

It All Boils Down to Efficiency, by Carla L. Romita The Mann Report, March 2007

Most people think they understand what boiler efficiency means. They know it impacts their fuel consumption and, therefore, their costs. What most people do not know is that there are three different types of boiler efficiency: combustion efficiency, steady state efficiency, and seasonal efficiency.

Combustion Efficiency - Combustion efficiency measures how efficiently fuel is burning in the boiler. Some conditions that negatively affect combustion efficiency are using an oversized nozzle, accumulated debris on the burner fan, and improper air adjustment during combustion. When there is more air than needed for combustion, the extra air becomes heated and is discharged into the atmosphere. If that air is being heated, the water inside the boiler is not. Too little air during combustion can give rise to carbon soot deposits inside the combustion chamber or even the boiler tubes. Soot deposits on heat transfer surfaces act as insulation and prevent effective transfer of heat to the boiler water, resulting in reduced efficiency. Too little air can also cause flue gases to build up inside the boiler and create a potentially dangerous situation. Therefore, many boiler operators choose to adjust their burners to have slightly too much air.

Steady State Efficiency - Steady state efficiency refers to how efficiently the boiler uses the heat from combustion when operating under the full-load demand of the boiler. Installing the largest possible boiler in the building is the most common reason for lack of steady state efficiency. When a boiler is too large for the structure, it will cycle on and off frequently. This condition, called "short cycling," creates a loss of efficiency because the boiler never reaches a level of steady state. When the boiler shuts down, heat from the boiler room continues to flow through the boiler. This air is drawn up through the chimney and cools off the boiler. When the boiler turns on again, it must reheat the water back to operating temperature. The worse the short cycling, the more downtime heat loss occurs and the lower the efficiency will be.

Seasonal Efficiency - Seasonal efficiency refers to how efficiently the heating system burns oil throughout the entire heating season. This is ultimately the efficiency of greatest concern to property owners and managers. Optimum seasonal efficiency can only be realized if the boiler and heating system are properly designed for application in the particular building in question. As indicated, the longer a boiler operates, the higher its seasonal efficiency will be. Therefore, a boiler that is somewhat smaller than required will more closely match the heating load of the building for the greatest part of the heating season because it will experience less short cycling. Some experts recommend that instead of just one large boiler for a new heating plant installation, two smaller boilers be installed. Each smaller boiler would have half the required capacity. When the first boiler can no longer keep up with the heat loss, a second boiler picks up the additional load. If three boilers are used, each would have one-third the capacity necessary to heat the building. In installations like these, each boiler cycle one-half to one-third less time than a single boiler, thereby increasing the seasonal efficiency. In order for this to work properly, the boilers must be isolated from each other so that the non-operating boilers would not contain hot system water.

In multiple boiler systems, the first (or lead) boiler will handle the heating requirements on the first cool day. Then, as the outdoor temperature drops, the second boiler will fire, and so on. The key to maximizing the efficiency is isolation of the individual boilers. There are advantages of multiple boiler systems. Multiple boiler systems will still function even if one of the boilers needs to be taken out of service. The piping system for multiple boilers will bring the coolest return water equally to each operating boiler, thus increasing efficiency.

When a building has a boiler that old but is not ready for replacement, there are still ways to increase seasonal efficiency. Since cold replacement water, which costs money, must be heated, and the lime that is deposited when the water is heated can coat boiler surfaces, thus reducing efficiency, all boiler leaks should be eliminated. Additionally, heavily limed boilers can fail. From a cost point of view, even a 1/16" layer of scale on inner boiler surfaces can markedly reduce efficiency. Water filters and chemical water treatment are also therefore recommended.

The above is a generalized description of improving heating plant efficiency. It should not be interpreted as advice concerning to your particular building's needs. You should seek the advice of a reputable technical heating professional who can properly inform you of the appropriate measures that you may take to improve seasonal efficiency in your building's heating plant.