Shade Trees & Building Energy Conservation: Right Tree, Right Place

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Mid-Atlantic Horticulture Short Course

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Virginia Beach, VA

VirginiaTech
College of Natural Resources and Environment

Virginia Cooperative Extension
Virginia Tech • Virginia State University

Presentation Overview

- Why tree shade and energy conservation matter
- How trees cool cities and cool buildings
- Tree selection and placement for optimal energy conservation
- Information and tools to use trees effectively for energy conservation

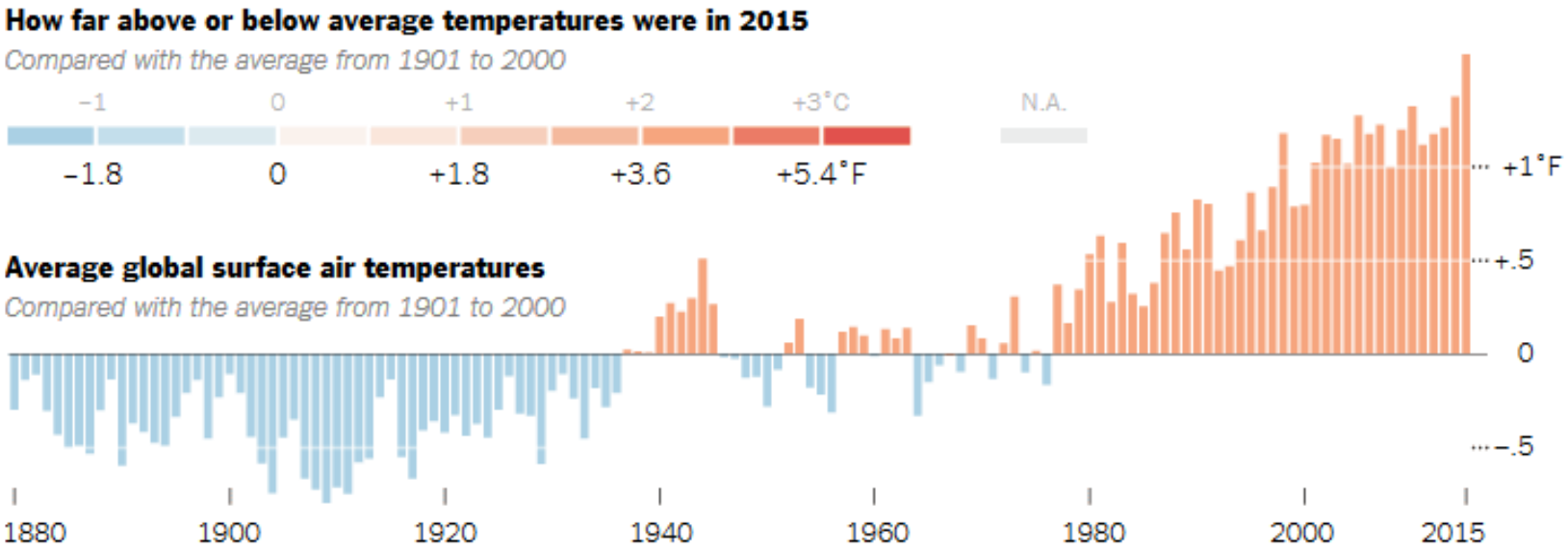
Why trees for energy conservation?

- **Macro Scale: Global Climate Change**

The New York Times

2015 Was Hottest Year in Historical Record, Scientists Say

By JUSTIN GILLIS JAN. 20, 2016



Source: NASA Goddard Institute for Space Studies

By The New York Times

Why trees for energy conservation?

- **Macro Scale: Global Climate Change**

Jad Daley Become a fan
Director, Climate Conservation program at The Trust for Public Land

HUFF POST GREEN

Trees: Helping Cities Solve Climate Change

Posted: 01/12/2016 5:04 pm EST | Updated: 01/13/2016 10:59 am EST

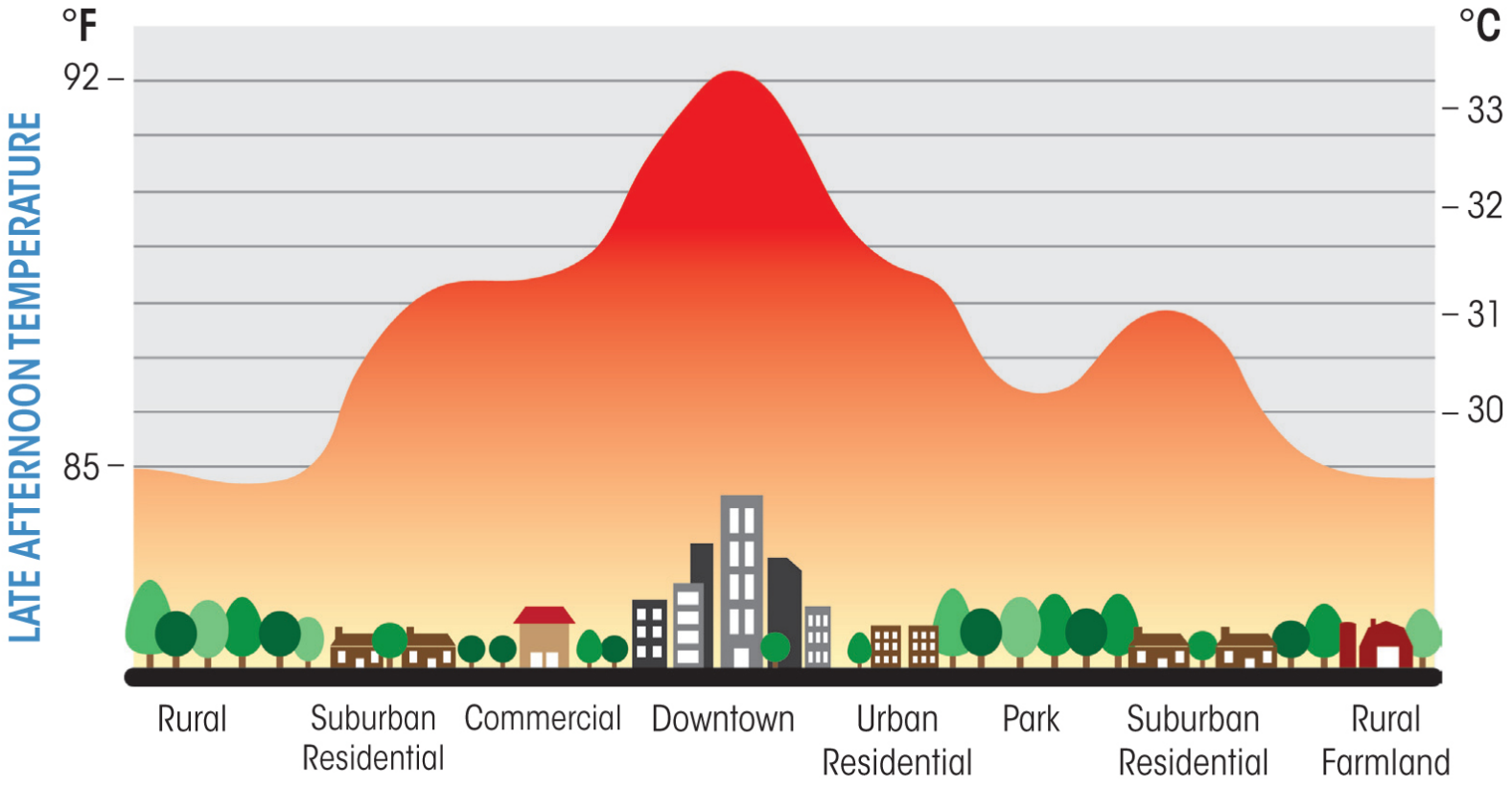
Quick, name a climate solution for cities which helps lower carbon emissions, protects vulnerable people who live there, and even helps students get better grades.

Give up? The answer is urban forests and you're not alone if you didn't come up with the answer. After all, most of us see the trees woven into our city streets and parks as just a pretty, cinematic backdrop for urban life. Nice to look at, certainly, but not profoundly important when compared to better mass transit and other steps cities can take to help fight climate change.

The strong recognition in the final Paris climate agreement or trees and forests of every kind, from cities to wilderness, is starting to change this perception.

Why trees for energy conservation?

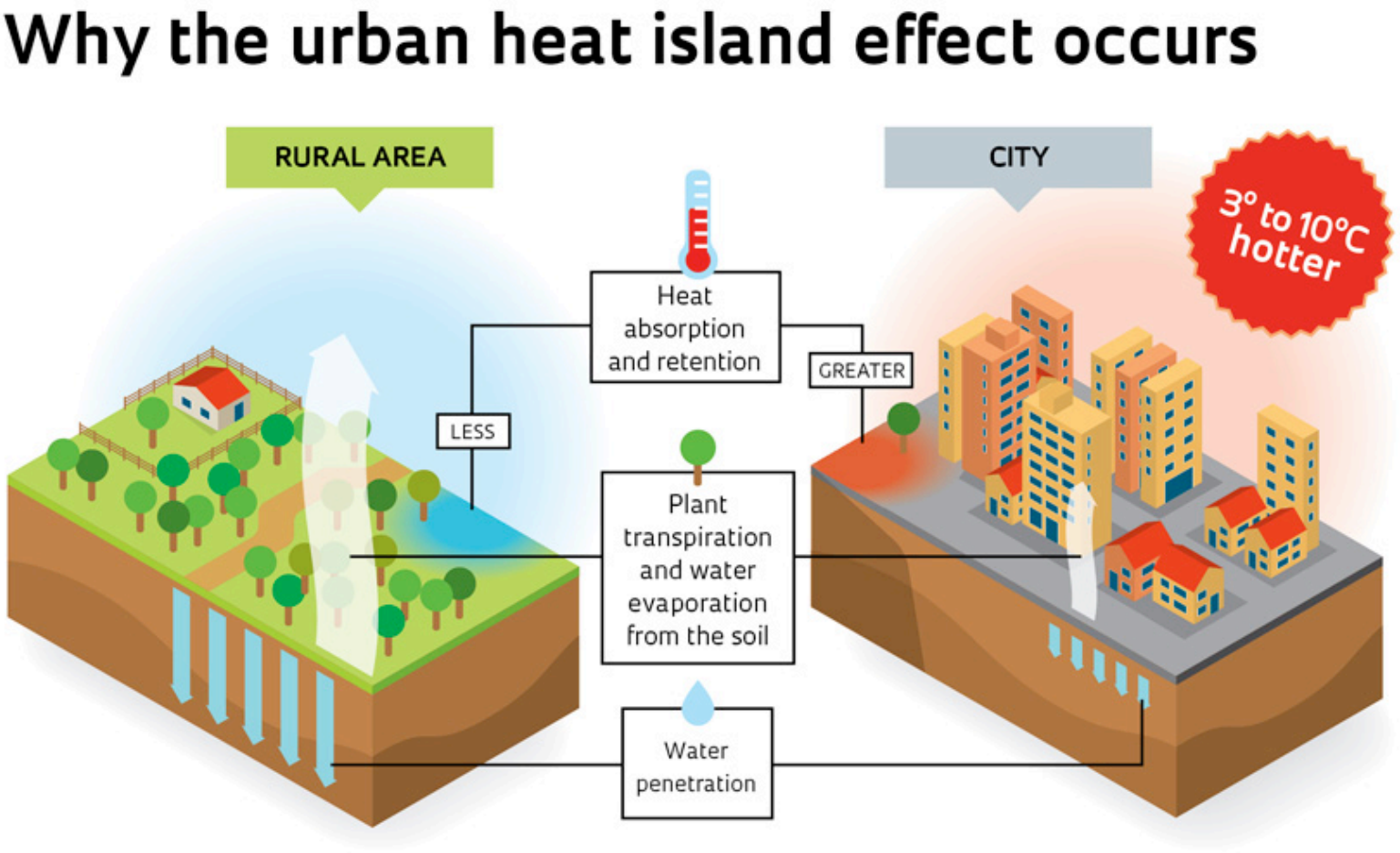
- **Meso Scale: Urban Heat Island**



http://www.cleanairpartnership.org/files/urbanheatisland.jpg

Why trees for energy conservation?

- **Meso Scale: Urban Heat Island**



http://revistapesquisa.fapesp.br/en/2013/01/24/a-heat-island-in-the-amazon/

Why trees for energy conservation?

- **Meso Scale: Energy Security and Reliability**

http://blog.delawareconsulting.com/delawareblog/author/fleurents

Why trees for energy conservation?

- **Meso Scale: Public Health**

Why trees for energy conservation?

- **Micro Scale: Home Energy Bill**

Home Cooling

6%

The percentage of the average household's energy use that goes to space cooling.

2/3 of all U.S. homes have air conditioners.

$11B

The amount it costs homeowners every year to power their air conditioners.

#DidYouKnow:

You can reduce air conditioning energy use by 20-50 percent by switching to **high-efficiency air conditioners** and taking other actions to lower your home cooling costs.

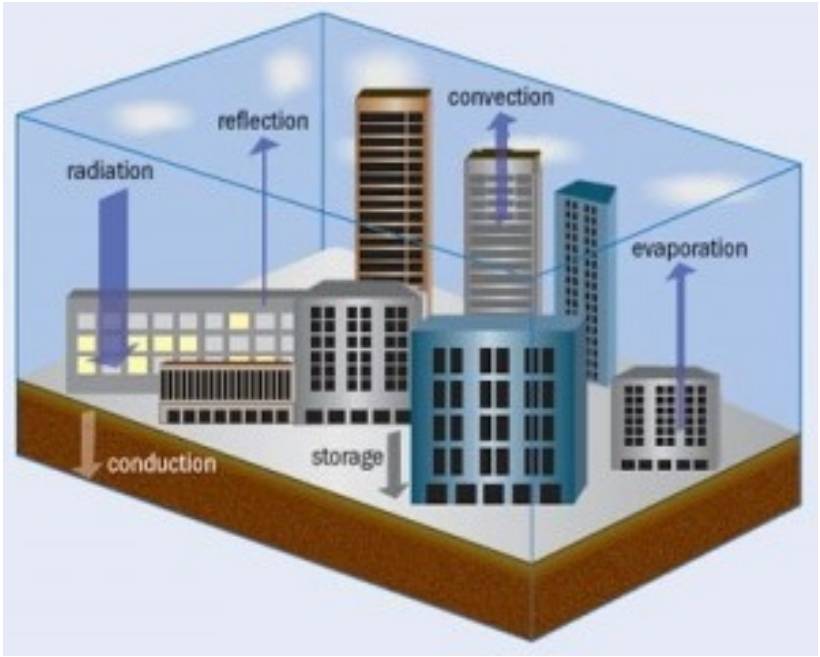
ENERGY-SAVING TIP:

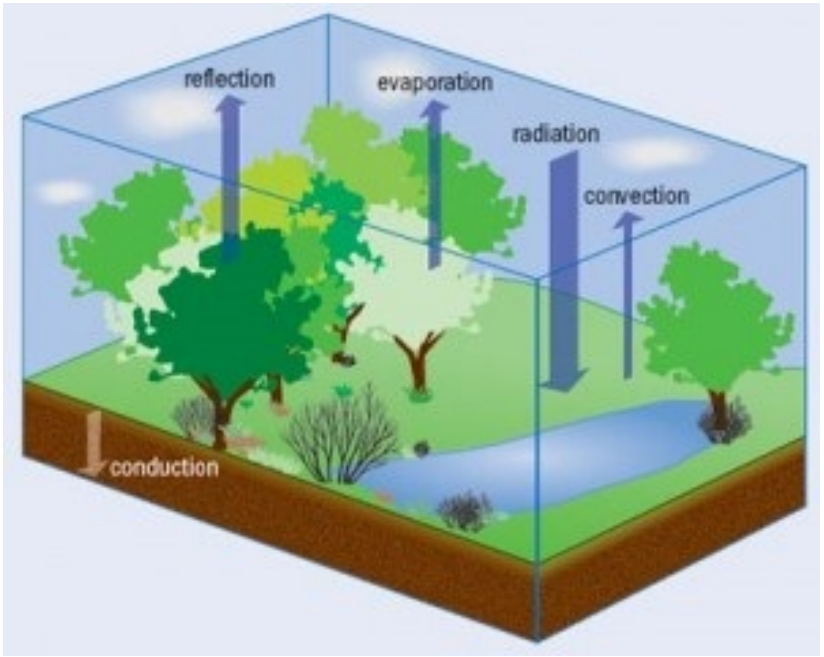
The quickest way to save energy on home cooling is to regularly clean and replace your cooling unit's filters.

ENERGY.GOV

How do trees conserve energy?

Evapotranspiration + Shade + Albedo





http://greensulate.com/benefits/save-energy/

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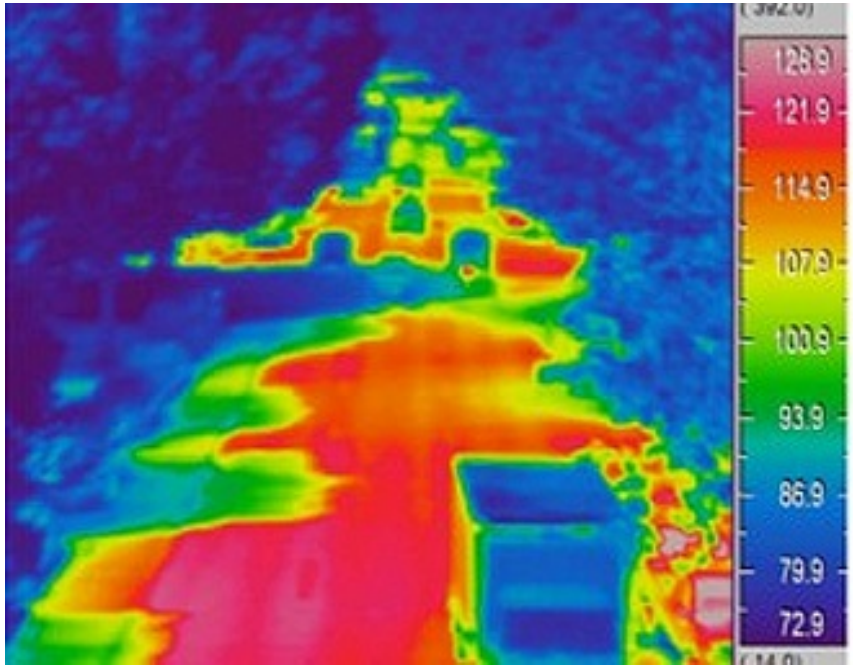
Evapotranspiration + Shade + Albedo



http://treelogic.com.au/facts/choosing-the-right-tree/

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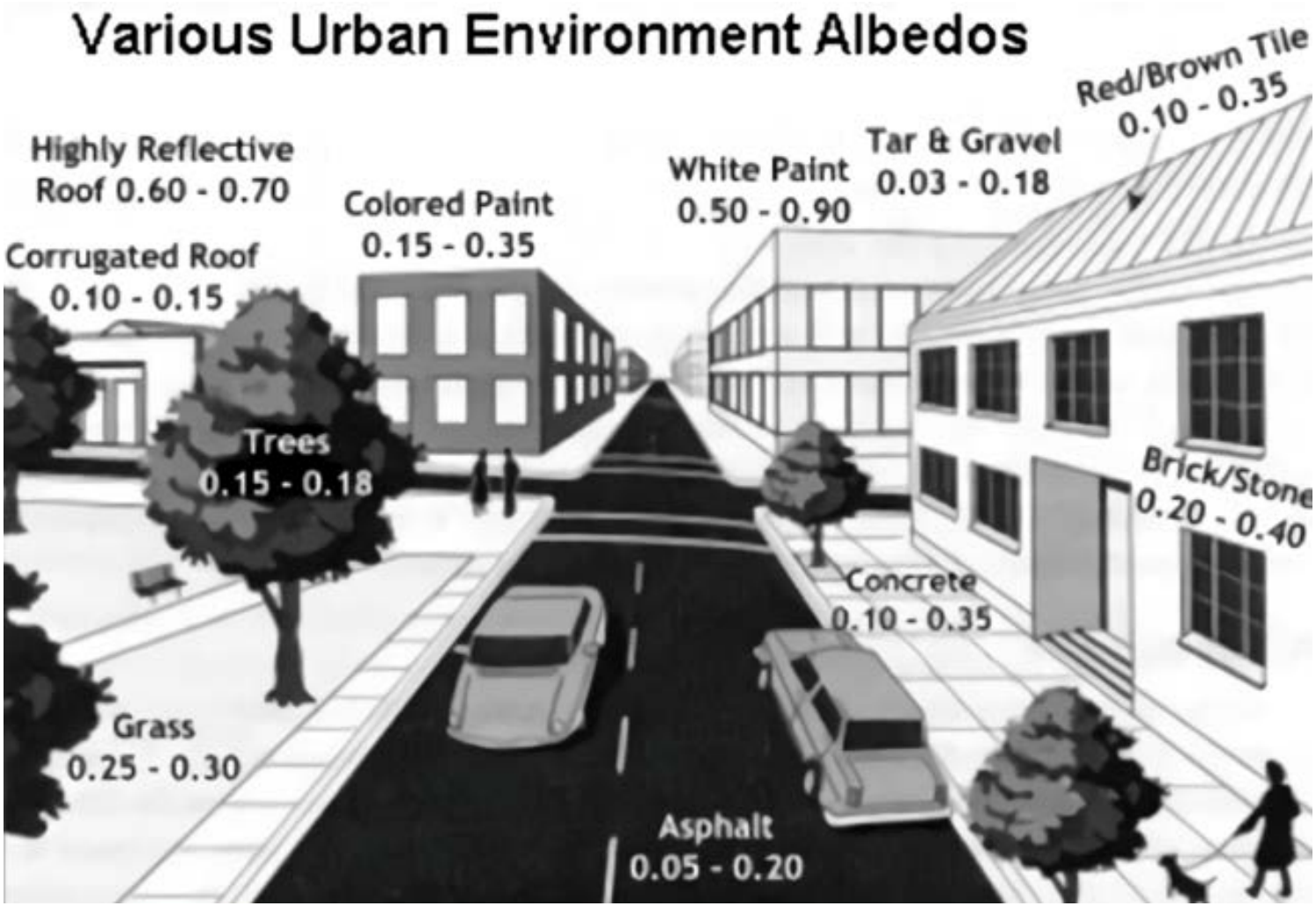

http://weather.msfc.nasa.gov/urban/urban_heat_island.html

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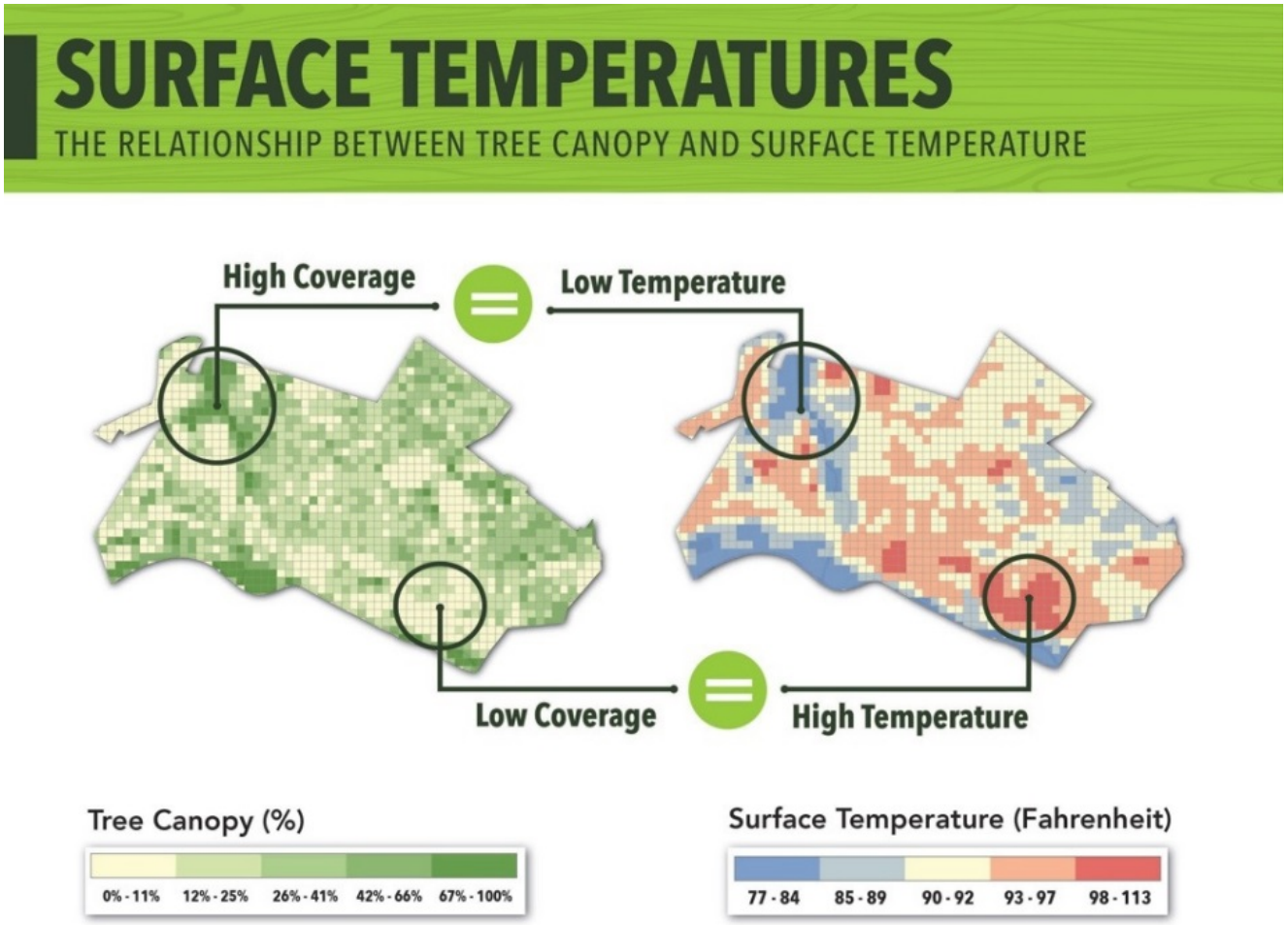


Analysis and image courtesy of J. O'Neil-Dunne. This Urban Heat Island assessment shows a high correlation between tree canopy cover and surface temperatures in the study area.

https://peopleandtreesincities.wordpress.com/tag/usfs/

How do trees conserve energy?

Science on Energy Savings

Energy Efficiency

- Just three strategically placed trees can decrease utility bills by 50%. [91]
- The net cooling effect of a healthy tree is equivalent to 10 room-size air conditioners operating 20 hours a day. [15]
- Evergreens serve as windbreaks and in the winter save 10-50% on heating costs. [85]
- A 20-percent tree canopy over a house results in annual cooling savings of 8 to 18% and annual heating savings of 2 to 8%. [13]
- Properly placed trees can reduce cooling costs by 30 percent. Shading an air conditioning unit can increase its efficiency by 10 percent.[68]

Benefits of Trees and Urban Forests: A Research List

- A 25-foot tree reduces annual heating and cooling costs of a typical residence by 8 to 12 %. [15]
- Trees on the west and south sides of houses can reduce summertime electricity use by 185 kWh or 5.2%. [84]

http://actrees.org/files/Research/benefits_of_trees.pdf

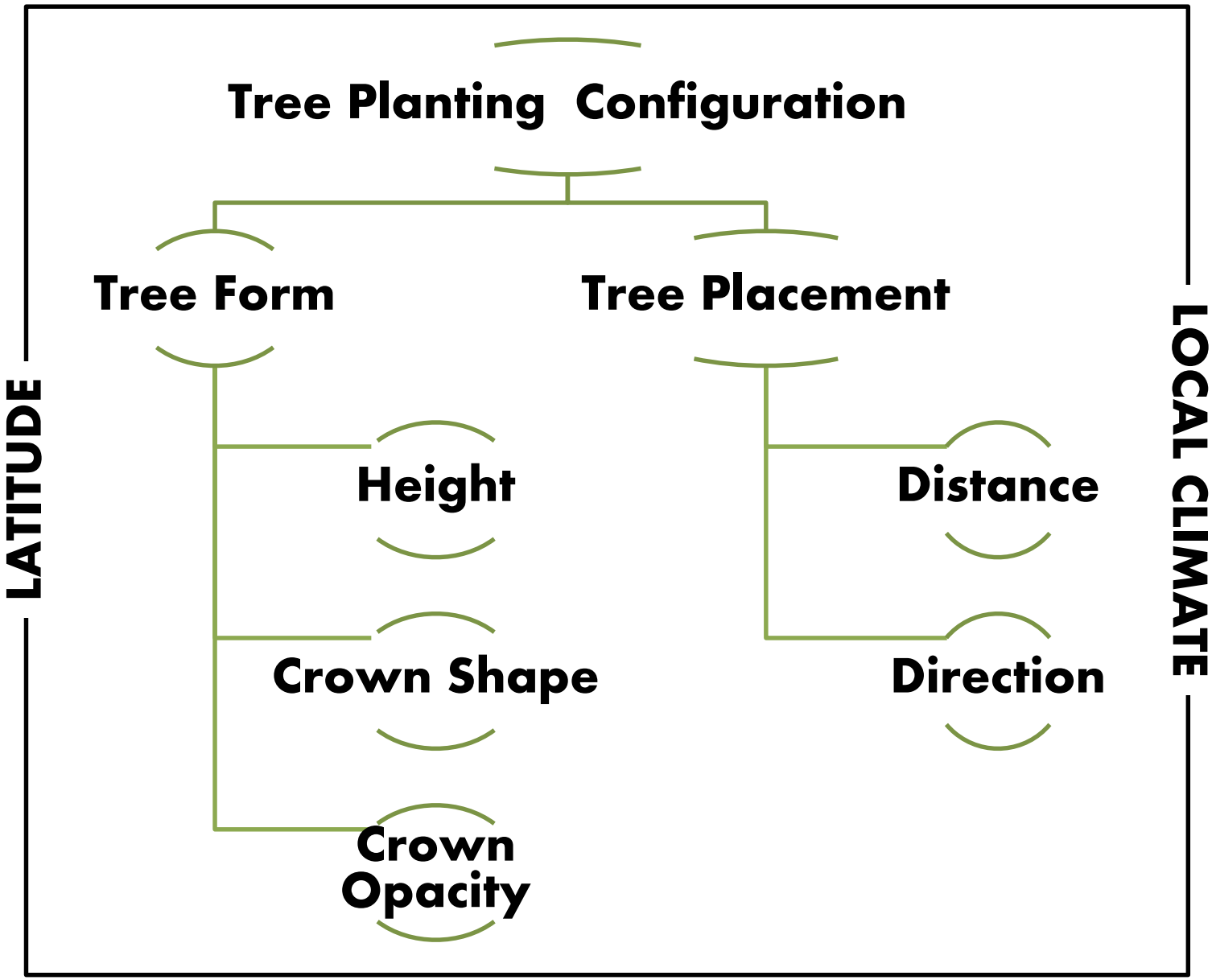
Right Tree, Right Place

GOAL:

MAXIMIZE COOLING SEASON SHADE

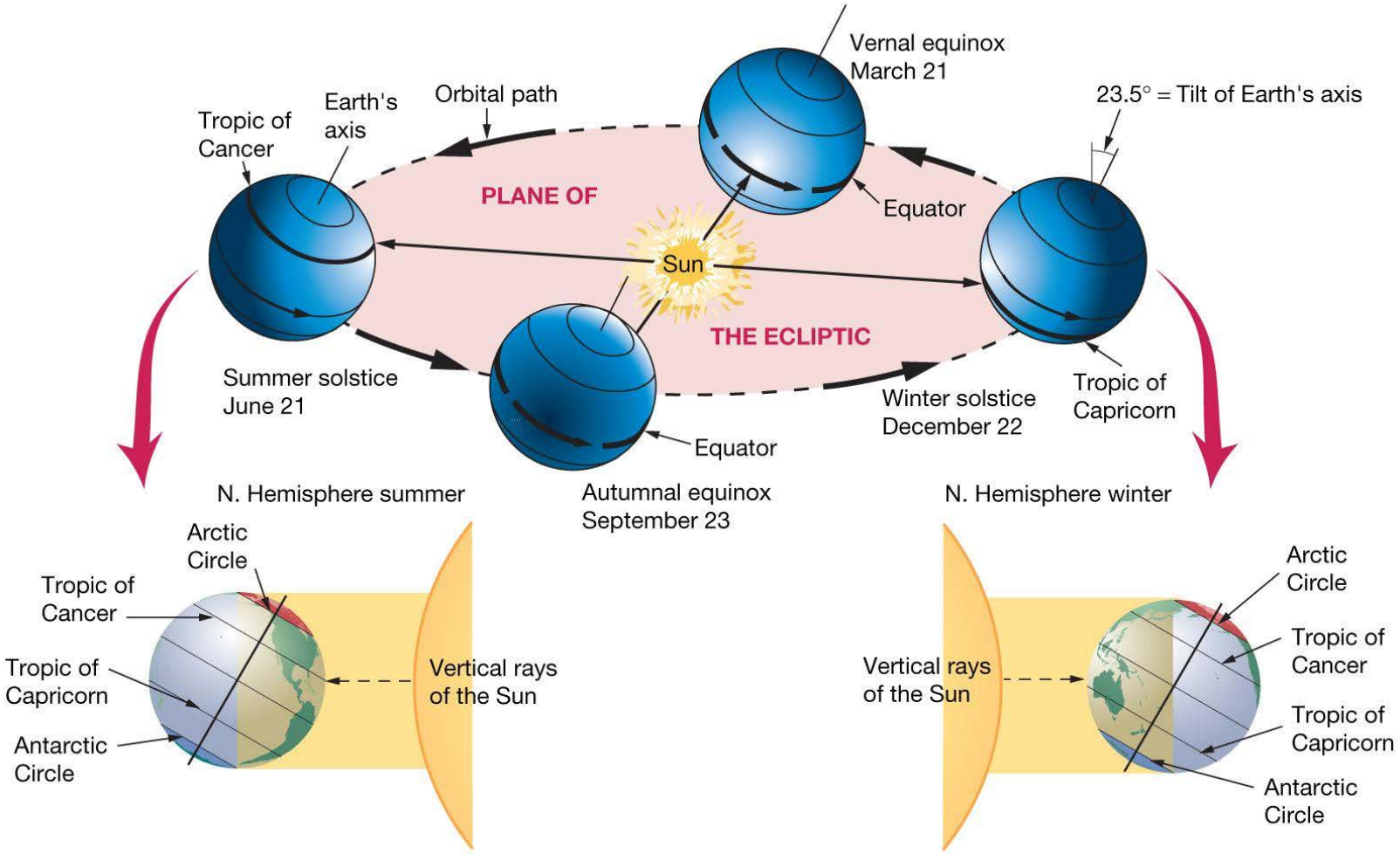
MINIMIZE HEATING SEASON SHADE

Right Tree, Right Place



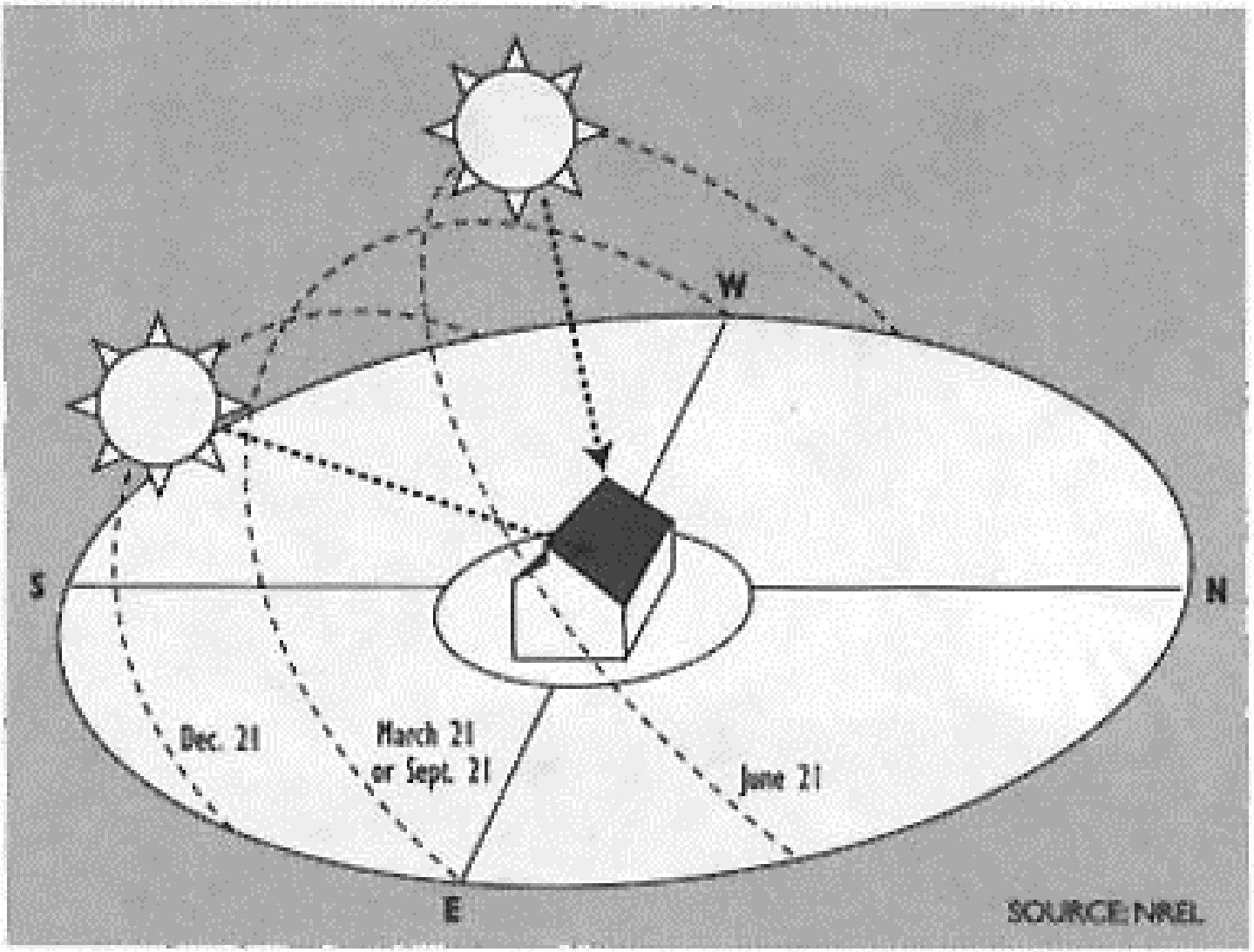
Right Tree, Right Place

Latitude and Seasonality



Right Tree, Right Place

Seasonal Sun Position



http://www.homeenergy.org/show/article/nav/remodeling/id/1298

Right Tree, Right Place

Seasonal Sun Position

https://www.arborday.org/trees/climatechange/summershade.cfm

Right Tree, Right Place

Seasonal Sun Position

https://www.arborday.org/trees/climatechange/winterwarmth.cfm

Right Tree, Right Place

Tree Height and Crown Conformation

http://energy.gov/energysaver/tips-landscaping

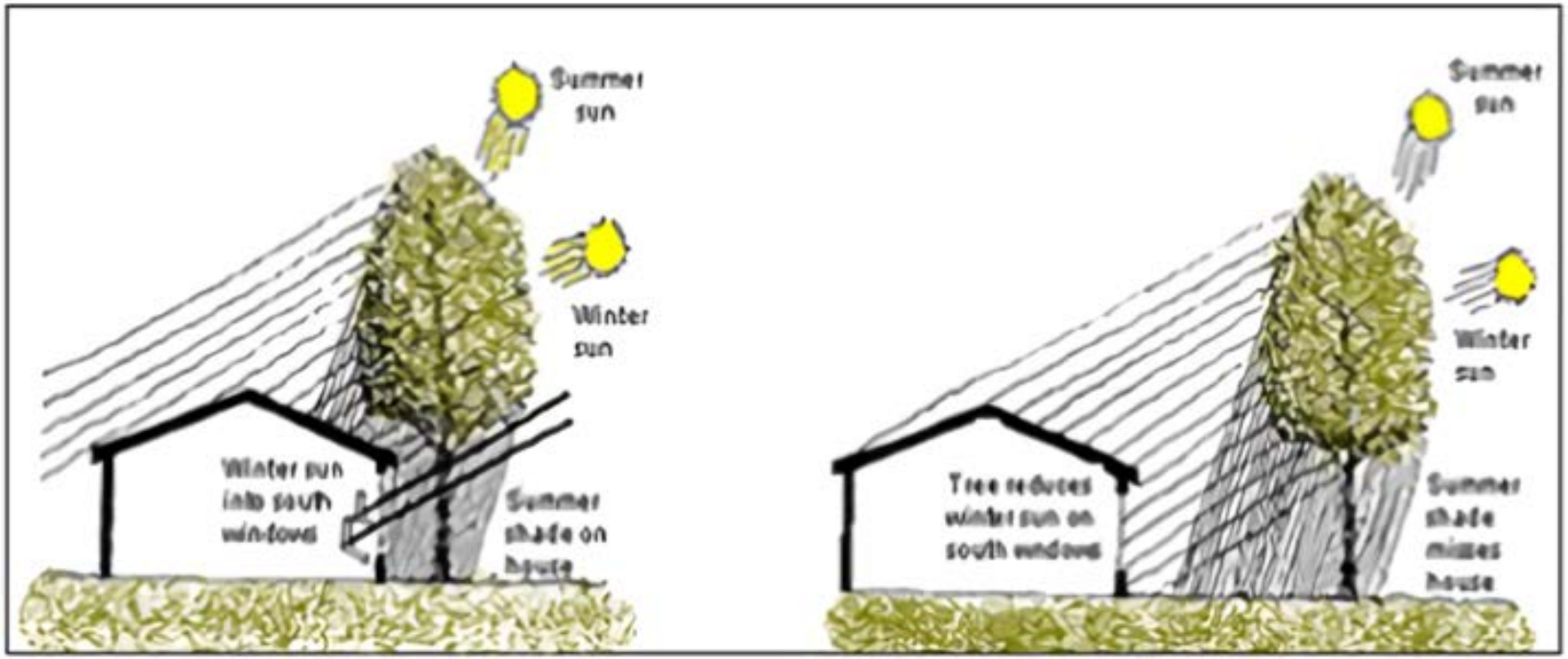
Right Tree, Right Place

Tree Height and Crown Conformation

http://www.greenandpractical.com/Passive%20Cooling.htm

Right Tree, Right Place

Tree Distance



http://www.binghamton.edu/environmental-studies/urban-forestry/environmental-values.html

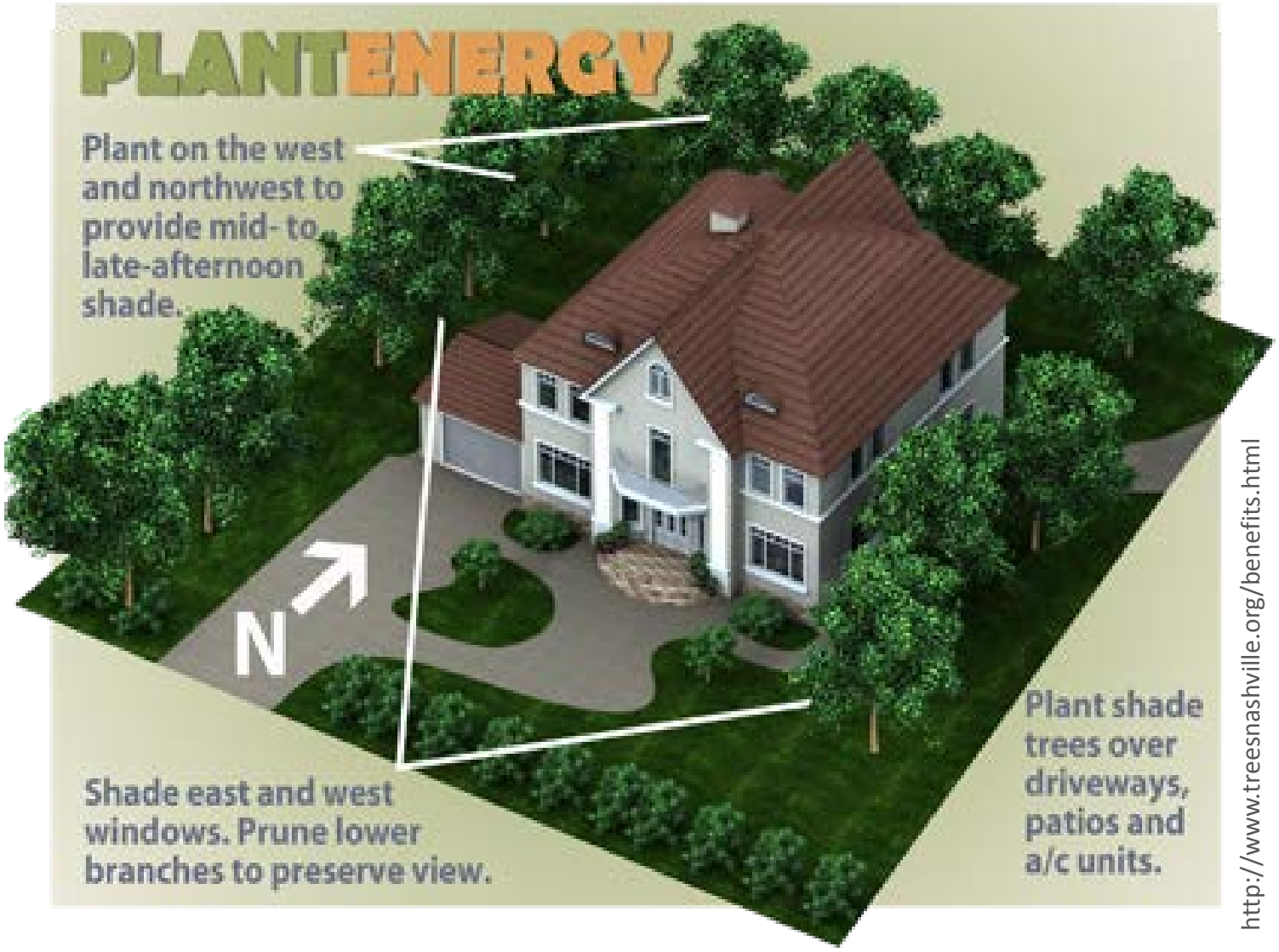
Right Tree, Right Place

Tree Distance

http://www.treesnashville.org/benefits.html

Right Tree, Right Place

Tree Direction



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Right Tree, Right Place

Resources

ENERGY.GOV
Energy Saver

SERVICES | HEAT & COOL | WEATHERIZE | DESIGN | ELECTRICITY & FUEL | ABOUT

Home » Design » Landscaping » Landscaping for Shade

LANDSCAPING FOR SHADE

- Design for Efficiency
- Landscaping
  - Shade
  - Windbreaks
  - Water Conservation
- Types of Homes
- Windows, Doors, & Skylights

A trellis with a climbing vine can shade a home and still allow air circulation. | Photo courtesy of John Krigger, Saturn Resource.

Resources

eXtension
Issues • Innovation • Impact
A Part of the Cooperative Extension System

Home Resource Areas eXtension.org

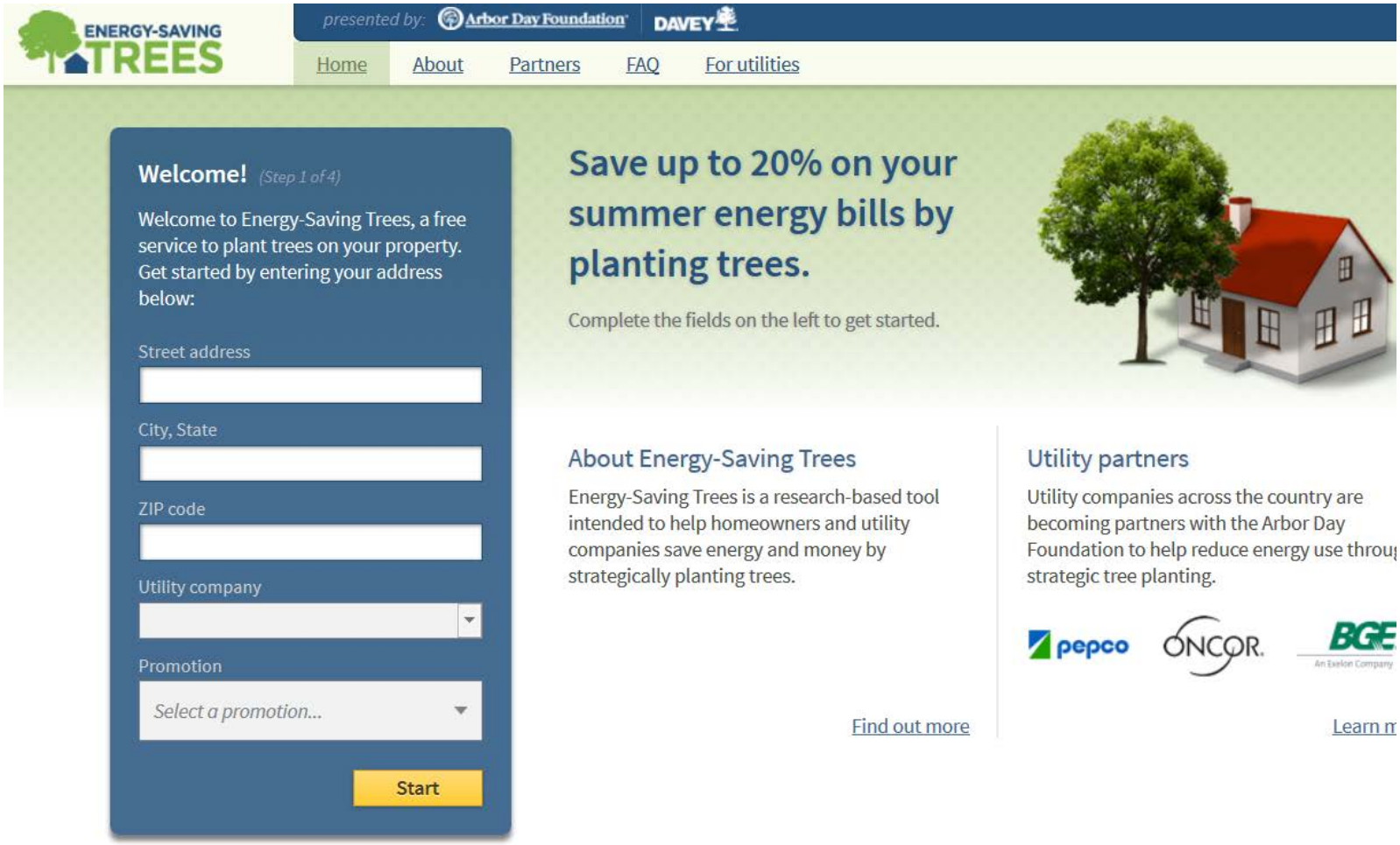
Trees for Energy Conservation

Tree Planting for Lower Power Bills

Whether it is winter or summer, trees can help you save energy at home. Shade for Savings
Did you know that only 17% shade over your house during the day...>Read More

http://articles.extension.org/trees_for_energy_conservation

Resources



http://energysavingtrees.arborday.org

Resources

i-Tree Design v6.0

35 Alexander Ct, Christiansburg, VA 24073, USA

Start Over
Save Progress
About

Get started with these easy steps:

1. Draw Structures ?
2. Place Trees ?

Describe your tree:

- Tree species: Elm, American
- Tree diameter: 4 Inches
  or circumference: 12.6
- Tree condition: Excellent
- Tree exposure to sunlight: Full sun

Tree benefit zones:

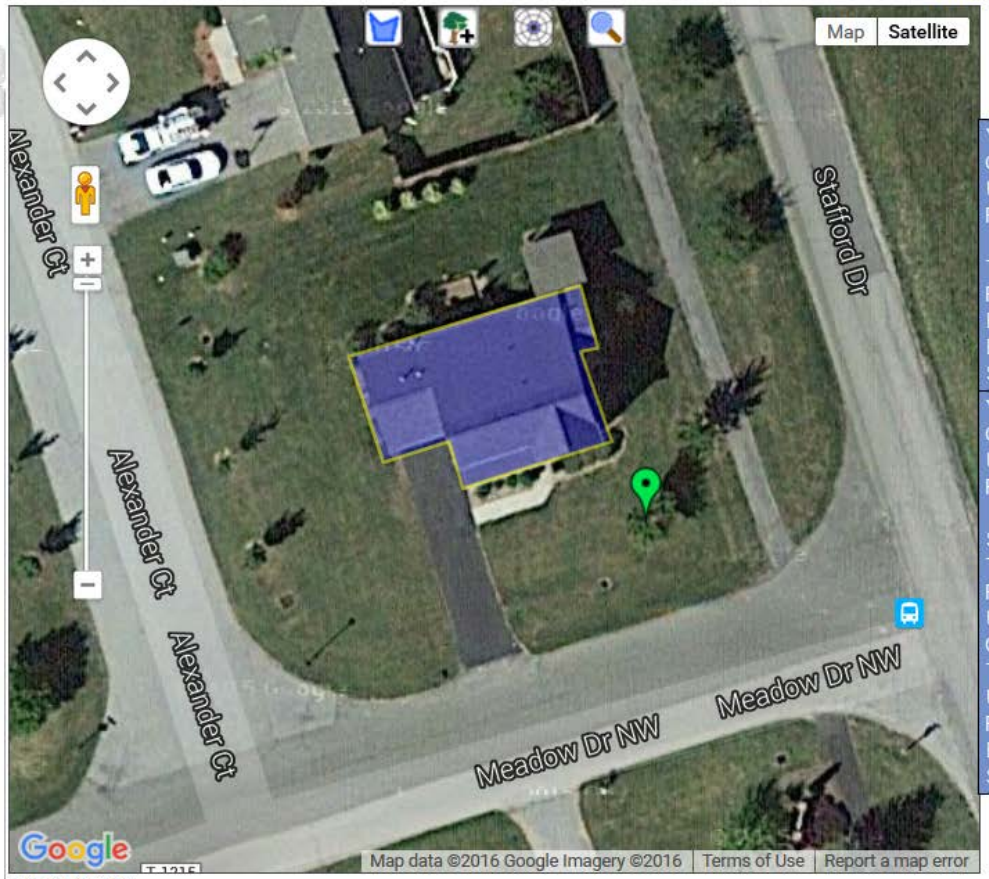
- The colored zones surrounding the structure, which appear as you describe your tree, illustrate the relative monetary value of energy savings that the tree would provide in each zone.
- Hover over each zone to see that energy benefit information displayed below the map.

To place a tree:

- Drag this icon to the location on the map where you would like to place your tree.
- Repeat to place additional trees.
- Hover over any tree you have placed on the map to display its benefits.

Model the tree(s) future crown growth over time:

Model Crown Growth



Lat: 37.16893
Lng: -80.43805

https://www.itreetools.org/design.php

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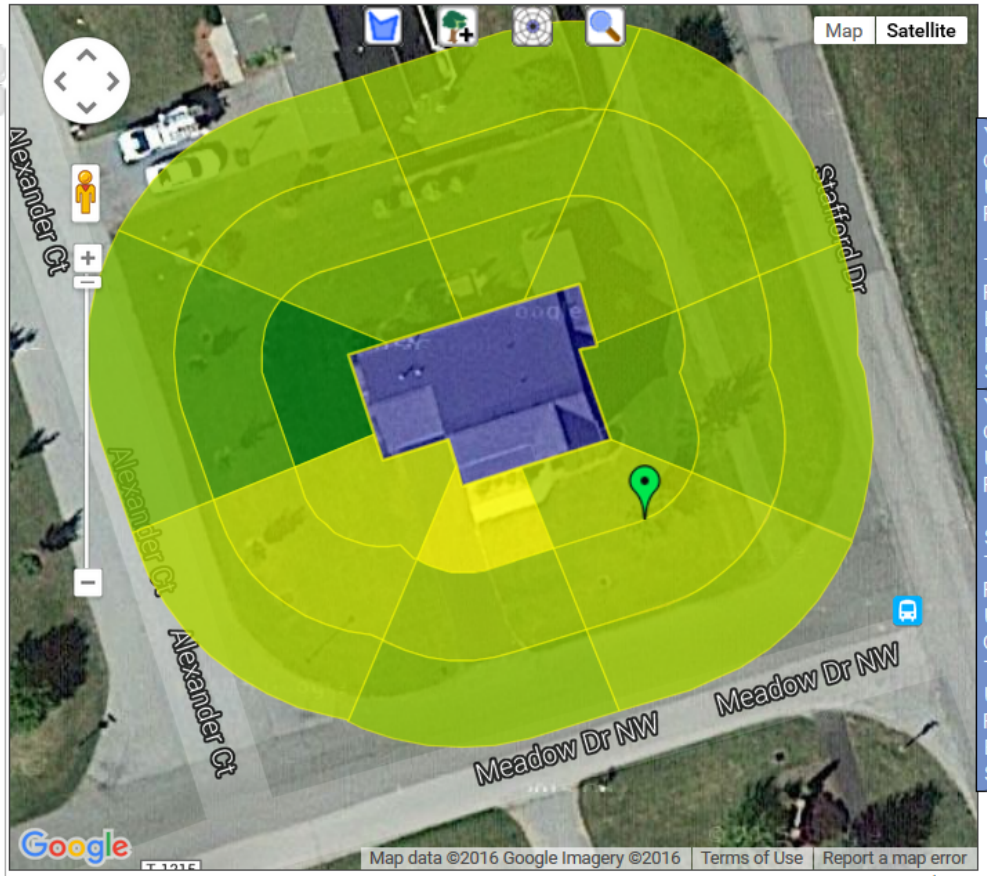

Lat: 37.16906 Bearing: 273.8 Tree: Elm, American (4 Inches) Energy Savings: $2.82
Lng: -80.43808 Distance: 15.2m (49.9ft) Total Savings: $5.94 kWh: 38.4 Therm: -1.1

Less desirable — More desirable

Preferred planting zones to maximize tree benefits are shown around the structure.

https://www.itreetools.org/design.php

Take Home

- Trees and urban forests play a key role in global climate and local energy conservation
- Start with understanding the orientation of your landscape and your local climate
- Goal is to maximize summer shade and minimize winter shade
- West is best, with a tall spreading tree close to the house

Questions and Comments

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