

Trees and Energy Conservation

Summary

CITYgreen's energy conservation analysis utilizes methods developed by Jill Mahon of AMERICAN FORESTS, interpolated from research by Dr. Greg McPherson of the USDA Forest Service. The program estimates the energy conservation benefits of trees resulting from direct shading of one- and two-story residential buildings.

Trees are most effective when located to shade air conditioners, windows, or walls and when located on the side of the home receiving the most solar exposure (in addition to other criteria). In many parts of the country the west side is most valuable, followed by the east and south, although this ranking can change based on geographical considerations.

CITYgreen assigns each tree an energy rating, 1 through 5, based on location characteristics listed above and information about tree size and shape. For many parts of the country, for instance, a large tree located near the west side of a building and shading an air conditioner or window would be assigned a near-maximum energy rating.

Each tree then is assumed to reduce a home's annual energy bill by a percentage associated with each energy rank, which varies based on the climate being studied. For instance a tree with an energy ranking of 3 in one city might be assumed to reduce an air conditioning bill by 1.2%, but in a more northern city a tree with an energy ranking might be assumed to reduce the bill by only 1%. The percentage savings produced by each tree around a home are multiplied by a home's average annual energy use for air conditioning (input by the user). CITYgreen adds the results together to produce the savings per home, which are in turn summed to estimate savings per site.

Technical Methodology

The program assigns an energy rating (0 = No Savings.....5 = Maximum Savings) to each tree that has been field-verified and inventoried based on the following criteria:

- * Distance from residential building structure
- * Orientation relative to the building
- * Ability to shade a window and/or air conditioner

CITYgreen incorporates research from 11 cities distributed across the United States. Users are asked to identify their region of the U. S.; the program uses data from the nearest of those cities. If data is available from more than one city within that region, the user is asked to identify which is closest to the project location.

Research from the following cities was used: Washington, DC; Tucson, Arizona; Atlanta, Georgia; Denver, Colorado; Boston, Massachusetts; Portland, Oregon; Los Angeles, California; Minneapolis, Minnesota; Dallas, Texas; Chicago, Illinois and Miami, Florida.

The user is prompted to enter the cooling cost associated with running an air conditioner during the summer. This information can be obtained from a local utility company or from the U.S. Department of Energy. Multipliers associated with each energy rating (representing % energy use-reduction) are assigned to each tree. Each home's annual energy use is multiplied by each associated tree's multiplier to produce an estimate of dollar and kilowatt hour savings per household.

Multipliers used in CITYgreen were interpolated from "Modeling Benefits and Costs of Community Tree-Planting in 12 U.S. Cities" and "Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project." Dr. McPherson's research includes savings associated with one- and two-story homes assumed to be roughly 1,500 square feet in size. The program uses an average of the two values for both one- and two story homes, and hence applies to both.

Estimated savings from a 20-year-old, 25-foot-high tree in each region were used as the maximum multiplier. The program disregards any trees located more than 35 feet from a home, under the assumption that they are too far from the home to provide significant shade. Dr. McPherson's research has found that a second tree located in an optimal location provides about 2/3 as much savings as the first. Therefore, when more than one tree is assigned a rating of 5 for a given home, only one tree is assumed to provide the full benefits; the rest are assumed to provide 2/3 of the equivalent of a number 5 energy rating.

References:

1. McPherson, E. Gregory, Nowak, David J and Rowan A. Rowntree, eds. 1994. "Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project." Gen. Tech. Rep. NE-186. Radnor, PA: USDA Forest Service, Northeastern Forest Experiment Station.
2. McPherson, Greg, Sacamano, Paul and Steve Wensman. 1993. "Modeling Benefits and Costs of Community Tree-Planting in 12 U.S. Cities." USDA Forest Service.