Heat Island Reduction Activities

Across the United States, a diverse group of stakeholders, from government agencies to corporations, have advanced urban heat island reduction strategies—urban forestry, green and cool roofs, and cool pavements—to lower summertime temperatures and achieve many energy and environmental benefits. Typically heat island mitigation is part of an energy, air quality, water, or sustainability effort,[1] and activities range from voluntary initiatives, such as cool pavement demonstration projects, to policy actions, such as requiring cool roofs via building codes. Some communities have elected to implement both voluntary and policy initiatives. These efforts can complement each other, and sometimes an initiative that begins as a voluntary activity becomes required over time.

This chapter draws from the experience of many different groups and covers a range of initiatives to highlight a variety of urban heat island reduction activities around the country. Examples for the following types of activities are included:

- Demonstration projects
- Incentive programs
- Urban forestry programs
- Weatherization
- Outreach and education
- Awards
- Procurement
- Resolutions
- Tree and landscape ordinances
- Comprehensive plans and design guidelines
- Zoning codes
- Green building standards
- Building codes
- Air quality standards.

1. Voluntary Efforts

Most community strategies to reduce heat islands have relied on voluntary efforts, which can generally be grouped into the following categories:

- Demonstration projects
- Incentive programs
- Urban forestry programs
- Weatherization
- Outreach and education
- Awards.

Many groups choose to conduct just one kind of activity; others combine approaches. For example, some utilities have focused on cool roof rebates to encourage consumers to install reflective roofing products. Some local environment departments have sponsored demonstration projects, conducted outreach and education efforts to publicize results, and have provided grants to support use of mitigation technologies by residents and industry.

1.1 Demonstration Projects

Local governments, universities, and other organizations have used projects to demonstrate a specific heat island mitigation strategy and quantify its benefits in a controlled environment. Documenting the project and its results can provide the data and publicity needed to develop larger initiatives, promote new technologies and help get them to market, and sometimes even encourage local economic development. (See the "Stimulating Local Economies and Businesses" textbox.)

Communities have found heat island demonstration projects to be most effective when they:

- **Target high-visibility projects.** Focusing efforts on a prominent building or site helps attract attention to heat island mitigation efforts.
- **Measure benefits.** Highlighting anticipated benefits and collecting data on actual impacts provides useful information for planning future activities. These benefits also illustrate to others the reasons and means to act.
- **Convey lessons learned.** Documenting how demonstration projects are conducted makes them easier to replicate and improve.

A variety of organizations can be the chief agents of change and the first to test alternative technologies, often in highly visible, public facilities. Demonstration projects have taken place in parks, schools, and municipal buildings like city hall. These projects often also monitor costs and benefits, such as energy savings. Examples include:

- **Chicago installed a green roof on its city hall** that includes 20,000 plants, shrubs, grasses, vines, and trees. The city expects to save directly more than 9,270 kilowatt-hours (kWh) per year of electricity and nearly 740 million British thermal units (Btu) per year of natural gas for heating. This energy savings translates into about $3,600 annually, and savings will increase with higher energy prices. In addition to assessing energy impacts, the green roof has been designed to test different types of rooftop garden systems, success rates of native and non-native vegetation, and reductions in stormwater runoff. This city hall green roof has helped to raise the visibility of green roofs and to increase public understanding of them. Chicago's Department of Environment staff has frequently given presentations about the roof, which has won numerous awards. For further information, go to <http://egov.city ofchicago.org> and look under the Department of Environment's City Hall green roof project.

- A demonstration project for **Tucson documented how a cool roof reduced temperatures** inside and on the roof of the building and saved more than 400 million Btu annually in energy. A white elastomeric coating was installed over a 28,000-square foot (2,600 m^2), unshaded metal roof on one of the city's administration buildings. Following the installation, energy savings were calculated at 50 to 65

Figure 1: Chicago City Hall Green Roof

Katrin Barth-Scholz/Department of Energy

Chicago's commitment to green roofs includes demonstration projects, such as on its City Hall, education, incentives, and policy actions.

Stimulating Local Economies and Businesses

The non-profit group Sustainable South Bronx has developed several goals for the green roof/cool roof demonstration project on top of its office building in Hunts Point. These goals include gathering research on local benefits, establishing a resource for the community, educating New Yorkers on the value of green roofs, and advocating sustainable building practices. The demonstration project has become a springboard for developing a local green and cool roof installation company to provide employment opportunities in the South Bronx area. The group's business is called SmartRoofs and includes a job-training program for local residents. See <www.ssbx.org/greenroofs. html#> for more information.

percent of the building's cooling energy—an avoided energy cost of nearly $4,000 annually. See <www.swenergy.org/casestudies/arizona/tucson_topsc.htm> for more information.

1.2 Incentives

Incentives have proven to be an effective way to spur individual heat island reduction actions. Incentives from governments, utilities, and other organizations can include below-market loans, tax breaks, product rebates, grants, and giveaways. For example:

- Since 2006, **Baltimore County's Growing Home Campaign has provided $10 coupons** to homeowners toward the purchase of most trees at local nurseries. Each coupon represents $5 of public funds and $5 of retail funds. In order to validate their coupons, homeowners provide information including tree type and location planted, which allows the county to integrate the data with future tree canopy studies. The county began the program as an innovative way to increase tree canopy cover as part of its larger "Green Renaissance" forest conservation and sustainability plan. In the first two months of the program, 1,700 trees were planted. See <http://fpum.org/pdf/MD%20managing_forest_resources.pdf> and <www.baltimorecountymd.gov/Agencies/environment/growinghome/index.html> for further information.

- Since 1990, the **Sacramento Municipal Utility District (SMUD) has partnered with the Sacramento Tree Foundation to provide more than 350,000 free shade trees** to residents in the Sacramento area. This program encourages residents to strategically plant vegetation around their homes to reduce energy consumption. Homes with an eastern, western, or southern exposure that heats up during the summer are eligible for this program. SMUD provides trees between four and seven feet tall (1.2-2.2 m), as well as stakes, ties, fertilizer, tree delivery, and expert advice on tree selection and planting techniques free of charge. Homeowners must agree to plant and care for the trees. See <www.smud.org/residential/trees/index.html> for more information. SMUD also offers rebates to residential customers who use cool roofing technologies. The utility offers a 20-cent-per-square-foot (0.09 m^2) rebate to customers who own single-family, multi-family, or mobile homes with flat roofs and who install ENERGY STAR® cool roof products.

- After the success of its green roof demonstration project, **Chicago established green and cool roof grant programs.** The green roof program cites the ability of green roofs to "create energy savings for building," "lower surrounding urban heat temperatures," and "reduce storm water runoff, improve water quality, and create conditions for longer-lasting roof systems." Similarly, the city recognizes cool roofs "not only help reduce cooling costs, but can also have a positive environmental impact by reducing the urban heat island effect." In 2005, its first year, the program supported 20 green roof installation projects; in 2006, it helped fund 40. In the fall of 2007, the city announced that it was expanding the program to include cool roofs and expected to provide about 55 $6,000 grants. Recipients can use grants for residential, commercial, or industrial buildings. See <http://egov.cityofchicago.org/>, under the Department of Environment portion of the website, for more information.

- The **Pennsylvania Department of Environmental Protection's Energy Harvest Program has been providing grants for specific energy saving projects** since 2003. In 2007, it dispensed more than $500,000 to green roof projects across the state. The Energy Harvest Program overall aims to deploy innovative technologies and encourages "proposals that are market-driven, create jobs, and produce economic development within the Commonwealth." See Energy Harvest Program information available at: <www.depweb.state.pa.us/energy/site/default.asp>.

- In addition to green roofs, building owners can also install vertical gardens—sometimes referred to as green or living walls—on exterior walls to shade buildings and provide evapotranspiration.[2] The **Houston Downtown Management District (HDMD) Vertical Gardens Matching Grant initiative first gave grants in 2007 to encourage plantings that cover walls.** The grants also support exceptional landscaping that adds significant evapotranspiration and shade for blank walls, parking garages, and sidewalks. The program goals include improving overall aesthetics, pedestrian comfort, air quality, and reducing the heat island effect. Grants cannot exceed half of the total project cost or $20,000, and contributions can be in kind. Tenants, property owners, and registered non-profits can all apply. See <www.houston-downtown.com/Home/Business/DoingBusiness/ DevelopmentAssistance/ Development%20Assistance.PDF>.

- Since 2002, **Austin Energy has given 10-cent-per-square-foot rebates for cool roof installations**. Customers must use cool roof products that have a minimum reflectivity of 75 percent, and the project must pass a cost-benefit analysis. The utility has been promoting cool roof products as a cost-effective and low-risk approach to reducing cooling loads and peak demand. As of 2005, Austin Energy had awarded more than $164,000 as rebates, representing more than 1.5 million square feet (140,000 m²) of roof area and saving an estimated 1.25 million kWh of energy. See <www.austinenergy.com/Energy%20Efficiency/Programs/Rebates/index.htm> for more information.

Energy Incentives

The Database of State Incentives for Renewables and Efficiency (DSIRE) provides current information on state, local, utility, and select federal incentives that promote renewable energy and energy efficiency. Some of the incentives listed, particularly those that involve energy efficiency and green building practices, include heat island reduction strategies. See <www.dsireusa.org>.

1.3 Urban Forestry Programs

Urban forestry or tree planting programs exist in most large cities and counties in the United States. These programs generally have broad goals that emphasize the multiple benefits trees can provide, including helping to cool cities. Most of these programs unite diverse stakeholders, and their efforts range from short-term, one-time projects to long-term community revitalization. Moreover, many states give grants to communities and organizations that promote or maintain urban forests. For example, Wisconsin will disburse $530,000 in roughly 40 grants in 2008 as part of a program it has operated since 1993; South Dakota has run a similar program since

1991.[3,4] As of early 2008, the Washington State legislature was working on several bills that would support and expand local urban forestry efforts in recognition of how urban trees and vegetation improve air quality, reduce temperatures, enhance quality of life, and reduce and filter stormwater runoff.[5]

Frequently, urban afforestation focuses on low-income communities, where tree cover is sparse. For example:

• The **Pennsylvania Department of Conservation and Natural Resources oversees a project called TreeVitalize,** which brings together county and local governments, foundations, trade associations, and private industry to restore tree cover in the southeastern part of the state. TreeVitalize aims to plant more than 20,000 trees in approximately 40 neighborhoods in Bucks, Chester, Delaware, Montgomery, and Philadelphia counties. The $8 million program targets neighborhoods in older cities, boroughs, and townships in which tree cover is below 25 percent. See <www. treevitalize.net/> for more information.

• **Groundwork Elizabeth,** a nonprofit group in Elizabeth, New Jersey, **works to involve neighborhood residents** in community revitalization projects,

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Tree Maintenance and Education

Many urban forestry programs explain that it is easy to plant trees but difficult to maintain them, particularly until they become well established. In order to ensure most trees survive, programs have enlisted and empowered volunteers to care for trees until they are established. Community participation is important because most urban trees are not under public jurisdiction.

Often tree planting programs train participants in proper tree planting techniques and care. In Pennsylvania, TreeVitalize provides nine hours of classroom and field training to community residents who want to become urban forestry leaders. The classes cover tree identification, planting, pruning, mulching, tree biology/physiology, proper species selection, community tree care, and proper pruning. Residents also can learn how to organize community-assisted tree planting projects. Graduates are eligible to participate in advanced training and other events.

Other programs require community members to pledge to maintain and protect the trees that are planted. For example, Los Angeles residents interested in free trees from the Trees for a Green LA program first participate in an online or neighborhood workshop. Then, they complete a site plan and apply for their free trees. Residents pledge on their applications to plant and care for the trees in a proper manner and allow the city to inspect their work for overall program evaluation and quality assurance. See <www.ladwp.com/ladwp/cms/ladwp000744.jsp>.

Please see the "Trees and Vegetation" chapter of this compendium for more information about urban forestry benefits and implementation considerations.

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including tree planting at local schools and parks. The organization was instrumental in getting Elizabeth involved in New Jersey's Cool Cities Initiative, which aims to plant trees primarily in the large cities of New Jersey with low tree coverage. See <www.groundworkelizabeth.com> for more information.

1.4 Weatherization

Communities have used weatherization programs as an opportunity to mitigate heat islands, protect public health, and save energy. Weatherization usually involves making the homes of qualifying residents, generally low-income families, more energy efficient at no cost to the residents. States use weatherization funds provided by the U.S. Department of Energy (DOE) Weatherization Assistance Program to help recipients cover heating bills and invest in energy efficiency actions that lower costs. States can also use the funds to install cooling efficiency measures, such as screening and shading devices.

The **Energy Coordinating Agency (ECA) of Philadelphia,** which administers the city's weatherization services, **has applied cool roof coatings** as part of its package of energy efficiency treatments. Through its Cool Homes Program, more than 550 residences in the Philadelphia area have had their roofs coated. ECA commissioned a study that found the cool coatings and increased insulation eliminated 90 percent of the heat gain through the ceiling, reducing top-floor ceiling temperatures by an average of 4.7°F (2.6°C) and chest-height temperatures by 2.4°F (1.3°C). These reduced temperatures lowered air conditioning loads by about one-third in a typical rowhouse.[6] See <www.ecasavesenergy.org/ses/whiteroof/roof-coolhomes.html> for more information.

Heat Health—An Opportunity to Advance Heat Island Mitigation Strategies

Several large cities have developed programs to minimize health impacts from excessive heat events. These efforts provide an opportunity to educate communities about urban heat islands and promote heat island reduction strategies, particularly shade tree planting and cool roof applications, as a long-term mitigation or adaptation strategy. For example, Philadelphia has long been concerned with reducing heat-related mortality. The city was the first in the United States to implement a Heat Health Watch-Warning System, which has become a worldwide model for heat wave forecasting.

When the Philadelphia Public Health Department educates citizens about excessive heat events and immediate counter-measures, such as using telephone heat hotlines and taking advantage of public air-conditioned buildings, or "cooling centers," it also provides them information about longer-term heat island reduction strategies.

EPA's *Excessive Heat Events Guidebook* explains how local public health officials and others can assess their vulnerability and develop and implement notification and response programs. See <www.epa.gov/heatisland/about/heatguidebook.html>.