



ENERGY SERIES: What about Landscaping and Energy Efficiency?

Landscaping has always played an important role in modifying the home environment for thermal comfort. Throughout the history of civilization, housing has been designed to offer protection from the most severe conditions imaginable. Until the invention of mechanical cooling and heating systems, people relied heavily on their ability to modify their surroundings to deal with extreme climates.

People have long used home design and landscaping to reduce the effects of summer heat and winter cold. In the Southeast, houses were once built with large porches that shaded windows and walls and were situated to take advantage of the shade provided by existing trees. The design of houses was very open, and trees and other landscape materials were used to channel breezes for cooling. In cold northern regions, evergreen trees and shrubs were planted as windbreaks to divert the chilling winds of winter away from houses and other structures.

Today, people are searching for cost-effective, yet curb-appealing, ways to both lower their energy bills and reduce their impact on the environment. We all know that we cannot control the weather, but with careful planning and design, we can use landscaping to cast shade, channel winds, and reduce moisture near our homes. Learning to moderate the effects of weather with landscaping can create a more comfortable home, reduce monthly utility bills, and protect the environment.

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

- Reducing energy costs by protecting the home from summer sun and winter wind
- Reducing sun damage to pavement and roofing materials with shade from nearby trees
- Reducing outdoor noise, stormwater runoff, and air pollution with multipurpose plants
- Reducing consumption of water, pesticides, and fuel for landscaping and lawn maintenance

Quick Facts about Energy-Efficient Landscaping

- Home and landscape designs that aim to decrease solar heat gain in summer and increase solar heat gain in winter are increasing in popularity.
- Large deciduous trees that lose their leaves in winter are good multipurpose plants for conserving home energy. During the summer, deciduous trees have a full canopy of leaves that provide shade. During the winter, they drop their leaves, allowing the warming sunlight to shine through while blocking wind.
- There is more to a plant's cooling effect than simply shading. Plants release large amounts of water from pores in their leaves. The evaporative cooling that results

from this release creates a zone of cool air around the plant. Using plants for shade and wind control, rather than structures such as fences or trellises, takes advantage of this additional cooling effect.

- Mature tree canopy can reduce air temperatures by about 5-10° F in a landscape.
- A 25-foot tree reduces annual heating and cooling costs of a typical residence by 8 to 12%.
- Evergreens serving as windbreaks in the winter can save 10 to 50% on heating costs.
- Fifty million shade trees planted in strategic, energy-saving locations across U.S. communities could eliminate the need for seven 100-megawatt power plants.

Tips for Cultivating an Energy-Efficient Landscape

- Shade your house by planting large-maturing trees within 10 to 20 feet of the east and west side of your home.
- Avoid planting low-branching trees on the south side to allow sunlight to pass under tree crowns in winter and provide passive heating.
- Shade your air-conditioning unit so that it operates efficiently in the summer (but keep it free of plant debris and don't block air circulation around it).
- Select and place plants purposefully for greatest energy efficiency and least maintenance.
- Plan your landscape to minimize use of water, fertilizer, and pesticides.
- Select energy-efficient landscape maintenance equipment.

Getting Started: Plan before You Plant

An energy efficient home can be enhanced greatly through careful planning, design, and maintenance of your landscape. Begin by making a list of specific issues you would like to address:

- Does the home have particular windows or walls that need to be shaded?
- Is humidity/moisture a problem on any particular side(s) of the home?
- Would the yard be more comfortable if you accentuated shade or wind movement?
- Does the home rely on passive cooling instead of air conditioning? (Note that homes with passive cooling will require different landscape techniques than homes that use air conditioning.)
- Plus other questions specific to your geographic region and your home site.

By answering these questions first, you can purposefully plan and design a landscape that meets the specific energy needs of your home.

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 and windows heat up the most 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 run more to maintain a comfortable temperature. Plants that cast shadows onto east- and west-facing walls and windows 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 an over-heated interior.

In northern regions, landscaping to conserve heating energy in winter is a common goal. The key is to facilitate passive solar heating by

avoiding shade on the home's south aspect and to block chilling winds using vegetative windbreaks on the north aspect. The behavior of wind can also affect summer cooling. The direction of prevailing summer winds depends on where in the state your home is located. Historic climatic wind data for select cities is available online at:

<http://www.ncdc.noaa.gov/sites/default/files/attachments/wind1996.pdf>. How best to use landscaping to manipulate winds for your advantage depends on whether you rely on passive or active cooling of your home.

Landscaping to Accentuate Passive Cooling of your Home

Passive cooling incorporates house design, site selection, and landscaping to minimize the use of mechanical air conditioning.

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

- Remove low branches on trees located on the summer windward (side from which the wind is coming) exposures to allow maximum air movement. This also allows winter sunlight to pass under tree crowns and heat your home.
- Make sure window-shading plants are located far enough away from the house to not restrict air circulation.
- If you're using shrubs primarily for "low" shade in early morning or late afternoon, then use species with an open branching pattern to permit air flow-through.
- Winter windbreaks situated on the north side of the house can do double-duty by

deflecting cooling southern summer breezes back toward the house.

Landscaping to Accentuate Active Cooling of your Home

Wind movement around an air-conditioned home in the summer can actually increase your energy costs by forcing infiltration of hot, humid air through cracks and openings around windows and doors. In this case, 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 summer windward exposures of your home lot to shade windows and shield them from air flow (but try to avoid casting unwanted shade in winter).
- Use a multi-layered summer windbreak along windward exposures, with the tallest plants closest to the house. This creates a "wind ramp" that will channel wind up and over the home and will also situate tall trees in an optimal position to cast shade.
- Create a dead air space along walls that face the summer winds with dense shrubs to insulate the home and reduce warm air infiltration.
- Use deciduous shrubs near south-facing walls to cast shade and calm winds in summer while allowing passive solar heating in winter.

A frequently overlooked tactic for increasing 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 the 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 heat of summer sun has an obvious impact on home energy, the effects of winter wind are also important. A home continually exposed to chilling winds can lose much heat due to cold-air infiltration through cracks around windows and doors, thus increasing the winter heating bill.

Windbreaks are trees and shrubs planted to diminish cold winter winds and the resulting energy required to heat a home. While even a single row of trees will provide some protection, the most effective design is 2 to 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). Because wind protection extends downwind 10 to 20 times the windbreak height, trees need not be planted close to the home to be effective.

Also effective at protecting the home in winter is a dense planting of evergreen shrubs adjacent to the walls facing the prevailing winter winds. Plan and plant so that, when fully mature, shrubs are at least two feet from the structure to help avoid moisture, humidity, and pest 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. Plant selection determines the quality and quantity of shade that is provided, the growth rate and durability of the plant, and its expected maintenance in terms of irrigation, fertilization, pest control, and pruning. Plant choices should be based on both energy efficiency and on finding plants that are best adapted to grow in your yard's conditions with the least maintenance.

Trees, shrubs, and vines are not the only things that create a cool “microclimate” in their immediate vicinity. Properly placed turf grasses and herbaceous 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, many types of turf grass also require periodic mowing, irrigation, and fertilization to stay healthy. However, there are numerous alternative groundcovers that adapt well in a variety of landscape conditions. For assistance to determine suitable ground covers for a particular area of your landscape, contact your local Extension office.

In an effort to maximize shade, there may be a tendency to overplant the landscape. Keep in mind

that crowding plants around the home may have negative consequences. Shrubs and small trees should be set back from the house to allow periodic drying by the sun and wind to prevent moisture damage. Also, 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. Consider the mature size of trees and shrubs when planning the landscape so that the correct number and spacing of plants is used.

Energy-Efficient Landscaping: Using Less Energy = Less Work

Landscapes can accentuate homes and provide comforting surroundings. However, in the process of creating an attractive landscape, homeowners often overuse water, fertilizers, and pesticides. These practices may result in accelerated plant growth and thus require more frequent pruning, mowing, and general cleanup. Also, production and delivery of these landscaping supplies generally require energy derived from fossil fuels. Yet a healthy, attractive landscape is possible to achieve without excessive plant growth and with minimal pest control. Below are some basic maintenance guidelines to cultivate an energy-efficient landscape.

Start From the Ground Up – Healthy Soils

A low-maintenance landscape starts with a healthy soil that will support healthy plants. Soils on residential lots are highly variable in their quality and are often degraded during the construction process. The most common problems are loss of organic matter and soil compaction. When a home lot is being graded, the top soil is typically removed or lost to erosion, leaving the remnant soil lacking in organic matter needed to support

root development and provide plant nutrients. Traffic by heavy grading machinery also compacts the soil, which causes problems with water infiltration and drainage. Be aware that compacted soil may require you to adjust your plant selection or landscape maintenance, particularly irrigation. Before planning your landscape, take a soil sample to your local Extension office for fertility testing to identify any nutrient deficiencies and determine the plant types that will best adapt to your soil conditions.

Use Less – Fertilizer, Water, and Pesticides

Moderate applications of fertilizer may improve the appearance and condition of plants under some circumstances, making them more attractive and pest and drought resistant. This is especially true for turf grass. However, excessive fertilization requires more maintenance 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 consumes energy—about 29,000 Btu of energy per pound of nutrient. To put this in perspective, one gallon of gasoline has an energy content of approximately 124,000 Btu. Natural, organic fertilizers may incur higher energy costs for transportation, but, unlike synthetic fertilizers, they are not derived from fossil fuels.

Careful planning, installation, and management can make landscapes and our lives more energy efficient. For example, each 2 pound reduction in synthetic nitrogen fertilizer per 1,000 ft² of land saves about 58,000 Btu per year, 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. To reduce fertilizer use, choose a turf grass or herbaceous ground cover that requires 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 irrigation, coupled with high fertilization rates, may result in a rapid flush of growth that is vulnerable to pests or drought. Energy is also used whenever irrigating with potable water. Wise irrigation practices are essential. In addition, consider tactics to slow the movement of water off your property and retain water on site where plants can absorb it (see *Low Impact Development (LID) Urban Design Tools Website* <http://www.lid-stormwater.net> and the U.S. EPA's LID Website <http://water.epa.gov/polwaste/green>). Also consider rainwater catchment systems, such as rain barrels or cisterns, to harvest water from the roof for later landscape use. Consult VCE's series of publications on home water quality: <http://pubs.ext.vt.edu/category/home-water-quality.html>.

Plant types may differ considerably in their maintenance needs. 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 at the highest recommended length for its type and irrigating only when 50% of it shows signs of wilt.

An increase in environmental and health awareness has caused many pesticide users to look for safer ways to manage pests in the landscape. By selecting vigorous plant types, intermixing plant types for diversity, conserving the natural enemies of pests, and judiciously fertilizing and irrigating, 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. Organic products on the market often require less energy inputs for manufacturing, but you can go a step further by recycling organic materials found in your home landscape to help with plant maintenance.

Save By Recycling

Trees, shrubs, and turf require periodic pruning and mowing to keep them healthy, attractive, and functional. As a result, you will have an assortment of plant waste to dispose. When you have excess plant material, rather than send it to a landfill or burn pile, recycle the nutrients it contains back into the landscape by converting it to compost or mulch. Detailed instructions on this process can be found in the VCE publication 452-055 entitled "The Virginia Yard-Waste Management Manual" at http://pubs.ext.vt.edu/452/452-055/452-055_pdf.pdf.

Grass clippings are a valuable energy resource that many homeowners throw away. When mowing, simply let the grass clippings remain on the lawn, allowing them to dry out and decompose. Your

lawn will recycle the clippings naturally, saving time, money, and energy. Filling plastic bags with grass clippings and other yard debris is hard work and wastes valuable space at landfills. Each bag of grass clippings thrown away contains as much as a quarter-pound of organic nitrogen. By using this free nitrogen, you can decrease your fertilizer needs, save the energy required to produce these products, and keep some dollars in your pocket. Get in the habit of leaving grass clippings where they fall. You will be rewarded with a healthy lawn and more leisure time to enjoy it.

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 usually decompose rapidly, they do not typically contribute to thatch. Excessive thatch rarely becomes a problem unless the turf is excessively fertilized or irrigated. Excessive accumulation of clippings on lawns for long periods can contribute to fungal turf problems. In this case, remove the clippings and compost them with other landscape debris.

Energy can also be conserved by composting yard wastes. Disposing of leaves, grass clippings, and other garden refuse is often a problem for gardeners, particularly in an urban area. However, 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 your plants. Healthy plants are better able to tolerate pests and environmental extremes, reducing the need for irrigation, fertilizer, or pest control. 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 Landscape Maintenance Equipment

Another source of energy consumption around the home landscape is the use of gasoline-powered lawn mowers, leaf blowers, string trimmers, and other motorized maintenance equipment. This equipment not only uses energy, but also contributes to air pollution by emitting carbon monoxide, hydrocarbons, and oxides of nitrogen. The U.S. EPA recently estimated that operating a lawn mower for one hour emits pollution equivalent to driving a car about 45 miles (<http://www.epa.gov/greenacres/wildones/handbk/wo8.html>).

Save energy by maintaining your gasoline-powered mower and keeping the engine tuned for maximum efficiency. Be especially careful to avoid spills when refueling. In looking at gasoline spills from refueling lawn mowers and other garden equipment, the U.S. EPA estimated 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). Most home landscape energy consumption revolves around lawn mowing and trimming. To minimize or eliminate fossil-fuel energy used for cutting your grass, consider using manual tools and a non-motorized mower such as a push reel, battery-powered, or solar powered mower. Electric mowers are more energy efficient, quieter, and less polluting than gasoline-powered mowers, but they still typically rely on electricity generated

from a nonrenewable energy source. Their compact size and limited charge duration may also be a limitation on large parcels. Manual push reel mowers are not motorized so they require no external energy source, plus they emit no noise or air pollution. Because they can be strenuous to operate, reel mowers are most appropriate for small yards and do not work well for cutting overgrown lawns.

Eliminating lawn mowing altogether may be the ultimate solution for long-term landscape energy efficiency. Consider reducing the amount of energy-intensive lawn on your property by converting some of your turf to shrub beds, herbaceous ground cover, or native meadow. Doing so will cut down on the amount of mowing, making the use of manual mowers and trimmers more feasible. 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. These practices keep the lawn healthy and less prone to pests and drought. Also, remember that applying fertilizer stimulates grass growth and the need to mow more frequently. Overly fertilized turf may also require more water and pesticides to keep it healthy, resulting in additional energy costs.

Summing Up the Benefits of Energy-Efficient Landscaping

Landscape maintenance can consume a great deal of energy. Remember that energy is used to produce and ship water, fertilizers, pesticides, and other purchased materials used in the landscape. However, with proper planning, you can minimize these inputs and have a beautiful, low-

maintenance landscape that uses less energy and saves you money.

By matching the plants with the growing environment of the property and using well-adapted plants for the site conditions, energy-efficient landscapes help maximize water, fertilizer, and pesticide efficiency. 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 such as leaves and brush, lawn clippings, vegetable and fruit scraps, and coffee grounds for soil amendments. Never use more water or fertilizer than dictated by the plant type and growing conditions. Be aware of the natural insect control already occurring on your property from birds, bats, and predatory insects 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.

Beyond saving energy, effort, and money, an energy-efficient landscape will also reduce a home's overall environmental impact. For example, a key benefit of planting shade 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. Also, having more vegetated areas and fewer impervious surfaces (like concrete) reduces the total amount of runoff water. High runoff volumes can reduce salinity (salt concentration) of saltwater ecosystems in areas where runoff water is piped into estuaries. Heavy runoff also causes erosion and alters the

topography of stream channels. Runoff carrying nutrients from excessive fertilizers and other pollutants also impacts water quality, which is vital to people and the environment. So planning and maintaining your landscape with energy efficiency in mind isn't just good for your wallet, but it's also good for the planet.

References and Resources

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Contact a Cooperative Extension System Office near you for assistance: <http://www.csrees.usda.gov/Extension/index.html> or <http://www.ext.vt.edu>. In addition to Extension faculty and staff, many counties have volunteers who can help you choose the correct plants for your landscape and offer additional assistance.

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