Burn Hot

Good wood burning stove practice

Introduction

If you abhor detail and would prefer a summary then please skip to the last paragraph in this article. Getting the most from a wood burning stove is not as well understood as one might expect. As a chimney sweep I see the state of numerous stoves, and the deposits I remove from them tell me more than the owners realise about their good and bad burning behaviours. I would suggest around 50% - 75% of users of wood burning stoves and open fires do not exhibit behaviours that use these appliances to best effect so this article has been written to help spread good wood burning practice.

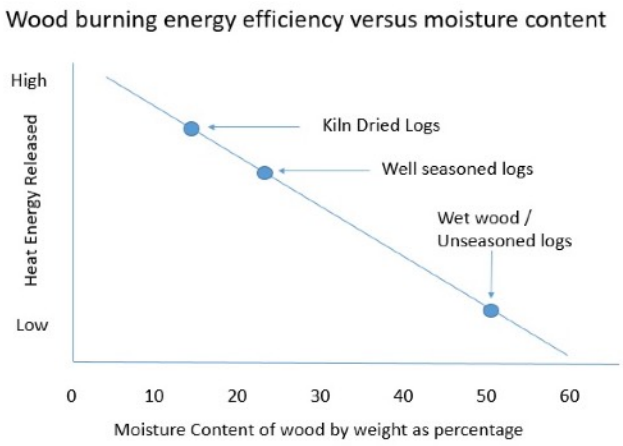
For many people burning for personal comfort and burning in a safe, effective and economic manner don't overlap, but they can do with small changes of habit. Burning practices acquired through personal experience, word of mouth or learned from some of our parents and their parents before them are often lacking on all of the above factors. Safe burning amounts to more than safe control of the fire but also minimises the likelihood of a chimney fire, the generation of poisonous carbon monoxide and and even minimising of harmful emissions into the atmosphere. Effective burning maximises the heat extracted from the wood into the home through a fuller combustion rather than losing a significant proportion of it (which can be well over 50%) either wastefully driving off moisture or sending unburnt fuel up the chimney. This not only contributes directly to economy by providing more heat from the wood but also by prolonging the life of the stove and the chimney above it.
Air pollution caused by wood burning stoves and open fires has recently received a lot of bad press. The single most influential factor in the efficiency and effectiveness of a wood burning stove, or an open fire, is how it is operated by the user. The top rated wood burning stoves are all capable of working at well below their rated efficiency when mis-operated and many users are doing just this. Efficient and effective burning is safe, provides more heat, saves money, reduces air pollution and prolongs the life of the stove and the chimney above it.

Wood Burning Theory

A little theory will help explain some of the 'good burning practices' explained below. Wood burning can be considered as having 3 phases. The order presented below is a logical sequence but in practice but they are all taking place simultaneously for much of the wood burning process.

1 - Driving off moisture

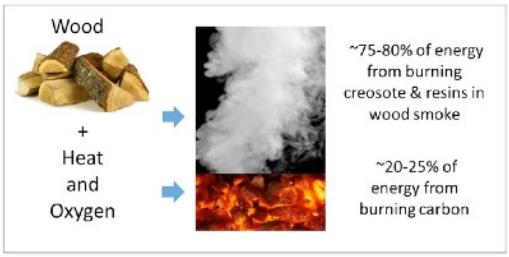
All wood will contain moisture. An average sized log can contain half a pint of water and still feel fairly dry. A freshly felled tree may contain as much as 50% (or even more) moisture by weight depending on the time of year at which it is felled. Wooden furniture in the living room of a centrally heated house might contain moisture at a level of 10-15%. Kiln dried wood typically contains moisture at 15% when it is sold.
Wood will adapt its moisture content according to the moisture of the environment in which it is stored so kiln dried wood stored outside can become more moist again. Optimal moisture content for burning wood on a stove is between 15% and 20%, 25% tops. Once you have a feel for it you can judge whether the moisture content is suitable for burning by the look and weight of the wood along with the sound it makes when you tap two pieces of it together. If you're less confident then use a moisture meter but split the wood and measure in the middle when doing this.



2 - Pyrolysis & burning of the gases

Once enough heat is generated the the hydro carbons that make up the cellulose in the wood will break down and vaporise. They are given off as a gas, wood smoke made up of creosote tars and resins. If there is enough heat and oxygen these gases burn providing more heat. Somewhere around 75-80% of the energy coming from wood burning comes from this phase of the burn. This is what's happening when you see flames licking around the wood. The smoke you see at the same time is creosote that hasn't burned. Initially and during periods of refuelling while the fire is relatively cool you'll see lots of smoke - go out and look at the chimney top when you've just lit the fire or refuelled to see it. Once the fire is burning hot there is likely to be little or no smoke - go out and look again once the fire is up to temperature and you should see no smoke at all. If the burn is not hot enough or there is not enough oxygen present the creosote can't burn and so goes up the chimney as unburnt smoke. More than 50% of the energy that could be available as heat can be lost through burning too cool (partial burning of the creosote) at this stage. The creosote gas will condense on anything with which it comes into contact less than around 250 degrees - much as your breath will condense on a cold window. This creosote, now in liquid form, will build up and can dribble down the inside of the flue surface like molten toffee dribbling down the sides of a saucepan. If the inside of your stove window is tarring up (going brown) this is creosote and its a sure sign the inside of the stove, the flue pipe and the flue itself are all tarring up - receiving a build up of creosote. This not only wastes fuel but it creates a risk of a chimney fire. Thus creosote or tar coming off the wood in the smoke can either be burned or can go up the chimney. Far better to burn hot, burning more of the smoke, allowing less to escape up the chimney and encouraging what does to go up faster so less sticks to flue walls.

3 - Carbonisation



Once the volatile hydrocarbons have been driven out of the wood what is left is carbon. Given heat and oxygen this will burn cleanly to give carbon dioxide or if insufficient oxygen is available then carbon monoxide. Carbonisation is what's happening when you burn charcoal on a barbecue. Its also what's happening when you see the red embers glowing way in the bottom of the wood burner. This stage of burn is referred to as the 'glowing embers' stage for the rest of this article. No flame is visible and around 20-25% of the heat from wood comes from this stage of the burn.

Efficient burning

If efficient burning is regarded as burning to maximise the energy available in the wood released as heat into the room then the most effective means of ensuring this is to burn hot enough to ensure the creosote burns. Wood creosote burns in the temperature zone of 300-500 degrees Celsius. The heat of the burn is more dependant on how the user operates the stove than any other factor. Ways of promoting a hot burn are as follows:

Burn dry wood: Below 20% by weight is ideal moisture content for burning wood. If the wood has too much moisture then, assuming you can get it burning, it will be giving off too much steam to burn hot. Steam will be around 100 degrees which is significantly below the 300-500 degrees required to burn the creosote so steam vapourising plentifully into the burning chamber is going to prevent the creosote burning. Before the steam vaporises the water from which it came had to be raised from room temperature to boiling point. Burning wet wood can result in over 50% of the energy in the wood, that could otherwise have been available as heat to the room, being lost driving off moisture.

Burn smaller wood: The same volume of wood in smaller pieces will present a larger surface area and will catch fire and burn more easily and hotter than its equivalent volume in larger pieces. Wood is a good insulator and the outside surface of larger wood slows down the rate at which the burn can get to the inner layers so it tends to smoulder on the outside at a lower temperature than the more complete burn of smaller pieces unless its in fire large and hot enough. The size of wood used needs to matched to the heat of the fire. Larger logs will be fine in a larger fire or on a deep bed of hot embers that enable them to blaze away, especially if amongst other wood already flaming away, but even smaller logs will only smoulder on the

outside if introduced to a cooler fire lacking in flames. Keep smaller wood and even kindling available to enliven fires where the flames have died away from larger wood.

Keep the vents appropriately open: The vents supply the air containing oxygen to the fire in the stove. By closing down the vents on a wood burning stove the flow of oxygen, the rate of burn and the temperature are all reduced as is the opportunity for burning creosote. When the vents are closed down too much in the earlier stage of the burning process while the flames are licking around the wood the burning of creosote is reduced in 2 ways: The temperature is reduced so the creosote doesn't burn because its not hot enough and the amount of oxygen required for the creosote to burn is reduced so less of it will burn even if it is hot enough.

So **dry wood**, **smaller pieces of wood** and **keeping the vents open** all increase the heat of the burn and thus the chances of burning off the creosote to increase efficiency. It is possible to burn too hot and I do come across a few people that manage this - see the paragraph on over firing later in the article to avoid this.

Stove vents

Stoves differ in the configuration of their vents but the principles for efficient wood burning are consistent across them all. It is usual to have a primary vent and a secondary vent and sometimes even a tertiary vent. These sometimes have their own separate control levers and sometimes they're all controlled from a single lever - your stove user manual will tell you how to operate them. The primary vent supplies air from underneath the fuel bed. The secondary vent supplies air from above the fuel bed, and usually down across the inside face of the glass, to promote burning of the creosote gas and help keep the glass clean. The tertiary vent, when present, supplies air to the back of the stove high up to aid with burning of residual emissions before they escape up the flue - which will only happen if the burn is hot and turbulent.

Hopefully it is now apparent that inside a wood bring stove considerable heat is required to get extra heat from burning the creosote (smoke) alongside that from the carbon in the embers.

Wood burns best inside a stove when taking its air from above. If the air comes from underneath the carbonisation can consume the oxygen from the air as it comes up through the fire and even with enough heat the creosote won't burn off without oxygen. In this situation the carbonisation proceeds more rapidly and the creosote escapes up the chimney instead of burning. Inside a stove wood thus burns hotter and more slowly on a bed of ash taking its air from above. By supplying air from above it mixes with the creosote providing maximum chance for this to burn if there is enough heat, and once the creosote is gone the oxygen can then be consumed by the carbonisation or 'glowing ember' stage of burning.

For this reason appropriate use of the stove vents makes a significant difference to the effectiveness of the burn - usually the most significant factor. In principle:

- All vents open to start with until the fire is well established with plenty of heat.
- Once the wood fire is well established close down the primary vent to slow down the rate of fuel consumption and promote burning of creosote using air from above.
    - If, a minute or two after closing the primary vent, the fire continues to burn strongly and is going to consume fuel too fast then the secondary vent can also be partially closed down but this is not usually required until the flames have died down leaving mainly embers. If closing the primary vent has caused the fire to stall and threaten to die down then open it up slightly until the fire regains a healthy flame. The exact setting of the primary and secondary vents will vary from stove to stove and even for the same model of stove with different flues above or when burning wood of different moisture content or type.
- Once the flames have died down leaving glowing embers then close down the secondary vent to slow down the rate at which these burn.

It is not usual to adjust a tertiary vent while burning. The same stove installed in different situations will draw differently depending on the air supply to the room and the draw from the flue and the tertiary vent is usually set and left at that setting according to these parameters. If you have a stove configuration that draws powerfully and is prone towards over firing then the tertiary vent is best set set towards closed and left there but if your stove configuration has a weak draw then the tertiary vent will be better set towards a more open setting and left there. An open tertiary vent is more likely to facilitate hot burning.

Size and type of wood

Kindling for starting a fire and small, medium and large logs are referred to in the text below. I sometimes come across clients who use 2" diameter logs as kindling. This can work but is usually too large. Kindling referred to in this article is wood split down to sticks somewhere around thumb thickness. It can vary in length but is usually between 6" and 9" long which enables it to be laid out in an open lattice with plenty of air between the sticks. Small logs are approximately 1"- 2" in diameter, medium logs 3"- 4" in diameter and larger logs are anything over 5" in diameter. Obviously this is relative and if you have a larger stove or open fire it will be able to take larger logs although a common mistake is to burn larger wood too cool both in stoves and open fires. This may be convenient but it also gums up the flue and sends lots of tar into the atmosphere. Stove manufacturers often state a model of stove can take logs up to a specific size. This is the size that can fit through the door and into the burning chamber. Its also too large a log for effective burning unless there are plenty of hot embers and other smaller wood burning to generate enough heat.

It's good practice to keep the wood basket beside the stove or fire adequately stocked with smaller and medium sized logs as well as the larger logs your stove can comfortably handle. This way a cooler fire in which larger logs have started to smoulder can easily be brought back up to heat by adding smaller wood and getting the flames blazing again. See **Burning Larger Logs** section later on.

Type of wood - softwood versus hardwood

Softwoods may burn faster and give less heat for their size than hard wood but pound for pound (weight) they'll give more or less the same heat output as hard woods. As its less dense the same weight of soft wood will be larger than it's equivalent in hardwood. As long as the wood is dry both soft and hard woods are suitable for burning on a stove. Softwood tends to make better kindling as it'll catch and burn more easily than an identically sized hardwood equivalent. Some woods spit sparks (willow and poplar in particular) and so are less suitable for open fires but any dry wood can be burned in a wood burning stove. Hard woods will take longer to burn so they'll 'stay in' longer on a wood burner or an open fire.

How to use a wood burning stove

The following are 'generic' instructions applicable to any wood burning stove. Many users will, and all users should, know their own stove better than I do but what follows is a set of starting principles from which specific refinements can be added for any individual stove. The more usual sources of instruction on wood burning stove operation are from stove installers (I am one) which tend to be verbal and thus don't persist or in the stove user manual and these tend to be lacking in detail and usually inadequate. If what is written below appears to contradict what you have have been instructed or already have written down, hopefully the theory above will help you understand why what is below is more likely to be appropriate. Feel free to contact me and discuss it if you're unsure.

Cold Flues: Some fires have cold flues which can be difficult to start. On being lit they can be prone to smoking into the room rather than up the chimney until the flue is warm and drawing. If your wood burner is not prone to such behaviour skip to the next section on **Starting the fire**. (Please be aware a wood burner or open fire should not smoke back into the room and if your's is prone to this at any time other than as described here then there is something wrong. If you need help to sort such an issue contact a qualified and experienced chimney sweep - you could try contacting a master sweep from the Guild of Master Chimney Sweeps.)

Cold flues may contain a plug of heavy cold air that, due to inertia, does not dislodge quickly enough using the small heat generated starting a fire. Metal system chimneys and masonry chimneys with 3 walls exposed to the outside are prone to this particularly on cold days or days with heavy damp air. The solution is to dislodge the plug of cold air with an injection of heat before lighting the fire.

In a stove newspaper can be used or some other heat source such as a fan heater (usually impractical due to ash being blown around) or an electric fire starter. Obviously this has to be done with due care not to lose control of the fire and if you live in a thatched property take care not to send burning embers up the chimney. If using newspaper it helps to keep the burning chamber empty of other fuel, especially if the chamber is small, so as to maximise the opportunity for air circulation and a big flame around the newspaper. Personally I scrunch up 2 or 3 sheets of newspaper then open them out and place them in the empty burning chamber. I open a window to the room as I'm about to displace a volume of air out of the room up the chimney and this is better facilitated if the air can be easily replaced. I make sure the vents to the stove are all open and I keep the stove door quarter open until the paper catches properly. After around 5-10 seconds the chimney usually roars as it starts to draw and continues to roar until the paper burns out. The column of cold air is now displaced and the flue is warm and drawing and will continue to do so until it cools down again which will vary between stove configurations but generally lasts around 2-5 minutes. I also make sure I have my rolled newspaper and kindling (see next section) ready to start the fire immediately after I have warmed the flue before it can cool down again but obviously I take care to ensure this is well away from the newspaper used to warm the flue so as not to have an accident.

Starting the fire:

As a fire is being started there is no heat (so there will be smoke as it won't burn off) and to compensate we maximise the oxygen supply by opening all vents on the stove and on an open fire if a vent is available. This includes opening any room vents in the wall that have sliders that can be closed. If there are no vents in the wall then opening a window or a door to another room will also increase ventilation to improve the draw.

Kindling is usually used to start a fire. It is also usual to use a small amount of solid accelerant such as a firefighter or paper to get the kindling started. Smaller kindling will start easier than larger kindling and obviously dryer kindling will start easier than wetter kindling. Personally I lay a bed of knotted newspaper rolls under an open lattice of kindling around 4 layers deep. I light the newspaper and ensure this catches before I partially close the stove door. My stove has a door catch to enable it to be wedged about 5mm open so as to facilitate extra air supply during start up, or after refuelling. Some stoves don't have this so the door has to be closed but they'll have at least one and sometimes 2 or 3 vents that should be open at this stage. The kindling usually lights within a couple of minutes of starting and I leave it with all vents open for 5-10 minutes. Once the flames have died down a bit the kindling sticks can be seen as partially burned black and red embers which are supplying strong heat into the stove. At this point, while there is still a bed of some heat (see picture left) but plenty of active flame I add another layer of kindling and some small or medium sized logs on top. I keep all the vents open for a further 5 minutes until these logs catch fire and are burning fiercely. At this point it is ok to start closing vents - start by closing down the primary vent.

A good default stove vent position for burning once up to heat is with the primary vent closed and the secondary vent open. If you have a stove thermometer then you can use this to judge the temperature. Make sure to place the stove thermometer on the flue pipe around 6 inches above the stove so as to record the correct temperature. An excellent guide to temperature is looking at the fire through the stove window and the stove window itself. Through the window you can judge whether the fire is struggling to burn and even threatening to die out or whether it is roaring

away and threatening to consume all the wood too quickly. Adjust the vents accordingly - closing the secondary vent some will slow the fire down or opening the primary vent some will enliven it. If the glass starts to tar up this is because the creosote is not burning but is condensing on the glass and it will be condensing on the stove insides and the flue and much of it will be pumping out into the environment as tar in the air. If the fire is burning hot enough to burn off the creosote then the glass will stay clean and there will be little or no deposit of creosote on the inside of the stove and the flue. It is relatively easy to burn any modern well designed wood burning stove and keep the glass clean. If you're tarring up the glass you're burning too cool - this might be due to wet wood, closing down the vents too much, using logs that are too large for the heat in the burning chamber or any combination of these factors.

The picture on the left shows a well ventilated fire in the pyrolysis stage burning hot. The picture on the right shows the same fire a few seconds after the vents have been closed so the flames and heat has been subdued and the creosote gas is no longer burning

Once the pyrolysis has more or less completed then it makes sense to slow down the carbonisation by further closing down the secondary vent. This is the stage when the flames have died down and the fuel in the stove is all glowing red embers. There may still be some flames but they'll be small and tight to the fuel rather than leaping all over the combustion chamber. Closing the secondary vent at this stage serves 2 purposes: It will prolong the burn and also slow down the rate of fuel consumption. Prolonging the burn at this stage is unlikely to cause any gumming up of the glass, stove or flue with creosote as most, if not all, of it has already burned off and what is left is burning in a good hot chamber so will burn off rather than escape up the flue.

There is now a choice: Refuel the fire or allow the embers to burn down some more before refuelling. If this is the first refuelling since the fire was lit the room may not yet be up to temperature in which case by all means open the vents, refuel and generate more heat for the room. If on the other hand the room is now 'up to temperature' there is no harm in keeping the vents closed and allowing the embers to burn down. The main downside of burning hot is that fuel is consumed more quickly. A way of reducing this is to lengthen the interval between refuelling. The stove can be refuelled every 45 minutes or so but there is no harm in allowing it to burn for an hour or an hour and a bit and then using some kindling and small logs to restart it. It won't be like starting from cold but it will want smaller wood and the vents open to re-establish a hot burn again. The stove temperature may thus vary up and down significantly more than the room temperature.
The refuelling interval can also be lengthened by burning hardwood rather than softwood but the same principle of prolonging the 'glowing embers' stage of the burn to conserve wood still applies.

Refuelling
Whenever fresh wood is added to the fire it is good practice to open the vents again until the flames are well established around the new wood. Other practices that can help here are adding smaller logs under larger logs to keep them up in the flames and making sure the larger logs are not too large for the heat in the chamber. If the larger logs just catch on the edge and smoulder on the outside rather than being consumed by flame then they're too large. The whole fire will cool down and creosote will not burn. If you look carefully at a fire in this state you'll see the smoke in the combustion chamber and you'll also see it starting to tar up the stove glass. To heat

it up open up the vents and give it some smaller wood or kindling until it's well established and ready to have the vents closed down again.

Closing down

From the perspective of minimising deposition within the stove and flue its best to burn hot through to the end so having decided to close down a stove appropriate action is to open all the vents and let the fire burn out. Typically you might be going to bed at the end of an evening and no longer want the heat. Sensible action here is to fully open the vents 20-30 minutes before wanting the fire out so that the fuel is more or less burned out by the time you want to leave it. Form a safety view point insurance companies will not condone leaving a stove unattended with the vents open so its best to have burned out the fuel before leaving the stove. Unless the fire consists of glowing embers only it is not sensible to totally close down the vents as this will cool down the fire and cause incomplete burning of the creosote.

Slumbering

Slumbering is the practice of getting a fire going then closing down all the vents to prolong the whole burn for as long as possible and often in the hope of 'keeping the fire in' all night long so all that is required to bring the fire back to life in the morning is to open the vents. This was common practice for some of our parents and their parents before them. I still have clients for whom the stove is the primary and only source of heating through the winter who like to slumber their stoves overnight despite any advice I give them. Other than a chimney fire it is absolutely the worst thing for a chimney liner. This practice is effectively charcoal generation alongside a long slow charcoal burn during which much carbon monoxide is also likely to be generated. The charcoal is created with a cool burn while the wood pyrolises, but most of the resulting creosote is not burned so much of it deposits on the glass and the stove and chimney walls and the rest pollutes the atmosphere. Its not unreasonable that pound of tar might be sent up the chimney from an overnight slumber.

The picture was taken looking up a chimney where the user has been slumbering the stove - the folds of creosote hanging from the sides of the flue can be seen covered in a light coating of ash generated from a more recent fire.

Over firing

It is possible to 'over fire' a stove or burn it too hot. The burning chamber should not be more than half filled with logs. If the burning chamber is consistently filled too full of dry logs and then burned hot (with the vents open) the stove can burn so hot as to damage itself. A stove thermometer may show the temperature over 300 degrees and if sustained for any length of time this can result in the stove warping and the doors being unable to close properly. Smoke and even flames can then escape from such a stove which is unsafe to use. An early sign of over firing is a warped baffle plate. The baffle plate is the plate sitting in the top of the burning chamber that stops the flames licking up the chimney and also helps keep the heat in the stove to generate a more complete combustion of the creosote. If this is made of metal and is drooping in the middle then its is a sign the stove has been over fired . Other signs include warped or melted fire plates (if they're made of metal) warped or melted grate (if burning wood in a multi fuel stove) and a heat bloom on the stove glass.

The best way to avoid over firing on a wood burner is not to over fill the burning chamber. This means keeping the burning load small enough so that flames are not licking all the way up the chimney. In order to better understand how to avoid over firing its easier to explain how to over fire: A way to over fire is to generate a good bed of hot embers then over fill the burning chamber with dry hard wood and keep the vents open to maximise the heat of the burn. The bed of embers helps promote a hot burn as does the hard wood and the fully open vents once the fire is up to heat. All of these factors would be okay together on any reasonable quality stove if the burning chamber were not over filled.

Carbon monoxide
Carbon monoxide is a highly poisonous gas to oxygen breathing animals such as ourselves and our pets. It is an insidious poisonous gas that can and does kill a number of people every year in the UK. Detailed discussion of carbon monoxide generation and poisoning from stoves is a topic for another article but suffice to say burning hot will help to ensure minimising of carbon monoxide emissions. When too little oxygen is available for full carbonisation carbon monoxide is generated instead of carbon dioxide. Heat and oxygen reduce generation of carbon monoxide. Any wood burning stove should have a carbon monoxide alarm installed within 3 meters.

DEFRA Exempt and modern efficient stoves
All stoves sold and installed legally in the UK are tested to a standard that promotes safety. Among other things tested are the pollutants released to the atmosphere when the vents are closed down on a stove. This is tested for each of the fuels able to be burned in the stove and if the levels of pollutant fall below an acceptable threshold the stove can be certified for use in a smoke controlled zone when burning those fuels that passed the test. These stoves are known as DEFRA exempt as DEFRA have exempted them from the ban on burning solid fuels in smoke control areas. Some stoves are DEFRA exempt by design and some have a retro fitted fixture that prevents the secondary vent being completely closed down. Whichever, WHEN CORRECTLY OPERATED such stoves release less pollutants into the atmosphere than stoves not classified as DEFRA exempt. As previously stated, the single largest contributor to the burning efficiency of a stove is the way the operator controls the heat within the stove. It is still possible and very easy for an operator to burn a DEFRA exempt stove cool enough so the creosote is incompletely burned and thus tars up the stove, the flue and pollutes the atmosphere. Correct user operation is thus still required with such stoves, as well as for even the most modern well designed stoves with features such as pre-heated combustion air fed in a turbulent manner to the combustion chamber and held in there longer using double baffle plates and having tertiary combustion features.
The standards that stoves need to pass to be certified as safe, efficient and clean enough for use in the UK has risen over recent years and is still rising. They are however not as stringent as required in some areas of the continent, such a Germany and parts of Scandinavia. New standards are due in 2022 and some newer stoves already meet these requirements. Older stove models are likely to be less efficient than newer ones - that is to say they will not as easily burn hot enough for complete combustion and will release more pollutants into the atmosphere. Newer stoves release ~80% less pollutants than stoves from 10 years ago. All of them however will burn hotter and more effectively with appropriate user operation as given in this article.

Burning Larger Logs
What constitutes a large or small log is best considered in relation to the stove on which the logs are going to be burned. A log that just fits into the burning chamber of a stove is a large log for that stove and, depending on the design of the stove, is likely to struggle to burn hot without some extra attention. The process illustrated below will help generate enough heat to burn such ‘larger logs’ effectively but on a larger stove the same sized log will more easily burn hot alongside others of similar size without such attention.
Burning large logs without enough heat and oxygen is a common way many users burn too cool. Logs that are large for the chamber in which they’re being burned need the vents more open and smaller wood alongside to sustain enough heat to burn the larger log hot as illustrated in the pictures that follow. The exact vent settings required will vary from stove to stove but the same principles as already described above should be used to promote healthy flames for the hot burn. The stove being used is over 10 years old and I find I need the vents more open than the manufacturers instructions indicate to sustain a hot burn.

1. In the picture on the right the large log in the middle is not only on a bed of hot embers but is also surrounded by smaller burning logs, at the sides and above, to generate enough heat to sustain the burn. The flames are sustained by keeping the vents open so as to keep burning the creosote gases.

2. With the vents open on the same fire as above the flames have now died back themselves - see left. The pyrolysis on the smaller wood is nearly complete but the charring on the larger wood is insulating the inner layers preventing further pyrolysis without more heat. Its time to add some more smaller wood while there is still plenty of heat from the glowing embers.

3. Further smaller wood has been added - see right - and the vents kept sufficiently open to enable this new wood to quickly catch and provide the heat required to continue to burn the larger log in the middle of the fire at a high enough heat to continue to burn off the creosote gases.

4. With the vents still open the flames on the smaller wood have nearly died away again but the pyrolysis of the larger wood remains incomplete (there is still a solid lump of wood inside the charred outside) so we repeat stage 2 above. More smaller wood is added to sustain the hot burn.

5. As in stage 3 above more smaller wood has been added - see right - and the vents kept sufficiently open to promote a hot burn of both this new wood and the gradually shrinking larger log.

6. Again, with the vents open, the fames have died back and the smaller wood is now into the 'glowing embers' stage of burning but this time so is the larger log as can be seen by the red glow throughout.
The repeated addition of smaller wood was required to burn this larger log in this stove. There is now a choice of either closing down the vents to prolong the glowing embers stage of burning or further wood could be added to the fire - either a large log onto of the bed of hot embers with some smaller logs around it or just some smaller logs.

Without the care described above when burning larger logs the glass on this stove (as well as the stove and flue insides) would start to tar up indicating too cool a burn. Modern stoves of similar size would cope with this size of log without such careful nursing. The exact requirements for a hot burn will thus vary from stove to stove - use 'keeping the glass clean' as an indicator of success.

Overall Summary
Effective use of a wood burning stove can be summarised as follows:
Burn hot. Use your stove glass as a guide. If the glass is tarring up (going brown or black) then you're burning too cool so increase the heat by doing some or all of the following:
- Use dryer wood
- Keep the stove vents more open and for a longer period during the flaming part of the burn process, particularly the secondary vent
- Use smaller wood pieces.

When burning:
- All vents open to start with
- Use small wood to establish a strong blazing fire before using larger wood
- Continue to burn a strong blazing fire until the 'glowing embers' stage of burning
- Regulate strength of flames and heat in the fire using the vents:
  - Once the fire is blazing and up to temperature close the primary vent
  - Re-open primary vent after refuelling until the fire is strong and blazing again
  - Only close the secondary vent when the flames have died down naturally and you're left with glowing embers.
- If the flames die down before the glowing embers stage of burning the fire burns too cool so enliven it by adding smaller wood and opening the vents
- Reduce the rate of wood consumption by prolonging the 'glowing embers' stage and starting the fire again with smaller wood when wanted - NOT BY CLOSING DOWN THE VENTS TO SUBDUE THE FLAMES AND THUS BURNING COOL.