

## An Independent Performance Review of Six Pellet Stoves

October 2015 By John Ackerly and Gabriella McConnel

(The online version of this report includes photos, many links to external sources and to additional background material about how we conducted the testing and determined the ratings. See: http://www.forgreenheat.org/decathlon/details.html)

### Introduction

Pellet stoves are regarded by many as a relatively new technology. However, they have been on the world market for more than 30 years. This renewable heating technology that began in the early 1980's now provides heat for more than one million households in the United States and has proliferated world-wide. Last year, two out of every five woodburning stoves sold in the United States burned wood pellets as a fuel.

A traditional woodstove uses stick-wood or cord wood as fuel and requires no electricity. Pellet stoves burn a densified wood made from sawdust that is compressed into a pellet form. Almost all pellet stove share electronic controls and motors to feed the pellets into the burn pot and automate the combustion process.

Pellet stoves are now becoming an accepted source of reliable heat that displaces enormous quantities of fossil fuel and may soon outsell their traditional cousin – the wood stove. A pellet stove with a full hopper of fuel can run unattended for twelve to 48 hours and offers a cleaner, more modern solution to wood heating.

Purchasing a pellet stove can still be a confusing endeavor. This report provides performance reviews of six popular pellet stoves and provides consumers with important

background for what to consider in any pellet stove purchase.

The Alliance for Green Heat bought six of the most popular American and European pellet stoves currently on the US market to conduct independent testing of their cleanliness, efficiency, and ease of use.

Figure 2. Length of time at each power setting

A big question for many appliances (solar panels, geothermal systems, VW cars, etc.) is whether the technology performs as well in the real world as it does in a test lab. Our testing focused on this and found that most of the pellet stoves we tested operated very similarly in "real world" conditions as they did in the lab.

We found, however, that popular pellet stoves did not live up to the efficiency expectations of many consumers and government agencies. While there are likely high efficiency pellet stoves on the market, we observed only lower to medium efficiency in the six models that we tested, despite claims made by their manufacturers. We also found that some of the stoves and the glass on the door needed much more frequent cleaning than others.

We tested the six stoves running them nearly twenty-four hours a day for thirty days (Figure 2). We purposefully did not clean them as often as the owners' manuals recommended in order to study how efficiency, emissions and overall operation would be affected by operators who neglected to clean them, which is common.

We tested them for performance attributes and rated them on five key things that consumers (and environmental stewards) care about: cleanliness, heating efficiency, required maintenance, heat output, and visibility of glass.

What makes our testing credible, reliable, and unusual is that we purchased the stoves and tested them side-by-side, using the same fuel and without the involvement of any stove manufacturer. During our endurance testing the stoves were monitored every day at various settings and the results were averaged over a thirty-day period (Figure 1). By using the same pellets on all the stoves, we reduced anomalies that can result when different labs test stoves with pellets from various manufacturers that have very different moisture, BTU and ash content.

The testing we performed and this report are one facet of a year-long Pellet Stove Design Challenge, that culminates in an intensive three day pellet stove workshop and design competition at Brookhaven National Laboratory in April 2016. To sign up for the workshop go to our website.

### **Stove Ratings**

The rating system below is on a scale from 1 to 5, with 5 being the best and 1 the worst. Even though a stove got the highest or lowest score, it does not mean that there aren't many other stoves that could perform better or worse.

STOVE RATINGS								
	RATING PARAMETERS							
STOVES	CLEANLINESS	EFFICIENCY	MAINTENANCE	HEAT OUTPUT	VISIBILITY	AVERAGE		
Quadra-Fire Mt. Vernon AE	5	2	5	3	5	4		
Harman Accentra 52i insert	1	4	4	5	5	3.8		
Enviro M55 insert	3	1	5	4.5	4	3.5		
Ravelli RV80	4	2	3	2.5	5	3.3		
Piazzetta Sabrina	2	5	1	3.5	1	2.5		
England Stove Works 25- PDVC	3	2	2	1	3	2.2		

Figure 1. Stove Rating Table

For each of the five criteria, we had numerical data from the testing and the lowest scoring stove always got a "1" and the highest got a "5." We then set ranges, such as 1-20, 21-40, 41-60, 61-80 and 81-100. If several of the stoves fell into the 61-80, for example, they both got a "4." In one of the scoring areas, no stove got a "2", and three stoves got a "5." A rating of "5" does not mean its five times better than a "1" and it may not even mean its twice as good, depending on the scoring criteria.

We chose these five criteria to assess because we could objectively test the stoves in these areas. We did not try to assess stoves on reliability, ease of operation and other important characteristics because we either did not have enough data or we felt it became too subjective. Other areas that we measured or discussed, but did not include in our fivepoint rating were hopper size vs. claimed hopper size, length of burn and cost, all of which are important and should be considered in purchasing decision.

# Disclaimer

We took many precautions to ensure that our comparison testing and measurements were fair and accurate. We make a number of disclaimers, however, to remind readers that we only tested one stove in each model line, not multiple ones. We also only tested with a single brand of pellets, and different quality pellets would likely produce slightly better or worse results in some of the categories. See more disclaimers at the end of this report.

# **Summary of ratings**

- The Quadra-Fire Mt. Vernon AE got the best overall rating. It did very well in cleanliness of emissions, maintenance, and glass visibility. It was average on heat output and the only area where it was lower than average compared to the other stoves was efficiency.
- The Harman Accentra 52i Insert performed very well in all categories except cleanliness.
- The Enviro M55 insert had top or good scores everywhere except efficiency.

- The Ravelli RV 80 had very good scores in cleanliness and glass visibility, but had only average efficiency.
- The Piazzetta Sabrina had the highest score for efficiency and good heat output, but low scores for maintenance and glass visibility.
- The England's Stove Works 25-PDVC got average scores in most categories but was a solid performer considering it costs less than a third of what most of the other stoves cost.

For the rest of this report, the above stoves will be referred to by their manufacturer's name: the Englander, the Enviro, the Harman, the Piazzetta, the Quadra-Fire and the Ravelli.

# Cleanliness

The amount of particulate matter (PM), commonly known as smoke is typically small in pellet stoves compared to wood stoves. The six stoves we tested are certified to meet the EPA particulate matter standard. We rarely observed any visible smoke after the first five minutes of start-up. Five of the stoves operated very cleanly on average, with the Quadra-Fire operating the cleanest of all.

To assess the cleanliness of emissions, we measured Carbon Monoxide (CO) in the stack, a common and easy way to test for combustion conditions. One notable result was that during the thirty day test, with the stoves operating almost twenty-four hours a day and without being cleaned regularly, four of the stoves– Harman, Englander, Ravelli and Enviro - maintained a relatively steady emissions throughout the thirty days, ending the month with virtually same average reading as they started. The Quadra-Fire did increase in emissions over the test period but it started far cleaner than the others and still ended as the cleanest stove.

The Harman operated cleanly at the lowest heat setting, but started to emit higher CO emissions on medium and had very high emissions when set at its highest heat setting during our simulated real world test regimen, similar to other studies.<sup>1</sup> When the stove was tested for EPA certification by OMNI-Test labs in Portland, Oregon, from Nov. 11 - 13, 2014, it emitted 5.61 gram per hour at its highest heat setting. The vent cap, where the smoke exited from the Harman chimney, also built up the most soot during the thirty-day trial. If low emissions are a top priority for you and your family, we would not recommend this stove when burning at its high heat setting.

<sup>&</sup>lt;sup>1</sup> Houck, James E., et al. "Low emission and high efficiency residential pellet-fired Heaters." Proceedings of the Ninth Biennial Bioenergy Conference. October, Buffalo, New York. 1999.

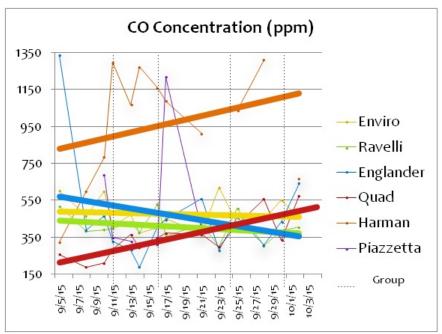


Figure 3. Carbon Monoxide (CO) levels with stoves burning at medium heat.

CO is a good proxy for the cleanliness of emissions from a steady state pellet stove. The straight lines are trend lines, showing the whether the stove was trending towards a cleaner or dirtier burn over the 30 day trial (Figure 3). Three of the stoves – the Englander, Enviro and Ravelli – had quite good and stable CO levels that slightly trended towards a cleaner burn. The Quadra-Fire started as the cleanest, and became dirtier. The Harman had by far the highest levels of CO, indicating a dirtier burn (Figure 3). Several data points are missing for the Harman because our test equipment went into shutdown mode because of extremely high CO levels (Figure 3). The Testo can read CO levels up to 5,000 ppm and starts its shutdown mode as it approaches 4,000 ppm. Other CO studies have found higher CO levels at a high power setting. The trend line for the Piazzetta is not shown because it only completed 3 of the 4 weeks of testing before it quit, which could produce an unrepresentative trend line (Figure 3).

One of the biggest environmental benefits of pellet stoves, compared to wood stoves, is that they can have consistent low emissions in the real world, whereas wood stoves depend on an experienced and attentive operator who uses seasoned wood. A pellet stove rated at 2 grams an hour could remain under 4 grams an hour in the real world for many years, assuming it is cleaned periodically. However, a wood stove rated at 3 grams an hour could easily emit 8 - 12 grams an hour in the real world, even if it is being operated relatively well and with relatively seasoned wood. This is because lab testing of wood stoves is not designed to predict how wood stoves operate in the real world. Lab testing of pellet stoves is able to be a better predictor of real world performance.

Pellet stoves should not leak any smoke or CO directly into a home, since consumers rarely open the door to the combustion chamber while the stove is lit. (The Harman is the only stove that suggests the user scrape the burn pot while the stove is lit.) Consumers

regularly have to open the door on a woodstove to refuel it. Smoke can re-enter homes from the outside, and therefore lower emitting pellet stoves could have a smaller health impact.

## Efficiency

Efficiency is important as it helps consumers calculate fuel savings between stoves as well as between fossil fuel alternatives and pellet stoves. Our test equipment, the Testo 320 combustion analyzer, calculates efficiency values differently from a test lab, therefore we are not releasing any exact efficiency percentages in our report. However, we can roughly assess the relative thermal efficiency of each of the 6 stoves compared to one another.

The most efficient stoves in our thirty-day testing regimen were the Harman and the Piazzetta. In our testing, the Ravelli, Quadra-Fire and Englander all had roughly the same efficiency, based on the Testo efficiency calculation. The Enviro had the lowest efficiency in our tests.

A key finding from our testing was that over a thirty-day period with very infrequent cleaning, efficiency dropped slightly in four out of six stoves based on medium burn rate testing (Figure 4). Most of the stoves showed about a five-point drop in efficiency except for the Enviro and Piazzetta, both of which went up slightly. More regular and more complete cleanings may have reduced the downward trend in efficiency shown by most of the stoves.

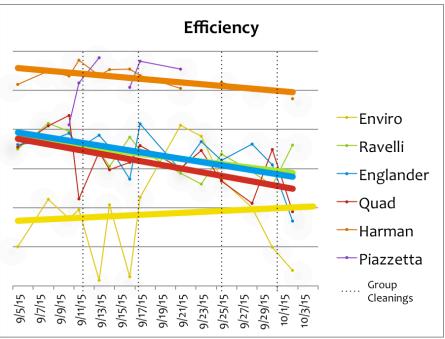


Figure 4. Efficiency percentages for stove burning at medium heat.

Our testing indicated that the six stoves had efficiencies within a fifteen-point spread (Figure 4). Other testing and pellet stove test data sets show a wide range of efficiencies, between 50 - 80%, with most falling between 60 and 75% using the EPA approved efficiency calculation (CSA B415.1), and an average between 67 - 70%. These data sets do not name the model and brand, but list the grams per hour and higher heating value (HHV) efficiency scores.

Based on the fifteen point range shown by existing data sets and our testing, if a home needed three tons of pellets, and spent \$900, to heat with a 60% efficient stove, they would need 2.4 tons with a 75% efficient stove. The savings would be 20%, or \$180.

All the stoves burned least efficiently at their lowest heat output setting, and we often found a 10-point efficiency difference between the low and high burn. If a stove has an average of 67% efficiency, it may run at 63% efficiency at its low level and 72% at its highest level. Using your stove on the lowest heat setting can still save you pellets, but you just won't be getting as much heat out of each pellet as you get at medium or high burn rates. If your stove is controlled by a thermostat, it may be best to use the medium or high burn rates to achieve your desired room temperature, if the stove can be set to operate that way.

Our testing challenges the commonly held belief that pellet stoves tend to be more efficient than wood stoves. The very high levels of oxygen in the stack of the these six stoves may indicate that pellet stove manufacturers are sacrificing efficiency in order to provide enough air to keep the glass clean. Stoves that have an air-wash for the glass are actually leaking air in, usually beneath the glass surface. This friction across the glass from the air allows the glass to stay clearer. Our most efficient stove, the Piazzetta, also had the dirtiest glass, which may be a sign that they prioritize higher efficiency combustion over seeing the flame. Pellet stoves should have the capacity to perform at consistently higher efficiencies than non-catalytic wood stoves, and some may achieve that, but they were not among the popular stoves we tested.

We do not recommend using manufacturer efficiency claims as many of them appear to be exaggerated and are not based on independent third party calculations using the EPA approved method. Consumers will see many pellet stoves claiming efficiencies in the 80s, whereas most of those stoves are more likely to be in the 60s or low 70s. Only a few small pellet companies have been willing to release verified efficiencies to their consumers and they are not among the ones we tested. The EPA has also dropped their default efficiency of 78%.

#### Maintenance

We assessed maintenance only on the frequency of cleaning required by an operator to keep a stove functional. We did not assess longer-term maintenance issues or potential repairs that stoves may need.

We found that these six pellet stoves all had excellent ash collection capacity and could store weeks worth of ash, but the burn pot on some stoves required a quick scrape-out

every day or two.

The three most expensive stoves – the Enviro, Quadra-Fire, and Harman–all performed very well without frequent burn pot cleaning. If your sole criterion in a stove is not to have to do anything to it for a week or more other than feed it more pellets, one of these stoves may be for you. These stoves are also likely to handle low quality pellets better, because each has a distinctive and effective way to keep their burn pot area from clogging up. The Enviro and the Quadra-Fire have internal automated mechanisms and the Harman through its burn pot design simply pushes the ash forward, which can result in the visible buildup of ash, but the stove keeps going.

Although we only tested only one stove each from Harman, Quadra-Fire and Enviro, these unique burn pot designs utilized by each company are found on other models within their product lineup. As an example, the Quadra-Fire we tested was a freestanding stove but is also available in a fireplace insert. Although we cannot speak to the insert's performance because we did not test it, one could assume that these variations will perform similarly from a maintenance point of view.

The three less expensive stoves – the Englander 25-PDVC, Ravelli RV 80 and Piazzetta Sabrina – have burn pots that likely need to be scraped-out every day or two, if the stoves are being run round the clock with medium or low quality pellets. Clogged burn pots usually make themselves known when the stove tries to relight and the crusted ash on the bottom of the burn pot prevents the igniter from lighting the pellets. Scraping out the burn pot only takes a minute, but is essential for the automatic ignition to light the pellets and to keep the stove operating. The Ravelli and Piazzetta have a "clean" cycle prior to start up, which is a higher than average velocity of air which is pulled through the burn pot to help clear ash which may be present but will do little to clear hard ash obstructions within the pot.

On several days, we tested stoves that had not been cleaned for a week, cleaned them, and tested them again. We did not always see a consistent performance changes except in the cleanliness of the stove, which always improved after the burn pot and surrounding areas were cleaned.

Pellet stoves require more maintenance than wood stoves and it is critical for consumers to understand that they have to periodically clean the stove for it to perform well.

### Heat output and turndown ratio

For this rating, we tested for two different attributes - maximum heat output and turndown ratio -and combined them into one score.

For heat output, we tested for sheer volume of pellets that the stove could deliver to the burn pot in an hour at its highest heat setting (Figure 5). All other things being equal, the stove that can burn the most pellets the quickest will provide the greatest amount of heat.

HEAT OUTPUT (BTU/HR.) COMPARISON					
STOVES	AGH CALCULATED	EPA LISTED	MANUFACTURER CLAIMED		
England Stove Works 25- PDVC	13,450-14,778	8,200-22,400	Not listed		
Enviro M55 insert	9,022-21,420	9,300-45,500	Not listed		
Harman Accentra 52i insert	8,136-21,586	10,300-39,800	13,800-53,000		
Piazzetta Sabrina	12,620-21,973	9,900-37,200	11,150-47,000		
Quadra-Fire Mt. Vernon AE	7,804-17,047	13,800-37,500	16,800-53,300		
Ravelli RV80	8,136-16,937	8,300-16,900	8,500-35,000		

Figure 5. Maximum BTU/hour of stoves at the highest heat setting.

The stoves that have the highest feed rate and can feed pellets into their burn pot the fastest are the Enviro, Harman and Piazzetta which all could burn about four pounds of pellets per hour. The pellets we used were independently tested at about 8,200 BTUs per pound, so if your stove could get 100% of the energy from those four pounds of pellets, you could get 32,800 BTUs per hour. However, most pellet stoves get in the 60 - 75% efficiency range, and we used an average of 67%, so the actual delivered BTUs are about 22,000 per hour.

Our BTU output calculations compared the stoves against each other based on their tested feed rate (pounds of pellets delivered to the combustion chamber per hour) and an assumed average efficiency of 67% (Figure 5). Test labs report BTU ranges to the EPA that are then recorded on the list of EPA certified wood stoves, but test labs did not have to use actual efficiencies. Virtually every pellet stove reports similar BTU output at its lowest burn rate setting, falling somewhere between 8,000 and 12,000 BTUs per hour. But manufacturers, including four whose stoves we tested, somehow claim far higher BTU output on their promotional literature than the test labs reported. We do not recommend using BTU output claims in promotional literature, as it appears to be another area, like efficiency, where manufacturers can exaggerate numbers.

One reason test labs may report higher BTU output than we found is because they could have used the old EPA default efficiency of 78% for pellet stoves or even higher, instead of the actual efficiency of the stove, using the EPA approved method (CSA B415). They also may have been able to report numbers using European calculations (LHV) instead of those preferred in the US (HHV).<sup>2</sup> The ability and willingness of manufacturers to claim far higher BTU output in their promotional literature than the EPA accredited labs reported points to a lack of industry or government guidelines for consumer advertising and may be perceived by consumers to be deceptive.

Can a pellet stove efficiently heat a home? Many consumers have years of experience heating a 1,500 - 2,500 square foot home with nothing more than their pellet stove. Of

<sup>&</sup>lt;sup>2</sup> In Europe, pellet stoves typically have a range between 8,000 – 35,000, using LHV calculations. See "European Wood Heating Technology Survey," NYSERDA, April 2010.

course, floor layout, insulation and region of the country are huge factors. A helpful guide of where a stove should be installed is typically within 25 feet of the common area of a home. Stoves in spare rooms or rooms above garages typically do not heat as well as a stove located within the insulated space near the center of the home. Sizing the stove is important because pellet stoves are not designed to be operated 24/7 at their highest heat setting. If your stove is undersized, it will likely have more performance issues than one that is correctly sized. Likewise, if you are just trying to heat an 800 - 1,200 square foot space, a smaller stove like the Ravelli or Englander will likely perform better.

Another consideration in stove sizing is recovery, or how long it takes to bring a cold home up to temperature. Smaller stoves will have a much longer recovery period than a large stove. A large stove with a good turndown ratio is ideal when considering the stove as a "whole home" heater. You get the best of both, quick recovery, but when demand is met, the stove can idle comfortably or if it has a thermostat, can modulate or even turn off and on as required.

## Turn down ratio

We also tested for turndown ratio, or the difference between the lowest and highest heat setting that gives the consumer the widest range of heat output. If the stove delivers 2 pounds of pellets to the hopper at its highest setting and 1 pound at its lowest, it would have a turn down ratio of 2.

The best stove for turn down ratio is the Harman which can burn almost 4 pounds of pellets at high and only 1.5 at low (Figure 6). The Enviro, Quadra-Fire and Ravelli also had good turn down ratios. Both the Piazzetta and the Englander would not turn down very low, using over 2 pounds of pellets per hour at their lowest settings. The Englander had a very narrow range, giving the consumer little control over the amount of heat (Figure 6).

BURN RATES (LBS./HR.)					
	AGH TESTED				
STOVES	LOW SETTING	HIGH SETTING	TURN DOWN RATIO		
England Stove Works 25- PDVC	2.43	2.67	1.10		
Enviro M55 insert	1.63	3.87	2.37		
Harman Accentra 52i insert	1.47	3.9	2.65		
Piazzetta Sabrina	2.28	3.97	1.74		
Quadra-Fire Mt. Vernon AE	1.41	3.08	2.18		
Ravelli RV80	1.47	3.06	2.08		

Figure 6. Burn rates at highest and lowest heat settings.

Length of burn

FULL HOPPER BURN (HR.)					
	AGH TESTED				
	LOW SETTING	HIGH SETTING			
STOVES					
England Stove Works 25-PDVC	15.25	13			
Enviro M55 insert	36.81	15.50			
Harman Accentra 52i insert	38.10	14.36			
Piazzetta Sabrina	26.54*	15.24*			
Quadra-Fire Mt. Vernon AE	49.65	22.73			
Ravelli RV80	19	8.17			

\*Piazzetta Sabrina only had one run on low and one run on high (not an average) Figure 7. Length of burn at highest and lowest heat settings.

We tested for how long the stove could burn on a single load of pellets at the highest and lowest heat setting (Figure 7). The longest was the Quadra-Fire. Its large hopper enabled it to burn for nearly 50 hours continuously on its low setting. The shortest was the Ravelli, whose small hopper only allowed an 8-hour burn at its highest setting (Figure 7). On a thermostat setting, stoves could go far longer since they would only be burning part of the time.

# Visibility of glass

The ability to see a nice flame is important to many consumers. Some stoves maintain clean glass far longer than others. No stove that we tested keeps the glass completely clean but the better stoves only got soot on the edges of the glass, leaving most of the middle of the glass clear. We consistently observed the Ravelli, the Quadra-Fire, and the Harman having the cleanest glass after many days of continuous operation. Next came the Enviro, and in the middle of the range was the Englander. The stove that was consistently the dirtiest, almost completely obscuring the flame after several days, was the Piazzetta. Even with a relatively good quality pellet, the Sabrina appears to need a quick glass clean on a daily basis, if the stove is operated around the clock.

We did not try to rate the quality of the flame or how well the consumer can see it based on the size of the glass. We only rated how much of the glass became obscured and the transparency of the obscuration. We took assessments of the glass after five to seven days of continuous operation three times during the thirty-day testing.

Stoves were assessed for glass visibility and cleanliness three times during the 30-day

testing period. Stove glass was assessed for two attributes: transparency and coverage. Transparency was measured by how well you could see through dirty glass and coverage was measured by how much of the glass was sooty. Transparency and coverage were given equal weighting in our scoring regimen. The whole glass panel was assessed although some of the stoves have features that conceal the dirtiest part of the glass, like the Enviro insert for example. The Piazzetta consistently had the dirtiest glass, while the Quadra-Fire and the Ravelli had the cleanest glass, week after week. Pictures were taken documenting the glass both before and after cleaning.

#### Cost savings with pellet stoves

Pellet stoves can offer great cost savings to consumers. With efficiencies in the 60s and low to mid 70s, however, cost savings compared to fossil fuels may be lower than expected, especially with lower fossil fuel costs in the 2015/16 winter.<sup>3</sup> But there are a few factors to keep in mind:

First, one of the biggest cost savings comes from only heating part of your house instead of the whole thing. By heating only the space where you spend the most time, you can avoid the energy losses that occur when piping air or water through a potentially leaky venting or pipe system throughout the house.

Second, make sure you are comparing apples to apples. Fossil fuel furnaces can also lose efficiency over time, especially if they are not sized or properly installed. A furnace rated at 80% or 90% may operate below that level and if the distribution system is old or poorly installed your 90% efficient furnace could actually only be delivering 70% of useful heat.

Payback periods are also very dependent on how much you use the stove. If you use your pellet stove 24/7 as your primary heat, and it is displacing an old, inefficient oil burner, payback times can still be in the 4-6 year range, assuming you are burning at least 3-5 tons of pellets per year. If you only burn 1 - 2 tons of pellets, and you still often rely on the old oil burner, payback times will be much longer. The Englander offers the quickest payback on your investment, potentially paying for itself in 2 years. However, it is not as powerful a stove as most of the others, so it does not have the capacity to displace as much fossil fuel as the higher output stoves, which may lead you to use your fossil fuel furnace or boiler even more.

Pellet stoves offer consumers the opportunity to save more than with wood stoves because it is easy to keep the stove running 24/7 and you can often avoid using your fossil fuel heater much more than with a wood stove. Pellet stoves are more likely to be used as a primary or sole heat source, making them a more effective technology to reduce fossil fuel use. In terms of savings, if you procure your own cordwood, it can be very cheap, but if you buy your cordwood, the savings compared to pellet stoves are often

<sup>&</sup>lt;sup>3</sup> See Short-Term Energy and Winter Fuel Outlook. Rep. U.S. Energy Information Administration, 6 Oct. 2015. Web. 23 Oct. 2015.

minimal.

Lastly, beware of heating calculators. Most calculators designed and used in the hearth industry use exaggerated efficiency numbers and some don't even disclose the efficiency numbers they use.

## Value

The six stoves we purchased ranged between \$1,200 and \$4,500. While the most expensive stove, the Quadra-Fire at \$4,500 got overall highest rankings, at \$1,200 the Englander is a stand out for value. The Englander may not be the prettiest stove, but it proved to be a solid performer with values comparable to far more expensive stoves in most of the categories we rated. Its burn pot and its glass needs more cleaning than the expensive stoves and it's a bit less efficient than some, but its reputation as a good stove appears warranted. The next most inexpensive stove, the Ravelli RV80 at just under \$3,000 also deserves mention as a good value. In addition to having a sleek European design, it has a very good view of the flame and solid performance numbers.

## **Hopper Size**

The size of the hopper is the biggest indicator of how long your stove will burn on a single hopper full of pellets. However, we found that with the exception of the Enviro, the manufacturers of the stoves we tested exaggerated their hopper size. Hoppers are measured in how many pounds of pellets they can hold, and there are slight variations in the density and dimensions of pellets that could account for small differences in measurements. We found the lid to the Enviro to be very narrow, making it difficult to load the pellets. The height of the two Italian stoves could make it harder to fill than the lower stoves, particularly for an elderly person.

An optimal hopper size should be at least 50-55 lbs. The reasoning behind this is this, if your hopper is 40 lbs and a bag of pellets is 40 lbs, you can only add a full bag of pellets when the stove is completely empty. Additionally, if you get a batch of low density pellets (pellets that occupy more volume by weight) having that extra 15 or so pounds to work with allows the entire contents of a bag and then some to be added when refueling is needed.

Hoppers are measured by the amount or weight of pellets able to be loaded into the stove at one time. Many of the stoves would register that there were no pellets in the hopper but still had a small amount of pellets that hadn't made it to the auger (i.e. pellets stuck on the sides or in crevices).

The Ravelli and the Piazzetta hoppers were measured when filled up to the metal screen inside their hoppers, as directed by the owner's manuals. The other 4 stoves did not have screens inside their hoppers. The other stoves were filled the maximum amount of pellets able to fit that would still allow the hoppers to close.

Claimed hopper size was higher than actual hopper size for all of the stoves, with the exception of the Enviro, which claimed the exact hopper size that was measured (60lbs.). The largest difference in hopper sized was observed with the Harman, having a claimed size of 64.5 lbs. but an actual size of 56 lbs., based on the pellets that we had. Our pellets were average density, measured at 43 pounds per cubic foot.

Hopper size can be very important to consumers and hoppers that can fit at least 50 pounds allow you can refill them with an entire 40-pound bag before the stove goes out. Some consumers may think that a 40-pound hopper would be the ideal for 40-pound bags. But aside from manufacturers exaggerating hopper size, the stove would have to run out of pellets each time for a 40-pound hopper to be useful.

# **Pellet Fuel**

We chose a widely available pellet that is sold through big box stores in an effort to use a representative fuel that is neither among the most expensive, nor the least expensive. We used a premium grade pellet by the Pellet Fuels Institute (PFI) Standards Program and had it independently tested at a third party lab to further check its moisture and ash content. We bought two batches of the same brand of Curran pellets. The first batch tested at 3.7% moisture content and 0.67% ash content. The second batch had 5.47% moisture content and 0.56% ash content. We encourage consumers to look for PFI graded pellets as this provides an assurance that the pellet meets quality control standards. PFI certification is likely to provide even more assurances for consumers buying less expensive pellets than it is for those who buy the most expensive ones.

# **Stove Description**

These six stoves cover a wide range of technology, price, and performance values. The details provided here represent the overall score from the month-long testing we conducted, the price we paid for each stove, the size of the hopper we measured and our calculated maximum heat output (BTU per hour). We also supply the size and warranties for each stove, retrieved from manuals and manufacturer websites.

# Quadra-Fire Mt. Vernon AE

- AGH Score: 4.0/5.0
- Price: \$4,239
- Hopper: 70 lbs.
- Maximum Heat Output: 17,047 BTU
- Size: 28 7/16" W x 32 5/16" H x 29 1/16" D
- Warranty:
  - 3 months (parts and labor): all replacement parts beyond warranty period
  - 1 year (parts and labor): all parts and material except as covered by Conditions, Exclusions, and Limitations listed in manual



- 2 years (parts and labor): igniters, electric components, glass, factory installed blowers
- 3 years (parts and labor): firepots and burnpots
- 5 years (parts and 1 year labor): castings and baffles
- 7 years (parts and 3 years labor): manifold tubes, HHT chimney and termination
- Limited Lifetime (parts and 3 years labor): firebox and heat exchanger

## Harman Accentra 52i insert

- AGH Score: 3.8/5.0
- Price: \$4,199
- Hopper: 56 lbs.
- Maximum Heat Output: 21,586 BTU
- Size: 41 13/16 " W x 32 1/8 " H x 29 5/16" D
- Warranty:
  - 3 months (parts and labor): all replacement parts beyond warranty period
  - 1 year (parts and labor): all parts and material except as covered by Conditions, Exclusions, and Limitations listed in manual
  - 2 years (parts and labor): igniters, electric components, glass, factory installed blowers
  - 3 years (parts and labor): firepots and burnpots
  - 5 years (parts and 1 year labor): castings and baffles
  - 7 years (parts and 3 years labor): manifold tubes, HHT chimney and termination
  - Limited Lifetime (parts and 3 years labor): firebox and heat exchanger

# Enviro M55 insert

- AGH Score: 3.5/5.0
- Price: \$4,349
- Hopper: 60 lbs.
- Maximum Heat Output: 21,420 BTU
- Size: 25" W x 23" H x 16" D
- Warranty:
  - 1 year: ceramic glass covered against thermal breakage, steel brick liner, exterior surface finishing, labour
  - 2 years: parts, firebox brick panels, burn pot liner, electrical components
  - 5 years: exterior panels (excluding finish)
  - Limited Lifetime (7 years): firebox, heat exchanger, burn pot, firebox liner panels with insulation, pedestal/legs and surround panels (excluding finish)





### Ravelli RV80

- AGH Score: 3.3/5.0
- Price: \$2,905
- Hopper: 27.9 lbs.
- Maximum Heat Output: 16,937 BTU
- Size: 512 mm W x 990 mm H x 484 mm D
- Warranty:
  - Covers defects of manufacturing materials
  - Not covered: vermiculite (Firex 600), glass of the door, fiber gaskets, painting, stainless steel combustion basket, resistance, cast majolica
  - "Guarantee" or Warranty coupon must be sent within 8 days of purchase to Ravelli srl in Italy

## Piazzetta Sabrina

- AGH Score: 2.5/5.0
- Price: \$3,299
- Hopper: 60.5 lbs.
- Maximum Heat Output: 21,973 BTU
- Size: 25" W x 46" H x 21.3" D
- Warranty:
  - Enclosed with the product

### **England Stove Works 25-PDVC**

- AGH Score: 2.2/5.0
- Price: \$1,199
- Hopper: 37 lbs.
- Maximum Heat Output: 14,778 BTU
- Size: 22 5/8 " W x 28 1/4 " H x 24" D
- Warranty:
  - 1 year: hopper, auger burn pot, baffle plate, auger shafts, auger bearings and fasteners covered against cracking, breakage and welded seams from separating; electrical components, accessory items, glass and the painted surface
  - 5 year: carbon steel and welded seams in the firebox covered against splitting and cast iron door/hinges covered against cracking







#### **Rebates and tax incentives**

Currently, there is no federal tax credit for wood or pellet heating appliances but the \$300 tax credit that expired in December 2014 may be reinstated later this year.

Eight states provide rebates or tax incentives in some form for pellet stoves. The program in Montana and New York requires the trade-in of an old wood stove (except for low income families in NY). The Oregon program is only \$288 unless the manufacturer disclosed their actual efficiency, which can bring the amount up to \$1,500. The Maryland program is a straight \$700 rebate and Maine provides a \$500 rebate. Idaho provides up to a \$20,000 tax deduction. Arizona requires the retrofit of an existing fireplace and Alabama requires the conversion from gas or electricity to primary wood or pellet heat. For low-income households, the New York program is very generous, offering a \$2,000 rebate and an additional \$500 to turn in an old wood stove.

Several states require pellet stoves to emit no more than 2 or 2.5 grams an hour, which would make the Englander and Ravelli ineligible for incentives in Maine, Maryland, Oregon and New York. The Piazzetta would be ineligible in Maryland and New York. The Harman, Enviro and Quadra-Fire would be eligible for rebates and incentives in all states, because they are all tested to EPA standards at less than 2 grams an hour. None of these companies disclose their actual efficiencies to the EPA, so in Oregon, they would be limited to the \$288 rebate amount.

Most programs require professional installation.

### **Consumers Recommendations**

#### General recommendations for consumers

The ratings we provided on six popular pellet stoves should help you think about attributes that are important to you and help you in doing further research and asking the right questions of retailers.

A. **Purchasing:** Buy from a reputable, local dealer who can service your stove. If you buy from a big box store, be prepared to do more of your own troubleshooting. There is also value in buying a popular stove that has been on the market for a number of years, which helps to ensure that the local dealers are really familiar with it. If a stove dealer near you does not service the stove you buy, it may be very hard to get service and repairs. The Englander that we tested is an example of an excellent value stove sold in chain hardware stores that do not service the stoves they sell. One reason Englander is such a popular brand is that the company offers good phone tech support to its customers, although wait times can be longer during the peak months of the heating season. Unlike wood stoves, most pellet stoves need repairs periodically during the first 5 years of their life and they also need annual professional cleaning, unless you are "handy" and prepared to undertake a substantial cleaning effort.

- B. Pellets: Be prepared to buy pellets early, store them properly and make sure the pellet works well in your stove. We used a medium priced PFI certified pellet sold in big box stores in New England. We paid \$250 a ton in the middle of the summer for four tons and bought more in the fall. It's important to buy a few bags of a brand before buying several tons, to ensure that the pellet is a high enough quality to work in your stove. We recommend sticking to pellets that are PFI certified if you are buying less expensive pellets in big box outlets. Most pellets that sell for \$300 and over are likely to be a better quality pellet that will not clog up your burn pot too quickly. Recent years have seen pellet shortages in the middle of the winter, partially because more and more people are buying pellets early in the season, depleting supplies. If you can, take advantage of lower prices in the summer and early fall, and store them off the ground in a dry, covered space.
- C. **Installation:** We recommend having your stove installed by a professional who is certified by the National Fireplace Institute (NFI) or the Chimney Safety Institute of America (CSIA), or in Canada, Wood Energy Technology Transfer (WETT). Installing pellet stove inserts can be particularly difficult. The Enviro would be particularly complicated for homeowners to install, but the Englander, for example, is feasible, if you follow guidelines very, very carefully. Check with your county or town about whether you need a permit to install it and/or an inspection once it's installed. Also check with your insurance company.
- D. Research: Our reviews only covered 6 stoves and did not cover reliability. We tested the stoves intensively but only for one month. Almost all pellet stove brands need repairs in their first 3 4 years of service, and some even more. It is important for consumers to research pellet stoves and it is not a simple task, as there are virtually no other independent reviews except for one 2009 review by Consumer Reports. The Harman P68 and Napoleon NPS40 came out on top. They also rated 6 stoves, but did not test for emissions or efficiency. Neither we nor they tested for noise. We provide some guidance for which sites may be more helpful to research a pellet stove purchase. Most accept advertisements from the brands they review and that may impact their reviews on some of the sites.

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#### Disclaimers

This report represents the view of the authors, based on testing conducted by the Alliance for Green Heat. Except where noted, it does not represent any of the pellet stove manufacturers' opinions or statements. Statements in this report are solely intended to inform the public of the results of our testing and are not intended to provide legal advice.

This report does not constitute an endorsement of any of the stoves evaluated, but is merely a report of our evaluation of the stoves under the five characteristics measured. The rankings in this report are based on our own judgment, as informed by the data obtained through our testing.

This rating of pellet stoves was conducted to be fair and impartial. However, certain things should be kept in mind that could have impacted the performance of any of the stoves.

- 1. We tested only one model of each stove and it is possible that characteristics we documented in the stove do not appear in other stoves of the same model.
- 2. We tested only with a single brand of pellet to ensure that we could compare results between the stoves as best as possible. Lower or higher quality pellets may produce different results.
- 3. The rating criteria we chose impacted which stoves received higher scores. If we had cleaned the stoves every day or two, for example, the ratings may be different. These ratings are specifically based on infrequent cleaning. Other criteria influenced the outcomes in various ways.
- 4. We tested all the stoves on their manual modes instead of using the thermostat functions that most of the stoves have. Thus, the stoves ran continuously at the settings we selected and did not cycle on and off, depending on the heat desired in the room.
- 5. We installed vent pipes that had vertical runs for about 7 feet before a 90 degree elbow that exited out the side of the structure. Test labs use far longer venting systems, and homeowners use a myriad of installation configurations, all of which could impact combustion performance.
- 6. During the first week of our testing, in early September, the ambient temperature outdoors was in the low 90s and the temperature around the stoves during testing was as high as 120. Throughout the month, the stoves were operated close to each other, but temperature in the testing area was typically in the upper 70s to the low

90s. Providing hotter intake air and hotter air surrounding the stove could impact performance (although it may be more likely to improve performance).

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The Alliance for Green Heat promotes modern wood and pellet heat as a low-carbon, sustainable and affordable residential energy solution. The Alliance works to advance cleaner and more efficient wood heating appliances and focuses on low and middle-income families. Founded in 2009, the Alliance is a 510(c)(3) non-profit organization based in Maryland.