OKLAHOMA COOPERATIVE EXTENSION SERVICE

Heating the Home with Wood

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For centuries wood was man's primary source of energy. As late as the middle 1800's, wood supplied nearly 75percent of the total energy used in the United States. By 1900, this percentage had dropped to less than 20percent. Presently only about 2percent of the annual U.S. energy consumption comes from wood. However, recent studies indicate that by harvesting the annual growth increase of U.S. forests, sufficient wood would be available to supply about 10percent of the current United States energy requirements.

One of the major uses of wood as an energy source is for residential heating. Heating with wood is not for everyone. Before investing in a heating unit, one should determine if wood heat is both economical and suited to one's lifestyle. This publication will discuss the suitability of wood for residential heating, the types of heating units available, and some of the factors which must be considered to heat a home effectively with wood.

Types of Wood Burning Units

Unlike other types of heating systems, wood heating units vary considerably in design and operating efficiency. There are six basic types of wood heating units: conventional fireplaces, convective fireplaces, fireplace inserts, airtight stoves, non-airtight stoves, and wood burning furnaces.

The conventional fireplace is the most common type of wood heating unit. It is found in over half the single-family residences in the United States. As a heating unit, the conventional fireplace has an operating efficiency of about 10percent, which means that about 10percent of the energy available in the wood is transferred into the home as usable home heat when the wood is burned. A conventional fireplace can be modified by using glass doors, simple heat exchangers and/or outside air to increase its operating efficiency up to 20percent.

A convective fireplace is a fabricated metal fireplace with a double wall around the firebox. Between the walls is an airspace of two to three inches through which room air is circulated. Some models use natural convection to circulate the air, while others rely on small 100-200 cfm blowers. The heated air may be blown directly back into the room through vents near the fireplace, or it may be distributed through ductwork. Convective fireplaces have average operating efficiencies of about 40percent.

A fireplace insert is designed to insert into an existing conventional fireplace to increase its operating efficiency. There are two distinct styles. One style uses a series of hollow "C" shaped tubes to circulate room air around the fire. The other style uses an airtight steel firebox similar to an airtight stove. A fireplace insert has an average operating efficiency of about 40percent.

Airtight stoves, the most popular type of wood heating unit, come in many different designs. All airtight stoves have an airtight firebox. An airtight firebox has carefully sealed joints and door openings. The only air allowed into the firebox must come through the air inlet openings. The amount of air allowed through these openings can be carefully controlled by dampers. Because the amount of air entering the firebox can be controlled, airtight stoves can be very efficient. The average operating efficiency of an airtight stove is about 55 percent.

A non-airtight stove does not have an airtight firebox. This style of stove will have loose fitting doors and side panels. Franklin stoves, parlor stoves, and old-fashioned, potbelly stoves are examples of non-airtight stoves. These units have an operating efficiency of about 25percent.

The Cadillac of wood burning units is the central wood burning furnace. Wood furnaces have an airtight firebox, can be attached to duct work, and can heat an entire house. Some units are designed to burn both wood and a secondary fuel such as natural gas. The secondary fuel is used only when the wood fire goes out or is not providing sufficient heat for the house. Units are also available which add on to existing natural gas, propane, or electric furnaces. Wood burning furnaces have an average operating efficiency of about 55percent.

For a more detailed discussion of the various units available, request copies of OCES Extension Facts 9432, "Selecting a Wood Burning Stove for Safety and Efficiency;" and OCES Extension Facts 9437, "Fireplaces and Fireplace Accessories" from the local OCES Extension office in your county.

Heating Values and Operating Efficiencies

To accurately compare costs for various types of heating fuels, two values must be known: the heating value of the fuel and the operating efficiency of the heating system. Using these two values, it is possible to calculate the amount of usable heat produced per unit of fuel. Usable heat is the amount of actual heat supplied to a home by the heating system. To determine a fuel's amount of usable heat, one multiplies the heating value of the fuel by the operating efficiency of the heating unit.

The heat value of fuel is measured in British Thermal Units (BTU's). By definition, a BTU is the heat required to raise one pound of water one degree fahrenheit. Each type of fuel has a specific BTU content per unit of fuel.

The operating efficiency of a heating system is a measurement of how effective the system is at transferring the energy in the fuel into usable heat. The efficiency is normally given in the form of a percentage. Operating efficiency will vary from unit to unit, depending on such factors as design, operation and maintenance. For the purpose of cost comparison, average operating efficiencies for the various types of heating systems will be used.

Natural gas produced in Oklahoma has a heating value of approximately one million BTU per MCF (1000 cubic feet). The average operating efficiency of a natural gas heating system is about 65percent. Considering this efficiency, one MCF of natural gas will supply approximately 650,000 BTU of usable heat to a home (1,000,000 x .65 = 650,000).

Propane has a heating value of 92,000 BTU per gallon. Propane heating systems have an average operating efficiency of about 65percent. Using these values, one gallon of propane will supply about 59,800 BTU of usable heat to a home (92,000 x. 65 = 59,800).

Electric heating systems have an operating efficiency of approximately 100percent. The heating value of electricity is 3413 BTU per kilowatt-hour (Kwh). With 100percent operating efficiency, one Kwh will add 3,413 BTU of heat to the living area of a home (3,413 x 1.00 = 3,413).

Wood varies in heating value depending on species and moisture content. Table I lists the heating values of some of the more common species found in Oklahoma. For the purpose of cost comparison, a cord of air dried mixed hardwoods will be used with a heating value of 24.5 million BTU. The operating efficiencies of wood heating units vary with the type of unit and how it is operated. To compare costs, the various types of wood heating were divided into four groups based on average operating efficiencies.

Conventional fireplaces have an average operating efficiency of about 10percent and will produce about 2.45 million BTU of usable heat per cord of air-dried mixed hardwoods (24.5 x .10 - 245) .

Convective fireplaces and fireplace inserts have average operating efficiencies of about 40percent and will produce about 9.8 million BTU of usable heat per cord of air-dried mixed hardwoods (24.5 x .40 = 9.8).

Table 1. Available Heat from Various Woods

	Million BTU's of heat per cord[1] Green	Air-Dry[2]
Black Locust	**28.7**	**29.2**
Hickory	**27.1**	**28.3**
While Oak	**24.8**	**26.3**
Honey Locust	**24.2**	**25.6**
Red Oak	**22.7**	**24.6**
White Ash	**23.7**	**24.2**
Sugar Maple	**22.4**	**23.7**
Sycamore	**18.5**	**20.0**
American Elm	**18.3**	**20.0**
Cottonwood	**13.8**	**15.8**
Willow	**13.7**	**15.6**

1 A cord is a stack of wood 4'x4'x8'. Equal to two ricks, if the ricks contain wood 24" long.

2 Based on 20percent miosture content. (After 6 to 9 months of seasoning.

Non-airtight stoves have an average operating efficiency of about 25percent or about 6.125 million BTU's of usable heat will be available per cord of air-dried mixed hardwoods (24.5 x .25 = 6.125).

Airtight stoves and furnaces have an average operating eff1ciency of about 55percent which results in the production of about 13.475 million BTU of usable heat per cord of air-dried mixed hardwoods (24.5 x .55 = 13.475).

Comparing Fuel Costs

Using the bar graphs in Figure 1, one can determine the heating cost in dollars per therm of usable heat by knowing the current price of the fuels shown. A " therm" is equivalent to 100,000 BTU. Having determined the heating cost in dollars per therm, compare costs of the various fuels to determine which is most economical.

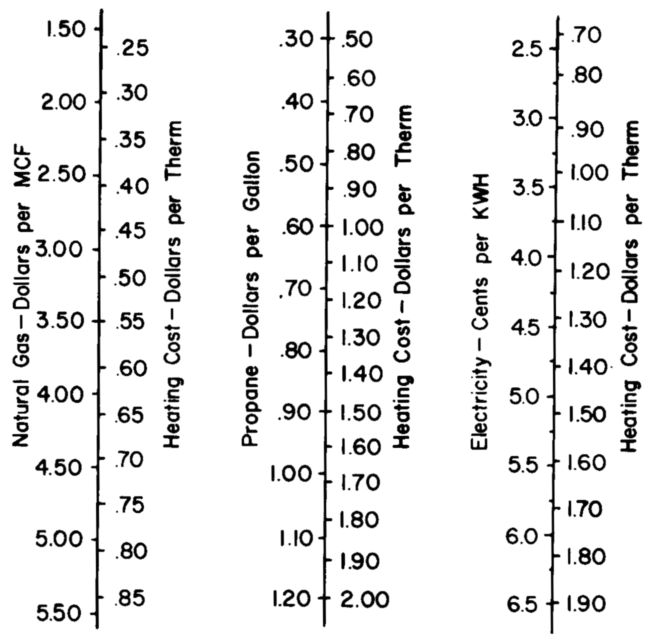

Figure 1. Comparative heating costs of natural gas, electricity, and propane.

The wood fuel graphs in Figure 2 can be used to compare the fuel costs of the various types of wood heating units. For example, if a cord of air-dried mixed hardwoods costs $70, the heating cost when it is burned in an airtight stove is about $.51/therm. If that same $70 cord is burned in a conventional fireplace, the heating cost would be $2.80/therm—over five times greater.

To compare the heating cost for various fuels, use the cost per therm to find the equivalent cost per unit of fuel. Using the $70 cord of air-dried mixed hardwood burned in an airtight stove (from Figure 2) as the basis for comparison, electricity would cost about 1. 7¢ per Kwh to have an equivalent heating cost of $.50/therm; natural gas would cost about $3.25/mcf, and propane would cost about $.30 per gallon (from Figure 1). By comparing these prices to the current selling price of each fuel, one can determine which is most economical. For example, if the current price of electricity is greater than 1.7¢ per Kwh, then wood costing $70/cord burned in an airtight stove is more economical.

Locating a Wood Burning Unit

The most important consideration when locating and installing a wood burning unit is safety. Proper clearances to combustible materials, such as walls and furniture, must be provided and the necessary precautions taken for a safe installation even if a portion of efficiency is sacrificed.

When considering stove location, give careful consideration to how the heated air is going to move throughout the living space. The basic rule is one large room is easier to heat than three smaller rooms containing the same floor space. With circulating stoves, the heated air must work itself around corners and through doorways to reach remote areas. Minimize air flow restrictions by keeping doors open and by locating the stove where there are a minimum of corners around which the heat must tlow. This will increase the ability of a single unit to heat a large area.

The main concern with radiant stoves is intervening walls. Since radiant stoves heat primarily by direct radiation, intervening walls must be warmed before they can transmit heat through to the other side. If there are two or more walls between the stove and a part of the living area, one will find it difficult to heat the outlying area satisfactorily with a single radiant wood stove.

Wood stoves do a more efficient job when they are located on an interior wall away from windows. They also are more efficient when located near large expanses of masonry or other heat absorbing surfaces. These surfaces will absorb heat while the stove is hot and then continue to give off heat after the fire has gone out.

Because hot air rises, wood burning units are more effective located on the lower floors of a multi-story home. The exception is installing a stove in an uninsulated basement. In this case a large amount of heat is required to heat up the masonry walls, resulting in little heat getting upstairs unless a blower and heat ducts are used. For a multi-story home, locating the stove near a stairwell is a good uay to get the heat upstairs. However, the stairwell should have a door at the bottom or top that can be closed to reduce the amount of heated air that goes up the stairwell when the upstairs is unoccupied. The placement of floor registers between the first and second floor is an effective way to help direct warm air in a multi-story home. For the most efficient heat movement, install return air registers along the outside walls to allow cool air to flow back downstairs to be heated. Carefully consider the location of these return air registers, because the cooler air flowing through will be uncomfortable to anyone sitting directly below. Recommended register size is 35 to 40 square inches.

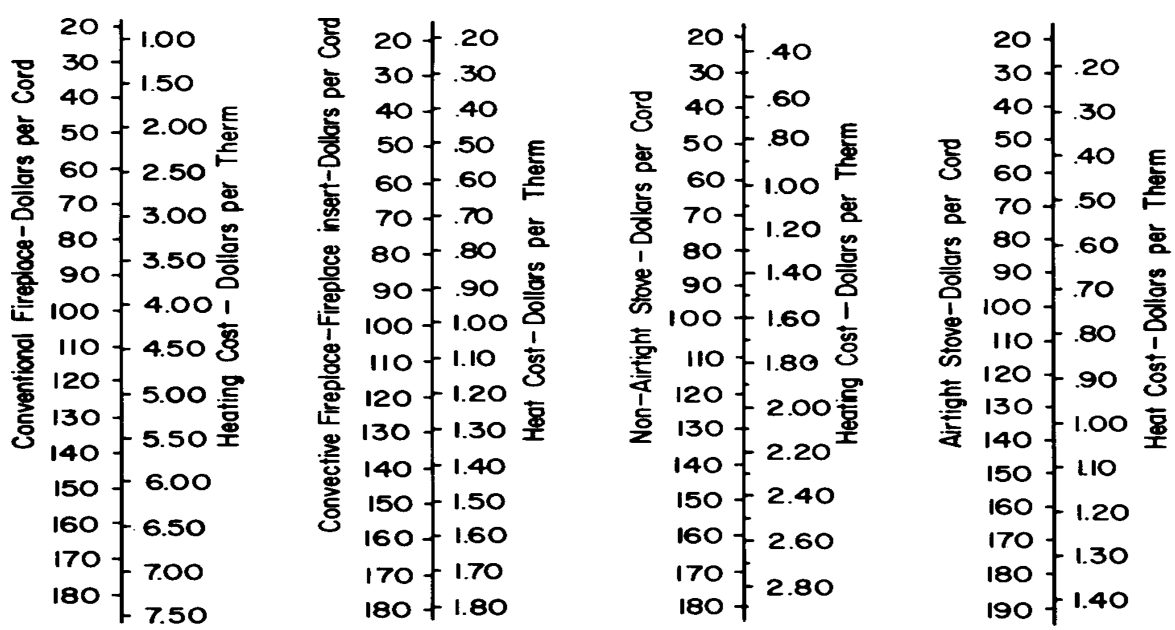

Figure 2. Comparative heating costs of various types of wood heating units.

When installing a wood stove in a home which already has central forced air heating, one can sometimes utilize the existing blower and duct work to distribute the heat. To utilize the existing heat distribution system, locate the stove near an existing return air duct or install a new return duct near the stove. Heat produced by the wood stove can then be pulled into the return system and distributed throughout the house by continuously running the blower on the conventional furnace whenever there is a fire in the stove.

Another important consideration on stove location is ease of fuelwood handling. Try to locate the stove to minimize the distance wood must be carried across carpeting or other floor coverings which are difficult to clean. An easy solution to this problem is to build a wood box with large furniture rollers. The wood box can be rolled to the back door, filled with wood, and rolled back to the stove with little effort or mess.

Summary

Wood is a renewable resource and can be a viable source of fuel for home heating, while reducing dependence on fossil fuels. The homeowner who is considering wood for home heating, either on a supplemental or primary basis, should give careful consideration to the economics involved and also the amount of personal attention that is required to operate a wood burning unit.

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