fee ordinance*** that requires new residential development to contribute a proportionate amount of open space or recreational facilities, or to pay fees that ensure community residents of continued access to greenspace. Chicago also replaced a 10,080 ft² conventionally paved alley with a ***light-colored permeable gravel pave system*****,** which has eliminated chronic flooding without requiring the installation of a sewer system. In addition, between 1991 to 1998 Chicago planted ***over 500,000 trees*** and achieved a citywide tree count of 4.1 million. Chicago's Bureau of Forestry now plants a minimum of 5,000 new trees per year and plans to install -- in addition to 120 miles of existing median planters -- ***280 miles of new median planters by 2005***. In June 2001, Chicago amended its ***energy code*** to include ***requirements for reflective or green roofs***. See: http://www.cityofchicago.org/Environment/

- **Increasing public education and outreach:** Heat island mitigation strategies should reflect local variation in the built environment, as well as local preferences and attitudes. Policies should be tailored to meet these needs, based on stakeholder input, and effectively communicated to the public. Committees formed to address urban heat mitigation should include representatives from citizen groups, local government, non-governmental organizations, universities, and others concerned about how the community grows. A lead organization should be appointed to disseminate information to the community, solicit feedback, and incorporate issues and concerns into action plans. Working together, communities can address urban heat islands while enhancing the quality and character of their neighborhoods.

Resources

For more information on heat islands, see www.epa.gov/heatisland, www.hotcities.org, and http://eetd.lbl.gov/HeatIsland.

For more information on smart growth, see www.smartgrowth.org and www.epa.gov/smartgrowth. Additional information on the relationship between the environment and the built environment can be found in "Our Built and Natural Environments: A Technical Review of the Interactions between Land Use, Transportation, and Environmental Quality." EPA 231-R-01-002.

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1 *"Cooling Our Communities – A Guidebook On Tree Planting and Light-Colored Surfacing"* U.S. Environmental Protection Agency 22P-2001, January 1992.

2 Kalkstein, LS, 1993. Health and Climate Change: Direct Impacts in Cities. *The Lancet* 342:1397-99.

3 Stone, B., and M.O. Rodgers. 2001. "Urban Form and Thermal Efficiency: How the Design of Cities Influences the Urban Heat Island Effect." *Journal of the American Planning Association* 67 (2) 186-198.

To learn more about Smart Growth and the Smart Growth Network, please go to http://www.smartgrowth.org.

Office of Air and Radiation (MC 6205J)

Office of the Administrator (MC 1808)

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"EPA's mission is to protect public health and the environment. EPA works with state and local decision makers to evaluate, promote, and implement integrated, common-sense strategies that capitalize on public health and air quality improvements, while encouraging economic growth. Studies have demonstrated that mitigating heat islands provide clear environmental and financial benefits including improved local and global air quality, reduced heat-related illness and death, and increased energy savings."