The Efficiency Rating Conundrum

There are many methods of measuring and reporting the efficiency of heating equipment.

In their promotional literature heating equipment manufacturers often use the rating method that implies the highest efficiency though it may not be the one most useful in comparing one system to another.

In the United States, **"steady state"** or **"combustion"** efficiency is often given by heating equipment manufacturers. This rating indicates the percentage of the total possible heat that is available in the particular fuel that is produced by a burner when it is burning at a continuous or steady rate. It merely evaluates the efficiency of the combustion process but does not measure the design effectiveness or long-term (seasonal) efficiency of the heating system. Independent tests of heating equipment usually use the **Annual Fuel Utilization Efficiency** (**AFUE**) rating which is considered a more accurate evaluation of how well the system is designed to deliver heat to the structure over a long period of time. This measurement evaluates both the combustion efficiency and, to some extent, the **effectiveness** of the heating system. It considers various design features (such as sealed combustion) and evaluates "standby" loss through the heating system (heat that leaves the structure when the heater is not operating).

In some countries (Japan and some European countries), manufacturers provide efficiency ratings based upon **the assumption that all vented heating systems necessarily lose about 6% of the heating potential** of the fuel (latent heat of vaporization) to vaporize the water produced by the combustion process (Hydrogen plus Oxygen yields H2O). In the U.S., it is understood that only condensing systems that are designed to intentionally extract enough heat to cool and condense the water vapor can achieve measured efficiencies greater than approximately 88% (called condensing systems). In countries whose practice is to assume the water vapor heat loss, a 100% efficiency translates into about 94% by US reckoning. Thus, a declared efficiency rating of 93% by this method would be equivalent to about 87% by the U.S. method. Some Japanese-made direct-vent space heater manufacturers (Toyotomi and Hitachi/Monitor) continue to use these efficiency ratings as do some European companies that sell "efficient" free standing oil stoves.

To compare efficiency ratings of various types of heating systems or water heaters, you must know what type of "efficiency rating" is being provided. They are not all the same!! For example, a Japanese or European made space heater with a manufacturer's efficiency rating of 93% is likely NOT more efficient than a similar product with an AFUE of 86%.

Types of Heat Transfer

- Radiant
- Convection
- Conduction

Nor is efficiency the whole story. Some systems with high combustion efficiency ratings may not be very practical or **effective** for your particular heating application. Some efficiency ratings do not consider other system design factors than can significantly impact your comfort and your heating cost. To compare "efficiency" you must also determine which method of heat transfer and distribution best suits your situation: **radiant, convection, or conduction.** Further, you should try to determine and evaluate various design features of the stoves or heating systems that you are comparing. Does it use outside air for combustion? Does it have electronic ignition or a standing pilot light? Can it be thermostatically controlled? Automatic On and Off or manual? Does it have a setback option?

Radiant

Radiant heaters transfer heat like the sun through infrared rays. The heat is absorbed or felt by the things and people close to the heat source or in the path of the infrared radiant heat rays. The closer to the source, the more heat absorbed. Wood burning stoves, fireplaces, and most electric heaters provide heat in this manner.

Convection

Convection heaters are designed to transfer heat into the air that passes through the heater or its heat exchanger. This hot air will then passively rise or can be "forced" to move by fans and can be distributed here and there though ducts. (Forced air furnaces). Some convection heaters also have fans that assist the flow of air through the heater. Usually convection heaters try to induce a "circular" flow or air in space to be heated and utilize the principle that hot air rises and cool air falls. (Convection loop).

Conduction

Heat can also be transferred by **conduction**. Heating devices that heat water usually do so through conduction. Conduction is what happens when a cool material (such as your finger) meets a hot material (such as a stove). Heat is transferred quickly and effectively. Heat transferred by conduction into water can then be distributed though pipes etc. and that heat is then often transferred by convection devices (baseboard or fan coils), radiant devices, or conduction (radiant floor heating.).

It can be argued that all heating systems utilize all methods of heat transfer somewhat. However, heating systems are designed to utilize one primary method.

Heating capacity of various fuels

1 Therm Natural Gas	= 100,000 BTU
1. Gal. Propane	= 92,000 BTU
1 kWh Electricity	= 3,413 BTU
1 Ga. #1 Fuel Oil	= 133,000 BTU
1 Gal. #2 Fuel Oil	= 140,000 BTU

Fuel Considerations

In some areas, it is also wise to **consider various fuel options** when evaluating the cost of heating your home. In many places, **the cost of the available fuels can vary tremendously**. Remember too that units of measurement vary from one fuel to another. The important information to know is how much heating potential are you getting for money you spend. For example, one gallon of propane has approximately 92,500 British Thermal Units (BTU's) of heat potential (at 100% combustion efficiency). One gallon of #1 heating oil has 133,000 BTU's of heating potential. Therefore, if the price per gallon is the same, you are paying much more for the heat from the propane. Be sure to compare equal amounts of heating potential (BTU's) and the correct cost for those heating units. In regions where, natural gas is readily available, the standard unit for comparison is the therm that is equal to 100,000 BTU's. It takes about 29 kilowatt hours of electricity to equal a therm. A gallon of #1 heating oil equal 1.33 therms. Etc.

Conclusion

To determine the most cost-effective heating system for your area; **first compare fuel costs for available fuels.** Include in this evaluation the delivery issues involved. When comparing heating systems be sure that you understand **the basis for each system's efficiency rating and compar**e – if possible – ratings of the same type. Also, be sure you evaluate the **energy saving design features** of the systems. Determine how the systems **distribute heat** and whether that method will meet your needs. Last, but not necessarily least, consider safety, convenience, and aesthetic characteristics – ease of use, color, noise level, and attractiveness.