1990-512-473
November 1990

Improving the Efficiency Of Your Oil Heating System[1]

U.S. Department of Energy[2]

THREE STEPS TO SAVING MONEY AND ENERGY WITH OIL HEATING SYSTEMS

If you heat your home with oil, you may be able to save over $400 per year in energy costs by having your heating system tuned up or replaced. Regular maintenance and servicing will keep your furnace or boiler operating at peak efficiency. In addition, new oil heat technologies, available as equipment retrofits to existing heating systems, and as new high efficiency furnaces and boilers, require substantially less oil to provide your heating needs while reducing harmful pollutants considered by many to cause global warming due to the "greenhouse" effect (Figure 1).

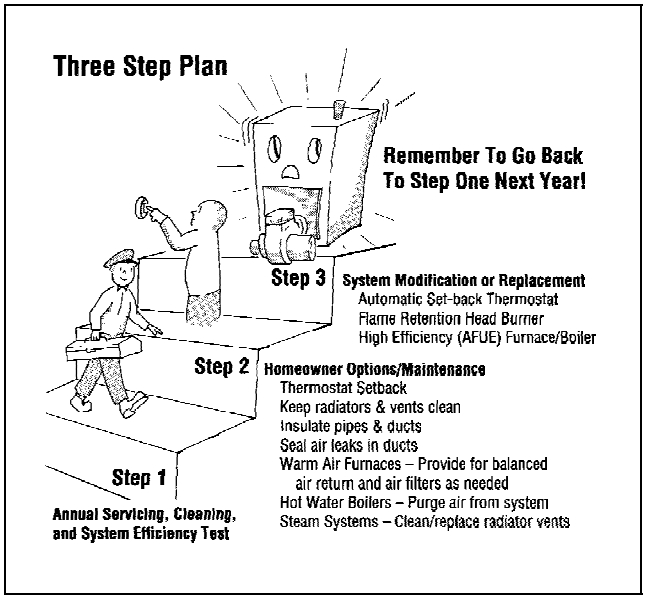

Figure 1. Three Steps to Saving Money and Energy With Oil Heating Systems.

The First Step: Annual Servicing and Cleaning

The first step towards a more efficient heating system is to have your furnace or boiler inspected by your fuel oil dealer or qualified service technician. All oil fired heating systems should be cleaned, tuned, and tested at least once a year. The tuneup should include brushing and vacuuming the heat exchanger to remove any soot buildup. In addition, the tuneup should include checking all components for wear and replacing items as required. The oil filter should be replaced as a matter of course, and in most cases efficiency will be improved by installing a new oil spray nozzle in the burner unit and adjusting the system for clean operation and maximum efficiency. The service technician will test the operating performance of your combustion system, and should leave you a record of the final readings and the "combustion efficiency" level. He should also adjust the controls on the boiler or furnace to provide optimum water and air temperature settings for both efficiency and

1. This document is 1990-512-473, from the U.S. Department of Energy, Assistant Secretary of Conservation and Renewable Energy, Office of Building Technologies, Washington, DC 20585. Publication date: November 1990.

2. Prepared for the U.S. Department of Energy, Assistant Secretary of Conservation and Renewable Energy, Office of Building Technologies, Washington, D.C. 20585. Prepared by Brookhaven National Laboratory, Associated Universities, Incorporated, Department of Applied Science, Upton, New York 11973, Under Contract No. DE-AC02-76CH00016.

comfort. At this time you may wish to discuss which efficiency upgrade options are recommended for your system, how much energy they can save, and how much you can expect to pay for their installation.

In addition to servicing your furnace or boiler, the technician should check the condition of your chimney and flue connector pipe. Parts of the venting system may have deteriorated over time and without proper maintenance could cause problems. It is important that the vent also be examined with regard to its size if a new high-efficiency furnace or boiler will be installed. Most older units are oversized. It often happens that when they are replaced, the vent and flue are much too big in diameter for the new furnace or boiler. In masonry chimneys, the system should be fixed by installing a chimney liner of the recommended size and any voids should be backfilled with high-temperature insulation.

The Second Step: What You Can Do Yourself

There are a number of things that you, the homeowner, can do to save money in heating your residence. An immediate energy saving action is to turn down the thermostat temperature set-point. The problem is in remembering to do so whenever the home is unoccupied and every night when people are asleep. This is why many people choose to have an automatic setback thermostat (Figure 2) installed that does the job for them. The saving that can be realized depends on how far the room temperature is reduced and for how long. With a typical house you could save over $60 a year by using a 5 degree setback over an eight hour period. If senior citizens or very young children occupy your home, please check with your physician before making any large reductions in room temperatures. (You may want to consider supplemental heating or separately controlled heating (zoning) of the involved occupant's living space.)

Significant savings also can be achieved through regular homeowner-performed maintenance of the oil heating system. Depending on the type of system installed, the following maintenance items should be undertaken.

For Hot Water and Steam Boiler Systems

If your home has traditional cast-iron radiators, adding reflectors behind the radiators increases the amount of heat directed into the room. Keep radiators and baseboard units clean, as dirt and dust

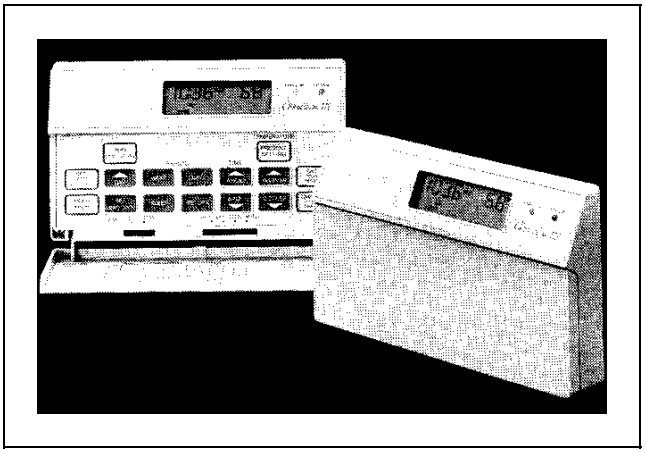

Figure 2. Automatic Set-Back Thermostat - Saves 3% Per Degree of Set-Back Over a 24-Hour Period.

resist heat and reduce heat output. Radiator covers also block air flow and should be removed if insufficient or uneven heating is a problem. Arrange your furniture and draperies so they do not block or obstruct vents, radiators, or hot water baseboard units.

Hot pipes passing through unheated areas, such as attics or crawl spaces, should be insulated. First check for water leaks, and make sure these are repaired. To insulate pipes, you can use specially made foam tubing (NOT with steam pipes because the heat can melt the foam), or strips of 7½ inch wide fiberglass batts folded and stapled around pipes. Wear protective clothing, gloves, and a respirator mask to avoid contact with fiberglass and other insulating materials that can be irritants.

Bleed air out of hot water radiators once or twice each heating season. Open the small valve at the top of the radiator and place a bucket or cup under it to catch the water. BE CAREFUL, AS THE WATER COULD BE HOT. After the air is eliminated, and only water is draining, close the valve.

With steam radiators, make sure air vents are working. These are small metal cylinders on the side of each radiator that hiss when hot steam fills the radiator and pushes the air out. If the radiator heats up and no steam comes out of the vent, the vent is functioning properly. if steam blows out the vent, it should be replaced. If the radiator does not heat up, unscrew the vent from the radiator and try to blow through it. If you can't, try to unclog the vent by boiling it or soaking it in vinegar, or replace it with a new unit of the same venting capacity.

For Forced-Air Furnace Systems

Change air filters in a forced air furnace once a month. If your system has a permanent air screen instead of filters, periodically check the screen and vacuum and/or wash it when necessary. If forced air enters the room through an inconveniently located register, such as under a piece of furniture, direct the air into the room with an air deflector. Registers should be vacuumed or dusted. Do not block them with carpeting or furniture. Closing registers in unoccupied rooms can divert heat to the occupied areas of the house, but may also upset the heat distribution system.

Like the pipes for steam and hot water systems, hot air ducts should be insulated where they pass through unheated spaces. First, seal any joints leaking air with duct tape. To locate the leaks, turn the furnace fan from "Auto" to "On" at the thermostat. Remember to turn it back to "Auto" when you are finished. Ducts should be insulated at least to an R7 value. Use foilfaced fiberglass batts, wrapping the ducts so that the foil is outside. Seal the seams and any exposed fiberglass with duct tape. Where heating ducts run through an unheated basement, an alternative to insulating the ducts is insulating the basement walls and caulking basement windows. This not only will save energy, it will also make the basement more useful, as heat lost from the ducts will also warm the basement instead of being lost through the foundation. Using insulation with an R-value of at least R8 is suggested. Always wear gloves and a respirator mask when handling fiberglass.

In houses where each room does not have its own return register (the majority of cases), pressure imbalances can occur between rooms when doors are closed. This wastes energy by increasing the rate at which warm air leaks out of the house and cold air leaks in. Undercutting doors or otherwise providing a free air path for air to move from closed rooms to the common return register (typically located in a hallway or other common space) can solve this problem. A space of at least 1/2 inch between the bottom of the door and the top of the rug pile is recommended.

The Third Step: System Modifications or Replacement

Improvements in oil heating system technology in recent years provide an opportunity to upgrade older heating systems, through retrofit or complete replacement, producing significant savings in annual energy costs to the homeowner.

Retrofit of Existing Systems

If your system is older (pre-1975), in good shape, but does not require complete replacement, a flame retention head burner (Figure 3) retrofit is one of the most cost effective upgrades available, often paying for itself in one to two years. The flame retention head burner does a much better job mixing the fuel spray with the air supplied for combustion. It then burns the mixture in a cleaner and more controlled manner requiring less excess combustion air, resulting in lower heating costs and reduced air pollution out of the chimney.

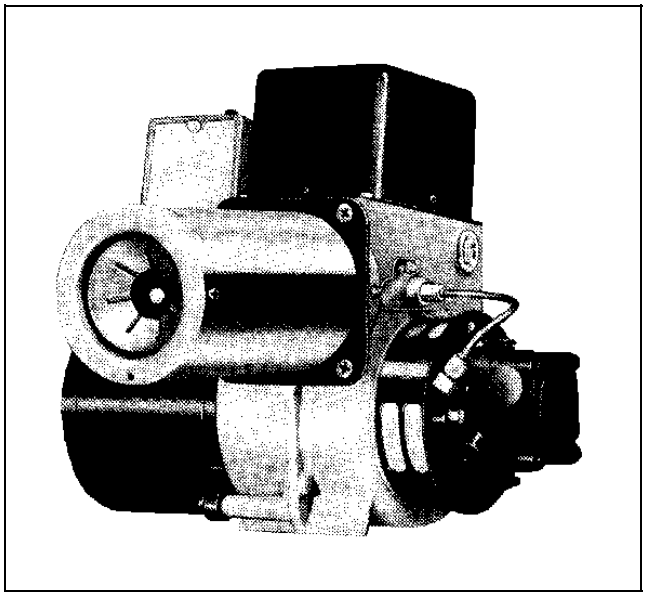

Figure 3. Modern Flame Retention Head Burner - Typical Savings 15 - 20%.

If a flame retention head burner cannot be installed, you should consider system replacement as discussed in the next section.

Many heating systems have a much larger heating capacity than that required even on the coldest day of the year. This causes the unit to use more fuel than otherwise needed. Derating the system by installing a smaller fuel nozzle, and properly adjusting the air/fuel mixture can save significant amounts of energy. Derating steam boilers is generally not recommended, and special attention must be given to derating hydronic heating systems which also supply domestic hot water so that an adequate hot water delivery rate is maintained. Excessive derating can also lead to problems with flue gas/water condensation and corrosion in the heat exchanger or chimney.

Retrofit of existing heating systems should only be performed by qualified heating service personnel. Homeowners should not attempt to perform retrofits themselves.

Heating System Replacement

Replacing an older heating system with a new, energy efficient furnace (Figure 5) or boiler (Figure 4) involves a substantial initial expenditure that pays off over the long term with yearly energy costs savings, lower maintenance expenses, and improved reliability. The cost effectiveness of buying a new unit depends on: (1) your present furnace or boiler condition and efficiency; (2) the new equipment efficiency, initial cost, and anticipated maintenance cost; and (3) your present annual heating cost.

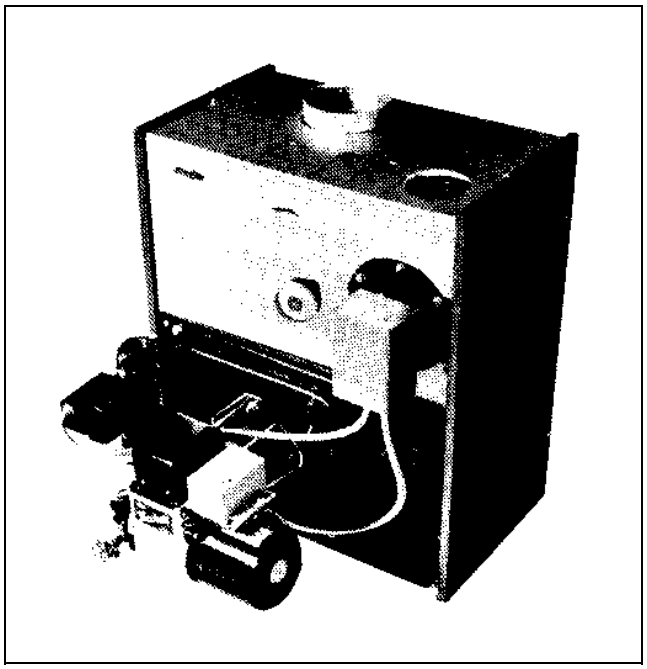

Figure 4. High Efficiency Replacement Oil-Fired Boiler - Typical Savings 20 - 40%.

The Federal Trade Commission requires that all new furnaces and boilers be tested and given an Annual Fuel Utilization Efficiency (AFUE) rating (Figure 6). The AFUE efficiency is a measure of seasonal or annual efficiency of a furnace or boiler. It takes into account the cyclic on/off operation and associated energy losses of the heating unit as it responds to changes in the load which in turn is affected by changes in weather and occupant controls. The heating unit can cycle on and off thousands of times in a single year. For this reason AFUE efficiency ratings are lower than "combustion efficiency" ratings measured in the field. The AFUE rating is very important when selecting a new heating system, and you should ask your supplier or dealer for the manufacturer's information listing the AFUE efficiency numbers. The AFUE efficiency information also includes estimated annual operating costs and is intended for comparison of different makes and models of boilers and furnaces, just like automobile gas-mileage figures. Ask your dealer or heating contractor for the manufacturer's "Energy Guide," fact sheets, and product literature sheets with the AFUE ratings for any heating systems you are considering for purchase.

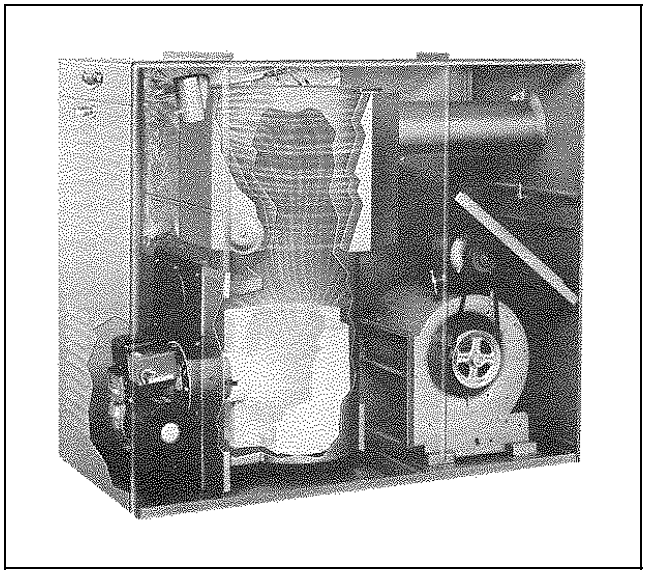

Figure 5. High Efficiency Replacement Oil-Fired Warm Air Furnace - Typical Savings 20 - 40%.

Beginning January 1, 1992, all furnaces and boilers manufactured for installation in houses in the U.S. must have a minimum AFUE rating of at least 78 percent under the National Appliance Energy Conservation Act of 1987. Many models available today already meet this standard, and it is suggested that as a minimum you should be looking for an AFUE efficiency level of at least 80% when replacing your heating system. AFUE ratings for presently available models are as high as 90 percent for oil fired furnaces and 89 percent for boilers (depending on make, model, and size - see Hydronics Institute and GAMA information).

If you utilize the services of a heating contractor, make every effort to select a reliable company. Ask for and check references, or call your local Better Business Bureau. When purchasing a new heating system directly from a dealer, be sure to size your system properly. Installing a system that substantially exceeds the heating requirements of a residence wastes energy and money.

SAVINGS FOR EVERY $100 OF FUEL COSTS BY INCREASING YOUR HEATING EQUIPMENT EFFICIENCY

From an Original Efficiency of: ↓ To an Increased Efficiency of: (assuming the same heat output) →

	55%	60%	65%	70%	75%	80%	86%	90%	95%
50%	$9.09	$16.76	$23.07	$28.57	$33.33	$37.50	$41.17	$44.24	$47.36
55%	—	8.33	15.38	21.42	26.66	31.20	35.29	38.88	42.10
60%	—	—	7.69	14.28	20.00	25.00	29.41	33.33	37.80
65%	—	—	—	7.14	13.33	18.75	23.52	27.77	31.57
70%	—	—	—	—	6.66	12.50	17.64	22.22	28.32
75%	—	—	—	—	—	6.50	11.76	16.66	21.10
80%	—	—	—	—	—	—	5.88	11.11	15.80
85%	—	—	—	—	—	—	—	5.55	10.50
90%	—	—	—	—	—	—	—	—	5.30

Figure 6. Dollar Savings in Fuel Costs Can Be Estimated By Comparing AFUEs for Different Makes and Models of Efficient Replacement Furnaces and Boilers.

ADDITIONAL INFORMATION SOURCES

Your state or county energy office, oil supplier, or public utility may be able to provide you with more information on choosing heating system improvements or a new furnace or boiler. In some states rebates are available if you purchase qualified high efficiency units and (or) they can sometimes help provide you with low interest loans to purchase the equipment. They are also an excellent source of information about "weatherization" of your home to reduce heat losses through windows, doors, walls, and roofs. For more information on "weatherization" and other energy-conserving steps, write or call CAREIRS. The phone number and address are listed at the end of this document.

Many states have "weatherization" assistance programs to help individuals with low or fixed incomes pay for energy improvements for their homes. CAREIRS can provide you with the phone number for the low-income "weatherization" assistance office in your state.

Your public library is another excellent source of information on improving the energy efficiency of your home. Many books and articles have been written on the subject over the last 15 years. Libraries may also have a copy of the Gas Appliance Manufacturers Association (GAMA) directory of efficiency ratings. You may choose to visit the local book store to see what is available on home energy conservation improvements, and don't forget to look for "how-to" books in your hardware store or home center retail store. The following sources of information are recommended:

Boiler Ratings and Efficiencies
Hydronics Institute
35 Russo Place
P.O. Box 218
Berkeley Heights, NJ 07922
Phone (201) 464-8200
Updated and printed every year.

Consumer's Directory of Certified
Efficiency Ratings for Residential
Heating and Water Heating Equipment
GAMA C/0 ETL Testing Laboratories, Inc.
Industrial Park
Route 11
Cortland, NY, 13045
Phone (607) 753-6711

Available at most local libraries, updated every year.

The Most Energy Efficient Appliances and also Oil And Gas Heating Systems
American Council for an Energy Efficient Economy (ACEEE)
1001 Connecticut Avenue, NW
Suite 535
Washington, DC 20036
1989 28 Pages $3.00 Each

For additional information on "weatherization" and energy conservation in your home write or call CAREIRS and ask for: *Caulking and Weatherstripping*, FS 203; *Improving the Energy Efficiency of Windows*, FS 216; and/or *Insulation*, FS 142.

CAREIRS
P.0. Box 8900
Silver Spring, MD 20907
800-523-2929
800-233-3071 (In Alaska & Hawaii)