



Part load Heating: Savings on Capital Investment and on Fuel

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Community leaders and business owners in the Northeast regularly confront the question, “Is the time right for me to replace my large fossil fuel heating system with a pellet-fired system for the savings that are available in fuel prices?”

This question is generally followed by a cost-benefit analysis in which the capital investment required includes the full replacement of the oil-based system. When the analysis results in an acceptable payback term for the community, institution, or business, the project is completed. When the fuel cost difference doesn’t lead to a payback period that satisfies the decision-makers, the project is put on hold for another time.

While the question is often considered a simple one with only two possible system configurations, all oil or all renewables, there is a third option that deserves careful consideration when doing a cost-benefit analysis to decide when the time is right for your organization to switch to renewable fuels for all the benefits that entails. A part- load capacity renewable heating system has most of the fuel savings benefits of full system replacement with only 60-70% of the capital costs.

Part-load capacity heating simply means the creation of a hybrid heating system in a building through partial replacement or supplementing of the existing fossil fuel system with a pellet boiler system. To consider part load heating, imagine a commercial building with a peak load demand of 2,000,000 BTU/hour. That means that on the coldest days of the year, the total heating system would be required to provide 2MM BTU/hour to meet the heat needs of the building’s occupants. Therefore, the installed total heating system must be able to provide that amount of heat.

However, in the climates of New York and New England, most of the heating over the course of a year is done at temperatures of 25°F, or higher, when only 1,000,000 BTU/hour or less would be required to heat the same building. So, if the building were retrofitted with pellet boilers to provide up to 1MM BTU/hour and retained oil boilers to provide up to 1MM BTU/hour additional heat during the coldest days of

the year, the pellet boilers would provide between 92% and 94% of the heat required for the building over the course of the heating year. The pellet boilers would operate during the entire heating season providing all the heat for the building down to an outdoor temperature of approximately 20°F. Below 20°F the pellet boilers would continue to operate at maximum capacity but would the heat would be supplemented by the oil-fired boilers only as necessary to make up the different between the pellet boiler capacity and actual heating load.

In our geographical region, this hypothetical building would have heat provided during 4838 hours (the number of hours/year that outdoor temperature is below 55°F) over the course of the year providing a total of 3,144 MM BTUs. For most of New England and Upstate New York, there are only about 850 hours during the heating season when the outdoor temperature is below 25°F.

Assuming comparable efficiencies for large oil boilers and pellet boilers, fuel consumption for those 3,144 MM BTUs would be as follows:

Annual Fuel Consumption for All-pellet or All-oil Boiler Options

Fuel	BTU/unit	BTU demand/yr	Consumption
Pellet	16MM/ton	3,144 MM	245 tons
Oil	138,700/gallon	3,144 MM	28,334 gallons

Pellet only retrofit model

With a retrofit of pellet boilers for the entire heating load, savings would be driven by the difference in cost of energy between pellets and oil. For example, if the difference in price between pellets and oil in fuel cost reduction/gallon equivalents were \$1/gallon, the savings realized by a complete conversion from oil to pellets would be \$28,334/year (28,334 gallons * \$1).

The payback period then, on a full-system replacement would be

$$\text{capital costs}/\$28,334$$

The payback term on a full-system replacement assuming boiler replacement was necessary anyway would be

$$\frac{\text{capital cost, pellet boiler installation} - \text{capital cost, oil boiler replacement}}{\$28,334}$$

Hybrid retrofit model

Retrofitting this model building with pellet boiler capacity to handle 50% of the peak demand, or 1,000,000 BTU/hour, while leaving an oil boiler in the system to provide heat when higher demands are present would produce surprising results. Capital savings can be 30-40% over a complete retrofit, but fuel savings do not drop proportionally because *in our climate 92-94% of the heat load of the building is provided by the pellet boiler having capacity equal to 50% of the peak heating load of the building.* That is, in this example the pellet boilers would provide the vast majority of the heat required for the building over the course of the year. Fuel consumption for this building under each of the three retrofit scenarios in a typical year in the New York/New England region, are represented in the chart below.

Fuel	Total heat load	Oil consumption	Pellet consumption
Oil system	3,144,000,000 BTU	28,334 gallons	0 tons
Pellet system	3,144,000,000 BTU	0 gallons	245 tons
Hybrid system*	3,144,000,000 BTU	2062 gallons	228 tons

*assumes pellet boilers provide 1MM BTU/hour and oil provides 917,000 BTU/hour

With a retrofit of pellet boilers for half of the heat demand (baseload) savings would again be driven largely by the difference in energy cost between pellets and oil. If the difference in price between pellets and oil in fuel cost reduction/gallon equivalents were \$1/gallon, the savings realized by a part load conversion from oil to pellets would be \$26,272/year, or 92.7% of the savings for 60-70% of the capital investment.

Summary

When considering retrofits of existing oil heated commercial or institutional facilities, decision-makers should carefully consider the hybrid model in which pellet boilers provide 50% of the heat load and an efficient oil boiler provides the additional heat during the very small part of the year when 50% heat load is insufficient. Capital costs for the retrofit are substantially reduced and fuel cost savings are nearly as good as with a full system retrofit.