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Is Burning Wood Economical?

This publication discusses factors to consider in determining the economics of heating with wood.

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Many residents are trying to reduce their home heating costs by burning wood in a fireplace, stove or furnace. Before getting too "fired up" over wood heating, it's a good idea to be able to answer "yes" to the question, "Is it worth it?"

People can frequently justify burning wood for social reasons because they enjoy the fire--it's fun, good exercise, an enjoyable family outing, or it gives a feeling of independence from the use of our nonrenewable energy resources. From a purely economic point of view, however, wood heating may cost more money than it saves. Some factors to consider are:

- The initial cost of a stove, chimney, home modification, labor and accessories.
- The cost of equipment needed to harvest, process and transport firewood.
- Wood availability, purchase price, and hauling distance.
- Personal time and labor limitations for harvesting, transporting, storing and burning wood.
- Low heating efficiency or a limited part of the home being heated by the wood burning appliance.

All of these factors should be seriously considered before a wood heating appliance is purchased and installed in the home.

Heating Equipment Cost

The initial investment in wood heating equipment can be expensive. This includes the stove, chimney, and connector pipes. Money often can be saved by shopping around or by purchasing during the spring or summer. Many wood stove dealers have sales during their off-season.

It is important to remember that wood stoves,furnaces or fireplaces are high temperature heaters. The

purchase and correct installation of a high quality stove and chimney flue are important to prevent fire hazards that could lead to loss of property or life.

The cost of home modifications and installation labor also must be considered. To install the chimney, holes may have to be cut through the floors, walls, ceiling and roof of the home. The National Fire Protection Association and local building codes for spacing, fireblocking, system assembly and finishing should be followed closely for every part of a wood heating system.

You also may need accessory tools such as an ash shovel, broom or metal ash bucket to safely remove ashes from the stove. All ashes should be stored in a metal trash can before disposal so the hot coals cool and do not start a fire.

Early warning fire alarms and a dry chemical fire extinguisher (at least 5 lb ABC) should be considered necessities for homes equipped with a wood heating system. They may save your home or family from fire loss.

Harvesting and Storage Equipment Costs

People who intend to purchase wood already cut and split will not need many harvesting tools. A storage area, axe and wood carrier are all that may be needed. People who intend to harvest, transport and store their wood will need a lot more equipment. Commonly needed items are a chain saw, a wood splitting device, personal protective equipment, and a trailer or pickup. Many of these items can be borrowed or rented, then purchased later. People frequently team up, pool their equipment, and share harvested wood to reduce equipment costs.

Variable Costs

Variable costs include the value of the time and labor you wish to devote to wood harvesting and heating. Those who burn a lot of wood will change their time priorities. Some activities may have to be given up in order to harvest and burn wood.

Travel can add considerable cost to a cord of wood if the wood lot is located a long distance away. Try to find a wood supply close to home to reduce these costs.

Finally, the cost of operation, maintenance and repairs should be estimated. Examples are chimney cleaning, chain saw fuel and repairs, wood splitter fuel and repairs, and any repairs needed for the stove or chimney system.

Estimating Yearly Costs of Wood Heating
(not including cost of wood)

Wood Heating Equipment Costs	Amount
--Wood stove or appliance	______________
--Chimney pipe	______________
--Stovepipe connector and other ---hardware	______________
--Home modifications needed	______________
--Fire extinguisher (5 lb ABC)	______________

--Early warning fire alarms ______________

--Stove accessories, tools, ash
---bucket, etc. ______________

--Installation labor ______________

--Other ______________

Total cost a) ______________

Cost per year on 10 year depreciation schedule (total cost line a ÷ 10) = b) ______________

Harvesting Equipment Costs

--Chain saw ______________

--Axe, wedges ______________

--Power wood splitter ______________

--Accessories: hearing protection,
---fuel cans, gloves, eye
---protection ______________

--Pickup or trailer ______________

--Other ______________

Total cost c) ______________

Cost per year on 5 year depreciation schedule (total cost line c ÷ 5) = d) ______________

Operation and Maintenance Costs

--Time and labor ______________

--Travel mileage ______________

--Operation and maintenance
---repair ______________

----stove, chimney ______________

----chain saw ______________

----wood splitter ______________

--Other ______________

Total cost e) ______________

Total Annual Cost ______________

	Initial cost	1st 5 years	Next 5 years
Wood Heating Equipment Costs	a) $____________	b) $____________	b) $____________
Harvesting Equipment Costs	c) $_____________	d) $_____________	--______________
	$____XXXX____	e) $_____________	e) $___XXXX___
Total	$______________	$______________	-$______________

Figure 1. Ownership and operating costs

Most of these ownership and operating costs are listed in *Figure 1*. By estimating these costs as accurately as possible you can determine the amount of initial investment you will have to make, as well as your annual costs for operation, maintenance, and depreciation on equipment.

The Energy Value of Wood

Another major economic concern is the wood supply. Wood heating can reduce home heating costs when free firewood is located close to home. The use of high efficiency (50 to 70 percent)* stoves or furnaces to heat a major portion of the home also can reduce heating costs. An important trade-off with free firewood is the time and labor required to keep wood supplied to the stove.

If wood has to be purchased, the economic situation is entirely different. The total cost of the woodburning equipment and the cost of the firewood also need to be compared to the cost of conventional utilities.

Since firewood is sold by the cord or fractions of a cord, it is important to know how much wood is in a cord. One standard cord of wood measures 4 ft x 4 ft x 8 ft with a volume of 128 cubic feet. One cord of wood contains an average of 80 cubic feet of solid wood. The remainder is air space.

Wood is also sold by the pick-up load. Depending on the capacity of the box, a pick-up load of wood usually equals 1/3 to 1/2 cord of wood. When air dried to 20 percent moisture content, all species of wood have an energy content of about 7700 BTU's** per pound. Since the density of wood varies among species, a lightweight wood such as cottonwood has a lower BTU content per cord than a heavy-weight wood such as oak.

Table I. The cord weight and energy content of various species of wood at 7700 BTU's per pound.

Wood Species	Weight lbs /cord 20% air dry	Total heat units in million BTU's	Useful heat units if burned at 50% efficiency in million BTU's
Osage Orange	4380	33.4	16.7
Oak	3920	30.2	15.1
Honey Locust	3540	27.3	13.7
Ash	3440	26.5	13.3
Elm	2900	22.3	11.2
Cedar	2680	20.6	10.3
Pine	2600	20.0	10.0
Cottonwood	2280	17.6	8.8

Table I lists several Nebraska woods and shows the total weight per cord at 20 percent moisture content, total BTU content and useful heat if burned at 50 percent efficiency. The heat that can be extracted from the wood for useful heat in a house also depends upon the efficiency of the wood heater. "Air tight" wood stoves as a group are the most efficient, ranging from 45 percent to as high as 70 percent. Note in *Table I* that you will have to burn nearly twice the volume or number of cords of cottonwood to obtain

the same amount of useful heat as is available from a hard wood like osage orange.

Table II. The quantity of various fuels equaling the energy content of one cord of wood (calculated as useful heat available to the home).

Wood species one cord burned at 50 percent gallons efficiency	Fuel oil[1] 65% efficiency gallons	LP gas[2] 75% efficiency gallons	Natural gas[3] 75% efficiency 100 cu ft.	Electricity 100% efficiency kWhs[4]
Osage Orange	185	245	245	4942
Oak	166	219	201	4423
Honey Locust	150	198	182	3994
Ash	146	192	177	3882
Elm	123	162	149	3272
Cedar	113	150	138	3024
Pine	110	145	135	2994
Cottonwood	96	127	117	2573

[1]Fuel oil = 140,000 BTU per gal. Burned at 65% efficiency, 91,000 BTU are useful.
[2]LP gas = 91,900 BTU per gal. Burned at 75% efficiency, 68,925 BTU are useful.
[3]Natural gas = 100,000 BTU per 100 cu. ft. Burned at 75% efficiency, 75,000 BTU are useful.
[4]One kWhr of electricity equals 3412 BTU.

Table II shows the equivalent amount of a conventional energy source required to obtain the same amount of useful heat energy from one cord of a specific wood. For example, the useful heat in one cord of ash burned in a stove at 50 percent efficiency is equal to the useful heat in 146 gallons of fuel oil burned at 65 percent efficiency, 192 gallons of LP gas burned at 75 percent efficiency, 177 cubic feet of natural gas burned at 75 percent efficiency or 3,882 kilowatt hours of electricity used at 100 percent efficiency. New furnaces may be 5 percent more efficient than the values listed above.

Comparing Costs

The fuel numbers in *Table II* can be used to compare the cost of wood to that of conventional heating energy. By making a few simple calculations, you will be able to determine a break-even cost where wood will be less expensive or more expensive than a specific conventional energy.

Using *Figure 2*, you can calculate the break-even cost for the specific wood species and conventional fuels you have available. For example, *Table II* shows the energy content in one cord of cottonwood can replace 96 gallons of fuel oil. If fuel oil sells for $1.05 per gallon then the equivalent fuel price, or break-even cost, is $100.80. This is the maximum price that should be paid for one cord of cottonwood to receive an equal amount of useful heat energy.

Wood Species	Fuel Equivalent[1]		Current Price[2]	Break Even Cost
cottonwood	Fuel oil 96 gal	x	$1.05/gal	$100.80
________________	________________	x	________________	________________
________________	________________	x	________________	________________
________________	________________	x	________________	________________

_______________ _______________ x _______________ _______________

Number of cords required _________ x cost per cord $ _________ = total wood cost $ _________

[1]The fuel equivalent is found on Table II.

[2]The current price per unit may be determined from winter utility bills or by contacting the supplier. Energy is sold by the following units: fuel oil, gallon; L-P gas, gallon; natural gas, 100 cu. ft; and electricity, kWhr.

Figure 2. Information needed to calculate break-even cost

If you would purchase and burn cottonwood at $30 per cord, it would be much cheaper than fuel oil. If the cottonwood cost $130 per cord, fuel oil would be cheaper, and the more economical source of heat. Remember that this compares only fuel energy costs and not the cost of operation and maintenance of the oil furnace versus a wood stove. Money will not be saved if a high priced, low energy per cord wood is used to replace a comparatively low cost fuel.

Annual Cost of Wood Heating When Wood is Purchased

Annual cost of wood heating (from *Figure 1*)	$________________
Cost of wood if purchased (from *Figure 2*)	$________________
Total annual cost of wood heat	$________________
Annual cost of conventional energy and equipment upkeep	$________________

Figure 3. Compare total costs

Figure 3 is provided to compare the total costs of conventional heating with the total costs for wood heating, particularly if wood must be purchased. The cost of the wood heating appliance and installation are as important as the costs associated with the wood. A person who must purchase wood will have the highest cost and must consider future price increases for wood when making comparisons to conventional energy.

Many people will choose to burn wood in spite of the cost factors simply because they enjoy burning wood. Fortunately, wood is a renewable resource that can reduce heating costs for many people, and also can help to reduce our dependence upon nonrenewable energy such as oil.

†Prepared originally by Richard D. Goodding II

*A stove that is 50 percent efficient will convert 50 percent of the total heat energy in the wood into useful heat to warm the house when operated at the most efficient adjustment.

**1 BTU = 1 British Thermal Unit or the energy required to raise the temperature of one pound of water 1°F

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