Creating the Urban Canopy for the 21ˢᵗ Century

The 21st century will hold many challenges for California's urban forests. Our climate is changing. More extreme weather events are expected, and the recent years of drought and wildfires bring home some of the challenges we can expect in the future.

In addition, each year brings new pests to California that weaken and kill trees. The polyphagous shot-hole borer, for example, was first discovered here in 2012, and has now spread throughout multiple parts of the state -- attacking 200 species and threatening 27 million trees in Southern California alone.
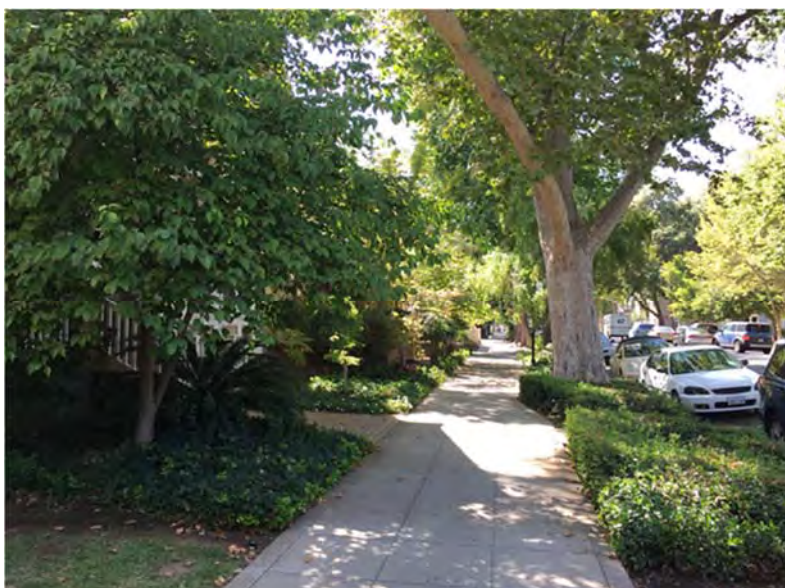
California has made a commitment to reduce greenhouse gas (GHG) emissions to 1990 levels by 2020, with further reductions by 2030. But reducing ongoing emissions is only part of the problem. Existing GHG levels in the atmosphere are very high, and no existing tool or technology can remove GHGs from the air, except trees!

Trees also have a role to play in reducing inequalities in environmental justice. Historically, underserved areas tend to have lower tree canopy, with residents of these communities having less access to the ecosystem services and other benefits that trees provide.

For all these reasons, the urban forest of the future must be resilient and adaptable.

This document offers guidance on choosing trees that will serve Californians of the present and future. The six guidelines cover a range of opportunities in tree planting, and should be carefully evaluated when determining your species selection.

Please keep in mind that no project can maximize every one of the guidelines. Therefore, it's best to consider each guideline along a spectrum from not-so-good to good, trying to move your projects up the spectrum toward the better end whenever possible. Following the list of guidelines is a graphic that offers some ideas to help move your planting project toward the "good" end of the spectrum. However, this is not an exhaustive list of all species to consider.

General Guidelines for Choosing Trees

Perhaps the most important aspect of your project will be deciding which tree species to plant and where to plant them. Here are some things to consider to make your project successful:

- Am I planting the biggest species possible for the space provided so that I maximize the ecosystem services of the trees, including GHG reductions?
- Can I plant my trees around buildings to provide shade, which will reduce energy use, increase greenhouse gas benefits, and reduce air pollution?
- Am I considering the water needs of my species and kept drought-tolerance in mind?
- Am I avoiding species with severe pest and disease problems?
- Am I avoiding species that are invasive?
- Will my species choices increase the diversity of my community's urban forest?
- Will my species choices provide other co-benefits, both social and economic?

Guideline #1: Plant the biggest species possible.

Nearly all of the environmental benefits that trees provide are linked to the mature size of the species. Bigger trees capture more GHGs, provide more shade to reduce energy use, capture more air pollutants on their leaves, and intercept more stormwater to keep waterways cleaner.

In parks, schoolyards, and in many street tree situations, large trees are usually the best choice. One full-grown oak tree provides the same environmental benefits as 10-20 small flowering trees. However, not every site can handle a big tree. Shorter species may be necessary under powerlines or adjacent to buildings.

Use the SelecTree website (see Required Resources) to check the mature size of the species you plan to plant. Your trees should be bigger than 25 feet in height and diameter.

Guideline #2: Plant trees to shade buildings when possible.

Planting trees to shade buildings can greatly increase the benefits they provide. Shade lowers the temperature inside buildings and can thereby significantly reduce energy use. Energy conservation is both inherently valuable and reduces the amount of greenhouse gases and air pollutants produced at the power plant. In a hot, dry climate like the Central Valley, a tree planted to shade an air-conditioned building can reduce GHG emissions by an amount equal to or greater than the amount that the tree captures through sequestration.

To maximize GHG reductions, air quality, and energy benefits, plant trees to the west, east, or south of buildings within 60 feet. Larger trees tend to have greater energy benefits.

Following is a graphic illustration of two scenarios—high vs low benefit—illustrating how three choices (species size and distance and direction from building) can impact the environmental and energy conservation benefits your trees will provide.

GETTING THE MOST OUT OF YOUR TREES:
Orientation Affects Outcome

To Maximize Benefits Consider:

1. **The size of the trees:** bigger is better

2. **The side of the building the trees are on:** west provides the most benefit.

3. **The distance from the building to the tree:** shade benefits accrue for trees planted within 60 ft of building.

4. **The number of trees:** more trees = more benefits!

High Impact Design at 40 years
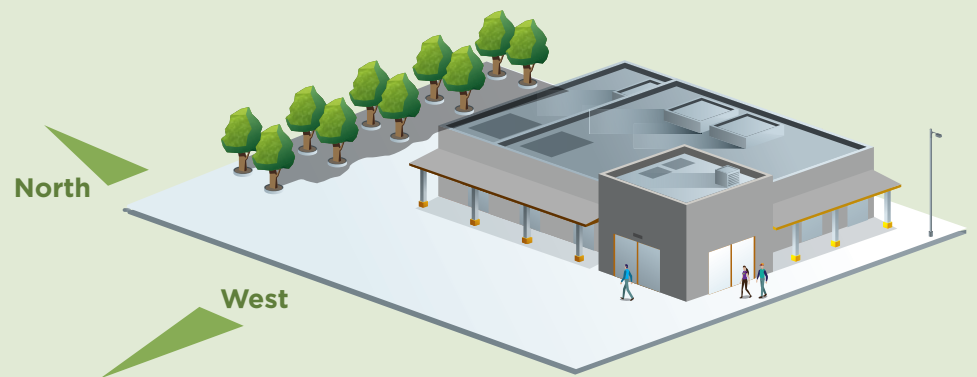
10 large trees planted 20-40 feet west of building.

- **Greenhouse Gases reduced** .... **52 t**
- **Stormwater captured** .... **158,100 gallons**
- **Electricity saved** .... **149,000 kWh**
- **Air Pollutants reduced** .... **590 lbs**

North

West

Low Impact Design at 40 years

10 small trees planted 40 feet north of building.

- **Greenhouse Gases reduced** .... **2 t**
- **Stormwater captured** .... **19,100 gallons**
- **Electricity saved** .... **0 kWh**
- **Air Pollutants reduced** .... **62 lbs**

North

West

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Guideline #3: Choose trees with low to moderate water needs except in special circumstances.

The 2017 wet weather events eased the historic drought conditions, but the next drought is likely not too far away, and even in non-drought years, Californians can't afford to waste water. Different tree species differ greatly in the amount of water they need and how frequently they need it. Some can't survive even a short time without rain or supplemental water, whereas others can go months without rain once they've established themselves.

Consider the water needs of your species with the planting site in mind. School and park sites with consistent irrigation can be good places for moderate water-use trees. Street trees that will require watering by nearby residents might be better as lower water-use specimens. Spots that are naturally wetter can be sites for trees that need more water.

Two sites with good information on trees' water needs are Selectree and WUCOLS.   More information on each of these can be found in the Required Resources section in this document.

Guideline #4: Select trees that have shown resiliency to pests and diseases.

Recent stressors from environmental and human action have made some urban trees vulnerable to new and/or exotic pest invasions, which are inadvertently introduced to vulnerable trees and then spread to other trees. Two examples are the Invasive Shot-hole Borer in Southern California and Sudden Oak Death in Northern California.

As researchers work to find solutions to these epidemics, those planting trees need to stay abreast of which species are most susceptible.   See the Other Resources section at the end of this document that provide links UC Extension professionals, Cal FIRE Regional Urban Foresters, or certified arborists that would be great resources for consulting on your tree selections and their potential resiliency in your region.

Guideline #5: Diversify tree selection whenever possible.

California's urban forests tend to have a great deal of species diversity, and for the sake of adaptability, it should be our goal to continue that trend. A wide variety of trees planted throughout a community reduces the risks associated with pests and diseases while creating an urban forest that is more resilient in the face of drought and climate change.

You can increase the species diversity of your urban forest in two ways: (1) choosing a wide variety of species for your project and (2) considering species that are less common in your community. The Other Resources section at the end of this document offers some inspiration for choosing species in the different regions of California.

Guideline #6: Avoid trees with a "moderate" or "high" invasive potential in your region.

A number of plants introduced to California can escape from cultivation and threaten natural habitats. These are known as "invasive species" and, for most projects funded with public money, they are not allowed to be planted (and should be avoided under most circumstances).

NOT SO GOOD — Greenhouse gas reductions from sequestration — GOOD

Trees that average under ½ ton of GHG reductions
- Most fruit trees
- Most ornamental flowering trees (i.e. crape, myrtle, dogwood, redbud)
- Any species that can be described as a "shrub or small tree"

Trees that average 1-2 tons
- Magnolia grandiflora
- Ginkgo biloba (outside the Central Valley)
- Koelreutaria spp.
- Pistacia chinensis
- Jacaranda mimosifolia
- Acer spp.
- Lophostemon spp.

Trees that average 2-3 tons
- Platanus x acerifolia
- Fraxinus spp.
- Ulmus spp.
- Zelkova serrata
- Ginkgo biloba (Central Valley)
- Carya spp.
- Cinnamomum camphora (in the Southern CA Coast)

Trees that average 4-5 tons
- Quercus spp.
- Pinus spp.
- Eucalyptus (non-invasive)
- Cedrus deodara

NOT SO GOOD — Greenhouse gas reductions from energy conservation — GOOD

No energy conservation value
- Trees planted to the north of buildings
- Trees planted more than 60' from buildings
- Small trees
- Medium trees planted more than 40' from buildings

Trees that average 0.5-1 tons
- Medium trees planted to the west, east, south of buildings within 40'

Trees that average 2-3 tons
- Large trees planted to the east, west, or south 20-60' from buildings

Trees that average 4-5 tons
- Large trees planted to the west of buildings within 20'

NOT SO GOOD — Drought tolerance — GOOD

High water use trees
- Birch trees
- Metasequoia glyptostroboides
- Populus trichocarpa
- Willow trees
- Sequoia sempervirens

Moderate water use trees
- Most maples
- Cedrus libani
- Cinnamomum camphora
- Most ashes
- Ginkgo biloba
- Platanus acerifolia
- Quercus virginiana
- Ulmus parvifolia
- Zelkova serrata

Low or very low water use trees
- Arbutus 'Marina'
- Cedrus deodara
- Gleditsia triacanthos
- Pinus pinea
- Quercus wislizeni
- Ulmus wilsoniana 'Prospector'

*For all benefit spectrums, numbers are only estimates. Actual benefits will depend on climate region, exact species, planting site, etc. and should be calculated with ARB-approved tools.

REQUIRED RESOURCES

Several state-funded programs supporting urban forestry and associated green infrastructure require applicants and potential grantees to utilize specific resources when developing proposed species lists for projects. These programs include those supported by the California Department of Forestry and Fire Protection and California ReLeaf.

Below are links to three websites that will help guide your species selection. <u>These are required resources that each applicant must use</u>. The last page offers additional resources that were referenced earlier in the document that will further provide guidance on regional tree selection, climate-ready species, and contact information for professionals in the field.

Eligible Trees:
Use SelecTree (http://selectree.calpoly.edu) and the Water Use Classification of Landscape Species Plant List (http://ucanr.edu/sites/WUCOLS/) to find trees that are appropriate for your planting site. Trees need to be suitable to the local climate, with available water and conditions of the planting site. 15-gallon trees are eligible for consideration, with other sizes eligible on a case-by-case basis.

Tree Planting Standards and Specifications:
The standards, specifications and requirements contained within CAL FIRE's Nursery Standards and Technical Specifications will be a condition of all awarded grants, and must be met to qualify for reimbursement. They can be downloaded at
http://calfire.ca.gov/resource_mgt/downloads/CALFIRE_Nursery_Standards_and_Specs11_12.pdf

Invasive Species:
The California Invasive Plant Council (Cal-IPC) maintains an inventory of invasive plant species at http://www.cal-ipc.org/plants/inventory/. Trees appearing on this inventory should not be planted.

Other resources

General guidelines

Climate Ready Trees: Drought-tolerant, climate-ready species
http://climatereadytrees.ucdavis.edu/meet-the-trees/

UC Extension Agents contact information
http://ucanr.edu/County_Offices/

CalFire Regional Urban Foresters contact information and map of assigned regions
http://www.fire.ca.gov/communications/downloads/fact_sheets/RegionalUrbanForesters.pdf

International Society of Arboriculture "Find an Arborist"
http://www.isa-arbor.com/findanarborist/arboristsearch.aspx

Sunset Climate Zones
http://sunsetwesterngardencollection.com/climate-zones

Species suggestions

Northern California
Friends of the Urban Forest (San Francisco)
https://www.fuf.net/resources-reference/urban-tree-species-directory/

Canopy (Palo Alto)
http://canopy.org/tree-info/canopy-tree-library/#

Central California

Sacramento Tree Foundation
http://www.sactree.com/shady80
www.sactree.com/assets/STF%20Greenprint%20Booklet.pdf

Tree Fresno
http://treefresno.org/wp-content/uploads/2017/04/Tree-Selection-Guide-3-25-2016.pdf

Southern California

CityPlants (Los Angeles)
http://www.cityplants.org/get-free-trees/yard-tree-list

TreePeople (Los Angeles)
https://www.treepeople.org/resources