

## Energy Efficient Homes: Landscaping<sup>1</sup>

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Landscaping has always played an important role in modifying the home environment. To survive, Native Americans and early settlers designed shelters that offered protection from the most severe conditions imaginable. Until the invention of mechanical heating and cooling systems, man was dependent upon his ability to change or modify his surroundings for comfort.

An instinct for survival may have been the driving force that taught settlers to use landscape materials to improve the effects of these harsh conditions. In southern territories, it was important to keep out the sun while encouraging cool breezes. Florida, with its moist, hot climate, presented an especially difficult challenge for settlers. To encourage airflow, these early settlers designed very open homes, and used trees and other landscape materials to channel tropical winds. This may partially explain why population centers first developed along coastal areas. These cooling coastal breezes offered a welcome relief from uncomfortably warm temperatures.

In those days before central heating and air conditioning, home design and landscaping played an important role in reducing the effects of summer heat and, particularly in North Florida, winter cold. Houses in Florida were built with large porches, which shaded windows and walls, and homes were situated to take advantage of the shade provided by existing trees. This combination of home design and site selection is effective in helping keep a home cool. This strategy is known as “passive” cooling, because it occurs without mechanical means. Conversely, “active” cooling requires energy to operate such as running an air conditioner.

Today, more and more people are searching for cost-effective yet curb-appealing ways to lower their energy bills and reduce their impact on the environment. From the hilly regions in the North to the tropical Keys, Florida provides many unique opportunities for using landscape materials to control the home environment. We all know that we cannot actually control the weather, but with design planning, we can cast shade, channel winds, and reduce moisture near our homes. Learning to control the effects of weather through landscaping can create

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a more comfortable home environment and actually reduce monthly utility bills, sometimes substantially. For example, the Department of Energy estimates that the proper placement of as few as three trees can save the average household between \$100 and \$250 annually in energy costs.

Landscaping with a focus on energy efficiency has many benefits, including:

- Reducing energy costs by protecting the home from winter wind and summer sun
- Reducing consumption of water, pesticides, and fuel for landscaping and lawn maintenance
- Helping control noise and air pollution
- Reducing the surface temperature of the pavement with shade from adjacent trees

### Quick Facts

In Florida, home designs that aim to reduce summer heat gain as the first priority are on the rise.

Deciduous trees shed all or most of their leaves at once each year. In North Florida, planting deciduous trees near the home helps reduce energy use for both cooling and heating. During the summer months, they have a full canopy of leaves that provide shade. During the cooler months, deciduous trees drop their leaves, allowing the warming effect of the sun to shine through.

Groups of trees have a greater cooling effect than the same number of individual trees scattered around the landscape.

Carefully positioned trees can save up to 25% of the energy a typical household uses for cooling (U.S. DOE, 2007).

Studies conducted by Lawrence Berkeley National Laboratory found summer daytime air temperatures to be 3–6 degrees cooler in tree-shaded neighborhoods than in treeless areas (U.S. DOE, 2007).

University of Florida geography researchers found the tree canopy in the city of Gainesville, which has a strict tree ordinance, is more than twice

as dense as that of Ocala. They concluded that Gainesville's added shade is the main reason residential utility bills average \$126 lower per year than in the city of Ocala (Davis, 2000).

There is more to plants' cooling effect than simple shading. Plants release large amounts of water from pores in their leaves, and the evaporative cooling that results from this release creates a zone of cool air around the plant. You can take advantage of this effect by using plants for shade and wind control, rather than structures such as fences or arbors.

The U.S. EPA has developed a Resource Conserving Landscaping Cost Calculator that estimates the cost of converting a landscape to a more resource efficient one and provides short term and longer term annual maintenance cost estimates. See <http://www.epa.gov/epaoswer/non-hw/green/tools/> for details.

Contact the UF/IFAS Extension office in your county for assistance (<http://solutionsforyourlife.ufl.edu/map/index.html>). In addition to Environmental Horticulture faculty, many counties have Florida Master Gardeners and/or Florida Yards and Neighborhoods faculty and volunteers who can help you choose the correct plants for your landscape. Your local Water Management District can also help.

### Key Tips for Cultivating an Energy-Efficient Landscape

- Shade your house.
- Shade your AC unit (but keep it free of debris and don't block its circulation).
- Select and place plants carefully for greatest energy efficiency and least maintenance.
- Use less: water, fertilizer, pesticides.
- Select energy-efficient maintenance equipment.

## Getting Started: Plan *Before* You Plant

The energy efficiency of your home can be enhanced greatly through careful planning, design, and maintenance of your landscape. Begin by making a list of specific problems you would like to correct.

- Does the home have particular windows that need to be shaded?
- Is humidity/moisture a problem on any particular side(s) of the home?
- Would the back yard be more usable if you encouraged wind movement?
- Does the home rely on passive cooling instead of air conditioning? (Note that homes that rely on passive cooling will require different landscape techniques than homes that use air conditioning.)
- And so on...

You need to ask yourself these questions so that the landscape design can be tailored to meet your specific needs.

The area around the home should be sufficiently ventilated to allow periodic drying by the sun and wind. An over-shaded home may actually have higher energy and maintenance bills, since lights will have to be on more and an air conditioner may be needed to control humidity.

In order for shade trees and other plants to be effective in reducing your energy bills, they must be planted in the right places. East- and west-facing walls receive the greatest amount of heat because they receive the direct morning and afternoon sun. Some of that heat is transferred into the home, which means your air conditioner has to operate longer and harder. Plants that cast shadows over east- and west-facing walls during the summer can greatly reduce the heat load on the home. It is much more energy efficient to stop the heat from entering your home in the first place, rather than trying to cool down a too-hot interior. Keep in mind that the sun warms your home in three ways:

- by direct radiation (solar radiation that reaches the earth surface from the sun);
- by reflected radiation that "bounces off" a surface such as patios, driveways, or other buildings; and,
- by re-emitted radiation (which is stored and released, usually later on in the day) from concrete, asphalt, and brick.

Therefore, when looking at the areas that need to be shaded, consider all three of these sources of heat. The first target area for shading should be the windows and glass doors in the walls facing West, East, and South. Trees, shrubs, and vines are all useful materials to shade walls and windows while maintaining curb-appeal, and properly placed tall trees will help shade the roof of a typical single family home.

In general, the best location for deciduous plants (those that shed all or most of their leaves each year) is on the southernmost and southeastern sides of your home. This is especially important in northern Florida, which typically has winters with temperatures below freezing. To decrease energy needs during the heating season, plant appropriate low maintenance deciduous vines, shrubs and trees.

## Providing Wind Protection in the Summer

The direction of prevailing summer winds depends on where you are in the state. Historic wind data for select cities is available online at <http://www5.ncdc.noaa.gov/documentlibrary/pdf/wind1996.pdf>. How best to use landscaping to your advantage depends on how you cool your home.

## Landscape for Passive Cooling

If you use air conditioning only minimally and rely on passive cooling to keep your home comfortable in the summer, then arrange trees and shrubs to channel cooling breezes *toward* the windows. General guidelines for landscaping for passive cooling include the following.

- Remove low branches on trees on the southeastern and southwestern exposures to allow maximum air movement.
- Make sure window-shading plants are located far enough away from the home so as not to restrict air circulation.
- If you're using shrubs on the southeastern or southwestern sides of the home primarily for “low” shade—early morning or late afternoon—plant species with small leaves and an open branching pattern.
- Winter windbreaks can do double-duty by deflecting cooling southern summer breezes back toward the house.

### Landscaping for Active Cooling

Wind movement around an air-conditioned home in the summer can actually increase your energy costs in part by aiding the infiltration of hot, humid air through cracks and openings around windows and doors. In this case, you'll want to position shrubs and trees to divert summer breezes *away* from the home, the opposite of what's desired in a passively cooled house. When landscaping for the air-conditioned home:

- Use low-branching trees on the southeastern and southwestern areas of your home lot to protect windows from air movement.
- Use a multi-layered summer windbreak along southern exposures, with the tallest plants closest to the house. This creates a “wind ramp” that will channel wind up and over the home.
- Create a dead air space along walls that face the summer winds, to insulate the home and cut down warm air infiltration.
- In North and Central Florida, use deciduous shrubs on south-facing sides to allow passive solar heating of walls in winter.

A frequently overlooked action for increasing your energy efficiency is to *provide shade for your air conditioning unit!* A unit in direct sunshine uses more energy than one in a shady area. Shade-casting plants

keep the air around the air conditioner cooler, so that cooling equipment doesn't have to work as hard. Make sure, however, that leaves and branches don't block your unit's airflow—if warm discharge air can't escape, then the temperature of the intake air rises and the air conditioner will not operate as efficiently. Place plants so that they cast shade without blocking airflow, and regularly clear off any leaves that collect on the unit's outside coils. Direct the condensation overflow pipes away from the building to reduce moisture buildup.

### Providing Wind Protection in the Winter

While the effects of the sun are a major environmental factor in Florida, the effects of wind are also important. In Florida, winter winds generally blow from the North and can bring frigid air into the northern part of the state. A home can lose more heat on a windy day than on a still day, due to infiltration—thus increasing the winter heating bill.

To decrease the effect of cold winter winds and the resulting energy required to heat a North Florida home, plant windbreaks on the northern and northwestern sides of your home. While even a single row of trees will provide some protection, the most effective design is 2–5 rows of trees and shrubs of varying heights and moderate foliage density. (Extremely dense windbreaks tend to concentrate their effects over a much shorter distance than those of moderate density.)

Also effective at protecting the home is a dense planting of evergreen shrubs adjacent to the North and Northwest walls. Plan and plant so that, when fully mature, shrubs are at least 2 feet from the structure of the home so you avoid moisture, humidity, and insect problems. This creates an insulating dead air space against walls and around windows, which also helps prevent heat loss via cold air infiltration through cracks and window spaces.

### Selecting the Right Plant for Shading or Cooling

Keep in mind that plant selection is the most important part of landscaping your yard. Your plant selection determines the wildlife value of your yard,

the level of maintenance that will be required, how much fertilizer or pesticide may be required, etc. Your plant choices should be based on both energy efficiency and on finding plants that are best adapted to grow in your yards conditions with the least maintenance.

### **Trees**

When choosing shade trees, you will need to keep in mind the mature height of the tree and the shape of its shade canopy in relation to the height of the home. This can influence how far from the house you decide to plant a tree. Typically, trees planted closer to a wall shade it for a greater portion of the day, and for a greater part of the summer. Research has shown that the shadow of a tree planted 10 feet from the home moves across the “target surface” four times slower than one planted 20 feet from the home, which means the shading benefit will be greater from the closer tree. When planting trees, however, be sure to plan for the mature size of the tree and avoid planting too close to the building or too near any aboveground or underground utility lines.

Keep in mind the *type* of shade cast varies by species. Broad-leaf evergreens such as Southern magnolia provide dense year-round shade. Needle-leafed evergreens (pines, cedars, and junipers) cast a sparser and more open shade—perhaps preferable where both shade and air circulation are important factors. To search a University of Florida database for trees that provide shade, be sure to click on “shade” under the “uses” tab at <http://lyra.ifas.ufl.edu/FloridaTrees/FloridaTreeSelector.swf>. Another source of information to help you select suitable trees is the Florida-friendly plant database at [www.FloridaYards.org](http://www.FloridaYards.org). If your home's exposure to hurricanes is a primary concern, see the UF/IFAS Trees and Hurricanes website at <http://treesandhurricanes.ifas.ufl.edu/> for information on planning a wind-resistant landscape. Finally, for maximizing your home's protection against threat of wildfires, see the *Landscaping in Florida with Fire in Mind* publication at <http://edis.ifas.ufl.edu/FR076>.

### **Shrubs and Vines**

If you're unable to use trees to shade your home, shrubs can also be used effectively. Shrubs trained to grow against a wall (*espaliered* shrubs) can block significant amounts of sunlight from reaching—and heating up—the home envelope.

Alternatively, consider vines. *Self-supporting* vines (such as Virginia creeper) can be used on brick or concrete block homes to protect walls from the heat of the sun. They are *not*, however, recommended for use on wood homes because they may trap moisture that can cause decay or potential pest problems. *Twining* vines such as confederate jasmine need the support provided by a trellis. You can place trellises to provide shade and air circulation wherever needed—for example, near walls, windows, or outdoor living spaces.

In North and Central Florida, use vines that lose their leaves in winter for southern exposures, so that you can take advantage of winter sunlight to heat the home. The FloridaYards.org website is again a good source of information to help you select suitable low maintenance shrubs and vines.

### **Grasses and Groundcovers**

Trees and shrubs are not the only things that create a cool “microclimate” in their immediate vicinity. Properly placed grasses and ground covers can also help reduce the amount of heat gain around a home. Ground covers are low-growing plants that can be used to cover an area in the landscape. Turf grass is undoubtedly the most commonly used ground cover. While turf grass makes an excellent choice for recreational areas for its ability to withstand foot traffic, most varieties do not grow well in dense shade, and it is difficult to establish in extremely wet or dry areas. Moreover, most types of turf grass in Florida also require irrigation and fertilizer applications to stay healthy. There are several alternative groundcovers, however, that adapt well in the variety of conditions in most Florida landscapes. For assistance on determining suitable ground covers for a particular area of your landscape, visit the Florida-Friendly plant database at <http://www.FloridaYards.org>.

## **Energy-Efficient Landscape Maintenance: Using Less Energy = Less Work**

Our landscapes can complement our homes and provide cooling, shading and comforting surroundings. However, in the process of creating an attractive home landscape, homeowners often overuse fertilizers, pesticides, and water. These practices result in accelerated plant growth and thus more frequent pruning, mowing, and general cleanup. They also generally require more energy derived from fossil fuels in their general production and delivery. A healthy, attractive landscape is possible to achieve without excessive plant growth, and with minimal pest control. To cultivate a good quality landscape, you will need to follow some basic maintenance guidelines.

### ***Start from the Ground Up – Healthy Soils***

Start with a healthy soil, which is the key to healthy plants. Take a soil sample to your county's UF/IFAS Extension office for testing. Be sure to check for and correct soil compaction problems, which can cause poor plant growth.

### ***Use Less – Fertilizer, Water, Pesticides***

Moderate applications of fertilizer may improve the appearance and condition of plants under some circumstances, making them more disease and insect resistant. This is especially true for turf grass. However, fertilizers may not be necessary for established plants, especially most trees. Excessive fertilization requires more effort, contributes to groundwater contamination, and wastes valuable energy. Most synthetic nitrogen fertilizers contain ammonia, created by heating natural gas and combining it with atmospheric nitrogen and hydrogen. Nitrogen production uses quite a bit of energy—about 29,000 Btu of energy per lb. of nutrient. To put this in perspective, one gallon of gasoline has a Btu content of approximately 124,000 (Fluck 1992, Energy Information Administration 2008). Natural, organic fertilizers may require higher energy costs for transportation but are not derived from fossil fuels, as are synthetic fertilizers.

Careful planning, installation, and management can make our landscapes and our lives more energy efficient. For example, each 2 lb/1000 sq. ft. reduction in synthetic nitrogen fertilizer saves about 58,000 Btu a year on each 1000 sq. ft. of land, just in terms of the energy used to produce the nitrogen in the fertilizer (and not counting the energy used in the packaging and transportation). For every acre of land, that's a savings of over 2.5 million Btu of energy each year, equivalent to the energy in about 20 gallons of gasoline. Reduce fertilizer use by choosing a low-maintenance turf grass or using plants that require less nitrogen, or by moving to the lower end of the range of recommended nitrogen rates.

A plant's growth rate is also affected by the amount of water it receives. Excessive use of water, coupled with high fertilization rates, results in a rapid flush of growth and contributes to insect and disease problems. Energy is also used whenever irrigating with potable water (see *The Energy and Water Connection* in this series). In addition, with Florida's limited potable water and mandatory water restrictions, wise irrigation practices are essential (see *The Irrigation System* in this series). Choose plants carefully, matching them to the specific site conditions and avoiding high-maintenance plants that require frequent watering. Whenever possible, choose and maintain plants that will require little to no supplemental irrigation or fertilization after establishment, and consider leaving or restoring areas of vegetation to their natural state. Use drought-tolerant plants in dry sites. Use micro-irrigation to get plants established, and once established, only irrigate during drought conditions. Train your lawn to need less water by: mowing it only to the highest recommended length for its type, and irrigating only when 50% of it shows signs of wilt (see <http://edis.ifas.ufl.edu/EP054> for details).

An increase in environmental and health awareness has caused many pesticide users to look for safer ways to manage disease and pests in the landscape. With appropriate plant choices, a diversity of plants, recognition of pest-eating insects, and moderate fertilizer and watering practices, you can reduce the need for frequent pesticide use. Besides the potential for surface and groundwater pollution associated with some pesticides, the manufacturing

process requires large amounts of energy. Synthetic fertilizers, pesticides, and herbicides that are fossil fuel-based all use energy in the production, packaging, and transportation processes. Organic products on the market often require less energy in these areas, but you may have some cost-free solutions already at hand.

### ***Save by Recycling***

By carefully planning your landscape maintenance practices, you can conserve energy. Lessen the amount of yard waste produced by minimizing fertilization and watering, which produce excess growth. Prune shrubs only when needed, and practice selective pruning rather than shearing. Non-selective pruning encourages unnecessary flushing of all the terminals instead of just selected ones. That leads to more tender growth, which in turn leads to more water demands and the greater likelihood of insect attack and disease incidence. When you do have excess plant material, recycle the nutrients it contains back into the yard by using it in compost or mulch.

Grass clippings are a valuable energy resource that many homeowners are throwing away. When mowing the lawn, simply let your grass clippings remain on the grass, allowing them to decompose. Your lawn will recycle the clippings naturally, saving you time, money, and energy. Filling plastic bags with grass clippings and other yard debris is hard work and wastes valuable space at landfills (Florida law also prohibits disposing of yard waste in lined Class I landfills). When you leave clippings on the lawn, you will reduce these negative effects and recycle important nutrients for free. Each bag of grass clippings you throw away contains as much as 1/4 of a pound of organic nitrogen. By using this free nitrogen, you can decrease your fertilizer needs, saving the energy required to produce these products and keeping some dollars in your pocket. Get in the habit of leaving your grass clippings where they fall. You will be rewarded with a healthy lawn and more leisure time to enjoy it.

However, keep in mind that “too much of anything is no good.” Problems can arise when a lawn is not mowed often enough and too many clippings are left behind. When clippings clump, it

means you waited too long between mows and are cutting off too much grass at one time. Increase your mowing frequency. In the meantime, you can use a rake to spread clippings out or mow over the area again. Because you haven't adjusted the mowing height, you won't be cutting up more grass, only the clumps. Remember to vary your mowing pattern the second time around to prevent ruts.

Keep in mind that excessive accumulation of clippings remaining on the surface for long periods can contribute to fungal turf problems. In this case, bag the clippings and compost with other gardening trimmings. Some people are concerned that returning clippings to the lawn may result in thatch accumulation (thatch is the intermingled layer of dead and living shoots, stems, and roots that develop between the zone of green vegetation and the soil surface). However, because clippings decompose rapidly, they do not contribute to thatch. In all cases, grass clippings should be disposed of appropriately and never dumped down the storm drain.

Energy can also be conserved by recycling yard wastes. Disposing of leaves, excessive grass, and other garden refuse is often a problem for gardeners, particularly in an urban area. These garden and landscape by-products can be turned into useful compost with little effort. Returning these organic materials to the land perpetuates the natural biological cycle, improving the health of your soil and therefore of your plants. Ecologically, this is a sensible means of reusing organic wastes. Creating and using compost on-site not only reduces the energy needed for transporting the material to a landfill, but also reduces the energy used in producing and transporting synthetic fertilizers and pesticides.

### ***Select Efficient Equipment***

Another source of energy consumption in the landscape is the use of gasoline-powered lawn mowers, leaf blowers, string trimmers, and other motorized yard maintenance equipment. This equipment not only uses energy, but also contributes to air pollution and global warming by emitting carbon monoxide, hydrocarbons, and oxides of nitrogen. The U.S. EPA recently estimated that operating a lawn mower for one hour emits the

equivalent amount of pollution as driving a car for about 20 miles

(<http://www.epa.gov/glnpo/greenacres/wildones/handbk/wo8.html>). In looking at gasoline spills from refueling lawn mowers and other garden equipment alone, the EPA estimated in 1997 that those few ounces spilled at a time added up to about 17 million gallons of gasoline each year (U.S. Environmental Protection Agency, 1997).

If you use a gasoline-powered mower, save energy by maintaining it and keeping the engine tuned for maximum efficiency, and be especially careful to avoid spills. Reduce your turf grass areas or use manual tools and a push reel mower to minimize or eliminate fossil-fuel energy used in cutting your grass. Also, remember that applying more fertilizer will mean faster grass growth and a need to mow more frequently. It will also require more water, with its resulting energy cost.

Alternative mowers, including reel mowers and solar powered mowers, are gaining in popularity. Electric mowers are arguably the more energy efficient, quieter, and less polluting choice than gasoline-powered mowers, but they still generally involve nonrenewable energy production. Reel mowers not only save the most energy, but also eliminate noise and air pollution. They are most appropriate for small yards and are more difficult to push when the grass is very high. Regardless of what type of mower you use, remember to cut no more than 1/3 of the grass blade at each mowing, keep your blades sharp, and raise your mower to the highest recommended cutting height for your grass type in order to improve the lawn's drought tolerance.

### **Benefits of Energy-Efficient Landscaping**

Landscape maintenance can consume a great deal of energy, and this energy consumption (at the fertilizer processing plant, the electric power plant, by the lawn mower, etc.) affects your environment. With good planning, you can have a beautiful, low-maintenance landscape that costs less energy. Remember that energy is used to produce and ship water, fertilizers, pesticides, garden tools and other

purchased materials used in the landscape. Energy-efficient landscapes help you maximize water, fertilizer, and pesticide efficiency by matching the plants with the microclimate and using the most adapted plants for the site conditions. Choose a diversity of plants for your lawn and landscape that perform well at lower water and fertilization levels. Keep the soil healthy by composting organic wastes like yard waste, vegetable and fruit scraps, coffee grounds, etc. for soil amendments. Never use more water or fertilizer than needed, and be aware of the natural insect control already occurring in your yard so that you can minimize pesticide use. By following these guidelines, you can enjoy a healthy landscape that saves energy and reduces your overall impact on the environment.

You can also enjoy the savings you'll see on energy bills, since energy-efficient landscapes use appropriately placed plants to minimize the home's heating and cooling costs. Beyond beautifying the yard, energy-efficient landscaping will minimize a home's overall environmental impact. A bonus of planting trees next to paved surfaces is a reduction in the surface temperature of the pavement. This in turn reduces the temperature of runoff from rain falling on the pavement. Runoff temperature is important, because heated runoff can be harmful to aquatic life in streams, ponds, estuaries, or other receiving bodies of water; this "thermal loading" disrupts organisms with finely tuned temperature limits. Having more appropriately maintained vegetated areas and fewer impervious surfaces (like concrete) also reduces the total amount of runoff water. High runoff volumes can reduce salinity (salt concentration) in areas where runoff water mixes with salt water thereby disrupting natural systems. Runoff carrying excess nutrients from fertilizers and other pollutants also has a great impact on water quality. Planning and maintaining your landscape with energy efficiency in mind helps both you and the environment.

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