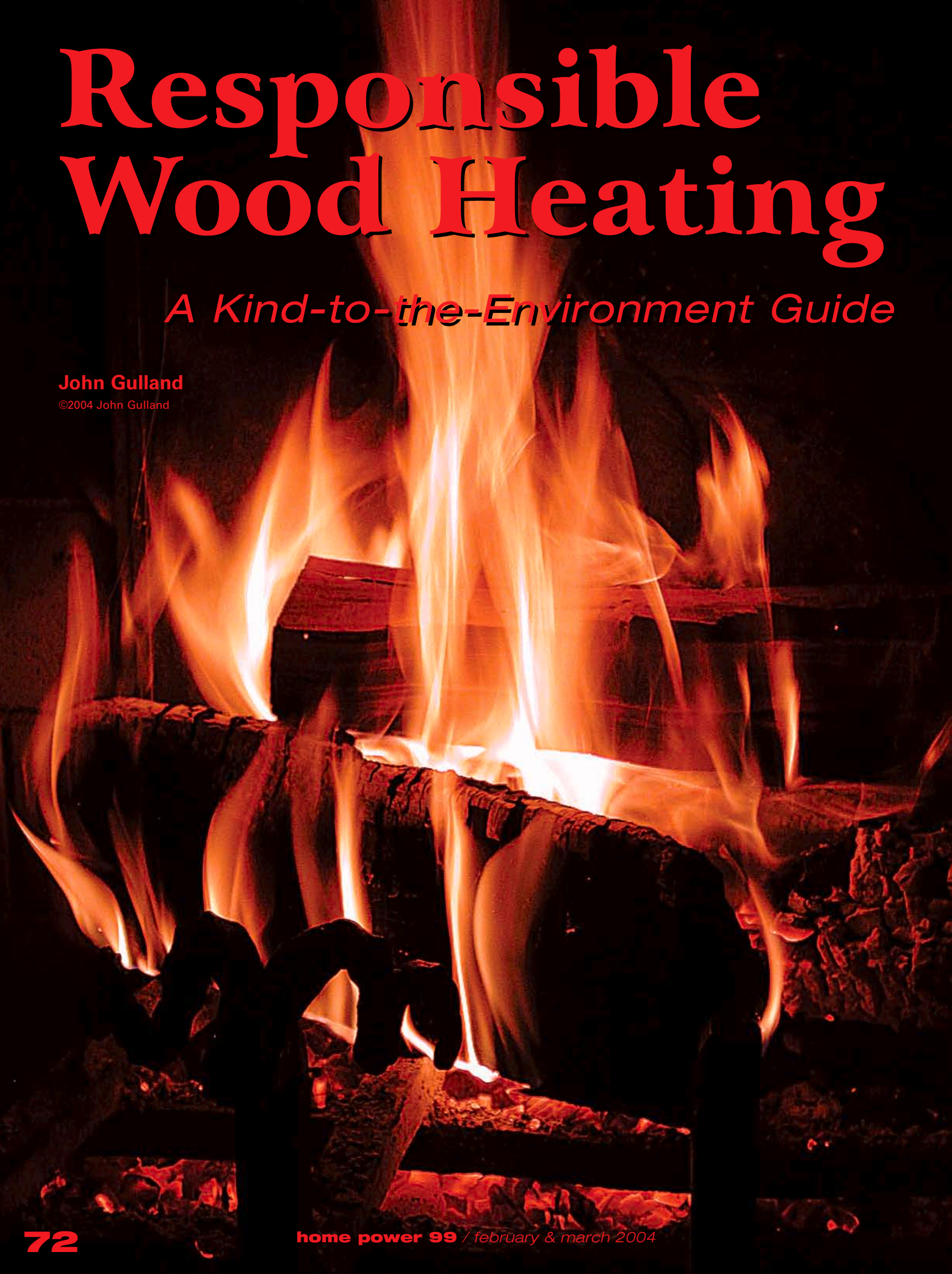
Responsible Wood Heating

A Kind-to-the-Environment Guide

John Gulland



Wood energy is the black sheep of the renewable energy family. Of all the renewable options, it causes environmentalists the most discomfort. Mostly they worry that burning wood means making a lot of smoke pollution and cutting down precious trees for fuel. Besides, woodstoves are not as technologically sexy as glittering solar panels and whirling wind turbines. As one anti-wood burning activist said at a public meeting, "We need to look to new sources of energy, not old ones."

But wood can be a renewable fuel, and as all renewable energy aficionados know, there aren't too many options available, especially ones good at providing bulk heat. In practical terms, households hoping to run on renewable energy in moderate and cold climate regions will likely rely on wood fuel to some extent.

Can Wood Be Good?

The main gripe about wood heating is the smoke, which can cause problems in your community and among neighbors. At the community level, topography and climate can conspire to trap smoke close to the ground. The pollution is visible, unpleasant, and downright unhealthy, especially for children, the elderly, and those with respiratory sensitivities.

A different kind of problem arises when one household's wood smoke is so dense that the neighbors are driven indoors, and even there the smell permeates clothes, rugs, and drapes. Both problems are serious, and together they give wood burning its bad name.

Copco Dave uses only a couple of cords a year to heat his mountain cabin in southern Oregon. An efficient Jotul woodstove provides lots of heat from not much fuel.

An EPA certified insert can convert an inefficient fireplace into a clean burning, energy efficient source of heat.

Clearly, the unreserved promotion of wood heating in all locations and circumstances is not environmentally acceptable. Even venturing to say something mildly positive about home heating with wood opens the door for criticism in some circles.

Acknowledging that heating with wood is not a good option for everyone, everywhere, how do you go about judging suitability in your particular case? A concise set of criteria to guide decision-making, or even to guide a discussion of the issue is a good place to start.

Three Myths & Four Questions

It might be useful to clear up three common myths:

- Wood heating involves simple equipment at the level of folk technology.
- Installation of wood heating systems entails only the application of common sense.
- The skills needed for successful heating with wood are intuitive.

In truth, effective wood heating is neither simple, "just" common sense, nor intuitive. Effective wood heating technologies are not simple. In fact, it is *simple* wood burning equipment that makes too much smoke and is

In Medford, Oregon, an inversion layer frequently traps auto, industry, and wood burning emissions, creating air quality problems. This can be mitigated somewhat by practicing environmentally responsible wood burning.

terribly inefficient. Common sense in the absence of proven technical guidelines for woodstove installation can cause house fires. And if anything, bad wood burning habits seem to come naturally. I've been building and maintaining wood fires every winter for almost thirty years, and I'm still learning. Maybe it's intuitive for some people, but not for anyone I know.

To make a sound decision about whether to burn wood or not, you'll need to answer these four questions:

- Should you even consider burning wood where you live?
- What kind of device should you burn the wood in, and how should the installation be arranged?
- What is an appropriate source of firewood, and how can you get some?
- How should you operate the wood heating system?

Each of these is a big topic, justifying its own article, so in the interest of brevity, this article will just skim the high points.

Should You Consider Wood Heating?

If you live downtown in a multi-story building, forget about wood heating. Even if it were physically possible, it wouldn't be responsible. Even in detached houses, urban wood heating can be problematic, unless you opt for a pellet stove, which is capable of very low emissions. Wood pellets are produced from sawmill waste, which is dried, ground, and compressed. Packaged in 50 pound (23 kg) bags, they are easier to transport, manage, and store than firewood in urban environments.

In general, wood heating works best at the urban fringe and beyond, but even using that criteria, there are limits. For example, if your nearby urban area has frequent air quality problems in winter, you might want to consider other options that have less local impact. If you're unsure about whether wood heating would be suitable where you live, consider this: if all your neighbors also decided that wood heating was a good idea, would it make your area a less pleasant or healthy place to live? If so, look for other options.

Also worth considering is the fuel supply. Wood heating is best done in a local context, so the fuel supply, in the form of standing trees, should be reasonably close to where you live. If your area is not well forested, other heating options would be better.

So, if you don't live in town, and your region doesn't have winter air quality problems, but is forested, then hey—wood heating might be for you.

Selecting & Installing the Right Equipment

Selecting wood heating equipment is when many costly mistakes get made, and is the source of one of the most common pitfalls. Strictly decorative or recreational wood burning is not environmentally appropriate. Conventional fireplaces without heat recovery are inherently wasteful and polluting. The goal is efficient, low pollution wood heating, and you can't do that with a conventional fireplace.

A word about houses—we shouldn't allow our houses to waste energy, because virtually all energy use produces environmental impacts. It is relatively easy these days, using standard building materials, to create a snug, efficient house, the very kind that is best suited to wood heating.

The most efficient form of wood heating is space heating with a woodstove, as distinct from central heating with a furnace. Ideally, the heater is located in the most lived-in part of the house, typically the central area consisting of the

A selection of freestanding, EPA certified woodstoves at Orley's Stoves & Spas in Medford, Oregon.

kitchen, living, and dining rooms. This arrangement makes the space where you eat, relax, and entertain the warmest in the house, while utility areas and bedrooms stay cooler. A moderately sized, energy efficient house can be heated comfortably with a single, well-located woodstove.

A chimney is an important part of heater operation—it is not simply an exhaust pipe. Think of it as the engine that drives the wood heating system. Straight chimney systems provide the most reliable, maintenance-free performance. So locate the chimney directly above the stove location so the flue pipe and chimney run straight up from the stove flue collar. This arrangement produces a quickly building, strong draft, with no back drafts and much less chance of smoke rollout when the door is opened for loading. Plus, maintenance is reduced—in thirteen years of use, my chimney has never had a brush through it, although I check for creosote build-up often. Straight-up chimney systems give the kind of performance we all want.

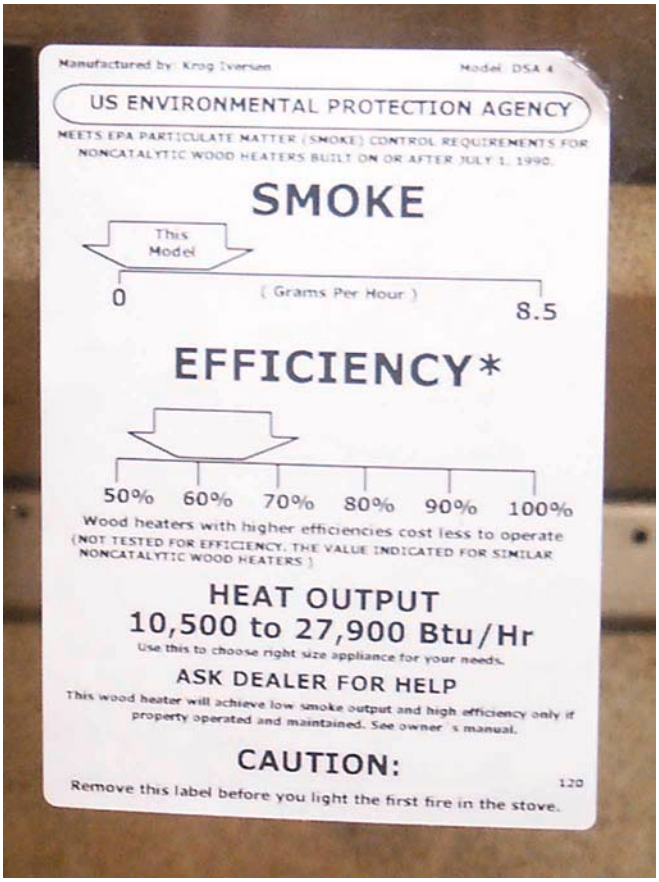
Getting the right heater is important, and fortunately, the general criteria are fairly simple. Look for anything that is certified for low emissions by the U.S. Environmental Protection Agency (EPA). A good selection of EPA certified woodstoves, fireplace inserts, and factory-built fireplaces is available. Not only will an EPA certified heater emit about ninety percent less smoke, it will deliver up to one-third higher efficiency than the old parlor or airtight stove. You'll get more heat from less wood and make less pollution in the bargain.

If you are a fan of masonry construction, you could consider a masonry heater, which cannot be EPA certified because of their design features, but which have been shown to burn clean and provide efficient heating. A masonry heater is a specialized design in which a fire is burned rapidly and the heat is absorbed by tons of masonry mass for gentle release over the next 12 to 24 hours.

You'll need help selecting the right heater. For stoves, inserts, and fireplaces, visit as many specialty hearth retailers as you can, and hear what the sales people have to say. If you are able to visit at least three, their relative competence will probably be revealed. I suggest you pick the dealer you trust first, before making the final product decision. A good dealer can offer you workable options. Then it is up to you to select what you think works best for you. Because the stove, insert, or fireplace will become an ever-present member of the family, you'd better like the look of it.

Minor differences in smoke emission ratings or in published efficiency figures don't really mean much, considering that your fuel and operating practices will have such a large effect on performance. Find a good dealer, listen to his or her advice, and pick what you like, as long as it is EPA certified. Chances are good that you'll be satisfied.

If a masonry heater is more to your liking and within your budget, contact a member of the Masonry Heater Association of North America. In my experience, heater builders are talented, committed individuals who could make a lot more money in some other line of work if they didn't insist on doing what they love.



A U.S. Environmental Protection Agency tag like this one identifies a clean burning heater. The efficiency rating is an average and is not meaningful.

Identifying Appropriate Firewood

Wood is considered to be a renewable fuel and almost carbon dioxide neutral because trees absorb CO_2 when they grow. When trees mature and fall in the forest and decompose there, the same amount of CO_2 is emitted as would be released if they were burned for heat. In heating our houses with wood, we are simply tapping into the natural carbon cycle in which CO_2 flows from the atmosphere to the forest and back.

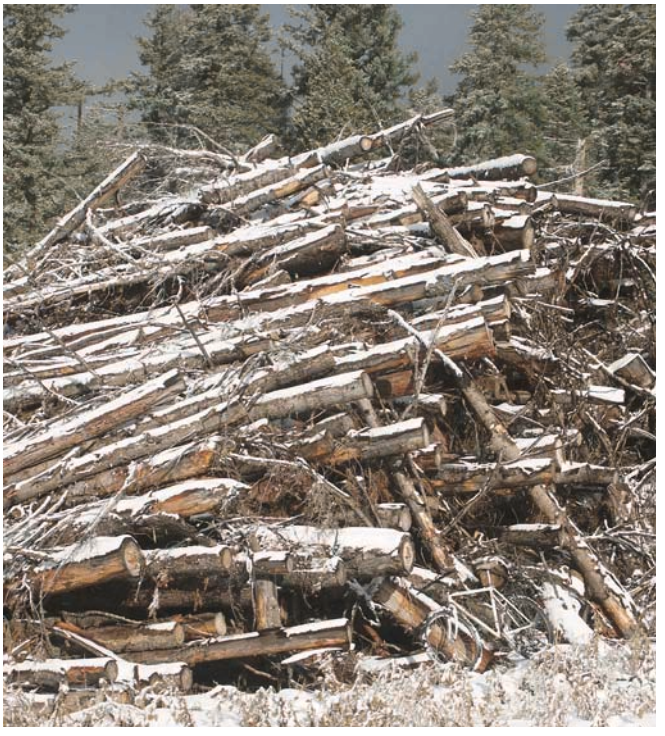
When wood fuel is used to displace the use of a fossil fuel, the reduction in net CO_2 emissions occurs quickly because of the increase in the rate of growth (and therefore the rate of CO_2 absorption) where trees are removed from the forest. Advanced wood heating technology enhances the effect since it allows you to burn less wood and at the same time conserve energy produced from fossil fuels.

Appropriate firewood is produced using sustainable forest management practices. The integrity of the forest, including the trees, the soil, and the site, is maintained and species diversity, both plant and animal, is maintained or enhanced. While this may seem like a tall order or a utopian vision, the fact is that sustainable forestry management has been practiced for decades in thousands of private woodlots across North America. Farmers' woodlots that look the same today as they did fifty years ago are really the proof of good forest management practices.

A healthy forest yields tons of biomass each year, some of which can be beneficially diverted for home heating. This forest in Oregon's Cascade mountains has been sustainably logged by the same ranching family for more than 100 years.

In practical terms, sustainable forest management can be described as uneven age selective harvesting. It means removing damaged or diseased trees and thinning concentrated stands of single species, while leaving seed trees of all present species and some standing dead trees to provide wildlife habitat. Woodlots in farm country generally conform to this prescription. If you can get your firewood from a farmer, there is a good chance that it comes from a sustainable source.

One man's slash.... Gathering firewood from a logging slash pile, which usually gets burned anyway, will put that wood to use while helping to clean up an unsightly mess.



The other major source of firewood is logging operations that produce lumber, pulp, or veneer logs. In these operations, there is always waste produced, such as trees that are rotten in the center or are damaged by road and trail building, and the tops and branches for which there may be no commercial market other than firewood. While these logging operations do not necessarily use sustainable methods, many do, and the damage would be done whether or not some of the waste wood is diverted as firewood.

The key to understanding sustainable forestry is to view the forest not as a museum containing exhibits, but as a living community, which like all communities, is constantly evolving. Climate, soil quality, and site characteristics vary widely, but many of the forested areas of North America are highly productive, meaning that a lot of firewood can be removed each year from each acre, while the quality of the stand and wildlife habitat are enhanced.

Those of us who heat homes with wood can do our part for sustainability by pressuring our firewood suppliers to prove that the wood they sell comes from a sustainable source. If many of their customers asked questions about sustainable forestry, firewood dealers would soon pressure their suppliers, and the public will would be expressed within the firewood market.

Firewood should be cut, split, and stacked in an open area in early spring to be ready to burn in the fall. Very hard woods like oak may take longer, and drying in damp climates can also take longer than just the summer months.

Here is one final suggestion about sustainable firewood. Ugly woodpiles that include wood from less desirable species tend to be more sustainable than perfect piles of maple or oak with regular pieces in the classic wedge shape. This is because straight lengths of these high-value, slow growing species should be used for furniture, not wood heating.

Ugly woodpiles are created by using everything, right down to 2 inch (5 cm) diameter sticks, and including all the bent and twisted sections of the tops. Although I live in sugar maple country, my firewood is mostly white birch and poplar because I have a lot of them on my property, and because they mature in about 35 years and then fall over. I just catch them for firewood before they fall.

Regarding fuel other than firewood, don't burn it. Burning waste paper, or even worse, general household trash, produces elevated emissions of dioxin and other nasty toxic gases. Burning saltwater driftwood has the same result. Burn clean, dry, uncoated, untreated wood and just enough newspaper to light the fires.

Operating a Wood Heating System

What day-to-day practices produce less smoke and higher efficiency? There is no simple formula for building and maintaining fires that deliver maximum heating efficiency and minimize smoke, except to say that wood should be actively flaming until it is reduced to charcoal. (See www.woodheat.org to learn about the top-down fire starting technique and more wood burning tips for maximum efficiency and minimal smoke.)

The design differences among woodstove models and chimney configurations, and differences in firewood and heat demand all have their effects on wood burning practice. That is to say, we users must adapt to conditions and learn by experience the best way to operate our wood heat systems to achieve the twin goals of high efficiency and low emissions. Given that limitation, however, here are some general guidelines that might be useful.

EPA certified woodstoves differ greatly from those built up until the late 1980s. These advanced stoves achieve higher combustion efficiency and fewer emissions by burning the smoke before it leaves the firebox. Catalytic models have a ceramic honeycomb coated with a catalyst inside the stove that lowers the ignition temperature of combustible gases.

Noncatalytic stoves use firebox insulation, large baffles, and super-heated combustion air distributed in the firebox to burn the smoke effectively. The operating instructions supplied with the heater should be followed, especially the procedures for operating catalytic stoves, which usually give precise instructions for ensuring that the catalyst lights off properly.

Beauty is in the eye of the beholder—a sustainable woodpile does not contain uniform pieces of only the "best" wood.

Tips for Clean Wood Burning

Understanding the key phases in the combustion process will assist you in achieving a cleaner and more efficient fire. There are three stages of burning.

Evaporation

The first stage of combustion is evaporation, when energy is expended to remove moisture from the wood. Using energy to drive off excess water in firewood robs the stove of energy needed for an efficient and clean burn. Also, much of the energy wasted in evaporating water is energy that could have heated your home.

Emissions

As heat inside the stove intensifies, waste gases are released from the wood. Unburned gases in smoke are emitted into the air as pollution or condensed in the chimney, causing creosote build-up. Waste gases from wood need oxygen in order to burn. This is why starving a fire for air, or "banking down a fire" is the worst way to burn. Always give a fire a generous supply of combustion air.

Charcoal

When most of the tar and gasses have burned, the remaining substance is charcoal, which burns with a steady red glow and little or no flame. A good-sized coal bed can give hours of efficient, smoke-free heating, so don't rush to add wood unless the space has started to cool off. Then rake the remaining charcoal to the front of the firebox where it can quickly ignite the new load.

Only Burn Seasoned Wood

Unseasoned wood is hard to ignite and very inefficient. When logs are cut, 50 percent of their weight is water. If wet when burned, a high amount of energy is wasted to drive off excess moisture, resulting in very poor combustion, increased pollution, and creosote build-up.

The best fuel is dry, "seasoned" wood. Seasoned wood has moisture content of about 20 percent or less. It tends to be dark in color, cracked on the ends, lighter in weight, and has bark that is more easily broken or peeled.

Source: Oregon Department of Environmental Quality

Gathered fallen deadwood ready to be bucked. Small diameter wood burns fast and clean.

Wood burns best in cycles. A cycle begins with the placement of several pieces of wood on a coal bed and ends when that wood has burned to a similar-sized coal bed. Adding one or two pieces per hour in the attempt to maintain constant heat output is *not* a good strategy. In fact, adding only one or two pieces is not a good idea at any time. When loading, always add at least three pieces to create a triangular formation where the glowing surfaces of one burning piece radiate on the other pieces, creating the site where a fire ignites and is sustained.

To burn in cycles, wait to reload until you notice that the room or space is beginning to cool off, then add a load of at least three pieces. Match the size of the load to heat demand. That is, in the relatively mild weather of spring and fall, use several smaller pieces of wood, rather than fewer of the large pieces you would use in colder weather.

A cycle should last between four and eight hours, depending on a variety of circumstances. For example, in spring and fall, I like to use the "flash fire" technique, which consists of three to six small pieces of firewood placed in a crisscross arrangement and burned fairly fast. The result is about four hours of heating, with no smoldering and no overheating of the space. In colder weather, use larger pieces placed compactly in the firebox to slow down the rate at which they ignite and burn.

Never let a fire smolder. In advanced, EPA certified stoves, the wood should be flaming brightly when you go to bed at night, and you should still have plenty of coals in the morning with which to rekindle the next fire. Gone are the days of "banking" fires with huge unsplit "blocks" and choking off the air supply before bed, a procedure that wasted much of the wood's potential energy and coated the chimney with flammable creosote. The new stoves call for new operating procedures.

Remove ashes frequently. Don't let them build up in the firebox or ash pan. In the firebox, they interfere with proper loading and make dealing with the coal bed more difficult. In stoves with ash pans, the forgetful owner who doesn't empty ashes frequently enough ends up with a dusty mess to clean up as ashes end up everywhere under and inside the stove body. In cold weather, I remove a small amount of ash from my firebox every morning before loading.

Much more could be said about the finer points of modern woodstove operation. But with these basic ideas and a good attitude as a starting point, you can develop your own special practices that suit your system, firewood, and heat demand. And that's part of the pleasure of heating with wood.

A Place for Wood in the Future

Some environmentalists take a dim view of wood energy, seeing it as crude and backward and just plain polluting. But in a post-fossil-fuel future, in which renewables dominate as they must, any serious analysis cannot overlook the limitations of sun and wind as producers of the bulk heat needed to warm houses in moderate to cold climates.

Instead of ignoring wood and hoping it will go away along with coal-burning power plants and toxic pesticides, we should confront the issue head-on by forcing wood energy into the twenty-first century. We should promote advanced combustion technologies and the social responsibility of using them appropriately. Those of us who choose to heat with wood need to pledge our commitment never to make visible smoke—an outcome, which with care, is achievable now.

Access

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Wood Heat Organization, Inc. • www.woodheat.org

HearthNet • www.hearth.com

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Oregon Department of Environmental Quality (DEQ) • www.deq.state.or.us/aq/woodstoves/woodstoves101.htm