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Firewood for Home Heating

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Introduction

During the 1800's, the burning of wood for home heat was a common occurrence throughout the United States. As wood for heat gradually gave way to coal during the early 1900's, technology rapidly advanced so that both fuel oil and natural gas became the preferred, safe, efficient, and convenient fuels. With the Arab oil embargo of the early 1970's, interest in home heating with firewood again increased. Firewood prices escalated rapidly, and the development of efficient, air-tight wood stoves, furnaces, and fireplace inserts made wood burning more popular. The 1980's saw an overall reduction in the price of oil and gas, and electricity prices stabilized, so that wood for fuel became less popular. However, many young homeowners have learned firsthand the advantages of wood heat. The comfort of a wood fire on a cold night; the feeling of self-reliance that comes with cutting, splitting, and stacking a cord of wood; and a reduced conventional fuel bill have all been experienced by thousands of Virginia wood burners (Figure 1).

However, these same folks have also learned the various reasons their parents and grandparents were more than happy to give up wood heat when oil and gas furnaces became available. The constant gathering, handling, and storing of large volumes of wood fuel; the dirt, dust, and bugs brought into the house with the wood; the weekly cleaning and disposal of ashes and the cleaning of flues and chimneys; and perhaps most important of all, the restriction of wintertime lifestyles so that someone is always close to home to keep the fires burning have all dampened the spirits of many enthusiastic wood burners. Perhaps the greatest use of wood fuel is as a secondary heat source. The warm, constant heat provided by a good wood stove is hard to beat for comfort, and coupled with another type of furnace or heat source (such as gas, oil, heat pump, or baseboard electric), can be a very effective choice for both comfort and cost.

Figure 1. The use of wood stoves to supplement conventional heat sources has become popular with Virginia landowners.

With Virginia's large hardwood forest resource and moderately cold winters, the Commonwealth is ideally suited to the burning of wood as either a primary or secondary fuel source. This publication provides you with information on the different types of firewood in Virginia, how to purchase firewood, how it is measured, and the economics of heating with wood as compared to other more traditional fuels. Finally, some concerns with the use of firewood, such as safety and air pollution, will be discussed.

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VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

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VIRGINIA STATE UNIVERSITY

Purchasing Firewood

There are two common ways to obtain firewood. The first is to gather it yourself; the second is to have the wood delivered to your house in some specified condition of length and dryness. Obviously, gathering the wood yourself is the cheapest way to obtain wood, but having your wood delivered is certainly the most convenient.

Wood Gathering

Individuals who each year gather their own firewood are often masters at "scrounging" (Figure 2). There are many ways to locate sources of inexpensive firewood, and it often takes a considerable degree of ingenuity on the part of the looker. Response to ads in papers for stumpage and prepared timber sales for the general public are often helpful if you live in an area where there is close access to public or industrial forest land. Cut tree tops from timber harvests or land clearing operations and wood mill wastes are also common sources of good firewood. It is always necessary to check with loggers, landowners, or mill supervisors before helping yourself to firewood, but burnable firewood often is considered a nuisance and is freely available for the asking. Standing trees, called stumpage, provide an excellent source of firewood, but these trees represent an asset to the landowner and most often must be purchased through a timber sale agreement. Stumpage costs for firewood generally vary from around $2 to around $12 per cord (prices vary greatly depending upon location and quality of wood).

Figure 2. Homeowners with a pickup truck and a chainsaw can often obtain their own firewood.

Often, this standing wood is available from timber stand improvement operations. In order to effectively consider gathering your own firewood, you need, at a minimum, a pickup truck or sturdy trailer and a chain saw with associated equipment. The fixed and variable costs of owning and operating a pickup are estimated at about 32 cents per mile, while the associated costs for owning and operating a chain saw are about $1.37 per operating hour. Depending upon the distance you have to travel to gather wood and the amount of time you wish to spend at this activity, it may or may not be financially advantageous to you.

Wood Delivery

In most areas there are several firewood dealers who regularly advertise and will deliver loads of firewood to your home. Generally the wood is sold as mixed hardwood only, and it is not possible to request a particular species. If the wood is clean, cut to the appropriate length, dry if it is advertised as "seasoned," and delivered promptly in the amount agreed upon, then you should be perfectly satisfied. It is always a good idea to check references and obtain more than one quote, if possible. Once a reliable relationship has been developed with a firewood dealer, it is often possible to order a year ahead. Sometimes special arrangements can be made in terms of species, lengths, and amounts.

For a first-time user of firewood, it is often difficult to determine how much wood will be needed. This depends upon many factors, such as whether or not the wood will be a primary or secondary fuel source, the type and efficiency of wood burner, the size and insulation value of the house, the location of the house and the amount of passive solar radiation received, the species of wood burned, the severity of the winter, etc. There are several ways to calculate wood needs, but they all rely on information that is difficult to obtain, such as the amount of heat your house loses each day during the winter and the amount of a certain type of wood (species and dryness) that must be burned to replace that heat loss. The best advice is to estimate conservatively your wood needs your first year, and then build upon your experience in succeeding years. Every house and heating system is unique and you will be the best judge of your situation after you have experienced a wood heating season.

Units of Measure for Firewood

The units of measure used in selling firewood are not always straightforward, and many people have been confused about the actual amount of wood they thought they were buying. The standard unit of measure for

firewood is the cord, which is simply a stack of wood 4 feet high, 4 feet deep, and 8 feet long (Figure 3). This stack of wood contains 128 cubic feet of solid space, which is usually 80 to 90 cubic feet of solid wood (the remainder is mostly air space between the stacked pieces of wood). Also, wood is often sold by the "face cord." A face cord is a stack of wood 4 feet high, 8 feet long, and some variable length in depth. Obviously, the depth measurement will determine just how much wood is contained in the face cord. If the pieces of wood are 48 inches long, the face cord will be the same as a full cord. If the pieces are 24 inches long, the face cord will contain 1/2 cord; if the pieces are 16 inches long, the face cord will contain 1/3 cord, etc. If all negotiations for buying and selling wood are on a cord basis, there should be no confusion.

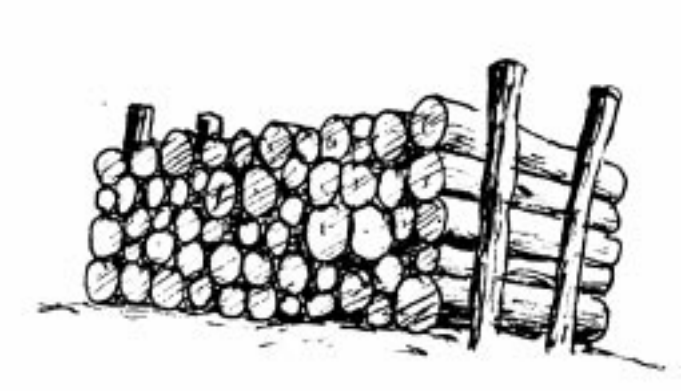

Figure 3. A standard cord of firewood measures 8 feet long, 4 feet high, and 4 feet wide.

Occasionally, firewood is sold on a weight basis, and this can be especially confusing because the weight of wood varies greatly depending upon the moisture content. A cord of wood, depending upon species and dryness, generally weighs between 2 and 3 tons. Purchase of a ton of green wood could mean that you are buying l/2 ton of wood and 1/2 ton of water; however, if the wood is air-dry, you would be buying about 1,670 pounds of wood and only 330 pounds of water. When buying firewood on a weight basis, you should be sure to specify whether or not prices are based on green or air-dry wood.

Characteristics of Firewood

There are many different species of firewood available to Virginia homeowners. Different types of wood have different properties in terms of heat value, ease of burning, ease of splitting, etc. The information in Tables 1 and 2 should prove useful in comparing some of the more common species in Virginia.

Economics of Wood Heat

The economics of heating your home with wood are difficult to determine because of the variable nature of home heating. In most cases, a homeowner is interested in one of three scenarios:

1. Selecting a heating unit for a new home.
2. Selecting a heating unit to replace a worn-out furnace.
3. Selecting a secondary or supplemental heat source that is cheaper or more convenient than the primary source.

The problem becomes one of comparing the costs of heat obtained from various fuels, which include heater costs, efficiency ratings, heater maintenance, costs of obtaining the fuel, and others. Also to be considered, but difficult to quantify, are convenience factors such as the comfort of the heat supply, the need for hand-feeding the stove or furnace (with wood), storage requirements for wood, etc. Table 3 presents some data that can be used to compare the common fuels and heaters used in Virginia. The prices listed may vary from location to location in the state, and should be considered as averages only. By using this table, it is possible to compare the actual heat values from several fuels and heaters, and also the costs associated with those heat values. Not included are the heater costs, which include purchase and installation of the heater and annual maintenance costs.

If you are concerned with one of the first two scenarios listed above, you are in the position of obtaining a new heating system. In this situation, you can compare the heat values and fuel costs provided in Table 3 to determine your overall heating costs. Excluding the costs of the heaters, the break-even points for fuel comparisons can be easily computed. For example, suppose you are interested in comparing the cost of the heat value from a cord of firewood to the other fuels listed in Table 3. For comparison to natural gas, this calculation is as follows:

$$\frac{\$00.49/\text{therm}}{92{,}000\ \text{Btu/therm}} = \frac{?\ \$/\text{cord}}{11{,}247{,}500\ \text{Btu/cord}}$$

This calculation indicates that if you pay more than $59.91 for a cord of firewood, you would be better off heating with natural gas. If you must purchase firewood delivered to your home, you could expect to pay $85/cord (Table 3) for your fuel; however, if you are able to obtain your own firewood, you may be able to realize a significant saving. Comparison of firewood with the other common types of fuels and heaters is presented in Table 4.

Table 1. Approximate heat values for common firewood species in Virginia. Based on air-dried, standard (4' x 4' x 8') cords.

Species	Btu/Cord
black locust	26,500,000
hickory	25,400,000
hophornbeam	24,700,000
beech	21,800,000
hard maple	21,800,000
red oak	21,700,000
yellow birch	21,300,000
yellow pine	20,500,000
white ash	20,000,000
white oak	19,200,000
soft maple	19,100,000
black cherry	18,500,000
white birch	18,200,000
sweetgum	18,100,000
elm	17,700,000
yellow poplar	15,900,000
hemlock	15,000,000
red spruce	15,000,000
fir	13,500,000
white pine	13,300,000
basswood	12,600,000

Table 2. General characteristics of common Virginia firewood.

Species	Relative Amount of Heat	Ease of Burning	Ease of Splitting	Production of Heavy Smoke	Production of Sparks	General Rating
ash, red oak, white oak, beech, birch, hickory, hard maple	high	high	high	low	low	excellent
soft maple black cherry	medium	high	high	low	low	good
elm, sweetgum	medium	medium	low	medium	low	fair
basswood, yellow poplar	low	high	high	medium	low	fair
yellow pine	high	high	high	high	low	good
white pine	medium	high	high	medium	high	fair
spruce	low	high	high	medium	high	poor

If you are interested in the third scenario, you are concerned with using two or more heating systems. In this case, one becomes the primary system and the other a backup. Some common systems include a wood furnace primary system with an electric backup for times when it is not possible or convenient to feed the wood burner; a heat pump main system backed up with a wood burner for use when the temperatures are very low and the heat pump is not as efficient; and a gas or oil main system with supplemental wood stove(s) for use during very cold periods. It is difficult to evaluate the economics of these mixed systems, and often their use is motivated by non-economic factors. If you are interested in these mixed systems, you should determine your heating costs for the main or primary system, then carefully consider the economic and/or convenience advantages of the secondary system. Obviously, those advantages should outweigh the expense of purchasing and maintaining two systems. With experience, you will be better able to assess your heating needs and how to best accommodate them.

Wood Heat Safety and Environmental Quality

As with any heating system, it is critical that a wood burning system be installed properly so that it is completely safe. If you are considering adding a wood heat system, you should check with your local fire department for information on installation and maintenance of your system. Your insurance company should be notified, and they can provide you with a checklist of safety considerations. Most insurance companies have strict requirements for keeping a wood stove a set distance from a combustible surface, having safe venting systems, and installing smoke detectors. Some companies will also require an on-site inspection by a fire department or company official. These strict standards are not designed to be deterrents to the use of firewood, but should be considered as safety features for your benefit.

The combustion of wood in a wood stove results in carbon dioxide, water vapor, ash, and heat. Incomplete combustion also produces carbon monoxide, various hydrocarbons, and other gases, which are considered pollutants. The gases that are vaporized from burning wood contain about 50 to 60% of the heat value of the wood, and these gases can only be burned at very high temperatures, around 1100ºF. The way in which you burn your wood, the condition of the stove, and the moisture content of the wood greatly determine the amount of smoke your stove emits. The greatest heating efficiency and the least smoke occur when the stove is burning at high temperatures. Unfortunately, it is not always desirable or possible to burn your wood in this way. Overheating a room, or the whole house, will occur if the outside temperature is not too cold, and at night most people prefer to reduce the fire intensity so that it will burn all night without requiring more wood.

As a homeowner, you should attempt to burn your wood in as safe and environmentally sound a manner as possible. Using only clean, seasoned wood of good quality (Table 2) will help. Burning your fire hot when

Table 3. Comparison of fuels and heating methods common in Virginia.

Fuel/Heater	Heat Unit	Value (Btu/unit)	Cost ($/unit)	Heater Efficiency (%)	Actual Heat Value (Btu/Unit)
natural gas/furnace	therm	100,000	0.45	85	92,000
no. 2 fuel oil/furnace	gal	141,075	0.90	80	112,000
baseboard electric	kwh	3,413	0.05	100	3,413
propane/furnace	gal	91,000	0.90	85	84,640
standard heat pump	kwh	3,413	0.05	220	7,099
high-efficiency heat pump	kwh	3,413	0.05	240	8,840
mixed oak firewood/ airtight wood stove	cord	20,450,000	80.00	55	10,225,000
geothermal heat pump	kwh	3,413	.05	300%	

possible will cut down on smoke and creosote in your chimney. The use of a catalytic stove allows the volatile gases emitted in the combustion process to burn at a much lower temperature, greatly reducing wood smoke and creosote, and also increasing heat output by 25 to 30%. These catalytic combustors can be purchased in new stoves or can be added to existing stoves. They generally add around $200 to the cost of a stove and must be replaced every several years.

Firewood and the Code of Virginia

§3.1-919: *Cord* means the amount of wood that is contained in a space of 128 cubic feet when the wood is ranked and well stored.

§3.1-956: It shall be unlawful to use the word *cord* or any abbreviation thereof other than to mean the standard as defined in §3.1-919 in, or in connection with the purchase or sale of pulpwood, firewood, tanbark, or any forest product customarily measured in cords of any size whatever, or in connection with any quotation of price, or measurement of, or settlement, or payment for any such wood, bark or product, in reference to any cord, unit or measurement.

Conclusion

Heating your home either partially or entirely with wood may be a desirable and economically attractive alternative to conventional heating systems. To make this decision, you must carefully evaluate your options and consider all of the costs associated with the various systems, as well as the lifestyle restrictions imposed by burning wood. For more detailed information, please consider the readings listed below.

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Table 4. Comparison of firewood with other common fuels and heaters in Virginia.

Fuel/Heater	Cost Equivalent to Cord of Firewood ($)
natural gas/furnace	59.91
no. 2 fuel oil/furnace	89.69
baseboard electric	164.77
propane/furnace	130.86
standard heat pump	74.89
high-efficiency heat pump	68.66
geothermal heat pump	54.92

Assumes a standard cord of air-dried mixed red and white oak firewood. Costs and heat values are in Table 3.