California Air Resources Board

User Guide

California Natural Resources Agency
Urban Greening Grant Program

California Climate Investments

FINAL Version 3
July 8, 2020

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List of Acronyms and Abbreviations

Acronym	Term
Btu	British thermal unit
C	carbon
CARB	California Air Resources Board
DBH	tree trunk diameter at breast height
Diesel PM	diesel particulate matter
g	grams
gal	gallons
GGRF	Greenhouse Gas Reduction Fund
GHG	greenhouse gas
kg	kilograms
kg C	Kilograms of carbon
kWh	kilowatt hours
lb	pounds
lb CO2e	pounds of carbon dioxide equivalent
MMBtu	one million British thermal units
MT	metric ton
MT CO2e	metric tons of carbon dioxide equivalent
MT C	metric tons of carbon
MWh	megawatt hour
NOx	nitrous oxide
PM_{10}	particulate matter with a diameter less than 10 micrometers
$PM_{2.5}$	particulate matter with a diameter less than 2.5 micrometers
ROG	reactive organic gas
scf	standard cubic feet
therm	one thousand British thermal units
VMT	vehicle miles travelled

Section A. Introduction

For the California Natural Resources Agency (CNRA) Urban Greening Grant Program (Urban Greening), California Air Resources Board (CARB) staff developed the Urban Greening Benefits Calculator Tool and accompanying Urban Greening Quantification Methodology to provide guidance for estimating the net greenhouse gas (GHG) benefit and selected co-benefits of each proposed project component. This User Guide provides instructions for using the Urban Greening Benefits Calculator Tool (Section B) and example projects (Section C). Methods and equations used in the Urban Greening Benefits Calculator Tool for estimating the net GHG benefit and air pollutant emission co-benefits are provided in the Urban Greening Quantification Methodology. The Urban Greening Benefits Calculator Tool and supporting Urban Greening Quantification Methodology are available for download at: www.arb.ca.gov/cci-resources.

Updates

CARB staff periodically review each quantification methodology and benefits calculator tool to evaluate their effectiveness and update methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified. The current Urban Greening Benefits Calculator Tool was updated to include:

- *Version 3:* Updated screenshots to reflect below updates and USFS i-Tree Planting (version 2.0.2) updates
- *Version 2*: Corrected missing formula to calculate irrigation water savings on the Tree Planting worksheets of the Urban Greening Benefits Calculator Tool;
- *Version 2*: Simplified User Guide instructions to calculate tree growth years;
- Updates to the emission factors used to estimate energy saved or avoided vehicle miles travelled and associated cost savings and air pollutant emission reductions;
- Inclusion of brake-wear and tire-wear emissions in $PM_{2.5}$ air pollutant emissions from reduced vehicle miles travelled;
- Correction of water savings estimate as irrigation savings only (previous version incorrectly summed rainfall interception, stormwater runoff, and irrigation savings as total water savings);
- Updates to default trip lengths for active transportation project components; &
- Categorization of air pollutant emission reductions as local (tree interception of air pollutant deposition and natural gas emissions from winter tree shade) or remote (avoided grid electricity use and avoided landfill emissions).

Program Assistance

Applicants should use the following resources for additional questions and comments:

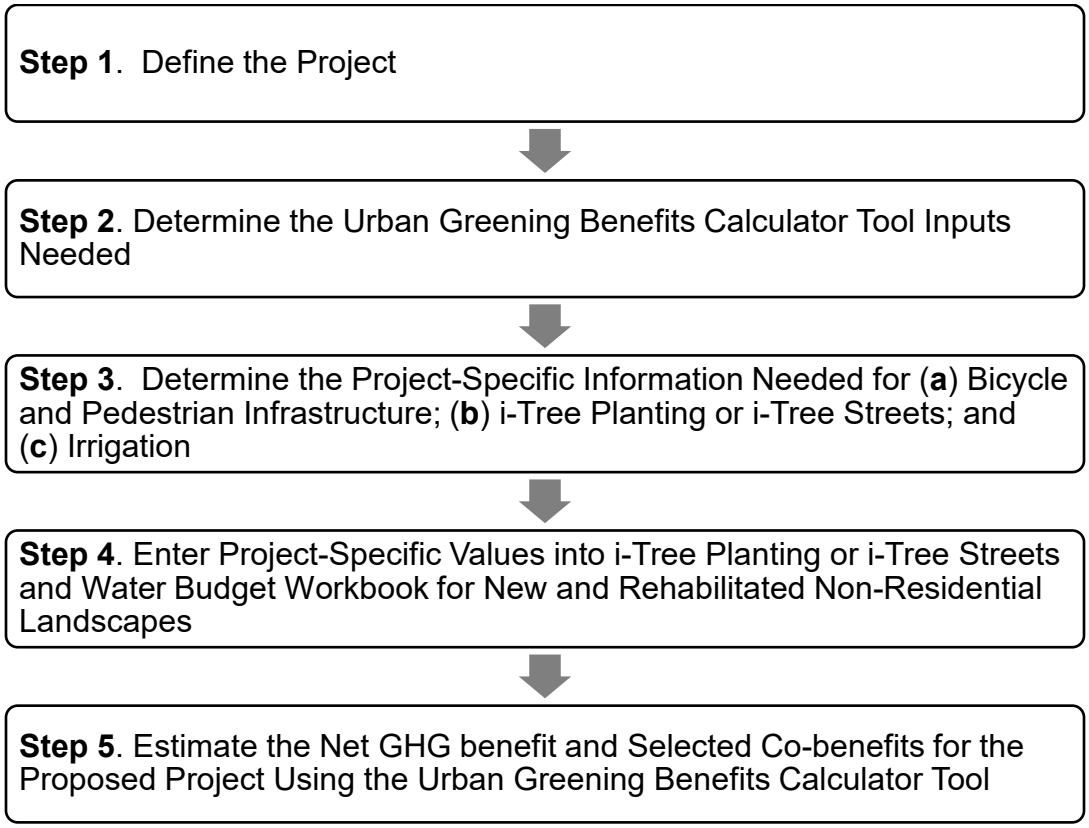
- Questions on this document should be sent to: GGRFProgram@arb.ca.gov.
- For more information on CARB's efforts to support implementation of California Climate Investments, see: www.arb.ca.gov/auctionproceeds.
- Questions pertaining to the Urban Greening Program should be sent to: urbangreening@resources.ca.gov.

Section B. Step-by-Step Guide

Overview

Applicants will follow the steps outlined in Figure 1 to estimate the net GHG benefit and selected co-benefits from the proposed project. Detailed instructions for each step are provided on subsequent pages. An example project showing how to estimate the net GHG benefit and selected co-benefits from a project is included in Section C.

Figure 1. Steps to Estimating Net GHG Benefit and Selected Co-benefits



Step 1: Define the Project

Applicants must define the project by identifying eligible project components that apply to the project. Applicants may incorporate more than one project component, as appropriate, to quantify the net GHG benefit and selected co-benefits. The project components identified will determine which sections of the Urban Greening Benefits Calculator Tool must be used in order to estimate the net GHG benefit and selected co-benefits.

Project Components

The CNRA Urban Greening Program achieves a net GHG benefit by sequestering carbon in trees, providing cooling shade for buildings, and avoiding vehicle miles traveled by constructing bicycle lanes and pedestrian paths. CNRA developed three project components that meet the objectives of the Urban Greening and for which there are methods to quantify a net GHG benefit.[1] Other project features may be eligible for funding under the Urban Greening; however, each project requesting Greenhouse Gas Reduction Fund (GGRF) funding must include at least one of the following:

- Sequester and store carbon by planting trees;
- Reduce building energy use from strategically planting trees to shade buildings; or
- Reduce commute vehicle miles traveled by constructing bicycle paths, bicycle lanes, or pedestrian facilities that provide safe routes for travel between residences, workplaces, commercial centers, and schools.

[1]California Natural Resources Agency (2019). Urban Greening Grant Program Final Guidelines. http://resources.ca.gov/grants/wp-content/uploads/2019/01/Urban-Greening-Program-Guidelines-Round-Three.pdf.

Step 2: Determine the Urban Greening Benefits Calculator Tool Inputs Needed

Table 1 identifies the data inputs needed to estimate the net GHG benefit and selected co-benefits for the proposed project with the Urban Greening Benefits Calculator Tool, organized by project component.

Table 1. Required Urban Greening Benefits Calculator Tool Inputs for Eligible Project Components

ALL PROJECTS
General Information (Project Info worksheet) • Project Name; • Applicant ID; • Contact Name; • Contact Phone Number; • Contact Email; • Date Completed; • Total amount of Urban Greening GGRF funds requested from this solicitation; • Total amount of additional GGRF funds to implement the project (include GGRF funds previously awarded to the project by CNRA's Urban Greening Program or another California Climate Investments program, GGRF funds currently being requested from another California Climate Investments program, and GGRF funds the project plans to request in the future from CNRA's Urban Greening Program or another California Climate Investments program); and • Other non-GGRF leveraged funds.

The following tables describe the information needed to estimate the GHG benefits and co-benefits from the project using the i-Tree Planting web tool or i-Tree Streets software. Applicants can choose which of these tools to use to estimate the GHG benefit of tree planting, however they should only use one per application. i-Tree Planting has an easy-to-use graphic user interface, and is recommended for users that do not have an existing tree planting inventory database.

Table 1 (continued). Required Urban Greening Benefits Calculator Tool Inputs for Eligible Project Components

Tree Planting Using Outputs if using i-Tree Planting
i-Tree Planting Inputs • City and County where trees will be planted • Species of trees that will be planted • Tree DBH at time of planting in inches (trunk diameter at breast height) • Distance to nearest building in feet (<20', 20'-40', 40'-60', or >60') • Cardinal direction from nearest building to tree (N, NE, E, SE, S, SW, W) • Vintage of building (Built after 1980, between 1950-1980, or before 1950) • Climate controls in nearest building (Heat&AC, AC Only, Heat Only, or None) • Tree condition at planting (Excellent, Good, Fair, etc.) • Exposure to sunlight at location of planting (Full Sun, Partial Sun, Full Shade) • Number of trees to be planted **Quantification Inputs** (Tree Planting-ITP worksheet of Benefits Calculator Tool) • If project involves additional irrigation, annual on-site water use in baseline and project scenarios (gal/year) (from Step 3c). • Group Identifier from i-Tree Planting (from Step 4); • Tree group characteristics (from Step 4); • Quantity of trees to be planted by group; • Total carbon sequestered in group of trees planted by the project 40 years after project start (lb CO_2e) (from Step 4); • Total electricity savings from the group of trees planted by the project over the 40 year quantification period (kWh) (from Step 4); • Total natural gas savings from the group of trees planted by the project over the 40 year quantification period (MMBtu) (from Step 4); • Total removal of NO_2 and $PM_{2.5}$ by the group of trees planted by the project over the 40 year quantification period (lb) (from Step 4); • Total rainfall interception (gal) (from Step 4); • Total avoided runoff (gal) (from Step 4); and • If project involves additional irrigation, annual on-site water use in baseline and project scenarios (gal/year) (from Step 4).

Table1 (continued). Required Urban Greening Benefits Calculator Tool Inputs for Eligible Project Components

Tree Planting Using Outputs if using i-Tree Streets
i-Tree Streets Inputs • Inventory of trees to be planted (if available) • Year of project start • Climate Zone (determined from Step 3a) • Species of trees that will be planted • Tree DBH 40 years after project start, (trunk diameter at breast height, in inches) **Quantification Inputs** (Tree Planting -ITS worksheet of Benefits Calculator Tool) • If project involves additional irrigation, annual on-site water use in baseline and project scenario (gal/yr) (from Step 3c). • Total carbon stored in population of trees planted by the project 40 years after project start (lb CO_2e) (from Step 4); • Total annual electricity savings from the population of trees planted by the project 40 years after project start (MWh/yr) (from Step 4); • Total annual natural gas savings from the population of trees planted by the project 40 years after project start (therms/yr) (from Step 4); • Quantity of trees to be planted; • Percentage of trees planted within 60 feet of an air-conditioned building; • Total annual deposition of NO_2 and PM_{10} absorbed by the population of trees planted by the project 40 years after the project start (lb) (from Step 4); • Total rainfall interception (gal/yr) (from Step 4); and • If project involves additional irrigation, annual on-site water use in baseline and project scenario (gal/yr) (from Step 4).

Table 1 (continued). Required Urban Greening Benefits Calculator Tool Inputs for Eligible Project Components

Bicycle and Pedestrian Facility Project Activities[2]
Quantification Inputs (New Bike-Ped Infrastructure worksheet of Calculator Tool) • Pedestrian or bicycle facility type (e.g., Bicycle Paths Class I) from the drop down menu; • County where the bicycle or pedestrian facility will be constructed; • First year of project. The final year of useful life will automatically be populated based on the facility type selected (Class II bike lanes have a 15 year life, all other types have a 20 year life); • Annual days of operation for the project. Use 200 days for bicycle and pedestrian facilities unless there is documented evidence to justify a higher number of annual days of operation[2]; • Annual average daily two way traffic (ADT) volume (trips/day) (maximum value is 30,000); • Length of bicycle or pedestrian path (miles); • Population of the city/town where the bicycle and/or pedestrian facilities will be constructed; • City/town has a university within city limits (Yes/No); • Number of Activity Centers within a quarter mile of the newly constructed bicycle or pedestrian facilities; and Number of Activity Centers within a half mile of the newly constructed bicycle or pedestrian facilities. Activity Centers include: bank or post office; grocery store; medical center; office park; pharmacy; place of worship; public library; school, university or college; or light rail station (park & ride) (from Step 3a).

[2] Defaults (except for bike and pedestrian default trip lengths) were based on *Methods to Find the Cost-Effectiveness of Funding Air Quality Projects*, (May 2005), https://www.arb.ca.gov/planning/tsaq/eval/eval.htm
Default bike trip length value was updated from 1.8 miles to 1.5 miles, based on California Household Travel Survey data, as recommended in *Quantifying Reductions in Vehicle Miles Travelled from New Bike Paths, Lanes, and Cycle Tracks, Summary Report* from the Institute of Transportation Studies, University of California, Davis (March 2019)
https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/bicycle%20facilities_summary_032519.pdf
Default pedestrian trip length value was updated from 1.0 miles to 0.3 miles, based on California Household Travel Survey data, as recommended in *Quantifying Reductions in Vehicle Miles Travelled from New Pedestrian Facilities, Summary Report* from the Institute of Transportation Studies, University of California, Davis (March 2019)
https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/pedestrian_facilities_summary_032519.pdf

Step 3a: Determine the Project-Specific Bicycle and Pedestrian Information

Eligible bicycle facility types include Class I, Class II, and Class IV bikeways, as defined below (from Assembly Bill 1193).[3]

- Class I bike paths or shared-use paths provide a completely separated right-of-way designated for the exclusive use of bicycles and pedestrians with crossflows by motorists minimized.
- Class II bike lanes provide a restricted right-of-way designated for the exclusive or semi-exclusive use of bicycles with through travel by motor vehicles or pedestrians prohibited, but with vehicle parking and crossflows by pedestrians and motorists permitted.
- Class IV separated bikeways provide a right-of-way designated exclusively for bicycle travel adjacent to a roadway and are protected from vehicular traffic by features such as grade separation, physical barriers, or on-street parking.

Multi-use projects (e.g., Class I Bike Path) that will result in reduced vehicle miles travelled (VMT) from bicycle and pedestrian uses may account for both uses by entering the component in the Urban Greening Benefits Calculator Tool separately as a bicycle facility and a pedestrian facility. Contiguous projects are considered to be a single project for quantification of emission reductions.

The number of Activity Centers within a quarter mile and within a ½ mile of the newly constructed bicycle or pedestrian facilities is required as an input into the Benefits Calculator Tool. Activity Centers include: bank or post office; grocery store; medical center; office park; pharmacy; place of worship; public library; school, university or college; or light rail station (park & ride).

[3] Assembly Bill 1193, available at: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1193

Step 3b: Determine the Project-Specific Information Needed for i-Tree Planting or i-Tree Streets

The following subsections describe the information needed to estimate the carbon stored in planted trees (using i-Tree Planting or i-Tree Streets) and GHG emission reductions from building energy savings (using i-Tree Planting or i-Tree Streets). Applicants can choose which of these tools to use to estimate the GHG benefit of tree planting, however they should only use one per application. Quantification methods are provided for both tools; applicants must follow the instructions applicable to the tool selected. i-Tree Planting has an easy-to-use graphic user interface, and is recommended for users that do not have an existing tree planting inventory database.

Tree Planting

Table 2 describes the information needed to estimate carbon stored in trees to be planted by the project using the two carbon accounting tools for urban trees.

Table 2. Required Information for Estimating Carbon Storage

Trees Species Planted
i-Tree Planting & i-Tree Streets i-Tree Planting and i-Tree Streets include over a hundred species for each climate zone. The program accepts the scientific or common names of species. A complete list of species codes by climate zone with scientific and common names is available at: http://www.itreetools.org/streets/resources/Streets Species Codes.xls **What if the tree species are not included in the tool?** If the tree species are not available options within the selected urban tree carbon accounting tool, the applicant will need to use proxy species (the species that best matches the genus, size, and other tree characteristics) to estimate the carbon and energy benefits. Applicants using i-Tree Planting or i-Tree Streets can use the i-Tree Streets species by climate zone list to assist in selecting the most appropriate proxy from the available species.

Table 2 (continued). Required Information for Estimating Carbon Storage

i-Tree Planting	i-Tree Streets
Years for the Project i-Tree Planting uses "years for the project" and the diameter at breast height (DBH) at time of planting to estimate tree growth and benefits over a given project life. CCI tree planting projects have a designated project life of 40 years. The "years for the project" input is the total years of tree growth 40 years from the project start date. For example, for trees planted in the first year of the project, enter "40". For trees planted in the second year, enter "39". For trees planted in the third year, enter "38", etc.	**DBH of trees 40 yr after project start** i-Tree Streets uses DBH at the end of the quantification period to provide an estimate of the total carbon stored. i-Tree Streets allows input of either an exact DBH or a range. If entering an exact number, the applicant will enter the DBH expected 40 years after project start. If entering a DBH class, the applicant will enter a number 1-9 that corresponds with the default range expected at that time.

i-Tree Planting	i-Tree Streets
Project location/Climate zone where tree planting will occur The drop down menus in i-Tree Planting tool allow the user to select the location of the project (State, County, City), which will provide the climate zone information required by the tool.	**Project location/Climate zone where tree planting will occur** Use the map in Figure 2 below to identify which of the climate zones (referred to as climate regions in i-Tree Streets) the project is located in. Climate zone boundaries are approximate; if in doubt, match cooling degree days and heating degree days for the project location with those in Table 3. Applicants can find information on local cooling degree days and heating degree days from the Western Regional Climate Center at: https://wrcc.dri.edu/Climate/west_lcd_2008.php

Figure 2. i-Tree Streets Climate Zones

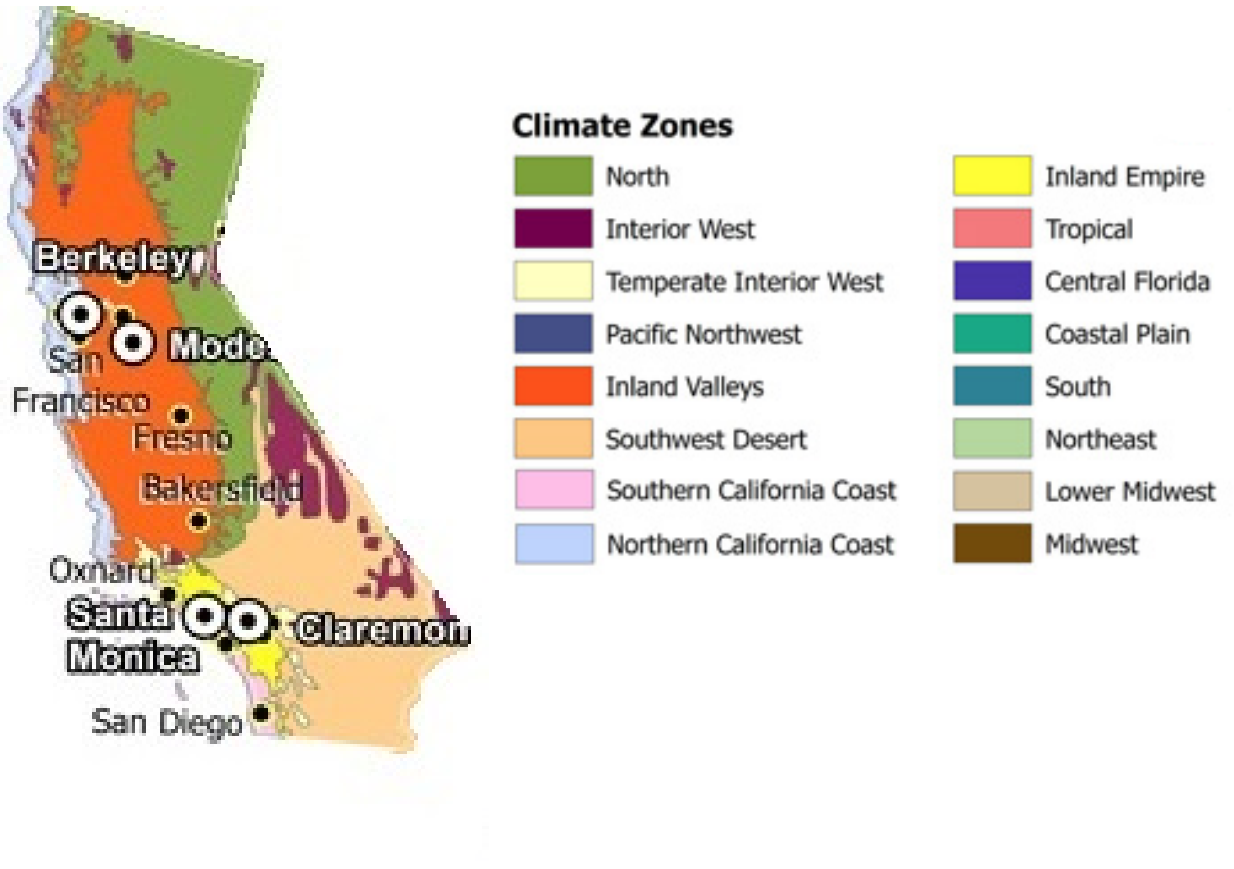


Table 3. Climate Zones

Climate Region	Reference City	CDD1	HDD2
Interior West	Albuquerque, NM	1210	4362
Northern California Coast	Berkeley, CA	69	3237
Temperate Interior West	Boise, ID	692	6001
Coastal Plain	Charleston, SC	2011	2209
South	Charlotte, NC	1514	3415
Inland Empire	Claremont, CA	937	2133
North	Fort Collins, CO	623	6013
Desert Southwest	Glendale, AZ	3815	1153
Tropical	Honolulu, HI	4327	0
Lower Midwest	Indianapolis, IN	911	5690
Midwest	Minneapolis, MN	634	8002
Inland Valleys	Modesto, CA	1884	2602
Northeast	Queens, NY	1002	5088
Southern California Coast	Santa Monica, CA	470	1291
Central Florida	Orlando, FL	3400	631
Pacific Northwest	Longview, WA	279	4461

1CDD=Cooling Degree Days
2HDD=Heating Degree Days

If tree planting sites are strategically selected to shade buildings (i.e., planted within 60 feet), applicants can also account for GHG emission reductions from building energy savings by entering additional information. Table 4 describes the information needed to estimate GHG emission reductions from energy savings.

Table 4. Required Information for Estimating GHG Emission Reductions from Building Energy Savings

Tree Location and Building Energy Use	
i-Tree Planting	**i-Tree Streets**
To calculate building energy savings, i-Tree Planting requires inputs for tree azimuth (compass bearing from nearest building), distance from the nearest air-conditioned/heated building, building vintage, and type of climate controls of nearest building. Because it is unlikely that specific tree site locations will be identified at the time of application submission, applicants can extrapolate information from previous planting efforts and neighborhood characteristics.	To calculate building energy savings, i-Tree Streets relies on tree species and size and embedded default values based on project location as described in the i-Tree Streets Reference City Community Tree Guides available at: https://www.itreetools.org/resources/archives.php. No additional inputs are required by applicants.

Step 3c: Determine the Project-Specific Irrigation Information

If the project involves additional irrigation, additional water use must be accounted for when determining water savings of the project. Urban Greening projects fall under Category 3 Urban Landscaping of the CARB Water Savings Co-benefit Assessment Methodology.[4] Per that methodology, users estimate water use with the California Department of Water Resources' Water Budget Calculator for New and Rehabilitated Residential/Non-Residential Landscapes[5] and the University of California's Division of Agriculture and Natural Resources' Water Use Classification of Landscape Species (WUCOLS IV).[6] The Water Savings Co-benefit Assessment Methodology includes information on the required inputs on page 11 and an example of how to use the tools on page 18. If the project involves additional irrigation, the user must input the annual baseline and project water use (in gallons) into the Urban Greening Benefits Calculator Tool to calculate the total water savings of the project.

[4] California Air Resources Board (2018). Co-Benefit Assessment Methodology for Water Savings.
https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/final_water_am.pdf

[5] California Department of Water Resources (2017). Water Budget Calculator for New and Rehabilitated Residential/Non-Residential Landscapes Beta version 1.30
https://cadwr.app.box.com/s/5k39tv10u42rp5bn2uebd7fodkxzgve7
Available at:
https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Model-Water-Efficient-Landscape-Ordinance

[6] University of California, Division of Agriculture and Natural Resources. Water Use Classification of Landscape Species (WUCOLS IV)
http://ucanr.edu/sites/WUCOLS/Plant_Search/

Step 4: Enter Project-Specific Values into i-Tree Planting or i-Tree Streets

This section provides instruction on using the project-specific values determined in Step 3b and emission factors provided to estimate the carbon stored in trees and GHG emission reductions from building energy savings. Applicants can choose which of these tools to use to estimate the GHG benefit of tree planting, however they should only use one per application. The sections below provide quantification methods for both i-Tree Planting and i-Tree Streets, where applicable. Applicants must follow the instructions appropriate for the urban tree carbon accounting tool selected.

Tree Carbon Storage and GHG Emission Reductions from the Effects of Tree Shade on Building Energy Use

i-Tree Planting

After navigating to the web-based tool i-Tree Planting,[7] select "Get Started" to enter project-specific data. For each tree and tree planting site modeled, enter values into the drop down menus or entry boxes as indicated in Table 5.

> **User Tip:**
> i-Tree Planting calculates tree carbon storage and emission reductions from building energy savings based on a similar group of trees. Applicants should use as many groups as necessary to accurately model their proposed project.

Table 5. Required Inputs for Estimating Carbon Storage and Energy Savings

Location Tab	
State/Province	Select California in the drop down menu.
County/Division	Select the County where the project will be located.
City	Select the City where the project will be located or nearest to.

[7] United States Department of Agriculture, Forest Service. i-Tree Planting Calculator version 1.2.0. https://planting.itreetools.org/

Table 6 (continued). Required Inputs for Estimating Carbon Storage and Energy Savings

Project Parameters	
Electricity Emissions Factor	Enter "227.9" kg CO_2e/MWh
Units	Select "kilograms CO_2e/MWh"
Fuel Emissions Factor	"53.1" kg CO_2e/MMBtu
Units	Select "kilograms CO_2e/MMBtu"
Years for the Project	The "years for the project" input is the total years of tree growth 40 years from the project start date. For example, for trees planted in the first year of the project, enter "40". For trees planted in the second year, enter "39". For trees planted in the third year, enter "38", etc. (See Step 3b for more details.)
Tree Mortality over Project Lifetime (estimated %)	Enter "0" (The Urban Greening Benefits Calculator Tool will account for tree mortality).
Tree Planting Configurations	
Units	Select "English (feet & inches)".
Nomenclature	Applicant can choose either Common Name or Scientific Name.
Species	Select the species of tree to be planted. Applicants can add multiple types of species by selecting the "+" next to "Group Number."
DBH in Inches	Enter the DBH at time of planting.
Distance to Nearest Building in Feet	Select the distance to the nearest climate-controlled building in feet from the drop down menu.
Tree is _____ of Building	Select the cardinal direction in which the tree is located from the building (e.g., North, South, etc.) from the drop down menu.
Vintage	Select the vintage (age range) of the nearby building from the drop down menu.
Climate Controls	Select the type of climate controls the nearby building has installed. (**Note:** If a tree is planted greater than 60 feet away from an air-conditioned building, select "None."
Condition	Select the condition of the overall health of the trees at the time of planting (Excellent, Good, Fair, etc.).
Exposure to Sunlight	Select the amount of sun that reaches the tree leaves, based on the surroundings (Full Sun, Partial Sun, etc.).
Number of Trees	Enter the number of trees that are the same species and have the same characteristics (e.g., distance to building, location in respect to building, exposure to sunlight, etc.) If some of the characteristics change

	between trees, the tool requires multiple lines of the same species to be input.

Table 7 (continued). Required Inputs for Estimating Carbon Storage and Energy Savings

Planting Report	
Units	English (pounds & tons; kWh & MMBtu; gallons)

The i-Tree Planting tool provides multiple benefit outputs including carbon sequestration, energy savings, air pollutant removal and water savings benefits for each group identifier. The applicant will enter the data from the output fields, shown circled in red in Figures 3 through 6, from each group into the Urban Greening Benefits Calculator Tool in order to calculate the total benefits for the project. Print the planting reports and submit along with your Urban Greening grant application.

Figure 3. i-Tree Planting CO_2 Benefits

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Location		CO_2 Benefits			
Group Identifier	Tree Group Characteristics	CO_2 Avoided (pounds)	CO_2 Avoided ($)	CO_2 Sequestered (pounds)	CO_2 Sequestered ($)
1	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted 20-39 feet and west (270°) of buildings that were built post-1980 with heat and A/C. • Trees are in excellent condition and planted in full sun.	-10,526.4	$-244.81	312,342.1	$7,264.12
2	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted >60 feet and north (0°) of buildings that were built post-1980 with neither heat nor A/C. • Trees are in excellent condition and planted in full sun.	0.0	$0.00	312,342.1	$7,264.12

Figure 4. i-Tree Planting Energy Benefits

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Location		Energy Benefits			
Group Identifier	Tree Group Characteristics	Electricity Saved (kWh)	Electricity Saved ($)	Fuel Saved (MMBtu)	Fuel Saved ($)
1	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted 20-39 feet and west (270°) of buildings that were built post-1980 with heat and A/C. • Trees are in excellent condition and planted in full sun.	49,164.8	$9,783.79	-321.5	$-4,159.68
2	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted >60 feet and north (0°) of buildings that were built post-1980 with neither heat nor A/C. • Trees are in excellent condition and planted in full sun.	0.0	$0.00	0.0	$0.00

Figure 5. i-Tree Planting Air Pollution Benefits

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Location		Air Benefits							
Group Identifier	Tree Group Characteristics	O_3 Removed (pounds)	NO_2 Avoided (pounds)	NO_2 Removed (pounds)	SO_2 Avoided (pounds)	SO_2 Removed (pounds)	VOC Avoided (pounds)	$PM_{2.5}$ Avoided (pounds)	$PM_{2.5}$ Removed (pounds)
1	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted 20-39 feet and west (270°) of buildings that were built post-1980 with heat and A/C. • Trees are in excellent condition and planted in full sun.	288.0	-0.5	67.2	-1.7	1.7	22.9	15.5	5.0
2	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted >60 feet and north (0°) of buildings that were built post-1980 with neither heat nor A/C. • Trees are in excellent condition and planted in full sun.	288.0	0.0	67.2	0.0	1.7	0.0	0.0	5.0

Figure 6. i-Tree Planting Water Savings Benefits

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Location		Ecosystem Services			
Group Identifier	Tree Group Characteristics	Tree Biomass (short ton)	Rainfall Interception (gallons)	Avoided Runoff (gallons)	Avoided Runoff ($)
1	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted 20-39 feet and west (270°) of buildings that were built post-1980 with heat and A/C. • Trees are in excellent condition and planted in full sun.	85.2	133,059.8	40,465.8	$361.60
2	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted >60 feet and north (0°) of buildings that were built post-1980 with neither heat nor A/C. • Trees are in excellent condition and planted in full sun.	85.2	133,059.8	40,465.8	$361.60

i-Tree Streets

Applicants have the option of entering tree and tree planting site information directly into i-Tree Streets[8] or uploading information from a Microsoft Access database that meets the i-Tree Streets formatting requirements. Database formatting requirements can be found in the i-Tree Streets User's Manual available at: https://www.itreetools.org/resources/manuals/Streets_Manual_v5.pdf or a supplementary guidebook, *Formatting Existing Inventories into Streets*, available at: https://www.itreetools.org/streets/resources/Formatting_Existing_Inventories_for_Streets.pdf.

After downloading and installing the i-Tree software suite, open i-Tree Streets and create a new project by clicking on the File menu > Open > New Project; a pop-up window will appear. Enter the information as indicated in Table 6.

Table 8. Required Inputs for Creating a New i-Tree Streets Project

New Project Inputs	
Database	Select "Create New" to enter inventory information or select existing to upload inventory information.
Project Name	Enter the name of the project.
Inventory Type	Select "Complete."[9]
Year	Enter the year 40 years after project start.
Climate Region	Select the project-specific California climate zone determined in Step 3b.

After entering this information, click "Finish". A series of pop-up windows will appear titled "Define City," "Define Cost," and "Benefit Prices." No entry is required in these windows and applicants may click "Cancel" in each window.[10] A pop-up window titled "User Defined Fields" will appear. Under the DBH tab, applicants can select to use the range (class) or exact DBH (measurement) and choose to enter DBH in inches or centimeters. Applicants can review the data descriptions in the other tabs and customize fields as desired. When finished, click "OK."

Applicants that choose to enter tree data directly into i-Tree Streets will start the process by clicking Input > Records. Click "New" in the pop-up window to enter a new tree record. Enter the information as indicated in Table 7 for each tree to be planted by the project.[11] Applicants that choose to upload tree and tree planting site

[8] United States Department of Agriculture, Forest Service. i-Tree Streets. https://www.itreetools.org/streets/index.php

[9] i-Tree Streets allows users to use a sample or complete inventory. For the purpose of this Quantification Methodology, applicants must provide a complete inventory (i.e., create a tree record for every tree to be planted by the project).

[10] Applicants may choose to input additional information but it is not required and will not impact the outputs used in this quantification methodology and the Urban Greening Calculator Tool.

data from a formatted database will start the process by compiling the data indicated in Table 7 for each tree to be planted by the project. When formatted to be compatible with i-Tree Streets, save the database and return to i-Tree Streets. Click File > Import > Inventory Data and follow the prompts to upload the data into i-Tree Streets.

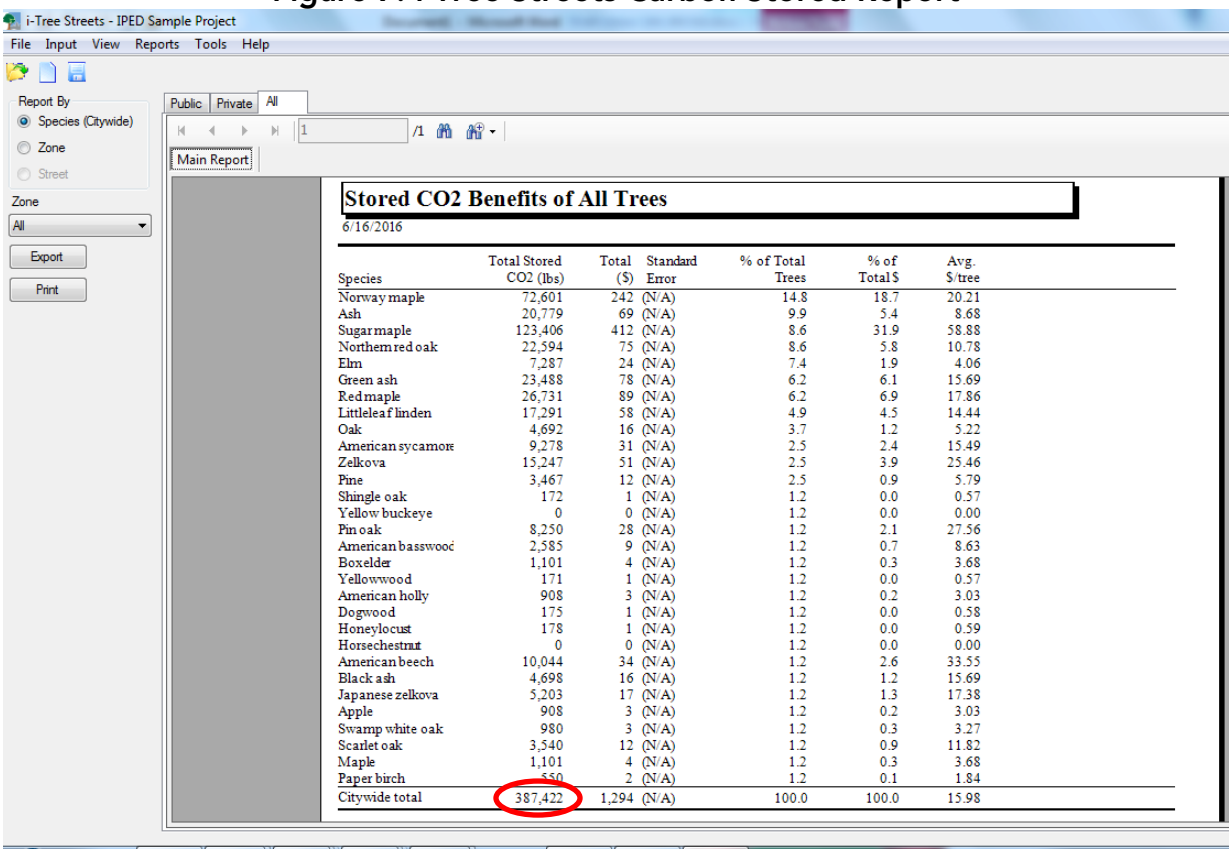
Table 9. Required Inputs for Estimating Carbon Storage and Energy Savings

Tree and Tree Planting Site Inputs	
Species (Tree Info tab)	Select the tree species (or proxy species) to be planted for the project as determined in Step 3b.
DBH (Tree Info tab)	If using ranges, select the DBH size class of the tree 40 years after project start as determined in Step 3b. If using exact values, enter the DBH of the tree 40 years after project start as determined in Step 3b.

After a complete tree inventory is entered or uploaded, applicants must run three reports in i-Tree Streets to obtain the project values for carbon storage, building energy savings, and air quality co-benefits.

To obtain the value for carbon storage, click Reports > Benefit-Cost Analysis > Annual Benefits > Carbon Stored. A report will appear that lists the stored CO_2 (lb CO_2e) for each species included in the inventory. The total CO_2 stored for the population of trees to be planted by the project is at the bottom of the report. The applicant will enter the total CO_2 value, shown circled in red in Figure 7, into the Urban Greening Calculator Tool in order to calculate the GHG benefit of tree carbon sequestration for the project.

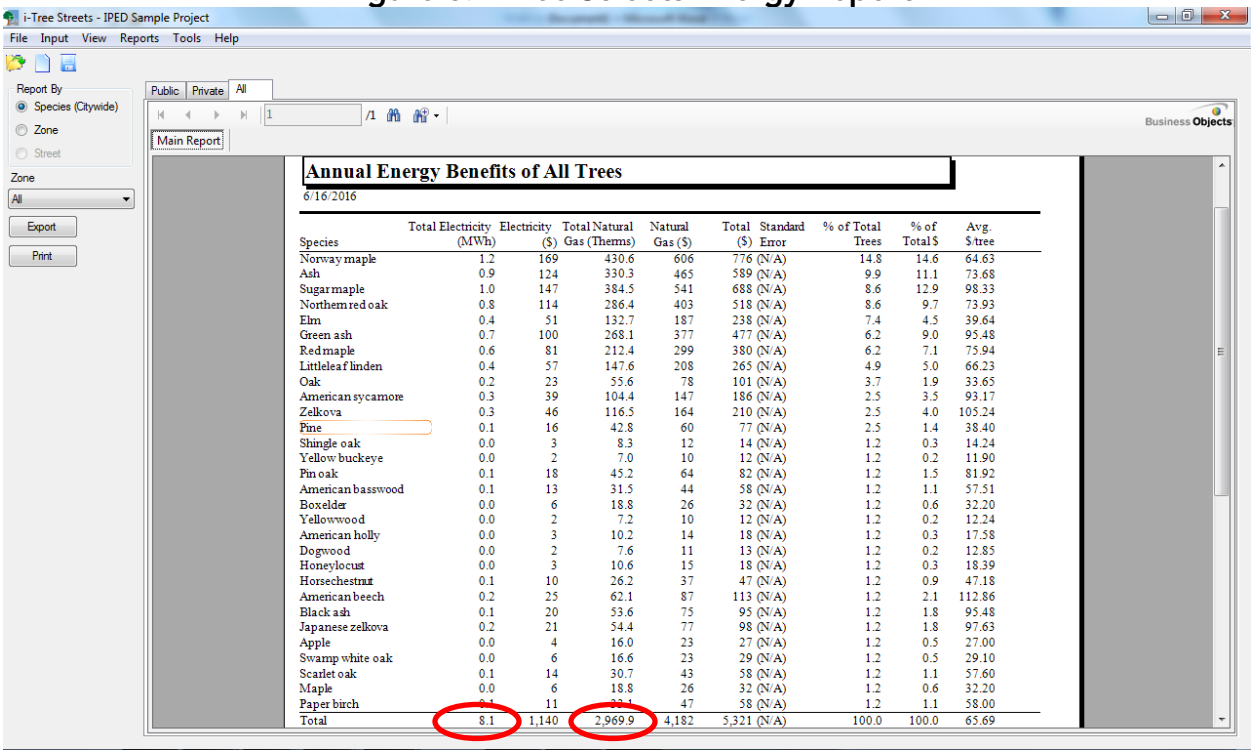
Figure 7. i-Tree Streets Carbon Stored Report



Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	72,601	242	(N/A)	14.8	18.7	20.21
Ash	20,779	69	(N/A)	9.9	5.4	8.68
Sugar maple	123,406	412	(N/A)	8.6	31.9	58.88
Northern red oak	22,594	75	(N/A)	8.6	5.8	10.78
Elm	7,287	24	(N/A)	7.4	1.9	4.06
Green ash	23,488	78	(N/A)	6.2	6.1	15.69
Red maple	26,731	89	(N/A)	6.2	6.9	17.86
Littleleaf linden	17,291	58	(N/A)	4.9	4.5	14.44
Oak	4,692	16	(N/A)	3.7	1.2	5.22
American sycamore	9,278	31	(N/A)	2.5	2.4	15.49
Zelkova	15,247	51	(N/A)	2.5	3.9	25.46
Pine	3,467	12	(N/A)	2.5	0.9	5.79
Shingle oak	172	1	(N/A)	1.2	0.0	0.57
Yellow buckeye	0	0	(N/A)	1.2	0.0	0.00
Pin oak	8,250	28	(N/A)	1.2	2.1	27.56
American basswood	2,585	9	(N/A)	1.2	0.7	8.63
Boxelder	1,101	4	(N/A)	1.2	0.3	3.68
Yellowwood	171	1	(N/A)	1.2	0.0	0.57
American holly	908	3	(N/A)	1.2	0.2	3.03
Dogwood	175	1	(N/A)	1.2	0.0	0.58
Honeylocust	178	1	(N/A)	1.2	0.0	0.59
Horsechestnut	0	0	(N/A)	1.2	0.0	0.00
American beech	10,044	34	(N/A)	1.2	2.6	33.55
Black ash	4,698	16	(N/A)	1.2	1.2	15.69
Japanese zelkova	5,203	17	(N/A)	1.2	1.3	17.38
Apple	908	3	(N/A)	1.2	0.2	3.03
Swamp white oak	980	3	(N/A)	1.2	0.3	3.27
Scarlet oak	3,540	12	(N/A)	1.2	0.9	11.82
Maple	1,101	4	(N/A)	1.2	0.3	3.68
Paper birch	550	2	(N/A)	1.2	0.1	1.84
Citywide total	387,422	1,294	(N/A)	100.0	100.0	15.98

To obtain the value for building energy savings, click Reports > Benefit-Cost Analysis > Annual Benefits > Energy. A report will appear that lists the electricity (MWh) and natural gas savings (therms) for each species included in the inventory. The total electricity and natural gas savings for the population of trees to be planted by the project are at the bottom of the report. The applicant will enter the total electricity and total natural gas savings, shown circled in red in Figure 8, into the Urban Greening Benefits Calculator Tool in order to calculate the GHG benefit from building energy savings for the project.

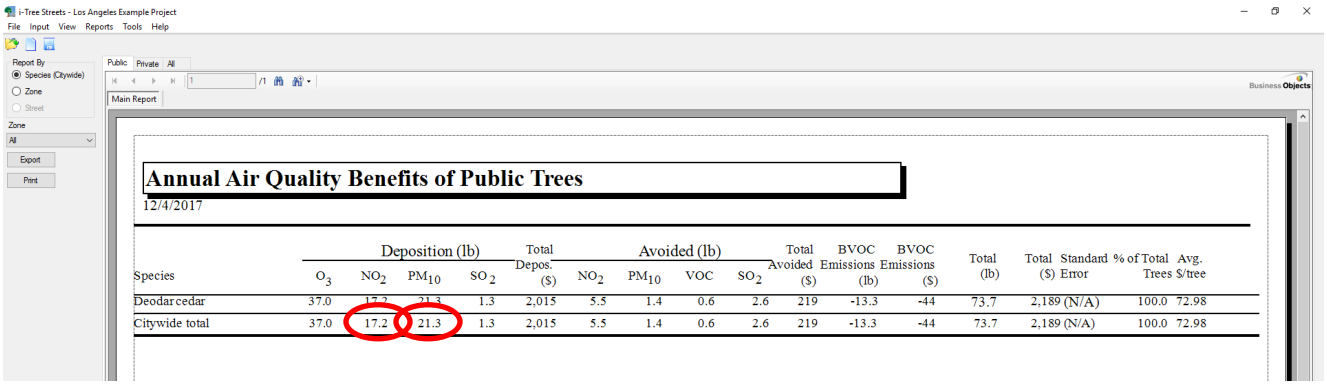
Figure 8. i-Tree Streets Energy Report



Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	1.2	169	430.6	606	776	(N/A)	14.8	14.6	64.63
Ash	0.9	124	330.3	465	589	(N/A)	9.9	11.1	73.68
Sugar maple	1.0	147	384.5	541	688	(N/A)	8.6	12.9	98.33
Northern red oak	0.8	114	286.4	403	518	(N/A)	8.6	9.7	73.93
Elm	0.4	51	132.7	187	238	(N/A)	7.4	4.5	39.64
Green ash	0.7	100	268.1	377	477	(N/A)	6.2	9.0	95.48
Red maple	0.6	81	212.4	299	380	(N/A)	6.2	7.1	75.94
Littleleaf linden	0.4	57	147.6	208	265	(N/A)	4.9	5.0	66.23
Oak	0.2	23	55.6	78	101	(N/A)	3.7	1.9	33.65
American sycamore	0.3	39	104.4	147	186	(N/A)	2.5	3.5	93.17
Zelkova	0.3	46	116.5	164	210	(N/A)	2.5	4.0	105.24
Pine	0.1	16	42.8	60	77	(N/A)	2.5	1.4	38.40
Shingle oak	0.0	3	8.3	12	14	(N/A)	1.2	0.3	14.24
Yellow buckeye	0.0	2	7.0	10	12	(N/A)	1.2	0.2	11.90
Pin oak	0.1	18	45.2	64	82	(N/A)	1.2	1.5	81.92
American basswood	0.1	13	31.5	44	58	(N/A)	1.2	1.1	57.51
Boxelder	0.0	6	18.8	26	32	(N/A)	1.2	0.6	32.20
Yellowwood	0.0	2	7.2	10	12	(N/A)	1.2	0.2	12.24
American holly	0.0	3	10.2	14	18	(N/A)	1.2	0.3	17.58
Dogwood	0.0	2	7.6	11	13	(N/A)	1.2	0.2	12.85
Honeylocust	0.0	3	10.6	15	18	(N/A)	1.2	0.3	18.39
Horsechestnut	0.1	10	26.2	37	47	(N/A)	1.2	0.9	47.18
American beech	0.2	25	62.1	87	113	(N/A)	1.2	2.1	112.86
Black ash	0.1	20	53.6	75	95	(N/A)	1.2	1.8	95.48
Japanese zelkova	0.2	21	54.4	77	98	(N/A)	1.2	1.8	97.63
Apple	0.0	4	16.0	23	27	(N/A)	1.2	0.5	27.00
Swamp white oak	0.0	6	16.6	23	29	(N/A)	1.2	0.5	29.10
Scarlet oak	0.1	14	30.7	43	58	(N/A)	1.2	1.1	57.60
Maple	0.0	6	18.8	26	32	(N/A)	1.2	0.6	32.20
Paper birch	0.1	11	33.1	47	58	(N/A)	1.2	1.1	58.00
Total	8.1	1,140	2,969.9	4,182	5,321	(N/A)	100.0	100.0	65.69

To obtain the value for air pollutant emission co-benefits, click Reports > Benefit-Cost Analysis > Annual Benefits > Air Quality. A report will appear that lists deposition (lb) for each species included in the inventory. The total deposition savings for the population of trees to be planted by the project are at the bottom of the report. The applicant will enter the total deposition savings, shown circled in red in Figure 9, into the Urban Greening Calculator Tool in order to calculate the air pollutant emission reduction impacts from planting trees for the project.

Figure 9. i-Tree Streets Air Quality Report



To obtain the value for stormwater benefits, click Reports > Benefit-Cost Analysis > Annual Benefits > Stormwater. A report will appear that lists rainfall interception (gal) for each species included in the inventory. The total rainfall interception for the population of trees to be planted by the project are at the bottom of the report. The applicant will enter the total rainfall interception stormwater benefits, shown circled in red in Figure 10, into the Urban Greening Benefits Calculator Tool.

Figure 10. i-Tree Streets Stormwater Report

Annual Stormwater Benefits of Public Trees

1/9/2019

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Deodar cedar	72,893	133	(N/A)	100.0	100.0	4.45
Citywide total	72,893	133	(N/A)	100.0	100.0	4.45

Step 5: Estimate Net GHG benefit and Selected Co-benefits for the Proposed Project Using the Urban Greening Benefits Calculator Tool

Applicants must use the Urban Greening Benefits Calculator Tool to complete this step. The Urban Greening Benefits Calculator Tool can be downloaded from: www.arb.ca.gov/cci-resources.

Users should begin with the **Read Me** tab, which contains general information about the Benefits Calculator Tool. Key terms used throughout the Urban Greening Benefits Calculator Tool are defined in the **Definitions** tab. The **Documentation** tab provides details on the documentation requirements to allow the calculations to be reviewed and replicated.

The **Project Info** tab prompts users to enter general project information.

The **Inputs** tab identifies inputs required by the user, generally requiring project-specific data or assumptions. Input and output fields are color coded:

- Green fields indicate direct user input is required.
- Grey fields indicate output or calculation fields that are automatically populated based on user entries and the calculation methods.
- Yellow fields offer helpful hints or important tips to the user.

The **GHG Summary** tab displays the estimated:

- GHG benefit from each project component (metric tons of carbon dioxide equivalent [MT CO_2e]);
- Total Urban Greening GHG benefit (MT CO_2e);[11]
- Total GHG benefit (MT CO_2e);
- Total GHG benefit per total Urban Greening GGRF funds (MT CO_2e/$); and
- Total GHG benefit per total funds (MT CO_2e/$).

The **Co-benefits Summary** tab displays the estimated:

- $PM_{2.5}$ emission reductions (lb);
- NO_x emission reductions (lb);
- ROG emission reductions (lb);
- Diesel PM emission reductions (lb);
- Trees planted;
- Total water savings (gallons);

[11] This is the portion of GHG benefit attributable to funding from the Urban Greening Program; GHG emission reductions are prorated according to the level of program funding contributed from Urban Greening Program and other California Climate Investments programs funded with GGRF, as applicable. The results in the Co-benefits Summary tab are prorated using the same approach, as applicable.

- Annual water savings (acre feet/year)
- Fossil fuel based energy use reductions (kWh and therms);
- Energy and fuel cost savings (dollars);
- Passenger VMT reductions (miles);
- Fossil fuel based transportation fuel use reductions (gallons); and
- Travel cost savings (dollars).

Section C. Example Project

Introduction

The following is a hypothetical project[12] to demonstrate how the Urban Greening Benefits Calculator Tool would be applied. This hypothetical project does not provide examples of the supporting documentation that is required of actual project applicants.

Overview of the Proposed Project

The proposed project will consist of two components and will begin in 2020. The project will cost and request $700,000 from the Urban Greening Program, and the applicant does not have leveraged funds. The first project component is the construction of 1 mile of new Class II bike lane. The proposed project is located in the city of Los Angeles and the bike path will be constructed in 2020. The road adjacent to the project has an ADT of 17,500 trips/day and there are no activity centers located within ¼ mile of the project site. Within ½ mile of the project site there is a post office, a bank, a grocery store, and a church.

The second activity will include development of an urban park, which will plant a total 30 *Cedrus deodara* trees. The trees will be planted in 2021 with half of the trees (15 trees) located 25 feet away from a building built in 1990 to provide shade to reduce energy consumption. The project does not involve additional irrigation.

Determine and Enter Project Data for the Class II Bike Lane

After consulting Table 1, the applicant can determine that all of the necessary inputs for a new Bike-ped Infrastructure project are known. The applicant can then enter the inputs into the **New Bike-Ped Infrastructure** tab in the Urban Greening Calculator Tool for a Class II bike lane. The required inputs are as follows:

- Select "Bicycle Lanes Class II" from the Pedestrian or Bicycle Facility Type drop down list.
- The project is located within Los Angeles County.
- The first year of project (Yr 1) is 2020.
- Based on a useful life of 15 years, the final year of useful life (Yr F) is 2035, which is automatically populated in the calculator.
- Annual Days of Operation (D) is the default of 200 days.
- Average Daily Traffic (ADT) is 17,500.

[12] The hypothetical project has not undergone verification of any Urban Greening requirements; all assumptions about location type and project features are for Urban Greening Benefits Calculator Tool demonstration purposes only.

- The Bicycle Path length is 1 mile.
- The population of Los Angeles is 4 million.
- Since the population of Los Angeles is greater than 250,000, the University Town cell will automatically turn black and does not need to be filled in.
- The Number of Activity Centers within ¼ Mile is 0.
- The Number of Activity Centers within ½ Mile is 4.
- The Adjustment Factor (A) and Activity Center Credit (C) will automatically populate based on facility type and number of activity centers.

See Figure 11 for a screenshot of the data entered into the Urban Greening Benefits Calculator Tool.

Figure 11. New Bike-Ped Infrastructure Calculator Tool Tab

Pedestrian or Bicycle Facility Type	County	Year 1 (Yr 1)	Year F (Yr F)	Annual Days of Operation (D)	Average Daily Traffic (ADT)	Bicycle or Pedestrian Path Length (L) [miles]	City Population	University Town (Yes/No)	Number of Activity Centers within 1/4 Mile
Bicycle Lanes Class II	Los Angeles	2020	2035	200	17,500	1.0	4,000,000		0

Number of Activity Centers within 1/2 Mile	Adjustment Factor (A)	Activity Center Credit (C)	GHG Emission Reductions ($MTCO_2e$)	Auto VMT Reduced (miles)	Fossil Fuel Use Reduced (gallons)	Travel Cost Savings ($)
4	0.0014	0.0010	74	189,000	6,633	102,060
			74	189,000	6,633	102,060

Total (Local) PM2.5 emission reductions (lbs)	8.00
Total (Local) NOx Emission Reductions (lbs)	23.07
Total (Local) ROG Emission Reductions (lbs)	6.06
Total (Local) Diesel PM Emission Reductions (lbs)	0.03

Use i-Tree Planting to Determine GHG Benefits of Tree Plantings

Project applicants have the option to use i-Tree Planting or i-Tree Streets for calculating the carbon storage and energy savings of tree planting. This section illustrates an example project using i-Tree Planting to plant 30 total trees. If the applicant chooses to use i-Tree Streets, skip to the next section.

Because i-Tree Planting groups similar trees together, two groups will be needed to account for all the variations of the tree planting activities. The first group will account for trees close to an air-conditioned building, which will shade the building. The second group of trees are 75 feet away from a building and do not provide shade benefits. Utilizing Table 8 for reference, the i-Tree Planting project specific inputs for

planting the 30 *Cedrus deodara* trees are compiled. The required inputs are as follows:

Table 10. i-Tree Planting Inputs

Location Tab	
State/Province	Select California in the drop down menu.
County/Division	Select Los Angeles.
City	Select Los Angeles.
Project Parameters	
Electricity Emissions factor	Enter "227.9" kg CO_2e/MWh.
Units	Select "kilograms CO_2e/MWh".
Fuel Emissions factor	"53.1" kg CO_2e/MMBtu.
Units	Select "kilograms CO_2e/MMBtu".
Years for the Project	Enter "39".
Tree Mortality over Project Lifetime, as an estimated percentage	Enter "0" (The Urban Greening Benefits Calculator Tool will account for tree mortality).
Tree Planting Configuration #1 (Energy Savings from Tree Shade)	
Units	Select English (feet & inches).
Nomenclature	Choose Scientific Name.
Species	Select "*Cedrus deodara*" from the drop down menu.
DBH in Inches	Enter "1.5" inches as the time of planting DBH.
Distance to Nearest Building in Feet	Select "20-39" feet away.
Tree is _____ of Building	Select "West."
Vintage	Select "Built after 1980."
Climate Controls	Select "Heat & A/C."
Condition	Select "Excellent."
Exposure to Sunlight	Select "Full Sun."
Number of Trees	Enter "15".

Table 8 (continued). i-Tree Planting Inputs

Tree Planting Configuration #1 (Energy Savings from Tree Shade)	
Units	Select "English (feet & inches)".
Nomenclature	Choose "Scientific Name".
Species	Select "*Cedrus deodara*" from the drop down menu.
DBH in Inches	Enter "1.5" inches as the time of planting DBH.
Distance to Nearest Building in Feet	Select ">60" feet away.
Tree is _____ of Building	Leave at default "(North)".
Vintage	Leave at default "(Built after 1980)".
Climate Controls	Select "None."
Condition	Select "Excellent."
Exposure to Sunlight	Select "Full Sun."
Number of Trees	Enter "15".
Planting Report	
Units	"English" (pounds & tons; kWh & MMBtu; gallons).

See Figures 12 through 14 for a series of screenshots of how the input data should be entered into i-Tree Planting and Figures 15 through 18 of i-Tree Planting outputs.

Figure 12. Location Information

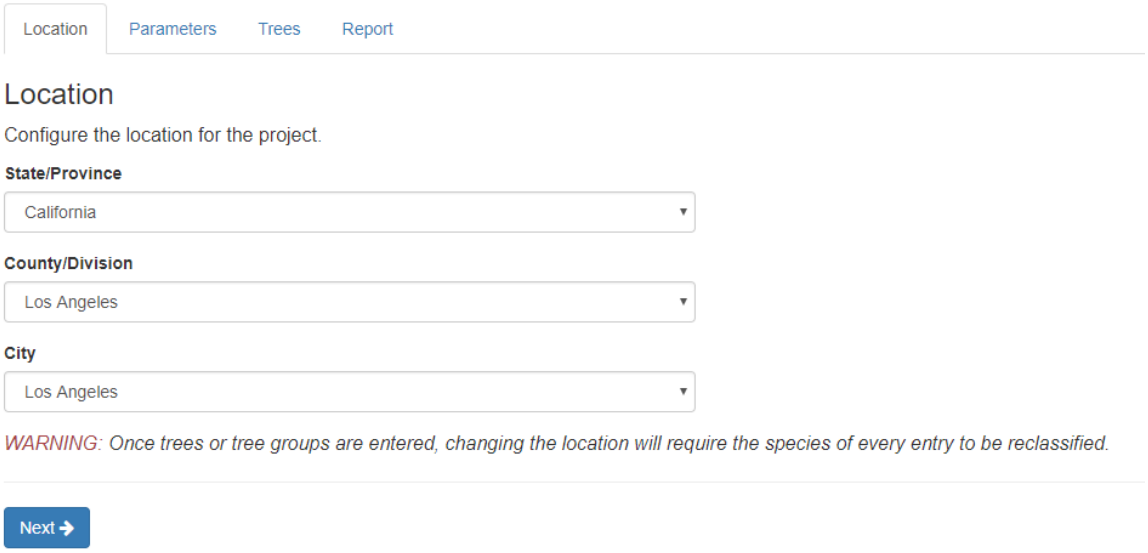


Figure 13. Project Parameters

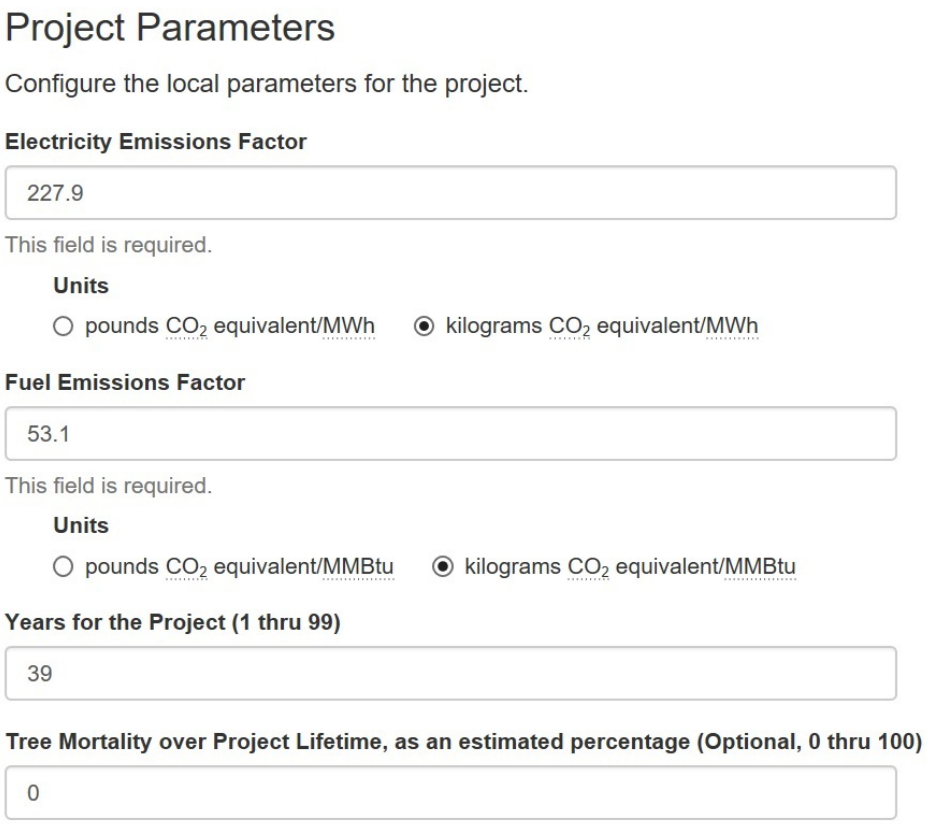


Figure 14. Tree Planting Configurations

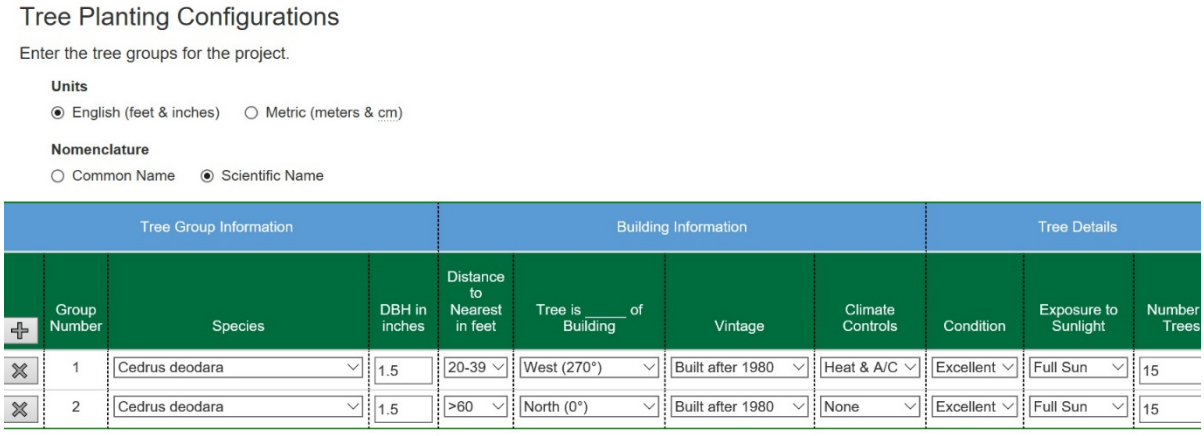


Figure 15. i-Tree Planting Carbon Benefits

Copy | Export | CO_2 | Energy | Eco | Air Pollution

Search:

Location		CO_2 Benefits			
Group Identifier	Tree Group Characteristics	CO_2 Avoided (pounds)	CO_2 Avoided ($)	CO_2 Sequestered (pounds)	CO_2 Sequestered ($)
1	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted 20-39 feet and west (270°) of buildings that were built post-1980 with heat and A/C. • Trees are in excellent condition and planted in full sun.	-10,526.4	$-244.81	312,342.1	$7,264.12
2	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted >60 feet and north (0°) of buildings that were built post-1980 with neither heat nor A/C. • Trees are in excellent condition and planted in full sun.	0.0	$0.00	312,342.1	$7,264.12

Figure 16. i-Tree Planting Energy Benefits

Copy | Export | CO_2 | Energy | Eco | Air Pollution

Search:

Location		Energy Benefits			
Group Identifier	Tree Group Characteristics	Electricity Saved (kWh)	Electricity Saved ($)	Fuel Saved (MMBtu)	Fuel Saved ($)
1	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted 20-39 feet and west (270°) of buildings that were built post-1980 with heat and A/C. • Trees are in excellent condition and planted in full sun.	49,164.8	$9,783.79	-321.5	$-4,159.68
2	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted >60 feet and north (0°) of buildings that were built post-1980 with neither heat nor A/C. • Trees are in excellent condition and planted in full sun.	0.0	$0.00	0.0	$0.00

Figure 17. i-Tree Planting Air Pollution Benefits

Copy | Export | CO_2 | Energy | Eco | Air Pollution — Search:

Location		Air Benefits							
Group Identifier	Tree Group Characteristics	O_3 Removed (pounds)	NO_2 Avoided (pounds)	NO_2 Removed (pounds)	SO_2 Avoided (pounds)	SO_2 Removed (pounds)	VOC Avoided (pounds)	$PM_{2.5}$ Avoided (pounds)	$PM_{2.5}$ Removed (pounds)
1	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted 20-39 feet and west (270°) of buildings that were built post-1980 with heat and A/C. • Trees are in excellent condition and planted in full sun.	288.0	-0.5	67.2	-1.7	1.7	22.9	15.5	5.0
2	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted >60 feet and north (0°) of buildings that were built post-1980 with neither heat nor A/C. • Trees are in excellent condition and planted in full sun.	288.0	0.0	67.2	0.0	1.7	0.0	0.0	5.0

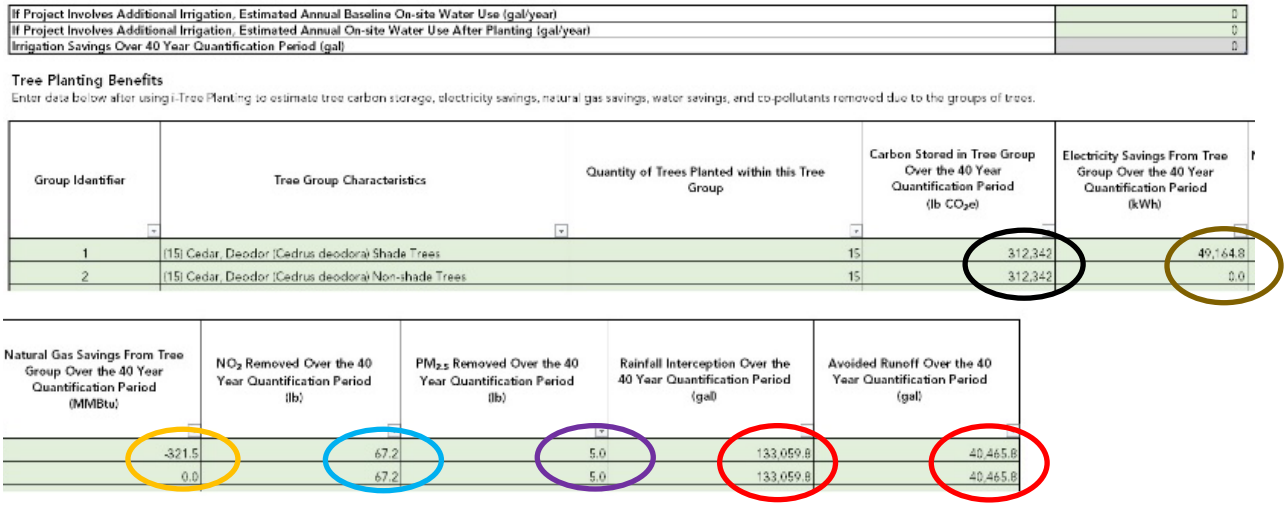
Figure 18. i-Tree Planting Water Savings

Copy | Export | CO_2 | Energy | Eco | Air Pollution — Search:

Location		Ecosystem Services			
Group Identifier	Tree Group Characteristics	Tree Biomass (short ton)	Rainfall Interception (gallons)	Avoided Runoff (gallons)	Avoided Runoff ($)
1	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted 20-39 feet and west (270°) of buildings that were built post-1980 with heat and A/C. • Trees are in excellent condition and planted in full sun.	85.2	133,059.8	40,465.8	$361.60
2	• (15.0) Cedar, Deodar (Cedrus deodara) at 1.5 inches DBH. • Planted >60 feet and north (0°) of buildings that were built post-1980 with neither heat nor A/C. • Trees are in excellent condition and planted in full sun.	85.2	133,059.8	40,465.8	$361.60

Once all the outputs (circled values from Figures 15 through 18) from i-Tree Planting are collected, they need to be entered into the "Tree Planting -ITP" tab of the Urban Greening calculator as shown below in Figure 19. Enter in the Group Identifier and Tree Group Characteristics from i-Tree Planting and the number of trees in that group. If the project involves additional irrigation, indicate the baseline irrigation (gal/year) and water use after planting (gal/year).

Figure 19. Urban Greening Calculator Inputs: Tree Planting-ITP Worksheet



If Project Involves Additional Irrigation, Estimated Annual Baseline On-site Water Use (gal/year)	0
If Project Involves Additional Irrigation, Estimated Annual On-site Water Use After Planting (gal/year)	0
Irrigation Savings Over 40 Year Quantification Period (gal)	0

Tree Planting Benefits

Enter data below after using i-Tree Planting to estimate tree carbon storage, electricity savings, natural gas savings, water savings, and co-pollutants removed due to the groups of trees.

Group Identifier	Tree Group Characteristics	Quantity of Trees Planted within this Tree Group	Carbon Stored in Tree Group Over the 40 Year Quantification Period (lb CO_2e)	Electricity Savings From Tree Group Over the 40 Year Quantification Period (kWh)
1	(15) Cedar, Deodor (Cedrus deodora) Shade Trees	15	312,342	49,164.8
2	(15) Cedar, Deodor (Cedrus deodora) Non-shade Trees	15	312,342	0.0

Natural Gas Savings From Tree Group Over the 40 Year Quantification Period (MMBtu)	NO_2 Removed Over the 40 Year Quantification Period (lb)	$PM_{2.5}$ Removed Over the 40 Year Quantification Period (lb)	Rainfall Interception Over the 40 Year Quantification Period (gal)	Avoided Runoff Over the 40 Year Quantification Period (gal)
-321.5	67.2	5.0	133,059.8	40,465.8
0.0	67.2	5.0	133,059.8	40,465.8

Use i-Tree Streets to Determine GHG Benefits of Tree Plantings

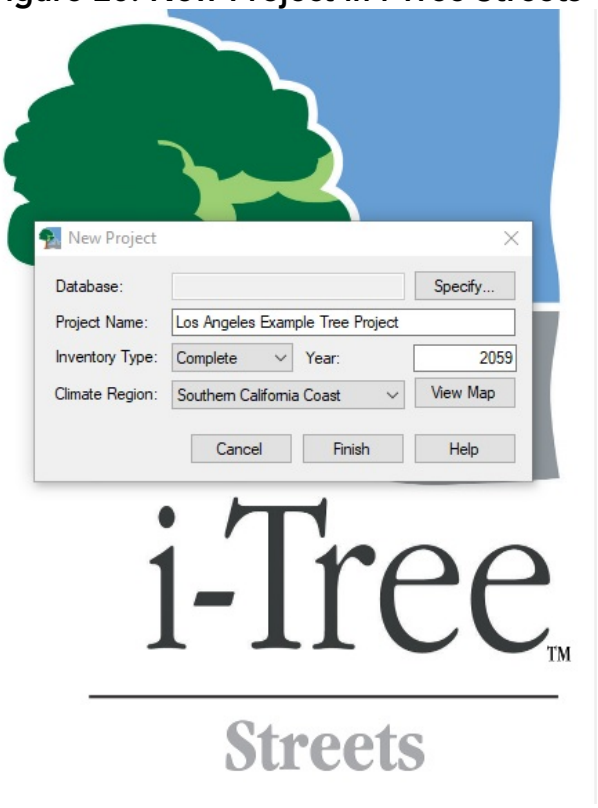
Project applicants have the option to use i-Tree Planting or i-Tree Streets for calculating the carbon storage and energy savings of tree planting. This section illustrates an example project using i-Tree Streets. If the applicant chooses to use i-Tree Planting, see the previous section. i-Tree Streets allows the input of multiple trees into the tool so all 30 trees can be entered into the tool upfront. Because i-Tree Streets gives all trees an energy benefit, the Urban Greening calculator tool will modify the i-Tree Streets output to reflect that only half of the trees provide shade to air-conditioned buildings.

Open i-Tree Streets and create a new project by clicking on the File menu > Open > New Project; a pop-up window will appear. This project assumes the following project defaults in Table 9 as seen in Figure 20.

Table 11. Inputs for Los Angeles Example i-Tree Streets Project

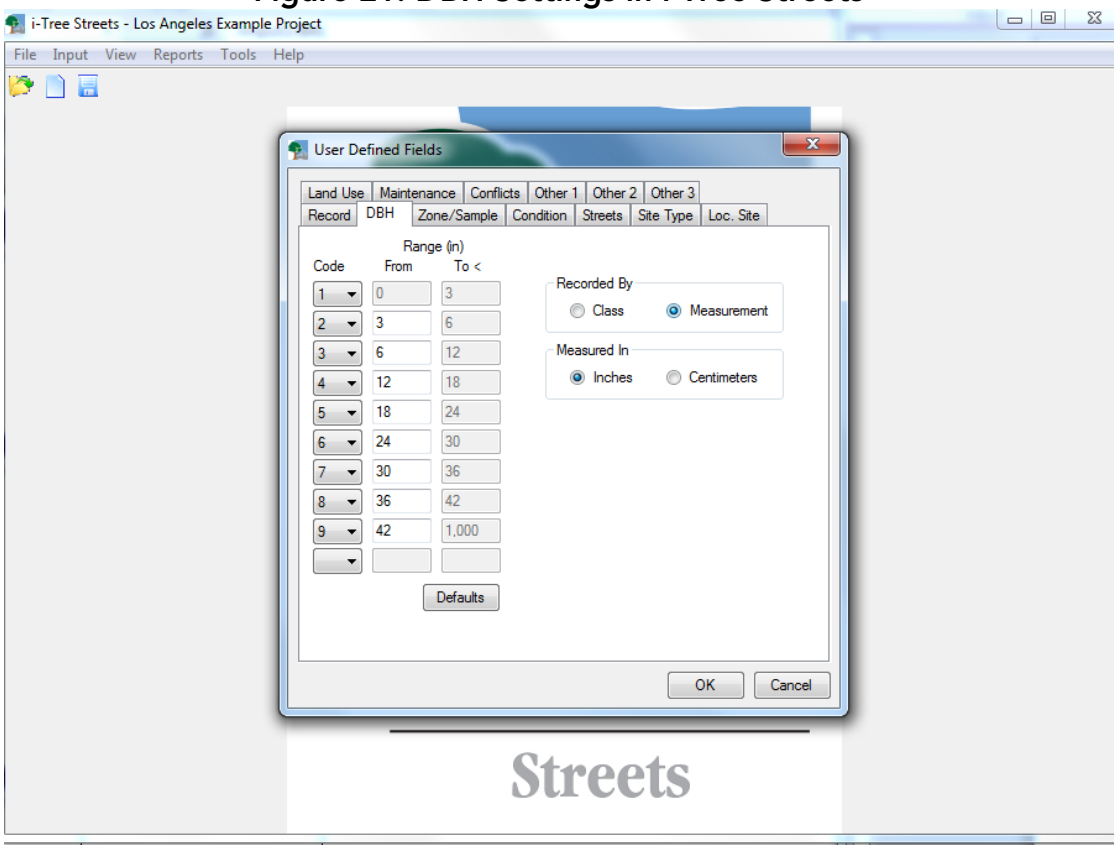
New Project Inputs	
Database	Select "Create New" to enter inventory information
Project Name	"Los Angeles Example Project"
Inventory Type	Select "Complete"
Year	"2060"
Climate Region	"Southern California Coast"

Figure 20. New Project in i-Tree Streets



After entering this information, click "Finish". A series of pop-up windows will appear titled "Define City," "Define Cost," and "Benefit Prices." No entry is required in these windows. Click "Cancel" in each window. A pop-up window titled "User Defined Fields" will appear. For this example project under the DBH tab, we used the exact DBH (measurement) and chose to enter DBH in inches as shown in Figure 21. When finished, click "OK."

Figure 21. DBH Settings in i-Tree Streets



Click Input > Records. Click "New" in the pop-up window to enter a new tree record. Under the Tree Info Tab, the following information was entered:

- Species – Deodar cedar
- DBH(in): 29 (See Step 3b for additional description on how to determine the DBH value)

Select "OK". Because this project is planting 30 of the same trees, select "Duplicate" in the tree inventory field and enter "29" in the popup field that asks "How many times do you want to duplicate the selected rows?" Select "OK" to finish the tree inventory.

Figure 22. Tree Inventory Accounting in i-Tree Streets

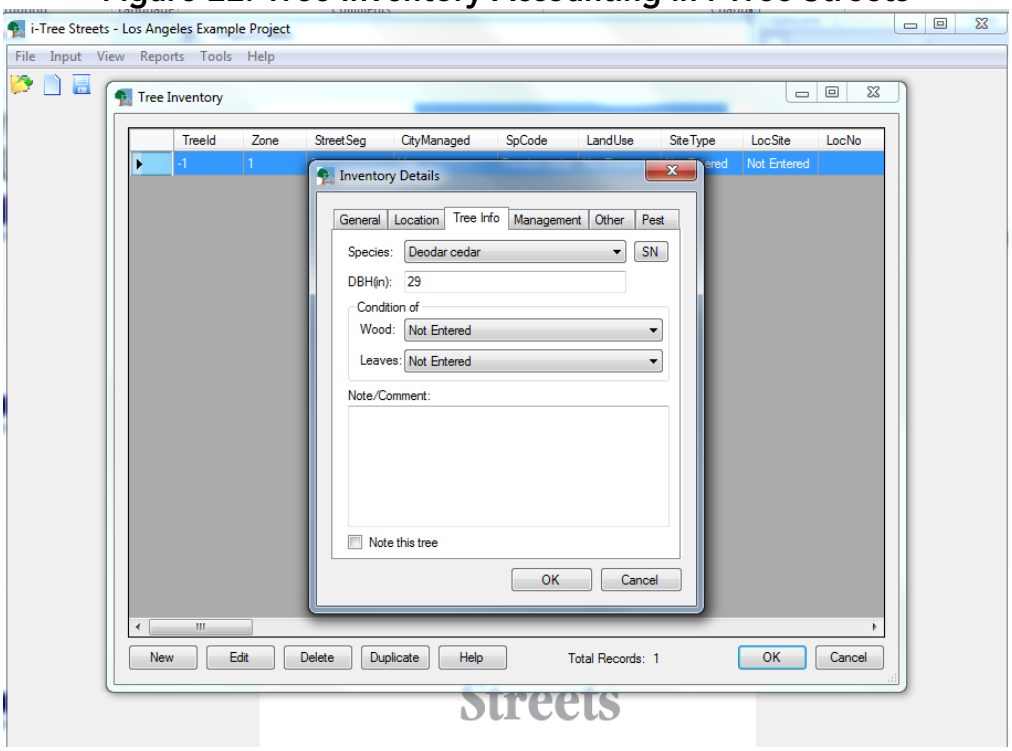


Figure 23. Duplicate Tree Inventory Accounting in i-Tree

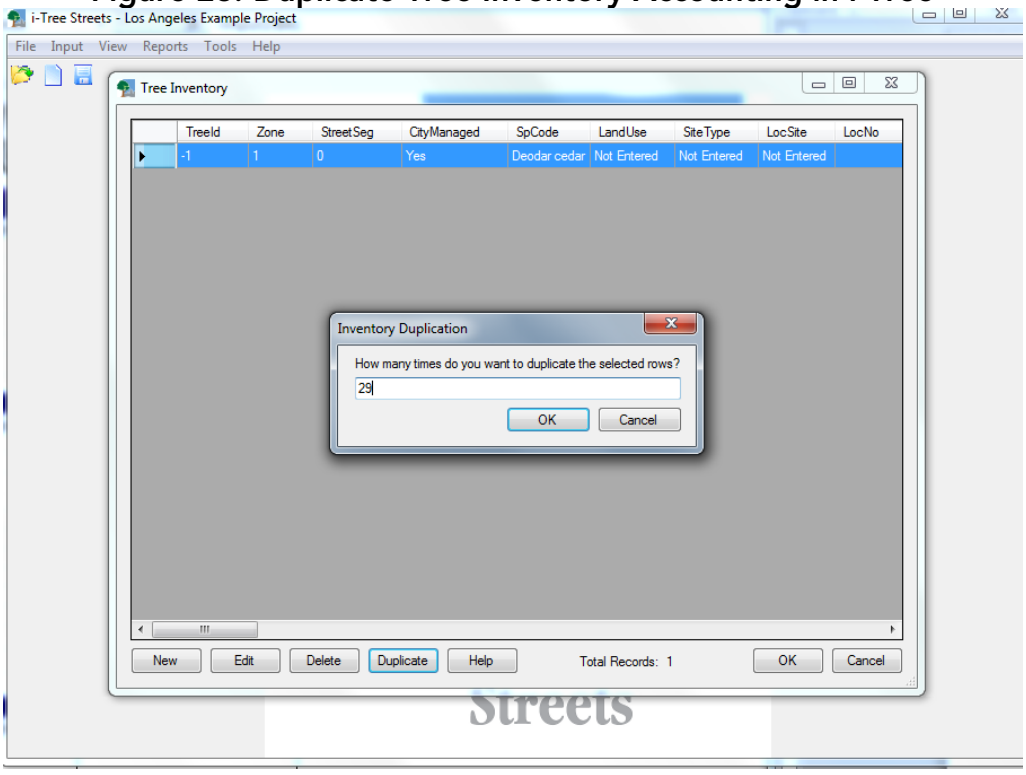
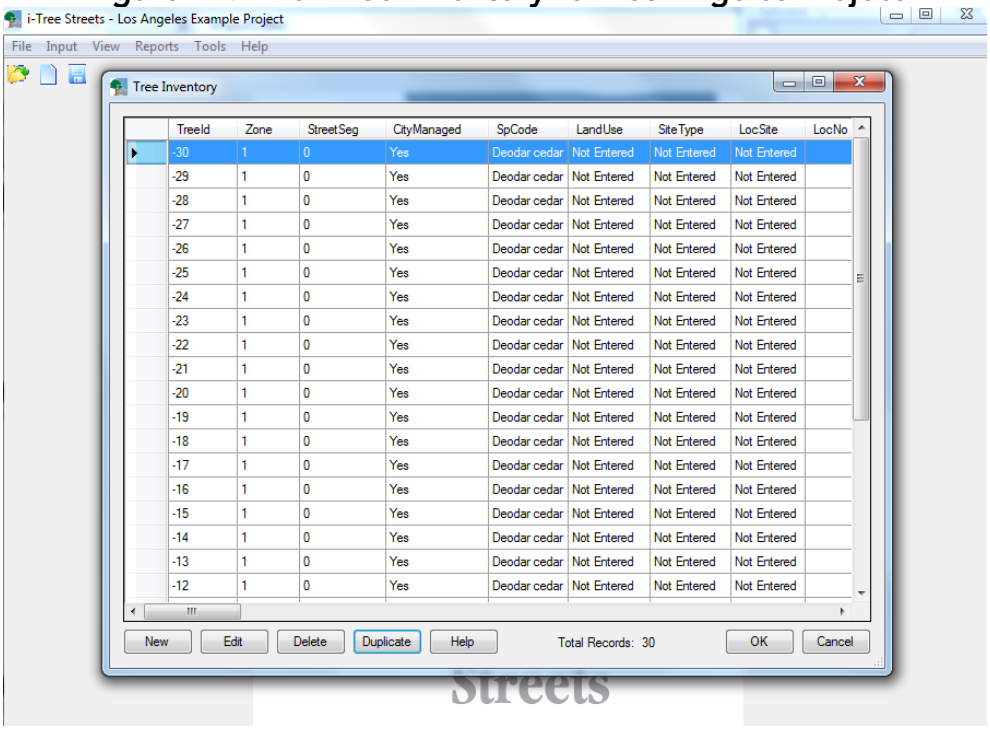


Figure 24. Final Tree Inventory for Los Angeles Project



To obtain the value for carbon storage, click Reports > Benefit-Cost Analysis > Annual Benefits > Carbon Stored. A report will appear that lists the stored carbon (171,871 lb CO_2e). Enter the total stored CO_2 value, shown circled in black in Figure 25, into the Urban Greening Calculator Tool "Tree Planting-ITS" tab (see Figure 29) in order to calculate the total carbon stored for the project.

Figure 25. i-Tree Streets Stored CO_2 Benefits

Stored CO2 Benefits of Public Trees

1/9/2019

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Deodar cedar	171,871	2,578	(N/A)	100.0	100.0	85.94
Citywide total	171,871	2,578	(N/A)	100.0	100.0	85.94

To obtain the value for building energy savings, click Reports > Benefit-Cost Analysis > Annual Benefits > Energy. A report will appear that lists the electricity (4.5 MWh) and natural gas savings (32.6 therms). Enter the total electricity and total natural gas savings, shown circled in brown and orange in Figure 26, into the Urban Greening Calculator Tool "Tree Planting-ITS" tab (see Figure 29) in order to calculate the GHG benefit from building energy savings for the project.

Figure 26. i-Tree Streets Energy Benefits

Annual Energy Benefits of Public Trees

1/9/2019

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Deodar cedar	4.5	733	32.6	43	776	(N/A)	100.0	100.0	25.85
Total	4.5	733	32.6	43	776	(N/A)	100.0	100.0	25.85

To obtain the value for air pollutant emission co-benefits, click Reports > Benefit-Cost Analysis > Annual Benefits > Air Quality. A report will appear that lists the NO_2 and PM_{10} deposition (17.2 and 21.3 lbs, respectively). Enter the total deposition savings, shown circled in blue and purple in Figure 27, into the Urban Greening Calculator Tool "Tree Planting-ITS" tab (see Figure 29) in order to calculate the GHG benefit from building energy savings for the project.

Figure 27. i-Tree Streets Air Quality Benefits

Annual Air Quality Benefits of Public Trees

1/9/2019

Species	Deposition (lb) O_3	NO_2	PM_{10}	SO_2	Total Depos. ($)	Avoided (lb) NO_2	PM_{10}	VOC	SO_2	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
Deodar cedar	37.0	17.2	21.3	1.3	2,015	5.5	1.4	0.6	2.6	219	-13.3	-44	73.7	2,189	(N/A)	100.0	72.98
Citywide total	37.0	17.2	21.3	1.3	2,015	5.5	1.4	0.6	2.6	219	-13.3	-44	73.7	2,189	(N/A)	100.0	72.98

To obtain the value for water savings emission co-benefits, click Reports > Benefit-Cost Analysis > Annual Benefits > Stormwater. A report will appear that lists the rainfall interception (3,350 gallons). Enter the total rainfall interception, shown circled in red in Figure 28, into the Urban Greening Calculator Tool "Tree Planting-ITS" tab (see Figure 29) in order to calculate the GHG benefit from building energy savings for the project.

Figure 28. i-Tree Streets Stormwater Report

Annual Stormwater Benefits of Public Trees

1/9/2019

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Deodar cedar	72,893	133	(N/A)	100.0	100.0	4.45
Citywide total	72,893	133	(N/A)	100.0	100.0	4.45

Once all the inputs from Figure 25 through 28 are collected, they need to be input into the "Tree Planting-ITS" Tab of the Urban Greening Calculator Tool as shown below in Figure 29. The final inputs necessary are the "Quantity of Trees to be Planted" and "Trees Within Population to be Planted to Shade Buidlings (i.e. within 60 ft)". For this example use 30 trees planted and use 50% to account for only 15 out of 30 trees that provide shade to a conditioned building. If the project involves additional irrigation, indicate the baseline irrigation (gal/year) and water use after planting (gal/year).

Figure 29. Urban Greening Calculator Inputs: Tree Planting-ITS Worksheet

Estimated Change in Water Irrigation from Planting Trees

Enter data below after using the UCANR Water Use Classification of Landscape Species (WUCOLS IV) and the DWR Water Budget Workbook for New and Rehabilitated Non-Residential Landscapes (Water Budget Workbook).

If Project Involves Additional Irrigation, Estimated Annual Baseline On-site Water Use (gal/year)	0
If Project Involves Additional Irrigation, Estimated Annual On-Site Water Use After Planting (gal/year)	0
Irrigation Savings Over 40 Year Project Life (gal)	0

GHG Benefit of Tree Planting

Enter data below after using i-Tree Planting to estimate tree carbon storage, electricity savings, natural gas savings, and co-pollutants removed due to the groups of trees.

Carbon Stored in Population of Trees 40 Years After Project Start (lb CO_2e)	Annual Electricity Savings From Population of Trees 40 Years After Project Start (MWh/yr)	Annual Natural Gas Savings From Population of Trees 40 Years After Project Start (therms/yr)	Quantity of Trees to be Planted	Trees Within Population to be Planted to Shade Buildings (i.e. within 60 ft) (%)	Annual NO_2 Deposition From Population of Trees 40 Years After Project Start (lb/yr)	Annual PM_{10} Deposition From Population of Trees 40 Years After Project Start (lb/yr)	Annual Rainfall Interception (gal/yr)
171,871	4.5	32.6	30.0	50%	17.2	21.3	72,893

GHG and Co-benefit Summary

After inputting the required fields, the GHG Summary tab of the tool will display the total Urban Greening GHG benefit, the total GHG benefit, the GHG benefit per Urban Greening GGRF Funds Requested, and total GHG benefit per Total GGRF Funds Requested, as shown in Figure 29. (Note: Figure 29 only shows the GHG benefit of using i-Tree Planting because applicants should only use one tool per application. If the applicant chooses to use i-Tree Streets, those respective cells will be automatically calculated.)

Figure 30. GHG Summary Calculator Tool Tab

Project Name:	LA Example Project

Project Information		
Total Urban Greening GGRF Funds Requested ($)	$	700,000
Other GGRF Leveraged Funds ($)	$	-
Total GGRF Funds ($)	$	700,000
Non-GGRF Leveraged Funds ($)	$	-
Total Funds ($)	$	700,000

GHG Summary	
GHG Benefit of Carbon Stored in Live Project Trees Estimated Using i-Tree Planting (MT CO_2e)	275
GHG Benefit of Carbon Stored in Live Project Trees Estimated Using i-Tree Streets (MT CO_2e)	0
GHG Benefit from Energy Savings Estimated Using i-Tree Planting (MT CO_2e)	-6
GHG Benefit from Energy Savings Estimated Using i-Tree Streets (MT CO_2e)	0
Avoided GHG from Establishment of New Bicycle and Pedestrian Facilities (MT CO_2e)	74
GHG Emissions from Tree Planting Project Implementation (MT CO_2e)	13
Total Urban Greening GHG Benefit (MT CO_2e)	329
Total GHG Benefit (MT CO_2e)	329
Total GHG Benefit per Total Urban Greening GGRF Funds (MT CO_2e/$)	0.000470486
Total GHG Benefit per Total Funds (MT CO_2e/$)	0.000470486

The Co-benefit Summary tab of the tool will display a summary of co-benefits and key variables. (Note: Figure 30 only shows the air pollutant emission co-benefits from i-Tree Planting because applicants should only use one tool per application. If the applicant chooses to use i-Tree Streets, those respective cells will be automatically calculated.)

Figure 31. Co-benefit and Key Variable Summary Calculator Tool Tab

Project Name:	LA Example Project

Co-benefits and Key Variables Summary	
Urban Greening GGRF Funds	
Total $PM_{2.5}$ Emission Reductions (lb)	20
Total NOx Emission Reductions (lb)	129
Total ROG Emission Reductions (lb)	6
Total Diesel PM emission reductions (lb)	0
Remote PM2.5 Emission Reductions (lb)	2
Remote NOx Emission Reductions (lb)	6
Remote ROG Emission Reductions (lb)	1
Trees Planted	30
Total Water Savings (gal)	0
Annual Water Savings (acre feet/year)	0
Fossil Fuel Based Energy Use Reductions (kWh)	47,690
Fossil Fuel Based Energy Use Reductions (therms)	-3,119
Energy and Fuel Cost Savings ($)	$3,253
Passenger VMT Reductions (miles)	252,000
Fossil Fuel Based Transportation Fuel Use Reductions (gal)	8,649
Travel Cost Savings ($)	$136,080
Total	
Total $PM_{2.5}$ Emission Reductions (lb)	20
Total NOx Emission Reductions (lb)	129
Total ROG Emission Reductions (lb)	6
Total Diesel PM emission reductions (lbs)	0
Remote PM2.5 Emission Reductions (lb)	2
Remote NOx Emission Reductions (lb)	6
Remote ROG Emission Reductions (lb)	1
Trees Planted	30
Total Water Savings (gal)	0
Annual Water Savings (acre feet/year)	0
Fossil Fuel Based Energy Use Reductions (kWh)	47,690
Fossil Fuel Based Energy Use Reductions (therms)	-3,119
Energy and Fuel Cost Savings ($)	$3,253
Passenger VMT Reductions (miles)	252,000
Fossil Fuel Based Transportation Fuel Use Reductions (gal)	8,649
Travel Cost Savings ($)	$136,080