

Cal-THRIVES

Outdoor Measure: Trees

Trees provide cooling through shade and a process called evapotranspiration.

Evapotranspiration (evaporation plus transpiration) leads to cooling by taking up heat from the environment to evaporate water in the soil and on leaves. Trees that maintain their leaves in summer and shed them in winter are preferred to provide more shade in the summer than in winter.

Keeping You Cool and Comfortable

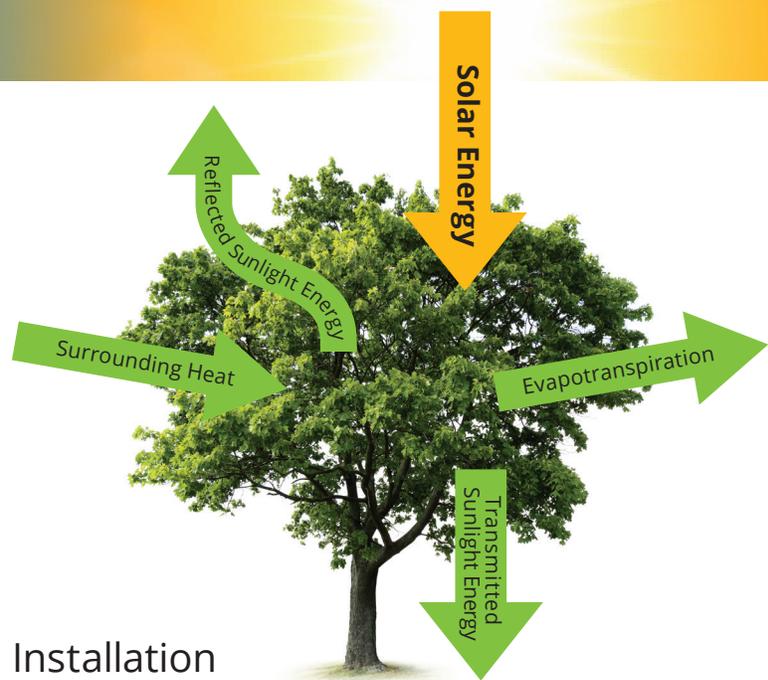
- **Tree shade provides a cooler environment for individuals** and improves perceived human thermal comfort (PET) by about 4 °F (2.2 °C) (e.g., Taleghani 2016)

Physiological Equivalent Temperature (PET) gives the perceived temperature of an individual by comparing indoor comfortable conditions to outdoor conditions

- **Trees reduce solar heat gain** of ground surfaces by shading the ground, absorbing solar energy for photosynthesis, and reflecting sunlight
- **Trees cool an entire neighborhood**, not just the area underneath the tree
 - Placing trees in the middle of residential yards in a neighborhood can improve perceived human thermal comfort averaged over the neighborhood by about 2 °F (1.1 °C) at the heat of the day during summer (e.g., Zhao 2018, Detommaso 2021)
 - Increasing the amount of urban vegetation canopy cover has been shown to reduce air temperature in a neighborhood by about 4 °F (2.2 °C) (e.g., Sailor 1998, Golden 2007, Sashua-Bar 2010, Chow and Brazel 2012, Middel 2015)

Other Benefits

- Trees can reduce annual cooling energy use of homes when shading west and south-facing walls and roofs during summer (e.g., Huang 1987, Akbari 2005)
- Trees can act as a sink for carbon (e.g., IPCC 2021)
- Trees provide ecological benefits, such as providing wildlife habitat



Installation

Trees can be purchased through a local nursery or home improvement store. Arborists can be consulted to determine the type of care required to ensure a healthy tree.

Trees are best placed in areas where they can grow without being obstructed by buildings, other trees, or power lines. There should be enough room for the tree canopy to grow for maximum shading of walls, windows, and dark surfaces like asphalt concrete.

Best Environment for Planting

- Trees with canopy spreads larger than 50 ft should be planted in 3 feet of soil depth with a distance of approximately 10-23 feet (3-7 meters) to paved surfaces. If soil is less than 3 feet (0.9 meters) deep, trees smaller than 30 feet (9.1 meters) should be planted instead (Gilman 2007).
- The crown of the tree will have enough room to reap the full benefits of building and ground area shading.
- Healthy soil is present or purchased to ensure healthy microbiome for root growth.

When to consider this measure—Ownership

- Homeowner
- Renter: Long- or Short-Term*
- Resident in a Condo/Multi-family Unit*
- Resident in a Historical District

*Contact landlord or property manager

Tips/Cautions

Drought-tolerant trees are best suited to thrive in California's current climate (e.g., Vahmani and Ban-Weiss 2016)

Trees require irrigation, especially during the establishment period (approximately 2 years); water availability should be taken into consideration in dry areas

Trees with large canopies may require maintenance such as trimming near houses or use of irrigation systems. Frequency and cost of maintenance should be taken into consideration (e.g., McPherson 2005).

Trees can emit air pollution precursors, which can exacerbate air quality concerns, so low-emitting species are preferred (e.g., Taha 1996, Benjamin and Winer 1998)

Recommended Installer

- Do it Yourself
- Arborist

Complementary Options

- Cool roofs and walls
- Artificial canopy structures (canvas)

Maintenance

Pruning and irrigation, especially before tree roots are established (approximately 2 years)

Considerations

	1	2	3	4	5
Ease of installation (1 = easier)			X	X (DIY)	
Availability (1 = more available)	X (DIY)		X		
Cost (1= lower cost)	X (DIY)	X			
Benefits: comfort and energy (1 = greatest)			X		

Example

Ten-year averaged annual estimated costs and savings for a tree* shading a home in Fresno, CA

Annual total expenditures**	-\$27
Annual energy savings from shading***	\$60
Annual social and environmental benefits***	\$29
Total annual benefits	\$62

* Established tree modeled to shade east wall of a residential building (Source: i-Tree)

** Maintenance, infrastructure and liability, and removal (Source: McPherson 2005)

*** Stormwater runoff savings, air quality improvements, CO₂ sequestration (Source: i-Tree)



Shade trees can be useful for cooling communities and individuals, as shown in the picture above of a neighborhood in Sacramento, CA (Source: Sactree.org).

References

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For more information

U.S. Department of Energy, Energy Saver, Landscaping for Energy Efficient Homes, <https://www.energy.gov/energysaver/design/landscaping-energy-efficient-homes>

U.S. Department of Energy, Energy Saver, Landscaping for Shade, <https://www.energy.gov/energysaver/landscaping-shade>

Native Plant List and Nursery Finder, <http://plantnative.org/index.htm>
i-Tree tool for estimating tree benefits, <https://www.itreetools.org/>