# An i-Tree Primer

*T*he i-Tree suite of computerized tools may well be the most significant development of the 21st century in the field of urban forestry. These tools provide valuable assistance to urban foresters, consultants, nonprofit organizations, and anyone who manages trees or owns a tree. They are scientifically based ways to have a better overall understanding of the trees in any area of interest and to quantify their environmental contributions.

Many of our readers will be familiar with the i-Tree tools. They are being used in thousands of American cities of all sizes and even internationally. However, there are many who have not heard of these amazing aids to urban forest management or have only a vague acquaintance with them. In this issue, we summarize some of the tools and their applications.

The i-Tree software tools were first released for public use in 2006. There were four initially available tools that followed more than a decade of research and development. The effort was led primarily by Dr. David J. Nowak of the U.S. Forest

The i-Tree tools have provided new ways to quantify and analyze urban forests and the benefits they provide.

Service's Northern Research Station in cooperation with staff at The Davey Tree Expert Company. Through the years, an i-Tree development team of urban foresters, academicians, and other collaborators have contributed to testing, improving, and expanding the tools, or apps (applications). Today there are 13 i-Tree tools available, and all are free to anyone who wants to use them.

The purpose of this amazing program is to aid and improve urban forest management by providing peer-reviewed, scientific methods for quantifying our urban trees and the environmental services they provide. The tools not only can help guide decisions about planting and best management, they provide a powerful way to illustrate the benefits of urban trees and gain public understanding and support.

# An i-Tree Overview

*Here is a brief and much-simplified overview of i-Tree that can serve as background for understanding what it is and how it can be of help in your community.*
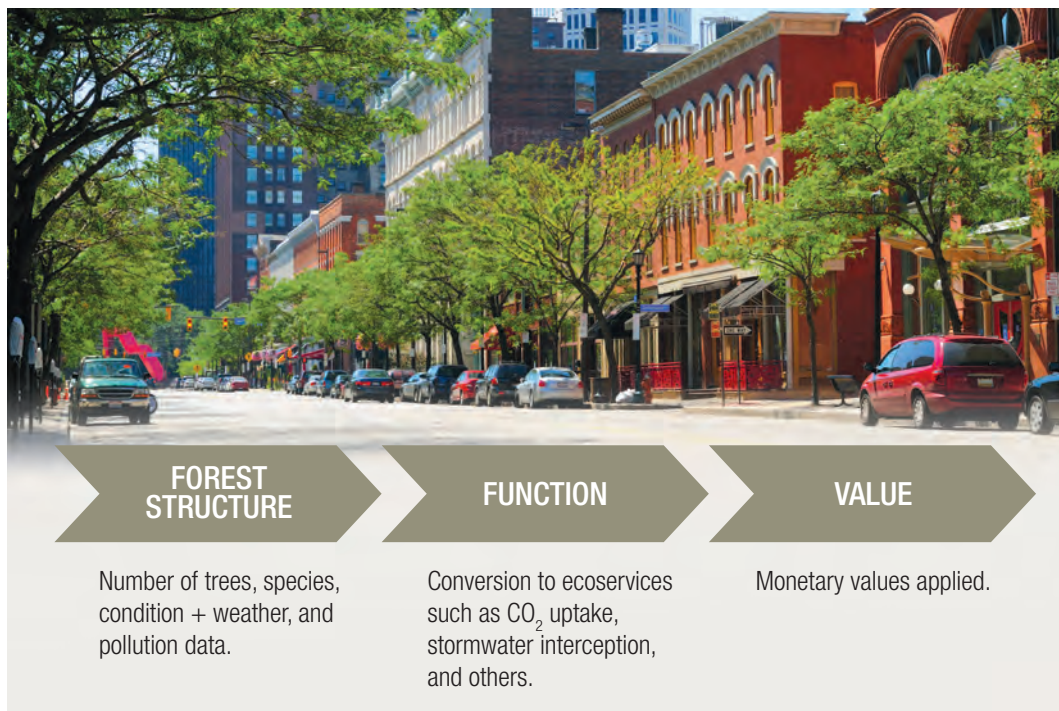
## SCIENCE-BASED

It is not hard to understand how trees help reduce stormwater. We have all sought shelter under a tree when it rains and noticed how it is much drier there. But how much drier? Through years of meticulous research, scientists have actually measured the volume of water retained by the leaves and bark of trees. Moreover, they have measured leaf surfaces of different species and determined their functions not only in mitigating stormwater runoff, but in absorbing carbon dioxide and other air pollutants, and shading buildings. You can only imagine the years of work it took to make these determinations!

This work was done on sites nationwide. Once quantified data were obtained, cost savings were applied and the value of the tree's ecoservices were determined. The result was the U.S. Forest Service's Urban Forest Effects model, or UFORE, a computer model designed to calculate urban forest ecosystem services and values based on the field data inputs and data sets from various other sources. In turn, when integrated with other models, this evolved into the i-Tree suite of tools now available to users. The studies continue, results are refined and updated, and new applications are continuing to be developed — all of it in the public domain and available for free use.

## COLLABORATIVE

The development and maintenance of i-Tree requires an enormous amount of cooperation. The primary partners in its creation, dissemination, and ongoing support are the U.S. Forest Service, The Davey Tree Expert Company, Arbor Day Foundation, Society of Municipal Arborists, International Society of Arboriculture, Casey Trees, SUNY College of Environmental Science and Forestry, and other academic institutions.

| FOREST STRUCTURE | FUNCTION | VALUE |
|---|---|---|
| Number of trees, species, condition + weather, and pollution data. | Conversion to ecoservices such as $CO_2$ uptake, stormwater interception, and others. | Monetary values applied. |

A conceptual overview of how the basic i-Tree tools were developed.

## USEFUL

The following pages contain examples of how i-Tree has become a broadly used aid to urban forestry and communication with the public. The suite of software apps provides:

- A clearer picture of the extent, composition, and condition of trees in any area of interest ranging from a street, neighborhood, entire city, or county.

- Health benefits and risks to humans.

- The amount and value of ecosystem services ranging from those provided by a single tree to the entire community forest.

- Predictions regarding the potential impact of insect or disease epidemics or storm damage.

**TO STAY CURRENT** For news about new i-Tree applications and other updates or changes, visit **itreetools.org/blog/newsletter**.

# For Trees in Your Yard

*Anyone can use the following two i-Tree programs to become acquainted with the power of these computerized tools.*

MyTree is a quick and easy way to obtain data about some of the ecoservices provided by backyard trees.

## i-TREE MYTREE

This is the simplest of all the i-Tree tools. Try it on one or more trees in your yard or business property. All you need to do is provide the address and answer a few easy questions about each tree. With the click of a mouse, you will receive information — including monetary values — such as:

Pounds of $CO_2$ sequestered.

Gallons of stormwater runoff avoided.

Air pollution removed, such as ozone, carbon monoxide, and others.

Energy usage saved per year (in kilowatt hours, natural gas, or fuel oil).

Avoided emissions from energy use.

## i-TREE SPECIES

This tool is a bit more sophisticated but still quite easy to use. It is intended to help with the selection of what tree to plant, depending on what ecoservices are important to you. By answering a few questions, it will provide a list of species for your hardiness zone that meet your choice of criteria such as:

Low volatile organic compounds

Carbon storage

Wind reduction

Air temperature reduction

Ultraviolet radiation reduction

Energy reduction in a building

Streamflow reduction

Low allergenicity

# The Big 3

*A key purpose of i-Tree tools is to take advantage of computer power to provide information about the structure (composition and condition) of a community forest or some portion of it, and to quantify its benefits. Some computer savvy is necessary to use these tools, and they are intended primarily for urban foresters and other professionals responsible for the community's trees. Here are three of the many i-Tree tools available and currently being widely used.*

## i-TREE ECO

This desktop app is the core tool in the i-Tree suite and the foundation for many of the other tools. Its modeling ability is the result of years of research and data collection about trees, weather, pollution, and other variables necessary to produce results for the user. Fortunately, these data are stored in a central location and applied when combined with local input about the trees in a designated area. In other words, the research and mathematical calculations have been done by the creators of i-Tree. The user has only to add local tree measurements.

Using i-Tree Eco can yield results for a single tree, a street or neighborhood, a cemetery, or other specified area. Tree measurements can be made specifically for this application, or they can be imported from an existing inventory. For large areas, sample plots can be used. In all cases, an online manual provides directions for collecting field data. Web-enabled smartphones or tablets can be used for this part of the project.

The results of using i-Tree Eco are detailed graphs and tables that provide a clearly understandable picture of the forest's structure and benefits. Here are just some:

- Urban forest structure including species composition, number of trees, tree density, tree conditions, etc.
- Hourly amount of pollution removed by the urban forest, and associated percent air quality improvement throughout the year.
- Total carbon stored and net carbon annually sequestered.
- Public health benefits.
- Effects on building energy use.
- Avoided stormwater runoff.
- Compensatory value of the forest, as well as the estimated economic value of its ecosystem services.
- … and much more.

### FORECAST MODELING

In addition to summarizing current conditions of a community's trees, i-Tree Eco has the ability to show how these conditions will change over time. This valuable management tool can be used to estimate future environmental benefits and structural changes such as crown and diameter sizes based on user selected mortality rates, potential future storms and pest outbreaks such as gypsy moth and Asian longhorned beetle. While the user currently inputs future mortality rates to visualize future outcomes, research is investigating actual mortality rates to aid these projections in the future.
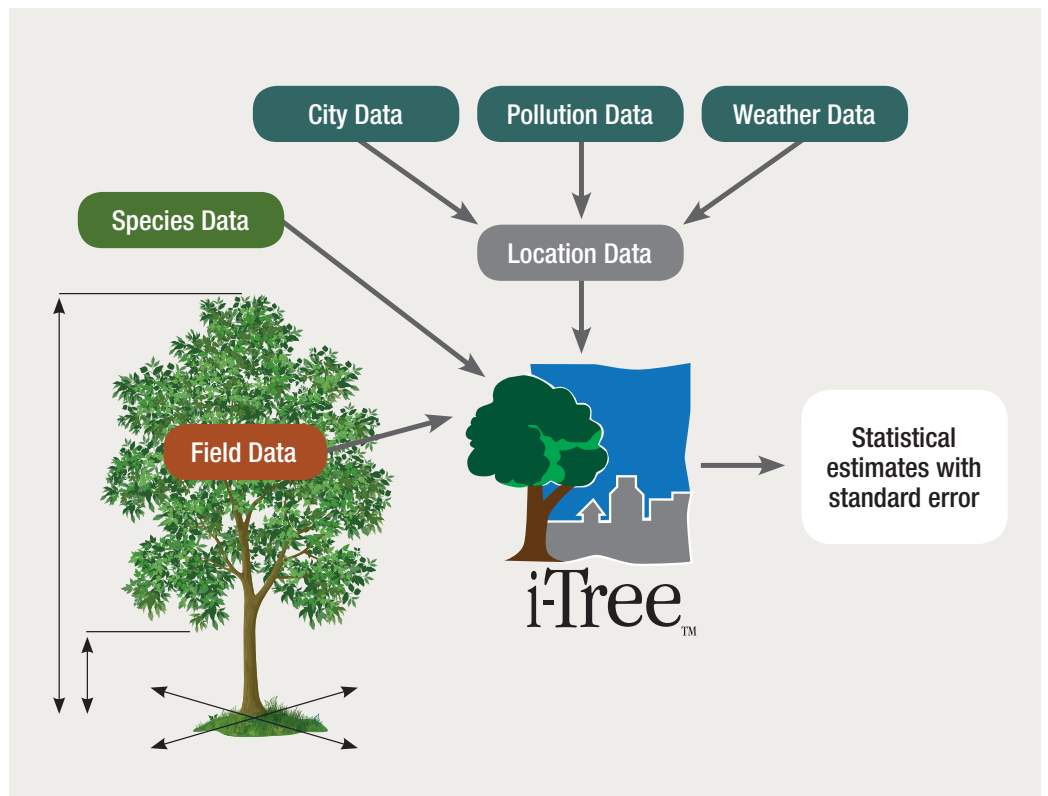
# i-TREE CANOPY
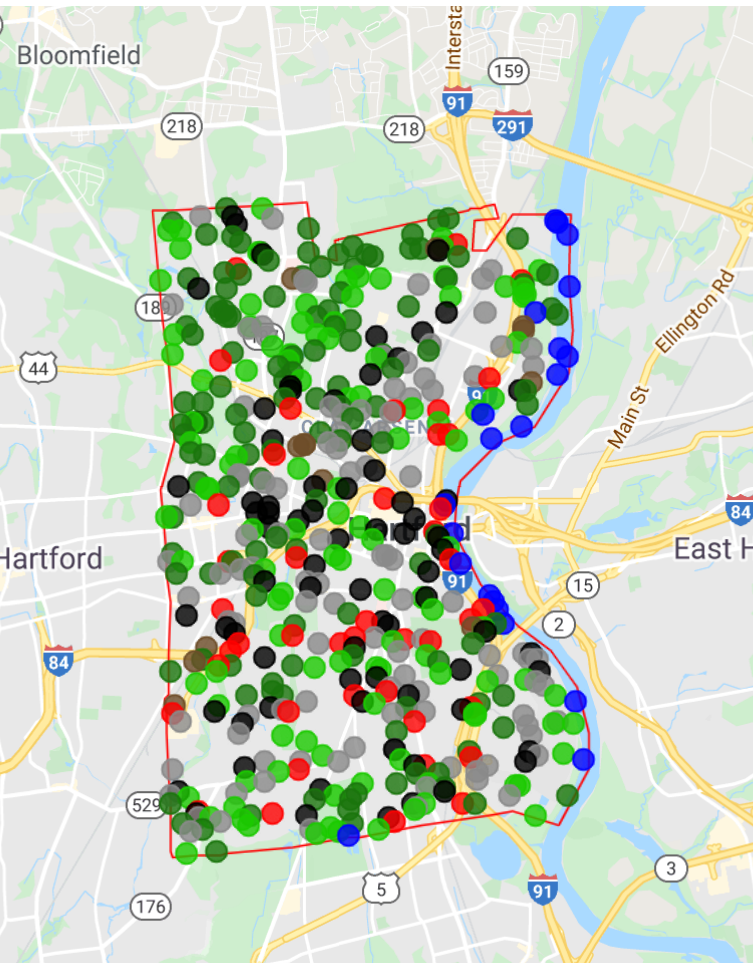
This web app is sort of like being an eye in the sky. From a high perch, you can estimate canopy cover and impervious surfaces, both important in planning and managing the urban forest, and monitoring changes over time. For example, it is a good method for communities concerned with warming trends that have set goals of increasing their shade-giving canopy cover through a planting program.

Using either Google map or online satellite images, you "visit" sample points throughout an area of interest. This can be your entire community or some other designated area. The program randomly generates sample points and zooms to each. You then select which cover types are present at that point. As an end result, you receive percentage data about any of the cover types you choose — and their associated benefits, if any. Cover types include:

- Trees/shrubs
- Grass/herbs
- Impervious — buildings
- Impervious — roads
- Impervious — other
- Water surface
- Soil/bare ground

Obviously, the more sample points used, the higher degree of accuracy when the data is summarized for the entire area of interest. Also, like all i-Tree programs, i-Tree Canopy undergoes regular updates with new and improved features. In version 7.0, the latest to date, report layout was improved and now includes a map of the selected project area. It can also estimate hydrology effects and provide export options for the surveyed points.

## Hartford, CT Land Cover

**Legend:**
- Grass/Herbaceous
- Impervious — Buildings
- Impervious — Other
- Impervious — Road
- Soil/Bare Ground
- Tree/Shrub
- Water
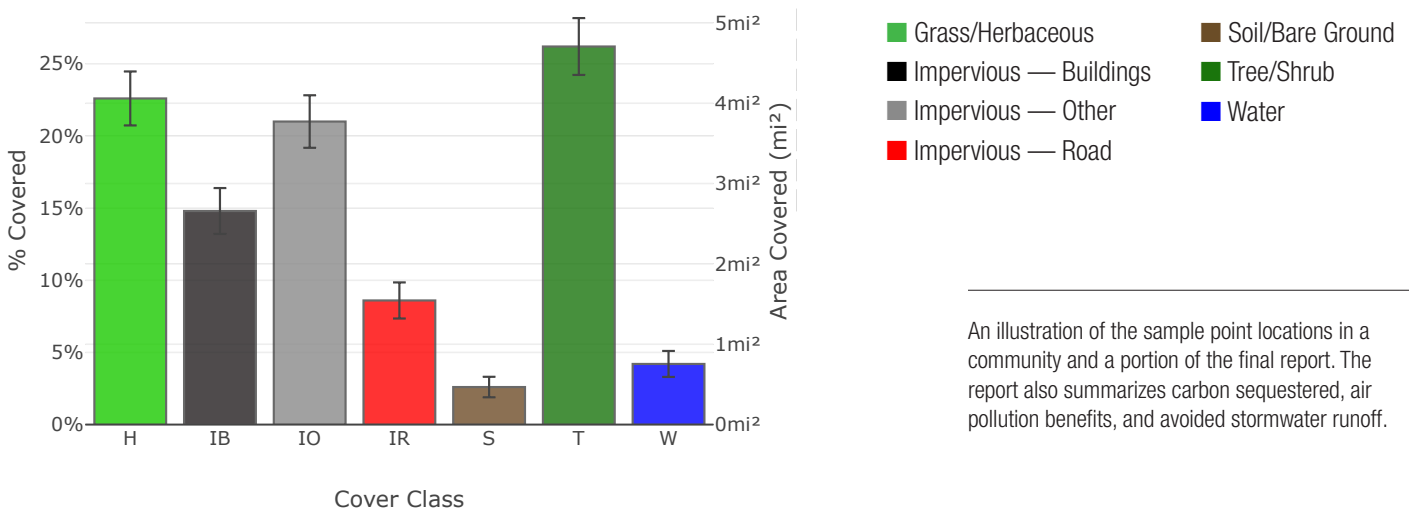
An illustration of the sample point locations in a community and a portion of the final report. The report also summarizes carbon sequestered, air pollution benefits, and avoided stormwater runoff.

## i-TREE LANDSCAPE

This is a powerful tool. As one expert said, "It is packed to the gills." As such, it is not as easy to use as some of the other tools, and instruction is necessary to use it properly. However, once this app is mastered, it allows you to obtain a great deal of information about locations throughout the country. Your choices are displayed under four main categories: Canopy & Land, Forest Risk, (Human) Health Risk, and Future Climate. Using an online map and panel of controls, you can get information such as:

• Forest structure and plantable spaces
• Quantified ecoservices
• Canopy cover and land cover
• Flood plains and fire risk areas
• Risks from tree pests
• Human health factors
• Predicted climate change by decade
• Social information such as population density, concentrations of poverty, etc.

In addition, iTree Landscape allows you to compare areas and, using selected criteria, prioritize your planting efforts. You can even see how planting will increase benefits.

**Note:** Currently it is not easy to select specific areas such as neighborhoods. Rather, the program uses existing boundaries such as census blocks, counties, Congressional districts, etc. However, program developers are working on making it easy to draw your own boundaries and receive selected information for that specific place.

A final attribute of i-Tree Landscape is the variety of reports it can generate for you under "Build Report." There are standard formats, or you can customize it. In all cases, you determine what information you want included and the computer does the rest.

i-Tree Landscape is packed with options for retrieving information ranging from planting sites and tree benefits to potential threats and social demographics — all helpful for planning and improving urban forestry.

# Other i-Tree Tools

*It is impossible in eight pages to do justice to the range of i-Tree applications and their attributes. All of them can help assessment and management of our urban forests in one way or another. Here is a list of some of the programs now available and not discussed elsewhere in this bulletin.*

**i-Tree County** provides numerous benefits that trees provide within a U.S. county.

**i-Tree Planting** estimates the long-term environmental benefits from a tree planting project.

**i-Tree Harvest** estimates the amount of carbon stored in harvested wood products.

**i-Tree Glossary** gathers in one place definitions of terms and abbreviations used in the specialized vocabulary of i-Tree tools.

**i-Tree Database** allows you to view and comment on the tree species and location data used by i-Tree tools (primarily Eco) and add new species, location, precipitation, and pollution data if needed.

**International Overview** is a starting point for users outside of the United States, with information on how to make i-Tree tools work in specific locations or even entire countries.





## i-TREE SPREADS ACROSS THE GLOBE

The use of i-Tree tools, particularly i-Tree Eco, is now being used in some 5,000 locations in 100 countries from Canada and Chile in the western hemisphere to China and Australia in the east. David Nowak says, "This international data collection provides valuable new data to aid in understanding the benefits and values of forests, promoting improved forest management, and understanding the patterns and variations in urban forest ecosystem services and values. By using a standard data collection process, i-Tree Eco can help serve as a global standard on data collection and analyses of urban forests."



Dr. Christopher Nytch of Puerto Rico's Friends of El Yunque Foundation, has adapted i-Tree Eco methodology used in urban settings to accommodate the management priorities in post-hurricane El Yunque National Forest.

# A Good Use of i-Tree Design

*i-Tree Design is one of the major components of the i-Tree suite of tools. Like others in the core group, it can be adapted to meet the specific needs of the user. In this case, the Arbor Day Foundation found it to be a perfect fit for two of its more recent programs.*

## i-TREE DESIGN

Like the tools on page 3, this one is very easy to use. In short, it provides parcel-level analysis of current and future tree benefits. It can be used, for example, to show the ecoservice values of either existing or proposed trees of a selected species at a particular site, now or over a span of years.
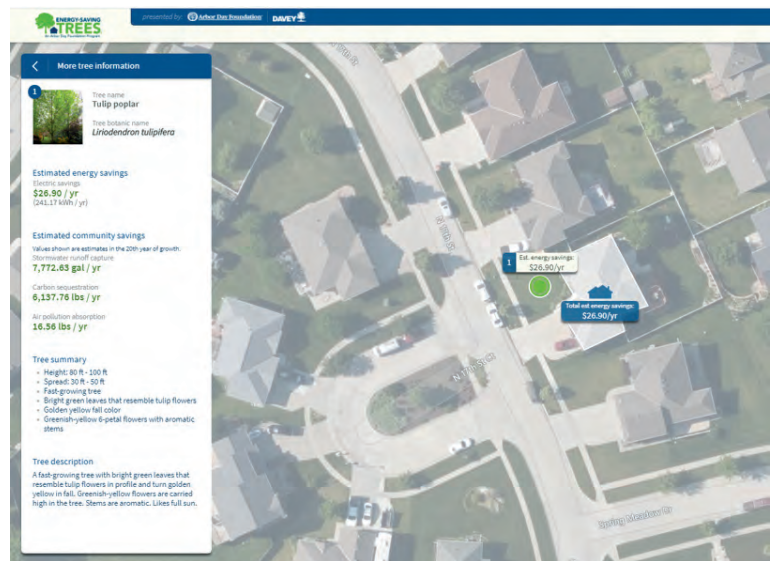
## ENERGY-SAVING TREES

*We've found that the fundamental architecture and data sets of the i-Tree suite provide a foundation for many different applications being created to meet needs around the world. The Arbor Day Foundation's Energy-Saving Trees application, for example, lets homeowners choose the right species for a specific site in their yard to best lower energy costs.*

— Matt Harris, Chief Executive, Arbor Day Foundation

The Arbor Day Foundation has combined the power of i-Tree Design with an opportunity to distribute free trees to homeowners by **partnering with utilities, cities, nonprofits, and corporate organizations** that are invested in the environmental benefits these trees will bring to their communities. The result is the Energy-Saving Trees program, which is supported by utilities, and Community Canopy, a similar program that is supported by cities, nonprofits, and corporate organizations.

*These programs offer our partners a turnkey solution for distributing trees to residents while also providing important metrics for the carbon sequestration, stormwater runoff avoidance, clean air, and energy savings associated with each tree.*

Here's how it works: **Program partners** choose the tree species and the number of trees to distribute to their audience. Homeowners are directed to a custom project website where they use an **online mapping tool** that guides them to the ideal location to plant trees around their home for the maximum



i-Tree Design powers the Arbor Day Foundation's Community Canopy and Energy-Saving Trees programs. The interactive online app helps homeowners decide where and what to plant to maximize savings on energy bills.

energy savings. The i-Tree technology powers these partner websites and provides the resident and partner with robust data surrounding the environmental and community impact of these distributed trees. Once trees have been reserved, the Arbor Day Foundation will deliver direct to homes or help partners arrange a pick-up event.

For information about how your organization or community can partner with Energy-Saving Trees or Community Canopy, email kbousquet@arborday.org.

You can also use this app by going to **design.itreetools.org**. This will provide the same information as above but without the opportunity to receive free trees.

## FOR MORE INFORMATION

For more information and direct links to the various i-Tree tools, please visit **arborday.org/bulletins**.

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