N-2. Expand Urban Tree Planting

GHG Mitigation Potential

Varies

Variable reduction in GHG emissions from urban tree planting

Co-Benefits (icon key on pg. 34)

Climate Resilience

Planting trees provides more shade, reducing the urban heat island effect and localized health impacts of higher temperatures. Trees can also help to improve stormwater management and air quality and support mental health and social resilience.

Health and Equity Considerations

Tree planting should be prioritized in areas that have lower levels of existing canopy. Tree-planting programs should be designed in collaboration with residents. This ensures not only that community preferences are considered, but that the community feels ownership over the trees and is more likely to participate in long-term tree care. Trees should be selected according to local preferences, such as avoiding high-pollen trees that may exacerbate allergies.

Measure Description

This measure requires tree planting in urban areas. Planting trees sequesters CO_2 while the trees are actively growing, thereby reducing GHGs. The amount of CO_2 sequestered depends on the type of tree and the duration of the active growing period. Urban trees may also provide shade, which can reduce the urban heat island effect and building cooling demands. Buildings that use less electricity for air conditioning reduce energy consumption and associated indirect GHG emission.

Given many parts of California are in dry climates, the selection of tree type is critical to minimize the use of additional water. Trees that have high water demands that are met through GHG-intensive water (such as water transported over long distances) can impact the amount of GHG reductions achieved by this measure. Nonetheless, even during times of drought, trees help to provide multiple benefits to communities, and state agencies as well as natural resource organizations have emphasized repeatedly the importance of watering and maintaining trees during droughts.

Scale of Application

Project/Site and Plan/Community

Implementation Requirements

See measure description.

Cost Considerations

Upfront costs of planting more urban trees will depend on how the land is currently being used and how much maintenance and assistance in growing the trees will need to be successful. However, urban trees can reduce the incidence and cost of heat exposure and pollution-related illnesses by reducing the urban heat island effect and filtering pollutants from the air and soil.

Expanded Mitigation Options

Best practices for urban tree planting programs include selecting native tree species that require minimal water and maintenance, planting low-biogenic VOC emitting and low-allergen trees, and appropriately distancing trees from buildings, especially in high fire areas.

GHG Reduction Formula

Users are directed to the U.S. Forest Service (USFS) (2021) i-Tree Planting tool. The i-Tree Planting tool quantifies increased carbon sequestration from urban tree planting using species-based biomass equations that account for user defined site-specific variables and tree growth rates. The tool also quantifies GHG reductions from energy savings (e.g., kWh), if applicable.

While simplified quantification methods for increased carbon sequestration resulting from urban tree planting have been used in the past, this Handbook does not recommend their application given the number and dynamic nature of variables that can influence the amount of CO_2 reduced. Tools like i-Tree Planting comprehensively account for these variables, enabling users easily to calculate the approximate benefits from individual trees.

The i-Tree Planting tool is available at: https://planting.itreetools.org/.

Depending on the scale of the project, users may also wish to consult other i-Tree tools, including i-Tree Design (https://design.itreetools.org/), i-Tree Canopy (https://canopy.itreetools.org/), and i-Tree County (https://county.itreetools.org/). Users may consult the Climate Action Reserves' *Urban Tree Planting Project Protocol* (CAR 2014) or CARB's *Quantification Methodology for Urban and Community Forestry Program* (CARB 2020).

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	CO_2 sequestered over project lifetime	[ ]	lb CO_2	calculated
B	CO_2 reduced from building energy savings over project lifetime	[ ]	lb CO_2	calculated
User Inputs				
C	Project state/province	[ ]	address	user input
D	Project county/division	[ ]	Text	user input
E	Project city	[ ]	Text	user input
F	Project lifetime	1–99	Years	user input
G	Tree mortality over project lifetime	0–100	%	user input
H	Tree species planted by the project	[ ]	species name	user input*
I	Diameter breast height of each tree	[ ]	Inches	user input*
J	Distance to the nearest building	[ ]	Feet	user input*
K	Direction of tree from the building	[ ]	degrees	user input*
L	Building vintage	[ ]	Text	user input*
M	Building climate controls	[ ]	Text	user input*
N	Tree condition	[ ]	Text	user input*
O	Tree exposure to sunlight	[ ]	Text	user input*
Constants, Assumptions, and Available Defaults				
Q	Carbon intensity of local electricity provider	Table E-4.3 Table E-4.4	lb CO_2e per MWh	CA Utilities 2021
R	Carbon intensity of natural gas	117	lb CO_2e per MMBtu	TCR 2020

* Inputs provided through a drop-down menu.

Further explanation of key variables:

- (A and B) – The GHG reductions are presented over the project lifetime. If users are seeking an annualized value, they will need to divide this result by the assumed project lifetime (F).
- (F) – Trees sequester CO_2 while the trees are actively growing. The i-Tree Planting tool will project the benefits for up to 99 years into the future. The tool defaults to 40 years.
- (G) – The i-Tree Planting tool will incorporate tree mortality into the projected benefits.
- (I) – The diameter of the trunk measured at 4.5 feet above the ground.
- (J) – For trees that will be planted to shade buildings, enter the distance class to the nearest building (0–19 feet, 20–39 feet, 40–59 feet, > 60 feet). Note that this could be a building on an adjacent site. The i-Tree tool will not calculate shade benefits (i.e., energy savings) for trees more than 60 feet away from the building.
- (K) – General direction of the tree from the building (e.g., north 0 degrees). This input can be ignored if the tree is more than 60 feet from the building.
- (L) – The age of the building affects its energy efficiency and therefore the potential benefits the trees can bring. Available inputs are built after 1980, built 1950–1980, and built before 1950. If the specific age of the building in unknown, the user can input the typical age of buildings for the area where the user is working. This input can be ignored if the tree is more than 60 feet from the building.
- (M) – Trees can only have an impact on energy use in buildings where energy is used to heat or cool. Available inputs are heating and air conditioning (A/C), heat only, A/C only, and none. If the climate controls of the building are unknown, the user can input the option that is most common for the area where the user is working. This input can be ignored if the tree is more than 60 feet from the building.
- (N) – The condition of the trees will affect how well they grow and thus future benefits. Available inputs are excellent, good, fair, poor, critical, dying, and dead. New plantings are likely to be excellent.
- (O) – The exposure to sunlight affects both how the trees grow and the degree to which a new tree adds shade to a building. Available inputs are full sun, partial shade, and full shade.
- (Q) – GHG intensity factors for major California utilities are provided in Tables E-4.3 and E-4.4 in Appendix C. If the project study area is not serviced by a listed electricity provider, or the user is able to provide a project-specific value (i.e., for a future year not referenced in Tables E-4.3 or E-4.4), the user should use that specific value. If the electricity provider is not known, the user may elect to use the statewide grid average carbon intensity or rely on the i-Tree Planting default.
- (R) – The carbon intensity of natural gas was calculated in terms of CO_2e by multiplying the U.S. natural gas combustion emission factors for CO_2, CH_4, and N_2O (TCR 2020) by the corresponding 100-year GWP values from the IPCC's Fourth Assessment Report (IPCC 2007). See Table E-4.5 in Appendix C for more natural gas emission factors.

GHG Calculation Caps or Maximums

None.

Example GHG Reduction Quantification

The user reduces emissions by planting shade trees at a new home site. In this example, the project is in the City of Sacramento (E)/Sacramento County (D)/California (C). The electricity provider for the project area is SMUD, and the analysis year is 2022. The carbon intensity of electricity is, therefore, 344 lb CO_2e per megawatt-hour (Q). The project lifetime is 40 years (F) and expected tree morality 10 percent (G). The project will plant two (P) live oaks (H) with a diameter breast height of 4 inches (I). The trees are 0 to 19 feet from the nearest building (J) and oriented east 90 degrees (K). The building was built between 1950 and 1980 (L) and includes heat and A/C (M). The tree condition is excellent (N) and has full sunlight (O). Based on these inputs to the i-Tree Planting tool, over the project lifetime, the trees would sequester 16,045 lb of CO_2 and reduce 6,787 lb of CO_2 from building energy savings. This totals 22,832 pounds of CO_2, or 571 pounds CO_2 per year (based on 40-year project lifetime).

Quantified Co-Benefits

The i-Tree tool outputs electricity savings (kWh), fuel savings (MMBtu), avoided runoff (gallons), and criteria pollutant emissions reductions (pounds). All values are over the project lifetime. Note that depending on user inputs, the measure may result in increased fuel consumption (MMBtu) from building shading in the winter.

Sources

- California Air Resources Board (CARB). 2020. *Quantification Methodology for Urban and Community Forestry Program*. California Climate Investments. Version 2.0. January. Available: https://ww2.arb.ca.gov/sites/default/files/classic//cc/capandtrade/auctionproceeds/calfire_ucf_finalqm_012820.pdf?_ga=2.67722641.1011230202.1624305360-1883459709.1621467679. Accessed: June 2021.
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- U.S. Forest Service (USFS). 2021. i-Tree Planting Calculator. Available: https://planting.itreetools.org/. Accessed: January 201.