Heat Island Assessment

Perform a heat island assessment.

WHAT IS IT?

The “heat island effect” describes the conditions that cause urban areas to have a higher average temperature than nearby rural areas. Elements of cities’ built environments contribute to the heat island effect, including “heat-absorptive surfaces (such as dark pavement and roofing), heat-generating activities (such as engines and generators), and the absence of vegetation (which provides evaporative cooling).” During sunny summer days, roof and pavement surface temperatures can be 50-90°F higher than air temperatures, compared to moist or shaded surfaces that remain closer to existing air temperatures.

As a result of higher temperatures, urban electricity use increases, causing increased greenhouse gas emissions as well as air quality concerns along with public health risks due to extreme heat. Starting from a temperature range of 68-77°F, electricity demands for cooling increase by 1.5–2.0% for every 1°F in air temperature. Extreme heat days increase the overall electricity demand as well as peak demand. This can increase the use of fossil fuels to meet this high demand and can overload systems, requiring controlled brownouts or blackouts. The primary pollutants related to fossil fuel use in power plants include: ozone, sulfur dioxide, nitrogen oxides, particulate matter, carbon monoxide, and mercury.

Heat islands can exacerbate the impact of natural heat waves, which put children, the elderly, and chronically ill populations at risk. Extreme heat events, which include abrupt or dramatic temperature increases, can cause premature death. From the period of 1999-2010, approximately 8,081 premature deaths due to excessive heat exposure in the United States.

In 2014, a Climate Central study of the 60 largest cities found that 57 cities experienced the urban heat island effect. The highest single-day temperature difference in urban versus rural areas was 27°F, averaging a maximum single-day temperature difference of 17.5°F. On average, summer temperatures are an average of 2.4°F warmer in urban areas compared to nearby rural areas. Of the 60 cities studied, Columbus ranked #8 on the list of cities with the most intense summer urban heat islands. During the summer, Columbus is an average of 4.4°F hotter than rural areas and has 16 more days above 90°F compared to rural areas. In Cincinnati, summer temperatures average 0.9°F higher than compared to nearby rural areas, reaching up to 17°F higher.

WHY IS IT IMPORTANT?

- Starting from a temperature range of 68-77°F, electricity demands for cooling increase by 1.5–2.0% for every 1°F in air temperature.
- The urban heat island effect can increase the peak demand on the electricity grid, increasing the use of power generated from fossil fuels.
- Higher surface temperatures can increase the rate of ground-level ozone formation, which occurs when NOx and volatile organic compounds react due to sunlight and hot weather.
- Heat is the number one weather-related cause of death in the United States, resulting in an average of 130 deaths per year. From the period of 1999-2010, approximately 8,081 premature deaths due to excessive heat exposure in the United States.

BENEFITS

Reducing greenhouse gas emissions

Reducing air pollution correlated with fossil fuel use for electricity generation

Decrease number of heat-related premature deaths

HOW CAN COMMUNITIES IMPLEMENT THIS POLICY?

Cities can utilize best practices recommended by the EPA to optimize their design of any planned study and set objectives at the start to best serve the goals prior to data collection.

- **Define and clarify the objectives of the study.** Prior to starting a heat island assessment, the City should clarify the information it would like to collect and analyze. By setting these objectives initially, the City can select the most effective techniques and set the tone for how the data will be used moving forward. Typically, the main objectives for heat island assessments are:
  - **Understanding energy impacts:** Identify "hot spots" within the city and assess energy demand
  - **Understanding public health risks:** Analyze how heat islands exacerbate air quality, extreme heat events, and other public health risks
  - **Understanding equity issues:** Assess impacts of heat islands and air quality on vulnerable communities
- **Define the geographic area and temporal boundaries of the study.** Urban heat islands will increase in intensity based on the quality of the built environment and the time of day or season. Cities should set the geographic and temporal parameters of the study based on the city's challenges, expanding the geographic barrier to understand differences in air temperatures across locations and demonstrating the changes in temperature intensity during the warmest seasons.
- **Prioritize the types of data to be collected.** There are three main types of data sets collected through a heat island assessment: air temperature, surface temperature, and seasonal and daily temperature patterns. For each type of data set, the EPA has recommended considerations:
  - **Air temperature:** In the context of heat island assessments, air temperatures are taken within the urban canopy, extending from ground level to the tops of buildings. Cities should identify existing data assets and monitors to assess where there are information gaps. For data collection, the City should choose a reasonable number of collection sites to avoid bias and establish a consistent protocol. Air temperature can be monitored by weather stations, fixed monitoring instruments, or mobile traverses, such as cars with sensors.
  - **Surface temperature:** Surface temperature describes the heat energy from surfaces, including pavements, buildings, and other city surfaces. Surface temperatures can be measured via satellites, aircraft-borne instruments, and ground-based thermal sensing. These techniques can provide temperature differences at fine scales.
  - **Seasonal and daily temperature patterns:** These patterns describe an additional element of the data collection. By tracking changes in seasonal and daily temperature, cities can proactively plan for changes in energy demand or public health response.

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