

City of Cambridge
Climate Protection Action Committee

Recommendation to the City Manager on Urban Heat Island Mitigation

Recommendation to take actions that mitigate and increase awareness of the urban heat island effect.

Climate Protection Goal F: Minimizes Urban Heat Island

Climate Protection Objective 10: Increase the overall amount of vegetative cover and reduce use of materials that absorb heat. Quantify the objective by 2015.

Introduction

The “urban heat island” (UHI) effect refers to an urban area – a region, a city or an area within a city – that is significantly warmer than its surroundings. It is the result of several factors, most notably a lack of tree cover and a built environment that uses materials that absorb rather than reflect solar radiation. The higher temperatures result in additional air conditioning load on buildings, which in turn leads to substantial additional waste heat, adding to the effect. Warmer temperatures induced by climate change will exacerbate the UHI effect and increase the resulting vulnerabilities.

The effect leads to hotter temperatures, both day and night. One consequence already mentioned is higher cooling loads and thus energy consumption by buildings. Another includes a range of public health risks from heat stress and temperature-related degradation of air quality (e.g., greater ozone formation at higher temperatures) which are particularly relevant for the elderly, the young, and people with compromised health.

There are several approaches to reducing the UHI effect. Tree canopy and vegetative surfaces have a cooling effect and do not significantly affect heating loads in the winter; in Cambridge, we can see this in the correlation between tree canopy and neighborhoods with higher heat indices. Similarly, use of lighter-color, more reflective materials in the built environment – roofs, walls exposed to the sun, walks, roads and parking lots – can play a positive role. And reduced use of air conditioning and greater efficiency can reduce the compounding effect of waste heat and the long-term impact of additional greenhouse gas emissions.

CPAC’s most recent goals for the City include the following goal and objective:

Goal F: Minimizes Urban Heat Island Effect

Objective 10: Increase the overall amount of vegetative cover and reduce use of materials that absorb heat. Quantify the objective by 2015.

We have several sources of useful data about the conditions in Cambridge as well as general information about standards and strategies to inform our thinking. These include:

UHIs in Cambridge

- Kleinfelder has produced an adjusted land surface temperature map and heat index map for the entire city for the climate vulnerability assessment.

Existing vegetative cover and tree canopy in Cambridge

- University of Vermont researcher Jarlath O’Neil-Dunne conducted an analysis of existing and possible tree canopy cover using LiDAR data.
- Laura Smead, an intern in the environmental and transportation planning Division conducted an analysis of all vegetative cover by neighborhood using Cambridge GIS data layers.

Public shade trees

- The DPW conducted an analysis of city and park trees in 2011

Existing impervious area including roads, sidewalks, driveways, and buildings

- GIS data

National standards for vegetative cover and material reflectivity

- LEED ND points for heat island can be achieved by designing 50% of hardscape surfaces to have the following; solar reflectance of 29 or higher, open grid paving with at least 50% pervious, 50% shading from tree canopy, shaded by structures with solar reflectance of 29 or higher, shaded by solar panels.
- STAR Communities requires that communities meet a threshold of 35% protected vegetative surfaces, and that 85% of the population is within a ½ mile walk distance of green infrastructure.

Best practices for implementing UHI reduction strategies

- American Council for an Energy Efficient Economy report, “Cool Policies for Cool Cities: Best Practices for Mitigating Urban Heat Islands in North American Cities”.
- The Environmental Protection Agency’s guide, “Reducing Urban Heat Islands: Compendium of Strategies”.
- Sydney, Australia’s “Green Roofs and Walls Policy”
- Georgetown Climate Center’s “Adapting to Urban Heat: A Tool Kit for Local Governments”.

Existing municipal programs, policies, ordinances related to UHI

- K2C2 recommendations include a cool roof standard
- Response to October 19, 2009 Council Order 0-13 regarding opportunities for white roofs on municipal buildings
- DPWs tree planting programs
- Zoning Ordinances with reference to vegetation and trees

CPAC recommends the following actions to quantify the existing objective, create an additional objective, and accomplish both of them.

1. Expand tree/vegetative cover programs and policies

- a. Adopt a new objective under Goal F to protect existing tree canopy/vegetative surfaces.

Protecting existing tree canopy and vegetated space is essential to reduce UHI. While new trees can be planted, they take years to fully develop into a shade-providing canopy. Cambridge's mature trees have developed extensive canopies that take decades to replace. Any removal of vegetated/pervious surfaces should be discouraged, as it is difficult and costly to revert to those surfaces at a later time.

- *Assess existing threats to tree cover, such as disease, pests, methane leaks, and climate-change induced stress, and develop strategies for addressing any that are significant.*
- *Review existing utility tree removal/trimming procedures*
- *Identify the points at which the City can influence removal of private trees and vegetative surfaces and develop intervention plans/strategies*

- b. Improve the existing tree planting program to help achieve greater tree canopy cover, especially in neighborhoods with the least existing tree canopy cover or greatest heat index.

The City should consider intensifying its existing tree planting program, and expanding it to include strategies and incentives for trees on private property.

- *Waiving existing fees for tree planting*
- *Intensifying training and outreach to residents and property owners about new tree care and maintenance*
- *Increasing financial and personnel resources to carry out a more robust tree planting program.*

- c. Develop implementation plan and timeline for increasing vegetative cover to 35% in all neighborhoods.

The implementation plan should focus on those neighborhoods that have less than 35% vegetative cover, and should allow them to achieve 35% vegetative cover in a given timeframe. The plan should include actions for both private and public property.

- *Identify possible locations for trees, what species of trees would be appropriate, how long it will take for the trees to mature and how much additional canopy cover they could provide once mature.*
- *Account for new planting mortality, and loss of existing canopy due to age, disease, natural disaster.*
- *Develop design specifications for landscaping that increase tree canopy, improve tree survival/health, and decrease use of hardscaping*

→ *Consider use of pervious surfaces around tree wells to improve water and air flow to trees*

2. Develop additional UHI reduction programs and policies.

These policies and programs should focus on neighborhoods with higher heat index and lower percent of vegetated cover.

a. Municipal Projects

- *Provide an update in response to October 19, 2009 Council Order 0-13 regarding opportunities for putting white roofs on municipal buildings*
- *Adopt municipal policies that will increase the use of strategies to reduce UHI in municipal projects.*
- *Develop new design specifications for use of cool/reflective surfaces in buildings, roofs, roadways, walkways, and parking lots.*
- *Develop plans to retrofit the public right of way and municipal properties to reduce UHI effect.*

b. New Developments – Residential and Commercial

- *Develop a citywide cool roof ordinance with standards for reflective roofs on new buildings.*
- *Develop other UHI reduction guidelines for buildings, roofs, roadways, walkways, and parking lots in new development that can become policy/be included in zoning.*
- *Consider appropriate incentives for UHI reduction strategies in new development.*

c. Existing Developments – Residential and Commercial

- *Develop a citywide cool roof ordinance with standards for reflective roofs that can be implemented at the time of roof replacement.*
- *Identify other leverage points at which the City can promote UHI reduction strategies for buildings, roofs, roadways, walkways, and parking lots in existing development.*
- *Provide appropriate incentives for UHI reduction strategies in existing buildings.*

3. Evaluate program progress

The amount of urban tree canopy and vegetative cover should be tracked over time, using a consistent methodology. The City should also track the number of buildings with cool/reflective surfaces and monitor the extent of UHI effect over time, taking climate change into account.

4. Develop UHI webpage

The UHI webpage should provide the following;

- a. *An overview of UHI*
- b. *A description of the factors that influence UHI in Cambridge*
- c. *Opportunities and resources for reducing UHI*
- d. *Case studies on existing strategies to reduce UHI*
- e. *Economic and environmental benefits*

5. Support and conduct pilot projects and research on UHI mitigation

The City should:

- a. *Work with MIT Sustainable Design Lab on Comfort in Motion modeling*
- a. *Assess and compare the effect of different mitigation strategies*
- b. *Work with the Harvard Graduate School of Design on UHI research and design strategies*
- c. *Assess the feasibility and effectiveness of green walls in reducing UHI effect and impacts on building energy performance*
- d. *Develop an understanding of the storm water management and other co-benefits*

6. Coordination

The City should coordinate the integration of UHI mitigation efforts with other related initiatives in the City. This includes but is not limited to the following;

- a. *The climate change preparedness and resilience plan*
- b. *The Sustainability Compact*
- c. *The Kendall Square EcoDistrict*
- d. *The forthcoming citywide master plan*
- e. *Storm water management policies*