Virginia Cooperative Extension
Virginia Tech • Virginia State University
www.ext.vt.edu

ENERGY SERIES: What about Landscaping and Energy Efficiency?

Authored by P. Eric Wiseman, Ph.D., Urban Forestry Specialist, Forest Resources and Environmental Conservation;
Robert "Bobby" Grisso, Ph.D., Extension Engineer, Biological Systems Engineering, and
Martha A. Walker, Ph.D., Community Viability Specialist, Central District

The design and management of a landscape can have a notable impact on household energy consumption. Throughout the history of civilization, people have altered their dwellings and landscapes to make them more comfortable and energy efficient. Until the invention of mechanical cooling and heating systems, people relied heavily on their ability to modify their surroundings to deal with extreme climates.

Home and landscape design were once critical to reduce the discomfort of summer heat and winter cold. In hot southern regions, houses were 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 with high ceilings, and trees and other landscape features were used to channel breezes for cooling. In cold northern regions, houses were oriented to maximize passive solar heating, and evergreen trees and shrubs were planted as windbreaks to divert the chilling winds of winter.

Climate control technology and energy abundance have made landscape design and management an afterthought of many modern dwellings. Yet landscape considerations can still impact the cost of heating and cooling the home as well as the comfort of outdoor activities on decks, patios, and playgrounds. Reducing energy use is also good for the community and the environment by conserving fossil fuels that contribute to air and water pollution. We all know that we cannot control the weather, but with careful design and management, we can use plants and landscape features 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 using diverse plant types
- Reducing consumption of water, pesticides, and fuel for landscape maintenance

Quick Facts

- 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 multi-purpose 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 walls or fences, takes advantage of this additional cooling effect while also improving the scenery and wildlife habitat.
- 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

- Select and place plants purposefully to modify sunlight and wind around the home and outdoor activity areas for climate control and thermal comfort.
- Minimize maintenance needs of plants such as pruning, irrigating, and fertilizing by selecting appropriate plants for the space.
- Select energy-efficient landscape maintenance equipment such as manual or battery-powered tools.
- Shade your house by planting sturdy large-maturing trees within 20 feet of the east and west side of your home.
- 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.
- Avoid planting evergreen or low-branching trees on the south side of your home so that sun rays can reach the windows and walls in winter to provide passive solar heating.
- Plant dense evergreen vegetation in north side windbreaks to block chilly winter winds.

Getting Started: Plan before You Plant

A home designed for energy efficient can be greatly enhanced 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 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.)
- Other items specific to your region of the country and your home site such as climate norms and patterns of sunshine and wind flow.

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 modify 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 site selection, house design, 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 is 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 to shade windows and shield them from air flow (but try to avoid casting unwanted shade in winter).
- Use a staggered-height 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.

Selecting the Right Plant for Cooling and Shade

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 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 because it can 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 costs since lights will have to be on more to illuminate rooms darkened by shade 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 for proper climate control.

Landscaping for Winter Warmth

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.

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. There are also economic and environmental costs of manufacture and use of landscape supplies that an energy efficient landscape seeks to minimize. Yet a healthy, attractive landscape is possible to achieve without excessive plant growth and with minimal irrigation and pest control. Below are some basic maintenance guidelines to cultivate an energy-efficient landscape.

Start with Healthy Soil

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 compaction. When a home lot is being graded, the top soil is typically removed or lost to erosion, leaving the remnant soil lacking 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 alter your plant selection for tougher species or adjust your landscape maintenance to replenish organic matter and conserve soil moisture. Before planning your landscape, take a soil sample to your local Extension office for fertility testing to identify any 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 when nutrient deficiencies exist, making them more attractive and tolerant of pests and drought. 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 design and management can make landscapes and households more energy efficient. For example, each 2-pound reduction in synthetic nitrogen fertilizer per 1,000 ft^2 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 is 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, chose 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* https://www.lid-stormwater.net and the *U.S. EPA's Green Infrastructure Website* https://www.epa.gov/green-infrastructure). 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 try to avoid high-maintenance plants that require frequent watering. Whenever possible, choose plants that will require little to no supplemental irrigation or fertilization after establishment and consider restoring disturbed areas to natural vegetation that requires minimal maintenance. Consider use of dry-area landscaping (xeriscaping), which uses plant and landscape materials that require minimal water. 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 so that roots will penetrate deeper into the soil for water and carefully regulate sprinkler outputs.

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 such as birds and wasps, 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 manufacture, 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. 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. 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 entitled "Backyard Composting" at https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/HORT/HORT-49/HORT-49-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 fertilizer, 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. However, because clippings usually decompose rapidly, thatch is an uncommon problem on most lawns. Excessive thatch rarely becomes a problem unless the turf is excessively fertilized or irrigated. In all cases, grass clippings should be disposed of appropriately and never dumped down the storm drain. Keep in mind that excessive accumulation of grass clippings for long periods can contribute to fungal diseases of turf. If excess clippings ambulate, rake and compost them with other landscape debris.

Select Efficient Landscape Maintenance Equipment

A major consumer of energy 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 nitrogen oxides. According to the U.S. EPA, in 2011, approximately 27 million tons of pollutants were emitted by gasoline-powered lawn and garden equipment (https://www3.epa.gov/ttn/chief/conference/ei21/session10/banks.pdf).

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 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).

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 air pollution and less noise. 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 excess irrigation and fertilizer stimulates grass growth and the need to mow more frequently.

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 landscaping supplies. 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 landscape that perform well at reduced irrigation 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 rain that falls upon hot summer 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 reduces the total amount of runoff. 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 household climate control, but it's also good for the planet.

References and Resources

This document is excerpted and adapted from *Energy Efficient Homes: Landscaping*, http://edis.ifas.ufl.edu/document_fy1050, by Terry B. DelValle, Joan Bradshaw, Barbra Larson and Kathleen C. Ruppert. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, 2008.

Bucklin, Ray. *Cisterns to Collect Non-Potable Water for Domestic Use*. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. http://edis.ifas.ufl.edu/AE029

Energy Information Administration. U.S. Department of Energy. *Converting Energy Units 101*. http://www.eia.doe.gov/basics/conversion_basics.html

Florida Energy Extension Service and Helen H. Whiffen. 1993. *Energy Efficiency & Environmental News: Landscape Maintenance*. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. 5pp.

Fluck, R.C. (ed.). 1992. Energy in Farm Production. pp. 177-201 In: Vol. 6, *Energy in World Agriculture*. Elsevier, NY.

Gilman, Edward F. 2003. *Specifications for Planting Trees and Shrubs in the Southeastern U.S.* Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. http://ltmcp.org/wp-content/uploads/2014/11/Specifications-for-Planting-Trees_ENH856.pdf

Hansen de Chapman, Gail. 2009. *Design Strategies for a Sustainable Home Landscape*. Florida

Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. 5 pp. http://edis.ifas.ufl.edu/EP374

Hansen de Chapman, Gail. 2009. *Landscape Design: Ten Important Things to Consider*. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. 10 pp. http://edis.ifas.ufl.edu/document_ep375

McPherson, Greg and James Simpson. 2001. Effects of California's urban forests on energy use and potential savings from large-scale tree planting. Davis, CA: USDA Forest Service, Pacific Southwest Research Station, Center for Urban Forest Research. 35.

University of Washington, College of Forest Resources. 1998. *Urban Forest Values: Economic* Benefits *of Trees in Cities*. Fact Sheet #3 – Human Dimension of the Urban Forest. Center for Urban Horticulture.

U.S. Department of Energy. 2007. *Energy Saver$ Tips on Saving Energy & Money at Home: Landscaping.* http://energy.gov/public-services/homes/landscaping

U.S. Department of Energy. 1995. *Landscaping for Energy Efficiency*. Office of Energy Efficiency and Renewable Energy (EERE). http://www.nrel.gov/docs/legosti/old/16632.pdf

U.S. Environmental Protection Agency. 1997. *Statements of Principles for Non-road Phase 2 Small Spark-Ignited Engines.* Federal Register (Volume 62, Number 59). http://www.govinfo.gov/app/details/FR-1997-03-27/97-7626

U.S. Environmental Protection Agency. 1996. *Your Yard and Clean Air*. Fact Sheet OMS-19. 2 pp.

U.S. Environmental Protection Agency. *GreenScaping - The Easy Way to a* Greener, *Healthier Yard.* http://www.epa.gov/safepestcontrol/greenscaping-easy-way-greener-healthier-yard

U.S. Environmental Protection Agency. *U.S. EPA Resource Conserving Landscaping Cost Calculator.* http://archive.epa.gov/wastes/conserve/tools/greenscapes/web/html/index-2.html

Contact a Cooperative Extension System Office near you for assistance: https://nifa.usda.gov/land-grant-colleges-and-universities-partner-website-directory 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.

Developed as part of the NASULGC/DOE Building Science Community of Practice.

2020 BSE-145(BSE-334NP)