How Trees Can Save Energy

TREE CITY USA® BULLETIN

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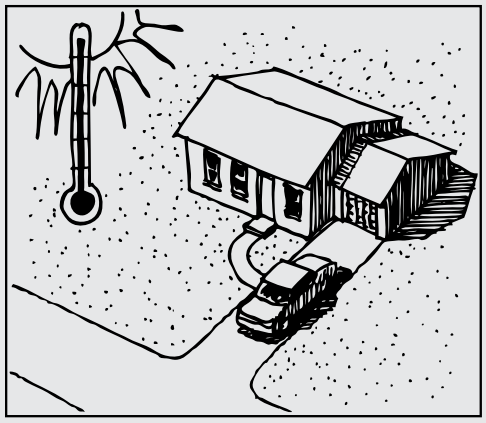

HIGH COST (above)
A lack of trees means less comfort and higher costs.

LOW COST (right)
Carefully planned trees annually save money and add comfort.

Trees have been called the low-tech solution to energy problems and climate change. Whether you want to reduce the amount of money you spend each month on utility bills or help guide your community toward wiser energy policies, the information in this Bulletin is of special importance.

There is an ongoing debate among community forestry leaders about the best approach to convince citizens and city councils about the importance of trees. Some suggest that aesthetics and liveable communities are the issues to promote. Others believe that the practical contributions of trees will tug at heartstrings (and pursestrings) more effectively. The Arbor Day Foundation takes the position that both appeals are correct. However, in this issue of the Bulletin, emphasis is decidedly on the practical.

The role of trees in saving energy has yet to be discovered by large numbers of people. When it is, a major step can be taken not only toward saving individual home and business owners a lot of money, but also toward less dependence on foreign oil and domestic sources of diminishing fossil fuels. The important role of trees in helping combat climate change should also not be overlooked or underestimated.

Trees can save energy many ways: (1) through shade, reducing the need for air conditioning, (2) through breaking the force of winter winds, lowering heating costs, and (3) by serving as a renewable source of fuel — and one that burns with less air pollution than other fuels when the right equipment is used. There are more subtle ways that trees contribute to energy savings. One is by sequestering carbon, an element that is a key villain in atmospheric pollution and the threat of climate change. Another is by landscaping with trees to reduce lawn space and the need for power mowing.

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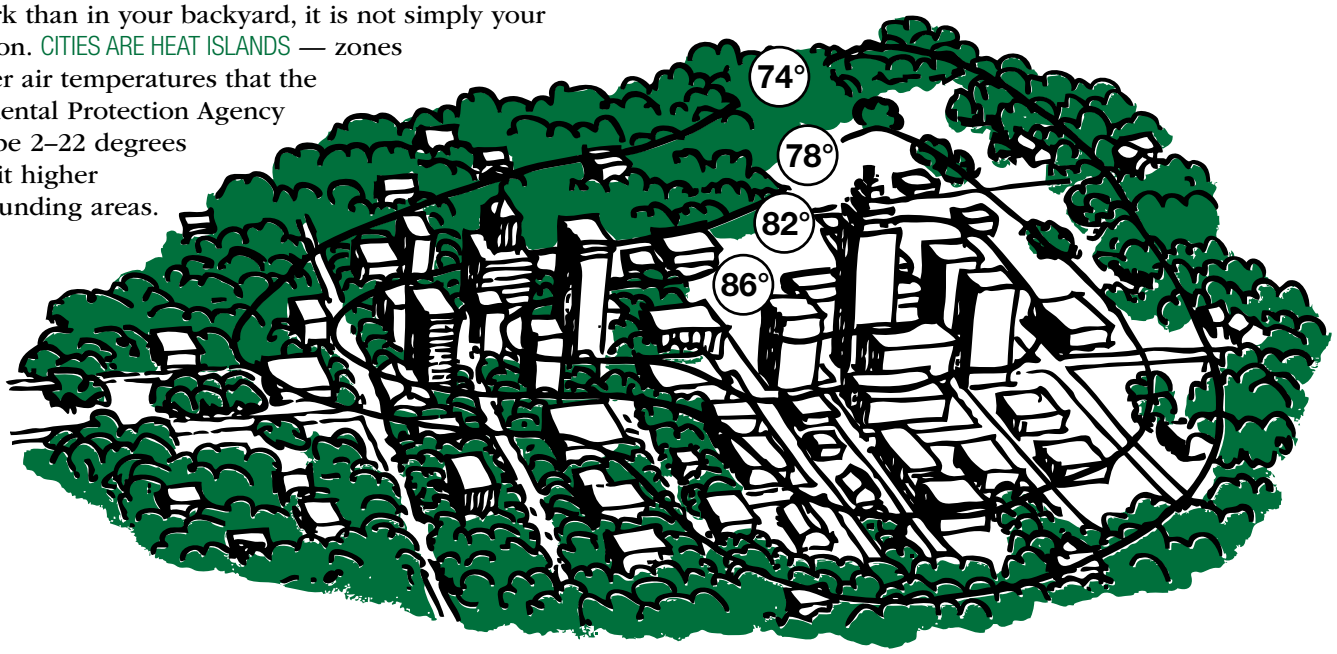
The Heat Island Phenomenon

If it seems hotter downtown than in the suburbs and cooler in the park than in your backyard, it is not simply your imagination. CITIES ARE HEAT ISLANDS — zones of summer air temperatures that the Environmental Protection Agency says can be 2–22 degrees Fahrenheit higher than surounding areas.



CITIES

- More engines and building exhaust create more heat.
- Fewer trees provide less cooling shade.
- Buildings, sidewalks, and streets absorb and hold heat.
- Dust and other air pollutants absorb and trap heat.
- Concrete and asphalt hasten the drainage of rainfall.

PARKS AND SUBURBS

- Fewer sources of heat exist.
- More trees provide shade, absorb solar radiation, and provide natural air conditioning through transpiration.
- Cleaner air allows heat to escape into space.
- Unpaved open areas retain natural moisture longer, helping to cool the air directly and to supply roots with moisture for tree health and transpiration.

HOW TO HELP:

- ☑ Support efforts to reduce air pollution.
- ☑ Reduce energy use through personal daily habits and by purchasing energy-saving cars and appliances.
- ☑ Protect open space areas, such as parks and greenbelts.
- ☑ Plant trees. Trees help cool cities and clean the air.

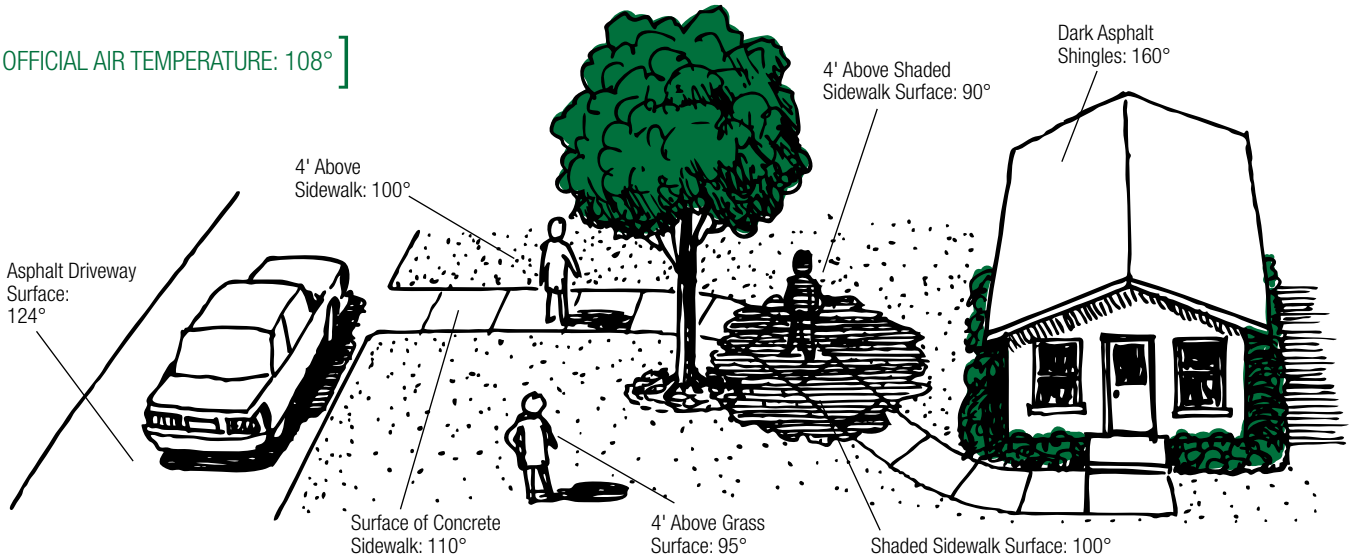
Widespread warming is an alarming trend, with an increase in the temperatures of American cities measured at a rate of 1 degree Fahrenheit per decade. At first, a 1-degree temperature increase seems too small to cause worry, but a 1-degree increase in Los Angeles' summer temperatures each decade since 1940 has been estimated by scientists at Lawrence Berkeley Laboratory to cost consumers an extra $150 million per year. The slight rise in air temperature also contributes to more days of high smog levels each year. And, like adding insult to injury, approximately one additional pound of carbon is dumped into the air for each kilowatt-hour of electricity generated by a coal-fired power plant.

City heat islands and climate change are problems that can be addressed, at least in part, by personal action. According to a U.S. Forest Service report, there are about 100 million mature trees around residences in the contiguous United States. Along with their other benefits, these trees save about $2 billion annually in reduced energy costs. And this is with an average of only 35 percent canopy cover in our nation's urban areas.

Using the tips presented in this Bulletin, a few more well-positioned trees in the yards, parks, and along the streets of your community could increase the effectiveness of the canopy exponentially. To see how this might affect your property, search for "Energy-Saving Trees" at **arborday.org**.

Trees for Shade

Homeowners and small-business operators can make significant cash savings by properly using trees for shade. How much is saved depends on climate, existing tree cover, and type of building. However, savings of 58 percent of daytime air conditioning have been documented and as high as 65 percent in the case of mobile homes. Ten percent savings are more common, but even this amount is no small matter in most family budgets. If applied nationwide to buildings not now benefiting from trees, the gift of shade could reduce our nation's consumption of oil by 500,000 barrels of oil per day!



LANDSCAPING IS THE KEY

Shade and surfaces around a house or business can have an extreme effect on temperatures. The illustration above shows actual temperatures measured on a summer afternoon in Arizona both at ground level and near the level of breathing.

To help trees keep you cool, here are some tips:

1. WHAT TO SHADE?

- Maximum benefit from shade usually comes from trees on the east and west sides of a building and close to the walls. A 25-foot tree 10 feet from a west wall may shade 47 percent of the surface in mid-afternoon compared with only 27 percent if planted 20 feet from the wall.
- Prioritize areas of greatest heat gain or importance for comfort.
- Windows — About three-fourths of total solar heat gain in a building comes through windows.
- Dark or rough-textured surfaces absorb more heat than light-colored or smooth surfaces.
- Shading asphalt shingles is more essential than shading cedar shakes.
- Provide shade for "heat sinks," such as driveways and parking areas.
- Consider high-use summer areas, such as patios and porches.
- Shading an air conditioning unit can increase its efficiency by 10 percent.

THE BENEFITS OF SHADE

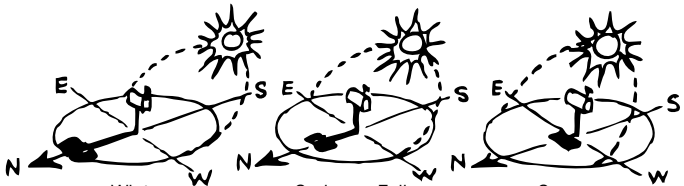
- Improved human comfort
- Reduced air conditioning costs
- Reduced peak load demands on utility companies, reducing the chance of power shortages
- Reduced imports of foreign oil and less pressure to develop domestic sources of oil, gas, coal, or nuclear power
- Relatively short payback periods on the investment
- Less sunlight damage to carpets, drapes, and furniture
- Long-term savings

A simple technique such as shading the air conditioner can return immediate savings to homeowners. Be sure not to block air flow.

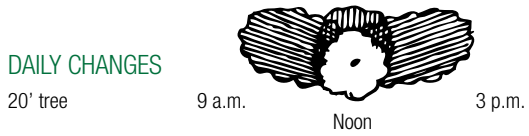
2. WHEN IS SHADE NEEDED?

When planning where to plant trees, remember that the sun's position in the sky changes hourly and daily. Plan for shadows that cover targeted areas during the hottest hours of the hottest weeks of summer. Your local power company has temperature data. Then, plan tree locations by observing summer shadows on your property.

SEASONAL CHANGES



DAILY CHANGES



RELATIVE SHADE VALUE OF DECIDUOUS TREES

Leaf density and branching characteristics combine to determine the amount of solar radiation that can penetrate the canopy of a tree. The less penetration, the higher a tree's shade value.

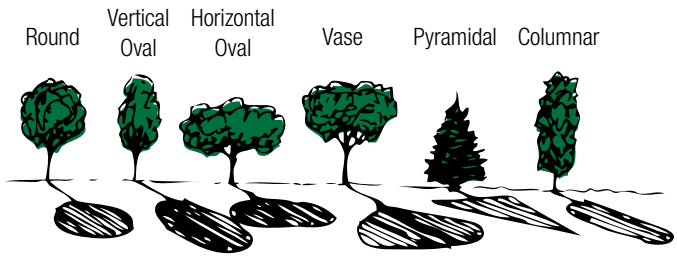
HIGHEST	MEDIUM	LOWER
Maples	European Birch	Hickories
Horse-chestnut	Crabapple	Catalpa
Hackberry	Sweetgum	Ginkgo
Beech	Oaks	Locusts
Walnut	Littleleaf Linden	Goldenraintree
Yellow Poplar	Kentucky Coffeetree	Quaking Aspen
Sycamores	Cottonwoods	Pears
	Elms	Washington Hawthorn

ADDITIONAL TIPS FOR ENERGY-CONSCIOUS LANDSCAPING:

Left: Espaliers (trees trained to grow in a vertical plane on a trellis) and vines can protect walls from direct solar radiation and create a buffer of cooler air. Right: Columnar cultivars are available from many nurseries and can fit within narrow urban spaces to provide shade.

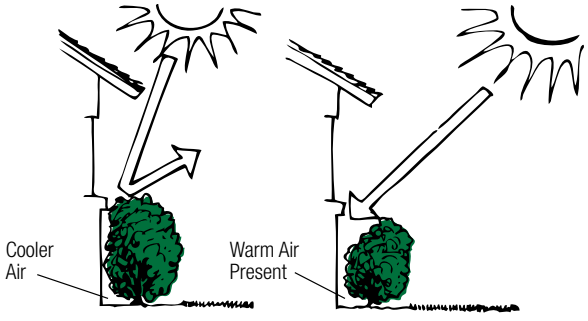
3. WHAT TO PLANT?

- Tree species with round, horizontal oval, and vase-shaped crowns when mature offer the best shading potential. An arborist or nursery professional can recommend suitable species that grow well in your area.
- Select species suited not only for shade, but for your site conditions, space limitations, and aesthetic preferences.



- Plant trees with strong wood. Fast-growing species with weaker wood (for example, willows and silver maple) may be useful for quick shade. Stronger, slower-growing trees that are shade-tolerant may be interplanted among them. When the slower trees reach a useful height, the weak ones should be removed.
- Plant larger trees or trees on mounds to hasten usefulness for shade. Be sure to monitor watering needs.
- Select trees with dense canopies to maximize blockage of solar radiation.
- Plant groups of trees to intensify shade and reduce lawn area.

Have your shade and a view, too. Trees with spreading crowns can be placed near windows for shade and pruned high to keep the view open.



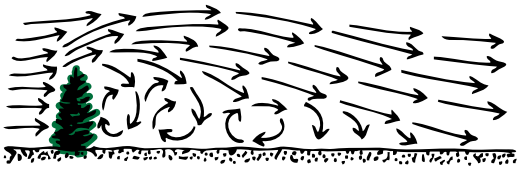
Shrubs are often best along south walls where winter sun helps warm the building. J. H. Parker of Florida International University recommends that arborvitae or similar foundation shrubs be pruned in the fall to help trap sun-warmed air. Spring growth will close the "trap" and provide added shade during the summer.

Trees for Winter Warmth

The contribution of trees for winter warmth is often not as appreciated as the shade of summer, but the effect can be just as dramatic. Even in urban areas, widely spaced trees break the force of chilling winds enough to save between 3 and 4 percent on heating bills. This translates to a national savings of $1.6 billion per year in single-family homes alone. With planning and enough space, suburban and rural homes that use windbreaks can save as much as 10-17 percent on average. By slowing winter winds, trees …

- Lower the loss of heat in buildings by reducing cold air infiltration.
- Reduce the drying effect on landscape plants.
- Reduce the abrasive effects of airborne particles.
- Cut down on dust and dirt entering a building.
- Lower wind damage to limbs and buildings.

TREES PLANTED TO FORM WINDBREAKS DO THEIR WORK IN THREE WAYS:



1. Friction and drag caused by limbs, needles, or broad leaves absorb some of the wind's energy.
2. Winds are deflected upward.
3. The smooth, horizontal force of air is broken up into turbulence.

DISTANCE OF EFFECTIVENESS

Effectiveness depends on the density of a windbreak and its height. A reasonably dense planting can be expected to provide maximum protection for a distance of up to eight times the height (H) of the trees as they approach maturity. For planning purposes, 20' is often used as the height at maturity. Protected buildings should be within two to five times the height of the trees. Where snowdrifts are a problem, a low-growing "snow trap" row can be planted to the windward of the main windbreak. Otherwise, drifting can be expected to be deepest from 100' to 200' from the windward edge of the windbreak.

HOW TO PLANT A WINDBREAK

The Cooperative Extension Service, U.S. Natural Resources Conservation Service, and your state forest service have localized literature to help with design and selection of the best species for effective windbreaks. Some general guidelines are:

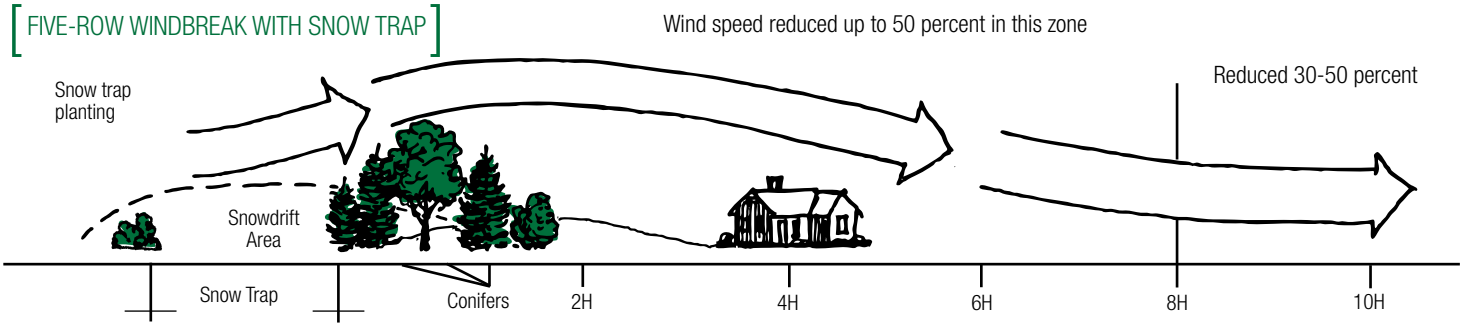
SPECIES Conifers form the best windbreaks. Depending on local conditions, some of the faster-growing favorites are pines, such as Austrian, ponderosa, and Scots. Douglasfir, true firs, redcedar, and junipers are also used. Spruces are excellent, but usually grow slowly.

ARRANGEMENT Two or more rows of trees are best if space allows, but even a single row will have an effect. Plant the rows perpendicular to prevailing winter winds. Trees should be spaced closely, 8' to 12' on center, or even as close as 4' to 6' with arborvitae, and 12' between rows. When planting two or more rows, stagger the trees for maximum effect.

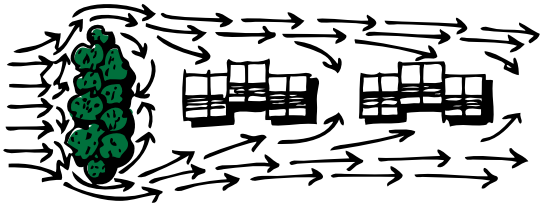
Two-row windbreak with trees staggered.

Where space limits plantings, a single row of closely planted conifers and a row of shrubs on the windward side will help reduce wind and control snow drifting. By directing snow away from driveways and walks, energy can be saved by reducing the need for removal.

FIVE-ROW WINDBREAK WITH SNOW TRAP



DESIGNING WITH NATURE SAVES ON HEATING BILLS



A clever builder aligned these townhouses parallel with the prevailing winter wind. A single, short windbreak protected the entire complex, with 10 of the 12 units further shielded from winter winds by their neighbors.

WHAT NOT TO PLANT …

To maximize winter warmth in northern climes, avoid planting evergreens where they block winter sun from the house. Even some deciduous trees provide as much as 50 percent blockage of winter sun. Where winter warmth is important, select deciduous trees with the most open canopies after their leaves are shed. Species with compound leaves such as Kentucky coffeetree and honeylocust are examples. Denser trees, such as pin oaks, can be pruned or spaced widely to allow more sun to penetrate.

THE ENERGY-SAVING TREES PROGRAM

An Arbor Day Foundation program that makes it easy for urban residents to plant trees for energy savings has been developed in cooperation with public and private utilities throughout the country. In the Energy-Saving Trees program, homeowners can go to **arborday.org** and use an online tool for help in deciding the best species to plant and the best location for the tree to provide energy-saving shade. Cooperating utilities then provide the selected tree(s). Details of delivery vary with different partners, ranging from 2- to 4-foot bareroot seedlings being sent directly from Arbor Day Farm to large-caliper trees delivered by the utility or a local partner.

To use the program, follow these steps:

1. VISIT **ARBORDAY.ORG** and type "Energy-Saving Trees" in the search box.

2. AT THE PORTAL, type in your address and local utility.

   - If your utility is not a partner in this program, you can use the site to urge its officials to join.

   - If your utility is a partner, the site will only be responsive during the period of the year during which enrollments are being accepted.

3. IF YOUR UTILITY IS A PARTNER AND THE ENROLLMENT PERIOD IS OPEN, a Google Earth view of your property will appear, along with moveable lines. You can then manipulate the lines to coincide with the walls of your house.

4. DRAG TREE ICONS onto your property anywhere in the yard. You will then receive the following helpful information:

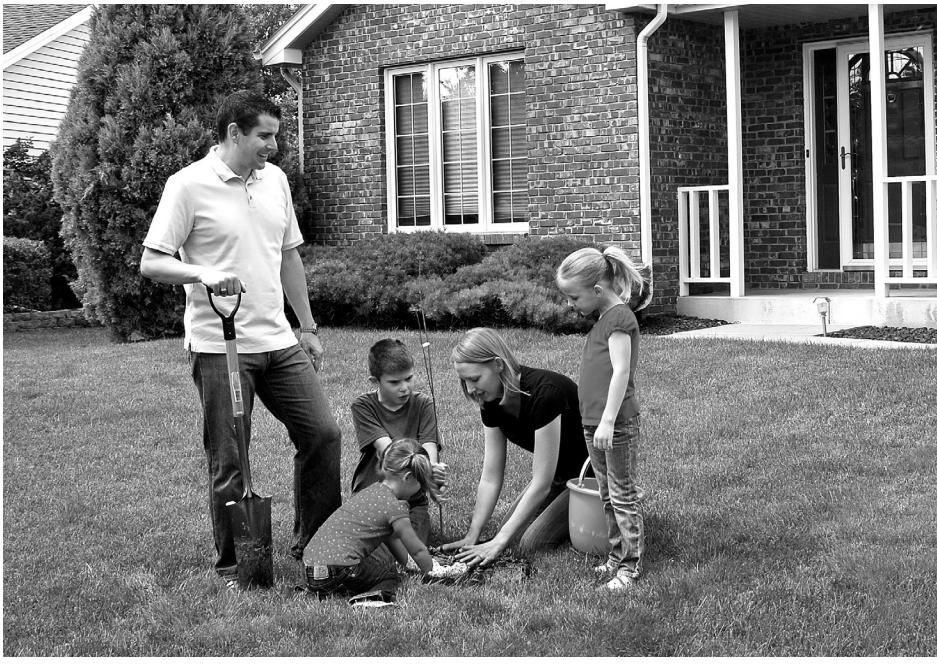
   - The most effective location that enables trees to reduce energy consumption in summer.

   - A list of free tree species available and recommended for your area, courtesy of your utility.

   - A description of each species.

   - The amount of energy savings per year from planting that species in the selected site.

5. AFTER YOU DECIDE WHAT AND WHERE TO PLANT, complete your contact information.



Trees, Energy, and the Community Forestry Program

Energy scarcity and related problems seem to be part of a cyclic phenomenon in the United States. One day, the need for energy reform and conservation is front-page news; the next, it is forgotten.

To the kind of individuals who plant trees and manage forestry programs, long-term problems are no strangers. The foresight and patience that goes into managing trees can also be applied to energy issues.

There are many ways that energy conservation can become part of a community forestry program. Here are some suggestions.

- ☑ SPONSOR AN ENERGY FAIR Many communities and organizations sponsor events that highlight energy conservation. Such events can be held on any scale, even at the local-school level, similar to a science fair. They are sure to help create a more enlightened public, and it is important to include how trees can contribute. Sponsorship or participation in such an event may help qualify your community for a Tree City USA Growth Award.

- ☑ INCLUDE TREES IN ENERGY AUDITS Some utility companies offer customers a service intended to help them conserve energy. Windows, weather-stripping, insulation, and similar features of the home are examined, followed by recommendations about how improvements can save on heating bills. Rebates for improvements are usually part of the package. Some utilities, such as Riverside (California) Public Utilities, already include conservation landscaping in their residential audit programs. Others do not, or will do so only if specifically requested by the homeowner.

Symbolic representation of the many things that work together to help conserve energy.

A good project for a tree board, urban forestry council, or similar organization would be to: (1) contact the local utility company and win support for the idea of including trees in conservation audits if this is not already being done, (2) provide samples of appropriate literature for public distribution (such as this Bulletin), and (3) provide training for the auditors.

- ☑ INCLUDE ENERGY CONSERVATION IN TREE OR LANDSCAPE ORDINANCES John H. Parker of Florida International University in Miami developed a model energy conservation landscape ordinance that is worth considering in other communities that have hot, humid summer weather.

At the heart of this model ordinance is a method for encouraging energy conservation using trees. In short, if an ordinance requires new developments to retain or create a specific amount of vegetative canopy, developers have the option of reducing this percentage by locating trees and other vegetation in energy-conserving positions. This is done through a canopy credit system that is based on the estimated potential energy savings from the vegetation placed to reduce the demand on air conditioning systems.

- ☑ PLANT TREES With an estimated 60-75 million spaces available for trees to be planted in American cities and with urban areas spreading into old fields and other open spaces at approximately 1 million acres per year, it is obvious that planting more trees can help reduce our nation's growing demand for energy. At the same time, trees can help reduce the amount of CO_2 in the air by locking up carbon through photosynthesis. When burned as fuel, wood also lowers the demand for energy, reducing the amount of CO_2 produced at power stations that use fossil fuels. Trees can make a much more significant contribution to both environmental protection and energy cost savings than is currently the case.

- ☑ THE SMUD EXAMPLE The Sacramento Municipal Utility District (SMUD), working in partnership with the Sacramento Tree Foundation, is trying to plant so many trees that the resulting energy savings will eliminate the need for a new power plant. The utility provides residents with up to 10 free trees from a selection of 30 species or cultivars. Volunteers help with planting, if necessary, and Foundation staff provides technical advice.

For More Information

For additional information about trees and saving energy, please visit **arborday.org/bulletins**. For an excellent explanation of climate change and how you may help reduce its effects, visit **arborday.org/climatechange**.

Trees provide energy-saving service in two ways — by reducing heating and cooling costs for homes and businesses and by reducing the need for additional power-generating plants. Trees also play an important role in reducing the impact of climate change by sequestering carbon and reducing the carbon emissions that come from fossil fuel power generation.

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ENERGY AND THE GROWTH AWARD

Tree City USA communities that are seeking ways to qualify for a Tree City USA Growth Award should consider public education programs about shade for energy savings. For a complete list of suggested activities and more information about the Growth Award, visit **arborday.org/growthawards.**

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