August 5, 2009

California Energy Commission
Dockets Office, MS-4
Re: Docket No. 09-OII-01
1516 Ninth Street
Sacramento, CA 95814-5512

DOCKET
09-OII-1
DATE 8/5/2009
RECD. 8/5/2009

RE: ARRA SEP Guidelines

On behalf of California ReLeaf and TreePeople, we are submitting the following comments regarding the California Energy Commission's State Energy Program. We are pleased that California is receiving funding for the State Energy Program through the American Recovery and Reinvestment Act, and we believe this is a unique opportunity to fund a myriad of different projects that will help make California a more energy-efficient place to live and work.

We ask that you consider these recommendations as you develop the specific criteria and guidelines for each of State Energy Program programs, including the Municipal Financing District Program, California Comprehensive Residential Building Retrofit Program, Municipal and Commercial Building Targeted Measure Retrofit Program, as well as the revolving loan program for state building retrofits, Green Jobs Training Program, and Energy Conservation and Assistance Account:

- We strongly recommend the inclusion of energy efficiency projects and techniques that may be incorporated into the site surrounding the building through both retrofits and new building design.

- Green infrastructure, including urban forests, shade trees, stormwater collection and reuse systems, and other types of green infrastructure are energy efficiency and conservation techniques that can be incorporated into a home, business, or commercial site design to provide energy savings and reduce greenhouse gas emissions.

- Training of design, installation, management and maintenance of green infrastructure, shade trees, and urban forest projects are viable skills for green jobs and workforce training programs.

- Individual shade trees and larger scale urban forests conserve energy by providing shade to buildings, homes, and businesses -- thereby reducing the demand for air conditioning,

especially at peak hours. Reduced demand for air conditioning, especially at peak hours, reduces energy demands and greenhouse gas emissions both on site and at the power generation plant.

- Several utilities in California have formalized energy saving shade tree programs due to their proven results in saving energy on site and in reducing overall energy demand at the power plant. The Sacramento Municipal Utility District's *Sacramento Shade* program, and the Los Angeles Department of Water and Power's *Trees for a Green LA* program are two successful examples of such programs. Information on these programs is included with this letter.

- Many non-profit organizations across the state help to manage such programs for utilities as well as run their own programs for green infrastructure and urban forests for energy savings, and co- benefits. California ReLeaf represents a network of over 100 of these groups across California. The Sacramento Tree Foundation and TreePeople in Los Angeles are two examples of organizations that have been serving their communities with such projects for several decades.

- As you may be aware, the California Climate Action Registry (now the Climate Action Reserve) and the California Air Resources Board, adopted an urban forestry protocol, recognizing the power of urban trees to first reduce emissions and secondly to sequester carbon. Due in part to this action we anticipate that more communities will be planting trees for energy efficiency in the coming years, and we are very hopeful that these projects will be considered eligible under the SEP.

- LA County Public Works has partnered with TreePeople and other entities to develop large-scale multi-purpose stormwater management projects, such as the Sun Valley Watershed Retrofit Project. These projects use green infrastructure to collect, treat, store, and either 1) reuse stormwater for irrigation on site, or 2) infiltrate stormwater to replenish groundwater sources. These projects result in more reliable local water resources, therefore reducing the demand for imported water which saves energy. Currently, the water sector is the largest consumer of energy in California, estimated to account for over 19% of California's electricity and about a third of the non-power plant natural gas use. We have included TreePeople's *Rainwater as a Resource* with this letter, a publication that describes water/energy conservation retrofit pilot projects at various scales.

- Green infrastructure and urban forest projects can be applied at the residential scale, as well as on municipal and commercial properties, state building sites, schools and campuses, hospitals, institutions, etc.; and in each case will result in energy savings and greenhouse gas emission reductions as well as many co -benefits. We have included with this letter a study done by the U.S. Forest Service Pacific Southwest Research Station Center for Urban Forest Research on the cost effectiveness of energy-saving shade tree programs statewide.

- Green infrastructure, including urban trees, also provides significant co-benefits such as improving air and water quality in our local communities, helping increase water use

efficiency and conservation, and providing public health and societal benefits by offering green places for people to live, work and play.

For these reasons, we would like to stress the importance of considering green infrastructure and urban forest programs as eligible projects throughout the suite of programs the CEC is developing as part of the State Energy Program. We are aware that there are many valuable and important projects that the Energy Commission could pursue with these funds, and we thank you for your time and consideration.

Sincerely,

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Claire Robinson, Executive Director
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Cc: Panama Bartholomy, CEC
Attachments

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URBAN FORESTRY & URBAN GREENING

Potential energy savings in buildings by an urban tree planting programme in California

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Abstract: Tree canopy cover data from aerial photographs and building energy simulations were applied to estimate energy savings from existing trees and new plantings in California. There are approximately 177.3 million energy-conserving trees in California communities and 241.6 million empty planting sites. Existing trees are projected to reduce annual air conditioning energy use by 2.5% with a wholesale value of $ 485.8 million. Peak load reduction by existing trees saves utilities 10% valued at approximately $ 778.5 million annually, or $ 4.39/tree. Planting 50 million trees to shade east and west walls of residential buildings is projected to reduce cooling by 1.1% and peak load demand by 4.5% over a 15-year period. The present wholesale value of annual cooling reductions for the 15-year period is $ 3.6 billion ($ 71/tree planted). Assuming total planting and stewardship costs of $ 2.5 billion ($ 50/tree), the cost of peak load reduction is $ 63/kW, considerably less than the $ 150/kW benchmark for cost-effectiveness. Influences of tree location near buildings and regional climate differences on potential energy savings are discussed.

Key words: urban forests, peak load reduction, energy conservation

Introduction

California is home to over 30 million people and the world's sixth largest economy. Its population is expected to nearly double to 60 million in the next 40 years, with concomitant increased demand for energy resources (California Department of Finance 1998). Providing adequate supplies of energy to fuel growth has proven to be a challenge, as evidenced by rolling blackouts during 2001 (Berthelsen & Winokur 2001).

Rapid growth of California cities is associated with a steady increase in ambient downtown temperatures of about 0.4 °C (0.7 °F) per decade. Because electric cooling load demand of cities increases about 3–4% per °C (1–2% per °F) increase in temperature, approximately 3–8% of electric demand for cooling is used to compensate for this urban heat island effect (Akbari et al. 1992). Warmer temperature in cities compared to surrounding rural areas has other implications, such as increases in carbon dioxide emissions from fossil fuel power plants, municipal water demand, unhealthy ozone levels, and human discomfort and disease. In addition, climate change may double the rate of urban warming, underscoring the need for more energy-efficient landscapes in new urban developments.

Urban forests modify climate and conserve building

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1618-8667/03/02/02-073 $ 15.00/0

energy use through 1) shading, which reduces the amount of radiant energy absorbed and stored by built surfaces, 2) evapotranspiration (ET), which converts liquid water in plants to vapor, thereby cooling the air, and 3) wind speed reduction, which reduces the infiltration of outside air into interior spaces (Heisler 1986). Trees and other greenspace within individual building sites may lower air temperatures 3 °C (5 °F) compared to areas outside the greenspace.

Although shade trees have potential to conserve energy, if located to shade solar collectors and south-facing windows they can reduce collector efficiency and increase winter heating costs. Other potential drawbacks include:

- conflicts between trees and sidewalks, power lines, and street lights when trees are improperly sited,
- falling limbs, fruit, and leaves that create hazards and require clean-up,
- certain species release allergens and emit biogenic volatile organic compounds (BVOCs) that contribute to ozone formation,
- many types of trees require ample amounts of water to grow,
- slow growth rates and high mortality rates can reduce tree planting cost-effectiveness.

Judicious tree selection and location are critical to maximizing energy benefits and minimizing the problems noted above (McPherson et al. 1999, 2000, 2001).

There are an estimated 6 million street and park trees and a total 148.6 million trees in urban areas in California (Bernhardt & Swiecki 1993; Dwyer et al. 2000). However, information is lacking on how these trees influence building energy use and the potential for new tree planting. Although previous research has addressed these questions at the scales of individual home sites (Meier 1991) and cities (Simpson 1998), statewide impacts have never been studied. Information at this scale is important to California government officials and electric utilities, who are actively investing in peak load reduction strategies. Moreover, because California is as large as many countries in Europe and Asia, the methods described here could be applied to conduct large-scale analyses elsewhere. Thus, the objectives of this study were to determine the effects of:

- existing trees on statewide and regional energy consumption for space heating and cooling and peak electricity demand,
- future tree plantings on statewide and regional energy consumption for space heating and cooling and peak electricity demand,
- regional differences on annual energy savings, peak load reductions, and cost-effectiveness.

Methodology

Aerial photo analysis

Data from aerial photography were previously collected for 21 California cities with print scales from 1:12,000 and 1:4,800 and dates ranging from 1988 to 1992 (USDA Forest Service 1997). The point below each randomly located dot was classified by land-use type, cover type, and the site's effect on building energy use (Fig. 1). A minimum of 3,495 sample points were analyzed from photos that covered the entire area of each city. Data were grouped by four land use classes: single family residential (SFR), multi-family residential (MFR), commercial/industrial (C/I), and institutional/transportation (I/T). Because our estimates focus on trees and planting sites with energy-saving potential, locations on agricultural, wildland, and abandoned areas within cities are excluded.

Points falling on tree canopy or plantable pervious cover were further classified into site locations based on whether their effect on heating and cooling energy use was positive, negative, or neutral. Trees or empty planting sites located within 12.2 m of east and west sides of buildings were in "positive sites" because trees provide benefits from shade. South trees located within 6.1 m from buildings were in "neutral sites" since benefits from limited summer shade are likely to be offset by undesirable winter shade. Points located between 6.1 m and 12.2 m of the south side of buildings were in "negative sites" because most shade occurs during the heating season. Points located to the north or greater than 12.2 m from buildings in other directions were in "neutral sites" because their shade would not fall on buildings. Trees at all sites were assumed to produce energy benefits from reduced ambient temperatures and wind speeds (climate effect). These site classifications reflect our general knowledge of how time, season, and tree location influence shading on buildings (Heisler 1986).

The number of existing trees and potential tree planting sites were calculated assuming an average tree cover density of 609 trees/ha (average crown projection area of 16.4 m^2 per tree) (Table 1). This tree density was derived from tree cover densities for land uses within city and suburban sectors of Sacramento and applied to all sample cities and land uses (McPherson 1998). The total number of trees T_{ik} for land use 'i' and site 'k' was calculated as

$$T_{ik} = p_{ik} * A/b$$

where

p_{ik} = proportion of interpreted points covering land use i on site k (i.e., positive, neutral, or negative sites),
A = city area,
b = average tree crown projection area.

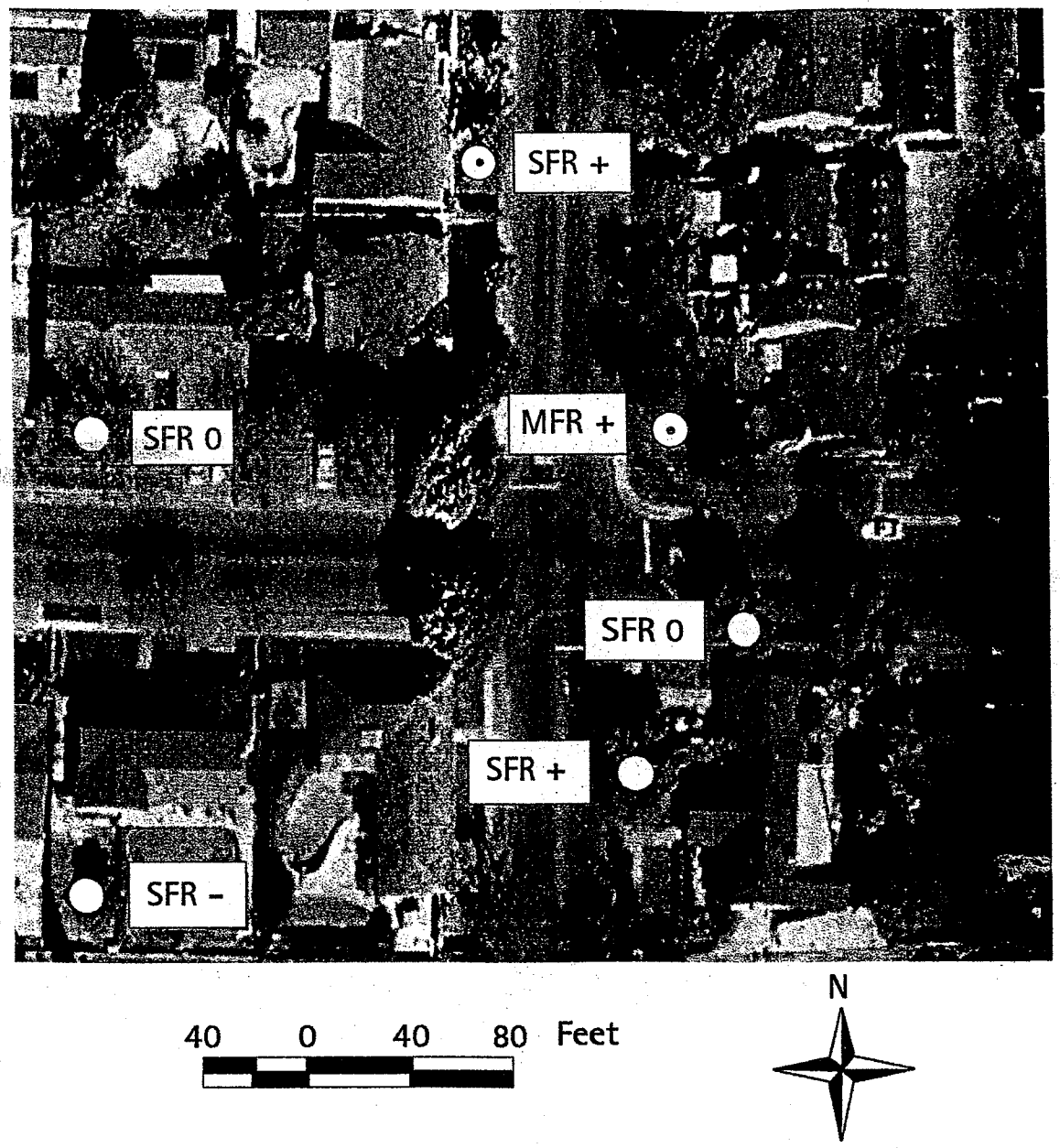

Fig. 1. Aerial image similar to those interpreted showing random dots landing on existing tree cover (unfilled circles) and empty tree sites (filled circles). Land use (single family residential [SFR], multi-family residential [MFR]) and site location (positive, neutral, negative) are shown for each point.

And the standard error was calculated as

$SE(T_{ik}) = A/b * SQRT[V(p_{ik})]$

where $V(p_{ik})$ is the variance of p_{ik} and calculated as

$V(p_{ik}) = p_{ik}(1 - p_{ik}) / \text{Total \# of interpreted points}$

This standard error for numbers of trees characterizes measurement error, but underestimates total error because other sources of error are present (discussed later in this paper).

Scaling-up from the sample to climate zones

California has the most diverse set of climatic conditions of any state in the US. The California Energy Commission (1995) analyzed data from over 600 weather stations and divided the state into 16 distinct and reasonably consistent climate zones based mostly on summer and winter mean temperatures. Climate zone boundaries are fairly consistent with jurisdictional boundaries and avoid creating pockets within zones.

Table 1. Tree cover data from previous aerial photo interpretation, estimated tree numbers (in thousands), and population and housing estimates (dwelling units [DUs] in thousands) for 1990 and 2000 used to scale-up sample data. Trees (se) is the standard error of the estimate of tree numbers

Region	Sample Cities	Tree	1990		1990	1990	2000	2000
		Cover (%)	Trees	Trees(se)	City Pop.	City DUs	Zone Pop.	Zone DUs
North Coast	Eureka	21.6	85.3	4.9	27.0	11.8	1,068.6	450.1
Cental Coast	Atherton	47.5	360.3	6.8	7.2	2.5	6,109.9	2,238.8
	Menlo Park	23.9	363.1	12.5	28.4	12.4		
	Santa Maria	5.4	109.2	7.8	61.6	21.2		
South Coast	Los Angeles	15.4	14,684.4	469.4	3,485.6	1,300.0	4,969.9	1,834.2
South Valleys	Pasadena	22.5	724.8	23.0	131.6	53.0	10,770.7	3,492.8
Inland Empire	Escondido	18.1	493.0	22.1	108.6	42.1	2,887.3	1,009.4
	Poway	10	290.7	16.3	43.4	14.4		
North Ctr Valley	Chico	11.4	308.3	15.4	40.0	16.2	786.9	345.0
	Redding	15.5	381.5	26.3	66.5	27.2		
	Yuba City	11.7	101.3	4.6	27.4	11.0		
Mid Ctr Valley	Merced	5.7	123.9	8.2	56.2	18.9	3,887.6	1,433.1
	Sacramento	14.1	2,065.4	76.1	369.4	153.4		
South Ctr Valley	Bakersfield	5.7	497.0	26.3	175.0	66.2	1,966.5	663.5
	Visalia	12.5	228.4	13.2	75.7	27.2		
High Desert	Lancaster	0.4	53.0	7.5	97.3	36.2	757.1	271.8
	Victorville	1.7	57.8	6.6	40.7	15.6		
Low Desert	Cathederal City	3.9	103.1	8.3	30.1	15.2	540.8	229.8
	Coachella	7.9	19.0	2.9	16.9	3.8		
	Desert Hot Springs	1.5	21.8	2.8	11.7	5.5		
	Palm Springs	3.9	367.1	23.8	40.1	30.5		
Mountains	South Lake Tahoe	41.7	340.5	7.5	21.6	14.1	582.0	286.0
							34,327.3	12,254.5

Table 2. Representative cities, air temperatures, radiation, and heating and cooling degree days for the 11 climate zones

Region	City	Avg. Daily Min. Temp (°C)	Avg. Daily Max. Temp (°C)	Direct Solar Radiation (W/m²)	Diffuse Solar Radiation (W/m²)	HDD	CDD
North Coast	Santa Rose	7.3	22.2	5.2	1.6	3,340	323
Central Coast	Sunnyvale	8.2	22.2	5.6	1.5	2,366	325
South Coast	San Diego	12.2	22.2	5.3	1.8	1,355	472
South Valleys	Burbank	11.2	25.2	5.6	1.7	1,488	893
Inland Empire	Riverside	10.2	25.8	5.7	1.8	1,570	1,243
North Central Valley	Red Bluff	9.1	23.7	6.2	1.4	2,518	1,337
Middle Central Valley	Sacramento	8.6	23.1	6.3	1.4	2,764	708
South Central Valley	Fresno	10.8	25.1	6.5	1.5	2,300	1,908
High Desert	China Lake	7.5	24.4	7.3	1.4	2,706	1,719
Low Desert	El Centro	14.6	31.3	6.6	1.6	776	4,018
Mountains	Mt. Shasta	2.1	18.2	5.4	1.5	5,600	253

One heating degree day (HDD) accumulates for every degree that the mean outside Temperature is below 65 °F (18.3 °C) for a 24-hr period.
One cooling degree day (CDD) accumulates for every degree that the mean outside temperature is above 65 °F (18.3 °C) for a 24-hr period.

We reduced these 16 zones to 11 because canopy cover data were not available for cities in certain climate zones (Fig. 2, Table 2). Climate zones that were joined were adjacent to each other, with relatively similar climates.

Tree numbers by location for each sample city were stratified into the 11 climate zones. Tree ratios, the number of trees per person or per dwelling unit, were calculated by land use and tree site (i.e., positive, neutral, or negative) for each sample city using 1990 demographic data (U.S. Census Bureau 1996) (Table 1). Tree ratios for SFR and MFR land uses were calculated per dwelling unit, and ratios for C/I and I/T land uses on a per capita basis. Tree ratios for sample cities in the same climate zone were averaged to derive zone-wide estimates. 2000 population and housing data were aggregated for all California cities and unincorporated areas by climate zone (California Department of Finance 2000) (Table 1). Ratios were multiplied by their respective year 2000 population and dwelling unit numbers to estimate the total numbers of existing trees and potential tree planting sites by land use and tree site for each climate zone. This scale-up assumes that tree distributions in 2000 are the same as those sampled in 1990. If new development patterns resulted in fewer tree sites than observed in 1990, this assumption may overestimate the number of sites.

The 21-city sample did not contain a city in the South Coast climate zone. Land cover and land use data were used from an earlier aerial photo analysis of

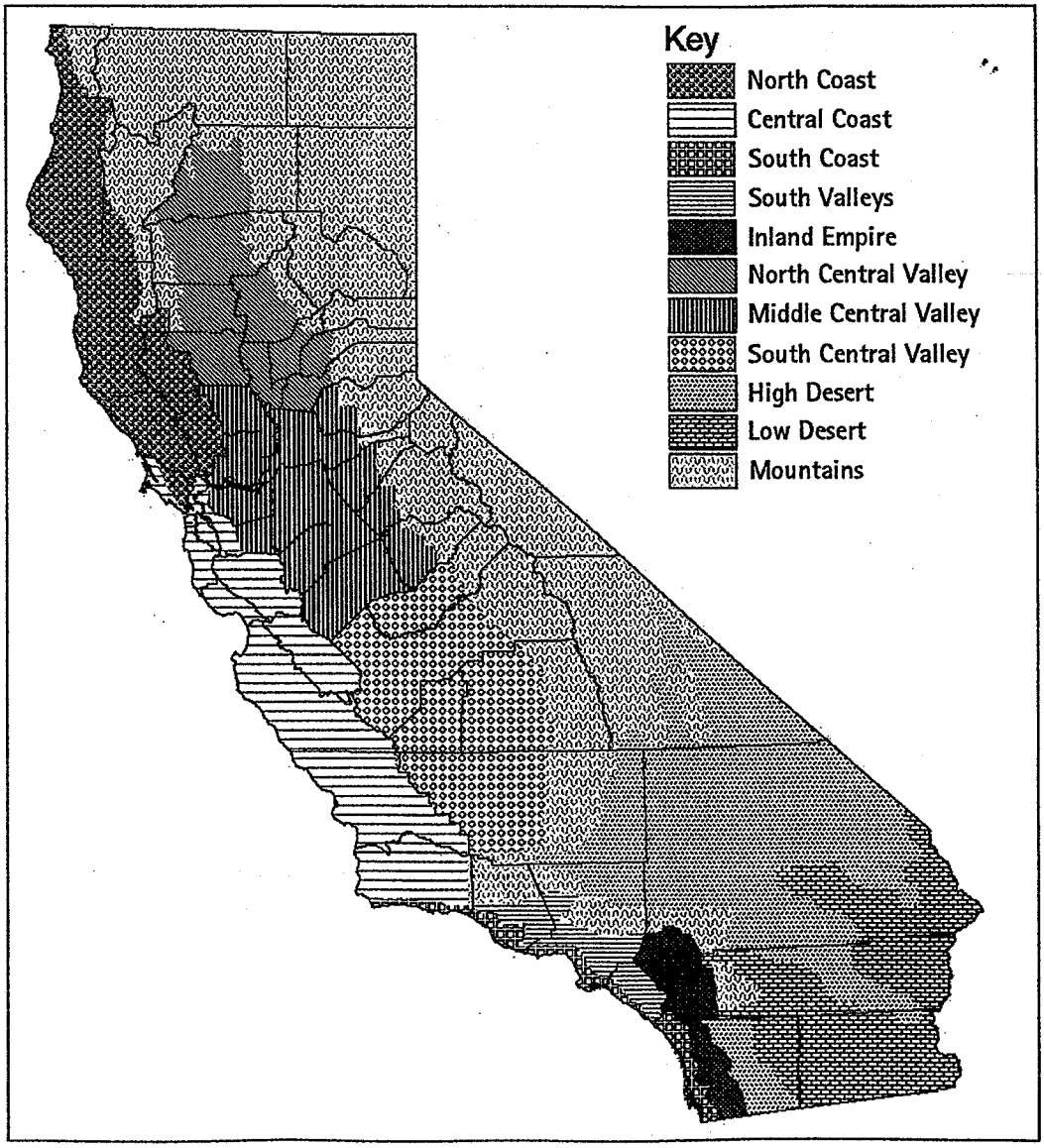

Fig. 2. Climate zones and county boundaries.

Los Angeles (McPherson et al. 1993), but data lacked specific information on tree sites. Tree site data from the 21-city study for Pasadena were applied to the tree canopy cover and plantable pervious land cover data for Los Angeles. Thus, while estimates of the overall numbers of trees and empty sites are specific to the Los Angeles imagery, the locations of trees and sites around buildings were extrapolated from nearby Pasadena and may not accurately reflect conditions in Los Angeles. Also, anomalously high canopy cover (47.5%) and trees/capita (50) for Atherton led to its removal from the database, leaving two sample cities for the Central Coast region (Menlo Park, Santa Maria) (Table 1).

Computer simulations

This study relied largely on results from previous computer simulations of the relative effects of different tree configurations on building energy use (McPherson & Sacamano 1992; Simpson et al. 1994; Simpson & McPherson 1996; McPherson & Simpson 1999). Energy savings were determined by comparing predictions for identical unshaded (base case) and shaded buildings. Base case results were calibrated and adjusted with residential energy use data from each utility (Table 3). Annual impacts on cooling (kWh) and heating (MJ) per residential unit (Unit Energy Consumption or UEC), and peak demand or capacity (kW) per residential unit (Unit Power Consumption or UPC) were based on hourly simulations using representative weather data for cites in each of the 11 climate zones (Mallette et al. 1983) (Table 3) A detailed description of how energy effects were estimated is described in the full technical report (McPherson & Simpson 2001).

UECs and ΔUECs in this study were based on results for 139 m^2 and 163.6 m^2 wood frame homes that meet California Energy Efficiency Standards (Title-24). The single-family residences had R-39 insulation in the roof and R-19 insulation in the walls, energy efficient heating (Annual Fuel Utilization Efficiency = 78%) and cooling (Seasonal Energy Efficiency Ratio = 10 [ratio of cooling output in kBtuh to power consumption in kWh]) equipment, dual-pane windows, and cooling by natural ventilation when the outside temperature dropped below the thermostat setpoint (25.6 °C). Results for smaller buildings were increased by the ratio of their conditioned floor areas (CFA) (163.6/139 = 1.18) to provide for more direct comparisons across regions, and to reflect the larger size of newer home construction. The use of this ratio is an approximation because smaller buildings have relatively larger surface area to volume ratios and greater conduction heat gains/losses per unit volume than larger buildings. Because the scaling adjustment here is small, its effect on the modeling results is minor.

In these studies shade was simulated using the deciduous Chinese lantern tree (*Koelreuteria bipinnata*). This species is commonly planted except in the mountains, has a broad, umbrella shaped crown, is a low to moder-

Table 3. Simulated heating and cooling loads for the base case buildings and regional air conditioning saturations weighted by equipment type

Region	Base Case Buildings			
	Annual Cooling (kWh)	Peak AC (kw)	Annual Heating (GJ)	SF Res. AC Saturation (%)
North Coast	881	2.51	21.7	39.7
Central Coast	539	2.29	13.5	32.4
South Coast	603	2.17	7.2	30.3
South Valleys	1,904	3.08	10.3	55.6
Inland Empire	2,493	3.30	14.5	59.5
North Ctr Valley	2,135	3.17	23.4	70.8
Mid Ctr Valley	1,490	3.15	20.5	68.6
South Ctr Valley	2,968	3.32	16.2	70.2
High Desert	2,646	2.94	28.9	78.0
Low Desert	5,453	3.32	5.5	78.0
Mountains	559	2.28	83.0	10.0

SF Res AC Saturation is the percentage of single family residential units with cental air conditioning. The calculation weights evaporative and room AC based on typical electric use relative to central AC.

ate water user, moderately pest resistant, and low emitter of volatile organic compounds. Results of shading at 5, 10, and 15 years after planting are reported and assume respective tree heights and crown spreads of 4 m, 5.8 m, and 7.3 m. These dimensions are consistent with measured data for street trees in Modesto and Santa Monica (Peper et al. 2001a, 2001b). Trees were estimated to block 85% of summer irradiance (April through November in most climate zones) and 30% during the winter leaf-off period (McPherson 1984). Shade effects from individual trees were simulated assuming trees were placed 3.8 m from east and west walls.

UECs were adjusted to account for forecasted saturation of central air conditioners, room air conditioners, and evaporative coolers in each utility service area (California Energy Commission 2000a) (Table 3). In this study the term saturation refers to the percentage of total dwelling units with air conditioning equipment. Equipment factors of 33% and 25% were assigned to homes with evaporative coolers and room air conditioners, respectively. These factors were combined with equipment saturations to account for reduced energy use and savings compared to those simulated for homes with central air conditioning. ΔUECs for multifamily residential buildings due to tree planting were estimated by adjusting single family ΔUEC for differences in energy use, shading, and climate effects between building types. UEC data were taken from US Energy Information Administration (1993a, 1993b) climate zones representative of California (zones 3, 4, and 5). Similar adjustments were used to account for UEC and CFA differences between single-family detached residences for which simulations were done, and attached residences and mobile homes.

Calibration and validation of simulation results

To improve the accuracy of initial simulation results they were calibrated with other findings until reasonably similar to those from the limited set of relevant simulation and field studies. Meier (1990/91) reviewed results from five studies that measured energy savings from landscaping and reported that air conditioning energy savings commonly measured 25–50%, but non of these studies were in California. In the only California field study (Akbari et al. 1997), 16 trees in containers, 8 large (7 m tall) and 8 small (3 m), were located to shade the walls of two residential buildings in Sacramento, California. The trees were reported to reduce annual air conditioning use by 26% for one building and 47% for the other. This difference in savings was due to different shading treatments and measurement sequences. After adjusting for tree size, the annual cooling savings were 3–8% per large tree (7 m). Our final simulations results for Sacramento (Mid-Central Valley) found that shade from a south tree (7.3 m tall) reduced annual cooling by 5% (76 kWh).

Computer simulations conducted by Akbari et al. (1990) in Sacramento were based on three trees and included effects of increasing roof albedo. After accounting for these effects the estimated savings from shade and climate effects was 424 kWh/tree. Estimated savings of 350 kWh from our 7.3 m tall west tree is somewhat less than this amount of 424 kWh/tree.

In simulation studies Huang et al. (1987) found annual savings of 261 kWh/tree in Sacramento, for similar houses, compared with 237–350 kWh/tree found in this study. Their trees had greater crown diameter (10 m vs. 7.3 m), but shading was "generalized" and not located to maximize summer shading. When shading was maximized, their savings increased to 343 kWh/tree, similar to our 350 kWh amount for a west tree.

Peak savings were also reported by Huang et al. (1987) of 0.66 kW/tree for Sacramento compared to 0.35 kW/tree found here for a west tree. Their savings increased to 1.24 kW/tree for a strategically located tree. Akbari et al. (1990) found an average peak cooling savings of 0.52 kW/tree in Sacramento. Smaller savings reported for this study are partly the result of the smaller trees (10 m vs. 7.3 m) and different modeling algorithms. Given this limited basis for comparison, it appeared that our final simulation results were reasonably similar to those reported in other studies.

Forecasted electricity and natural gas prices and demands

For this analysis we assumed that the base contract price of $ 69/MWh ($ 66.34 in 1998 real dollars) remained constant because in 2001 California purchased long-term contracts for electricity at an average price of $ 69/MWh. Another 10% was added for ancillary services that utilities provide, as well as 10% for additional spot market contracts. The total wholesale price was $ 79.61/MWh. We use wholesale prices and take a utility perspective in this analysis because investment in a large-scale tree planting program would need to be economically acceptable to utilities and their regulators. The retail price paid by residential customers is approximately twice the wholesale price because of additional costs for transmission and other services.

Annual natural gas prices were based on forecasted values obtained for residential, commercial, and industrial end-uses from Pacific Gas & Electric, Southern California Gas, and San Diego Gas & Electric (California Energy Commission 2000b). Prices for the 15-year planning period averaged $ 6.06/GJ ($ 6.39/MBtu) and $ 4.67/GJ ($ 4.93/MBtu) for residential and commercial/industrial uses, respectively.

The present value of benefits (PVBs) from heating and cooling savings were calculated assuming a 5% nominal discount rate for a 15-year planning horizon (2001–2015). The 15-year planning period is a compromise between the short-term financial and political need for return-on-investment and the long-term life span of trees. Because statewide, shade trees slightly increase annual heating costs, the PVBs for heating alone can be negative.

The net present value of benefits (NPVB) was calculated by subtracting total discounted costs from total PVBs. The ratio of benefits to costs was also calculated. All trees were assumed to be planted in 2001 at an average cost of $ 50 per tree. This cost includes expenditures for administration, marketing, and stewardship, as well as costs associated with tree purchase and planting (5-gallon trees). Shade tree programs sponsored by the Sacramento Municipal Utility District (SMUD) and Los Angeles Department of Water and Power (LADWP) have budgeted costs of about $ 50 per tree.

In 2001 it cost $ 150–250 to produce, purchase, or conserve a kW at the summertime peak (Messenger, personal communication). Hence, peak load reduction measures that cost less than $ 150 per kW saved are considered cost-effective. This price of $ 150 per kW avoided at the peak was used to estimate the value of peak load reduction.

Forecasted demand data were used to estimate the relative effect of existing and newly planted shade trees on statewide energy use during the next 15 years. Annual forecasts by end use were obtained for 2000–2010 and extrapolated to 2015 using a linear trend function (California Energy Commission 2000a).

Simulation scenarios and modeling assumptions

Results are presented for existing trees and a scenario that assumes strategic planting within 12.2 m of the east and west sides of residential buildings. Previous analyses in Sacramento, CA indicate that some residents will not accept additional shade trees even though vacant planting sites are available (Sarkovich, personal communication). Therefore, we assume planting of 50 million trees in sites that occupy 66% of all vacant sites within 12.2 m of east and west walls of residential buildings. A second scenario planted trees at 66% of all residential sites to compare the effects of trees located away from buildings (climate only) with those that are strategically located to provide east and west shade (shade + climate).

The planting scenarios assume that 15% of planted trees die and are removed during the 5-year establishment period after planting. An additional 5% of the number planted are assumed to have died by year 10 and another 5% by year 15. Thus, 75% of the trees planted are assumed to survive after 15 years. This survival rate is similar to rates reported for street trees that are more prone to vandalism and stress than trees in residential yards (Miller & Miller 1981).

Results

Tree numbers and locations

Existing trees

There are approximately 177.3 million (standard error [se] 2.8 million) existing trees with energy-saving potential in California cities (Fig. 3). Thirty percent of all trees are in the South Valleys zone. Overall, there are 5.2 trees per capita (34.3 million human population). The ratio of trees per capita is highest in the Mountains and North Central Valley climate zones and lowest in the High Desert.

Seventy-one percent of all trees are on single-family residential (SFR) land uses and 6% are on multi-family residential (MFR) land. The average number of residential trees per dwelling unit is 11.2, with ratios as high as 27.3 in the mountain climate zone, and as low as 2.3 in the high desert. Trees on institutional/transportation (I/T) land uses account for 17% of the total, with 6% on commercial/industrial (C/I) land uses. Forty-seven percent of all trees are located in "positive" sites east and west of buildings so as to provide shade and climate benefits, while 2% are in "negative" locations (6–12 m south of buildings) and 51% are in "neutral" locations that produce only climate benefits.

Potential planting sites

There are approximately 241.6 million (se 3.2 million) empty planting sites with energy conservation potential

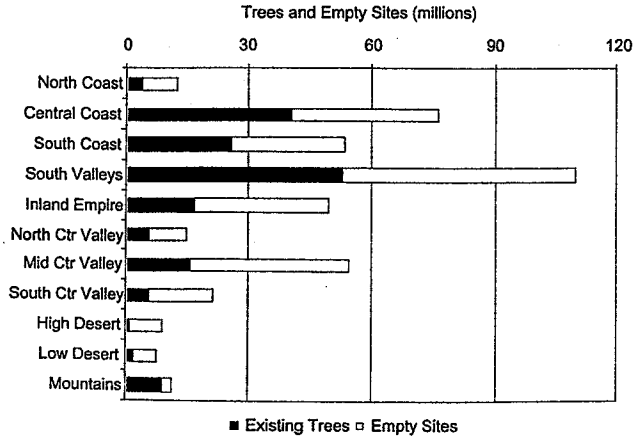

Fig. 3. Estimated current numbers of existing shade trees and empty tree planting sites in millions by climate zone.

(Fig. 3). Empty planting sites are more evenly distributed among climate zones than existing trees, although zones with the most trees also tend to have the most planting sites. There are 7.0 empty sites per capita on average, with highest ratios in the North Central Valley, High Desert, Inland Empire, and Low Desert zones, and the lowest ratios in the more heavily treed Mountains, South Valleys, and South Coast.

The distribution of empty planting sites among land uses is similar to the distribution of existing trees: 63% are on SFR land uses, 4% MFR, 26% I/T, and 7% C/I. The average number of empty residential planting sites per dwelling unit is 13.2, with ratios as high as 28.3 and 21.5 in the Inland Empire and High Desert zones, and as low as 6.7 and 7.8 in the Central Coast and Mountains, respectively. Forty percent of all potential tree sites are in "positive" locations, 4% are in "negative" locations, and 56% are in "neutral" locations that produce only climate benefits.

The technical potential for shade trees, defined as all planting sites including those with trees, is 418.9 million (se 4.2 million) in California. Statewide, technical potential is 12.2 sites per capita, and ranges from 10 (South Valleys) to 20 sites (Mountains). Current shade tree saturation, the percentage of technical potential with energy-conserving shade trees, is 42%. Saturation is highest in the Mountains (76%) and Central Coast (53%) and lowest in the High (8%) and Low (24%) Deserts. Saturation is greater in residential land uses (45% SF and 56% MF) than C/I (39%) and I/T (32%). East and west sites (positive) have higher saturations (46%) than south sites (negative) (33%).

Zones with the greatest number of empty planting sites are the South Valleys, Mid-Central Valley, Central Coast, Inland Empire, and South Coast. Together, sites in these five zones account for 79% of all empty sites. For these five zones, tree saturation is lowest in the Mid-Central Valley and Inland Empire zones, indicating that these zones have the greatest opportunity for new tree planting.

Building energy savings

Existing trees

California's 177 million energy conserving urban trees reduce annual electricity use for cooling by 6,407.8 GWh (2.5%), providing a wholesale savings to utilities of approximately $ 485.8 million (Table 4). The savings to customers is about twice this amount, or $ 970 million. Residential savings is 5,302 GWh (6.9% of total residential use) and C/I savings is 1,105 GWh (0.8% of total commercial use). The average savings for all trees is 36 kWh/tree ($ 3/tree), and trees shading SF residences are most efficient (41 kWh/tree). Electricity savings are greatest in the South Valleys, Central Coast, and Mid-Central Valley, while average savings per tree are greatest in the South Central Valley, High Desert, and Low Desert/North Central Valley.

Existing trees in California communities have an even greater effect on peak electricity consumption, reducing peak use by 5,190.2 MW (10%) over the 15-year period. Assuming a price of $ 150/kW, the value of peak load reduction is $ 778.5 million. Peak load savings are greatest in the South Valleys, Central Coast, South Coast, and Inland Empire. Average savings per tree is 0.03 kW, with values ranging from 0.02 (Mountains and other zones) to 0.09 (Low Desert). These relatively low values are partially due to tree location. Only 25% of existing trees are opposite west- and south-facing walls where benefits from shade are greatest for peak load reduction.

Existing trees increase natural gas consumption for space heating by 4.4 million GJ (2.8%), costing $ 27.4 million. Although trees reduce winter air infiltration rates, thus saving energy used for heating, this benefit is more than offset by increased heating demand due to shading from leaves and branches when solar access is a benefit. Statewide, existing trees near single-family buildings increase natural gas consumption 6.1 million GJ ($ 35 million). Trees near other buildings (e.g., multi-family residential, commercial) have a slightly

Table 4. Simulated annual cooling, peak cooling, and annual heating savings from existing trees. For the 50 million planted tree scenario, annual savings are shown at 5-year intervals after planting, assume 25% tree mortality over the 15-year period, and dollar savings are discounted at a 5% nominal rate

Tree numbers	Cooling Saved (GWh)	Cooling Saved (million $)	Peak Cooling Saved (MW)	Peak Cooling Saved (million $)	Heating Saved (GJ)	Heating Saved (million $)
177 million existing	6,408	485.8	5,190	778.5	-4.4	-27.4
50 million at 5 years	1,792	142.7	641	108.8	-4.1	-22.8
50 million at 10 years	3,949	314.4	3,427	657.9	-6.2	-34.5
50 million at 15 years	6,093	485.0	6,545	1,421.8	-7.7	-43.1

positive effect on natural gas use for heating because these larger structures are less influenced by shade effects and more influenced by climate effects compared to detached homes. The average annual cost per tree statewide is only $ 0.15 (60.1 MJ). Average annual effects on heating are most costly in the Mid-Central Valley (219 MJ/tree, $ 0.54) and most beneficial in the Mountains (397 MJ/tree, $ 0.91).

The net economic impact of existing California shade trees on cooling and heating is $ 458 million (se $ 4.1 million). Annual net benefits per tree are greatest in zones with the hottest summers ($ 4–$ 7), such as Desert, Inland Empire, and Central Valley, and savings are least in the cooler Mountains and Coastal zones ($ 1–$ 3). Statewide, tree-related additional heating costs are only 5.6% of total annual cooling savings.

Planting 50 million trees

In this scenario 50 million trees are planted to shade east and west walls with approximately 38 million surviving 15 years later. Ninety-three percent of the trees are planted in SFR land use and the remainder in MFR land. Over the 15-year planning period these trees are estimated to reduce electricity consumption by 46,981 GWh (1.1%) and peak demand by 39,974 MW (4.5%) (Table 4). The discounted savings associated with these projected reductions is $ 3.6 billion ($ 71/tree) and $ 7.6 billion ($ 150/tree), respectively. Heating energy use increases by 74.9 million GJ (2.8%) with a discounted cost of $ 398 million ($ 8/tree). The PVB (discounted cooling savings minus heating costs) for the 15-year period is $ 3.16 billion (se $ 17.9 million) ($ 63/tree). Ninety-seven percent of total PVBs are from SFR trees ($ 65/tree) and 3% are from MFR trees ($ 28/tree).

Assuming program costs of $ 50 per tree, and total costs of $ 2.5 billion for 50 million trees, the net present value of benefits is $ 660,000, or $ 13/tree planted. The discounted payback period is 13 years and the benefit-cost ratio is 1:1.27. For every $ 1 invested in the hypothetical program, $ 1.27 is returned in annual net cooling and heating benefits. The benefit-cost ratio jumps to 1:1.42 when only the PVBs for annual cooling savings are considered.

During the year 2015 California is projected to add 550,000 new residents and electricity consumption will increase by 5,000 GWh. The projected annual electricity savings of 6,093 GWh ($ 485 million, 1.8% of projected demand) due to shade trees planted 15 years earlier will entirely offset the increased electricity demand associated with the state's new residents and associated development (Table 4).

Effects of tree location and climate zone

West trees produced greater annual cooling savings than east trees, which produced greater savings than south trees except in the South Coast zone, where morning fog reduces cooling benefits from east trees (Table 5). Savings from west trees were about 50–100% greater than savings from east trees. A similar pattern is observed for peak cooling savings, but the benefit from west trees is more pronounced. Annual cooling savings from trees located too far from homes to provide direct shade (climate only trees) is generally 25–50% of savings from west trees.

Table 5. Simulated annual energy saving effects of one existing tree (4.6 m crown diameter) at different locations around the base case residences. Climate only trees do not shade buildings (> 12.2 m)

Region	Annual Cooling Savings (kWh/tree)				Peak Cooling Savings (kWh/tree)				Annual Heating (MJ/tree)			
	South	East	West	Climate only	South	East	West	Climate only	South	East	West	Cimate only
North Coast	31	38	59	27	0.03	0.03	0.06	0.03	−469	−165	−230	151
Central Coast	16	22	38	22	0.02	0.02	0.04	0.03	−448	−101	−162	94
South Coast	18	15	23	16	0.03	0.02	0.04	0.03	−186	−59	−98	45
South Valleys	32	36	60	25	0.02	0.02	0.05	0.02	−273	−95	−48	22
Inland Empire	45	51	85	37	0.03	0.03	0.06	0.03	−252	−119	−81	32
North Ctr Valley	62	81	139	36	0.02	0.02	0.05	0.01	−474	−140	−205	60
Mid Ctr Valley	42	58	114	28	0.01	0.02	0.04	0.01	−520	−210	−210	52
South Ctr Valley	76	107	164	53	0.03	0.03	0.07	0.02	−344	−113	−220	41
High Desert	72	74	170	47	0.05	0.04	0.13	0.04	−501	−154	−239	63
Low Desert	66	94	112	48	0.08	0.09	0.16	0.07	−101	−49	−12	21
Mountains	4	5	7	4	0.02	0.02	0.03	0.02	13	−18	13	284

South, east, and west trees increase heating costs except in the Mountains zone, where south and west trees provide slight heating savings (13 MJ/tree, $ 0.07 US) (Table 5). The adverse effects of tree shade on heating is greatest for south trees. In most zones, shade from west trees increases heating costs more than shade from east trees. Trees located too far away to shade homes provide heating savings through reduced wind speeds and cold air infiltration.

The influence of climate on cooling and heating savings is considerable. Both annual and peak cooling energy savings are greatest in the Desert, Central Valley, and Inland Empire zones and least in the Coastal and South Valleys zones. The magnitude of cooling savings tends to increase with the amount of solar radiation, which trees obstruct, as well as CDD (Table 2). For this reason, climate effects are relatively more important in climate zones with the least solar radiation, such as the coastal zones. Shading effects are most important to cooling savings in the hot, arid desert zones.

The influence of climate on heating costs is coupled to air temperature and HDD, but solar radiation also plays a role. For example, heating impacts for climate only trees track HDD quite closely, with savings greatest in the Mountains and North Coast zones. The adverse impacts of shade on heating are greatest in zones with the most solar radiation, such as the Desert and Central Valley zones. However, it is important to note that the economic consequences of these adverse impacts is minor, with the maximum per tree cost only $ 2.69 US (520 MJ/ south tree in the Mid Central Valley).

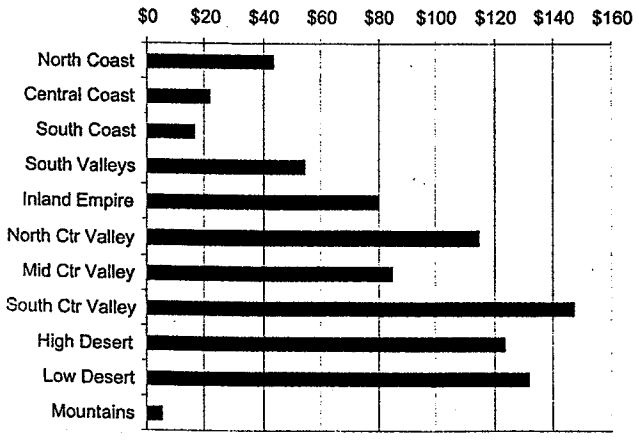

Fig. 4. Present value of benefits (PVBs) per tree planted (50 million trees) to shade east and west walls around single-family residences in each region. This calculation assumes a 5% nominal discount rate, 25% mortality for the 15-year planning horizon, and includes effects on annual heating and cooling, but not peak demand. If tree planting and stewardship costs were $ 50/tree, programs would be cost-effective in regions where PVBs are greater than $ 50.

Cost-effectiveness

PVBs per tree planted indicate the break-even cost for a shade tree program assuming wholesale energy prices. In this analysis PVBs include effects on annual heating and cooling, but not peak demand. PVBs per tree planted ranged from $ 5 in the Mountains to $ 146 in the South Central Valley (Fig. 4). Assuming program costs of $ 50/tree planted, potentially cost-effective programs are in the Inland Empire, Central Valley, and Desert zones.

The 50 million trees were estimated to reduce peak load demand by 39,974 MW over 15 years at a total cost of $ 2.5 billion assuming $ 50/tree. The cost of peak load reduction is $ 63/kW saved. Because this cost is considerably less than the $ 150/kW benchmark for cost-effectiveness, investment in a shade tree program could be a cost-effective peak load management measure in certain regions of California.

Discussion

Limitations and uncertainties

The standard errors of estimates presented with these results include only measurement errors, and are therefore underestimates. The effects of sampling and modeling errors are also important to consider. Sampling error reflects variability city-to-city and because the 21-city sample was not a simple random sample the error is impossible to quantify. Eliminating Atherton from the sample and applying tree location data from Pasadena to Los Angeles also introduces non-randomness and sampling errors.

Modeling error occurs when estimates of tree numbers are transformed from the 1990 tree count to expected numbers in 2000. The potential size of this error and its effect on bias and precision is unclear. Using average tree cover density to estimate tree numbers and empty planting sites is another source of modeling error. The impact of this error is probably small. If a density value higher than the one used here was selected, the result would be higher estimates of tree numbers. However, this increase would be offset because each tree would be smaller and cooling savings per tree would be less. Also, computer simulations contain modeling error because they rely on a limited set of weather data and building and tree types. Results presented here are sensitive to discount rates, energy prices, tree planting costs, building characteristics, tree

mortality, and other factors that cause cost-effectiveness to increase or decrease. An analysis of how each of these factors influences the findings is beyond the scope of this study.

These findings indicate that there are approximately 177.3 million energy-conserving trees in California communities. This estimate is relatively close to the estimate of 148.6 million trees in urban areas of California derived from satellite data by Dwyer et al. (2000). Their estimate applies to communities with at least 2,500 people. Our estimate applies to all urban and rural communities. McPherson (1998) estimated that there were 6 trees/capita in Sacramento County, slightly more than the 5.2 trees/capita reported here. The Sacramento number includes all trees, whereas this study omits trees in agricultural, wildland, and abandoned areas.

Previous shade tree program impact evaluations found that findings are sensitive to tree growth and mortality rates (Hildebrandt & Sarkovich 1998). Our analysis assumed a single growth rate for all trees, where in fact growth will vary across climate zones, among species, and by location. SMUD's analysis of PVBs over a 30-year period assumed low and high mortality rates of 25% and 45%, respectively. This analysis assumed a 25% mortality rate over a 15-year period, a relatively high mortality rate. Lower mortality rates result in greater benefits, but may require increased investment in tree planting, care, education, and monitoring.

One limitation to conducting this type of study elsewhere may be availability of computer programs and expertise to simulate both tree shade and building energy performance. DOE 2 (Birdsall et al. 1994) and Micropas (McPherson et al. 1985; Enercomp 1992) are programs that integrate tree shading with building energy analysis. Both are complex and require considerable technical expertise to assign appropriate inputs and fully interpret results. Aerial photo analysis of tree cover follows standard procedures that are more easily replicated than computer simulations.

One drawback associated with tree planting is the delay between investment and realization of return on investment. Although simulated benefits from planting 50 million trees steadily accrued through the 15-year period (Table 4), the discounted payback period of 13 years is longer than most private sector investors like. To reduce the payback period planners could target climate zones where trees provide the greatest benefits, try to reduce planting costs, increase survival rates, and select rapid growing trees. However, institutional and governmental investors could regard tree planting as a long-term strategy to diversify their portfolio. In this case, the strategy might be to plant large-stature, long-lived trees that will provide benefits well beyond those simulated in this analysis.

Implications of findings

There are several ways that this information can be used to increase energy efficiency in California. First, strategically located shade trees should be planted with new home construction. The CEC and the state's homebuilders should adopt strategic shade tree planting as a mandatory energy conservation measure under Title-24 Energy Efficiency Standards for Residential Buildings. Second, where cost effective, California should implement shade tree programs that retrofit existing buildings with strategically located shade trees. Third, communities should rededicate themselves to increasing their street and park tree canopy cover. Reinvestment in California's green infrastructure is needed to reverse the disturbing decade-long trend of reduced tree program budgets, fewer trees being planted, and increased use of small-stature trees (Thompson & Ahern 2000).

Although these findings do not have direct application in locations outside California, several important relationships have relevance to planners everywhere. Energy savings from shade tree programs will be greatest in cooling dominated climate zones and least in heating dominated regions. In cooling dominated climates, a tree opposite the west-facing wall provides greatest net energy benefit. This benefit tends to be greatest in hot, arid climates, where trees effectively reduce irradiance and drybulb temperature during a relatively long cooling season. Net energy savings are less in more heavily populated coastal regions because temperatures are moderated and fog may reduce irradiance. In heating dominated climate zones it is important to optimize wind speed reductions during winter by placing evergreen trees between the building and prevailing wind. Locating trees for summer shade is less important than ensuring that trees do not obstruct winter irradiance from the south. Shading buildings during the cooling season can be an issue when building envelopes contain large amounts of glass that result in overheating or buildings to have air conditioning.

Summary and conclusions

California's urban forests are often taken for granted, but they are quietly working full-time to make cities more livable. Approximately 177.3 million trees in energy conserving locations shelter buildings and moderate urban climates. As a result, utilities save $ 485.8 million annually in wholesale electricity purchases and generation costs (6,408 GWh, $ 3/tree), while ratepayers save about twice this much in retail expenditures for air conditioning. Annual cooling reductions are equivalent to power produced by 7.3 100 MW plants,

enough power for 730,000 homes. These same trees reduce the summer peak demand by 10% (5,190 MW) and provide a host of other benefits that make them an invaluable component of every community's green infrastructure.

Only 42% of all tree sites in California cities are filled and planting 50 million trees in residential sites to shade east and west walls would fill 21% of all vacant sites. After 15 years their total cooling savings (46,981 GWh, $ 3.6 billion, $ 71/tree planted) would offset 60% of increased electricity consumption associated with California's 8 million new residents. These trees would reduce peak loads by 4.5% (39,974 MW). The present value of peak load reduction is $ 7.6 billion or $ 63/kW, substantially less than the $ 150/kW benchmark for cost-effectiveness. Shade tree programs are cost-effective peak load reduction measures in many parts of California.

Strategically locating trees to shade west walls/windows in climate zones where PVBs are highest will increase net benefits. Although shade trees do not curtail peak loads immediately, they do promise reductions that will increase as trees grow larger. Planting trees now for future peak load reduction, annual cooling savings, improved air quality, and climate change mitigation is a sensible way to soften the impact that California's growing population will have on limited energy resources and quality of life.

Acknowledgements. We appreciate staff at the California Energy Commission who provided information and advice including Todd Peterson, Richard Rohrer, Michael Messenger, David Vidaver, and Ray Darby. Drs. Gordon Heisler (US Forest Service) and Misha Sarkovich (Sacramento Municipal Utility District) provided helpful reviews of an earlier version of the manuscript. Other US Forest Service people who assisted with the study are Sylvia Mori (statistics), Sabrina Mathis (data collection and analysis), Steven Lennartz and Qingfu Xiao (map), and Jim Geiger (manuscript review).

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Received: November 11, 2002
Accepted: July 4, 2003

Energy Savings Facts

Sacramento Shade is a partnership between SMUD, a not-for-profit electric utility, and the Sacramento Tree Foundation. Since the program began in 1990, more than 380,000 trees have been planted.

As a SMUD customer it's easy for you to get FREE shade trees.

Planting shade trees from SMUD:

- will save you up to 40% on your summer cooling costs when the trees are mature,
- beautifies your home,
- improves air quality,
- increases property value.

There are more than 25 species of free shade trees available – large, medium and small.

The average cost of making these trees available to you is $70 per tree.

If a program tree dies within the first three years, it will not be replaced; you may be eligible for a $10 off tree replacement coupon.

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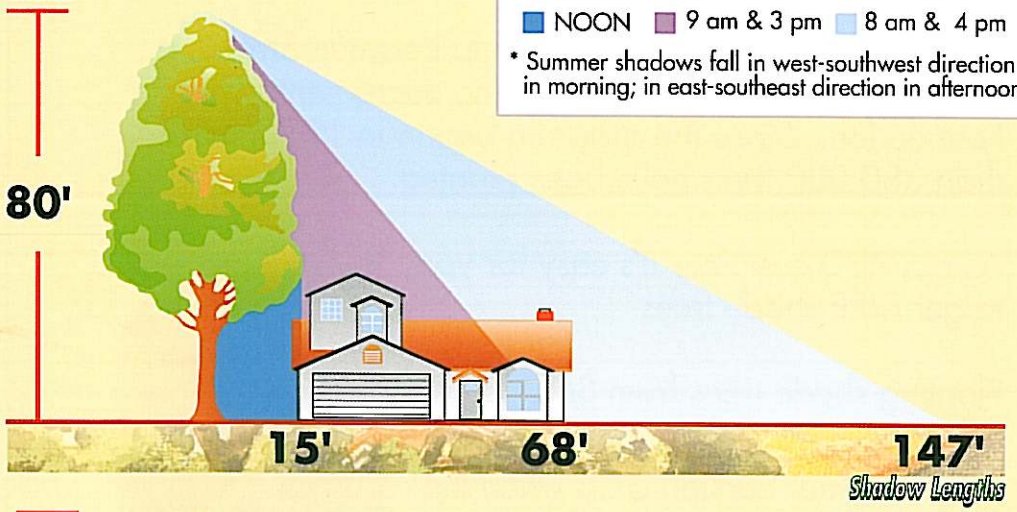
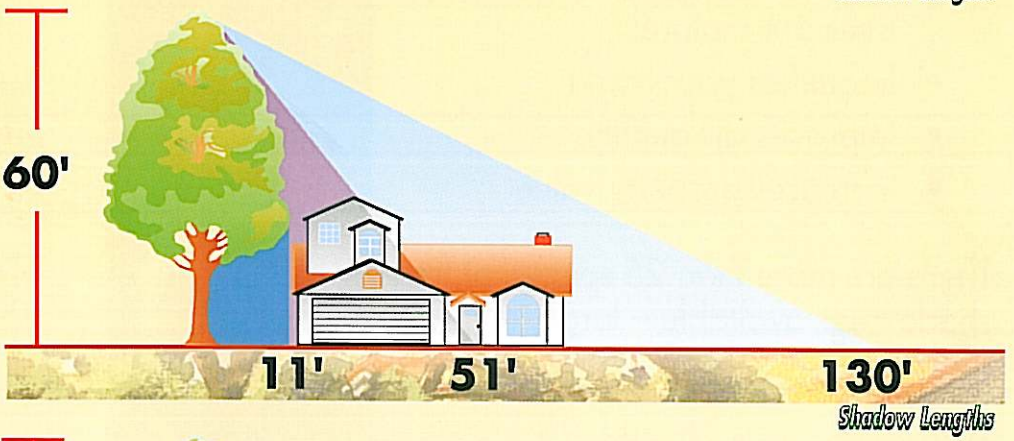
Seasonal Shadow Lengths

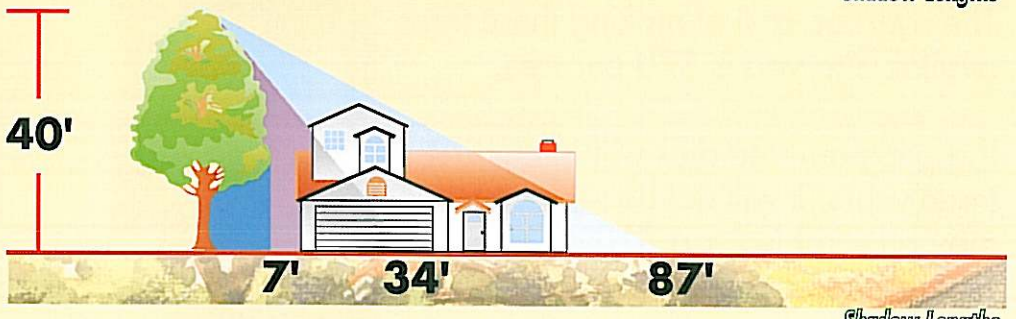
June 21
Summer
Solstice*

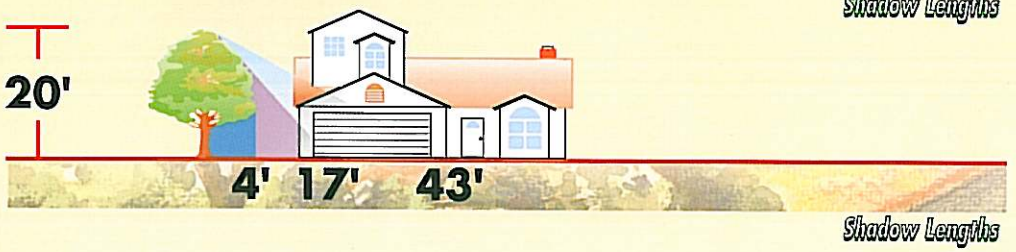
NOON 9 am & 3 pm 8 am & 4 pm

* Summer shadows fall in west-southwest direction in morning; in east-southeast direction in afternoon.









MidSummer Shadow Lengths

Los Angeles Department of Water & Power

Home Tree Guide

Using Shade Trees to **Save Energy** and **Money** and **Beautify** Your Home's Surroundings

Sponsored by the Los Angeles Department of Water and Power to help Los Angeles residents reduce energy use, improve air quality, and beautify their surroundings by planting shade trees.

Thank you for your interest in the Los Angeles Department of Water and Power's (LADWP) *Trees for a Green LA* tree planting program. Through this exciting program, the most ambitious of its kind in Los Angeles, LADWP provides our electric customers with free shade trees and the knowledge to plan for, plant and protect them. As your trees grow and flourish, their shade will create natural cooling to help reduce the use of air conditioners and fans, saving you both energy and money. At the same time, the trees will improve air quality and beautify our surroundings, allowing you to take part in profoundly benefiting our environment one yard, one neighborhood, one community at a time. Knowing that we are all caretakers of the environment we share, we welcome your participation in building an "urban forest" that allows us to make the most of nature as a precious energy conservation resource.

Ronald Deaton, *General Manager, Los Angeles Department of Water and Power*

About this Guide

This guide is part of LADWP's ***Trees for a Green LA*** program that helps Los Angeles residents plant shade trees to help them save energy and money, and create more sustainable communities.

The LADWP would like to extend its sincere gratitude to the following organizations for their assistance in developing this guide, and/or supporting the Trees for a Green LA Program.

Community-Based Organizations
Asian American Drug Abuse Program
Hollywood Beautification Team
Korean Youth and Community Center
Los Angeles Conservation Corps
North East Trees
Tree People

City Departments
Office of the Mayor, City of Los Angeles
Los Angeles City Council Offices
Department of Public Works, Bureau of Sanitation
Department of Public Works, Bureau of Street Services
Department of Recreation and Parks
Environmental Affairs Department
Los Angeles Fire Department
Los Angeles Police Department
Los Angeles Public Library
Los Angeles Zoo

Other Organizations
California Polytechnic State University, Urban Forest Ecosystems Institute
California Urban Forest Council
Community Forest Advisory Committee
Los Angeles County Arboretum
Los Angeles County Fire Department
Sacramento Municipal Utility District
Underground Service Alert of Southern California (DigAlert)
United States Department of Agriculture, Forest Service

Consultants
David Evans and Associates, Inc. and Mindy F. Berman Communications

In addition, numerous individual contributions have collectively resulted in the following comprehensive product. We are grateful to all of those who have assisted us in this effort.

Table of Contents

The information in this Guide was developed and prepared by the Los Angeles Department of Water and Power in consultation with the Los Angeles Conservation Corps, David Evans & Associates, and Mindy F. Berman Communications for the Los Angeles Department of Water and Power's *Trees for a Green LA* Shade Tree Program. The developers of this Guide have used their best efforts in preparing the information contained in this Guide. The developers make no representations or warranties with respect to the accuracy or completeness of the contents of this Guide and specifically disclaim any implied warranties. The accuracy and completeness of the information provided herein and the opinions stated herein are not guaranteed or warranted to produce any particular results, and the advice and strategies contained herein are only informational and advisory in nature and may not be suitable for every site, environment, building, landscape plan or project or individual situation. Only a licensed landscape contractor or other qualified and licensed professional should advise you on the actual and appropriate information and decisions relating to your site or individual shade tree project.

Neither the City of Los Angeles, the Board of Water and Power Commissioners of the City of Los Angeles, the Los Angeles Department of Water and Power, the Los Angeles Conservation Corps, David Evans & Associates, nor Mindy F. Berman Communications, as the developers of this Guide shall be liable for, and any user of this Guide who uses or implements the information found in this Guide shall hold harmless and defend the above-said parties from and against any claims which come against the above-said parties for personal injury and/or death to any person, property damage of any kind or nature whatsoever, or other loss claimed against the above-said parties, resulting in any manner arising directly or indirectly from the use or implementation of the information provided in this Guide.

This Guide is intended to only offer general information on trees. Trees are organic and there is no guarantee for how they (and their roots or underground systems) will grow. The information contained in this Guide may not be applicable to your particular environment, site, building, or landscape plan. It is mandatory that you and/or your licensed landscape contractor review and comply with all applicable building, planting and other codes, statutes, regulations, and guidelines that may be pertinent to your particular environment, site, building, or landscape project/plan. When performing any planting or pruning task, it is highly recommended that due to inherent hazards, dangers and risks that you obtain the services of a licensed landscape architect or contractor, and/or any other licensed and qualified professional. Should you choose to perform the work yourself, you must at all times exercise appropriate care and caution, and determine and institute adequate safeguards to ensure your own safety and the safety of others in and around the work area. If you have any questions about your ability to safely complete a planting or pruning project, you should contact a licensed landscape architect or contractor or other licensed professional with expertise in your particular task, for assistance and inspection.

Introduction to *Trees for a Green LA*

As part of the Los Angeles Department of Water and Power's (LADWP) ongoing commitment to environmental initiatives that reduce energy use, improve air quality and beautify our surroundings, we proudly offer *Trees for a Green LA*, which continues to add thousands of shade trees annually to Los Angeles' urban forest.

***Trees for a Green LA* includes four major elements, which primarily involve strategically planting trees to achieve energy savings in Los Angeles:**

- **Planting trees near residences,**
- **Adding trees around public buildings and in public spaces,**
- **Placing trees in new development projects, and**
- **Replacing trees that interfere with LADWP power lines with more appropriate species.**

Through *Trees for a Green LA*, the trees planted today will yield benefits well into the future because:

- **By providing natural urban shading, mature trees help reduce air conditioning use and associated costs at homes and other buildings by up to 20 percent.** An independent analysis of *Trees for a Green LA*, conducted by the U.S. Department of Agriculture Forest Service's Center for Urban Forest Research, shows that the annual average energy savings per mature tree, strategically planted, will total 81 kilowatt-hours. That's enough energy to keep a typical TV on for 400 hours, or 24 hours a day for almost 17 days!

- **By reducing energy use, trees directly lessen the air pollution that comes from the generation of electricity.** The analysis also indicates that, over the expected 30-year lifespan of the first 200,000 trees planted through *Trees for a Green LA*, the program will reduce the emission of smog-forming pollutants (including nitrogen dioxide, particulate matter, sulfur dioxide and carbon monoxide) by more than 7,600 tons.

- **By removing carbon dioxide from the atmosphere, and reducing carbon dioxide emissions from electricity generation, trees help lower the rate of global warming.** In addition, the analysis finds that the first 200,000 trees planted will prevent the yearly release of approximately 29,000 tons of carbon dioxide (a greenhouse gas) into the atmosphere, or 290 pounds of carbon dioxide per tree per year.

- **By trapping and holding up to 50 gallons of water each, trees decrease the stormwater runoff that causes flooding and pollution during the rainy season.** Finally, the analysis notes that each tree planted also will prevent 1,500 gallons of stormwater runoff each year.

Los Angeles already has a vital urban forest – street trees, park trees, residential trees and other naturally occurring trees in our urban area – that brings all of us untold benefits daily. With trees among the most effective air conditioners around, we at LADWP hope you'll join us in planting trees, and thus provide shade and improve our city's environment for generations to come.

LADWP'S Commitment to Trees

Trees for a Green LA marks yet another effort to build upon the successes of previously established LADWP tree planting programs. These include:

- Planting more than 50,000 tree seedlings in the mountains of Southern California, in partnership with a local tree planting organization, in the early 1990s.
- Working with local tree planting organizations to plant more than 8,900 shade trees at over 100 schools and in surrounding neighborhoods through *Cool Schools*, the largest school-based community tree planting program in Los Angeles' history.
- Following practices that promote the dual goals of providing dependable utility service and supporting abundant, healthy trees as a *TreeLine USA* utility recognized by the National Arbor Day Foundation.

LADWP also offers a variety of environmental programs – ranging from energy efficiency incentives to opportunities to purchase renewable energy - to enhance the quality of life in our city. To find out more, visit **www.LADWP.com**, or call **1-800-GreenLA** (1-800-473-3652).

Residential Shade Trees – Getting Started

LADWP wants to make it simple for Los Angeles residents to participate in *Trees for a Green LA*. Here's a summary of how the program works:

1. Call **1-800-GreenLA** (1-800-473-3652) to request a tree planting workshop DVD, or if you have internet access, you can complete the workshop online. Log on to www.LADWP.com/trees and select the online workshop completion option. Completion of a workshop is required to receive one or more shade trees, up to a maximum of seven trees per property.
2. You will learn about proper tree selection, siting and planting techniques, and draft a site-specific plan based on your residence. You then sign an agreement to plant and maintain your tree(s).
3. Representatives of the *Trees for a Green LA* program deliver your tree(s) within two to three weeks of receipt of your tree order. You then plant and care for the tree(s), and reap the benefits of tapping into nature's air conditioners!

For More Information: To find out more about *Trees for a Green LA*, visit **www.LADWP.com/trees**, or call **1-800-GreenLA** (1-800-473-3652). You also can send an E-mail request for additional information to **tree.program@ladwp.com**. Please include the following information in your E-mail:

Name
Street Address, City and Zip Code
Daytime Phone Number and Evening Phone Number
E-mail Address
Comments and/or Questions

Trees and You

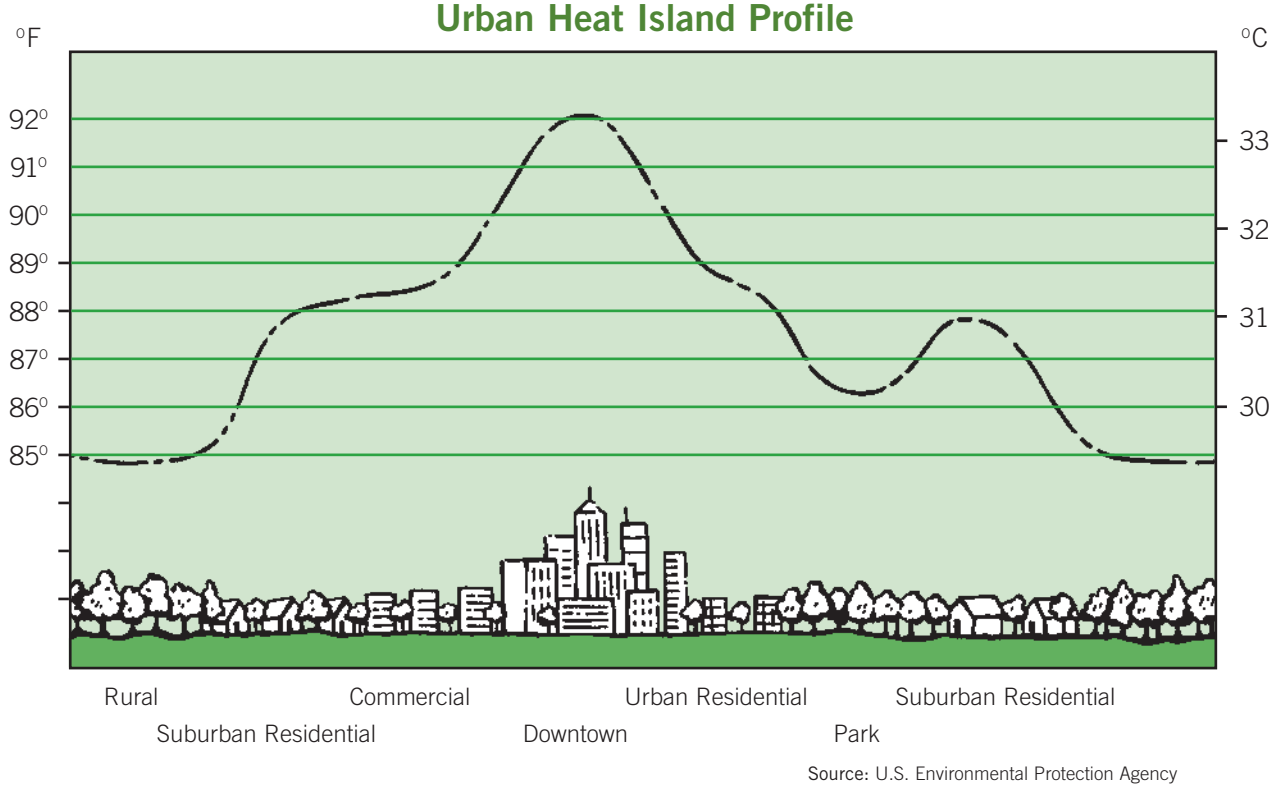
Why Should You Plant Shade Trees?

Many of modern life's conveniences, and even necessities, can produce unfortunate side effects. For example, as growing numbers of computers, home electronics and appliances are used, more power generation is required, which in most cases increases air pollution. And, as more buildings and roadways are constructed, more hard surfaces are created that absorb heat, producing the "urban heat island effect" that radiates heat back into the environment and increases outdoor temperatures.

Urban areas are particularly susceptible to experiencing these effects; summer air temperatures are higher than in rural areas, air pollution is more concentrated, the landscape is significantly altered, and personal health benefits are reduced with little access to open spaces and woodlands.

Trees, though, help solve these problems. Besides directly shading homes and buildings, and bringing more of nature's harmony to the urban environment, trees counteract the urban heat island effect by absorbing and diffusing radiant energy from the sun, and by releasing water vapor into the air. Trees thus provide a natural cooling mechanism and create a much more pleasant atmosphere for all of our neighborhoods.

Urban Heat Island Profile



Source: U.S. Environmental Protection Agency

An independent analysis of the *Trees for a Green LA* program, conducted by the U.S. Department of Agriculture Forest Service, shows that for every dollar spent, approximately $17.50 will be returned as avoided costs for energy supply and air pollution control. This total also takes into account the other environmental and social benefits associated with planting trees.

We all can make a difference in our environment by planting and caring for trees in our yards, on our streets, and in our communities.

Trees and You

Trees save energy and improve local climates. Strategically planted shade trees can:

- Help reduce overall air conditioning use and associated costs by up to 20 percent at homes and buildings.
- Shade outside air conditioning units, allowing them to operate 10 to 15 percent more efficiently than unshaded units.
- Provide shade that makes an attic 20 to 40 degrees Fahrenheit cooler on hot, sunny days, and walls about 15 degrees Fahrenheit cooler than unshaded walls, meaning less energy is needed for indoor cooling.
- Reduce the urban heat island effect, lower outside air temperatures, and cut down glare on sunny days.
- Lessen dryness in arid climates by releasing moisture through their leaves.
- Create wind barriers to help provide savings on winter heating costs.

Trees reduce air pollution and fight global warming. They:

- Decrease energy use by providing natural shade, thus lowering the amount of air pollutants and greenhouse gases that come from electricity generation, and helping to create fewer smoggy days.
- Settle out, trap and absorb numerous pollutants (such as dust, ash, pollen and smoke) from the air.
- Act as a carbon "sponge" by removing the carbon from carbon dioxide (a greenhouse gas that contributes to global warming) and storing it in their trunks, while releasing the oxygen back into the air.

Trees conserve water and reduce water pollution, because they:

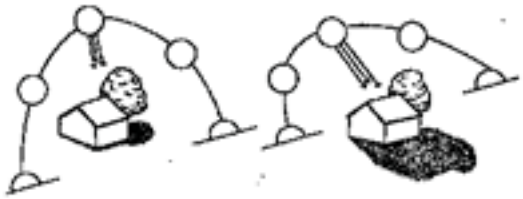
- Trap and hold water from storms, which also lessens the amount of pollution that can enter streams and oceans.
- Increase the amount of water filtered back into the ground, counteracting the effects of large areas of pavement.
- Reduce soil erosion and sedimentation in streams.
- Require, in many cases, minimal watering once mature, and help lessen the need to water lawns by providing the lawns with much-needed shade.

Trees enhance our communities. They:

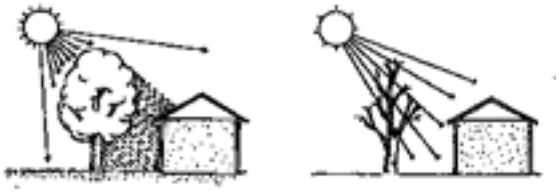
- Increase property values (by 5 to 20 percent compared to non-landscaped homes, according to the International Society of Arboriculture).
- Establish more business- and shopping-friendly areas.
- Add natural character to our communities and create more livable neighborhoods.
- Provide us with color, flowers and fruit.
- Create feelings of relaxation and well being.
- Provide privacy and a sense of solitude and security.

Trees and You

How Can You Plant Trees to Save Energy?



Summer Winter



It is important to consider how both summer and winter sun affect your home and your energy use, and how the insulation in your walls and attic, plus the placement of your windows, impacts the extent to which the sun heats up the inside of your home. Planting the right trees in the right places will give you the greatest benefits, and greatest enjoyment, from these natural air conditioners.

In mid-summer, the sun shines most intensely on east-, west-, and south-facing walls, doors and windows, plus beats straight down on the roofs of homes. Temperatures reach their highest points during hot summer afternoons, and energy use increases as air conditioners and fans are turned on to cool homes.

During winter, the sun — because it's lower in the sky — shines more on the south side of homes, actually creating warmth and reducing energy needed for heating. So, it's important to recognize when shade offers maximum benefits and when it actually causes more energy use.

Strategic use of two types of trees — evergreens (which keep a full cover of leaves all year) — and deciduous (which lose their leaves once a year, usually in the late fall or winter) — can assist you in lowering your energy use both in summer and winter.

Following these guidelines, and referring to the diagrams above, will help you maximize the benefits you receive from home tree plantings:

Plant evergreens and/or deciduous trees on the east, west, and in some cases (with larger trees) on the northeast and northwest sides of your home to produce shade that minimizes the impacts of summer sun.

- Pay particular attention to shading windows, doors and air conditioners (if you have one) to provide the greatest energy-saving benefits. Help any outdoor air conditioning units run more efficiently by shading them without blocking airflow into the units.
- Shade patios and driveways adjacent to your home if possible, because these areas absorb and radiate unwanted heat in the summer. (You can counteract their tendency to raise the surrounding air temperature by shading at least 50 percent of the paved areas near the house. This also will lower your need for air conditioning or fan use inside.)

  For shading purposes on the east and west sides of your home:
  - Select evergreens to get year-round greenery and privacy.
  - Select deciduous trees to see fall colors and let in a maximum amount of winter sun.

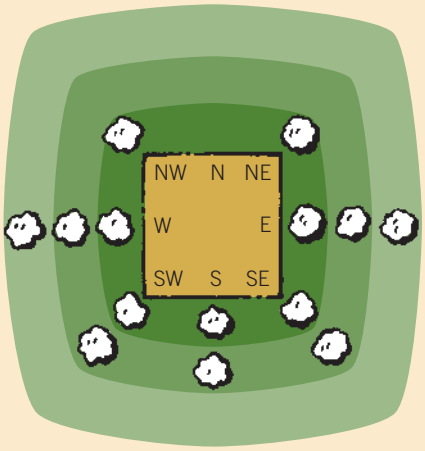
Plant deciduous trees on the south side, and, for medium and larger trees, on the southeast and southwest sides of your home to create shade, plus to let winter sun in to help warm your home during cooler months:

- Avoid planting evergreens on the south, southeast and southwest sides of your home, as their year-round cover of leaves will interfere with natural solar heating in the winter, costing you more money in the winter than you save by shading your house in the summer.

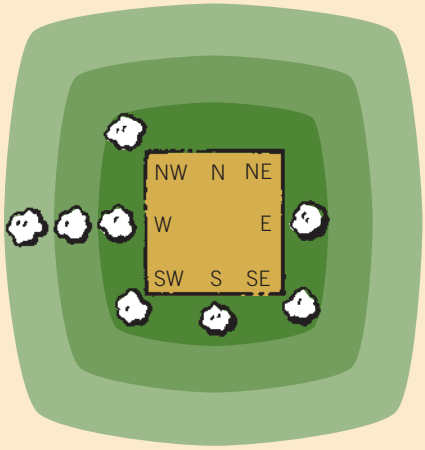
Strategically Planting Shade Trees

Up to 18 feet from your home
18 to 30 feet from your home
30 to 50 feet from your home
Shade tree providing maximum energy savings benefits

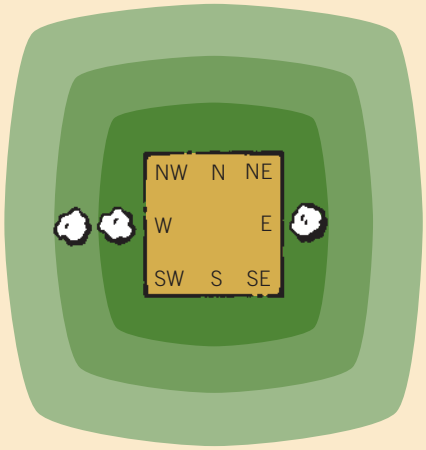
Saving Energy with Trees



Large trees – 40' and up



Medium trees – 25' to 40'



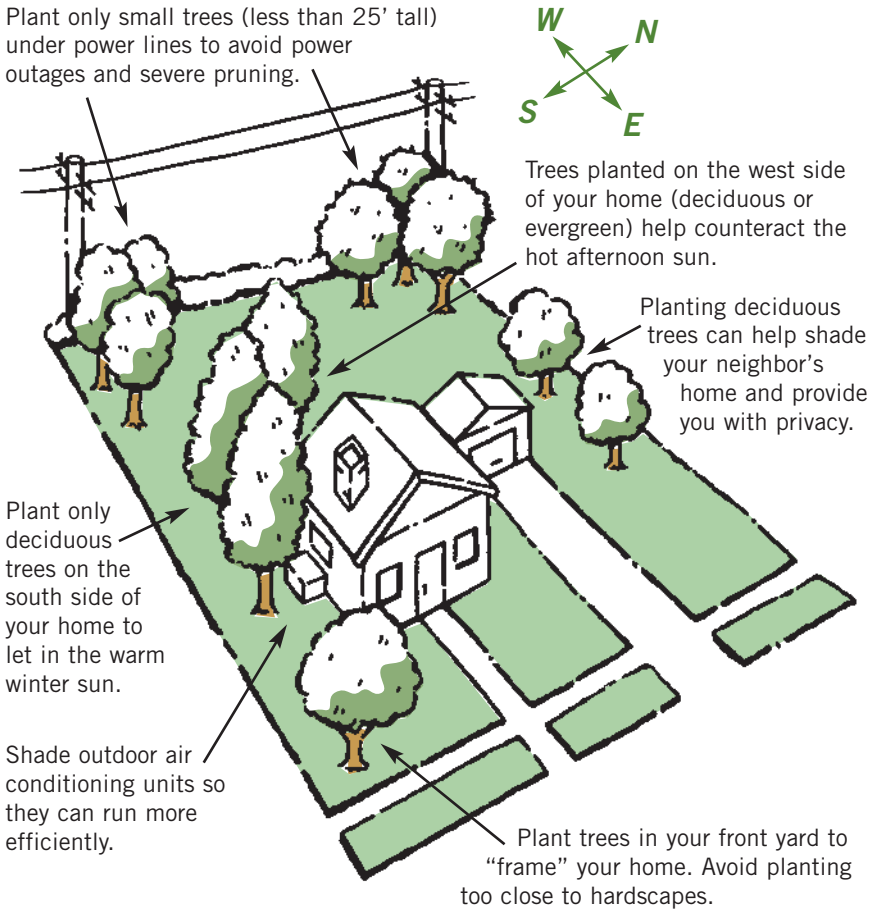
Small trees – up to 25'

Represents an aerial view of your home

Gaining the most from your trees is easy; it only requires some thinking about your property, your surrounding neighbors' properties, and what is overhead and hiding underground.

Studies show that maximum energy savings result from strategically planting shade trees on the east, south and west sides of your home, with the greatest benefits coming from trees planted less than 18 feet from your home. Always remember, though, to keep adequate space between the trees and your foundation and other "hardscapes" to avoid damage from growing roots. Although energy conservation benefits diminish as trees are planted farther away from your home, even small trees continue to provide benefits when planted on the west and east sides of your home. As reflected in the diagrams to the left, shade trees planted on the west side of your home can counteract the heating effects of the hot afternoon sun when air conditioning is most needed.

Trees and You



The Three P's: Planning, Planting, Protecting

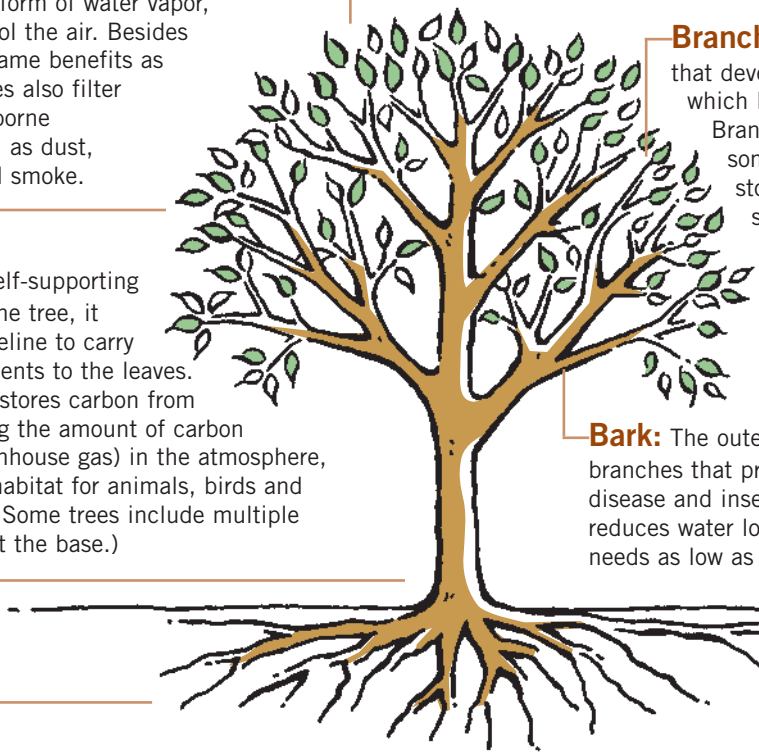
Successful tree planting occurs when trees remain safe and healthy, while increasing in beauty, usefulness and value for 30 years or more. For the best chance of success with your trees, you need to consider three essential tasks:

1. **Planning:** Knowing your property and what space you have, determining what areas you can most effectively shade, and then selecting the right trees.
2. **Planting:** Following the proper steps to plant your trees so they grow vigorously.
3. **Protecting:** Providing ongoing care to allow the growth of healthy, mature trees that provide shade and other benefits to you and your neighbors.

Before you learn about these tasks, it's important to understand a little more about your home's newest shady addition.

Leaves: Leaves, attached to branches, use sunlight, carbon dioxide and water in a process called photosynthesis to manufacture sugar, which "feeds" the tree. In addition, leaves handle transpiration, or the passage of water out of the tree in the form of water vapor, which helps cool the air. Besides providing the same benefits as branches, leaves also filter and absorb airborne pollutants such as dust, ash, pollen and smoke.

Crown: As the portion of the tree above the trunk – formed by branches, twigs and leaves – the crown, especially its uppermost section, can create a canopy that provides much-needed shady areas, making for cooler, more comfortable neighborhoods with cleaner air.



Branches: Secondary lines of growth that develop off of the trunk and from which leaves and flowers grow. Branches absorb sound, deflect some rainfall (helping to lessen stormwater runoff), provide shade, lower windspeeds, and offer a habitat for birds and wildlife.

Trunk: The self-supporting main stem of the tree, it serves as a pipeline to carry water and nutrients to the leaves. The trunk also stores carbon from the air, lowering the amount of carbon dioxide (a greenhouse gas) in the atmosphere, and creates a habitat for animals, birds and insects. (*Note:* Some trees include multiple trunks joined at the base.)

Bark: The outer covering of the trunk or branches that protects the tree from injury, disease and insect infestation, and also reduces water loss (to keep watering needs as low as possible).

Roots: The tree's underground anchor, roots supply the tree with water and nutrients from the soil, and also store sugar (the tree's primary "food"). By absorbing water, roots stabilize the soil to prevent erosion and minimize stormwater runoff.

Planning

To successfully grow shade trees, you must take a careful look at your property. The first step in planning for trees involves identifying the space available and the existing conditions of your home and yard. Since you are planting for shade, it is essential to know which way your home faces, and where the north, south, east and west sides are located.

After you have determined your home's orientation, you need to consider how much room you have to plant trees, considering space overhead, next to your home, and below ground. For a tree to be healthy and beneficial, it must have room to grow up, out and down.

So, first look carefully for overhead power lines. Check out the "hardscape" around your property, meaning any driveways, sidewalks, fences, patios and pools. And look at your neighbors' properties to see if there is a roof or pool close to a property line. Roots, branches and buildings don't mix, and will lead to trouble in the long run if you ignore this factor when you plant.

Keep in mind that you should plant large trees a minimum of 15 feet from the walls of your home, and small and medium trees a minimum of 10 feet from the walls, so the tree roots won't damage the foundation. In addition, you should plant no closer than 5 feet from any driveways, sidewalks, fences, patios and pools so the roots don't affect any hardscape.

The Three P's:
Planning, Planting,
Protecting

To help you plan for your trees, consider the following questions:

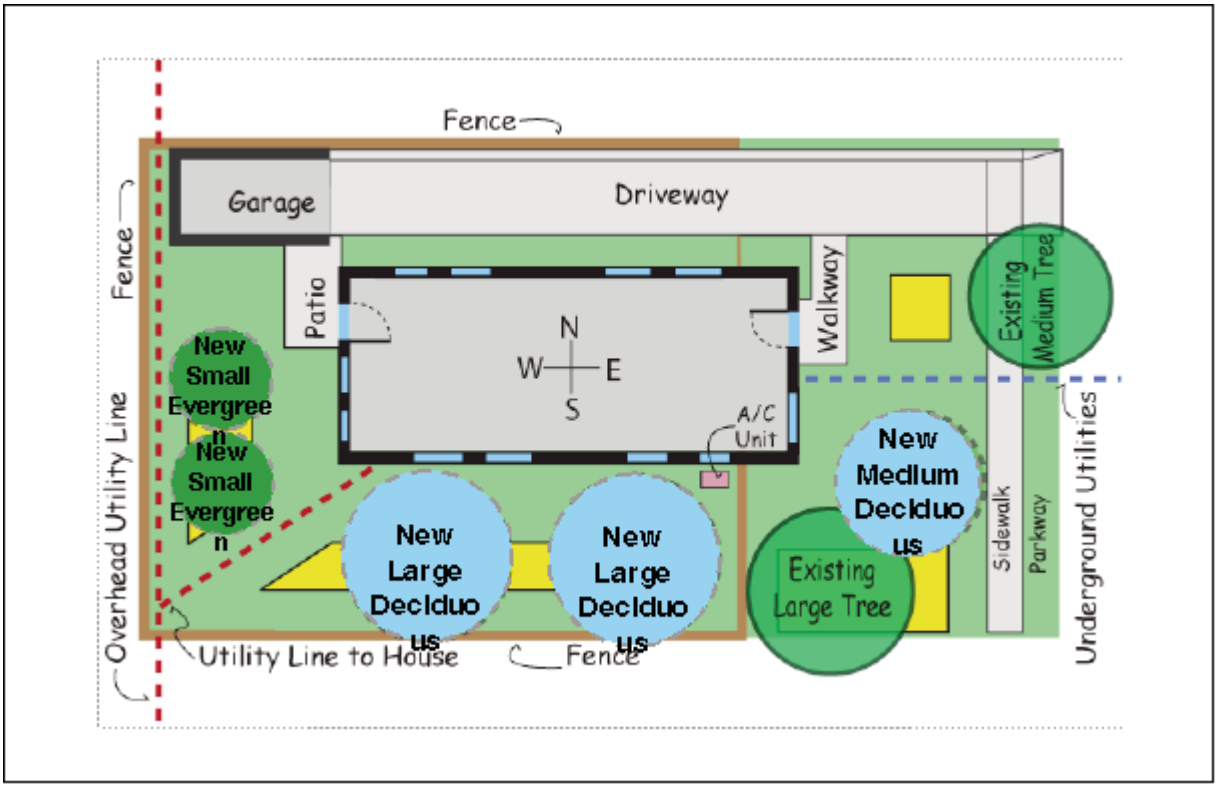
1. How tall can the tree grow before it reaches utility lines or overhead structures? Is there ample room for proper development of the branches and leaves?
2. Is tree height or placement regulated by a local ordinance or your homeowners association? If so, what are the requirements? Also, does your homeowners association provide a list of approved trees for planting?
3. Do you need to consider any existing or planned solar photovoltaic panels or satellite dishes on your or your neighbors' rooftops to avoid conflicts with the location of your tree?
4. How wide can the tree grow before it reaches adjacent buildings, signs, light posts, traffic areas, or other trees?
5. How close will the base of the tree be to the house foundation and to surface structures such as walkways, driveways, patios, curbs, etc.? (*Note: It's important to plant no closer than 10 to 15 feet from the foundation and 5 feet from surface structures.*)
6. What kind of below-ground space is available for roots? Are there any utility lines or other underground structures in the root zone of the planting area?
7. Will the tree be planted in a lawn or shrub bed, in a pavement cutout, or in some other way?
8. Will leaves, flowers, or fruit drop be acceptable around the planting site? (*Note: Fruits or flower parts may stain paving, clog pool filters, or even cause a pedestrian hazard if they fall on nearby pavement.*)
9. Will the tree be watered with an automatic sprinkler, manual sprinkler, hand-held hose, or drip irrigation? (*Note: Deep watering with a hose or a drip irrigation system, as explained later in this guide, will keep your tree the healthiest.*)

The Three P's: Planning, Planting, Protecting

Preparing Your Home Site Analysis

The following illustration shows a sample property diagram of a typical Los Angeles home. Use a grid sheet to create a similar diagram that analyzes your property. The more information you can show, the easier it will be to plan for new shade trees. So please follow these steps as completely as possible to ensure you pick the best location(s) to plant your tree(s):

1. Measure your property, from property line to property line.
2. Mark the boundaries on the grid, with the street in front of your house on the right side of the page. Identify north, south, east and west orientations.
3. Draw your home, showing the approximate location of any east-, west-, and south-facing windows or doors.
4. Note the approximate location of the major features of your yard, such as a driveway, sidewalk(s), patio, pool, and overhead utility lines (including the lines connected to your house).
5. Include the location of any air conditioners (either condensers or window units) if you have them.
6. Show the sites of existing trees.
7. Indicate where the underground sewer, gas, water and cable (if applicable) utility lines run from the house to the street (if you know).



Remember, planning to add the right tree in the right place will ensure you avoid damage to your home's foundation and other features (such as sidewalks and driveways) and prevent costly maintenance trimming and/or removal, while at the same time effectively "framing" your home and enhancing your property value.

Overhead Lines/Equipment

If you need to plant trees near overhead utility lines, it is absolutely essential that you select trees that will remain small, not exceeding 25 feet in height. Taller trees, even when carefully trimmed, often will interfere with the utility lines, potentially causing hazardous situations and power interruptions. When they are trimmed to maintain clearance from the power lines, taller trees often take on an unnatural appearance, and still may pose a future hazard.

If you have a pad-mounted transformer on your property, remember to allow room for the doors to swing open when the tree is fully grown. The law requires a clearance of 8 feet in front and 2 feet on the other three sides. Encourage soil drainage away from the transformer.

LADWP's nationally recognized power line clearance tree trimming program, which follows practices that promote the dual goals of providing dependable utility service and supporting abundant, healthy trees, wants to ensure that you can safely reap the positive benefits of trees. While LADWP trims branches away from power lines that connect two poles, you are responsible for keeping branches clear from the individual service lines on your property. However, please remember to **NEVER** put yourself in danger by attempting to prune or climb a tree near an energized utility line. Instead, if you see a tree that has grown into power lines, or need your individual electric service line temporarily disconnected so you can safely prune branches on your property, call **1-800-DIAL-DWP** (1-800-342-5397).

Please refer to the list of "Small Trees" in the section titled *Your Tree Choices* for species that, because they grow no higher than 25 feet, you can safely plant under overhead utility lines.

The Three P's: Planning, Planting, Protecting

Underground Lines/Equipment

To help you make the best planting location choices, you must have your underground utility lines marked for free by calling Underground Service Alert of Southern California, known as DigAlert, at 1-800-227-2600. DigAlert requests that you call between two and 14 days prior to planting, and that you know the proposed planting site. When you call, please ask about any other preparations required of you before you use this service.

DigAlert will notify utility companies to check for underground lines such as sewer, gas, water and cable lines. Tree roots need space to spread, but if it turns out that it works best to plant somewhat near underground utilities or barriers like a concrete driveway or patio, select a tree with non-invasive roots. (Keep in mind that to protect features like driveways, sidewalks, fences, patios and pools, you should plant at least 5 feet from them.)

Rooftop Structures

Besides considering overhead and underground utility lines, you also need to take into account any rooftop structures, like solar photovoltaic panels and satellite dishes, on your and your neighbors' homes. If you or any of your neighbors have installed solar photovoltaic rooftop panels (or if you are considering installing them), factor in your trees' future shading patterns to avoid potential solar blockage. Any shade on a solar photovoltaic system can dramatically reduce or even eliminate the production of electricity from the shaded solar modules.

Rooftop Structures, *continued*

Likewise, keep in mind that satellite dishes must maintain a direct line of sight to the satellite, with no barriers (including trees) in their path. Check your satellite dish owners' manual or contact the dish manufacturer to determine the directional area from the dish that requires no obstruction.

These rooftop structures should not, however, prevent you from planting trees. The "Small Trees" listed in the *Your Tree Choices* section should allow you to avoid interference with solar photovoltaic panels and satellite dishes while still enjoying the benefits that trees offer.

Selecting the Right Trees for Your Home

Remember, you generally want to plant either evergreen or deciduous trees on the east and west sides of your home to provide shade during the summer, and to plant deciduous trees on the south side of your home to provide shade but also to let in winter sun that helps provide warmth during the cooler times of the year.

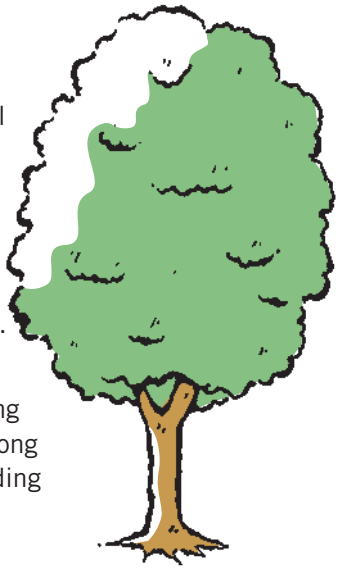
After you have analyzed your property and identified the best places to plant trees, you need to consider what type(s) of trees to plant. It is important to not only select trees that meet your needs for shade and space, but also to choose those that you like and that will prosper in the site's soil and climate conditions. You also might consider trees not seen frequently in your neighborhood, as long as they still will grow well in the area. Tree diversity benefits the urban forest, and adds variety and visual interest to our communities.

To help you select the best trees for your home, answer the following questions:

1. What type of trees do you prefer? (Select one, or both for multiple plantings)

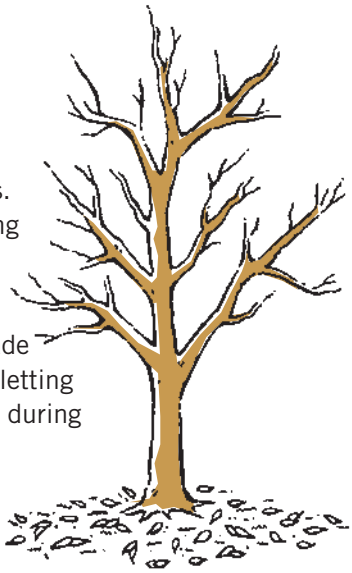
Evergreen:

- Keeps a full crown, or cover, of leaves all year, and provides denser shade than a deciduous tree. Produces some leaf drop, but not a significant amount.
- Useful for cooling walls heated by strong sun, for diverting strong winds, and for providing privacy screening.
- Best for West & East side of your home.



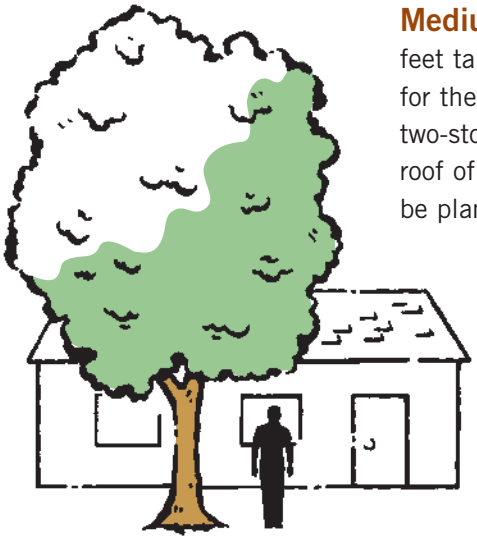
Deciduous:

- Loses its leaves once a year, usually in the late fall or winter. May offer attractive fall colors before it loses its leaves. Often features interesting branch structure and/or bark patterns.
- Useful for providing shade in the summer, and for letting the sun warm the home during winter and early spring.
- Best for South, West & East side of your home.



2. What tree height will work best for your planting location? (Select one, or more than one for multiple plantings)

Small: Grow up to 25 feet tall. Can grow above the rooftop of a single-story home, and work well for shading walls and windows. Suitable for planting under overhead utility lines, and also are good candidates for those who need to avoid interference with rooftop solar photovoltaic panels or satellite dishes.



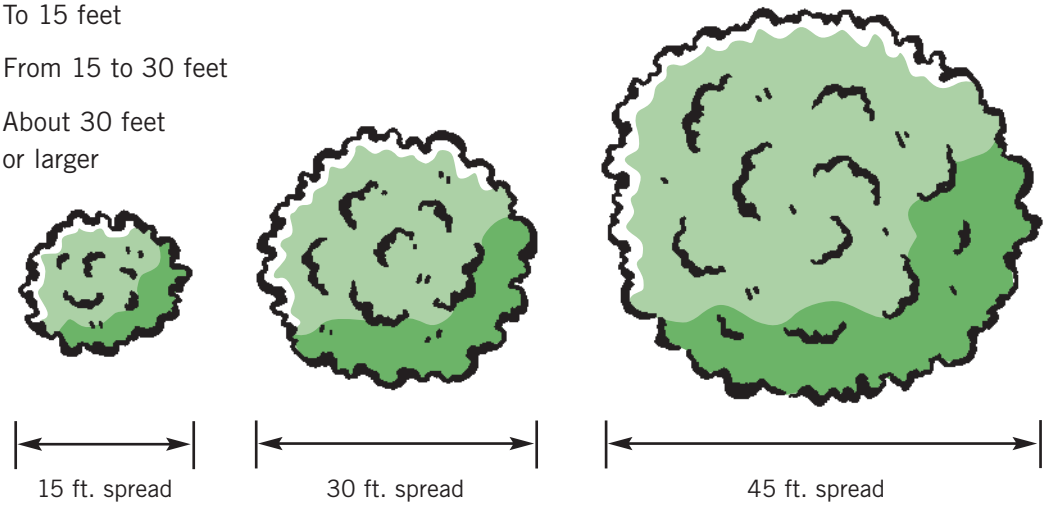
Medium: Grow 25 to 40 feet tall. Will provide shade for the walls and windows of a two-story home, and for the entire roof of a single-story home. Should **never** be planted under overhead utility lines.

Large: Grow (in most cases) larger than 40 feet tall. Will provide the most complete cover to shade a home, driveway, and at times, an adjacent street. Should **never** be planted under or next to overhead utility lines.

The Three P's:
Planning, Planting,
Protecting

3. **What tree spread will work best for your planting location? The tree spread is the width of the tree crown, or the mature tree's branches, twigs and leaves. (Select one, or more than one for multiple plantings)**

- To 15 feet
- From 15 to 30 feet
- About 30 feet or larger



4. **What type of tree shape appeals to you? (Select all that apply)**

Narrow: Columnar-like, fairly even in width, with much more height than width.

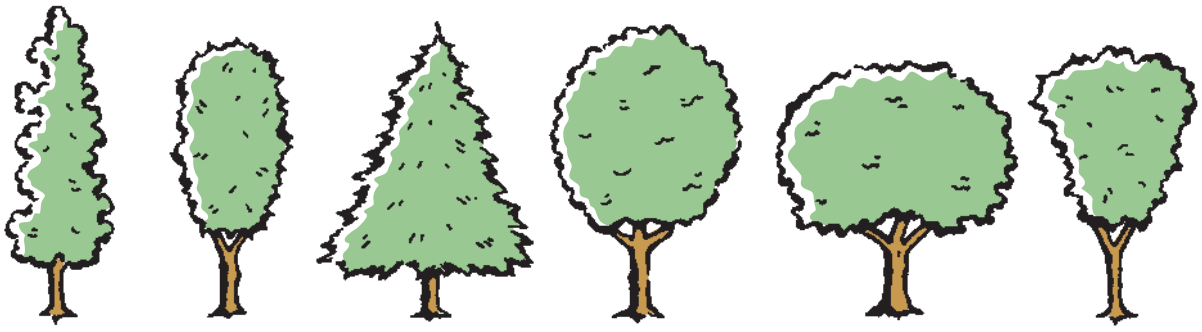
Oval: Rounded, but taller than it is wide.

Pyramidal: Wider at the bottom branches; narrows with height.

Round: Generally as tall as it is wide.

Spreading: Dome-shaped at the crown, with spreading branches.

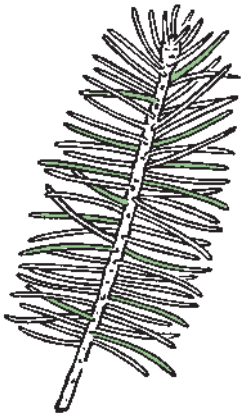
Vase-shaped: Narrower at the bottom branches; spreads with height.



5. What type of leaves do you prefer? (Select one, or more for multiple plantings)

Larger, broader leaves that provide denser shade.

Smaller, narrower leaves (with more of a lacy look) that provide shade but also let in filtered sunlight that allows for other plantings underneath the tree.



Needle-like leaves, like those typically found in pine trees, that can provide dense or medium shade, depending on the tree species.

The Three P's:
Planning, Planting,
Protecting

6. What are some of the aesthetic qualities you want from your trees? (Select all that apply)

- Flowers
- Fall color
- Fine foliage
- Dramatic form
- Leaf color

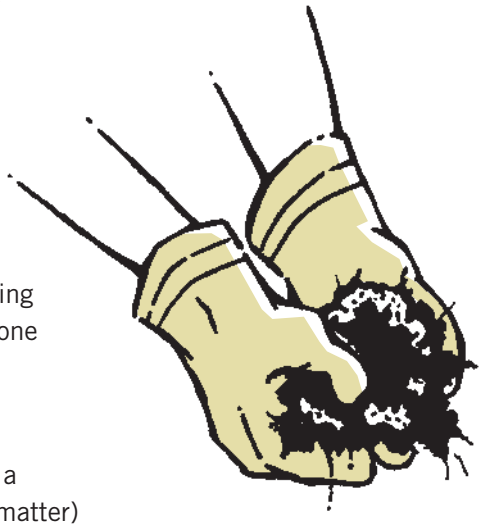
7. In what kind of soil will the trees be planted? This is very important, because you want to select trees that will thrive in the soil conditions in the planting area. Test the soil two ways – with your shovel and with your hand.

First, make a hole and moisten the soil by letting a hose trickle 10 to 15 gallons of water into it over the course of about two to four hours. (*Note: It typically takes from 10 to 15 minutes for a hose to let 1 gallon of water trickle out. This translates into approximately two to four hours for 10 to 15 gallons. If you want to double check, time how long it takes for your hose to trickle 1 gallon, and then multiply that number by 10 to 15.*) After moistening the soil, push a shovel into it. If the shovel goes in easily, the soil is soft and it will be easier to prepare for planting. If it is difficult or requires effort to push the shovel into the soil, the soil is hard and it will take more work to prepare the planting site. Also, check whether there is a lot of rock or gravel material when you turn over a shovelful of dirt. Select one of the following about the soil based on this test:

7. In what kind of soil will the trees be planted?, *continued*

- Soft
- Hard
- A combination of soft/rocky
- A combination of hard/rocky

Second, pick up a handful of moist soil in the tree planting area and squeeze it, then indicate its type (by selecting one of the following) based on how it responds:



- Sandy (crumbles as you open your hand)
- Loam (holds its shape but crumbles if you poke it; a combination of clay and sand, mixed with organic matter)
- Clay (remains in a tight, firm lump)

8. How well does the soil drain?

You can check by digging a test hole at the planting site and first pre-wetting it by filling it with water and letting it drain the night before or a few hours before your actual soil draining test. Then, when you're ready to test the soil, fill the hole with water again, and see how many inches of water drain per hour. Well-draining soils are those that drain at 1 to 3 inches per hour. Keep in mind that many drought-tolerant trees can thrive on relatively small amounts of water and tolerate typical Los Angeles soil conditions and temperatures.

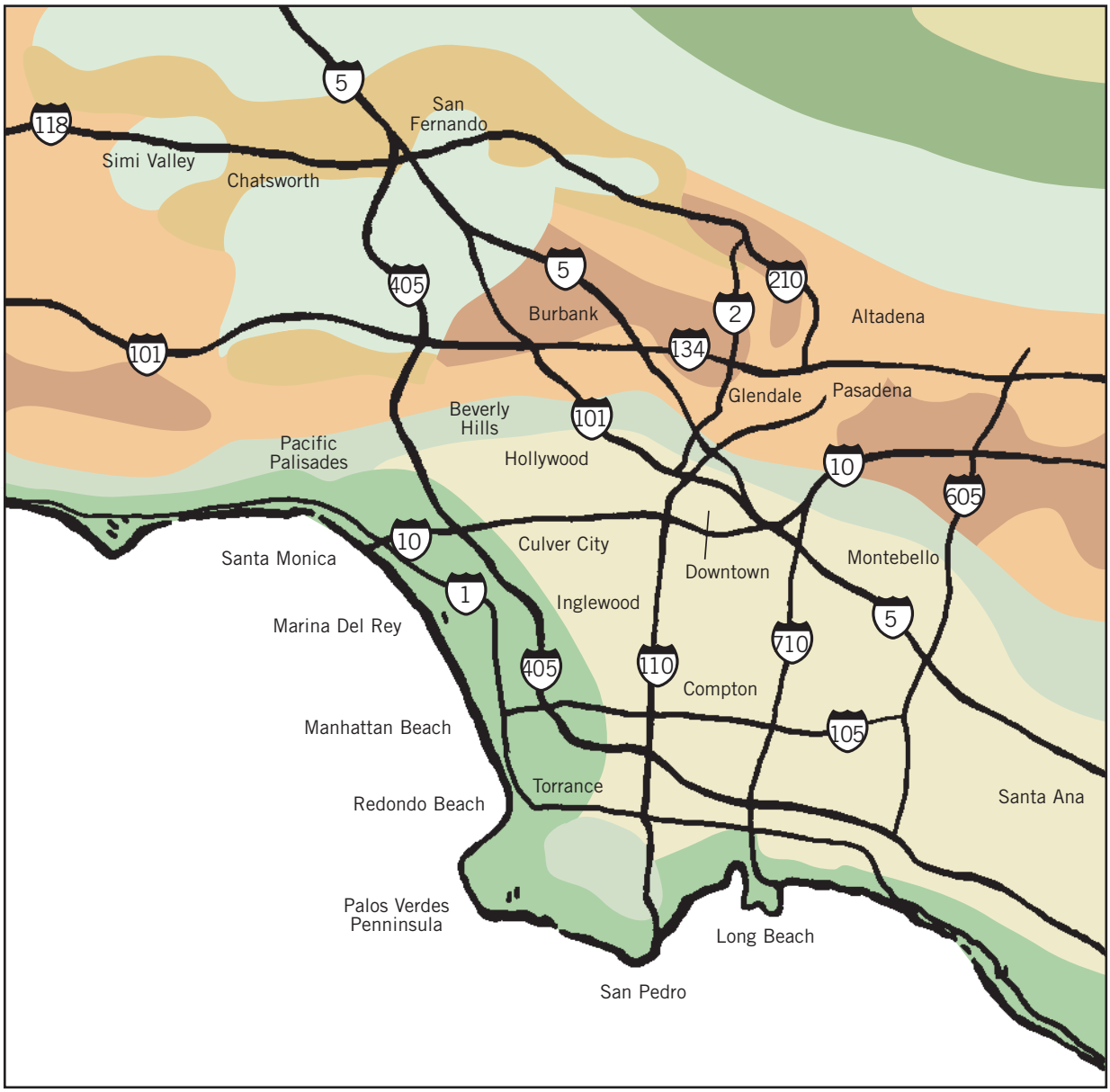
9. Do you or others who live in your home have any allergies to pollen that might be affected by the types of trees you plant?

(Certain trees – and not necessarily those with big, showy flowers – naturally produce higher levels of pollen than others.) If you're not sure about pollen allergies, check with your doctor, and refer to the section titled *Your Tree Choices* for information on high- and low-pollen-producing species.

After you've answered these questions, you should determine what climate zone you live in as the final step before selecting trees to plant. Overall, Los Angeles has a Mediterranean climate, with mild wet winters and hot dry summers. Parts of the city have a strong coastal influence, and considerable differences can exist in the climate among the various regions within the city.

The following map shows the main climate zones in Los Angeles. The tree listing in this guide includes a climate zone reference showing which trees grow best in which zones. For more detailed climate zone information, please refer to a current edition of the *Sunset Western Garden Book*, which is widely available at bookstores and libraries.

Identifying Your Local Climate Zone



Climate Zones 18 19 20 21 22 23 24

Climate zone references from *Sunset Western Garden Book*, courtesy of Sunset Publishing Corp.

The Three P's: Planning, Planting, Protecting

Planting

Because of Los Angeles' mild climate, planting can occur year-round, though experts suggest that late fall and early winter remain the best times to plant. Keep in mind that if you do plant during the hot summer months, you need to give your tree additional care and attention to ensure it receives enough water at the root zone, stays healthy and becomes well established.

Before you begin planting, make sure you have the necessary tools:

- **A shovel, rake and gloves**
- **Water supply (often a hose that reaches the tree, or watering can or bucket)**
- **Composted mulch (shredded bark, wood chips or leaves) Free mulch available, please see resource section in back of book.**

Trees for a Green LA provides you with two wooden stakes per single-trunk tree, along with soft, flexible tree ties, to support and protect your tree. (See information under the *Protecting* section for more details. Multi-trunk trees, or those with several main trunks joined at the base, do not require stakes.) For staking and other planting needs, you also might require:

- A sledgehammer or other stake-pounding tool
- Hand pruning shears (for cutting circling or matted roots from the root ball)
- A trunk guard or other barrier to protect the base of the tree's trunk

Until you plant, keep the soil in the tree container moist, and protect the tree from the sun. When you're ready to plant your new tree, follow these steps:

1. Remove and discard weeds and grass from the planting site. Loosen the soil in an area about three times the width of the tree's container to create adequate room for root growth and penetration. Then dig a hole at least twice the width of the tree's container and as deep as the root ball. Rake out large rocks and break up any clods (lumps of soil). Leave a 1 to 2 inch "pedestal" (hard mound) in the bottom of the hole on which to place the root ball, which is made up of the tree's root stock and surrounding soil, to prevent the root ball from sitting in a pool of water if the soil drains slowly. **Measure to make sure the top of the root ball will sit 1 to 2 inches above the surrounding ground when placed on the pedestal.**

2. Carefully remove the tree from the container. Cut the container along the sides if the tree does not initially come out easily to avoid damaging the root ball. Then, gently loosen any outside roots with your hands. Inspect the root ball for any large circling roots, and for matted roots at its bottom. If these are apparent, clip them with hand pruning shears. Use your hands to break up any root masses at the bottom of the root ball. Make sure you don't allow the roots to dry out.

3. Place the tree in the planting hole on the solidly packed soil "pedestal" to prevent the tree from settling below the surrounding soil. Face the tree so the branches are oriented in the preferred direction. Again, make sure the top of the root ball is 1 to 2 inches above the surrounding soil level.

Properly Planting to Give Your Young Tree a Healthy Start

4. Start to fill the hole in and around the root ball with the soil removed from the hole. When the soil is about halfway up the root ball, drop two fertilizer tablets (provided through *Trees for a Green LA*) in the hole away from the root ball. Finish replacing the soil in the planting hole. Lightly tap the soil around the root ball to eliminate all air pockets. **Do not put soil on top of the root ball.** (*Note: If you select an appropriate tree for the type of soil at your planting site, properly prepare the site and remove rocks and large lumps of soil, you do not need to use any kind of soil amendment when you plant.*)

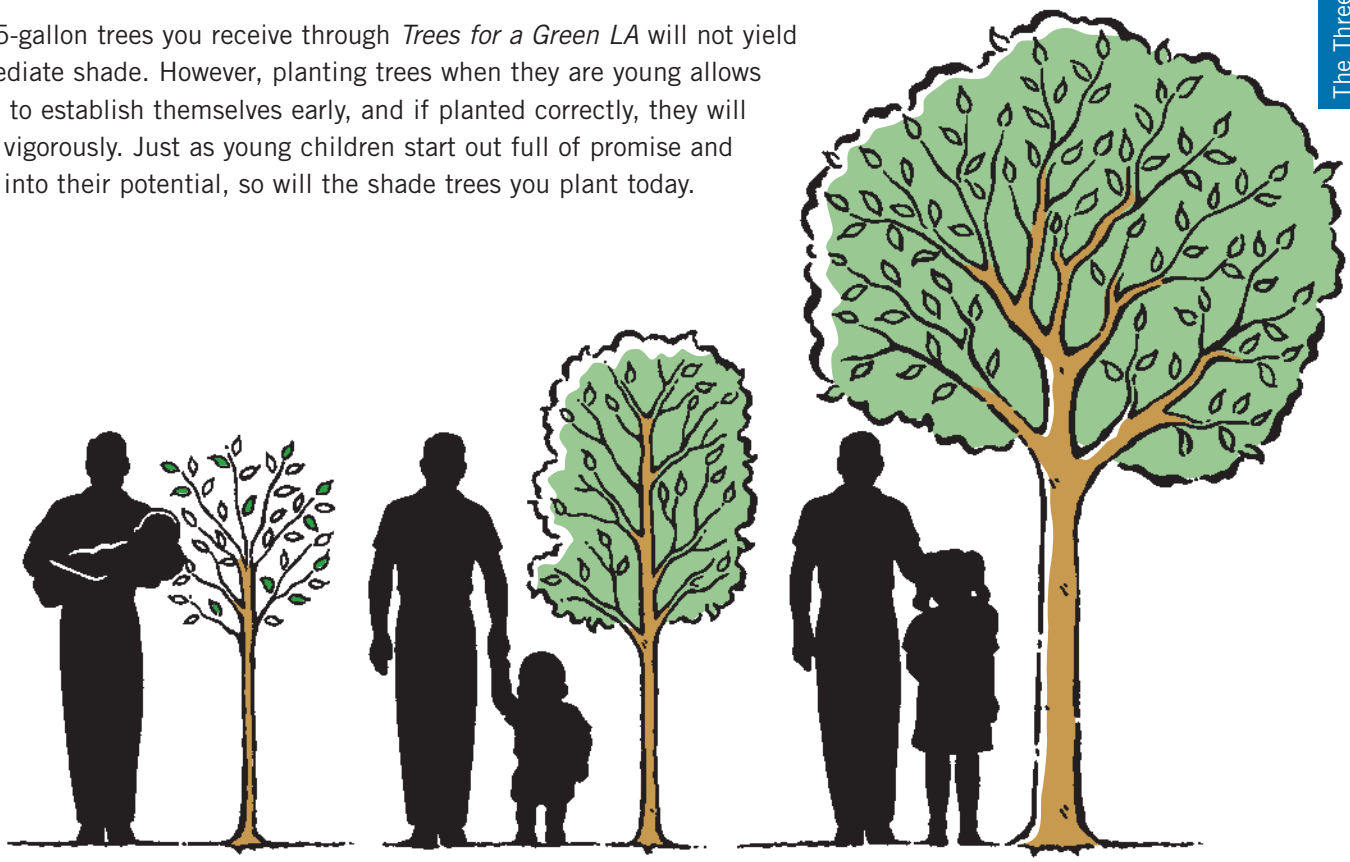
5. Mound what soil is left into a 6-inch-high berm (mound of earth) around the edge of the planting hole, approximately 30 inches in diameter. Construct this basin so water will drain away from the trunk, and into the root zone.

6. Water thoroughly right after planting to soak the planting area and settle the soil. If the soil sinks too far below the top of the root ball (for example, due to air pockets left in the soil), add additional soil. (*See Step 4.*)

7. Place a 3-inch layer of composted mulch, such as shredded bark, wood chips or leaves, around the tree to help control weeds and retain water in the soil. Cover the root ball with mulch, but keep the mulch at least 2 to 3 inches away from the trunk, as the trunk will rot if it is covered. If the tree is planted in a grass lawn, keep the grass at least 18 inches away from the base of the tree.

The Three P's: Planning, Planting, Protecting

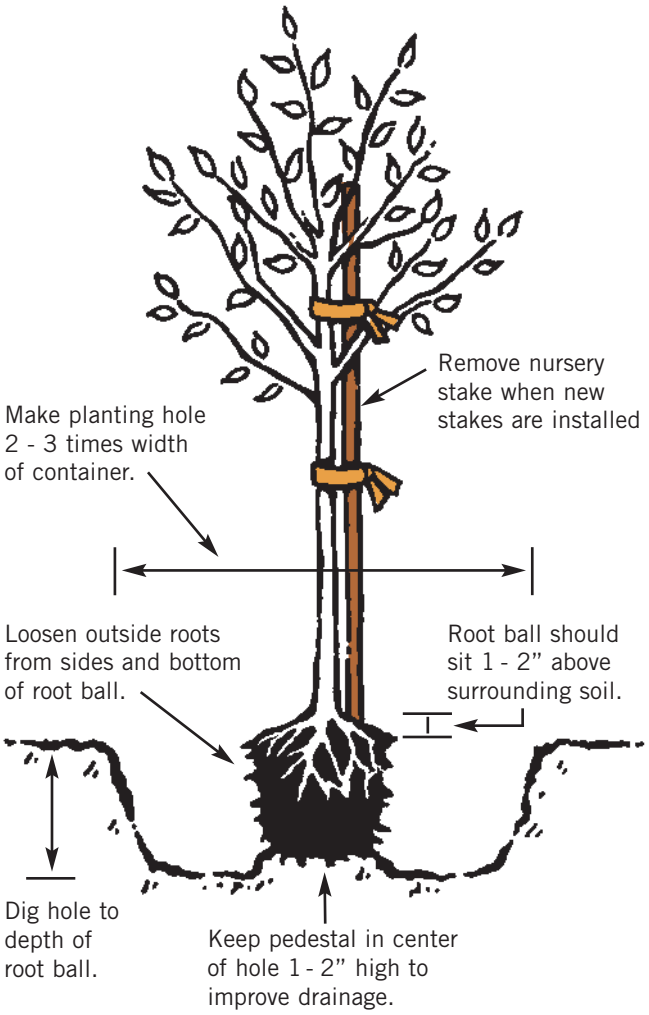
The 5-gallon trees you receive through *Trees for a Green LA* will not yield immediate shade. However, planting trees when they are young allows them to establish themselves early, and if planted correctly, they will grow vigorously. Just as young children start out full of promise and grow into their potential, so will the shade trees you plant today.



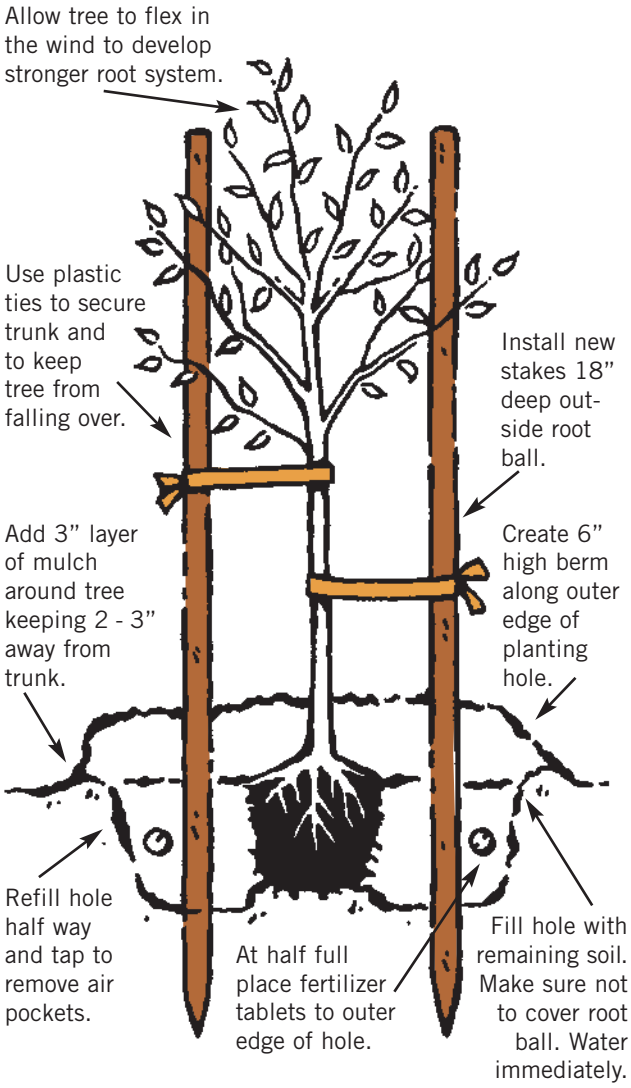
Newly planted 5 gallon tree | 2 - 3 years after planting | 7 - 8 years after planting

The Three P's: Planning, Planting, Protecting

Creating the Planting Hole



Planting and Staking Your Tree



Planting Street Trees

Tree-lined streets enhance any neighborhood, so besides planting trees on your property, you may want to join with your neighbors to plant trees along parkway strips (the area between the sidewalk and curb). Keep in mind that the 5-gallon trees provided through *Trees for a Green LA* for residential property plantings are not intended for use in parkways.

Parkway plantings in the City of Los Angeles require trees of at least a 15-gallon size. For such plantings, you first must obtain a permit from the Bureau of Street Services, Urban Forestry Division. A Bureau of Street Services representative will contact and/or meet with you to discuss the appropriate tree species for your proposed planting site and to determine proper tree spacing.

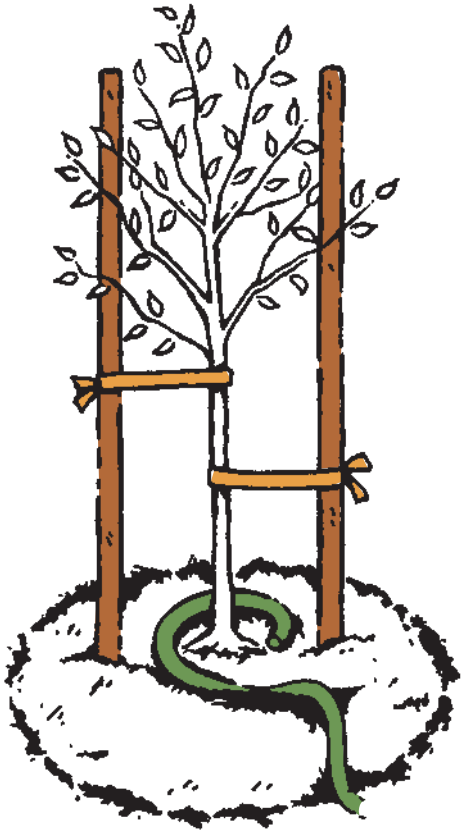
To initiate the planting process, please call 1-800-996-CITY (1-800-996-2489). Or, for more information, visit www.lacity.org/BOSS/StreetTree/index.htm.

Protecting

To allow your trees to grow to their full potential, it is important to provide protection and care for them. When they are young, they need more attention to ensure that they are not inadvertently damaged by lawn equipment, the sun or the weather. Your trees will grow 30 to 60 percent faster with regular care during the first five growing seasons. Good care means more shade sooner!

Staking

Stake a tree **only** if it cannot support itself. The sooner stakes and ties are removed, the stronger the tree will become. Keep in mind that in nearly all cases, it will help to stake the 5-gallon standard (single-trunk) trees provided through *Trees for a Green LA* to assist them on particularly windy days. Multi-trunk trees, or those with several main trunks joined at the base, do not need stakes.



1. Use two wooden stakes (provided through the *Trees for a Green LA* program) and place them on opposite sides of the tree, outside of the root ball and 18 inches into the soil. If you can determine the direction the wind typically blows in your yard, position the stakes so that, when the tree is tied, the wind doesn't push the tree into one of the stakes. Also make sure the stakes don't interfere with or rub on any major branches.

2. Next, remove the nursery stake from the tree and fill in the small hole in the root ball left from the stake.

3. Finally, use the flexible, non-constricting ties (also provided through *Trees for a Green LA*) to secure the tree to the stakes. **(Never use wire or nylon rope for this purpose, because they can damage or strangle the trunk as the tree grows.)** Tie the tree no higher than necessary, as trees build strength when they can flex in the wind. Check your stakes and ties occasionally for signs of wear on the tree, and replace them if necessary. Remove the tree stakes within two years; by then your tree should be able to support itself.

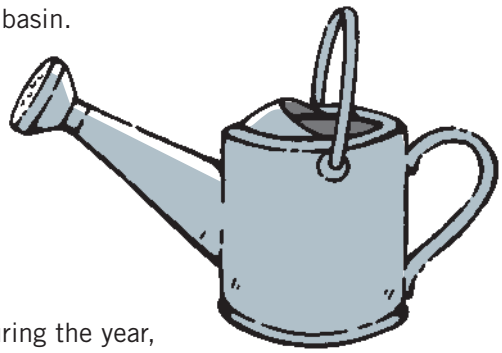
Watering Young Trees

For the first year, trees need regular watering to establish their roots. Check the soil frequently by inspecting it at a depth of 2 to 3 inches around the root ball before watering. If the soil won't form a ball or crumbles when you press it together between your fingers, you need to water. Use **deep watering** – letting a hose trickle 10 to 15 gallons of water into the watering basin over the course of about two to four hours – as the best way to avoid disturbing the soil and to ensure your tree's roots receive the moisture they need to grow healthy and deep. (As previously noted, it typically takes from 10 to 15 minutes for a hose to let 1 gallon of water trickle out. This translates into approximately two to four hours for 10 to 15 gallons. If you want to double check, time how long it takes for your hose to trickle 1 gallon, and then multiple that number by 10 to 15.) Or, consider installing a drip irrigation system as an alternative to deep watering with a hose. Such systems, available at garden centers, conserve water and effectively regulate the flow of water to the tree.

Watering Young Trees, *continued*

When you water, do your best to minimize runoff from your landscape. Water that leaves your yard in the form of runoff doesn't have the opportunity to benefit your trees, and also can pick up pollution as it makes its way to rivers and the ocean, thus harming the environment.

As a general rule of thumb, use the following guidelines for watering your young tree. Keep in mind, though, that watering requirements will vary depending on the type of soil and tree, weather conditions, and other factors. So, during the first year after planting your tree, regularly check the soil to ensure you adhere to an appropriate watering schedule.



- **The 1st month:** Deep water twice a week inside the watering basin.
- **The 2nd and 3rd months:** Deep water weekly.
- **The 4th through 8th months:** Deep water every other week.
- **The 9th through 12th months:** Deep water every three to four weeks, or every two weeks during hot summer months.
- **The 2nd and 3rd years:** Deep water every four to six weeks during the year, with perhaps more frequent waterings during the summer, depending on the type of tree and soil conditions. Continue to check the soil for its moisture level if you're not certain whether the tree needs water.

Remember, do not keep the soil saturated with water; water only when the soil shows signs of light moisture or dryness. Make sure that, if you're dealing with clay (poorly draining) soil, you don't over-water. Both over- and under-watering can lead to brown-edged leaves. If you see brown-edged leaves, check the soil about 12 inches down. It's only time to water if you find the soil hard and cannot get a shovel down that far.

For information on watering requirements for mature trees, see the guidelines in the section titled *Your Tree Choices.*

Remaining Water Wise

Since Los Angeles is located in an arid region, we must import most of our water from hundreds of miles away. And, we need to remember that water is a precious commodity that we cannot take for granted and must always use wisely.

Planting new trees doesn't mean you need to dramatically increase your water use. All of the trees offered through *Trees for a Green LA* use only low or moderate amounts of water. If you select a drought-tolerant, or low-water-use, species, you need to deep water it just two or three times during the summer once it matures.

Shading Your Soil

Composted mulch is a proven, inexpensive method to nurture your trees through the long, dry summer months. Composed of shredded bark, wood chips or leaves, composted mulch keeps the weeds down and helps moisture stay in the soil. Spread mulch out in a 4-foot area around your tree. Put the mulch 3 inches deep around the base of your tree, but **not** against the trunk (as it can cause the trunk to rot).

Do not use rock, gravel or black plastic, because tree roots need insulation and need to breathe. Organic mulch, such as wood chips, improves the soil structure and its fertility, and works much better in helping your tree become established. In fact, the composted green waste from trimming your trees and plants provides an ample and excellent supply of mulch, and using it helps minimize the waste that goes to local landfills. (Make sure it is fully composted, though, or else it will use valuable nitrogen from the soil to complete the process, leaving fewer nutrients for your tree.)

Fertilizing

Use two fertilizer tablets (provided through *Trees for a Green LA*) once – upon planting – to supply nutrients to your tree for approximately one year. After that, let your trees establish themselves, and check with a professional about fertilizing in future years. Keep in mind that there is a much greater danger of over-fertilizing than under-fertilizing. (Over-application of liquid fertilizer also can lead to dry weather urban runoff that can damage the ecosystems found in rivers and the ocean.) Do not use "weed and feed" fertilizers, as they harm young trees.

Protecting the Trunk

To protect the trunk of your young tree, avoid using lawn mowers or weed trimmers within about 4 feet of the trunk. Also, consider purchasing a trunk guard or other barrier from your local nursery or home improvement store to ensure you prevent any garden power equipment from coming in contact with and damaging the trunk. Make sure that debris does not collect inside a trunk guard if you use one, and that air can circulate around the trunk.

In addition, for the first few years, leave the lower limbs on your tree to shade its trunk and to help develop trunk taper, thereby creating a stronger tree (thicker at the bottom). Also, young trees can sunburn, so check for cracking or blackened bark. Some trees are more susceptible to this problem than others.

Weeding

Keep weeds, grass and other plant life out of the watering basin area, because competition from other plants restrains young tree growth. Pull the weeds by hand, or use composted mulch, which inhibits the growth of weeds. Avoid use of weed killers and herbicides.

Pruning

Pruning helps a tree develop proper structure, controls its size, directs its growth and maintains its health, safety and beauty. Experts recommend that you not prune young trees for the first three years following planting, because the trees grow faster and stronger when more foliage remains on them. If, however, a young tree's lower side branches (along the trunk) grow too long, you can cut them to 4 to 5 inches long – but **DO NOT** cut them all the way down to the trunk. Because they help the tree grow more vigorously and help protect the trunk from sunburn, you should not remove these lower side branches until the tree reaches at least three years of age.

Pruning, *continued*

Once the tree passes the three-year mark, emergencies (like a broken branch) aside, it's best to prune in the winter, when most trees are dormant. (You want to prune before the tree puts out any new spring growth). If you cannot prune your tree yourself, hire only an International Society of Arboriculture (ISA) certified arborist. (You can find a list of certified arborists near you by visiting www.isa-arbor.com.) Ask for references and credentials and request pruning according to the ISA tree pruning guidelines. A good pruning job (for shaping purposes) should never result in the removal of more than 25 percent of the leaves and branches, and branches should not have cuts over 1/2 inch in diameter. However, diseased or broken branches may require larger cuts.

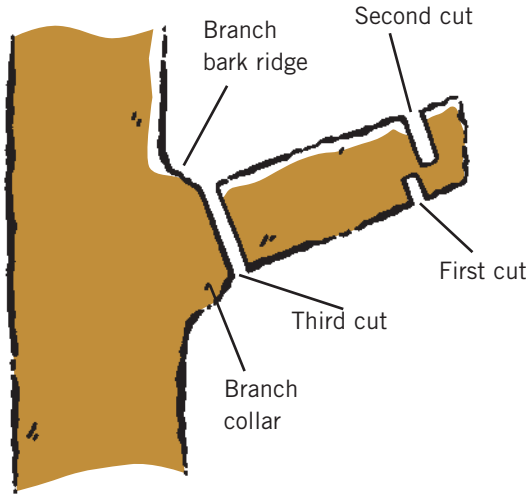
When pruning, follow these procedures:

1. Use only clean and sharp pruning tools so you don't tear the bark. **Never** pull a branch off by hand.

2. Remove dead, damaged and the weakest of any crossing limbs (those that interfere with another branch), as well as sprouts on the trunk near the base of the tree, even when tree is young.

3. Use the three-cut method as shown here, if you need to remove a large branch.

4. Cut branch selected for removal outside the small ridge known as the branch bark ridge, located where the branch joins the trunk. Leave the branch collar intact for any size cuts. Make any cuts at a slight angle at the start of the branch collar, not flush with the trunk. Do not use wound dressings for pruning cuts.



5. **Never "top" your tree;** you will harm it by destroying its structural stability and weakening its new growth. Topping includes drastic pruning that reduces the size of the crown by cutting branches back to stubs. This method of pruning will stress the tree, cause decay, and create a hazard, as the new growth will be weak and prone to breaking. (Too much pruning actually can create the risk of fatal damage to the tree.)

6. Prune the lower limbs to approximately 1 foot off ground level after three years if desired. If you want to walk under your tree canopy, continue to remove the lower limbs (1 additional foot off the ground) each year for up to five or six years.

7. Leave most pruning that cannot be done from the ground or a short ladder to a certified arborist. Contact your local nursery, or visit the ISA Website at www.isa-arbor.com, for names of certified arborists in your area.

Your trees will require your attention on a regular basis, though it is not difficult or demanding work. In fact, by providing the right amount of care, you will reap the rewards of watching the growth of healthy trees that will provide you with years of shade and beauty.

Long-Term Tree Health

With proper care, your trees should live a long, healthy life. However, it's important to keep an eye out for signs of damage or disease. If you notice any of the following problems, check with a certified arborist or other tree care professional for the most appropriate steps to take:

- Large dying or dead branches
- Reduced growth
- Rot (including fruiting bodies of fungi, such as mushrooms) in the tree roots or base
- Large, deep, vertical cracks on the opposite sides of the trunk
- Clustered, or non-spreading, leaves at the end of branches
- Yellowing leaves or excessive leaf drop out of season
- Signs of insect infestation

Maintaining the right soil conditions, and keeping your tree properly watered and mulched, are the best ways to prevent your tree from becoming weakened or wounded and more susceptible to additional health problems.

Trees and Fire Safety

In an arid region like Southern California, it's crucial to follow practices that minimize fire hazards. To this end, the Los Angeles Fire Department ensures that property owners in the city's hilly and mountainous regions adhere to brush clearance requirements. The Fire Department identifies parcels of property located in what is called the Brush Area, which along with the adjacent interface makes up the Very High Fire Hazard Severity Zone (VHFHSZ). Residences within the VHFHSZ are contacted annually to provide mandatory brush clearance.

According to the requirements for VHFHSZ sites, all properties within 200 feet of a residence are subject to inspection annually by the Fire Department's Brush Clearance Unit, which evaluates the type and amount of ornamental vegetation found within this 200-foot area. In addition, native specimen trees and large brush are subject to specific guidelines for pruning – generally that they include no foliage in the bottom third of the trees or plants – to control their mass.

Other specific requirements for VHFHSZ property owners include:

- Prune trees to provide 10 feet of clearance in all directions from chimney outlets, and 5 feet of clearance above the roof surface.
- Clean all dead leaves from the roof and rain gutters.

In addition, the Fire Department recommends that those who want to plant trees on slopes or hillsides – often areas of questionable soil stability – should obtain an assessment from professionals to assist in developing a comprehensive vegetation management plan for the property.

For more information on fire safety issues, contact the Fire Department's Brush Clearance Unit at 818-374-1111, or visit www.lafd.org/brush.

Your Tree Choices

The following pages list a variety of trees commonly planted in Southern California, along with information such as height, shape, the horizontal spread of branches and leaves, the best climate zones for planting, the growth rate, water requirements, and other characteristics. This list, developed with input from urban forestry experts, such as landscape architects and local arborists, includes numerous species appropriate for the different areas in Los Angeles. However, please keep in mind that available species through the *Trees for a Green LA* program may vary from season to season.

Reference Information

Tree Types:

Evergreen: Keeps a full cover of leaves all year

Deciduous: Loses its leaves once a year, in the late fall or winter

Growth Rate:

Slow: Grows 1 to 2 feet per year

Moderate: Grows 2 to 3 feet per year

Fast: Grows 3 to 4 feet per year
(Note: These growth rates apply to young trees. Growth rates for all trees slow down as the trees mature.)

Water Use *(water required after the tree reaches three years of age):*

Coastal Area: Generally within 5 miles of the ocean

Inland Area: Generally more than 5 miles from the ocean

Low: Deep water every four to six weeks in hot months

Moderate: Deep water every four to six weeks year-round

Key Definitions

Size:

Height: The height to which the tree will grow, as measured to the top of the crown (the uppermost layer of branches and leaves)

Spread: The width of the crown

Climate Zones:

Based on the *Sunset Western Garden Book* designations: The City of Los Angeles falls into climate zones 18 - 24, so the following climate zone references indicate which of these zones support each tree. All of the trees on this list also may thrive in areas outside of Los Angeles. For more information on climate zones, refer to a current edition of the *Sunset Western Garden Book*.

The following small trees, which can grow above the rooftop of a single-story home, work well for shading walls and windows. These trees are suitable for planting under overhead utility lines, and also are good candidates for those who need to avoid interference with rooftop solar photovoltaic panels or satellite dishes.

Cassia leptophylla
Golden Medallion Tree

Type: Semi-deciduous
Shape: Spreading
Size: Height: 20 - 25 feet; spread: to 30 feet
LA Climate Zones: 20 - 24
Growth Rate: Fast
Leaf Type: Divided into pairs of dark green leaflets. Provides medium shade.
Characteristics: Golden-yellow flowers in July and August; foot-long seedpods (like large bean pods) in winter and spring.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Prune after tree flowers to minimize number of bean-like seedpods produced.
Considerations: Prefers well-drained soil. Seedpods can pose a litter problem.

Small Trees: Grow up to 25 feet tall

Your Tree Choices

Chitalpa x tashkentensis 'Pink Dawn'
Pink Dawn Chitalpa

Type: Deciduous
Shape: Broadly oval
Size: Height: 20 - 25 feet; spread: to 25 feet
LA Climate Zones: All; longer period of leaf drop in San Fernando Valley
Growth Rate: Fast
Leaf Type: Long, narrow, 4 - 7 inches long. Provides medium shade.
Characteristics: Light pink flowers bloom profusely from May to September. Grown as a single-trunk tree, may have sucker growth (smaller offshoot branches) at base.
Water Use: *Coastal:* Low; *Inland:* Low
Tree Care: Remove any sucker growth at base regularly.
Considerations: Drops leaves and flowers; not suitable near pools. Susceptible to powdery mildew, a pest that results in a white mildew-like appearance on leaves.

Your Tree Choices

Lagerstroemia hybrids
Crape Myrtle

Type: Deciduous
Shape: Round, single trunk; vase-shaped, multi-trunked (several main trunks joined at the base)
Size: Height: to 25 feet; spread: 10 - 15 feet
LA Climate Zones: All; best away from direct coastal influence
Growth Rate: Moderate
Leaf Type: Oval, glossy green, 1 - 2 inches long. Provides light shade.
Characteristics: Profuse flowers from July to September in shades of red, lavender, pink or white. Decorative bark is mottled (marked/striped) light brown. Fall color varies from yellow to red.
Water Use: *Coastal:* Moderate; *Inland:* Moderate, prefers infrequent deep watering
Tree Care: Prune sucker growth (offshoot branches from the roots) from trunk base(s) regularly. Plants bloom on new growth only, so trees should be pruned yearly in winter or early spring.
Considerations: Varieties provided are mildew-resistant. Non-hybrids are susceptible to powdery mildew.

Small Trees: Grow up to 25 feet tall

Prunus cerasifera 'Krauter Vesuvius'
Krauter Vesuvius Purple-leaf Plum

Type: Deciduous
Shape: Oval
Size: Height: to 18 feet; spread: to 12 feet
LA Climate Zones: All; best away from direct coastal influence
Growth Rate: Fast
Leaf Type: Dark, blackish-purple, 2 inches long. Provides dense shade.
Characteristics: Bare branches covered with light pink blossoms in spring, followed by dark purple leaves. Very ornamental in all seasons. Little or no fruit.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Prune off suckers (offshoot twigs or stems) from branches regularly.
Considerations: Prefers well-drained soil; does not do well in soggy conditions.

Rhaphiolepis 'Majestic Beauty'

Majestic Beauty
Indian Hawthorn

Type: Evergreen

Shape: Compact, round

Size: Height: to 20 feet; spread: to 10 feet

LA Climate Zones: All

Growth Rate: Moderate

Leaf Type: Glossy, leathery, deep green, 4 inches long. Provides dense shade.

Characteristics: Fragrant, light pink flowers in large clusters. Heaviest bloom in late spring, with intermittent blooms throughout winter and spring.

Water Use: *Coastal:* Low; *Inland:* Low

Tree Care: Use corrective pruning to shape the tree.

Considerations: Good seacoast plant; tolerates coastal salt air.

Your Tree Choices

Your Tree Choices

Agonis flexuosa
Peppermint Tree

Type: Evergreen
Shape: Spreading
Size: Height: 25 - 35 feet; spread: 15 - 30 feet
LA Climate Zones: 20 - 24; requires temperatures above 27 degrees in frost-free conditions
Growth Rate: Moderate - fast
Leaf Type: Long, narrow, pale green with a reddish cast. Smells like peppermint when crushed. Provides medium shade.
Characteristics: Fine texture with a weeping willow-like appearance with age. Small white flowers bloom profusely in late spring. Trunks and branches are covered with distinctive, coarse, red-brown bark.
Water Use: *Coastal:* Low; *Inland:* Moderate
Tree Care: Minimal
Considerations: Needs fast drainage. Tolerates poor soil, strong wind, drought conditions and seaside locations.

Medium Trees: Grow 25 to 40 feet tall

Albizia julibrissin
Mimosa

Type: Deciduous
Shape: Spreading
Size: Height: 40 feet; spread: same or larger
LA Climate Zones: 18 - 23
Growth Rate: Fast
Leaf Type: Fern-like, 6 - 15 inches long; folds at night. Provides medium shade.
Characteristics: Unique, flat-topped spreading canopy. Watermelon-pink, fragrant puffy pompom flowers; blooms in late summer.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Best if left in multi-trunk form (several main trunks joined at the base). Requires pruning for pedestrian clearance.
Considerations: Open shade tree, attracts birds. Low spread and heavy litter from leaf, flower and bean-like seedpod drop need to be considered. Surface roots can lift sidewalks and driveways, so plant at least 10 feet from them. Does well in hot summer heat. High pollen producer.

The following medium-sized trees will provide shade for the walls and windows of a two-story home, and for the entire roof of a single-story home. These trees should **never** be planted under overhead utility lines.

Bauhinia purpurea
Purple Orchid Tree

Type: Semi-evergreen to deciduous
Shape: Round
Size: Height: 20 - 35 feet; spread: same
LA Climate Zones: All
Growth Rate: Moderate
Leaf Type: Light green, double-lobed, 2 - 3 inches across with deep notch on end. Provides dense shade.
Characteristics: Very showy light pink to orchid-purple flowers, 2 - 3 inches wide. Blooms winter into spring. Loses leaves in winter during flowering.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Requires pruning to develop strong structure. After flowering, produces crop of bean-like seedpods; remove for appearance as well as generation of new growth sooner.
Considerations: Does best with moderate watering but will tolerate drought conditions once established.

Your Tree Choices

Fraxinus oxycarpa 'Raywood'
Raywood Ash

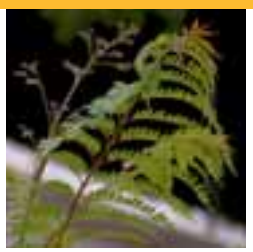
Type: Deciduous
Shape: Round
Size: Height: to 35 feet; spread: 20 - 25 feet
LA Climate Zones: All; hardy to 10 degrees
Growth Rate: Fast
Leaf Type: Serrated leaflets up to 2 1/2 inches long. Light green to yellow, turning purple-red in fall. Provides medium shade.
Characteristics: Fairly compact, small-leafed, fine-textured ash with a delicate, lacy look. Beautiful fall foliage.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Minimal
Considerations: Tolerant of a wide variety of soil types, but prefers well-drained soil. Ash whitefly, a small 1/8-inch-long insect, can be a problem. It is usually controlled with natural predators and does not require chemical treatment. Very low pollen producer.

Your Tree Choices

Geijera parviflora
Australian Willow

Type: Evergreen
Shape: Oval, weeping effect (drooping outer branches)
Size: Height: to 40 feet; spread: 20 - 25 feet
LA Climate Zones: All; best away from direct coastal influence
Growth Rate: Moderate
Leaf Type: Narrow, medium green, drooping (like on a weeping willow). Provides medium shade.
Characteristics: Weeping habit gives willowy look. Small, creamy-white flowers bloom in early spring and early fall.
Water Use: *Coastal:* Low; *Inland:* Moderate
Tree Care: Will grow faster with regular deep watering. Prune young trees carefully to correct form. Low maintenance once established.
Considerations: Needs well-drained soil. Roots are deep and non-invasive. Low branches good for shading walls.

Medium Trees: Grow 25 to 40 feet tall



Jacaranda mimosifolia
Jacaranda

Type: Semi-deciduous
Shape: Broadly oval; sometimes multi-trunked (several main trunks joined at the base)
Size: Height: 25 - 40 feet; spread: 15 - 30 feet
LA Climate Zones: All; frost damage below 25 degrees
Growth Rate: Moderate
Leaf Type: Fine, fern-like. Provides medium shade.
Characteristics: Striking lavender-blue blossoms on bare tree in May and June, remaining while tree leafs out. Produces flat, hard, round seedpods 2 inches across.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Prune to shape when young, and prune off suckers (offshoot twigs or stems) from branches regularly.
Considerations: May not flower well with direct coastal influence. Flower drop is sticky and messy; do not use this tree near pools. Surface roots can lift sidewalks and driveways, so plant at least 10 feet from them.

Koelreuteria bipinnata
Chinese Flame Tree

Type: Deciduous
Shape: Spreading, flat-topped with age
Size: Height: 20 - 40 feet; spread: same
LA Climate Zones: All
Growth Rate: Slow - moderate
Leaf Type: Medium green, 1 - 2 inches long and divided into pointed oval leaflets. Turns yellow or brown before dropping in the fall. Provides medium shade.
Characteristics: Showy yellow flowers in late summer, and 2-inch salmon or red-colored papery seed capsules (resembling Chinese lanterns) in large clusters above leaves in autumn.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Stake and prune to develop high branching.
Considerations: Prefers well-drained soil. Non-invasive roots.

Your Tree Choices

Laurus nobilis
Sweet Bay

Type: Evergreen
Shape: Pyramidal
Size: Height: to 40 feet; spread: 30 - 40 feet
LA Climate Zones: All
Growth Rate: Slow
Leaf Type: Leathery, dark green, 2 - 4 inches long. Traditional bay leaves used in cooking. Provides dense shade.
Characteristics: Small yellow spring flowers and small black or dark purple inedible fruits in the spring.
Water Use: *Coastal:* Low; *Inland:* Low
Tree Care: Remove suckers (offshoot branches growing from the roots).
Considerations: Needs good drainage. Does best in filtered shade in the hottest climates. Tolerant of most soils. Dense habit makes it a good background tree, shrub or hedge. High pollen producer.

Your Tree Choices

Melaleuca quinquenervia

Cajeput Tree or Paperbark Tree

Type: Evergreen

Shape: Narrow; can be a multi-trunk (several main trunks joined at the base) or a single-trunk tree

Size: Height: 20 - 40 feet; spread: 10 - 25 feet

LA Climate Zones: 20 - 24

Growth Rate: Fast

Leaf Type: Narrow, pale green, 2 - 4 inches long. Provides light shade on a single-trunk tree, medium shade on a multi-trunk tree or on trees grouped in a grove.

Characteristics: Distinctive spongy white bark; blooms with yellowish-white flowers like bottlebrushes in summer and fall. Branches are pendulous (hanging or declined).

Water Use: *Coastal:* Moderate; *Inland:* Moderate

Tree Care: Thin out branches to see decorative bark.

Considerations: Can tolerate wind, seacoast exposure and alkaline (non-acidic) soil.

Medium Trees: Grow 25 to 40 feet tall

Olea europaea (Fruitless)

Fruitless Olive

Type: Evergreen

Shape: Round, spreading; usually multi-trunked

Size: Height: 25 - 30 feet; spread: same

LA Climate Zones: All

Growth Rate: Slow

Leaf Type: Deep green, 1 - 2 inches long. Provides medium shade.

Characteristics: Creamy yellow flowers appear in spring.

Water Use: *Coastal:* Low; *Inland:* Low

Tree Care: Periodically deep water to encourage deeper roots for drought tolerance. Thin each year to display branching pattern and gnarled trunks and branches. Withstands heavy pruning.

Considerations: Tolerates sun, heat, cold and drought as well as coastal areas. Produces no fruit and little or no pollen. Looks best when grown in deep, rich soil, but adapts to many types of soil, including calcareous (containing calcium or calcium carbonate, and not acidic).

Pyrus kawakamii
Evergreen Pear

Type: Semi-evergreen
Shape: Round
Size: Height: 15 - 30 feet; spread: same
LA Climate Zones: All
Growth Rate: Fast
Leaf Type: Glossy, leathery, dark green, oval, 3 inches long. Fall color includes yellow, red and orange. Provides dense shade.
Characteristics: Blooms with masses of white flower clusters in late winter or early spring.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: When tree is young, train it into tree form with staking and shaping. Needs minimal pruning when mature.
Considerations: Fireblight and aphids are significant pest problems.

Your Tree Choices

Rhus lancea
African Sumac

Type: Evergreen
Shape: Round with spreading habit of weeping (drooping) outer branches
Size: Height: 20 - 30 feet; spread: same
LA Climate Zones: All
Growth Rate: Moderate
Leaf Type: Dark green, shiny, leathery, narrow, divided into three leaflets, 4 - 5 inches long. Provides medium shade.
Characteristics: Graceful, open look. Known for brilliant fall color in colder areas. Inedible pea-size yellow or red fruit follows small late-winter flowers.
Water Use: *Coastal:* Low; *Inland:* Low
Tree Care: Can be trained as a single-trunk tree or multi-trunk tree (with several main trunks joined at the base). Remove suckers (offshoot branches growing at the tree base) on young trees.
Considerations: Tolerates heat, wind, aridity and poor soils. Requires good drainage. Flowers and fruit can make a mess on pavement. High pollen producer.

Your Tree Choices

Cinnamomum camphora
Camphor Tree

Type: Evergreen
Shape: Round
Size: Height: 35 - 55 feet; spread: same or larger
LA Climate Zones: All
Growth Rate: Slow - moderate
Leaf Type: Apple-green in winter, colorful pink or bronze new leaves in spring. Smells like camphor when crushed. Provides dense shade.
Characteristics: Mature tree forms arching canopy over streets. Bark is dark gray, looks black after rain. Tiny yellow flowers in May, followed by small black inedible fruit. Leaf drop quite heavy in March.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Deep and infrequent watering prevents root problems.
Considerations: Best for large areas. Surface roots can lift sidewalks and driveways, so plant at least 10 feet away from them. Fruit drop can be messy. High pollen producer.

Large Trees: Grow larger than 40 feet tall

Ficus retusa 'Green Gem'
Green Gem Cuban Laurel

Type: Evergreen
Shape: Round
Size: Height: 45 - 55 feet; spread: same
LA Climate Zones: All
Growth Rate: Fast
Leaf Type: Blunt-tipped, oval, dark green, 2 - 4 inches long. Provides dense shade.
Characteristics: May have upright or weeping (with drooping branches) form. Smooth, light gray trunk and branches.
Water Use: *Coastal:* Low; *Inland:* Moderate
Tree Care: Prune at any time of the year.
Considerations: Unaffected by thrips, a common pest in the regular Ficus retusa. Surface roots can lift sidewalks and driveways, so plant at least 10 feet from them. Low pollen producer.

Metrosideros excelsus
New Zealand Christmas Tree

Type: Evergreen
Shape: Round
Size: Height: to 30 feet or more; spread: 30 feet
LA Climate Zones: 23, 24
Growth Rate: Moderate
Leaf Type: Long, leathery, 1 1/2 - 4 inches long. Juvenile leaves are dark green; mature leaves are more gray and wooly white on the underside. Provides dense shade.
Characteristics: Showy bright red bottlebrush-like flowers in summer.
Water Use: *Coastal:* Moderate; *Inland:* Not recommended for inland areas
Tree Care: Prune lower branches to form tree.
Considerations: Needs well-drained soil. Works well in lawns or parkways near coast.

Your Tree Choices

Ginkgo biloba 'Autumn Gold'
Autumn Gold Maidenhair Tree

Type: Deciduous
Shape: Pyramidal, somewhat irregular
Size: Height: 25 - 50 feet; spread: 25 - 35 feet
LA Climate Zones: All
Growth Rate: Slow
Leaf Type: Light green, fan-shaped, 1 - 4 inches long. Provides light shade.
Characteristics: Brilliant yellow fall color. Graceful and hardy. Width is usually 1/2 - 2/3 of height. May appear awkward when young; tree proportions improve with age.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: May need some staking when young. Prune to desired form.
Considerations: Tolerates pollution, heat and almost all soil conditions.

Your Tree Choices

Magnolia grandiflora
Southern Magnolia

Type: Evergreen
Shape: Pyramidal
Size: Height: to 80 feet; spread: to 60 feet
LA Climate Zones: All
Growth Rate: Fast
Leaf Type: Glossy, leathery, up to 8 inches long. Provides dense shade.
Characteristics: Very showy, large, pure white flowers, 10 inches wide, throughout the summer and fall. Fall fruit follows with 3 - 4 inch cone-shaped pods with shiny bright red seeds.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Minimal care other than leaf litter clean up.
Considerations: Litter problem from leaves. Surface roots can lift sidewalks and driveways, so plant at least 10 feet away from them. Dense shade inhibits lawn growth underneath. May take up to 15 years before blooming, can be less. Does best with ample space.

Large Trees: Grow larger than 40 feet tall

Pinus eldarica
Afghan Pine

Type: Evergreen
Shape: Pyramidal
Size: Height: 30 - 80 feet; spread: 15 - 25 feet
LA Climate Zones: All
Growth Rate: Fast
Leaf Type: Dark green needles in clusters of two, 5 - 6 inches long. Provides dense shade.
Characteristics: Classic pine for Southern California; can be shaped. Light-brown cones attach directly to branches.
Water Use: *Coastal:* Low; *Inland:* Low
Tree Care: Prune up lower branches if desired for clearance.
Considerations: Thrives in heat, drought and poor soils. Perfect for windbreak or quick shade.

The following large trees will provide the most complete cover to shade a home, driveway and, at times, an adjacent street. These trees absolutely should **never** be planted under or next to overhead utility lines.

Pistacia chinensis
Chinese Pistache

Type: Deciduous
Shape: Oval, round
Size: Height: 30 - 60 feet; spread: same
LA Climate Zones: All; best away from direct coastal influence
Growth Rate: Moderate
Leaf Type: Divided into several paired leaflets, 2 - 4 inches long. Provides dense shade.
Characteristics: Striking fall color ranges from red in low temperatures to reddish-brown or yellow in milder climates.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Prune when young to encourage high branching.
Considerations: Tolerates wind and most soil conditions. Does best with moderate watering but will tolerate drought conditions once established. High pollen producer.

Your Tree Choices

Platanus racemosa
California Sycamore

Type: Deciduous
Shape: Pyramidal, spreading irregular with age
Size: Height: 30 - 80 feet; spread: 30 - 40 feet
LA Climate Zones: All
Growth Rate: Fast
Leaf Type: Deeply lobed, yellowish-green, 4 - 9 inches long. Turns yellow and brown in fall. Provides dense shade.
Characteristics: Beautiful, patchy, buff-colored bark on large, often-leaning trunk and gracefully twisted branches. Lots of character. Hard, brown, spiky seedpods hang on bare branches in winter. Often found in natural settings. Can be rangy.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Prune to encourage more regular form if desired.
Considerations: Works best in larger areas. Susceptible to mildew on leaves and to anthracnose (a fungus). High pollen producer.

Your Tree Choices

Podocarpus gracilior
Fern Pine

Type: Evergreen
Shape: Round
Size: Height: to 60 feet; spread: same
LA Climate Zones: All
Growth Rate: Moderate
Leaf Type: Narrow, dark glossy green, 1 - 2 inches long. Provides dense shade.
Characteristics: Soft, graceful, billowy appearance.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Stake to develop a strong trunk. Prune to desired form.
Considerations: Clean, pest-free tree. Leaf drop is light and inconspicuous. Does best with moderate watering but will tolerate drought conditions once established. Also tolerates most soil types (including high salinity), air pollution and marine exposure. High pollen producer.

Large Trees: Grow larger than 40 feet tall

Pyrus calleryana 'Bradford'
Bradford Callery Pear

Type: Deciduous or semi-evergreen
Shape: Pyramidal
Size: Height: to 50 feet; spread: 30 feet
LA Climate Zones: 18 - 21
Growth Rate: Fast
Leaf Type: Glossy, leathery, dark green, rounded at tip, with wavy edges. Fall color ranges from yellow to orange-red or maroon. Provides dense shade.
Characteristics: Profuse late-winter or early-spring show of white flowers and glossy, attractive leaves with nice fall color. Strong vertical branches provide an oval silhouette.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Dense vertical habit may cause branch crotches (the angle formed between two joining branches) to split. Prune carefully.
Considerations: Pest problems may include purple leaf spot. Does well in heavy clay soil.

Quercus agrifolia
Coast Live Oak

Type: Evergreen
Shape: Spreading
Size: Height: 40 - 70 feet; spread: same
LA Climate Zones: All
Growth Rate: Moderate
Leaf Type: Round, holly-like, 1 - 2 inches long. Provides dense shade.
Characteristics: Massive trunk twists beautifully with age. Strong branches. Smooth, narrow acorns.
Water Use: Does not tolerate lawn watering. *Coastal:* Low; *Inland:* Low
Tree Care: Keep a large area around the base clear of turf and plants that require water. Selected native plants are okay underneath.
Considerations: Good for hillside sites. Susceptible to oak root fungus if over-watered. High pollen producer.

Your Tree Choices

Tipuana tipu
Tipu Tree

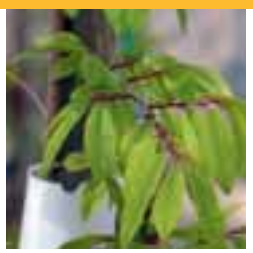
Type: Semi-evergreen to deciduous
Shape: Spreading, flat-topped with age
Size: Height: 35 - 50 feet; spread: 40 - 50 feet
LA Climate Zones: All; frost damage below 25 degrees
Growth Rate: Fast
Leaf Type: Divided into many light green, rounded-oval leaflets, 1 - 2 inches long. Provides medium shade.
Characteristics: Clusters of apricot-yellow sweet pea-shaped flowers bloom in June and July, followed by winged, flat seedpods. Fallen flowers create a carpet of yellow under trees.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Prune lightly for symmetrical form and branch structure.
Considerations: Roots sometimes are invasive. Over-watering encourages brittle growth. Flower litter can be a problem. Relatively low pollen producer.

Your Tree Choices

Tristania conferta (Lophostemon confertus)
Brisbane Box

Type: Evergreen
Shape: Oval
Size: Height: 30 - 60 feet; spread: 20 - 40 feet
LA Climate Zones: 19 - 24; frost damage below 26 degrees
Growth Rate: Moderate - fast
Leaf Type: Leathery, oval, bright green, 4 - 6 inches long. Provides dense shade.
Characteristics: Reddish-brown bark peels away to show lighter new bark underneath. Small white flowers in summer.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Prune to shape when young.
Considerations: Non-invasive roots, very tough tree. Tolerates all soil types, including high alkalinity (non-acidic soil).

Large Trees: Grow larger than 40 feet tall



Ulmus parvifolia 'Drake'
Drake Chinese Elm

Type: Semi-evergreen or deciduous (usually evergreen in California)
Shape: Round, spreading with weeping habit (drooping branches)
Size: Height: 40 - 60 feet; spread: 50 - 70 feet
LA Climate Zones: All
Growth Rate: Fast
Leaf Type: Oval, glossy and dark green above and paler beneath, less than 2 inches long. Fall color ranges from yellow in mild climates to reddish to orange in cooler areas. Provides dense shade.
Characteristics: In older trees, bark is mottled (marked/striped), resembling that of a sycamore. Spreading, arching habit with weeping branches.
Water Use: *Coastal:* Moderate; *Inland:* Moderate
Tree Care: Shorten overlong branches or strongly weeping branches to strengthen scaffolding (the main side branches). Thin older trees to lessen chance of storm damage.
Considerations: Tolerates a wide range of soils (including alkaline, or non-acidic, soil), plus cold, urban heat and wind. Does best, though, in well-drained, fertile soil. Relatively high pollen producer.

Your Tree Choices

The following summarizes the key information presented in the previous section

Small Trees

Medium Trees

Name	Type	Height (in feet)	Spread (in feet)	LA Climate Zones	Growth Rate	Water Use	Pollen Production
Lagerstroemia hybrids *Crape Myrtle*	Deciduous	To 25	10 – 15	All	Moderate	Moderate	Medium
Cassia leptophylla *Golden Medallion Tree*	Semi-deciduous	20 – 25	To 30	20 – 24	Fast	Moderate	Medium
Rhaphiolepis 'Majestic Beauty' *Majestic Beauty Indian Hawthorn*	Evergreen	To 20	To 10	All	Moderate	Low	Medium
Chitalpa x tashkentensis 'Pink Dawn' *Pink Dawn Chitalpa*	Deciduous	20 – 25	To 25	All	Fast	Low	Medium
Prunus cerasifera 'Krauter Vesuvius' *Krauter Vesuvius Purple-leaf Plum*	Deciduous	To 18	To 12	All	Fast	Moderate	Medium
Rhus lancea *African Sumac*	Evergreen	20 – 30	20 – 30	All	Moderate	Low	High
Geijera parviflora *Australian Willow*	Evergreen	To 40	20 – 25	All	Moderate	Low (coastal); moderate (inland)	Medium
Koelreuteria bipinnata *Chinese Flame Tree*	Deciduous	20 – 40	20 – 40	All	Slow to moderate	Moderate	Medium
Pyrus kawakamii *Evergreen Pear*	Semi-evergreen	15 – 30	15 – 30	All	Fast	Moderate	Medium
Olea europaea (Fruitless) *Fruitless Olive*	Evergreen	25 – 30	25 – 30	All	Slow	Low	Very Low
Jacaranda mimosifolia *Jacaranda*	Semi-deciduous	25 – 40	15 – 30	All	Moderate	Moderate	Medium
Albizia julibrissin *Mimosa*	Deciduous	40	40+	18 – 23	Fast	Moderate	High
Melaleuca quinquenervia *Cajeput Tree or Paperbark Tree*	Evergreen	20 – 40	10 – 25	20 – 24	Fast	Moderate	Medium
Agonis flexuosa *Peppermint Tree*	Evergreen	25 – 35	15 – 30	20 – 24	Moderate – fast	Low (coastal); moderate (inland)	Medium
Bauhinia purpurea *Purple Orchid Tree*	Semi-evergreen to deciduous	20 – 35	20 – 35	All	Moderate	Moderate	Medium
Fraxinus oxycarpa 'Raywood' *Raywood Ash*	Deciduous	To 35	20 – 25	All	Fast	Moderate	Very low

An Easy Reference Summary

Name	Type	Height (in feet)	Spread (in feet)	LA Climate Zones	Growth Rate	Water Use	Pollen Production
Laurus nobilis *Sweet Bay*	Evergreen	To 40	30 – 40	All	Slow	Low	High
Pyrus calleryana 'Bradford' *Bradford Callery Pear*	Deciduous or semi-evergreen	To 50	30	18 – 21	Fast	Moderate	Medium
Tristania conferta (Lophostemon confertus) *Brisbane Box*	Evergreen	30 – 60	20 – 40	19 – 24	Moderate to fast	Moderate	Medium
Cinnamomum camphora *Camphor Tree*	Evergreen	35 – 55	35 – 55+	All	Slow to moderate	Moderate	High
Pinus canariensis *Canary Island Pine*	Evergreen	50 – 80	20 – 35	All	Fast	Low	Medium
Pistacia chinensis *Chinese Pistache*	Deciduous	30 – 60	30 – 60	All	Moderate	Moderate	High
Quercus agrifolia *Coast Live Oak*	Evergreen	40 – 70	40 – 70	All	Moderate	Low	High
Ulmus parvifolia 'Drake' *Drake Chinese Elm*	Usually semi-evergreen	40 – 60	50 – 70	All	Fast	Moderate	Relatively high
Podocarpus gracilior *Fern Pine*	Evergreen	To 60	To 60	All	Moderate	Moderate	High
Ficus retusa 'Green Gem' *Green Gem Cuban Laurel*	Evergreen	45 – 55	45 – 55	All	Fast	Low (coastal); moderate (inland)	Low
Ginkgo biloba 'Autumn Gold' *Autumn Gold Maidenhair Tree*	Deciduous	25 – 50	25 – 35	All	Slow	Moderate	Medium
Magnolia grandiflora *Southern Magnolia*	Evergreen	To 80	To 60	All	Fast	Moderate	Medium
Tipuana tipu *Tipu Tree*	Semi-evergreen to deciduous	35 – 50	40 – 50	All	Fast	Moderate	Relatively low

Note: Source of information for pollen production levels of the species listed in this guide: *Allergy-Free Gardening*, *The Revolutionary Guide to Healthy Landscaping*, by Thomas Leo Ogren

Additional Resources

Government Agencies

Los Angeles Department of Water and Power
111 N. Hope St., Los Angeles, CA 90012
Website: www.ladwp.com
Tree Planting and *Green LA* Program Information: 1-800-GreenLA (1-800-473-3652)
Tree Trimming and General Information: 1-800-DIAL-DWP (1-800-342-5397)

Los Angeles Bureau of Sanitation (Free Mulch)
Website: www.lacity.org/SAN/index.htm
Information: 818-834-5128

Los Angeles Bureau of Street Services, Urban Forestry Division
600 S. Spring St., 10th Floor, Los Angeles, CA 90014
Website: www.lacity.org/BOSS/StreetTree/index.htm
Service Requests: 1-800-996-CITY (1-800-996-2489)

Los Angeles County Environmental Affairs Department
200 N. Spring St., Suite 2005, Los Angeles, CA 90012
Website: www.lacity.org/ead
Information: 213-978-0888

Los Angeles County Fire Department Forestry Division
Website: http://fire.Lacounty.gov
Information: 323-881-2411

Los Angeles Department of Recreation and Parks
(Horticulture Centers and Gardens)
3900 W. Chevy Chase Drive, Los Angeles, CA 90039
Website: www.laparks.org/dos/horticulture/horticulture.htm

Los Angeles Fire Department Brush Clearance Unit
14555 W. Sylvan St., Van Nuys, CA 91411
Website: www.lafd.org/brush
Information: 818-374-1111

Department of Public Works Bureau of Sanitation
Smart Gardening Classes Subsidized Compost Bin Sales
Website: www.lacity.org/san
Information: 213-485-2260

Additional Resources

Publications

The Los Angeles Greening Resources Guide
Los Angeles Environmental Affairs Department
200 N. Spring St., 20th Floor
Los Angeles, CA 90012
Website: www.lacity.org/EAD
Information: 213-978-0888

Allergy-Free Gardening, The Revolutionary Guide to Healthy Landscaping
By Thomas Leo Ogren (Author)
Check the publisher's Website at www.tenspeed.com for more information.

Sunset Magazine
80 Willow Road
Menlo Park, CA 94025
Website: www.sunsetmagazine.com/index2.html
Information: 1-800-777-0117

Sunset Western Garden Book
By Kathleen Norris Brenzel (Editor)
Check local and online bookstores, and home and garden stores, for copies.

Professional Associations

California Association of Nurseries & Garden Centers
3947 Lennane Drive, Suite 150
Sacramento, CA 95834
Website: www.cangc.org
Information: 1-800-748-6214 or 916-928-3900

California Landscape Contractors Association
1491 River Park Dr., Suite 100
Sacramento, CA 95815
Website: www.clca.org
Information: 916-830-2780

International Society of Arboriculture
P.O. Box 3129
Champaign, IL 61826
Website: www.isa-arbor.com
Information: 217-355-9411
Toll free: 888-ISA-Tree (888-472-8733)

State of California Architects Board, Landscape Architects Technical Committee
2420 Del Paso Rd., Suite 105
Sacramento, CA 95834
Website: www.latc.dca.ca.gov
Information: 916-575-7230

Western Chapter, International Society of Arboriculture
368 S. Glassell St.
Orange, CA 92866
Website: www.wcisa.net
Information: 714-639-3610

Others

Cal Poly State University
San Luis Obispo, CA 93407
Urban Forest Ecosystems Institute
(Pictures & Descriptions of Trees)
Website: http://selectree.calpoly.edu
Information: 805-756-5171/805-756-1402

Los Angeles Conservation Corps
El Mercado La Paloma
3655 South Grand Ave., Suite 280
P.O. Box 15868
Los Angeles, CA 90007
Website: www.lacorps.org
Information: 213-747-1872

Los Angeles County Arboretum
301 N. Baldwin Ave.
Arcadia, CA 91007
Website: www.arboretum.org
Information: 626-821-3222

National Arbor Day Foundation
100 Arbor Avenue
Nebraska City, NE 68410
Website: www.arborday.org
Information: 1-888-448-7337

Additional Resources

Underground Service Alert of Southern California (DigAlert)
P.O. Box 77070
Corona, CA 92877
Website: www.digalert.org
Information: 1-800-227-2600

U.S. Department of Agriculture Forest Service
Pacific Southwest Research Station
P.O. Box 245
Berkeley, CA 94701
Website: http://cufr.ucdavis.edu
Information: 510-559-6300

More *Green LA* Programs

Now that you know about LADWP's exciting *Trees for Green LA* effort, why not check out our other environmental programs that give you the power to use energy and water more efficiently, lower your bills and create a more sustainable future? Here's a brief summary of what our *Green LA* activities include:

Green Power
Sign up for energy from new renewable, nonpolluting sources, like the sun and wind.

Energy and Water Conservation
Save energy, water and money, and even earn cash, with efficiency programs and incentives.

Recycling
Drop off used eyeglasses, hearing aids and greeting cards for donation to nonprofit groups.

To learn more, visit **www.LADWP.com**, or call **1-800-GreenLA** (1-800-473-3652).

Notes

Together,
we have the **Power** to
make a **Difference!**

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www.LADWP.com

Los Angeles Department of Water & Power

Printed on recycled paper

3/07

Sacramento Shade

FREE ENERGY SAVING SHADE TREES FOR HOMES AND BUSINESSES

Through our partnership with the Sacramento Municipal Utility District (SMUD), you are eligible for up to 10 free energy saving shade trees! Call today to have a Sacramento Tree Foundation Forester visit your home, help you pick the right tree for the right place, and give you planting and tree care tips. Your properly planted and cared for shade trees can begin cooling your home in as little as three years. When the trees mature, they can save you up to 40% on your cooling costs, clean your air, and raise your property value by as much as 2%! An additional 5 million trees in our region will reduce our ambient air temperature by 3°F.

NO COST

After a Forester visits your property, your free trees, ties and stakes will be delivered in about 10 days- all at no cost to you.

HIGH QUALITY TREES

SMUD's large buying power allows it to set its own growing standards (the best in the industry) and force nurseries to meet those standards. You will notice that all of the SMUD trees on your property share the following characteristics:

No "lollipop" trees: Your young tree will grow to be a better shaped tree when lower branches are left on. They are necessary for young tree health and good growth.

A single leading branch: Trees should have a single leader. Sometimes nurseries need to cut back the "leader", but it must be done so that it maintains the main trunk. Done improperly, it will cause big problems as your tree matures.

Good form: Your tree will look like it should for its age and size of species. Substandard trees are rejected.

Good in the ground: Often, you end up with a healthy looking tree that has serious problems where you can't see them- in the soil. SMUD trees are inspected to make sure there are no strangling roots, rot, or other root problems.

MAXIMUM BENEFIT FROM YOUR TREES

Your tree is a long term investment for your home that grows each year. Healthy, extensive tree cover in your home's yard and throughout your neighborhood can increase the value of homes throughout. Sacramento Tree Foundation Foresters take all the benefits of trees into consideration and strategically place your trees to maximize their benefit to you.

PROTECTION OF HOME AND PROPERTY

Planting the wrong tree in the wrong place can cost you time and money. Sacramento Tree Foundation Foresters take into account the long-term growth of your tree so you don't end up with maintenance issues like broken sidewalks, cracked foundations, the need for frequent pruning, or any number of challenges that a poorly sited tree can cause.

CONTACT

Contact a Scheduling Coordinator today at (916) 924-8733 ext 121 or shadetrees@sactree.com to schedule your free appointment.

SUPPORT

Join the Sacramento Tree Foundation today. Your membership is an investment that keeps growing. www.sactree.com

191 Lathrop Way, Suite D, Sacramento, CA 95815 | (916) 924-8733 (TREE) | (916) 924-3803 FAX | www.sactree.com

Courtesy of Dome Printing 8-2008

Sacramento Tree Foundation

How 5,000,000 Trees Work for Us

to Save Energy and Improve Our Air and Water*

	Units		Dollars
Energy Saved			
Reduced Electricity Use	12,410,190,694	kWh (1)	$1,489,126,390
Effect on Natural Gas Used to Heat Homes	(5,742,363,423)	kbtu (2)	($46,662,984)
Net Energy Saved Through Trees	**118,359,267,934**	**kbtu**	**$1,442,621,841**
Air Benefits			
Air Pollutants Avoided Though Reduced Energy Consumption (3)	75,997,226	lbs	$369,007,203
Air Pollutant Uptake (4)	714,991,383	lbs	$3,097,936,159
Air Quality Subtotal: Air Pollutants Avoided & Uptake	*790,988,609*	lbs	*$3,466,943,361*
Net CO2 (Carbon Dioxide) Absorbed	27,182,226,714	lbs	$407,528,877
Total Air Benefits from Trees			**$3,874,472,238**
Water Benefits			
Stormwater Reduction and other Hydrology Benefits	72,391,296,013	gal	**$578,611,372**
Environmental Benefits Subtotal			**$5,895,590,199**
Property and Other Benefits			**$2,615,591,259**
Total Tree Benefits			**$8,511,181,458**

Total Tree Cost	**($1,717,910,719)**
5,000,000 Trees: Total Lifetime (40 Years) Net Benefits:	**$6,793,270,739**

Notes:

* Based on an average mix of tree size, tree location, and compass orientation for the Sacramento region.

(1) kWh : Kilowatt hour = one kilowatt of electricity supplied for one hour

(2) kbtu : one thousand British thermal units = measure of gas energy used to heat homes

(3) Pollutants Avoided: NO2, PM 10, VOC's

(4) Pollutant Uptake: O3, NO2, PM 10, O2

Data Source: *Tree Guidelines for San Joaquin Valley Communities* by McPherson, Simpson, Peper, and Xiao — U.S. Forest Service Center for Urban Forest Research. March 1999.

191 Lathrop Way, Suite D, Sacramento, CA 95815 | (916) 924-8733 (TREE) | (916) 924-3803) FAX | www.sactree.com

California ReLeaf's mission is to empower grassroots efforts and build strategic partnerships that preserve, protect, and enhance California's urban and community forests. Founded in 1989, the organization was incorporated as a 501(c)(3) nonprofit organization in 2004.

California ReLeaf works statewide to promote alliances among community-based groups, individuals, industry, and government agencies, encouraging each to contribute to the livability of our cities and the protection of our environment by planting and caring for trees. California ReLeaf also serves as the State's volunteer coordinator for urban forestry in partnership with the California Department of Forestry and Fire Protection.

California ReLeaf offers a variety of programs and services, including:

- Coordinating the California ReLeaf Network, a growing alliance of 100 urban forestry groups that share the common goals of planting and protecting trees, fostering an ethic of environmental stewardship, and promoting citizen involvement.
- Administering the California ReLeaf American Recovery and Reinvestment Act Grant program in partnership with the USDA Forest Service.
- Administering tree planting and volunteer outreach grant programs on behalf of the State of California.
- Publishing *California Trees*, a newsletter that explores current issues in urban forestry.
- Providing assistance, information, and referrals to individuals, organizations, and agencies working to improve the management of urban forests in California communities.
- Monitoring state and federal legislation and keeping the urban forestry community informed of opportunities to influence public policy on behalf of urban trees.

For more information, contact:

Martha Ozonoff
Executive Director
California ReLeaf
P.O. Box 72496
Davis, CA 95617

Ph: 530-757-7333
Fax: 530-757-7328
Email: mozonoff@californiareleaf.org

California ReLeaf Network members:

Arroyo Seco Foundation
Atascadero Native Tree Association
Atherton Tree Committee
CA Association of Local Conservation Corps
California Community Forests Foundation
California Oak Foundation
California Urban Forests Council
Canopy
Carpinteria Beautiful
Carquinez Regional Environmental Education Center
City Beautiful of San Diego
CityTrees
Common Vision
Community ReLeaf
Community Services & Employment Training
Coronado Street Tree Committee
Fair Oaks Beautification Association
Fallbrook Land Conservancy
Friends of Carmel Forest
Friends of El Cerrito Trees
Friends of the Urban Forest
Friends of Rodeo, Refugio, and Carquinez Watersheds
Friends of Trees Nevada County
Goleta Valley Beautiful
Greater Modesto Tree Foundation
Greenspace - The Cambria Land Trust
Highland Environmental Education Coalition
Hollywood/Los Angeles Beautification Team
Huntington Beach Tree Society
Ivey Ranch Park Association
Keep Downey Beautiful
Keep Eureka Beautiful
Keep Oakland Beautiful
Keep Riverside Clean and Beautiful
Koreatown Youth & Community Center
LA Community Forest Advisory Committee
Los Angeles Conservation Corps
Magic
Marina Tree Committee
Marin ReLeaf
Mendocino County ReLeaf
Merced River Watershed Ecological Restoration Club
Mountains Restoration Trust
Mountain View Trees
National AIDS Memorial Grove
North East Trees
North Hills Landscape Committee
Ojai Valley Land Conservancy
Orange County Conservation Corps
Orange for Trees
Our City Forest - Silicon Valley
Pasadena Beautiful Foundation
Patricks Point Garden Club
Petaluma Tree Planters
Placer Tree Partners
Professional Tree Care Association of San Diego
Rancho Cielo Youth Campus
ReLeaf Costa Mesa
Richmond ReLeaf
Riverside-Corona Resource Conservation District
Roseville Urban Forest Foundation
Sacramento Tree Foundation
San Bernardino Volunteer Yard Beautification Project
San Diego Community Forest Advisory Board
San Mateo Arboretum Society
San Mateo Park Association
Santa Barbara Beautiful
Santa Barbara County ReLeaf
Santa Margarita Community Forestry
Seal Beach Tree Committee
ShadeTree Partnership
South San Francisco Beautification Committee
Stewards of the Coast and Redwoods
Streaminders
Street Tree Seminar
TREE Davis
Tree Foundation of Kern
Tree Fresno
Tree Guild of Arroyo Grande
Tree Lindsay
Tree Lodi
Tree Musketeers
Tree Partners Foundation
TreePeople
Trees for Cayucos
Trees for Seal Beach
Tule River Parkway Association
Urban Corps of San Diego
Urban ReLeaf
Urban Tree Foundation
Vacaville Tree Foundation
Vallemar Conservators
Victoria Avenue Forever
Visalia Beautification Committee
Walnut Creek Open Space Foundation
West Oakland Commerce Association
West Hollywood Tree Preservation Society
WildPlaces
Woodland Tree Foundation

Energy Conservation through Trees Act
One-Page Summary

WHAT THE BILL DOES

The Energy Conservation through Trees Act creates a grant program to assist electric utilities with programs that use targeted planting of shade trees to reduce residential energy demand.

The purpose of the legislation is to help homeowners lower their electric bills (and help utilities lower their peak load demand) by reducing residential energy demand caused by the need to run air conditioners and heaters at a high level. Shade trees not only help mitigate the urban heat island effect, but also help to shield homes from sun in the summer and cold winds in the winter.

Guidelines: The legislation requires the use of science-based tree-siting guidelines to ensure that trees are not planted in locations that will disrupt pre-existing infrastructure, block solar panels and wind turbines, or damage power lines. Consultation during the development of these guidelines must be provided by Technical Advisory Committees that are composed of local energy and arboricultural experts.

Partnerships: The legislation requires utilities that receive assistance to partner with nonprofit tree-planting organizations or other municipal infrastructure groups to run the technical side of the program. These nonprofit groups are meant to serve as tree-planting experts to complement utilities' financial interest in lowering peak energy demand and reducing consumption. They will provide technical and outreach assistance, work with tree recipients, and ensure that trees are planted in the right place to maximize energy conservation.

Cost Sharing: The bill contains a requirement that all Federal funds be matched at least one-to-one with non-Federal dollars.

BENEFITS OF STRATEGICALLY-PLANTED TREES

Planting shade trees around homes in a strategic manner is a proven way to lower energy demand in residential areas. According to research conducted by the Department of Energy, three shade trees strategically planted around a house can reduce home air-conditioning bills by about 30 percent in some cities, and a nationwide shade program could reduce air-conditioning use by at least 10 percent.

Shade trees also help to:

- Improve public health and air quality by absorbing particulate matter;
- Store carbon dioxide to help slow global warming;
- Reduce the risk of flooding in urban areas by absorbing stormwater runoff;
- Improve private property values and increase residential aesthetics;
- Preserve public infrastructure, such as streets and sidewalks.

SUPPORT FOR CONSERVING ENERGY THROUGH TREES

Conserving energy through the use of strategically-planted trees is supported by the following organizations:

National Arbor Day Foundation; Alliance for Community Trees; Pacific Gas and Electric Company; American Forests; Sacramento Municipal Utility District; American Public Power Association; International Society of Arborists; American Public Works Association; California Urban Forests Council; Urban Ecology Institute; Utility Arborists Association; California ReLeaf; American Society of Landscape Architects; Trees Atlanta; Friends of Trees.