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Heating With Wood:
Producing, Harvesting and Processing Firewood

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This NebGuide explains the basics of producing, harvesting and processing firewood.

Why Heat With Wood?

Our forefathers heated their homes with wood because it was the only energy source available. Today, most people heat their home with electricity or natural gas, but wood heat remains a viable home heating alternative.

Heating with wood provides several advantages over other sources of energy. Wood heat does not stop working when there is a blackout. With electric heat, you may find yourself in the cold when severe winter weather interrupts electrical service.

Heating with wood is also environmentally friendly. Burning wood produces little pollution, especially with modern high-efficiency stoves. Additionally, ashes from your fireplace or wood stove may be used in your garden to prevent pests and enrich the soil.

Wood is a renewable resource, as compared to finite fossil fuels, such as coal or gas. Fuelwood can be harvested from low-quality trees in woodlands, providing more space for the remaining healthier, higher quality trees.

Species Characteristics

Each species of wood differs widely in its characteristics *(*see *Table I* on page 2*)*. For example, a cord of white oak firewood produces 29 million BTUs of heat, while one cord of linden firewood produces 13.8 million BTUs. High-density hardwoods, such as hickory, oak, ash, red elm and walnut, produce the most heat per cord and burn slowly and cleanly. In general, if heating efficiency is important, high-density woods, particularly hardwood species, are more desirable. Softwoods, such as most spruces, pines and junipers, and low-density hardwoods, such as cottonwood and willow, burn quickly and produce less heat per cord than dense hardwoods.

Because of resins in softwoods, they tend to smoke and spark and may present safety hazards. Softwoods also produce more creosote, a sticky tarlike substance that clings to chimneys and increases the risk of chimney fires.

How Firewood Is Measured

The standard measure for firewood is the "cord." A cord may be either a *full* cord or a *face* cord. A full cord is a stack of wood 4 feet tall, 8 feet wide and 4 feet deep (128 cubic feet). The weight of a cord of wood varies by species *(Table I)*.

A face cord is a stack of wood 4 feet high, 8 feet long and approximately 12 to 18 inches deep. The weight of a face cord also varies by species.

Firewood may also be measured by the "pickup load." This measure is imprecise, but a full-sized pickup with an 8-foot bed will hold approximately one-third to one-half cord of wood, depending on how it is loaded. A pickup bed will hold more when wood is stacked, rather than thrown.

How Much Wood Will You Need?

The number of trees per cord depends on the size of the tree *(Table II)*. A tree's diameter is measured at a height 4 1/2 feet from the ground. This measure is called diameter at breast height (DBH). If trees 5 inches DBH are harvested for firewood, it will require 46 to 55 trees to make one full cord of firewood. However, one tree 22 inches DBH will produce one full cord of firewood.

Table II. Firewood cutter's rule of thumb.

Tree Size (diameter at breast height)	*Number of Trees Per Cord*
5	46-55
6	21-33
7	14-18
8	9-14
9	6-9
10	4-6
16	2
22	1

Depending on the type and quality of wood stove used; the type of wood burned; and the size, insulation and desired temperature of the area to be heated, you may need 4 1/2 to seven full cords of wood per year to heat your home. If you use wood heat as a partial heat source for your

Table I. Firewood facts for Nebraska trees.

Species	*Weight (lbs./cord) Green*	*Dry*	*Heat/Cord (Million BTUs)*	*% Green Ash*	*Ease of Splitting*	*Smoke*	*Sparks*	*Coals*	*Fragrance*	*Overall Quality*
Apple	4850	3888	27.0	135	Medium	Low	Few	Good	Excellent	Excellent
Ash, Green	4184	2880	20.0	100	Easy	Low	Few	Good	Slight	Excellent
Basswood (Linden)	4404	1984	13.8	69	Easy	Medium	Few	Poor	Good	Fair
Birch, Paper	4312	2992	20.8	104	Medium	Medium	Few	Good	Slight	Fair
Boxelder	3589	2632	18.3	92	Difficult	Medium	Few	Poor	Slight	Fair
Buckeye, Ohio	4210	1984	13.8	69	Medium	Low	Few	Poor	Slight	Fair
Catalpa	4560	2360	16.4	82	Difficult	Medium	Few	Good	Bad	Fair
Cherry, Black	3696	2928	20.4	102	Easy	Low	Few	Excellent	Excellent	Good
Coffeetree, Kentucky	3872	3112	21.6	108	Medium	Low	Few	Good	Good	Good
Cottonwood	4640	2272	15.8	79	Easy	Medium	Few	Good	Slight	Fair
Douglas-Fir	3319	2970	20.7	103	Easy	High	Few	Fair	Slight	Good
Elm, American	4456	2872	20.0	100	Difficult	Medium	Few	Excellent	Good	Fair
Elm, Red	4800	3112	21.6	108	Easy	Medium	Few	Excellent	Good	Good
Elm, Siberian	3800	3020	20.9	105	Difficult	Medium	Few	Good	Fair	Fair
Fir, Concolor	3585	2104	14.6	73	Easy	Medium	Few	Poor	Slight	Fair
Hackberry	3984	3048	21.2	106	Easy	Low	Few	Good	Slight	Good
Hickory, Bitternut	5032	3832	26.7	134	Medium	Low	Few	Excellent	Excellent	Excellent
Hickory, Shagbark	5104	3952	27.5	138	Difficult	Low	Few	Excellent	Excellent	Excellent
Honeylocust	4640	3832	26.7	133	Easy	Low	Few	Excellent	Slight	Excellent
Ironwood	4590	4016	27.9	140	Difficult	Medium	Few	Excellent	Slight	Excellent
Juniper, Rocky Mountain	3535	3150	21.8	109	Medium	Medium	Many	Poor	Excellent	Fair
Locust, Black	4616	4016	27.9	140	Difficult	Low	Few	Excellent	Slight	Excellent
Maple, Other	4684	3680	25.5	128	Easy	Low	Few	Excellent	Good	Excellent
Maple, Silver	3904	2752	19.0	95	Medium	Low	Few	Excellent	Good	Fair
Mulberry	4712	3712	25.8	129	Easy	Medium	Many	Excellent	Good	Excellent
Oak, Bur	4960	3768	26.2	131	Easy	Low	Few	Excellent	Good	Excellent
Oak, Red*	4888	3528	24.6	123	Medium	Low	Few	Excellent	Good	Excellent
Oak, White	5573	4200	29.1	146	Medium	Low	Few	Excellent	Good	Excellent
Osage-Orange	5120	4728	32.9	165	Easy	Low	Many	Excellent	Excellent	Excellent
Pine, Eastern White	2780	2250	15.6	78	Medium	Medium	Few	Poor	Good	Fair
Pine, Jack	3200	2488	17.2	86	Difficult	Low	Many	Poor	Good	Fair
Pine, Ponderosa	3600	2336	16.2	81	Easy	Medium	Many	Fair	Good	Fair
Redcedar, Eastern	2950	2632	18.2	91	Medium	Medium	Many	Poor	Excellent	Fair
Spruce	2800	2240	15.5	78	Easy	Medium	Many	Poor	Slight	Fair
Sycamore	5096	2808	19.5	98	Difficult	Medium	Few	Good	Slight	Good
Walnut, Black	4584	3192	22.2	111	Easy	Low	Few	Good	Good	Excellent
Willow	4320	2540	17.6	88	Easy	Low	Few	Good	Slight	Poor

*Pin Oak is in the same group as Red Oak.

home, you may need only 1 1/2 to three full cords of wood per year. If you use a fireplace occasionally, you may only need one-half cord of wood per year.

As prices of other traditional heating fuels vary, the savings based on using wood heat also vary *(Table III).*

Table III. Wood fuel values compared to conventional fuels.

Conventional energy source	*Wood*
1 gallon #2 fuel oil	22.2 pounds
1 therm (100 cubic feet) natural gas	14 pounds
1 gallon propane	14.6 pounds
1 kilowatt/hour electricity	0.59 pounds
1 pound coal	1.56 pounds

How Much Wood Will a Nebraska Woodland Produce Each Year?

Most Nebraska woodlands fall into one of two categories: eastern hardwood and western coniferous. The species most commonly found in Nebraska's hardwood forests include bur oak, red oak, silver maple, green ash, cottonwood, black willow, hackberry, black walnut, American basswood, boxelder, American elm, honeylocust, hickory and mulberry. While eastern redcedar is a conifer, it is also frequently found in Nebraska hardwood forests. Nebraska's conifer forests consist primarily of ponderosa pine and Rocky Mountain juniper.

The species composition of a woodland will determine its growth rate. An oak-hickory forest can grow an average of 27 cubic feet per acre annually; a cottonwood forest can grow up to 24 cubic feet per acre annually; and eastern redcedar and maple-basswood forests can each grow up to 22 cubic feet per acre annually. These rates are averages and will vary depending on many factors, such as weather, soil and the woodland's condition.

The rate of a woodland's growth can be increased through proper management. By determining the primary objectives for your woodland, taking an inventory of tree species in the area and identifying appropriate management practices, your woodland can become a highly productive, sustainable resource. For more information on woodland management, see NebGuide G97-1329, *How to Manage Your Woodlands for Sustained and Maximum Benefits (http://ianrpubs.unl.edu/forestry/g1329.htm).*

Gathering Firewood

Harvesting timber from woodlands is the most obvious means of gathering firewood, but there are other readily available sources as well. Wood waste, such as the logs, limbs and tree tops toppled by storms, can be reclaimed from urban landfills and used as firewood. As much as 30 percent of the debris in some landfills is wood debris. Other sources of firewood include industrial wood waste from lumber processors or trees and tree limbs removed during powerline maintenance efforts. Even though the wood from these sources could be free, be sure to seek permission before removing it for personal use.

For those who own a woodlot, cutting trees for fuelwood

can improve the quality and growth rate of the remaining trees *(Figure 1)*. To maximize the value of trees in your woodlot, first identify high-quality trees of the better timber species. Then, create space around these trees by removing poor quality trees that are crooked, diseased, decayed or of low commercial value. These diseased, dead or damaged trees can be used as firewood unless they are valuable to wildlife.

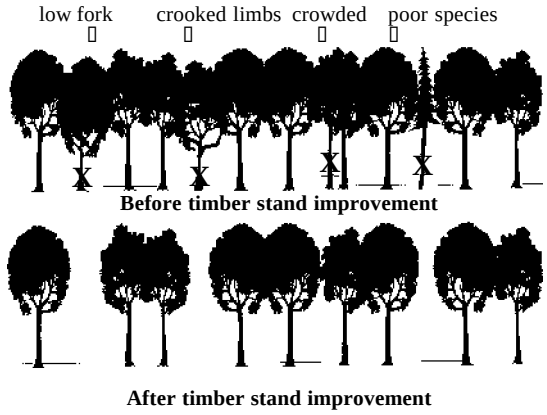


Figure 1. Thinning can greatly improve the quality of remaining trees in a woodland. (Image: *Woodland Stewardship: A Practical Guide for Midwestern Landowners* (1993) by M. Baughman, et al. Minnesota Extension Service, St. Paul, Minn.)

Sometimes, straight, reasonably high-quality trees must be removed because they are crowding other good trees. In young woodlots, future timber trees will respond rapidly to increased growing space. Over time, the periodic thinning of the stand will enhance the quality of the remaining timber trees. The trees removed during thinning are a good source of firewood.

Undesirable timber species, such as boxelder, elm, mulberry and honeylocust, should be harvested for firewood to encourage the growth of higher-value species, such as black walnut, ash, oak and hackberry.

Safety

For safety, you should have a hard hat, ear protection, safety shoes, safety glasses and chain saw chaps (to prevent leg injuries). Never work alone in the woods. It is also a good idea to have a first-aid kit and cellular phone with you when cutting timber.

Cutting standing trees requires skill and the proper equipment. You will need a chain saw, extra sharpening chains, chain sharpening and saw maintenance tools, gas and oil and possibly wedges, mauls and an axe.

Remember, one cord of freshly cut wood can weigh more than two tons, so you will also need heavy-duty hauling equipment and a strong back. Keep the axes and saws sharp and well maintained for easy, safe cutting. Sharp tools will also reduce user fatigue. Never let the chain oiler go dry, and keep the chain saw air filter clean. Refer to your chain saw owner's manual for proper maintenance guidelines.

Cutting Firewood

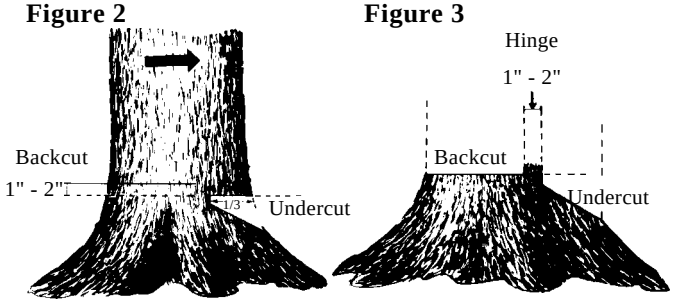
Felling

There are a number of safety concerns involved with cutting trees. You need to consider factors such as wind direction, the natural lean and balance of the tree, location of large limbs and whether the trunk is hollow or partially rotted. When harvesting firewood, be careful not to scar or damage the timber trees that are left standing.

Before cutting, clear brush around the tree that could interfere with your work. Pick an escape route for when the tree begins to fall. Plan to move far enough away so the butt end of the tree will not hit you if it kicks back off the stump.

A. Make a horizontal cut about one-third of the way through the tree. This cut should be as low as possible and on the side toward the direction you want the tree to fall. This is the undercut *(Figure 2)*.
B. Make a 45-degree downward cut into the horizontal cut to saw out a notch. The wedge of wood forming the notch can then be knocked out *(Figure 2)*.
C. Make a horizontal backcut 1 to 2 inches higher than the first cut and on the opposite side of the tree from the first cut. Saw toward the notch you just cut in step B. This is the backcut. Leave 1 to 2 inches of uncut wood as a hinge to hold the tree as it falls. This hinge controls the falling tree *(Figure 3)*.

Figure 2 **Figure 3**



Figures 2 and 3. Illustrations of an undercut and backcut. (Images: *Felling and Bucking Hardwoods* (1978) by F.J. Petro. Canadian Forestry Service, Ottawa, Ontario.)

D. If necessary, use a wedge in the backcut to start the tree falling.
E. Move away at a 45-degree angle from the direction of the falling tree to the side and rear of the tree as it falls *(Figure 4)*.

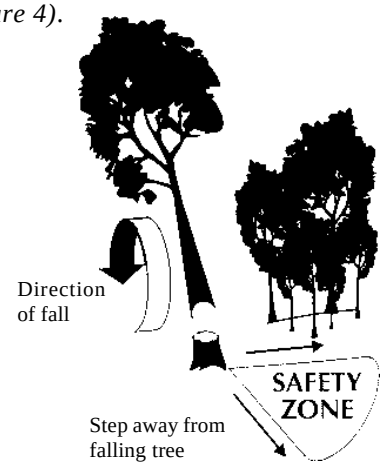


Figure 4. Be aware of your safety zone when felling trees. (Image: *Woodland Stewardship: A Practical Guide for Midwestern Landowners* (1993) by M. Baughman, et al. Minnesota Extension Service, St. Paul, Minn.)

If a tree becomes lodged in another tree while felling, the safest way to get the tree down is to pull it away from the other tree with a tractor or winch. Never attempt to cut the tree in which the felled tree is lodged, and do not climb either tree.

Limbing

Once the tree is on the ground, you can begin removing its branches. This process is called "limbing." While limbing the tree, keep the tree trunk between you and the saw whenever possible. Begin limbing at the base of the trunk and remove limbs from the top of the tree before removing limbs resting on the ground. The likelihood of the tree rolling increases as more branches are removed. Branches resting on the ground help stabilize the tree and should be cut last. Be alert for any movement in the tree or the branches as they are cut and be ready to move away quickly if necessary.

Bucking

With all the limbs removed from the tree, you'll need to cut the trunk and large branches into short, firewood-sized sections. Cut the wood about 4 inches shorter than the length of your firebox. Watch for metal in the wood, such as fence wire or nails, that will dull the chain saw. Cut logs on the pinching side first, then make the final cut on the opposite side. Avoid cutting into the ground, as this will quickly dull the saw.

Splitting

Wood dries more rapidly when a large amount of surface area without bark is exposed to the air. This is why it is important to split firewood. Split firewood also ignites easier and is lighter and easier to handle.

The least expensive, but hardest and slowest, way to split wood includes the use of axes, mauls and wedges. Stand pieces of wood upright on a solid block approximately 20 inches high and wider than the piece of wood to be split. Do not split wood directly on the ground, as you could hit your foot or leg. Split toward the center of the wood. You may need to use several wedges to complete the split *(Figure 5)*.

Power log splitters can take much of the labor out of splitting, but the purchase cost of these wood splitters should be weighed against the amount of firewood to be split. Examples of power log splitters include hydraulic, mechanical jack and screw models, which can be operated from a tractor, automobile or independent power source. Power splitters also can be rented, reducing overall costs.

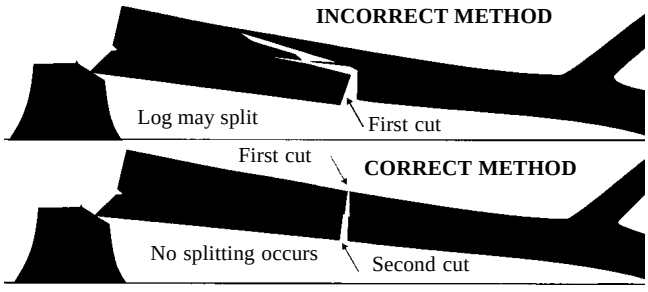


Figure 5. The correct method for bucking a log. (Image: *Woodland Stewardship: A Practical Guide for Midwestern Landowners* (1993) by M. Baughman, et al. Minnesota Extension Service, St. Paul, Minn.)

Seasoning Firewood

The primary reason for seasoning firewood is to get the moisture content of freshly cut logs below 20 percent. Reducing moisture in firewood increases burning efficiency because drier firewood uses less heat to change water to steam. This means less wood must be harvested, saving you time and money. Also, reducing the amount of moisture in wood decreases the occurrence of firewood ignition problems, creosote buildup in the chimney, wood decay and insect pests.

Proper splitting and storage are important to the seasoning process. Start harvesting and seasoning your firewood early; the fall is not the best time to build a firewood supply for the forthcoming winter. It is best to cut your firewood one year before you will need it. Some firewood cutters fell trees in the summer and leave them in place with the branches and leaves intact for two to four weeks. The branches and leaves draw moisture from the wood, accelerating drying.

Air drying firewood takes time and space. Freshly cut trees are higher in moisture and need six to 12 months to air dry before they will burn efficiently. Proper allocation of space for stacking and seasoning firewood will save you time and problems. Firewood stacks can be messy and present a fire hazard, so avoid stacking them too close to the house. Stacking firewood too close to the house will also cut down on circulation within the stack and could create insect problems inside the house.

Place firewood in an open area for rapid drying and to prevent deterioration of the firewood. Stacked firewood should be raised off the ground slightly to increase air circulation. Stacking wood under a well-ventilated shelter will reduce drying time by keeping outside moisture off the stack. Shelters made of clear plastic sheeting (4 millimeters thick) located in sunny places can be used to speed up the seasoning process by increasing the temperature within the shelter. However, shelters made of plastic sheeting need to have proper ventilation so moisture can escape.

Harvesting, hauling and preparing firewood generally take four to 10 hours of work per standard cord. Proper planning and organizing will save you time and headaches during the burning season. Technical assistance is available through your local forester.

References

Baughman, M., Alm, A., Reed, A., Eiber, T., and Blinn, C. (1993). *Woodland Stewardship: A Practical Guide for Midwestern Landowners*. Minnesota Extension Service: St. Paul, MN.

NebGuide G79-443, *Firewood Plantations.*

NebGuide G88-881, *Heating with Wood: I. Species Characteristics and Volumes.* http://ianrpubs.unl.edu/forestry/g881.htm.

NebGuide G90-968, *Nebraska's Forest Resources: Acreages and Ownership.* http://ianrpubs.unl.edu/forestry/g968.htm.

NebGuide G97-1329, *How to Manage Your Woodlands for Sustained and Maximum Benefits.* http://ianrpubs.unl.edu/forestry/g1329.htm.

Petro, F. (1975). *Felling and Bucking Hardwoods: How to Improve Your Profit.* Canadian Forestry Service: Ottawa, Ontario.

USDA Forest Service Research Paper NC-332, *The Forest Resources of Nebraska*. (1998). http://216.48.37.142/pubs/viewpub.jsp?index=10017.

University of Missouri Extension Publication G5450, *Wood Fuel for Heating.* (1995). http://muextension.missouri.edu/explore/agguides/forestry/g05450.htm.

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