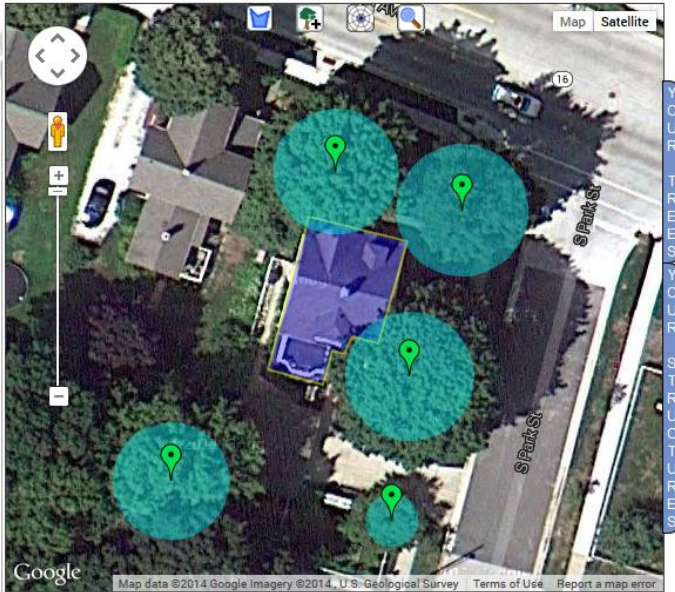


Energy Efficiency Through Landscape Design



i-Tree Design

*Al Zelaya
The Davey Institute
A division of the Davey Tree Expert Company
Chicago, IL*



i-Tree is a
Cooperative
Initiative among
these partners



Talk focus

🌳 Tree benefit-based approach

🌳 Trees and energy effects

🌳 Intro to related i-Tree Tools

i-Tree Design v6.0
1035 North Grove Avenue, Oak Park, IL 60302, USA

Get started with these easy steps:
1. Draw Structures
2. Place Trees

Describe your tree:

- Tree species: Oak, Swamp white
- Tree diameter: 13 inches or circumference: 40.8
- Tree condition: Good
- Tree exposure to sunlight: Partial 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:

YOUR TREES

26	Maple, Sugar (Good)	(17 inches or 43.2 centimeters)	Delete
27	Ginkgo (Good)	(5 inches or 12.7 centimeters)	Delete
28	Elm, American (Good)	(34 inches or 86.4 centimeters)	Delete
29	Linden, Littleleaf (Good)	(13 inches or 33 centimeters)	Delete
30	Elm, American (Good)	(35 inches or 88.9 centimeters)	Delete
31	Tree, Tulip (Good)	(15 inches or 38.1 centimeters)	Delete

Google
Lat: 41.90463
Lng: -87.79700

Crown Growth Modeler

SAMSUNG
MyTree beta

More Info About

Click or tap Calculate All or Calc to see your tree benefits.

Add Tree Calculate All

Elm, American (Ulmus americana)	Calc	✓	✗
Elm, American (Ulmus americana)	Calc	✓	✗


Clear All Start Over

Feedback

i-Tree...

“Putting USFS Urban Forest science into the hands of users”

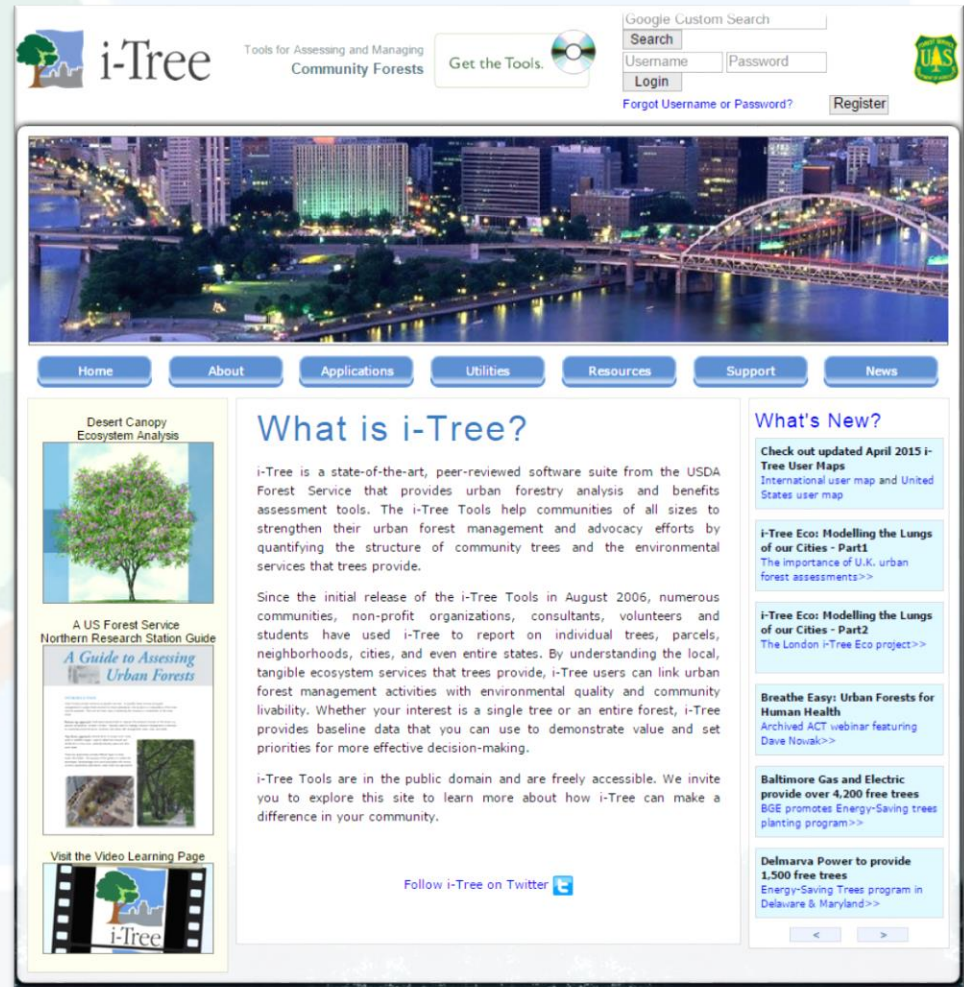
 Free public Domain Software

 Based on peer-reviewed research

 Technical support

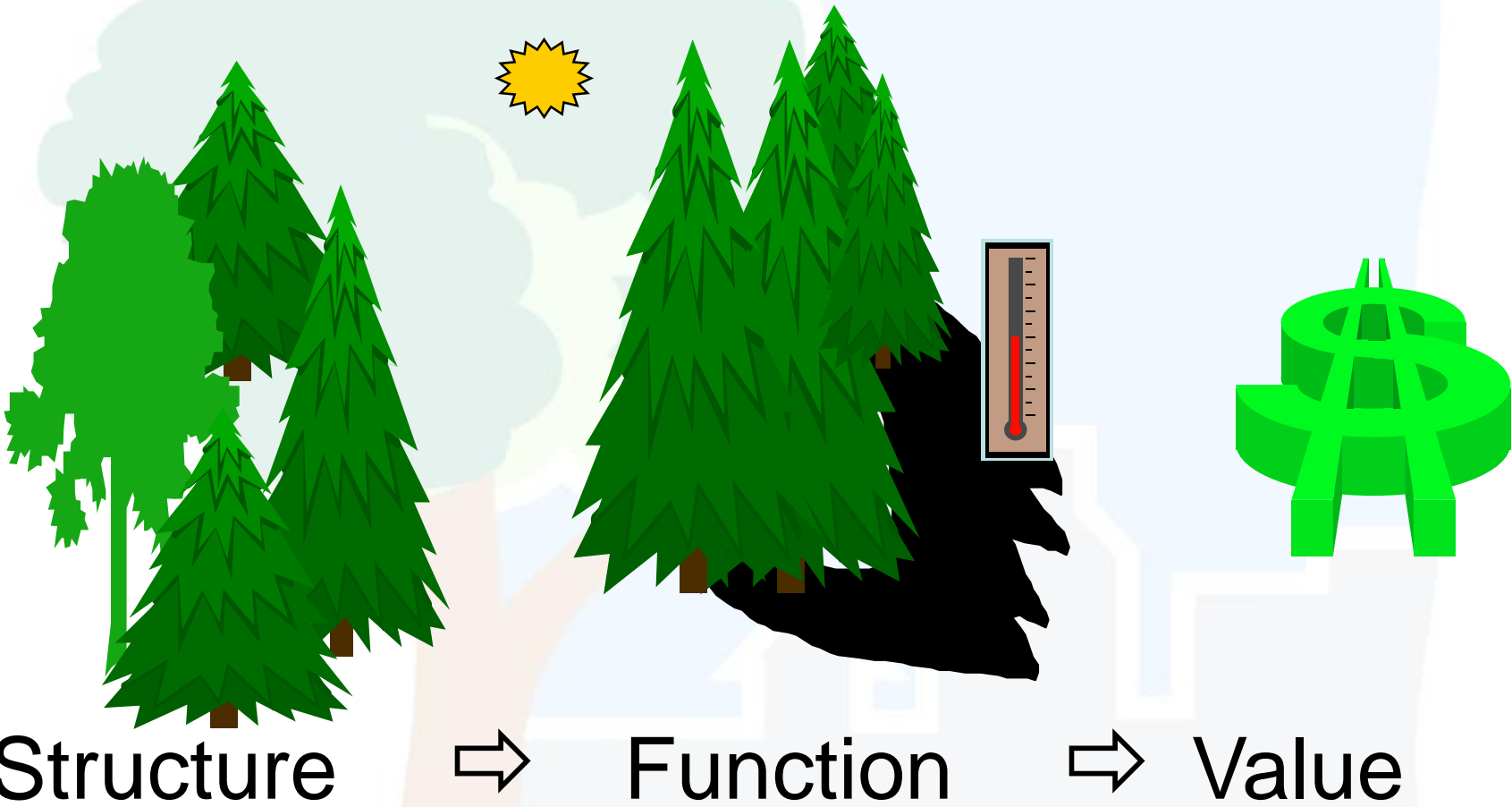
 Continuously improved

www.itreetools.org



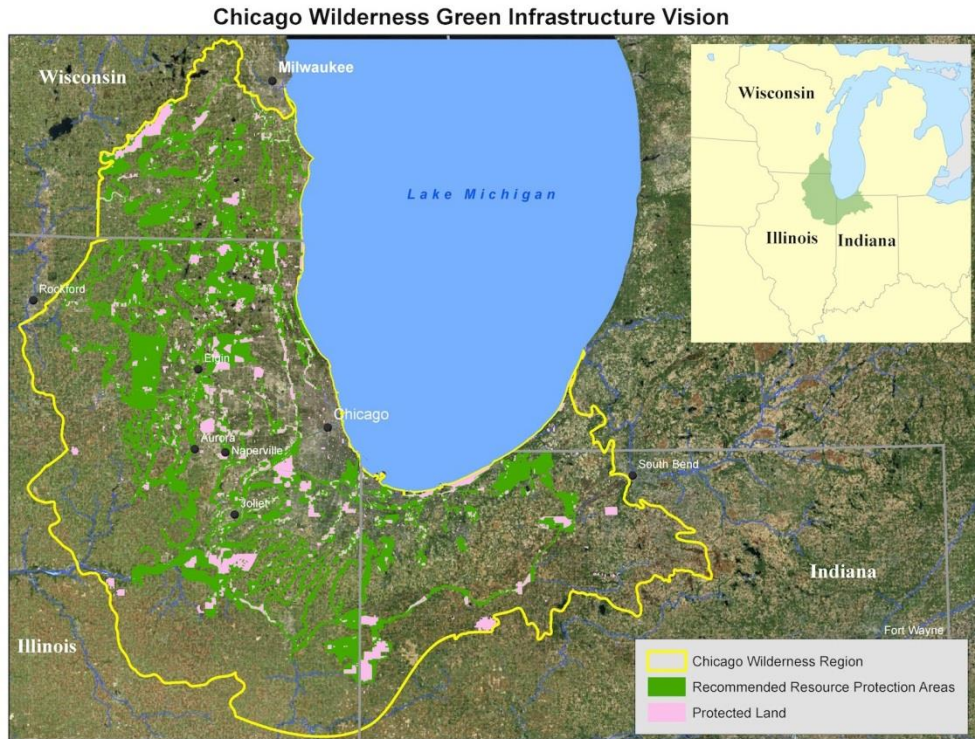
The screenshot shows the i-Tree website homepage. At the top, there is a navigation bar with the i-Tree logo, the tagline "Tools for Assessing and Managing Community Forests", a "Get the Tools" button with a CD icon, a Google Custom Search box, and a "UAS" logo. Below the navigation bar is a large banner image of a city at night with a bridge over a river. Underneath the banner is a horizontal menu with buttons for Home, About, Applications, Utilities, Resources, Support, and News. The main content area is divided into three columns. The left column features a "Desert Canopy Ecosystem Analysis" section with a tree image and a "A US Forest Service Northern Research Station Guide A Guide to Assessing Urban Forests" section with a book cover image. The middle column has a "What is i-Tree?" section with a detailed paragraph about the software's purpose and a "Visit the Video Learning Page" section with a filmstrip icon. The right column contains a "What's New?" section with several news items, including "Check out updated April 2015 i-Tree User Maps", "i-Tree Eco: Modelling the Lungs of our Cities - Part1", "i-Tree Eco: Modelling the Lungs of our Cities - Part2", "Breathe Easy: Urban Forests for Human Health", "Baltimore Gas and Electric provide over 4,200 free trees", and "Delmarva Power to provide 1,500 free trees". At the bottom of the main content area, there is a "Follow i-Tree on Twitter" button.

i-Tree Basis: Benefit based approach

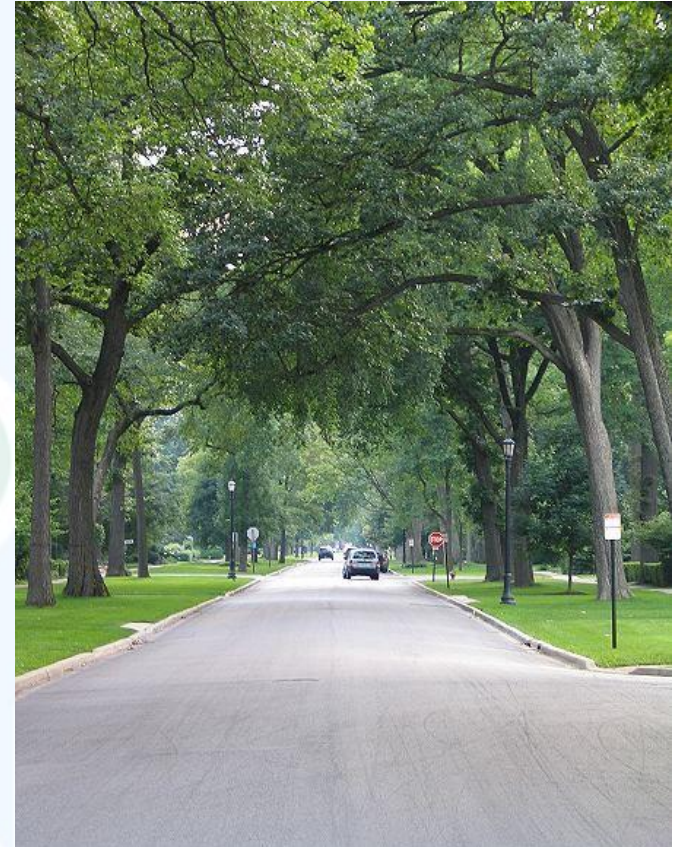


Structure → Function → Value

Figure 1.1: Map of Chicago Wilderness Region



State, regional or city scale



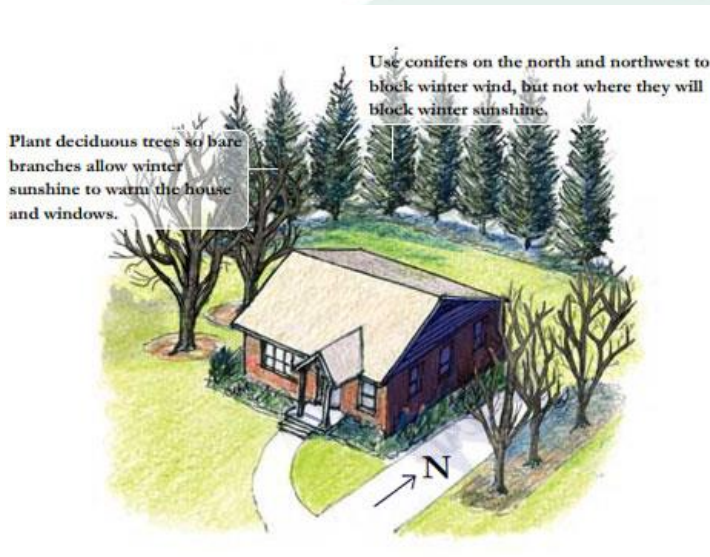
neighborhood scale



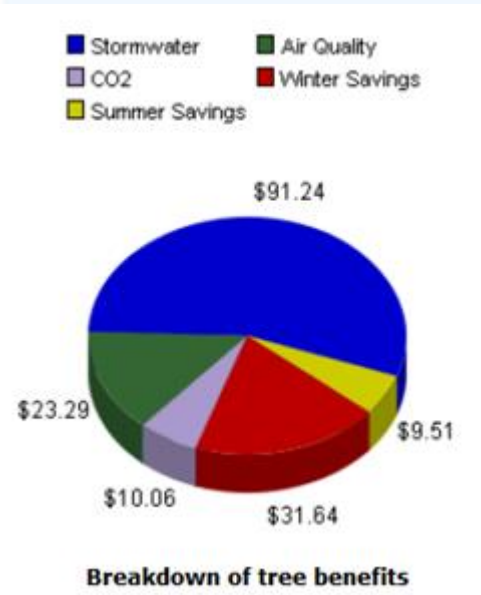
i-Tree is a
Cooperative
Initiative among
these partners



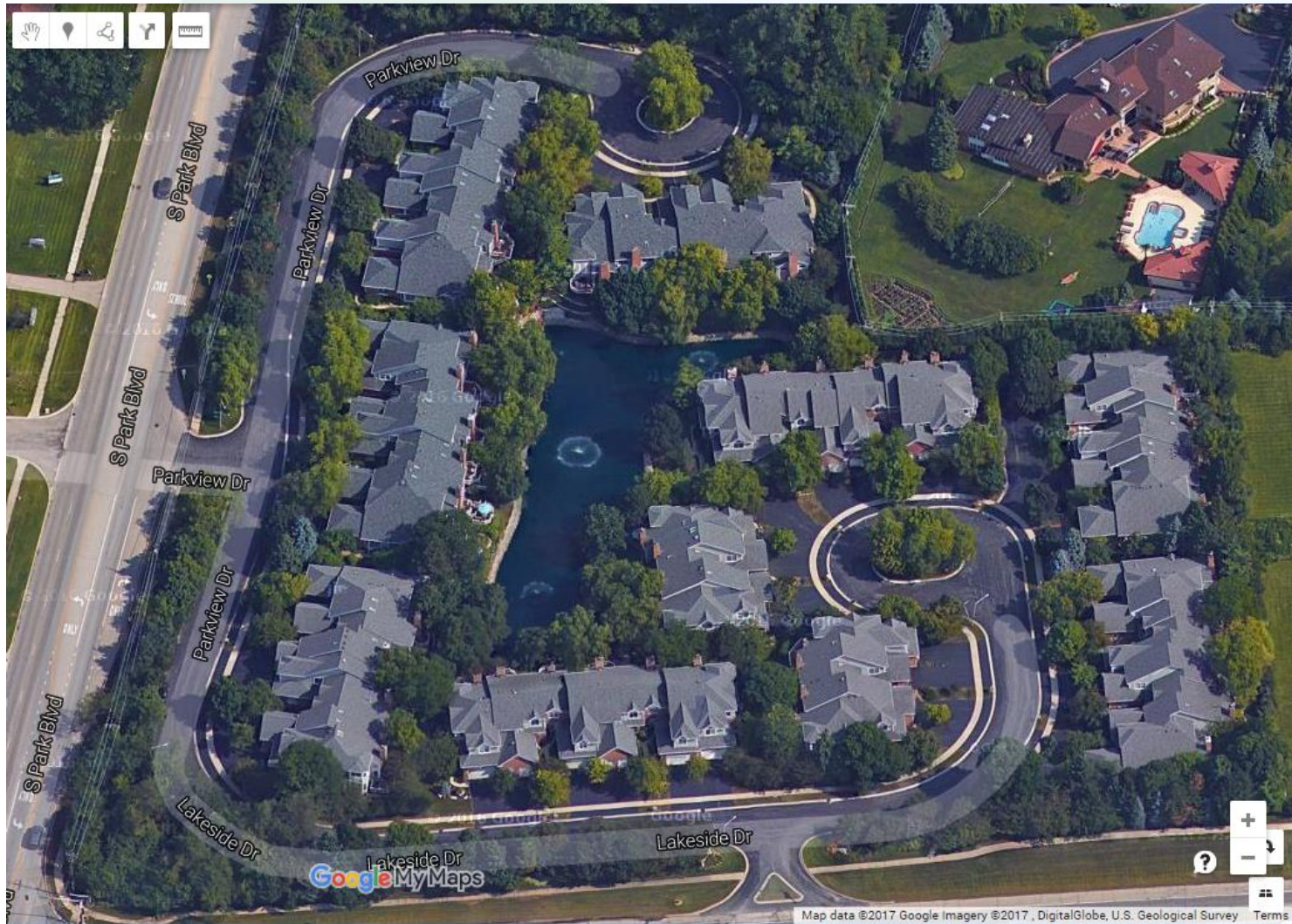
Structure → Function → Value



Homeowner scale



Structure → Function → Value



i-Tree is a Cooperative Initiative among these partners



Structure → Function → Value

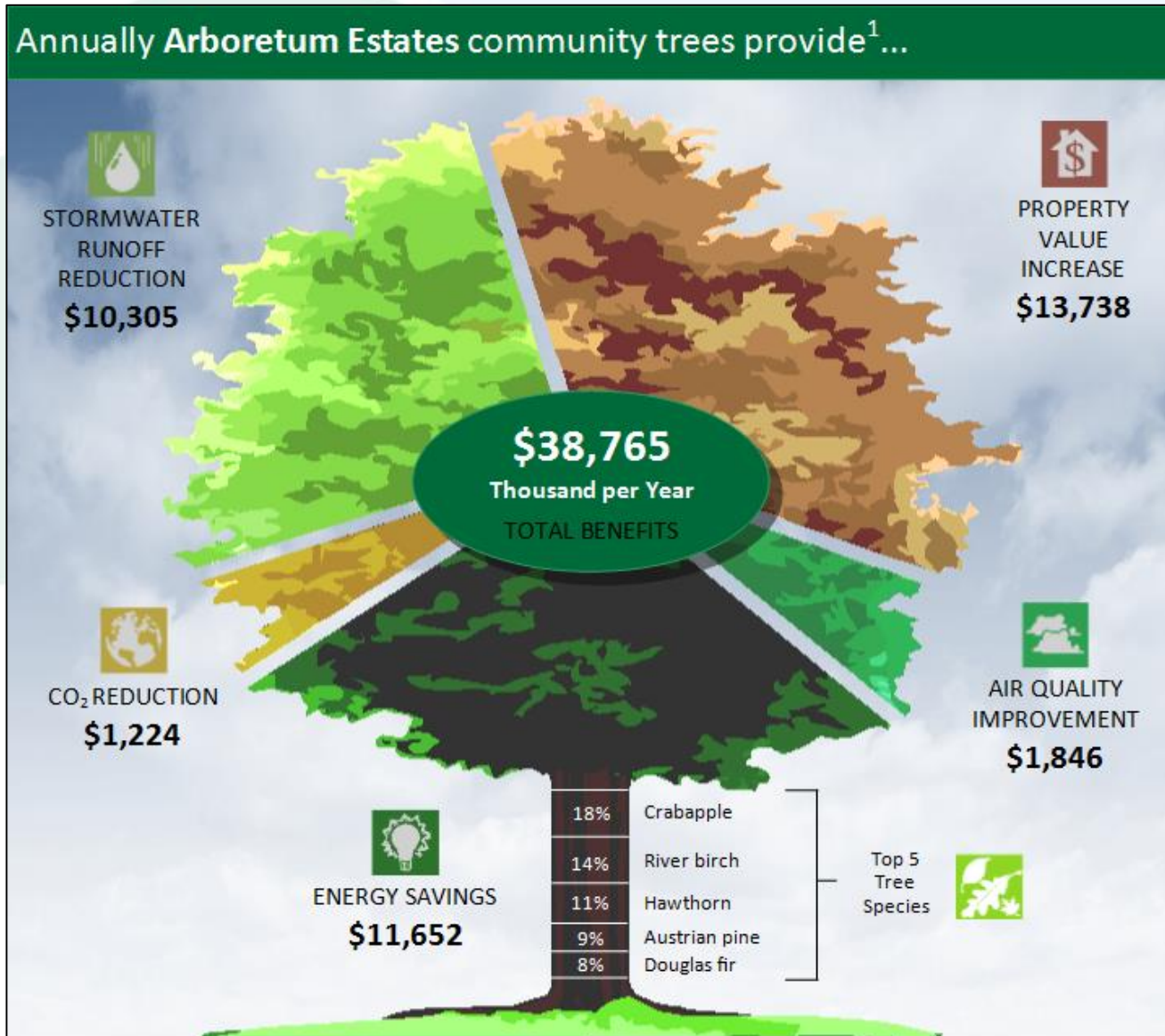


i-Tree is a Cooperative Initiative among these partners



State University of New York
College of Environmental Science and Forestry

Structure → Function → Value



i-Tree is a Cooperative Initiative among these partners



Benefit 1: Improve air quality

🌳 Absorb pollutants through leaf surfaces

- O₃ (ozone)
- NO₂ (nitrogen dioxide)
- SO₂ (sulfur dioxide)

🌳 Intercept dust and/or particulate matter (PM10 and PM2.5)

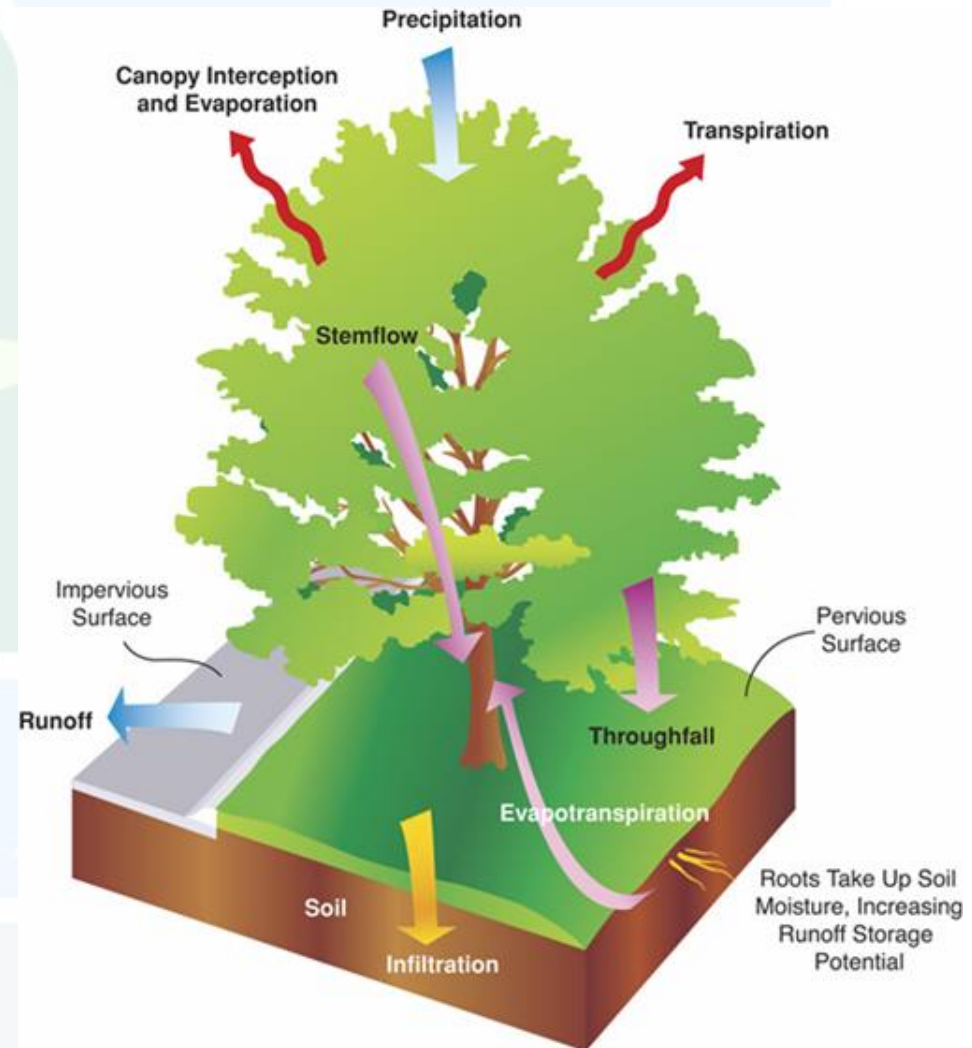
🌳 Reduction in **energy** production needs reduces creation of many pollutants

🌳 Release oxygen



Benefit 2: Stormwater reduction

- 🌳 Intercepts and holds rain on leaves, branches, and other surfaces
- 🌳 Reduces stormwater runoff
- 🌳 **Increases storage in soil**
- 🌳 Reduces erosion



i-Tree is a
Cooperative
Initiative among
these partners



DAVEY

Arbor Day Foundation



ESF
State University of New York
College of Environmental Science and Forestry

Benefit 3: CO₂ Reduction

- 🌳 Trees are largely made of carbon so they take carbon out of the air and turn it into tissue (bark, leaves, wood, etc.)
- 🌳 Reduce **energy** needs and help avoid carbon release in the first place



i-Tree is a Cooperative Initiative among these partners



Trees & Energy – Summer Effects

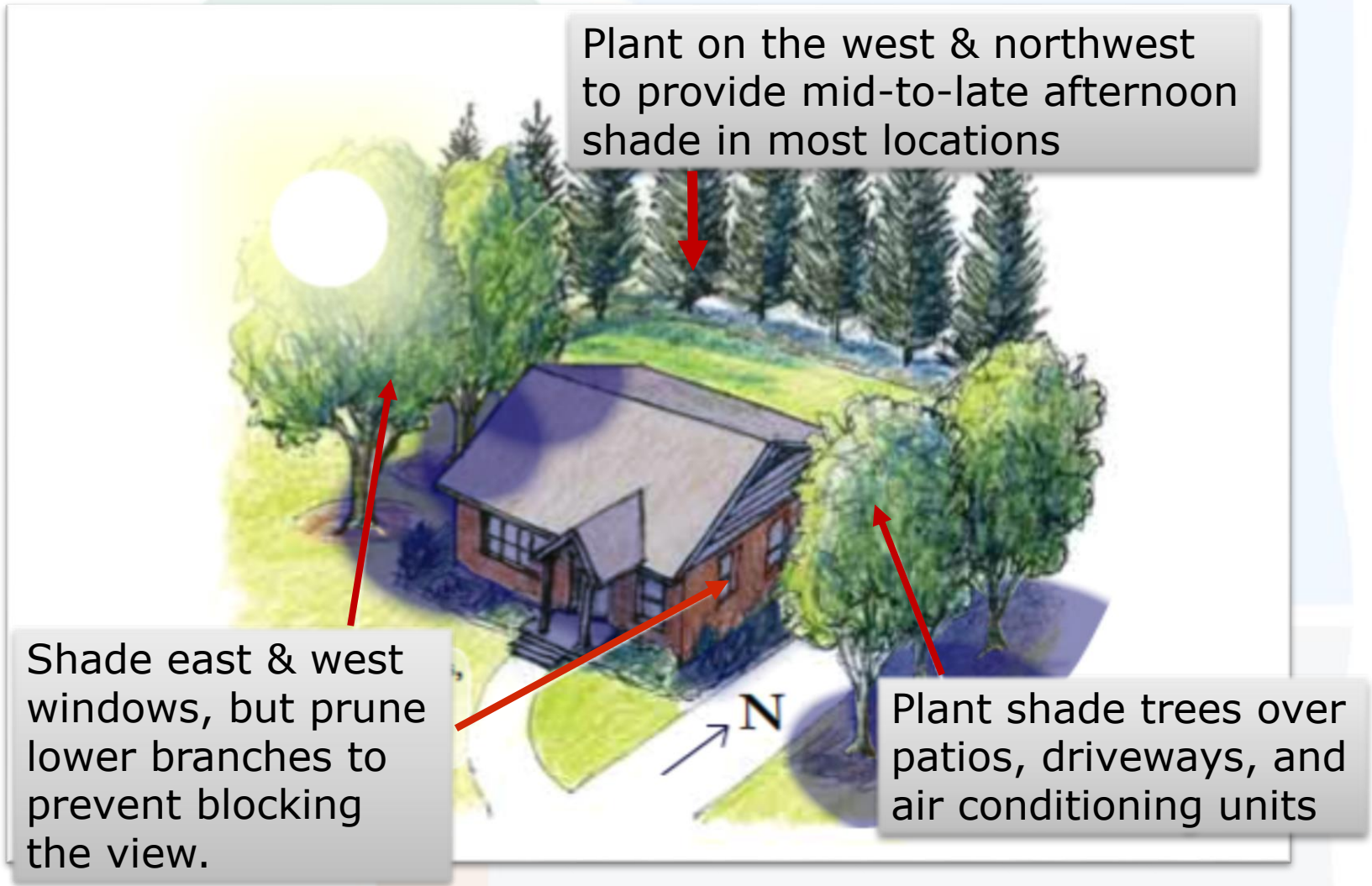


Image courtesy of Arbor Day Foundation



i-Tree is a
Cooperative
Initiative among
these partners



Trees & Energy – Winter Effects

Tree windbreak can reduce a 35 mph open wind velocity to about 10mph near here

...and about 15mph here

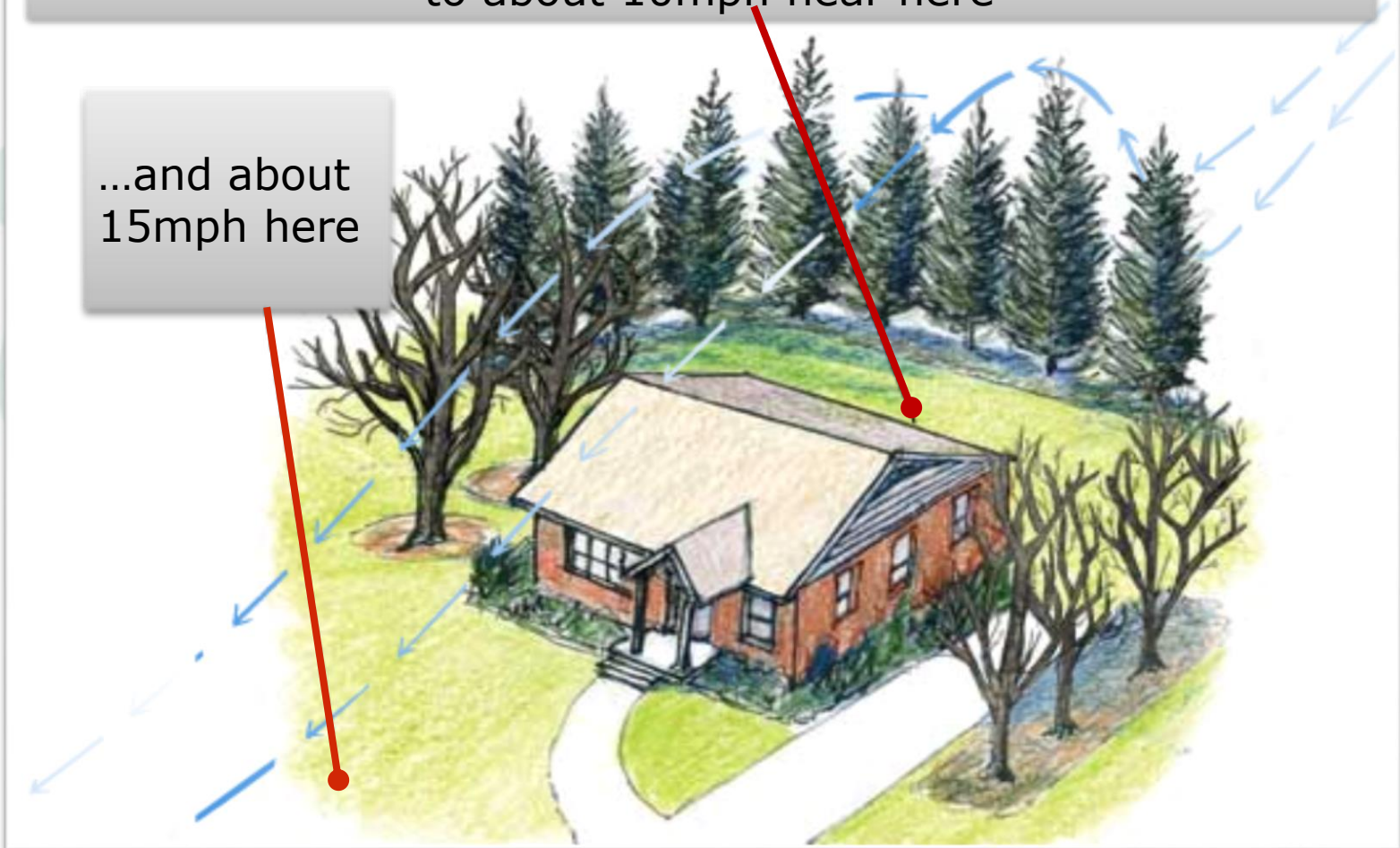


Image courtesy of Arbor Day Foundation

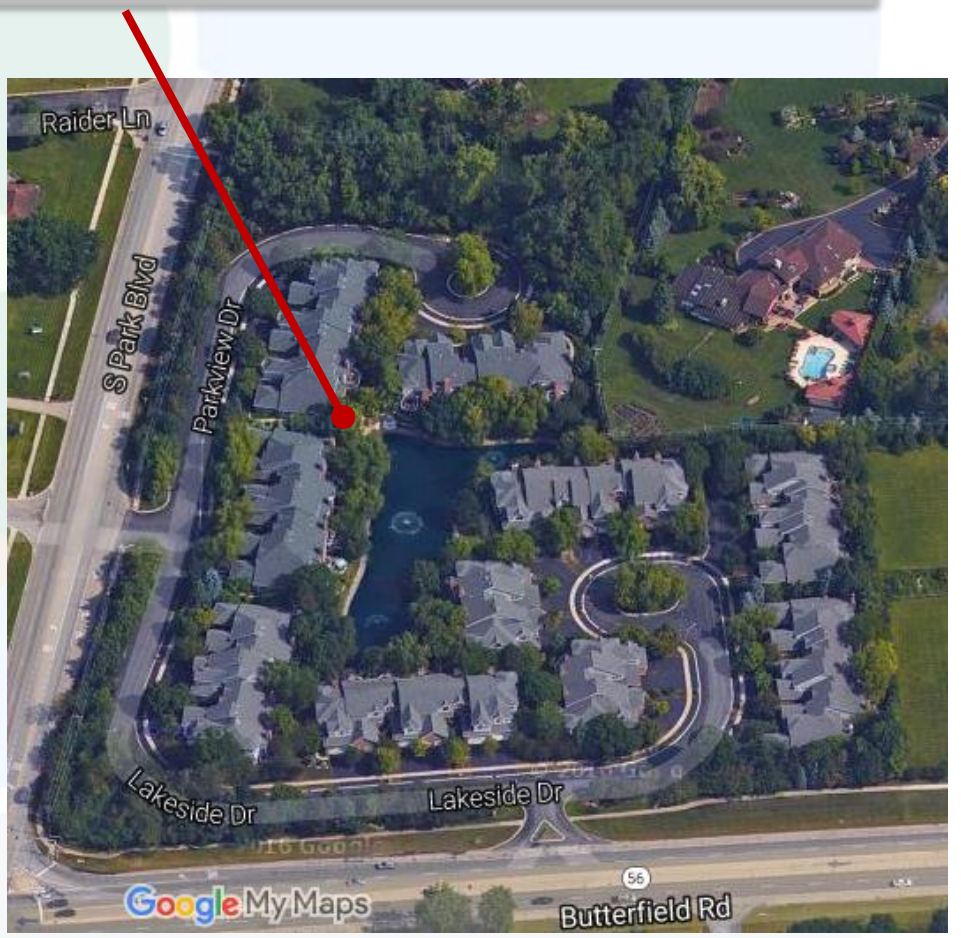
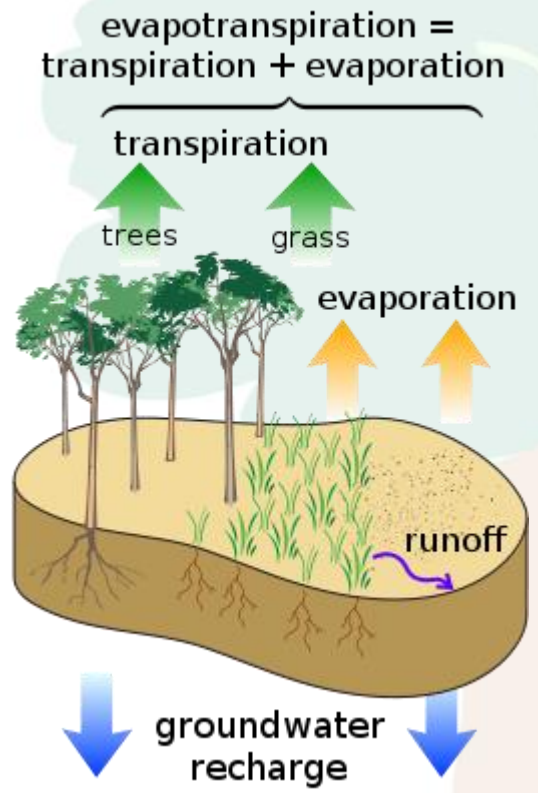


i-Tree is a
Cooperative
Initiative among
these partners



Trees & Energy – Combined Climate Effects

Combined effects of transpirational cooling along with shading of below canopy built surfaces can reduce air temps by as much as 9°F.



Source: Akbari et al., 1992. Cooling Our Communities: A Guide on Tree Planting and Light Colored Surfacing.

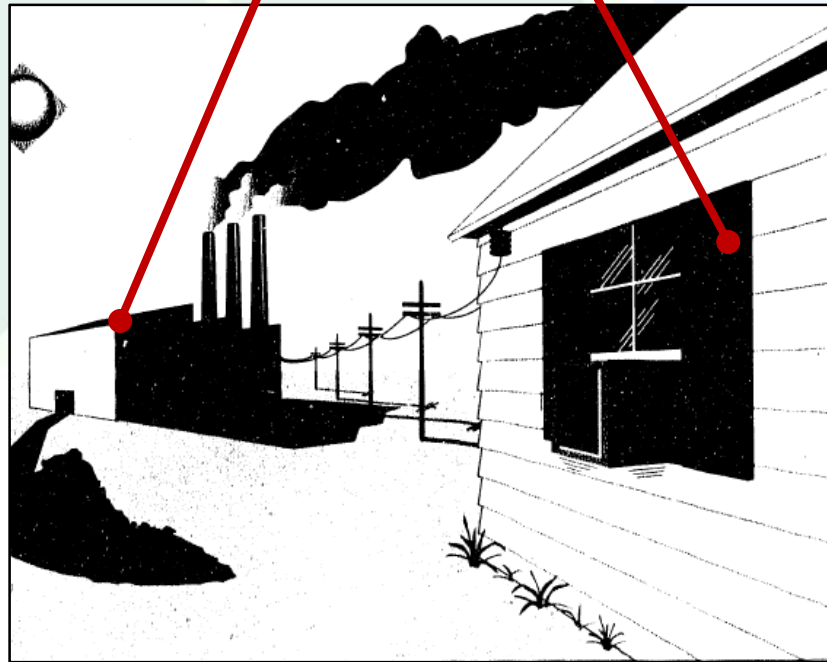


i-Tree is a Cooperative Initiative among these partners



Trees & Energy – Indirect Effects

Reducing energy use at home lessens energy production demand – and associated emissions at power generation source



Source: Akbari et al., 1992. Cooling Our Communities: A Guide on Tree Planting and Light Colored Surfacing.



i-Tree is a
Cooperative
Initiative among
these partners



Benefit 4: Trees & Energy Summary

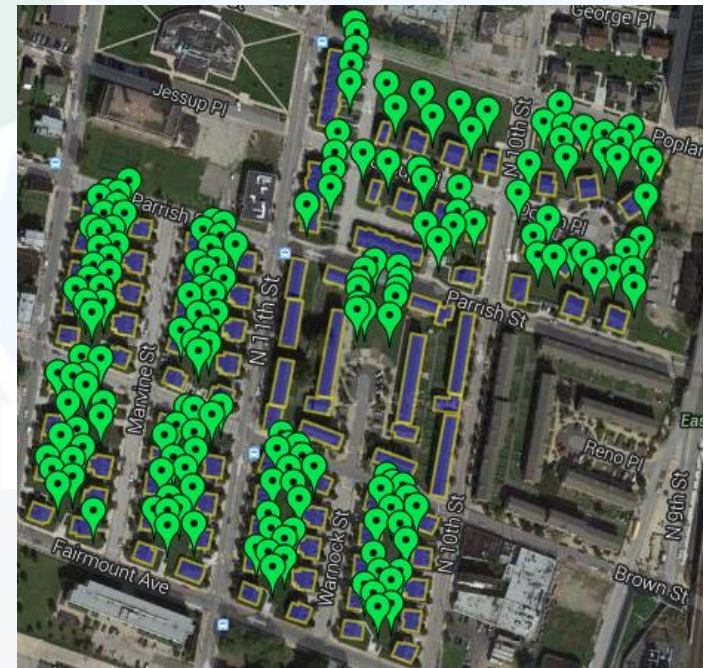
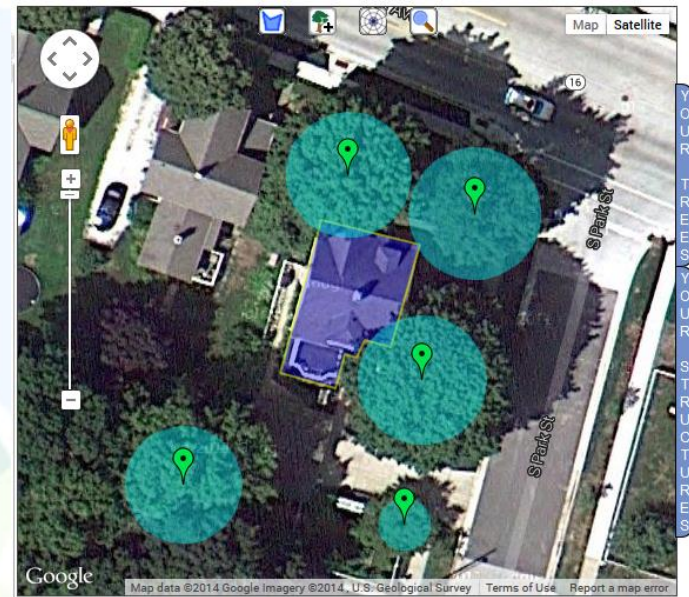
- 🌳 Shade air conditioned buildings (summer)
- 🌳 Act as a wind break reducing heat loss in (winter)
- 🌳 Transpiration cools the air – (climate effect)
- 🌳 Reduce energy demand at power generation source (indirect)



i-Tree Design

- Analysis of individual trees associated with structures
- Calculates benefits over time
- Designed for general public use
- Web accessible

<http://design.itreetools.org>



i-Tree is a
Cooperative
Initiative among
these partners

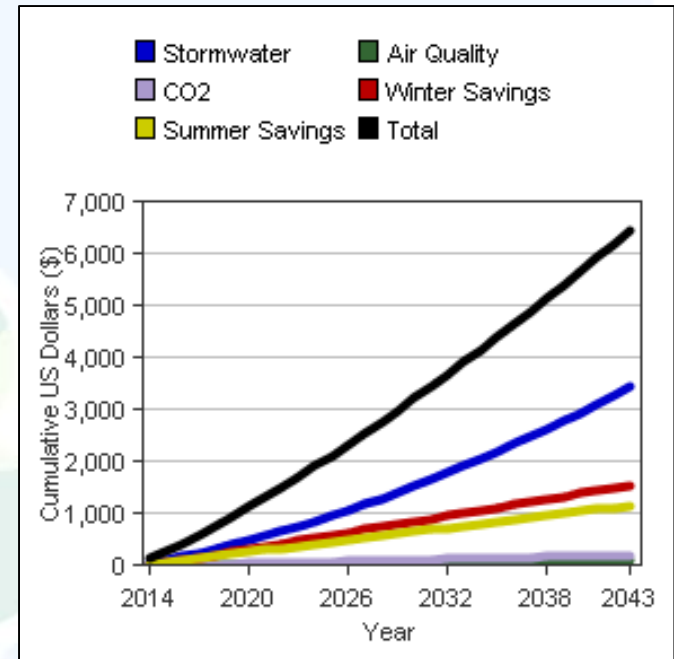


i-Tree Design

Estimates 4 core ecosystem services

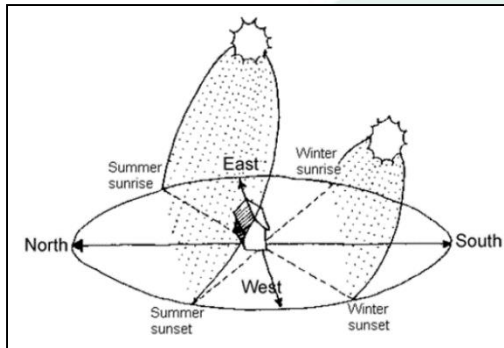
- Stormwater interception
- Energy (impacts on heating/cooling)
- Air quality improvement
- Carbon sequestration

Assesses value (\$) of current and future benefits



\$6,476 worth of benefits over the next 30 years ...and growing

Provides a \$ value for tree benefits



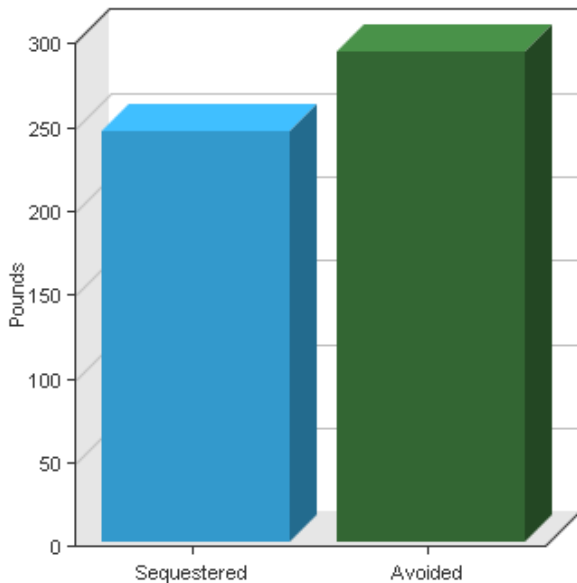
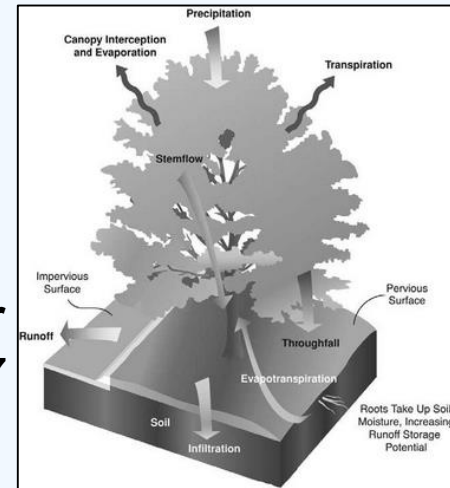
Energy

305.7 kwh = \$35.85

21.6 therms = \$35.00

Stormwater

5,714 gallons = \$56.57

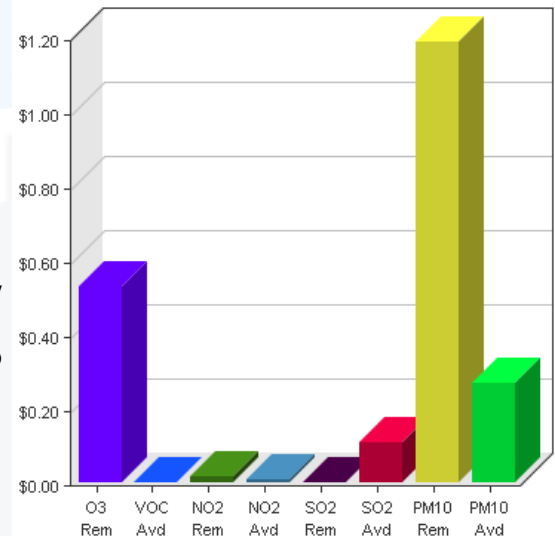


Carbon dioxide

612 lbs = \$5.95

Air Quality

Improved health = \$2.23



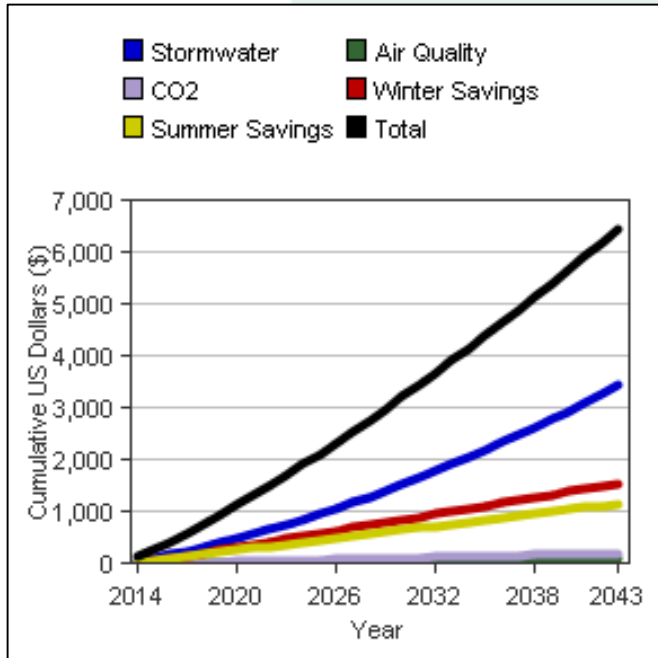
Total benefits this year = \$136



i-Tree is a Cooperative Initiative among these partners



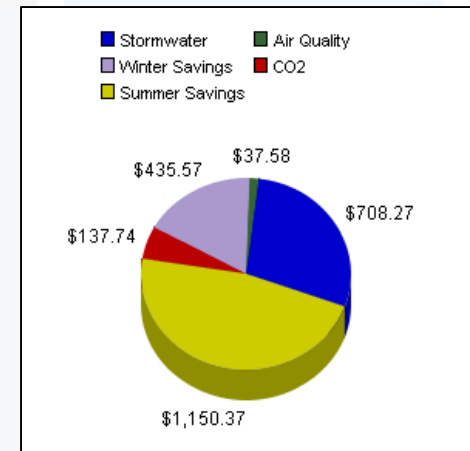
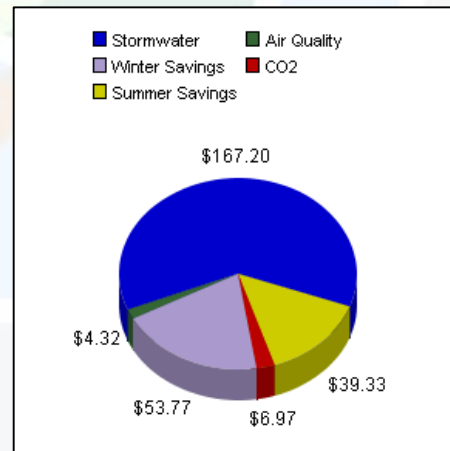
Shows trees are an investment



\$6,476 worth of benefits over the next 30 years ...and growing

Benefits in 2044 = **\$272**

To date = **\$2,470**



Display results for: All Trees

Overall Benefits

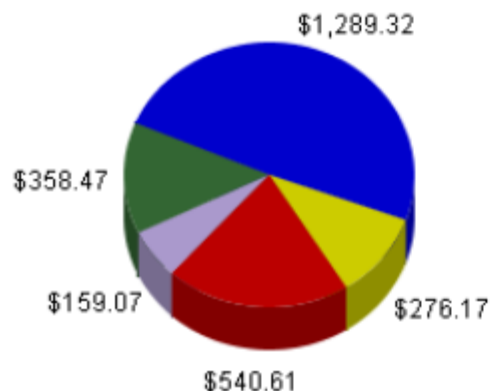
Stormwater

Energy

Air Quality

Carbon Dioxide

- Stormwater
- Air Quality
- CO2
- Winter Savings
- Summer Savings



Breakdown of tree benefits

Click on one of the tabs above for more detail

To date, these trees have provided overall benefits of \$2,617.

While some functional benefits of trees are well documented, others are difficult to quantify (e.g., human social and communal health). Trees' specific geography, climate, and interactions with humans and infrastructure are highly variable and make precise calculations that much more difficult. Given these complexities, the results presented here should be considered initial approximations to better understand the environmental and economic value associated with trees and their placement.

Benefits of trees do not account for the costs associated with trees' long-term care and maintenance.

Current Year (2013)

Future Year (2038)

Total (2013-2038)

Total to Date

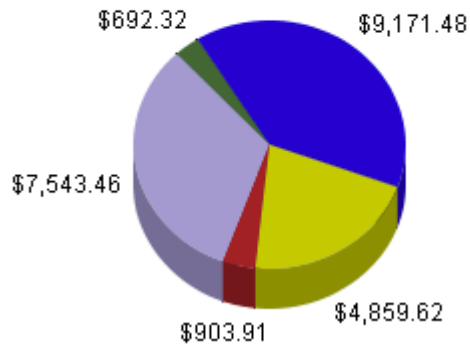
Strategy: Evaluating tree planting energy effects

Pennsylvania Horticultural Society planting for the Philadelphia Housing Authority

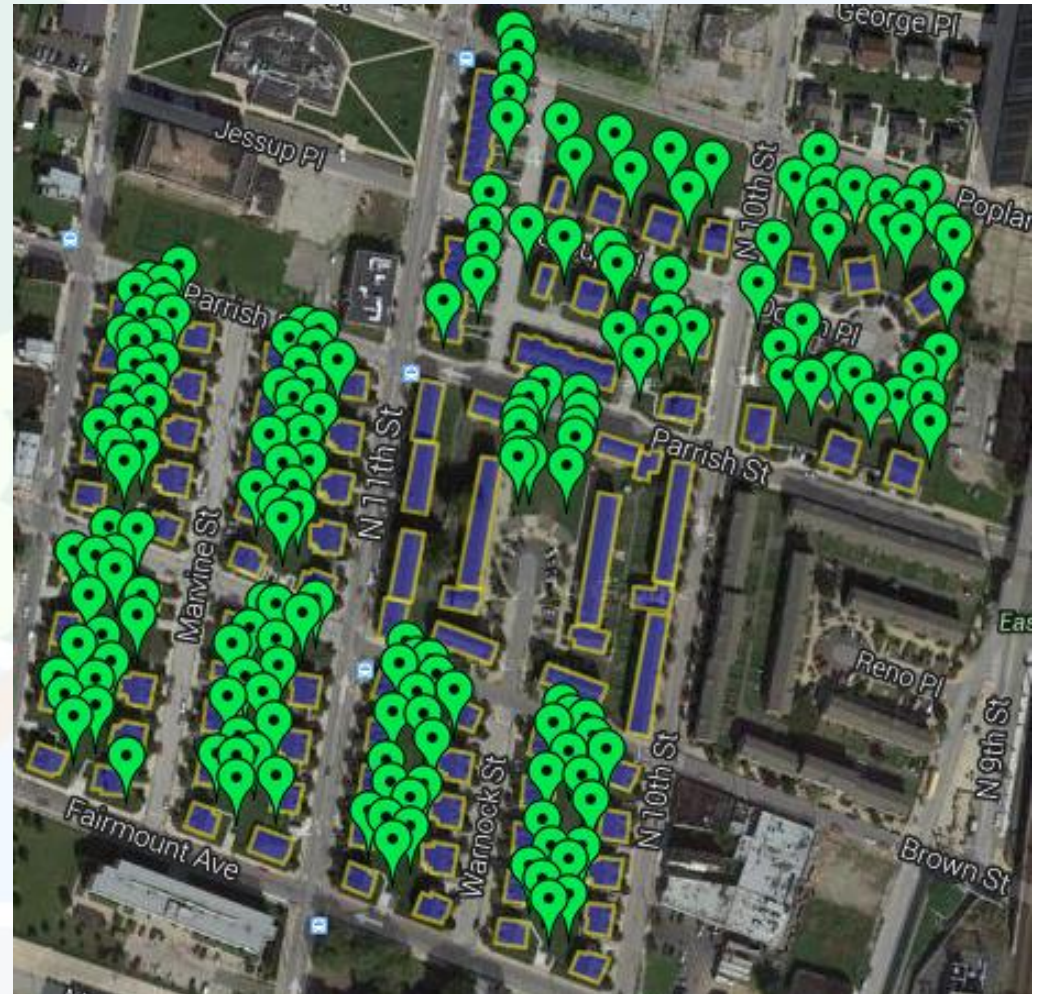
Savings over the next 30 yrs

- **\$108,000** in winter
- **\$87,000** in summer

- Stormwater
- Air Quality
- Winter Savings
- CO2
- Summer Savings



Benefits in year 30



i-Tree is a Cooperative Initiative among these partners



Strategy: Evaluating tree planting energy effects

Energy Saving Trees

Arbor Day Foundation

- Dynamic tree suitability modeling
- Utility partnerships
- Consumer oriented

Energy-Saving Trees

Place your trees (Step 3 of 4) Back Checkout

You've reached your limit of 2 trees

1 American Hornbeam *Carpinus caroliniana* Est. savings \$72.56 /yr

POOR GOOD IDEAL

Eastern Redbud American Hornbeam

2 Eastern Redbud *Cercis canadensis* Est. savings \$48.88 /yr

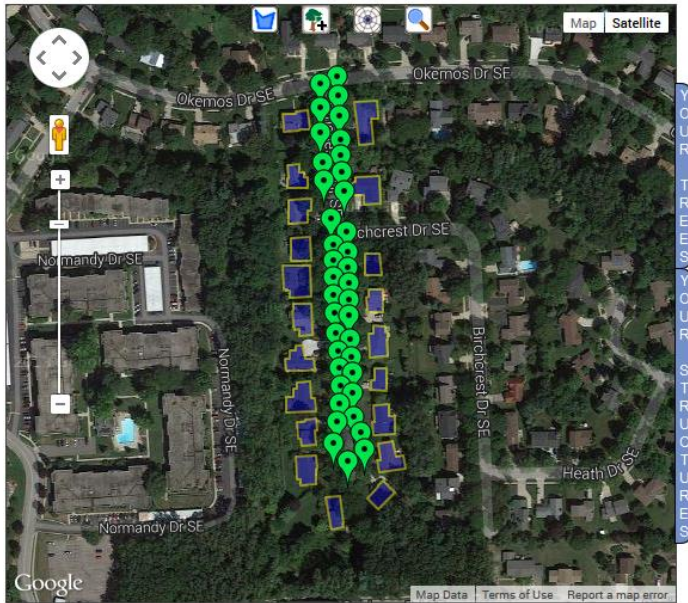
POOR GOOD IDEAL

Eastern Redbud American Hornbeam

\$121.44/yr 2 \$48.88/yr

1 \$72.56/yr

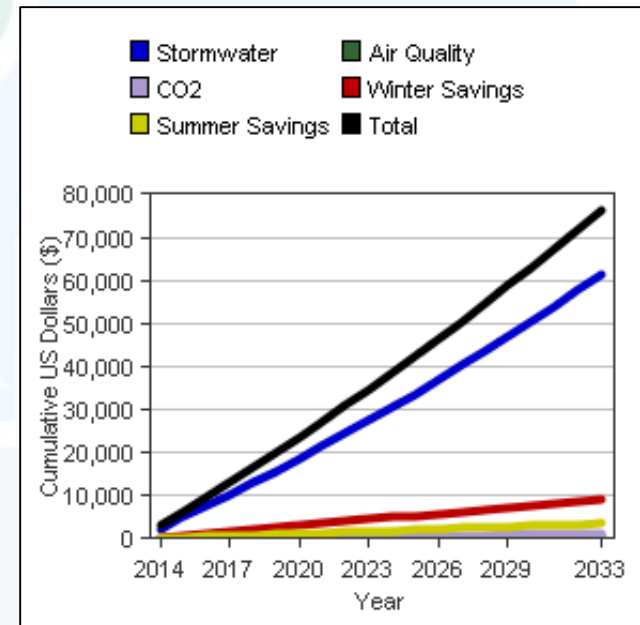
Strategy: Tree preservation scenarios



From Google Street View

The 39 Ash trees will provide \$76k worth of benefits over the next 20 yrs.

Residents decides they are worth protecting



Strategy: Community sustainability programs

i-Tree Design v6.0

West Bowery Street & West Exchange Street, Akron, OH 44308, USA

Start Over
Save Progress
About


Get started with these easy steps:

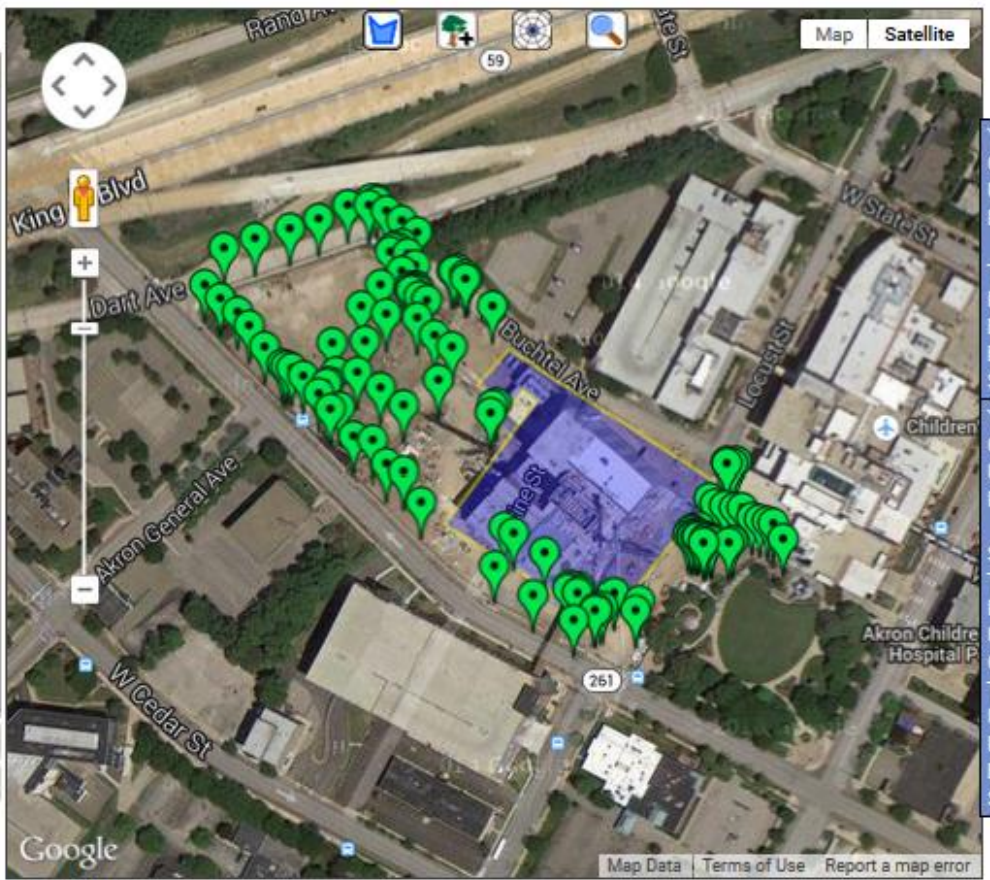
1. Draw Structures ?

Would you like to calculate the impact of trees on your cooling and heating utility bill?

Yes No

To draw a structure:

 - Outline heated or air-conditioned areas only.
 - Drag this icon  to the first corner of the structure to start drawing. Then click on the next corner and continue in this way to outline your structure. Double-click on the final corner to complete your drawing.
 - Repeat to draw additional structures.
2. Place Trees ?
3. Estimate Benefits ?

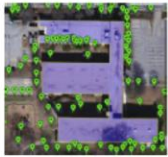


Strategy: Advocacy and Outreach

From very simple...



TREES FOR TOMORROW



Strategically planting trees around the north, west, and east side of school buildings, in court yards, by the entrance and exit, near paved drives, parking lots, playgrounds, and recreational fields can maximize the benefits trees provide Bethune Elementary School. Trees that grow large generally provide the greatest benefits compared to small- or medium-growing trees. Optimizing the space available for trees to grow will be key in future planting efforts for increased benefits.

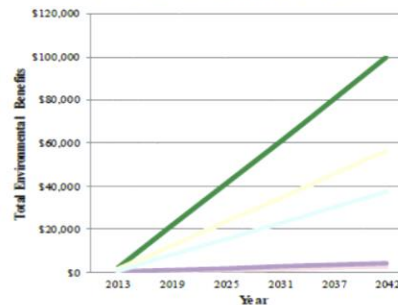
Using i-Tree Design, new trees were plotted in these areas with consideration for proper spacing between trees and individual site space restrictions. The results show there is the potential for 18 or more trees. In 30 years, planting and maintaining 18 additional trees would increase the environmental benefits by 6% at Bethune Elementary School.

Bethune School District Bethune Elementary School 220 Northside Drive NW, Atlanta, Georgia

Fast Facts

Number of Possible Strategic Tree Plantings:	18
Number of Existing Trees on School Property:	130
Current Year Annual Tree Benefits (2013):	\$1,816
Future Year Annual Tree Benefits (2043):	\$4,661
Total Projected Tree Benefits (2013-2043):	\$99,797

Total Tree Benefits Forecasted for 30 Years



Tree Benefit Type	Projected Benefits with Possible Future Trees (30 Years)	Change (Existing vs. Possible)
Stormwater Management	\$56,463	6%
Energy Savings	\$37,213	6%
Carbon Dioxide Reduction	\$4,006	7%
Air Quality Improvement	\$2,115	7%
Total Benefits	\$99,797	6%



AMERICAN FORESTS

Launched in spring 2013, American Forests developed a project dedicated to the assessment, restoration, and monitoring of urban forests in five cities. The ultimate purpose is to raise awareness of the critical importance of trees to the well-being of the City. In Atlanta, Georgia, the focus is on determining how the urban forest surrounding the City's schoolyards improves students' well-being. Twenty-six schools and 51 districts are included in this project. This factbook is a single piece of a much greater educational effort by American Forests' Community ReLeaf program.

For more information, visit the Community ReLeaf website or call American Forests.

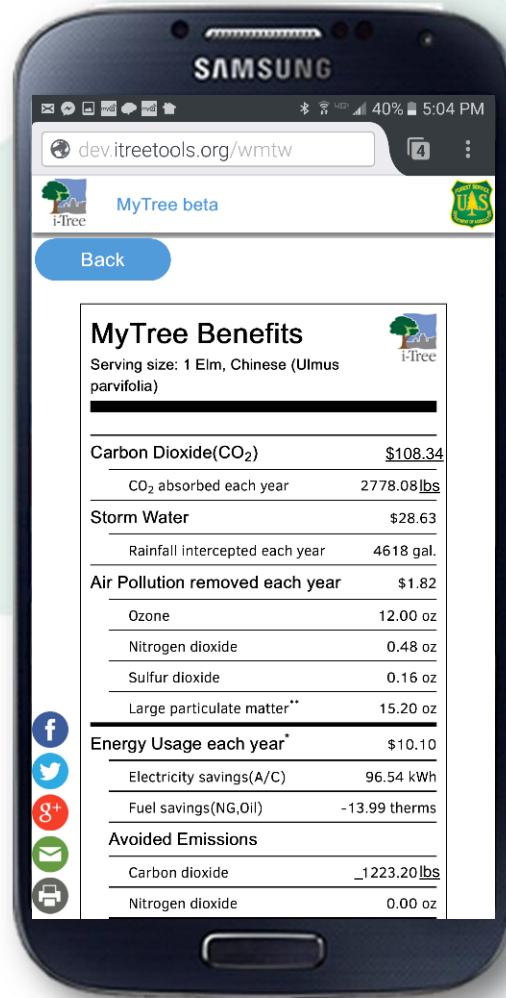


i-Tree is a
Cooperative
Initiative among
these partners



... to more involved

i-Tree MyTree *beta - new*



 i-Tree on the go!

- Running on the i-Tree Design engine

www.itreetools.org/MyTree



i-Tree is a
Cooperative
Initiative among
these partners



DAVEY 

 **Arbor Day Foundation**



ESF
State University of New York
College of Environmental Science and Forestry

i-Tree Species *version 2.0 - new*

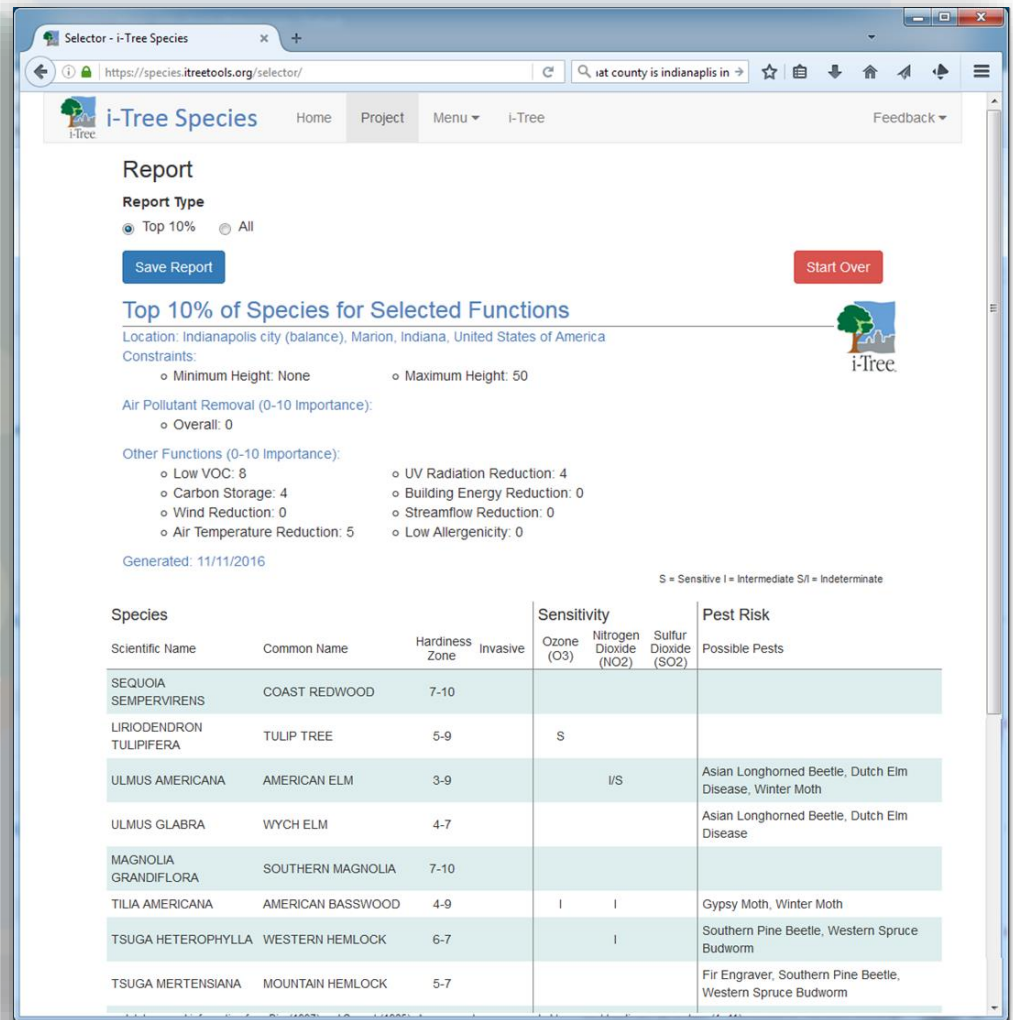
 Web version replaces previous desktop version

- And ready for Mobile – smartphone or tablet!

 New features

- Hardiness zones
- Pest / Host
- Invasive designation
- Bug fixes!

www.species.itreetools.org



The screenshot shows the 'i-Tree Species' web application interface. The browser address bar displays 'https://species.itreetools.org/selector/'. The page title is 'i-Tree Species' and the navigation menu includes 'Home', 'Project', 'Menu', and 'i-Tree'. The main content area is titled 'Report' and shows 'Report Type' set to 'Top 10%' with a 'Save Report' button and a 'Start Over' button. Below this, it displays 'Top 10% of Species for Selected Functions' for the location 'Indianapolis city (balance), Marion, Indiana, United States of America'. Constraints include 'Minimum Height: None' and 'Maximum Height: 50'. It also shows 'Air Pollutant Removal (0-10 Importance): Overall: 0' and 'Other Functions (0-10 Importance):' with various metrics like 'Low VOC: 8', 'Carbon Storage: 4', 'Wind Reduction: 0', 'Air Temperature Reduction: 5', 'UV Radiation Reduction: 4', 'Building Energy Reduction: 0', 'Streamflow Reduction: 0', and 'Low Allergenicity: 0'. The report was generated on 11/11/2016. A legend indicates 'S = Sensitive | = Intermediate SI = Indeterminate'. The main table lists species with columns for Scientific Name, Common Name, Hardiness Zone, Invasive status, Sensitivity (Ozone, Nitrogen Dioxide, Sulfur Dioxide), and Pest Risk.

Species	Scientific Name	Common Name	Hardiness Zone	Invasive	Sensitivity			Pest Risk
					Ozone (O3)	Nitrogen Dioxide (NO2)	Sulfur Dioxide (SO2)	
	SEQUOIA SEMPERVIRENS	COAST REDWOOD	7-10					
	LIRIODENDRON TULIPIFERA	TULIP TREE	5-9		S			
	ULMUS AMERICANA	AMERICAN ELM	3-9			I/S		Asian Longhorned Beetle, Dutch Elm Disease, Winter Moth
	ULMUS GLABRA	WYCH ELM	4-7					Asian Longhorned Beetle, Dutch Elm Disease
	MAGNOLIA GRANDIFLORA	SOUTHERN MAGNOLIA	7-10					
	TILIA AMERICANA	AMERICAN BASSWOOD	4-9		I	I		Gypsy Moth, Winter Moth
	TSUGA HETEROPHYLLA	WESTERN HEMLOCK	6-7			I		Southern Pine Beetle, Western Spruce Budworm
	TSUGA MERTENSIANA	MOUNTAIN HEMLOCK	5-7					Fir Engraver, Southern Pine Beetle, Western Spruce Budworm



i-Tree is a Cooperative Initiative among these partners



Additional i-Tree learning resources

www.itreetools.org

- Videos
- Documentation
- Online tools
- Newsletter
- Support
- Examples
- Downloads

Home Lessons About i-Tree About NGSS Environmental Enrichment Fellowship

Welcome to iTreeLessons.com

Integrate the iTree Software Suite with NGSS Standards-based lesson plans in your classroom.

View Lessons

Lesson Plans

All lesson plans are hosted on Google Drive. You will need a Google Account in order to access the files. If you can't have a Google Account, sign up for an account now.

info@itreetools.org or al.zelaya@davey.com



i-Tree is a
Cooperative
Initiative among
these partners

