

## Using Your Wood Stove Efficiently and Effectively

### Introduction

Every winter, thousands of Pennsylvanians keep their homes warm using renewable, affordable, locally produced wood heat. However, very few of us put much thought into whether or not we are using it properly. Most fossil fuels require no effort beyond setting the thermostat, but this is not the case with wood. The way that you use your wood stove, boiler, or fireplace insert can dramatically affect its performance.

### The Key Principle

Operating your stove effectively will not only boost the amount of useful heat you get, it will also help make the air cleaner. Why? It comes down to one simple principle:

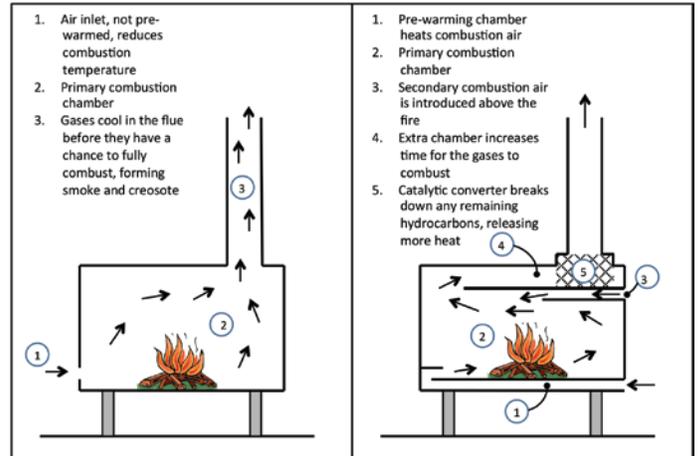
*Efficient heat is clean heat.*

Complete, 100 percent efficient combustion of wood means that all of the combustible material in the wood is converted into heat, CO<sub>2</sub> (carbon dioxide), and water vapor. All that is left behind is ash, the mineral content of the wood. Incomplete combustion, on the other hand, means that some of the carbon and hydrogen is left unburned; typically, this corresponds to emissions of things like carbon particles, carbon monoxide, and polycyclic aromatic hydrocarbons. These are generally not things we want to be breathing, nor do we want to be blowing them onto our downwind neighbors.

So, you can save yourself fuel and at the same time help keep the air clean by making sure that you use your wood stove, insert, or boiler at peak efficiency. How? Here are a few simple tips.

### Use a High-efficiency Stove

Indoor wood stoves and inserts sold in the United States since 1988 are required by the U.S. Environmental Protection Agency (EPA) to use high-efficiency designs that help ensure that the wood is more completely combusted. Outdoor wood boilers are not covered by this regulation, but voluntary certification programs are available. Check the EPA's "burn wise" website at [www.epa.gov/burnwise](http://www.epa.gov/burnwise) for lists of manufacturers as well as stoves and boilers that meet high-efficiency standards. Stoves and boilers that were built before 1988 or boilers that do not have an EPA certification are generally not as efficient.



Typical cross-section showing older and newer wood stove features.

The most common method used for high-efficiency stoves is to add prewarmed combustion air above the fire. Many people don't realize that about half of the energy in wood fuel is from "volatiles," gases that escape from the wood and combust in the surrounding mixture of gases and air. If those gases don't have oxygen available or don't stay hot enough, they won't combust. High-efficiency stoves also use "shelves" or other baffles to force the hot gases to follow a longer path before they leave the hot stove, thus giving them more dwell time to combust completely. Catalytic devices are also sometimes used; they use special chemical materials to break down more uncombusted hydrocarbons, further improving heat output and reducing emissions.

If you have an older stove or one that is not EPA certified, please consider replacing it. It may seem crazy to get rid of an old stove that still works "perfectly well," but if you do, the improvement in efficiency and reduction in emissions will be significant. You'll also end up using less wood—saving 30 percent is not unusual.

### Use Dry Wood

Sure, we know that dry wood is easier to burn, but did you know that it also provides a lot more heat? Properly dried and seasoned wood, at about 20 percent moisture by weight, has about 12 percent more available energy in it than if you use it when it is freshly cut at 45 percent moisture. On top of that, residential wood stoves tend to burn more efficiently when using dry wood.

If at all possible, keep your wood well stacked and under cover in a sunny spot (a tarp will do, but a solid roof is better). If you cut your own wood, let it dry before using; many recommendations suggest a minimum of six months of drying, but one full year or even two is better. While wood suppliers usually will tell you that their wood is “fully seasoned,” many users have noticed that storing it for an extra year makes a big difference in the wood’s moisture content and burnability.

### Keep It Hot

One of the keys to high-efficiency combustion is keeping the combustion zone hot, at least 600°C (1,100°F). If it is colder than that, the wood will tend to “smolder” (hot enough for combustible gases to escape from the wood, but not hot enough for those gases to burn). If you keep the stove hot by using dry wood and refueling the stove before it cools down, you can ensure that your fuel is as completely combusted as possible, minimizing emissions as well as creosote buildup in the flue.

### Don’t Starve the Fire

Many of us were taught that we can “control the heat” by closing down the dampers and limiting the amount of air going into the wood stove. While this may technically be possible, it has the negative side effect of preventing complete combustion of the wood—the oxygen in air, after all, is a necessary ingredient for combustion (oxygen + fuel at the right temperature = combustion). Heat output from wood stoves is notoriously difficult to control. Your best bet is to vary the rate at which you feed the fire, rather than trying to control airflow.

If you want to operate your stove cleanly and efficiently, resist the urge to damp down the stove except for one important time: when the fire has burned down to only glowing embers and you do not plan to add more fuel (for example, at the end of the day before you go to sleep) is the one time to partially close the damper to limit airflow through the stove. As the fire burns down the amount of air needed drops down, so “banking the fire” by partially closing the damper on the bed of coals reduces the amount of heat drawn out of the house overnight.

### Conclusion

Wood stoves, boilers, and fireplace inserts are a popular option for home heating in Pennsylvania, but like most equipment, the way you use them has a big impact on how they perform. Fortunately, it is not too tough to operate wood-fired heating equipment well. If you take a little time to follow the four simple tips outlined above, you will find that not only is your stove running at a higher efficiency, but the air in and around your house will be cleaner as well. Your wallet, and your lungs, will thank you.

For more information visit Penn State Extension’s Renewable and Alternative Energy website at [extension.psu.edu/natural-resources/energy](http://extension.psu.edu/natural-resources/energy) and click on “Energy Use and Efficiency.”



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