Chapter 14

Heating with Wood

Wood heat and rural life

Most folks who head out to rural areas think about using wood for heat. The property we purchased consists of 45 acres of dense hardwood forest. Using fallen limbs and dead trees for firewood to provide at least part of the heat for our house during the winter was an attractive idea. We could clean up some of the clutter of dead wood that is common to mature forests while reducing our heating costs. That was a very good choice on our part. We've enjoyed the comfortable feel of wood fires while saving quite a lot of money on our heating.

Heating with wood is potentially very dangerous if done incorrectly. For obvious reasons, today's urban and suburban folks receive very little useful information on that subject. It is important that use of wood heat be approached with serious thought and planning.

You should realize that woodstoves and fireplaces are a serious fire hazard. Merely touching the outside surface of a woodstove can seriously injure people and pets. Hauling wood into your house will also bring in dirt, wood chips, and sometimes insects. No matter how careful you are, ash dust will be released into the house. Furthermore, cutting, hauling, splitting, and stacking firewood is very hard work. With that said, you should also realize that most of us who retire to a rural life enjoy the challenges and rewards of heating with wood.

Many rural working people don't care for the bother of heating with wood. They would rather spend some of their money for gas or electric heat than spend the time and effort needed for wood heating. As retirees, we have the advantage that we have the spare time to dedicate to wood heating activities if we wish.

Ecological consequences of wood heating

So often these days we hear about the dangers of impending Global Warming. A responsible person should ask whether burning wood is ecologically sound. After all, a fire does, at the very least, give off carbon dioxide.

The best way to determine the consequences of heating with wood is to figure out what happens if we don't. To begin with, trees like all organisms on this planet are carbon based life forms. They live by chemically burning sugar and oxygen and producing carbon dioxide. Yes, trees breathe oxygen. Tree roots absorb water and oxygen. If either is not available, the tree dies. The trick that trees and other plants employ is to use chlorophyll (the green stuff in leaves) and sunlight to chemically produce the sugars that they need. It is that photosynthesis production of their sugar that has a side effect of producing free oxygen. Trees give off oxygen only when the sun is shining on green leaves.

When dead limbs fall off trees and when trees die, their wood decomposes. Wood decays very quickly when in contact with the ground. Insects, fungus, and bacteria eat away at it giving off heat and carbon dioxide. Often up to 90% of its carbon and sugar is gone within two years depending upon temperature and available moisture. Burning dead wood makes no practical difference in how much carbon dioxide is released to the atmosphere. Even cutting live trees merely provides room for new trees to grow.

We should also consider how we heat our homes if we are not burning wood. Either some electric power plant somewhere has to generate power for you or you have to burn gas, oil, or coal yourself. Burning wood seems pretty good when you take time to think about it.

Wood heat only?

It is probably a bad idea for retirees to plan on heating their homes exclusively with wood. You should, at the very least, provide a backup-heating scheme for times when you may be too ill to tend a fire. The right approach is to have a thermostatically controlled furnace as your primary heat source and wood as a supplement. Insurance companies prefer you have an automatic heating system to keep water pipes from freezing, breaking, and flooding the house.

You may still use wood for most of your heating even with an automatic furnace on line. You simply turn the furnace thermostat down to the low end of your comfort range. You then heat your house with wood as if the furnace was not there. You can

enjoy heating with wood without concern about the house becoming too cold if you are away when your fire burns out.

The approach we took was to design our house for efficient wood heating but also have a propane furnace - air conditioning combination unit installed. Our propane furnace is more than adequate for handling the worst kinds of winters. We installed one of the smaller woodstoves available, providing only about thirty thousand BTUs per hour maximum heat output. We set our furnace thermostat to sixty-five degrees. If we are slow at getting around to reloading the woodstove or the weather outside is extremely cold, the furnace periodically cycles on to keep us from getting too cold.

Our single small woodstove keeps our house warm enough to prevent our furnace from cycling on until the outside temperature gets below thirty-five degrees Fahrenheit. Even at zero degrees Fahrenheit, the furnace cycles on only infrequently. The woodstove is still providing most of our heat. The combination works well for us here in south central Missouri. A larger woodstove would be better in more northern states. The smaller stove allows us to operate our woodstove in its most efficient range even with our typically mild winter temperatures.

Designing a house for wood heat

Effective use of wood heat requires that house layouts be open, allowing good air circulation throughout. This limits your architectural choices somewhat. Fortunately, open house designs are often a good match for retired lifestyles.

The best location for a woodstove or other wood-heating appliance is right in the middle of your main living area. You will get the most benefit from wood heat if it is near where you spend much of your time. Also, heat radiated from your stove pipe or chimney will provide additional heat for the house. A chimney that is protected from cold outside temperatures will draw better and be less subject to creosote buildup.

Often people will consider placing a woodstove in their basement. The idea is to allow heat to rise up to the rooms above. The concept is sound but seldom implemented adequately. Basements are usually a poor location for woodstoves.

Basements are often inadequately insulated and poorly weather sealed. Much of the heat produced by the woodstove is lost before it can heat the rest of the house. Most houses have relatively poor air circulation between the basement and floors above. Probably worse is the fact that the woodstove is out of sight so fire burn rates that are too low causing creosote buildup or too high possibly damaging the stove and presenting a fire hazard may go unnoticed.

Basement installations, however, can be made to work. Our woodstove is located in our basement. We insulated and finished the entire basement, putting in a spare bedroom and a bathroom, as well two storage rooms. Most of the floor space, however, is a big family room for hobby activities and watching TV. Our woodstove is thus easily monitored. The heat from the woodstove does warm the rooms above though the basement temperature is typically about 5 (F) degrees warmer.

Woodstoves

First off, modern EPA certified woodstoves and fireplace inserts are very efficient. They give off almost no smoke or particulate matter. These newer appliances can extract 60% to 80% of the heat value of the wood they burn. High efficiency means you burn less wood, typically a third less than what was needed for similar heat output from older woodstoves. Less wood means less work cutting, splitting, and stacking.

Modern high efficiency EPA certified woodstoves put out a lot of heat. You must be careful how large a woodstove you buy and where you place it. A romantic fire in a woodstove in your master bedroom is probably not a good idea. Even a small stove like ours would drive you out of an average size bedroom very quickly. Trying to use too large a woodstove for the space heated usually means that you will have to damp the airflow down so much that the fire will smolder inefficiently. Rapid creosote buildup will result, increasing the risk of damaging chimney fires.

There are many different models of woodstoves from many good manufacturers available. Most of them will work just fine for you, provided they are sized correctly for your application. Modern woodstoves are HEAVY. They are built with heavy cast iron pieces or thick steel plate. Their fireboxes are lined with firebrick. A good one often weighs hundreds of pounds. That is good. More mass means more even heating. They heat up slowly but are also slow to cool allowing them to give off useful heat even as the fire dies down during the night. Woodstoves do not last forever but it will normally be upwards of twenty years before replacement might be considered. Of course, the newer technology stoves may last longer. It's too soon to tell. They don't burn out fast enough for good data to be available.

There are two main categories of woodstoves today. They are the Cat and Non-Cat type stoves. (Actually, there are three categories if you count the cheap EPA exempt stoves that are usually just Asian copies of old style wood appliances - avoid those.) The Cat stoves have catalytic smoke combustors added at the chimney port to reduce smoke and particulate discharge levels to meet EPA standards. The catalytic elements add around ten to twenty-five percent improvement in burn efficiency.

With a Cat type stove, the fire must be started with the catalytic element bypassed until chimney gas temperature reaches five hundred to seven hundred degrees F. Also, the catalytic combustor can be damaged if chimney gas temperatures exceed about eighteen hundred degrees. Catalytic combustors are relatively expensive and have a limited lifespan. Plan on $150 to $200 to replace them every few. Woodstove manufacturers have improved Non-Cat technology making that a viable option and even have become the most common type sold now.

EPA certified Non-Cat stoves achieve approximately the same performance as Cat types through a moderately complex scheme for introducing air into the firebox. Typically, main combustion air flows down behind the door glass onto the burning wood. Additional tubing or chambers preheat and distribute a secondary airflow into the hot combustion gases at the top of the stove to burn remaining unburned gases and carbon particles. The stainless steel secondary burn tubes must be replaced every few years but they cost much less than a catalytic combustor for a Cat type stove.

The most noticeable difference between Cat and Non-Cat woodstove operation is in their heat output versus time profile. Both types produce about the same number of BTUs per pound of wood they burn. Non-Cat woodstoves produce high peak output early while burning a firebox full of wood. The heat output drops off noticeably as the wood burns to the charcoal stage because of the reduced smoke for secondary burn. This kind of burn profile probably works best with heavy cast iron and soapstone appliances that are typically slow to heat up.

Cat type woodstoves, on the other hand, can be operated at a somewhat more constant heat output. Only a medium high burn rate is needed to initiate proper catalytic smoke burner operation. The burn rate can be kept at a medium level throughout the cycle of burning a firebox full of wood. Cat type woodstove burn profile can thus be more even than with Non-Cat. Operation of Cat type woodstoves, however, must always be based upon the needs of the catalytic smoke burner. Too low or too high a fire can damage it.

Ours is a Cat type stove. It was not hard to learn how to operate it. We stuck a woodstove thermometer on the top of the stove. We just wait to un-bypass the catalytic combustor until the proper temperature is reached. We don't worry too much about the eighteen hundred degree end of the scale: Our whole stove would probably be glowing red by the time that temperature was reached, something that should never be allowed to happen.

Woodstoves and manufactured fireplaces often offer kits for pulling combustion air from outside instead of drawing warm air from inside the house. For the most

part, they are not necessary. Modern EPA certified woodstoves draw a relatively low volume of air for combustion so little room heat is lost. Some states and some insurance companies require them however.

Fireplaces typically require comparatively larger volumes of air for proper operation. Outside air kits available on some manufactured fireplaces. They are, however, able to supply only a fraction of the large airflow needed for those appliances.

Outside air kits do, however, provide a method for achieving pressure balance between combustion air intake and chimney outflow. This effect is installation specific depending upon wind direction, building shape, chimney location, and outside air intake port location. Outside air kits work well in most homes. They are usually most effective with Cat type woodstoves because of the slightly higher backpressure of the catalytic combustor. Installers try to avoid them though. In rare cases when they don't work, customers complain because of experiencing poor chimney draw or smoke leakage under some wind conditions. If you are building a new house, include provisions for outside air for your woodstove or manufactured fireplace. You can try your wood-burning appliance with and without the connection to see which works best. Our woodstove burns at a more consistent rate under varying wind conditions with the outside air connection than without it. In some other house, our setup might perform poorly.

It should be kept in mind that every woodstove installation operates differently, even with identical stoves. You will have to learn your own stove's quirks. That is part of the charm of wood heat.

Thermometers

Thermometers are very handy to have on woodstoves. Knowing the temperature of the gasses leaving the stove allows you to adjust it for optimum operation. There are two main kinds of thermometers available. The first is the kind that actually sticks through a hole into the chimney gas stream or the catalytic burner area. The second kind has a magnetic back that sticks it against the stovepipe and measures the surface temperature of the pipe. Nominally, a stovepipe exterior surface temperature runs roughly half that of the gas at the center of the pipe flow. Obviously, a thermometer measuring the gas temperature directly will be more accurate but extreme accuracy is not necessary so the magnetic kind works just fine. Just follow the woodstove and/or thermometer manufacturer's installation instructions.

Woodstove thermometers are marked with both temperature scales and burn rate zones. Our thermometer is labeled "Creosote" for low temperatures, "Burn Zone" for normal fire temperatures, and "Overfire" for too hot. The "Burn Zone" range nicely matches the safe range for catalytic burners. It makes operating our woodstove nearly a no-brainer.

Fireplaces

Now, even though modern woodstoves are wonderful, that does not mean there is no place in a home for a fireplace. We have one in our living room. It is great for atmosphere and a little extra warmth on a cold evening. You just have to keep in mind that a standard fireplace is not very efficient at producing heat. It draws warm air from the room, pulling cold outside air drafts into the house. It's not a good main heating unit.

There are fireplace options today that make them attractive additions to a home. The first option, of course, would be to use a fireplace insert that is really just a modern woodstove disguised as a fireplace. The second is a modern manufactured fireplace.

Manufactured fireplaces are light, allowing them to be installed without massive support structures under them. Many of these units are zero-clearance designs that allow them to be installed in ordinary framed walls. They are used with modern triple wall metal chimneys that are also very lightweight. Ours has built in ducting to pull room air around the firebox and discharge it back into the room.

The chimney – the most critical component

What most folks that are new to the subject of woodstoves don't often realize is that much of the cost associated with a woodstove or fireplace installation is the chimney. The special metal components and the labor for their installation are not cheap. A $1000 woodstove might easily require $1000 to $2000 worth of chimney materials and labor. There is no safe way to reduce this cost. Hire professionals for installation. Use high quality materials. You will be sleeping in a house with a fire burning in it. Make sure your woodstove or fireplace is installed correctly and safely.

An optimum chimney installation is one where the triple walled metal chimney pipe runs straight vertically from the top of the woodstove and is surrounded by a warm insulated airspace. Building an insulated chase around your chimney that extends to within a foot or so below the top of the chimney pipe is well worth the

cost and effort. The payoff will be in the form of greatly reduced creosote buildup, better draft, and more consistent woodstove performance.

Heat shields for walls

Woodstoves are very hot when they are in use. Their external surfaces typically run three hundred to five hundred degrees Fahrenheit. They give of much of their heat in the form of infrared radiation. Unprotected flammable material must be kept several feet away from them.

Typically, woodstoves must be installed at least three to five feet away from unprotected walls. It is sometimes inconvenient to stick a woodstove that far out into a room. You can reduce that clearance requirement by about two thirds by adding heat shields to the walls near the woodstove.

Heat shields are sheet metal panels spaced about an inch out from the wall and with a few inches gap at the bottom and top. Heat radiated from the stove warms the metal, which in turn warms the air behind it. That air rises and pulls cool air up from the floor, keeping the wall behind the shield and the shield itself cool. Some woodstoves are available with additional heat shields mounted on them, reducing stove to wall spacing requirements even more.

We had our heating and air conditioning contractor fabricate our heat shields in their shop. They are the folks who usually have the most experience and best equipment for sheet metal work like this. Our cost was about $150 total.

Fire starters

There are lots of ways to start a fire. Everyone has his or her own favorite technique. When you are starting a fire every night during the early spring and late fall, you get lots of practice. (The fire is usually kept burning day and night all winter so relighting it is not necessary.)

When natural gas is available, gas fire starters are handy for fireplaces. You simply turn on and light the gas. The flames start your wood on fire. Unfortunately, that convenience is not easily available with propane service. Natural gas is lighter than air so any leaks would dissipate up your chimney. Propane is heavier than air so leaking gas would seep down to a low spot in your house and be an explosion hazard. Woodstoves are not built to accommodate gas fire starters.

Fire lighting turned out to be much easier than we had expected. You simply go to Wal-Mart and buy a box of "StarterLogg" fire starters. Each fire starter is a small block of pressed, waxed, sawdust. A box contains two dozen fire starters but each is large enough that half is all we ever need. I just split them in half lengthwise with a knife. Two or three boxes easily get us through a winter starting fires in both the woodstove and the fireplace. There are several other brands of fire starters that should work just as well as the “StarterLogg” product.

Starting the fire in our cat type woodstove is simple:

1. Pull the catalytic combustor bypass handle to the bypass position.
2. Pull the air damper all the way open.
3. Stack the woodstove full of cordwood.
4. Poke a fire starter into a gap in the cordwood near the bottom of the firebox.
5. Light the end of fire starter with a long neck butane lighter and leave the door open about ½ inch.
6. Once the wood starts burning, close the woodstove door.
7. When the thermometer indicates the temperature is in the "Burn Zone", slide the catalytic combustor bypass handle in and adjust the air damper to maintain temperature.

Notice there is no mention of kindling or wadded up newspapers. None of that is necessary for our woodstove. Our wood is well seasoned so it lights easily. We just load the wood and put a fire starter under it. That's all it takes. The same fire starters work well for starting a fire in our fireplace.

The overnight burn

One thing that most people who heat with wood strive to achieve is a good overnight burn. We prefer to not have to get up in the middle of the night to reload our woodstove.

The first thing to learn is how a normal overnight burn is done. Late at night, right before bedtime, load your woodstove with tightly packed hardwood over an established bed of coals. Load as much wood as experience tells you is safe with that particular woodstove. Allow sufficient time for the wood to begin burning well and the stove to be up to normal operating temperature and then set the air controls to a low-medium burn rate.

It takes experience and practice to know what the proper burn rate setting is on your woodstove. All installations are different. The goal is to have as low a burn rate as possible without being so low as to cause creosote buildup in the chimney.

The heavy load of dense hardwood should burn with a medium, even heat for three or four hours then slowly die down as the charcoal is slowly consumed. With a successful overnight burn, the woodstove will still be warm in the morning.

The real test of a successful overnight burn is whether there are sufficient hot coals in the morning so that once they are raked forward, will light your morning load of firewood. With a still warm firebox and hot coals, seasoned wood lights quickly and heats the woodstove quickly to counter the morning chill.

Without a supply of hardwood like oak, hickory, or maple, an overnight burn may be difficult to achieve. That will depend upon your specific woodstove installation and available wood.

Dealing with ashes

It's pretty obvious what you do about ashes when a woodstove is allowed to burn out completely. You just shovel the ashes out and dispose of them in a safe place. There are nicely painted metal buckets that come with tight fitting lids available at hardware stores. The key point is that you must have such a container for handling ashes. Embers can smolder for days in ashes if exposed to the air. Place ashes you remove from the woodstove into your ash bucket to smother any remaining embers.

During winter, it is common for a woodstove to be burning wood all day, every day, for weeks. You might wonder what you do about removing the ashes from the stove. Some stoves come with removable plates in the bottom that allow ashes to be scraped into a pan below the firebox. That pan can be dumped into your ash bucket. Unfortunately, many of these ash pan schemes are designed to be used only when the fire is completely out. Many stoves don't even have these pans. That is really not a problem. In fact, most people only use them for final cleanup in the spring at the end of the heating season.

Each stove has its own burn pattern. You will discover there is an area where coals burn out quickest. In our woodstove, it is at the very front where the door glass air downwash flows. We just push glowing charcoal back and then shovel the front few inches of ashes into the ash bucket. The remaining coals and ash are then raked forward. Don't worry about emptying all the ashes at one time. Just reducing their volume to a manageable level is OK.

Yes, there will be small smoldering chunks of charcoal in the ashes you remove from a burning woodstove. That is both unavoidable and no problem. The metal ash bucket will not catch fire and the tight seal of the lid will quickly smother any smoldering material. It does point out, however, that you must be careful how you dispose of ashes. I try to dump them on days when the leaves on the ground around the house are wet. That way any possible windblown embers would fall on non-flammable material. On dry days, I am very careful how I dump the ashes.

Dust and dirt

Heating with wood is dirty. First you are dragging wood in from outdoors. Dust, dirt, and woodchips come in with it. You are also removing the ashes. No matter how careful you are, a little ash dust escapes every time you empty ashes. Each time you bring in a load of wood and empty ashes, only a small amount of dust or dirt is released but you do it several times a day. The mess adds up over the weeks.

A scheme that often works to mitigate the problems of wood heating is to decorate the area around the woodstove in a rustic style. Embrace the rural hominess of a woodstove and stack of firewood. That way the attendant ashes and wood chips become part of the decoration. Alternatively, you must choose decorating colors and surfaces that are less likely to show dirt.

Firewood

Of course, woodstoves and fireplaces need wood. We have 45 acres of forest on our property. We will always have wood to burn. The fallen limbs and trees dying from lightning strikes and other natural causes provide more than enough wood for our use. It is the ultimate in renewable resource. If we don't burn the wood, the forest insects, fungus, and bacteria will convert it to carbon dioxide within a couple years anyway. (Nope, the carbon in fallen wood does NOT soak into the ground.)

Firewood must be dried or seasoned for at least 6 months and preferably a year before it is burned. Most newcomers to wood burning don’t understand how important this is. Wood should be cut to firewood length, split, and stacked in the open air but shielded from rain and snow.

Most people don’t start collecting firewood until after they have a woodstove. That usually results in their using green or partially unseasoned wood for their first fires. Their early experiences with wood burning are often disappointing.

Fires built with unseasoned wood are hard to light and keep burning. They are excessively smoky and cause creosote buildup in chimneys. If the green wood can be kept burning long enough, it will eventually dry out and produce heat giving beginners the impression that things are working correctly.

Dried or seasoned cordwood lights easily in a woodstove, heats the woodstove quickly, and produces more total heat than wood with higher moisture content. It burns with much less smoke making the viewing windows on most woodstoves almost completely self-cleaning.

Different kinds of firewood

Not all wood provides the same heat. A cord of soft wood such as Pine produces only about sixty percent of the heat produced by a hardwood such as Oak. It takes about five cords of Pine to equal the heat provided by three cords of Oak. Actually, the heat output per pound of wood is roughly the same for most tree species. Those five cords of Pine weigh just about the same as three cords of Oak. Below is a short table of approximate heat values and weights for seasoned wood from different tree species.

Tree Species	Million BTU's / Cord	Lbs / Cord
Alder	18	2700
Apple	27	4100
Ash, Black	19	3000
Ash, White	24	3700
Aspen	15	2300
Beech	25	3800
Birch, Black	27	3900
Birch, White	20	3200
Birch, Yellow	24	3700

Box elder	18	2800
Cedar, White	12	1900
Cherry	20	3000
Cottonwood	14	2100
Elm	20	3000
Fir, Balsam	14	2200
Fir, Douglas	21	3200
Hemlock	16	2500
Hickory	28	4300
Maple, Red	19	1900
Maple, Sugar	24	3800
Oak	25	3900
Pine	15	2500
Spruce	15	2200
Willow	15	2100

Pellet stoves

Pellet woodstoves are available that burn small wood pellets. You buy the stuff by the bag, pour it into a hopper on the back of the stove, and a thermostat operated motor slowly feeds the pellets into the stove. It is clean and nearly effortless. It also means that you are not burning cordwood. With tons of wood falling to the ground around us, it seemed silly for us to buy wood in the form of manufactured pellets for heat. For those without ready access to wood, a pellet stove might be an attractive choice.

It's hard work!

Let there be no misunderstanding though, firewood is heavy-duty work. A cord of firewood weighs up to two tons. We burn about four cords of Oak and Hickory each winter. It would be significant work just moving that much wood once. When you are cutting your own, you move it multiple times while you are cutting, splitting, and stacking it. It is, however, great exercise, though a little dangerous at times, and it's outdoors, with no meetings and no computers!

Lessons learned about wood heat

1. *While properly seasoning firewood is critical to wood burning appliance performance, it is possible for wood to sit too long. After about two years, bugs and fungus activity begins to reduce wood mass. I use this as a good excuse to not get too far ahead cutting and stacking firewood.*
2. *One of the most neglected aspects of wood heat is ash disposal. Without a safe and convenient way to dispose of a large volume of ashes, burning wood will seem more trouble than it is worth. Find someplace out of view but not too far from the house to dump them.*
3. *Cats and dogs enjoy woodstoves and fireplaces at least as much as we do. It appears that a nap in front of a warm fire during the winter is highly favored.*
4. *A crackling fire makes even a cold winter day seem cheerful.*