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#### Introduction

Residential energy use comprises about 26% of all the energy used in the state of Florida (Florida Energy Office, 1992). In south Florida, about 35% of this annual residential energy expenditure is for cooling the home during Florida's 5- to 7-month-long summer, and about 10% is used for heating in winter (Cook, 1993). As utility rates escalate, so does the cost of staying comfortable in the home.

Glass windows and doors can account for between 30 and 60% of a building's total heat gain in the summer (Cook, 1986). As much as 270 Btu (heat unit called British thermal unit) of direct and diffused solar radiation can enter a home or building through each square foot of glass on the east and west sides. For example, if sunlight strikes only 50 square feet of a clear glass window (sliding-glass door) on a west wall, the cooling effect of more than one ton of air conditioning is required to remove the heat gained from this source alone. This is more than eight times the heat gain caused by conduction and infiltration. Even windows facing north or south can have twice as much indirect radiant heat gain than that from conduction and infiltration combined.

Before central heating and air conditioning, homes were designed and built to take advantage of natural heating and cooling. For example, a tree with high branches offers shade in the summer and insulation from cold winter winds. Today, passive methods of climate control are once again of interest because we are now aware of fossil-fuel supply limitations and the environmental effects of fossil-fuel use. New information has substantially improved many passive, energy-saving landscaping concepts (known as enviroscaping) from the past.

Landscape plants can improve the appearance of our surroundings and modify the extremes of local climate (microclimate modification). Plants provide shade, insulate the home from heat loss or gain, and cool the air that surrounds their leaves through transpiration (release of water from plant pores).

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This document is Circular EES-42, formerly Landscaping to Conserve Energy: Trees for South Florida, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Publication date: July 1993. Revised September 2003. Please visit the EDIS website at http://edis.ifas.ufl.edu/

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The Florida Energy Extension Service receives funding from the Florida Energy Office, Department of Community Affairs and is operated by the University of Florida's Institute of Food and Agricultural Sciences through the Cooperative Extension Service. The information contained herein is the product of the Florida Energy Extension Service and does not necessarily reflect the views of the Florida Energy Office.

Trees are the main types of landscape plants used around the home for passive energy conservation. They provide shade, influence air movement around the house and, once established, require little maintenance. The energy-conserving impact of a particular tree species depends on 1) whether it keeps its leaves during the winter and 2) the shape and density of its foliage.

## **Planting Site Selection**

House walls are the most practical to shade because new tree plantings take many years to cast an effective shadow on the roof. Heat transmitted through the roof is best reduced by using attic insulation, radiant barriers and ventilation. This is because tree limbs over the roof can present both a nuisance (litter clogging rain gutters) and a risk of damage or injury should heavy limbs fall off in a storm. Existing vegetation that can provide roof shade without undue risk, however, should be incorporated into the homesite design.

The correct placement of trees shading the home involves consideration of the angle of the sun's rays in summer and winter, mature tree height and structure height. In general, the target areas for shading during Florida's warm months are the walls on western, eastern and southern exposures, in that order. Though an exposure facing due south receives little direct sun on June 21, by August the sun is low enough in the sky to increase heat loads considerably on south walls. Windows provide the most direct entry for heat into the home. Consequently, special attention may need to be given to walls containing the most windows.

The benefits of new shade trees should be felt within 5 years. To accomplish this goal, a distance of 7 to 20 feet from tree to wall is recommended. Lot size and the mature tree height directly influence this distance. The closer a tree is to the house, the longer its shading effects last during the day. The shadow of a tree planted 10 feet from the home moves across the shaded surface four times slower than a tree planted 20 feet away.

If winter windbreak effects are desired, trees should be planted on the north and northwestern exposures of the home. This is the prevailing direction of blustery, winter winds in most of Florida (see **EES-5** Florida Climate Data). The effects of summer breezes, which usually prevail from the southeast and southwest in Florida, are often desirable during mild, transitional times of the year. Where air conditioning exclusively cools the home for most of the hot season, summer winds can reduce cooling efficiency by increasing hot, humid air infiltration around window and door fittings or cracks in siding and masonry. In this case, a tree windbreak located on the southeast exposure of the house deflects the energy-robbing winds from the home.

#### **Tree Selection**

The chart at the end of this circular provides information that will help you choose one or more species best suited to your house and landscape. The trees are alphabetized by scientific name. The size category specifies the mature height of the tree (small, small-medium, medium, medium-large, and large).

If shade requirements are immediate, give careful attention to the growth-rate designation in the chart. A fast-growing tree increases in height by 3 or more feet per year and provides shade benefits within 5 years. Most fast-growing trees, however, are both short lived and weak wooded, two undesirable characteristics. In such cases, it may be desirable to plant both a small, rapidly growing tree and a moderate or slow-growing species nearby. The fastgrowing tree could then be removed once the other species provides shade benefits.

Site conditions directly influence the establishment and the life of a landscape tree. Coastal residents should heed the salt-tolerance ratings of the listed species. The "General Comments" column on the chart gives specific tolerances (or intolerances) of a particular species. Tailor your choices to match the conditions in your site. For instance, a tree requiring well-drained soils does not prosper where standing water accumulates after a heavy rain. If this condition applies to your homesite, choose trees for wet-soil tolerance as indicated (e.g., red maple, *Acer rubrum*; pond apple, *Annona glabra*; and bald cypress, *Taxodium distichum*).

Relative drought tolerance is also indicated for each species. These ratings refer to Florida conditions only and should be interpreted as follows: High -- survives without supplemental irrigation after establishment; Moderate -- requires supplemental irrigation during very dry periods to maintain satisfactory appearance and health; and Low -- little or no drought tolerance. Drought tolerance also varies with soil and other environmental conditions.

Whether a tree is evergreen or deciduous ("Leaf Persistence" on the chart) affects its performance. Deciduous trees, which drop their leaves in winter, are recommended for use on south, southeast and southwest exposures. In summer, they provide desired shade. In winter, their bare canopy allows the sun's rays to warm the home, creating additional energy savings. On the other hand, evergreen trees, which have leaves all year, on the north and northwest exposures provide the most effective barrier to cold, winter winds.

The shape of a tree influences how long shade lasts. Spreading, round and vase-shaped canopies provide the longest periods of shade during the day. With attention to both this category and the shade-density rating, home-shading methods can be fine tuned to meet individual needs and desires.

Interest in native plant materials has increased greatly in the state, so all native species are marked with an asterisk (\*) on the chart. In some cases, native plants may be better adapted than exotic species to local soil and weather conditions.

A few common landscape trees in south Florida are not on this list. Australian pine (*Casusarinaequisetifolia*), punk or cajeput tree (*Melaleuca quinquenervia*), and Brazilian pepper (*Schinus terebinthifolius*) are exotic, invasive species that are considered noxious weeds in some parts of the state. It is recommended that their use as landscape plants be severely curtailed if not eliminated. Additionally, the following species can be invasive under certain conditions: ear tree (*Enterolobium cyclocarpum*), bishopwood or toog (*Bischofia javanica*), laurel fig (*Ficus retusa*) and weeping fig or banyan (*Ficus benjamina*). Precaution should be exercised in their use.

#### **Planting and Maintenance**

All new tree plantings benefit from soil preparation, regular irrigation, and, in some cases, protection from insects, disease or weather extremes. Young trees require a period of regular aftercare to ensure proper establishment. Knowledgeable nursery employees and county extension agents are good sources for answers to individual problems.

Detailed information on proper tree placement, shading patterns, and microclimate modification are in the following publications available at your county extension office:

**EES 43** Enviroscaping to Conserve Energy: Microclimate Modification

**EES 49** Enviroscaping to Conserve Energy: Determining Shade Patterns for North Florida

**EES 50** Enviroscaping to Conserve Energy: Determining Shade Patterns for Central Florida

**EES 48** Enviroscaping to Conserve Energy: Determining Shade Patterns for South Florida

#### References

Cook, Gary. 1986. A guide to selecting window and glazing options for Florida buildings. IFAS/Florida Energy Extension Service EES-36. Gainesville, FL.

Cook, Gary. 1993. Personal communication. Gainesville, FL.

Florida Energy Office. 1992. *Florida energy data report:* 1970-1990. Dept. of Community Affairs, Florida Energy Office, Tallahassee, FL.

#### Key to South Florida Tree Chart

Leaf Persistence: D = Deciduous, E = Evergreen, S = Semi-Evergreen

Form: C = Columnar, O = Oval, P = Pyramidal, R = Round, S = Spreading, V = Vase-Shaped

Growth Rate: S = Slow, M = Moderate, F = Fast

Shade Density: L = Light, M = Medium, H = Heavy

Size: S = Small (up to 25 feet), M = Medium (25 - 40 feet), L = Large (more than 40 feet)

Drought Toler.: L = Low, M = Moderate, H = High

Salt Tolerance: N = None, L = Low, M = Moderate, H = High

Scientific Name Common Name * = native	Leaf Persistence	Form	Growth Rate	Shade Density	Size	Drought Tol.	Salt tol.	General Comments
*Acacia farnesiana Sweet acacia	S	V	F	Μ	S	Н	М	Thorny. Subject to defoliation by caterpillars.
Acer rubrum Red maple	D	S	F	Μ	M-L	L	L	Tolerates wet soils. Red flowers and fruit in late winter/early spring.
*Annona glabra Pond apple	D	S	Μ	Μ	S-M	L	L	Tolerates wet sites.
<i>Araucaria bidwillii</i> Bunya-bunya	E	Ρ	Μ	Μ	М	Μ	М	Spiny foliage. Large, heavy cones can be a nuisance.
Araucaria heterophylla Norfolk Island pine	E	Ρ	Μ	Μ	M-L	М	М	Formal specimen tree.
Averrhoa carambola Carambola	E	R	Μ	Н	S	М	N	Edible fruit several times per year.
<i>Bauhinia x blakeana</i> Hong Kong orchid tree	S	S	Μ	Μ	М	н	L	Intense flower color. Long season of bloom.
<i>Bixa orellana</i> Annatto	E	R	Μ	Μ	S	Μ	Z	Requires wind protection. Attractive flowers and fruit; fruit a source of natural dye.
<i>Bombax ceiba</i> Red silk cotton tree	D	S	Μ	Μ	L	Μ	N	Red or orange-red flowers in winter. Spiny trunk and branches.
Brassaia actinophylla Schefflera	E	V	F	Μ	S	Н	L	Shade tolerant. Spectacular red flowers.
Bucida buceras Black olive	E	R	Μ	Μ	M-L	H	I	Seed-grown stock variable in many characteristics. Excellent windbreak.

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*Acacia farnesiana Sweet acacia	S	V	F	Μ	S	Н	М	Thorny. Subject to defoliation by caterpillars.
<i>Bucida spinosa</i> Bucida	E	0	S	L	S	Н	Н	Wind tolerant. Good seaside tree.
<i>Bulnesia arborea</i> Bulnesia	E	S	М	Н	М	Н	М	Yellow flowers.
<i>*Bursera simaruba</i> Gumbo limbo	D	R	F	Μ	Μ	Н	т	Attractive form and bark. Needs ample room.
Butea frondosa Flame of the forest	D	S	S	Μ	М	М	н	Spectacular flowers; fertile soil.
Callistemon citrinus Citrus leaf bottlebrush	E	R	Μ	Μ	S	Μ	L	Numerous red flowers in spring. Tolerates moist sites.
Callistemon viminalis Weeping bottlebrush	E	R	Μ	Μ	S	М	М	Weeping habit. Attractive red bottlebrush flowers. Moderate salt tolerance.
Calophyllum inophyllum Indian laurel	E	0	Μ	Η	М	М	Н	Very fragrant flowers.
<i>Canaga odorata</i> Ylang-ylang	E	V	F	Μ	Μ	М	Ν	Extremely fragrant flowers.
<i>Cassia fistula</i> Golden shower	D	0	F	Μ	S	Н	L	Bright yellow flowers. Seed pods messy.
<i>Cassia javanica</i> Pink cassia	D	S	F	М	Μ	М	L	Pink and white flowers.
Chorisia speciosa Silk floss tree	D	S	F	Μ	L	Н	N	Needs adequate space. Surface roots. Can be messy.

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*Acacia farnesiana Sweet acacia	S	V	F	Μ	S	Н	М	Thorny. Subject to defoliation by caterpillars.
*Chrysophyllum oliviforme Satinleaf	E	R	М	Μ	S-M	Н	Н	Attractive foliage. Excellent accent tree.
<i>Citrus spp.</i> Citrus	E	R	Μ	Μ	S	Н	L	Well-drained soils. Fragrant white flowers. Edible fruit. Some pest problems.
*Coccoloba diversifolia Pigeon plum	E	V	Μ	Μ	S-M	Н	H	Interesting bark. Good accent or specimen tree.
*Coccoloba uvifera Sea grape	E	S	Μ	Μ	S	Н	Н	Superb seaside tree. Edible fruit.
Cochlospermum vitifolium Buttercup tree	D	0	F	Μ	S-M	Н	N	Large yellow flowers. Drought tolerant.
*Conocarpus erectus Buttonwood	E	V	Μ	Μ	S-M	Н	Н	Can be clipped as hedge.
*Conocarpus erectus var. sericeus Silver buttonwood	E	R	М	L	S	Н	н	Silver-leafed form of species. Stays smaller than typical variety.
*Cordia sebestena Geiger tree	E	R	Μ	Μ	S	Н	н	Brilliant orange flowers most of the year.
<i>Dais cotinifolia</i> Torch tree	E	0	Μ	Μ	S	Н	М	Rosy-pink flowers. Good patio specimen.
<i>Delonix regia</i> Royal poinciana	D	S	F	М	M-L	Н	Μ	Spectacular flowers. Brittle wood. Large, woody fruits may be a problem. Fallen leaves can inhibit turf growth.

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*Acacia farnesiana Sweet acacia	S	V	F	Μ	S	Н	М	Thorny. Subject to defoliation by caterpillars.
Enterolobium cyclocarpum Ear tree	D	S	F	Μ	L	М	L	Brittle wood. Litter can be a problem.
<i>Eriobotrya deflexa</i> Bronze loquat	E	R	Μ	Η	S	Н	М	New growth attractive bronze or red color.
<i>Eriobotrya japonica</i> Loquat	E	R	F	т	S	Н	М	Fragrant flowers in the fall. Edible fruit. Host for Caribbean fruit fly.
<i>Erythrina spp.</i> Coral trees	D	S	F	Μ	M-L	Н	L	Showy red flowers. Seeds toxic. <i>E.</i> <i>indica</i> and several other species do well in Florida.
<i>Eucalyptus camaldulensis</i> Murray red gum	E	0	F	Μ	L	н	L	Can invade sewer, septic and water lines. Litter may be a problem.
<i>Eucalyptus cinerea</i> Silver-dollar gum	E	V	Μ	L	S	Н	L	Interesting foliage and shape.
<i>Eucalyptus torelliana</i> Torrelliana eucalyptus	E	0	Μ	Μ	S	Н	Н	Low branching.
*Eugenia spp. Stopper trees	E	0	М	Μ	S	н	М	Several native species available. Aromatic foliage. Edible fruit.
*Ficus aurea Strangler fig	E	V	F	L	M-L	Н	M	Often scraggly. Not as aggressive as many exotic fig species, but needs adequate space.

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*Acacia farnesiana Sweet acacia	S	V	F	Μ	S	Н	М	Thorny. Subject to defoliation by caterpillars.
Ficus benjamina Banyan	E	S	F	н	L	н	М	Aggressive root system will damage water and sewage lines. Out of scale for most homes.
*Ficus citrifolia / F. brevifolia Shortleaf fig	E	S	М	Μ	M-L	н	М	Few aerial roots.
<i>Ficus elastica</i> Rubber tree	E	S	F	Н	M-L	Н	М	Aggressive root system. Out of scale for most homes.
<i>Ficus lyrata</i> Fiddleleaf fig	E	R	Μ	н	М	н	М	Much less aggressive than other figs. Interesting leaves.
<i>Ficus religiosa</i> Bo tree	E	V	Μ	М	М	Н	М	Quaking aspen-like quality to leaves.
<i>Ficus retusa</i> Cuban laurel	E	S	F	H	L	Н	М	Aggressive. Out of scale for most homes.
<i>Ficus rubiginosa</i> Rusty fig	E	R	М	Н	М	М	L	Drought tolerant.
<i>Harpullia arborea</i> Harpullia	E	R	Μ	Μ	М	Н	L	Ornamental fruits and seeds.
*llex cassine Dahoon	E	0	Μ	L	М	Μ	М	Salt tolerant. Best in moist soils. Attractive red fruits on female plants.
Jacaranda mimosifolia Jacaranda	D	S	F	L	М	Н	N	Beautiful lavender flowers in spring. Ferny foliage.
<i>Kigelia pinnata</i> Sausage tree	E	Ρ	Μ	Н	М	M	L	Novelty tree for its large, dangling flowers and fruits. Messy.

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*Acacia farnesiana Sweet acacia	S	V	F	Μ	S	Н	М	Thorny. Subject to defoliation by caterpillars.
<i>Lagerstroemia speciosa</i> Queen crepe myrtle	D	S	М	Μ	М	Н	N	Very showy flowers. Problems with scale insects.
<i>Ligustrum japonicum</i> Japanese privet	E	V	F	Μ	S	М	L	High salt tolerance. More commonly used as shrub.
<i>Litchi chinensis</i> Litchi	E	R	М	н	М	Μ	N	Delicious fruit. Handsome shade tree. Several cultivars.
*Lysiloma bahamense Wild tamarind	E	V	Μ	L	М	Н	Н	Tolerant of seaside locations.
<i>Macadamia integrifolia</i> Macadamia nut	E	R	S	Н	S-M	Н	N	Several cultivars. Nut production erratic in Florida.
<i>Mangifera indica</i> Mango	E	R	М	Н	L	М	М	Popular, edible fruit.
Manilkara roxburghiana Mimusops	E	R	S	н	М	Н	Н	Edible fruit. Takes wind.
*Mastichodendron foetidissimum Mastic tree	E	R	S	н	M-L	Н	М	Edible fruit. Attractive leaves.
<i>Myrciaria cauliflora</i> Jaboticaba	E	V	S	Н	S	М	L	Edible fruit.
<i>*Myrica cerifera</i> Wax myrtle	E	R	М	Μ	S	Н	Н	Tolerates salt and unfavorable soils. Aromatic foliage.
Noronhia emarginata Madagascar olive	E	0	М	Μ	S	Н	Н	Tough, seaside specimen.

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*Acacia farnesiana Sweet acacia	S	V	F	Μ	S	Н	М	Thorny. Subject to defoliation by caterpillars.
Parkinsonia aculeata Jerusalem thorn	D	S	F	L	S	н	L	Unusual green branches and picturesque form. Good late spring flower show. Very drought tolerant.
Peltophorum pterocarpum Yellow poinciana	D	S	F	Μ	М	Н	Μ	Surface roots. Showy yellow flowers. Can topple in strong winds.
Persea americana Avocado	E	R	F	H	М	М	Z	Low branching when young. Edible fruit.
*Pinus clausa Sand pine	E	0	F	L	Μ	н	L	Persistent cones. Picturesque leaning or twisted habit when old. Very tolerant of poor, dry soils.
*Pinus elliottii Slash pine	E	R	F	L	L	Н	М	Straight trunk.
*Pinus taeda Loblolly pine	E	R	М	L	L	Н	N	Irregular crown. Good screen or windbreak.
*Piscidia piscipula Jamaican dogwood	D	S	F	Μ	M-L	Н	H	Drought tolerant. Attractive pink flowers in spring.
Platycladus / Thuja orientalis Arborvitae	E	С	Μ	Н	S-M	М	Ν	Good windbreak tree. Many cultivars.
<i>Plumeria spp.</i> Frangipani	E	V	F	L	S	Н	Η	Large fragrant flowers. Does poorly on wet soils.
Podocarpus gracilior Weeping podocarpus	E	0	Μ	Н	М	Μ	L	Attractive weeping form.

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*Acacia farnesiana Sweet acacia	S	V	F	Μ	S	Н	М	Thorny. Subject to defoliation by caterpillars.
Podocarpus macrophyllus Podocarpus	E	С	Μ	Н	S-M	М	М	Low branching.
Podocarpus nagi Nagi podocarpus	E	0	S	L	M-L	Μ	М	Moderate salt tolerant. Pest free. Can be clipped as hedge.
<i>Pongamia pinnata</i> Karum tree, Pongam	D	S	F	Μ	М	Н	М	Leaves and pods can create litter problems.
Pseudobombax ellipticum Shaving brush	D	S	F	Μ	S	М	N	Spectacular pink flowers when leafless.
*Q <i>uercus laurifolia</i> Laurel oak	S	0	F	H	L	н	L	Height greater than spread. Lives only 30-50 years.
*Quercus virginiana Live oak	S	S	Μ	н	L	н	I	Old trees very picturesque. Spread greater than height. Long-lived. Salt tolerant.
*Sapinus saponaria Soapberry	D	R	Μ	Μ	М	Н	Μ	Soap-like compound derived from fruits. Fruits can be messy.
*Simarouba glauca Paradise tree	E	R	S	Μ	Μ	Н	L	Excellent specimen tree. Yellow spring flowers.
Spathodea campanulata African tulip tree	E	V	F	Μ	M-L	Н	Μ	Very showy red flowers. Brittle; weak limbs can break off in strong winds.
Stenocarpus sinuatus Firewheel tree	E	С	Μ	Μ	L	М	Ν	Attractive foliage, showy red flowers.

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*Acacia farnesiana Sweet acacia	S	V	F	Μ	S	н	М	Thorny. Subject to defoliation by caterpillars.
*Swietenia mahogoni West Indian mahogany	D	S	Μ	Μ	Μ	T	М	Wind resistant. Interesting fruit.
<i>Tabebuia caraiba / T. argentea</i> Golden trumpet tree	D	0	Μ	Μ	Μ	н	Σ	Irregular crown. Silvery leaves. Large yellow flowers.
<i>Tabebuia chrysotricha</i> Yellow trumpet	S	V	Μ	L	М	Н	М	Yellow flowers. Larger tree than <i>T.</i> argentea.
Tabebuia heterophylla / T. pallida Pink trumpet tree	E	0	Μ	Μ	Μ	H	М	Pink flowers. Fine street tree.
<i>Tabebuia impetiginosa</i> Purple tabebuia, Ipe	D	V	Μ	L	S	I	М	Pink-purple flowers.
<i>Tamarindus indica</i> Tamarind	E	R	S	Μ	Μ	H	м	Handsome form. Wind resistant. Litter of pods may be objectionable to some.
*Taxodium distichum Bald cypress	D	Ρ	Μ	L	L	н	N	No serious pests. Very tolerant of both wet and dry soils.
*Tecoma / Stenolobium stans Yellow elder	E	R	F	Μ	S	н	L	Yellow flowers most of the year. Often shrubby.
<i>*Zanthoxylum fagara</i> Wild lime	E	R	Μ	Μ	S	Н	М	Thorny. Takes coastal conditions well.