



# SAVE ENERGY WITH TREES

Minnesota Department of Commerce Energy Information Center

Trees shade our homes in summer and shelter us from harsh winter winds. Estimates indicate that in Minnesota, strategically placed shade trees could reduce an air conditioning bill by up to 25% and a windbreak could reduce annual fuel bills by up to 10 to 20%. A tree-canopied neighborhood is cooler in the summer and winter winds are cut in half. When summer temperatures are cooler, fewer air pollutants form. Thus, trees create more comfortable and cleaner places for people to live.

## How your home uses energy

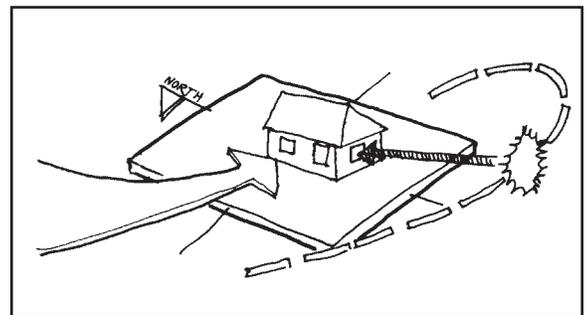
Our summers may be hot and sticky, but Minnesotans typically spend about ten times more for heating, than cooling, even when their homes are fully air-conditioned.

## Winter heating factors

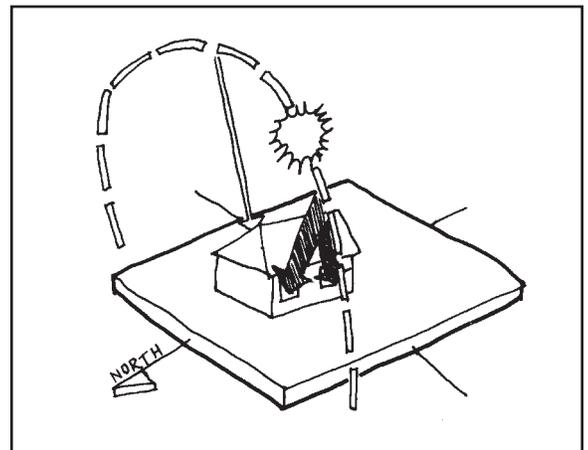
The temperature of our homes in winter is affected by the sun and wind. Homes can gain significant amounts of solar energy from the sun shining through south windows in the winter when the sun is low in the sky. East and west windows will also provide modest solar gains in winter. This free energy may represent 5 to 20% of the energy needed to heat a typical Minnesota home. Cold wind leaking into a home and warm air escaping outside is the most important factor increasing heating costs, accounting for 25 to 40% of the heating load. The wind has the most effect when its velocity is greatest and when the temperature difference between inside and outside is greatest.

## Summer cooling factors

Because our homes are well insulated, very little of the sun's energy comes through a home's roof and walls. About half of the unwanted heat in a home in the summer comes from sun shining through the windows, but less than 5% comes



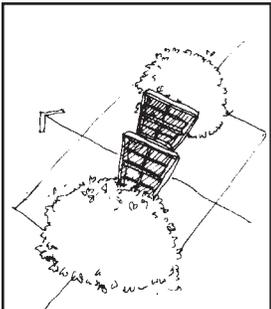
Northwesterly winds cause the most heat loss in winter, but the sun's path low in the southern sky contributes significant free solar energy through south windows.



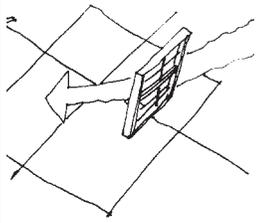
Most unwanted summer heat comes through east and west facing windows and almost no heat makes it through well-insulated roof and walls.



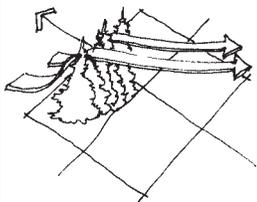
**Related Guides:**  
Windows & Doors  
Home Cooling  
Home Heating



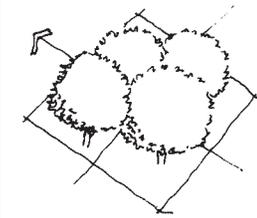
Shade west and east windows



Avoid trees south of windows



Create windbreaks

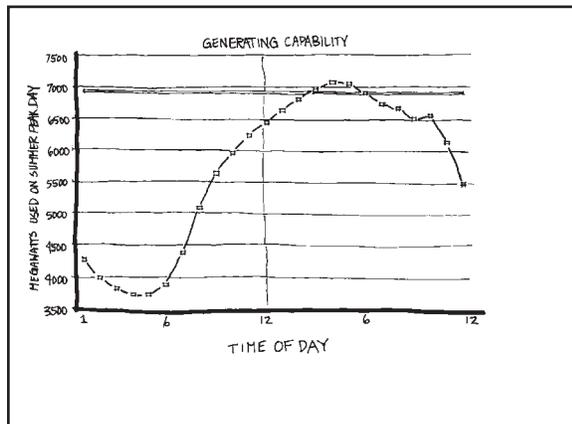


Increase tree canopy

through roof and walls combined. Because of the angle of the sun, nearly twice as much of the sun's energy strikes the east windows in the morning or the west windows in the afternoon as hits the south windows. Broad roof overhangs on the south further reduce the sun from shining in south windows.

### Peak electricity use

The highest use of electricity occurs late in the afternoon on the hottest days of the year when air-conditioning use is highest. To avoid or delay the need to build costly new power plants to meet peak demand, afternoon shading of west-facing windows to reduce air conditioning use is most important.



Electricity use peaks on the hottest summer days in later afternoon (the chart indicates usage on a typical day of peak demand).

## Strategic Shade

The most critical actions for planting for energy conservation

- shade west and east windows
- avoid trees south of windows
- create windbreaks
- increase tree canopy

Deciduous trees that provide maximum summer shade and minimum winter shade are ideal for reducing air-conditioning use, but they must be located and selected properly for best year-round results.

### Shade west and east windows

Give highest priority to planting shade trees due west of west windows. Planting shade trees due east of east windows is second priority. Select a tree that can be planted within twenty feet of the window and will grow at least ten feet taller than the window. When space permits, use as many trees as needed to create a continuous planting along all major west and east facing windows.

### Avoid trees south of windows

Contrary to intuition, the worst place to have a tree from an energy-saving perspective is out in the yard south of a home. In summer when the sun is high in the sky at midday, the shadow of a tree falls directly under the tree and entirely misses a home to its north. In winter, however, the shadow of the same tree will fall on the house throughout most of the day. To avoid shading south windows, any trees south of the home should be located at least twice their mature height away from the house.

## Prune lower branches of trees near south windows

Any trees on the southwest or southeast sides of the home should be pruned as they grow to remove their lower branches to allow more winter sun through; however, lower branches on trees northwest of the home are desirable to create the most shade in late afternoon. Large deciduous trees very close to the south side of the building can have their lower branches removed to allow more sun to reach the building in winter.

## Shade air conditioners, parking places and paved areas

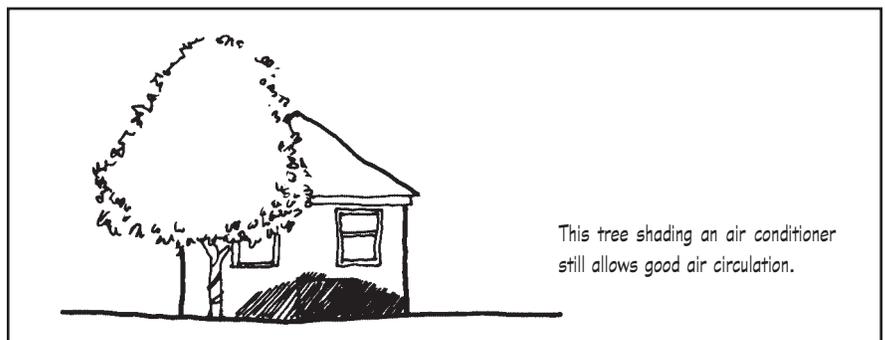
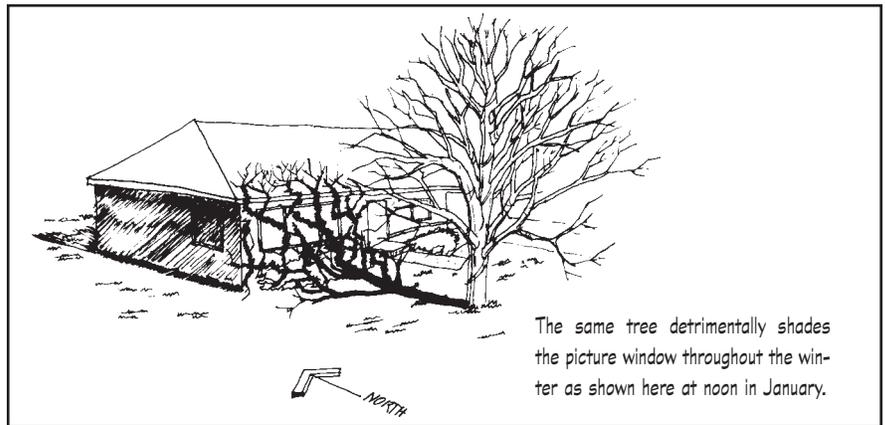
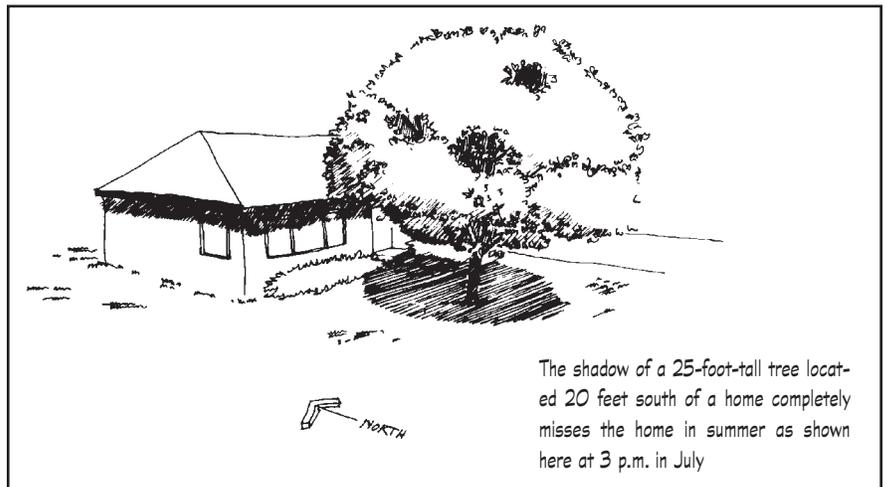
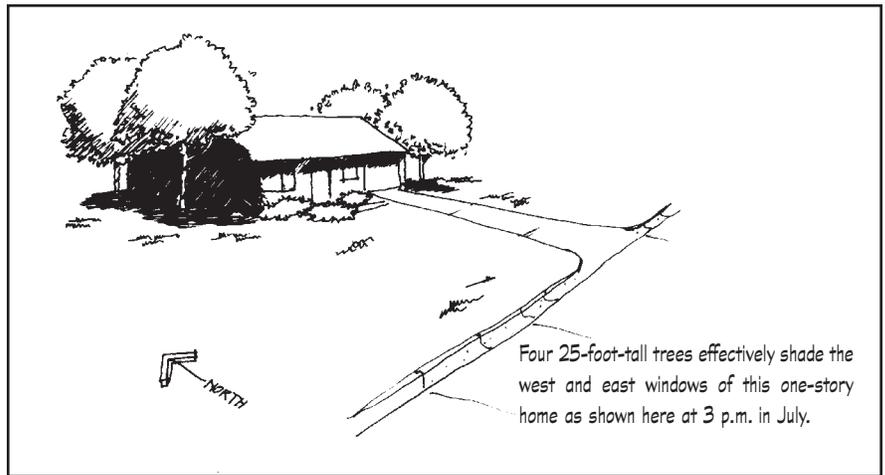
An air conditioner runs more efficiently if it is in a cooler environment. Less air conditioning is used to cool a car if it was parked in the shade. The air heats up immediately around paved areas like driveways and patios. Therefore, locate paved areas and air conditioners away from south windows and shade them with trees.

## Use solar friendly trees

For greatest benefit, a shade tree should have a broad crown of dense foliage during the hottest times of the year. It should lose its leaves just as the thermostat kicks on the furnace in the fall, and in winter its branches should be sparse. Trees that best meet these characteristics are the most “solar friendly.” The amount of sun blocked by a mature deciduous tree in summer ranges from about 60 to 90%. A mature tree’s branches and twigs typically block 30 to 50% of the sun—a significant reduction in beneficial free solar energy over our long winters.

The most solar friendly species inherently have denser foliage and a more open winter form, giving them a good summer to winter ratio of crown density. This is true of trees with compound leaves that shed more of their branching structure each fall. Examples are Kentucky coffeetree, walnut, and ash which have moderately dense summer shade with sparse winter branching. Other desirable trees, such as sugar and red maple, have denser summer shade with moderately open winter branching.

The foliage of solar friendly trees should be there when it is needed most. For a northern climate, this typically favors trees that leaf out moderately



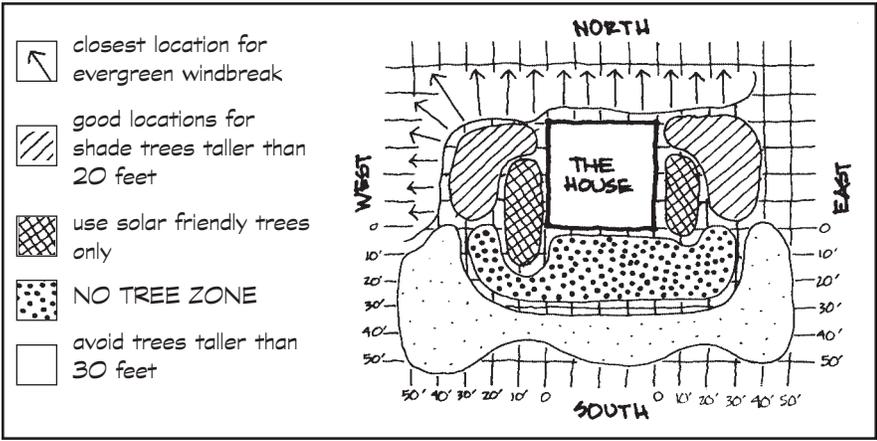
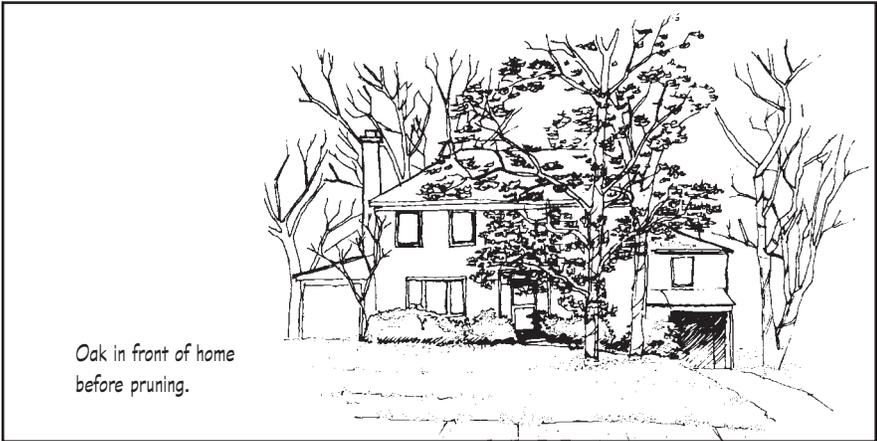
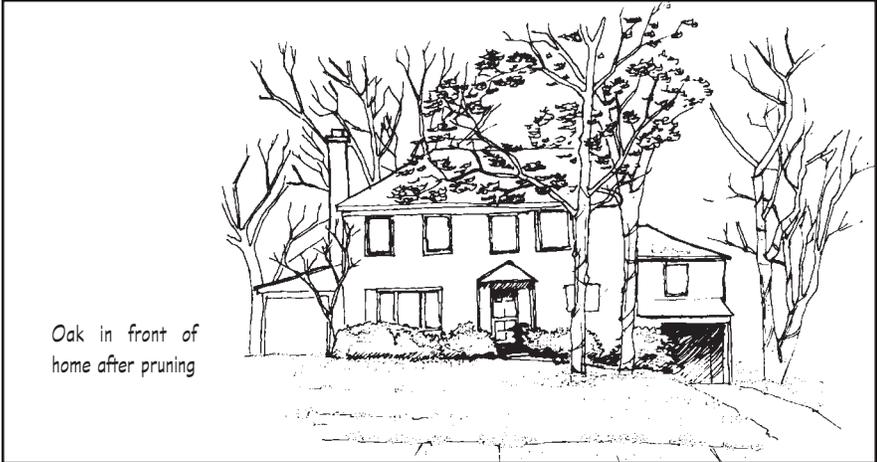


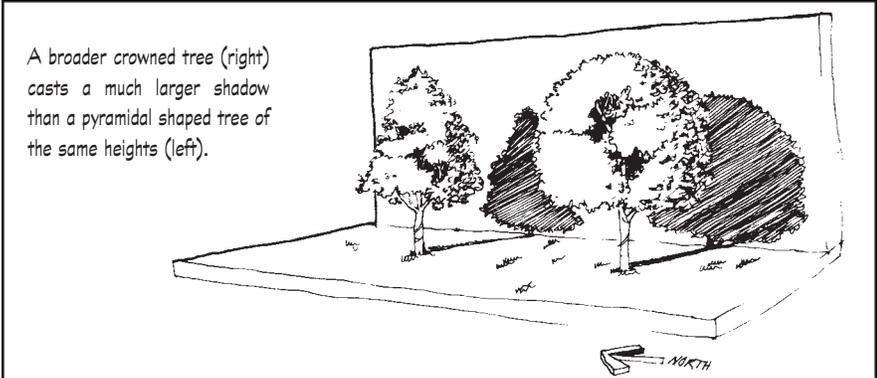
Diagram 1  
Use this map to strategically locate trees. The grid marks 10-foot increments going out from the house. For example, the best locations for shade trees are 10 to 15 feet due west and east of the house.



Oak in front of home before pruning.



Oak in front of home after pruning



A broader crowned tree (right) casts a much larger shadow than a pyramidal shaped tree of the same heights (left).

late in spring and drop their leaves fairly early in fall. The worst choices are non-native deciduous trees, such as Norway maple, that may wait until November to lose their leaves, and those oaks that retain their leaves through the winter. Species that naturally grow over a large geographic area may have many different cultivars that vary significantly in the timing of leaf drop. For example, some types of red maple lose their leaves a month later than others. Thus, whenever possible, select trees from northern seed sources.

**Choose the right tree for the right place**

Generally, the bigger the tree, the more environmental benefits it provides. Select a tree that will grow as big as growing space permits. Remember, a tree needs space for both branches and roots. Since the most beneficial locations for shade trees are close to the east and west sides of buildings, the best trees will be strong, resisting disease and pests and damage from storms. Many species are inherently more appropriate for energy-conservation plantings. Others are not desirable as strategic shade trees for various reasons: because they keep their leaves in winter (such as many oaks), because their branching is too sparse (such as a ginkgo), because their form is too narrow to cast the best shadows in the summer and their branches too dense in winter (like the Greenspire linden), or because they grow too large and weak wooded to be planted very close to a building (such as silver maple and cotton wood). Trees are more healthy and vigorous when they are well suited to the site's soil and climatic conditions, so check with a local forestry or landscape professional before making your selection.

## Wind shelters

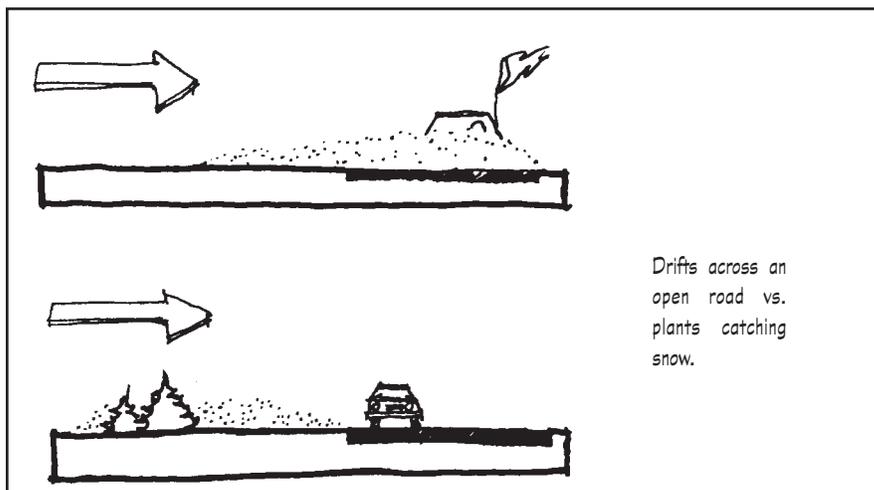
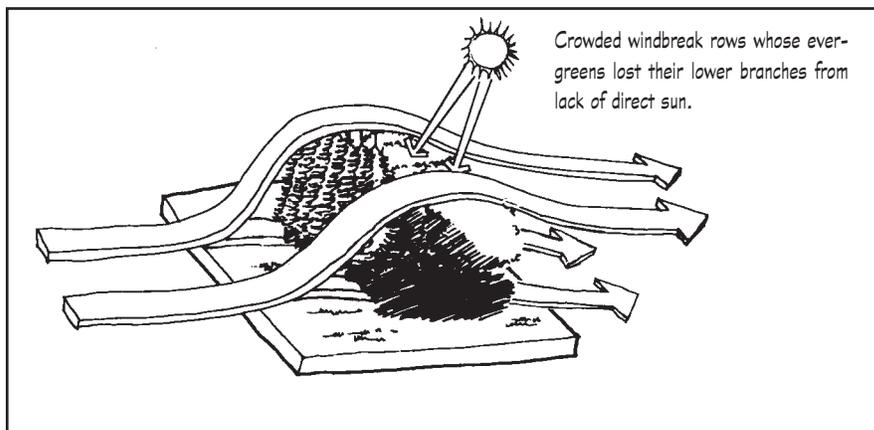
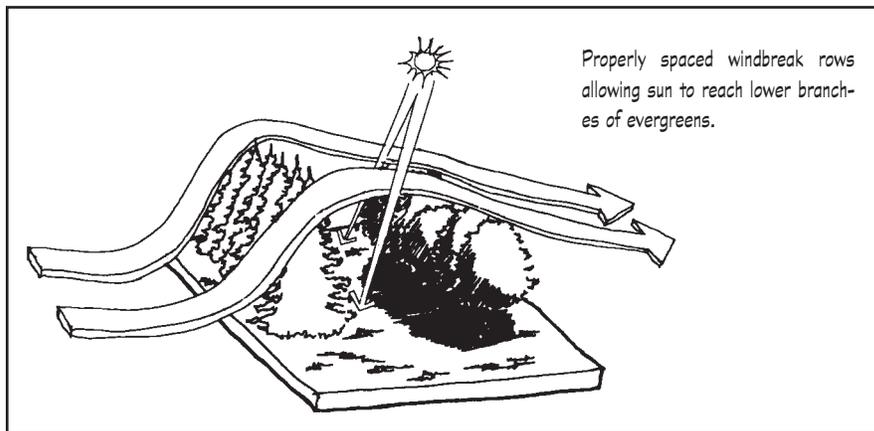
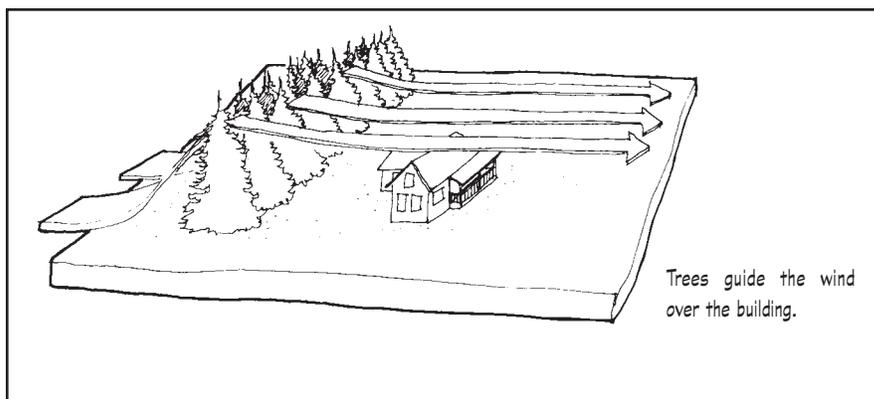
Trees are ideal wind filters. They are large, with branches and twigs which bend in the wind, gently breaking its force with minimal turbulence. A shadow of relatively calm air extends downwind from a windbreak about ten times the height of the trees. Nothing people can build could be as cost-effective as trees in sheltering homes and neighborhoods from the onslaught of harsh winter winds.

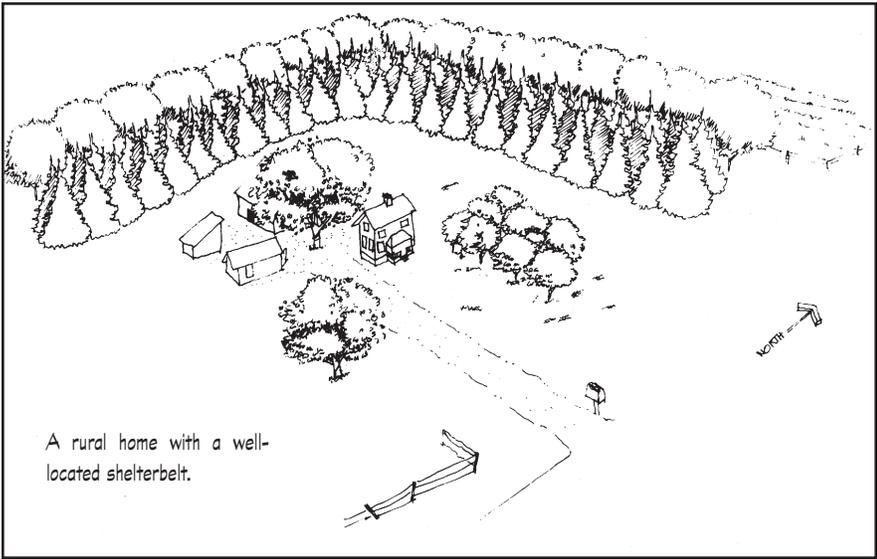
### Plant all dense trees upwind

For maximum wind protection, trees need to be dense enough, tall enough, and there needs to be enough of them. The ideal windbreak tree is a dense evergreen whose branches extend from ground level to a height at least twice as tall as the building being sheltered. Windbreak trees need to be clustered together to reduce wind going between the trees. The most efficient way to do this is to plant trees in rows perpendicular to the primary winter wind direction—usually running along the west and north sides of the property. Since the wind will increase some at the edges of the windbreak, not only should the trees be taller, but the windbreak should be much longer than the buildings being sheltered. To keep dense branches to the ground, evergreens need full sun which means they must not be overcrowded. Select windbreak trees from the recommended list that are best adapted to the site's growing conditions so they will be tall, yet dense.

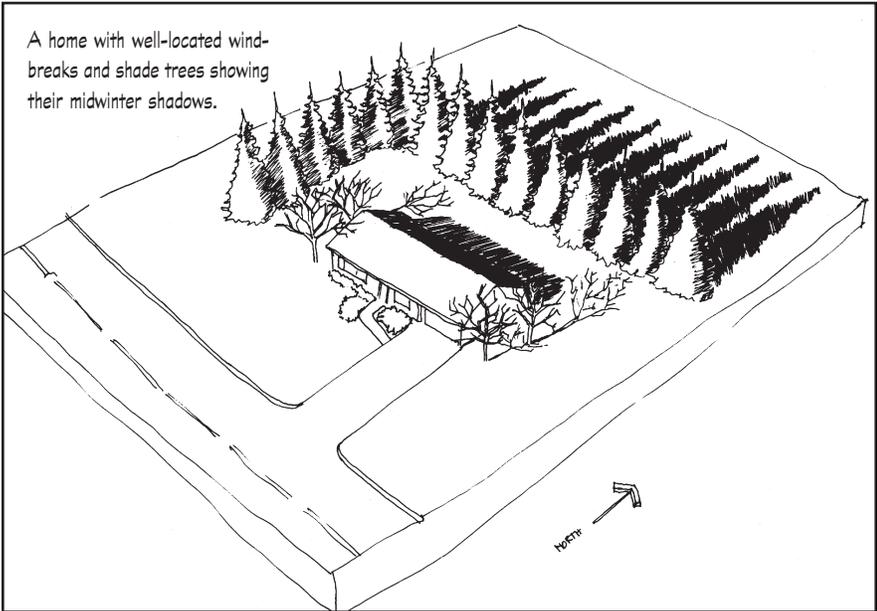
### Create a shelterbelt on a large site

Where enough land is available, plant a multi-row shelterbelt like those traditionally used around farmsteads. A shelterbelt can be used for a single rural residence or to shelter a whole neighborhood. A shelterbelt may have up to seven rows of trees and be several hundred feet long. Most rows are evergreen trees at a recommended spacing of twenty feet apart within and between rows. Some rows may consist of larger or faster growing shade trees which must be spaced far enough from the evergreens to minimize detrimental shading. On the open prairie, shelterbelts not only stop the wind, they stop the snow. Therefore, a row of shrubs is used just inside or outside the trees and typically the home is downwind from the trees at least fifty feet.





A rural home with a well-located shelterbelt.



A home with well-located windbreaks and shade trees showing their midwinter shadows.

### Create a windbreak in a residential yard

A home on a site of a quarter-acre or so should have a room for a windbreak along its west and/or north side. The same principles apply as in a shelterbelt, but less space means fewer rows of trees. Giving evergreens plenty of sun to keep their lower branches is particularly important. With a one or two row windbreak, as long as the evergreens receive direct sun on the outside of the row, the spacing between the trees should be about ten feet apart. On smaller sites, the windbreak may need to be placed closer to the home. Then, the row of evergreens to the west needs to be shortened so no evergreens are south or southwest of any windows.

### Increase tree canopy cover in urban neighborhoods

Smaller residential yards just do not have space for large dense evergreen trees whose spread may reach thirty feet. However, remember the canopy of tall trees throughout the neighborhood also provides significant shelter. Imagine what you see of your neighborhood from an airplane: your goal should be to have mature trees covering at least half the surface when seen from above. These can be a variety of trees, placed to the west, north, and east of homes, shading pavement, with as few trees as possible in yards south of homes.

## Putting it all together

To have energy-conserving trees in your yard requires taking a careful look at your situation and careful attention to planting and caring for the young trees, as well as preserving large healthy trees.

### Identify existing house and yard conditions

- Figure out which side of your house faces north.
- Draw your house on a piece of paper with north facing the top of page. Show on the house drawing the approximate location of east and west-facing windows.
- Draw in the approximate location of the major features of your yard: driveway, property lines, power lines, existing trees.

### Determine where you need trees for energy conservation

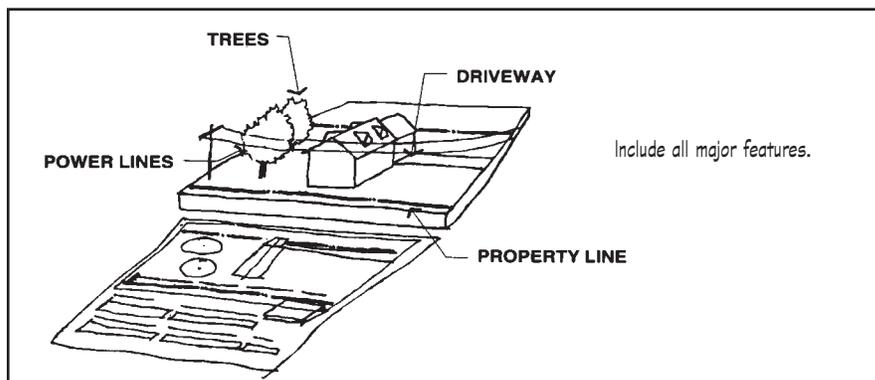
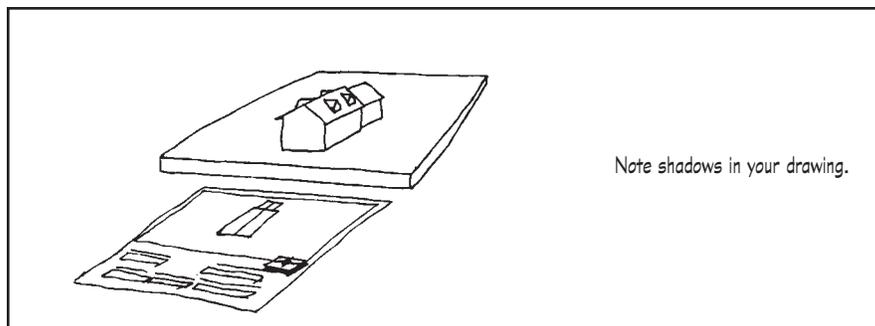
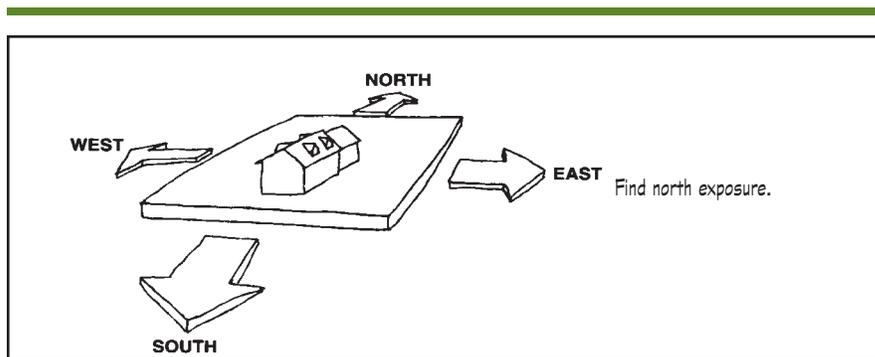
Evaluate where trees will be most beneficial:

#### PRIORITIES

- Planting shade trees due west of west-facing windows.
- Planting shade trees due east of east-facing windows.
- Planting an evergreen windbreak tree to the north and west.

Select and mark your best planting site so that it doesn't conflict with existing trees, wires, etc.

See Diagram 1 to locate appropriate trees. Identify which trees you want to use from the list provided. Make sure the trees selected grow well in your area. Try not to pick trees used often in your neighborhood.



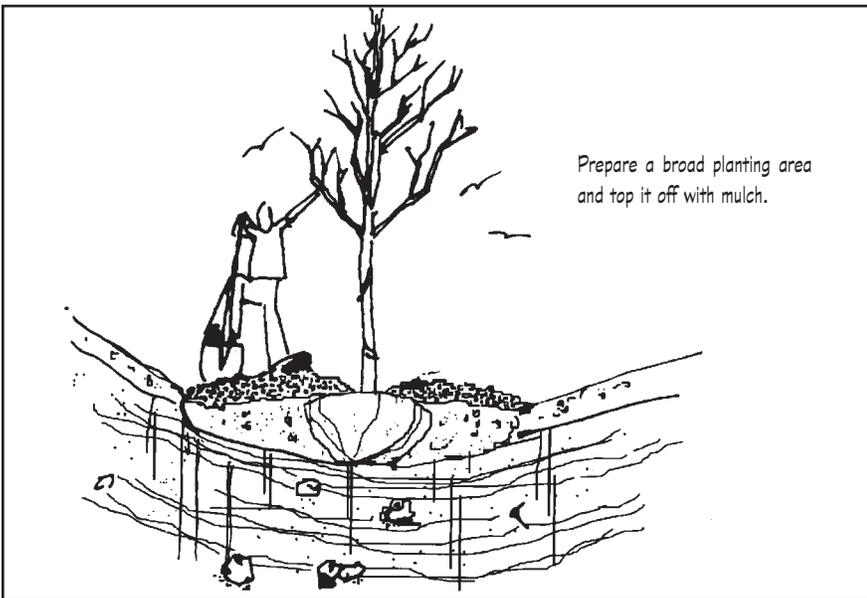
Yard and boulevard trees effectively shade the east and west sides of this house, evergreens help block northwesterly winds, and trees shade the parked car in the driveway and the air-conditioner at the northeast corner of the home.

## Buy a good tree

Once you have decided on the best location and species of tree, you will want to shop for the best tree. As you look at the tree in the nursery, look for good branching structure and a root system big enough to support the tree. The most cost effective tree will be a smaller, less expensive tree, because with proper care and protection from vandalism, a tree that starts small will reach the beneficial size close to the same time as a tree that started large. For example, good selections would be a container grown evergreen 3 feet tall and a bare root or containerized shade tree with a 1-inch diameter trunk.

## Plant it right

Before digging always check for underground and overhead utilities. Trees do better if young roots near the soil surface are given a good place to grow. Dig a broad shallow planting area the depth of the root ball and about five times the width of the root ball. Usually it is best to plant trees using the same soil that came out of the hole. After planting, mulch a large area around the tree. Throughout the growing season, generously soak the whole planting area with water on a weekly basis.



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This brochure was prepared in cooperation by the Minnesota Department of Natural Resources, Division of Forestry; the University of Minnesota; and the Minnesota Department of Public Service. Margaret (Peggy) Sand, author; William W. Weaver, illustrator; Amy Beyer, graphic designer; JoAnne Ray and Chris Gilchrist, editors; Patrick Huelman, technical advisor.

## Trees Recommended for Energy Conservation

COMMON NAME	MATURE HEIGHT	DISTANCE FROM HOUSE**	COMMENTS
<b>Recommended shade trees</b>			
Norway Maple	40+'	15-30'	many varieties; either dark green or with red spring color
Red Maple*	40+'	15-30'	red fall color; select northern variety e.g. 'Northwoods'
Sugar Maple*	40+'	15-30'	gold to orange fall color; prefers rich soil
Ohio Buckeye	30'	10-20'	white flower; large nuts; unusual foliage
Horsechestnut	40'	15-25'	white flower; large nut; unusual foliage
European Alder	30+'	10-20'	small nutlets hold over winter
River Birch	30+'	15-25'	reddish peeling bark; needs good soil
Northern Catalpa	40+'	15-25'	large flower, leaves, and pods (native further south)
Hackberry	40+'	15-30'	bumpy bark; very tough once established
White Ash*	40+'	15-25'	such as 'Autumn Blaze' with purple fall color
Manchurian Ash*	40+'	15-25'	easy to grow
Green Ash	40+'	15-25'	only use green ash if a few already exist in the neighborhood
Kentucky Coffeetree*	40'	10-20'	double compound leaves; seed pods
Walnut or Butternut*	40+'	15-30'	has nuts; avoid near vegetable garden
Ironwood	30'	10-20'	smaller version of elm; has hoplike fruit
Amur Corktree	30'	10-25'	corky bark; females have black berries
Robusta Poplar	40++'	15-30'	one of many seedless acceptable cottonwoods; short lived
Black Cherry	40'	15-30'	white flowers; fruit; somewhat scraggly looking with age
Bicolor Oak	40'	15-30'	acorns; more tolerant than most oaks
Littleleaf Linden	40'	15-30'	fragrant June flower; avoid pyramidal-shaped cultivars
American Linden	40+'	15-30'	fragrant June flower; avoid pyramidal-shaped cultivars
<b>Shade trees for use under overhead wires</b>			
Amur Maple	20'	10-20'	red fall color
Serviceberry*	25'	10-20'	spring flowers; berries attract birds
Hawthorn	20'	15-20'	white flowers; red fruit; use thornless variety
Russian Olive	25'	15-20'	silvery foliage; can look scraggly
Flowering Crab	15-25'	10-20'	many varieties available; some have no fruit
American Plum*	20'	10-20'	white flowers; fruit attract birds
Amur Chokecherry	20'	10-20'	bronze bark; white flowers; berries attract birds
Canada Plum*	15'	10-20'	'Princess Kay' with double white flowers; red fruit
Mountain Ash*	25'	15-25'	European, Showy, or Korean; white flowers; red fruit
Japanese Tree Lilac	20'	10-20'	white flowers; seed pods through winter
<b>Recommended windbreak trees (note: avoid placing windbreak trees in the shade of other trees)</b>			
Concolor Fir	40+'	40-80'	blue-gray color; looks like Colorado spruce
Norway Spruce	40+'	40-80'	graceful pendulous branches
Black Hills Spruce	40'	40-80'	dark green; slower growing; drought tolerant
Colorado Spruce	40+'	40-80'	green or blue forms; avoid using too many
Douglas-fir	40+'	40-80'	medium green color; similar to fir and spruce
American Arborvitae	30+'	40-80'	somewhat shade tolerant; avoid dwarf varieties

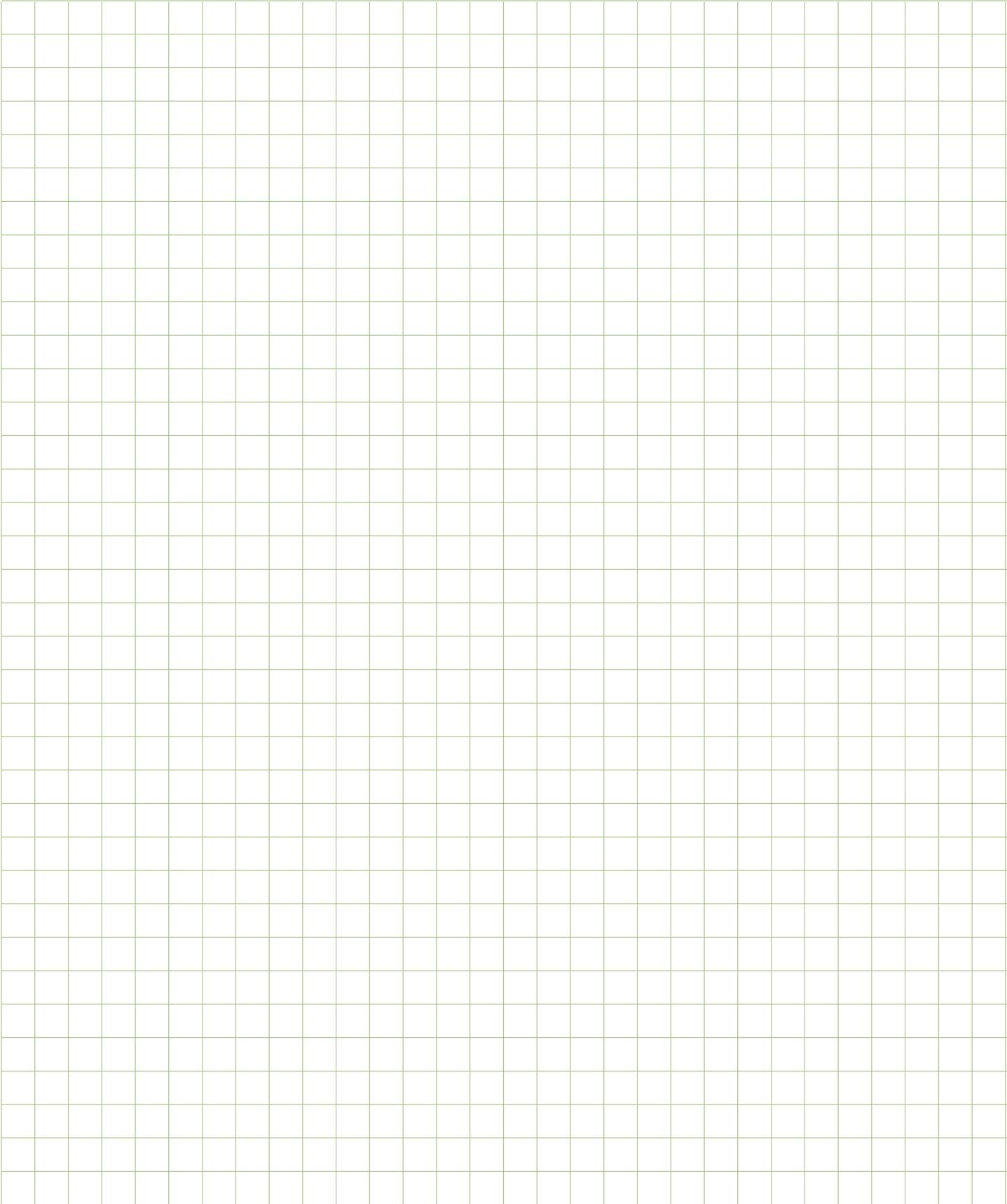
Note: Pines (Austrian, Red, White Scotch - all 40+') are also appropriate as part of a multi-row windbreak.

\* Use only these solar friendly trees near east and west windows.

\*\* Use closer distance for solar friendly shade trees to east and west, for other shade trees use further distance from windows, Evergreens should be no closer than their mature height to east and west windows. DO NOT locate any trees closer to the south windows than TWICE their MATURE height.

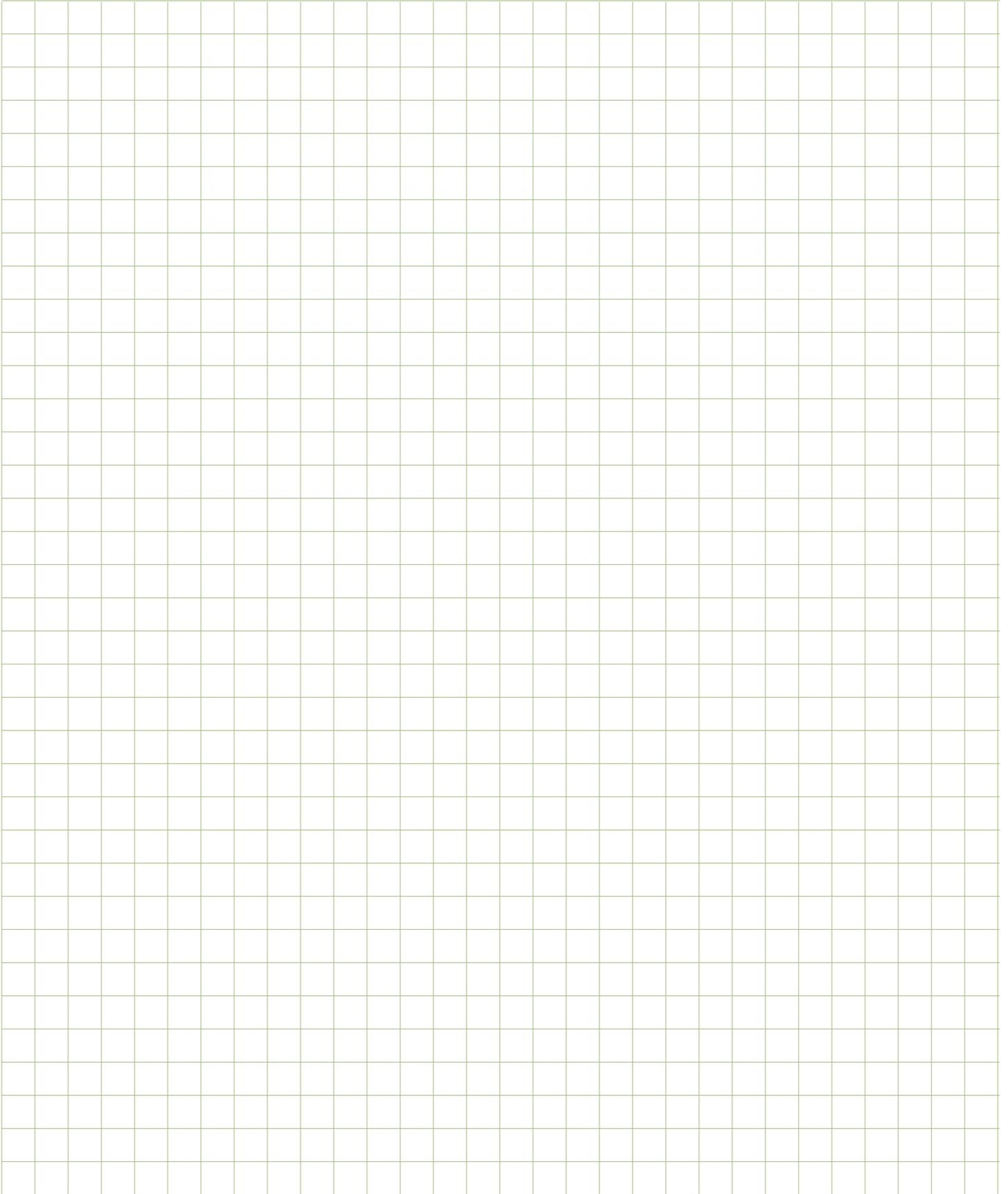
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**Design your own landscape**



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## Department of Commerce

Suite 500  
85 7th Place East  
St. Paul, MN 55101-2145  
www.commerce.state.mn.us

## Energy Information Center

Twin Cities:  
651-296-5175

TTY: 651-297-3067

Statewide toll free:  
1-800-657-3710

E-mail:  
energy.info@state.mn.us

This information will be made available, upon request, in alternative formats such as large print, Braille, cassette tape, CD-ROM.

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## Minnesota Home Energy Guides

This guide is one in a series of publications designed to help Minnesotans save energy in their homes. Copies of the titles listed below are available by calling or contacting the Minnesota Department of Commerce.

**CD-ROM** contains all of the Home Energy Guides as well as several other publications of interest to homeowners, builders and contractors.

**Appliances** advises consumers on what to look for in energy efficient appliances and includes information on efficient operation and maintenance of refrigerators, freezers, washers, dryers, dishwashers, cooktops, ovens, and home office equipment.

**Attic Bypasses** explains how to find those “hidden air passageways” and fix them to prevent costly heat loss and damage to roofs, ceilings, walls, and insulation.

**Basement Insulation** discusses options to improving basement comfort, many not even involving insulation. It also provides details on exterior basement insulation, special foundation products and recommendations on interior insulation.

**Caulking and Weatherstripping** describes how to identify sources of air leaks, lists various types of caulk and weatherstripping, and provides illustrated how-to-apply instructions.

**Combustion & Makeup Air** describes the causes of dangerous combustion air problems and tells how to install an outside combustion makeup air supply. It also tells how to test your home for combustion air problems.

**Energy Saving Landscapes** describes how to use trees and shrubs for long-term energy savings, and lists trees appropriate for energy-savings.

**Home Cooling** tells you how to cool without air conditioning, and provides information on buying and operating energy efficient air conditioners.

**Home Heating** describes proper maintenance techniques and helps you become an educated shopper if you are buying a new heating system.

**Home Insulation** helps the homeowner evaluate the benefit of added insulation, providing information on buying and installing insulation.

**Home Lighting** looks at new technologies for residential lighting, identifying four basic strategies and providing examples for putting them into practice.

**Home Moisture** describes symptoms of moisture problems, lists common indoor and outdoor causes, and discusses preventive and corrective measures.

**Indoor Ventilation** describes the types of home mechanical ventilation systems that are available, the amount of ventilation air needed, and how best to operate and maintain the system.

**Low Cost/No Cost** addresses the often overlooked energy saving tips for all areas of your home.

**New Homes** discusses a wide range of options for increasing energy efficiency beyond the normal building code requirements. Subjects covered include insulation, ventilation, air-vapor controls, heating and cooling, windows, doors, and appliances.

**Water Heaters** helps you determine whether to buy a new water heater or improve the old one. It explains the efficiency of different types of water heaters and provides installation tips.

**Windows and Doors** helps you decide whether to replace or repair windows or doors and gives a good summary of energy efficient replacement options.

**Wood Heat** offers advice on purchasing and installing a wood stove, with special emphasis on safety.