HOME ENERGY GUIDE

TECHNIQUES TACTICS & TIPS

WATER HEATERS

Minnesota Department of Commerce Energy Information Center

Water heating is often the second largest energy expense in the Minnesota home, and may account for up to 20 percent of annual household energy costs.

There are three ways of reducing hot water expenses: improve the efficiency of your present hot-water heater or purchase a new high efficiency model. You also can use less hot water.

Buy new, or keep the old?

Water heaters have an average life expectancy of 10-12 years, but they can last much longer. Most are not replaced until the tank fails and it begins leaking. In many cases, however, it is wise to change the heater long before the water begins accumulating on the floor.

An old water heater can operate for years at very low efficiencies before it finally fails. It is often cheaper to remove an operating, but inefficient, older unit and replace it with a new highly efficient model.

There are also instances when a properly operating model should be replaced. For example, if you have an energy efficient furnace that exhausts through the side of your house, and your chimney is in need of repair or a liner, you may want to consider replacing the existing water heater with one that would exhaust through the basement wall, not needing the use of a chimney. Fixing the chimney while continuing to pay more for hot water may cost considerably more than simply capping the chimney and buying a new water heater that also vents out through the side of the house.

If your water heater tank is leaking, then your course is clear: buy a new unit. But if it isn't, your answer is less obvious.

Ask yourself some questions:

- Does the water heater make popping or cracking noises?
- Have you been forced to turn the temperature setting up over time to maintain an adequate supply of hot water?
- Do you have very hard water?
- Look under the burner. Is there a buildup of rust or other deposits?
- Open the drain tap at the bottom of the heater. Is the stream of water equal to any faucet? If the stream is small or nonexistent, then you have a big buildup of scale inside the heater that is wasting energy.

CAUTION: If your heater is old and does have a scale buildup, you may not be able to close the drain tap. Be prepared to shut off the water with the valve at the top of the tank and use a wrench to tighten the drain tap.

If you answered "yes" to several of these questions, a new hot-water heater is probably a good investment.

If your answers indicate that the heater is operating well, call the Energy Information Center and ask for the Home Energy Guide, "Low cost/no cost energy ideas." It contains several good tips on improving the operation of hot water heaters.

Related Guides:
Low Cost/No Cost Ideas
New Homes
Combustion Air
Indoor Ventilation

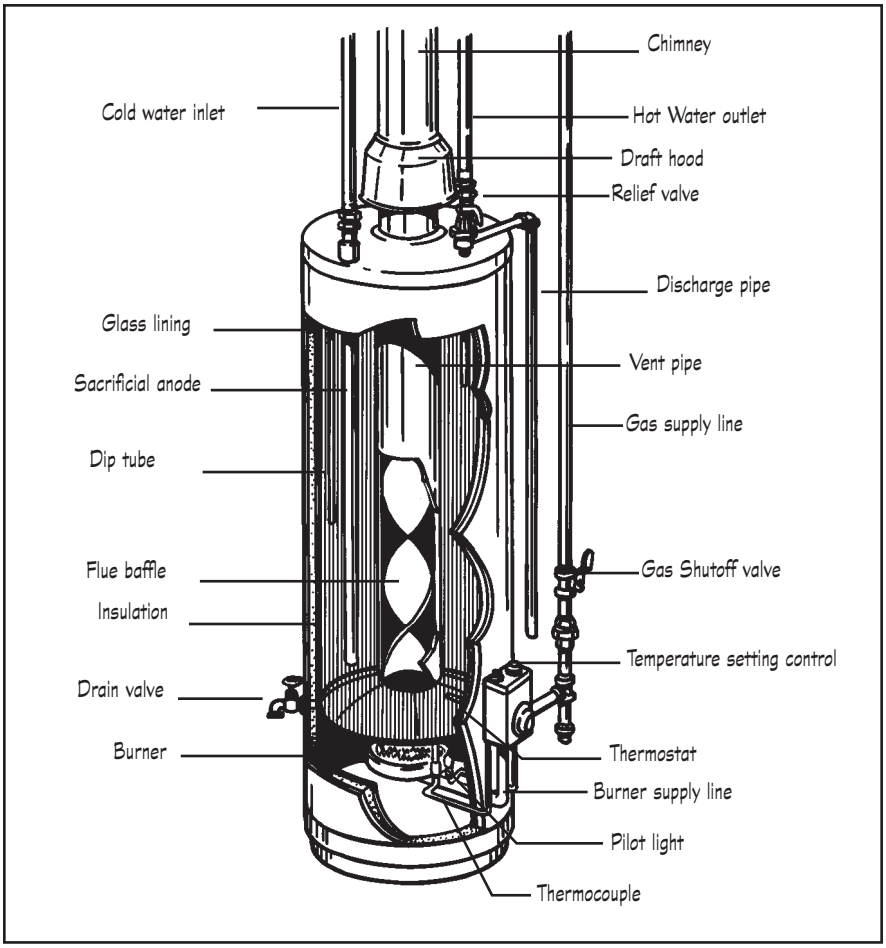

Figure 1
Gas water heater

Switching fuels

Before switching to a different fuel, make sure it will really save you money. Find out how much it will cost for piping and wiring. Make sure there is proper space for the water heater. Check to see if additional plumbing will be needed.

If you use electricity, call your utility and ask about the availability of off-peak rates, and how they can save you money.

If you must replace an old heater, then you may save money by using a different fuel – but not always. If gas is already in the house for clothes drying or space heating, replacing a malfunctioning electric hot-water heater with a natural gas unit may be a good decision.

If you have any questions regarding fuel switching, call the Energy Information Center.

Buying a new hot-water heater

When you do decide to install a new water heater, buy an energy efficient model. It will cost a little more, but the extra cost will pay for itself in a few years time. After that, the better efficiency will save you money for the life of the water heater.

A conventional water heater is a fairly simple appliance. It consists of a storage tank and a source of heat. The tank is usually steel and coated with glass or enamel to prevent corrosion. It is covered with insulation and enclosed in a steel jacket.

The most common sources of heat are a gas burner or an electric resistance heating element. Both are controlled by a thermostat that keeps the water temperature constant.

Gas hot-water heaters. The most common size natural gas water heater is 40 gallons. Typical gas models have a burner under the tank and an exhaust stack/heat exchanger which runs through the middle of the tank (Figure 1).

The exhaust stack has two functions: it is a vent for the burner and it transfers heat to the water. A gas heater is usually taller and thinner than an electric model.

Variations of this standard design are available. An example is the **submerged combustion** or **wet base** water heater. The burner sits inside a combustion chamber completely surrounded by water. The tank is insulated on the bottom to reduce heat loss to the floor.

Many newer gas water heaters do not vent the exhaust up a chimney. They may use a small electric fan motor that pushes the exhaust out through the side of the house. A few side venting water heaters still rely on natural draft to remove exhaust gases.

Don't rely on design features alone to assure energy efficiency. Read and use the rating found on the yellow and black Energy Guide tag found on all new water heaters. The tag will tell you the estimated yearly cost of operating the unit. Call the Energy Information Center for help in identifying the most efficient water heater.

Electric water heaters. Electric models use resistance coils inside the tank (Figure 2). Electric water heaters typically have slower recovery rates and larger tank size than water heaters that rely on combustion. Some models have only one heating element, others have two. Quick recovery electric heaters are available.

Although electric water heaters are generally more expensive to operative than natural gas models, they do have some advantages over gas. Electric units have no flue pipe, so you can put one almost anywhere in your home: in a closet, under a sink, etc. The entire tank is surrounded with insulation so less heat is lost when compared to a standard gas model.

Space heat-water heater combinations. Almost all high efficiency boilers will heat water. This may be done with an indirect fired water heater, also known as a "sidearm" water heater (Figure 3). This is a separate zone of heat flow from the boiler to an insulated tank. The hot water flows through a water-to-water heat exchanger which in turn heats the water in the tank. Some boilers may also have a coil inserted into the boiler itself, but this is not as good an idea: it's less efficient than the sidearm. When considering such a unit, make sure that the boiler is not too large for your home heating needs, and that the water heater is reasonably priced.

Point-of-use water heaters. Point-of-use water heaters are also called "tankless" heaters because they have no storage tank. They are relatively small units that provide hot water on demand. They use gas or electricity for fuel, and can be installed near demand points, such as under kitchen sinks. They are often more expensive than a conventional water heater. Gas units may also require a large, expensive flue and will increase space heat loss up the chimney. The large energy input may overload many existing chimneys, preventing them from exhausting properly. Electric units need updated wiring.

Another major drawback is capacity. A tankless heater typically provides 1-2 gallons of hot water a minute. You may find this adequate. However, you may not have enough hot water for more than one use at a time. Before installing a tankless water heater in your home, make sure its reduced capacity will be adequate for your needs.

Heat pump water heaters. Heat pump water heaters (HPWH) extract heat from air and put it into the hot water tank. They can be more efficient than electric hot-water heaters, but can also be more expensive.

Heat pump technology has been around as long as refrigerators and air conditioners, but only in recent years has the concept been applied to heating water. The flow of heat is opposite that in a refrigerator or air conditioner. Instead of taking heat out of a container and dispersing it into the air, the HPWH takes heat from the surrounding air and pumps it into a tank filled with water.

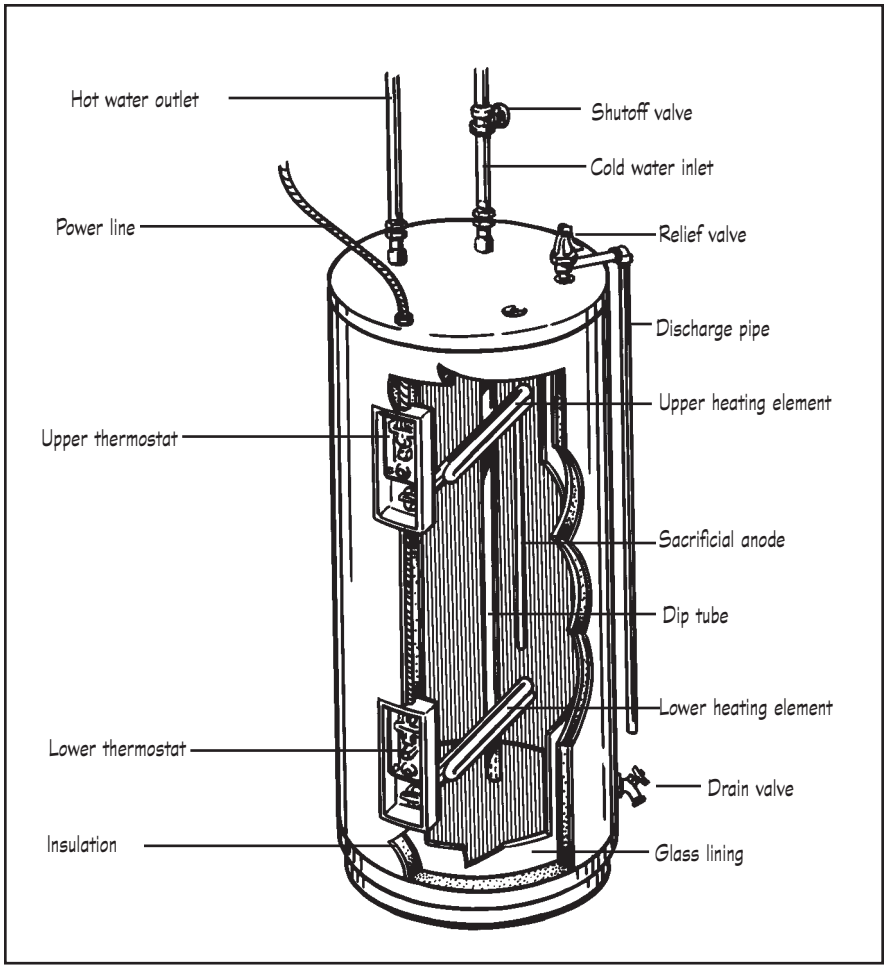

Figure 2
Electric water heater

There are two types of heat pump water heaters: integral and remote. The integral unit is a heat pump with its own water tank. The remote unit is a heat pump that can be connected to an existing electric resistance heater. The remote unit is cheaper than an integral heat pump and can be easily added to an existing system.

Both types have a resistance element as a backup, either built into the integral unit or left over in the old system to which the remote unit was added. Heat pump water heaters use about half as much electricity as resistance heaters to do the same job.

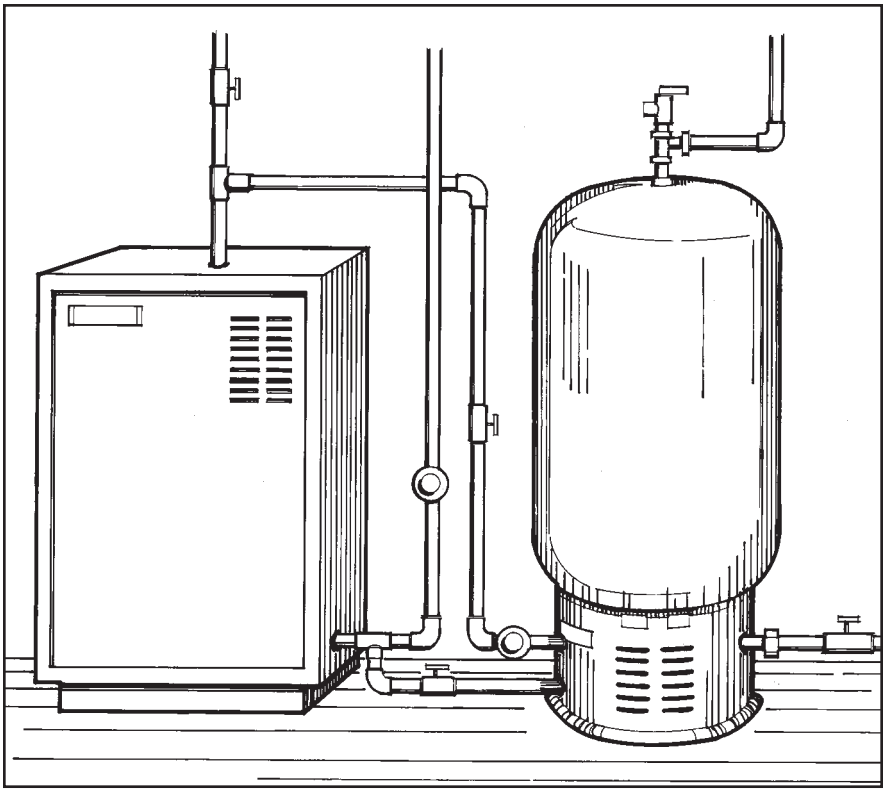

Figure 3
Space heat-water heater combination (also know as a "sidearm" water heater).

A HPWH also lowers the temperature of the air around the heat pump. In summer the cooling and dehumidification provided by the HPWH amounts to free air conditioning. During the heating season, the HPWH unit will rob heat produced by the space heating system.

Whether or not this is a disadvantage depends on the cost of the fuel used and annual efficiency of your space heating system.

One disadvantage of the HPWH is its low recovery rate: 10 to 15 gallons per hour, somewhat less than the recovery rate of a typical electric water heater. To avoid hot water shortages, the size of the hot water tank should be increased.

Solar water heaters. Solar water heaters can reduce the annual fuel cost of supplying hot water to your home by more than half. Throughout the year, the solar system preheats the water before it reaches the conventional water heater. During the summer, the solar system may provide all the required heat. Many homeowners report the the most noticeable result of installing a solar water heating system, in addition to lower water heating bills, is that they no longer run out of water with heavy hot water use.

A solar water heater typically includes collectors mounted on the roof or in a clear area of the yard, a separate storage tank near the conventional heater in the home, connecting piping, and a controller. The cost of a solar water heater in Minnesota may be justified if the traditional energy costs are high (such as heating water with high cost electricity) and the installation is fairly straight forward.

National organizations currently certify the quality and performance of solar collectors. Look for the Solar Rating and Certification Corporation (SRCC) label and compare performance by using the SRCC rating numbers. Use only quality equipment and experienced installers. Obtain competitive bids from at least three firms.

Energy efficient water heaters

Until recently, all gas water heaters sent their exhaust out of the house through a standard chimney. These natural draft heaters consume large quantities of indoor air. In some cases, the draft in the flue can be reversed and spill dangerous fumes into the house. This does not happen with a sealed combustion or a side-vent system.

Sealed combustion. This type of water heater brings air directly into a combustion chamber without mixing with house air. A sealed combustion heater does not need a chimney, since its exhaust gases are blown from the side of the house with a fan (Figure 4). This eliminates the potential danger of the hot-water heater backdrafting into the house.

Side-vent heaters. Because these heaters blow the exhaust out through the side of the house, the traditional flue or chimney is not needed for the heater. Some side vent heaters are sealed combustion types, while others use house air for combustion. All side-vent heaters allow for greater installation flexibility; the water heater can be put closer to where the water is used instead of next to a chimney.

Kits to modify an older heater to exhaust through the side wall are available, but they can be expensive to buy and install. In some cases, the cost can be as much or more than an entirely new heater. As with any product added to an appliance, it should have an American Gas Association, Under-

writers Laboratory or other appropriate listing agency approval for the appropriate water heater. It should not void the warranty of the appliance.

Remember: any modification work done on your vent system must be inspected and approved by local building officials.

Water-space heating combinations. Some high efficiency furnaces and most high efficiency boilers can provide hot water throughout the year. For health and safety reasons, only a unit specifically designed to do this should be used.

Some manufacturers have developed integrated appliances: one appliance that will heat the house, provide air conditioning and heat water as well.

Heating water with wood. Wood is sometimes used to heat water and there are a few products on the market for this purpose. Anyone who is considering this should be cautioned that it is difficult to do safely. A tempering tank in the same room, but which is *not* connected to the wood stove is one safe way. Some wood-fueled boilers can provide domestic hot water needs.

It is recommended that you buy a wood boiler or water heater that has been tested and listed for heating water by Underwriters Laboratories or equivalent agencies.

Sizing, installing a water heating system

It is important to buy the right size hot-water heater: Too small and you may run out of hot water in the middle of a shower; too large and you'll pay for hot water that is never used.

To find the size you need, determine the time of the day when your household uses the most hot water. Use the chart to list how and how many times the hot water is used in one hour during the peak period. Multiply the number of uses by the average amount of hot water consumed by each activity and add the totals to find your peak demand.

Normally, you should buy a water heater than can handle your peak needs.

But if you reach that peak only once a week, and use less hot water the rest of the time, try adjusting your life-style to spread out demand, and buy a smaller heater.

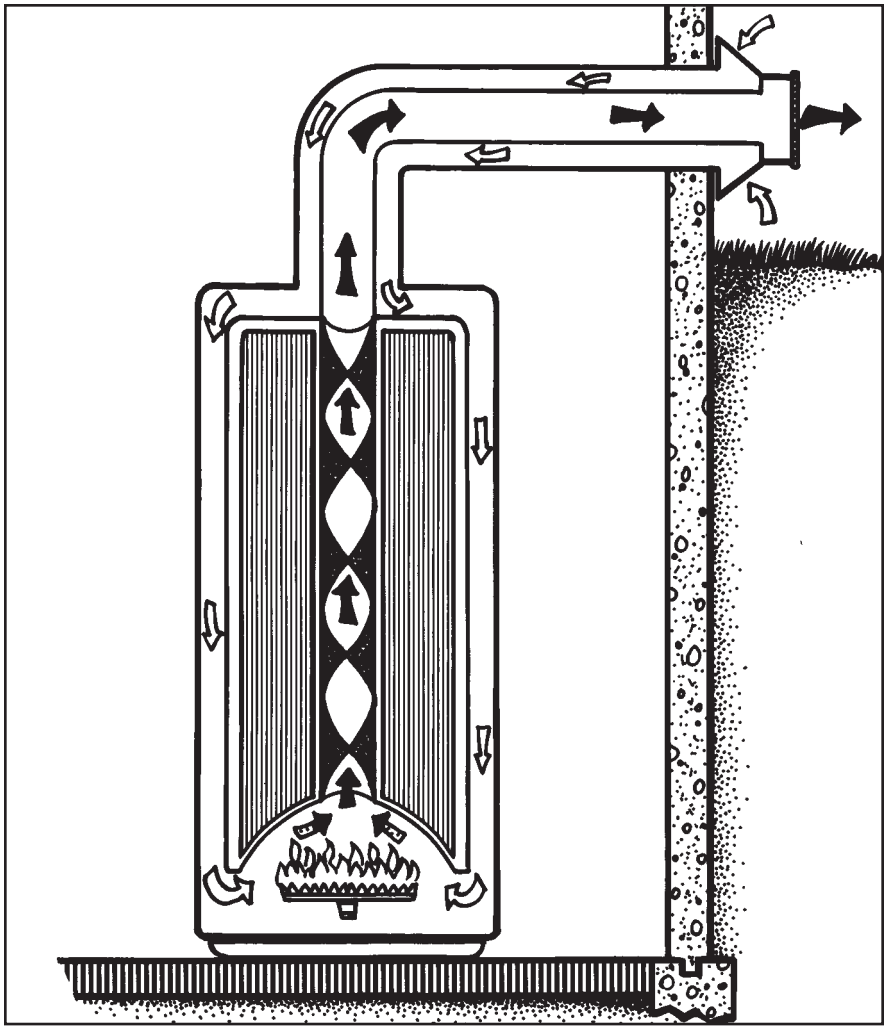

Figure 4
Sealed-combustion, side-vent water heater.

When installing your new hot-water heater, place it as near as possible to where the largest amount of hot water is used. Use pipe insulation and heat traps to conserve energy.

Pipe insulation. Water pipes extending vertically from the hot water storage tank are really part of the tank itself. The lighter hot water flows up the pipe, replacing cooler and heavier water. Insulate both pipes with foam or fiberglass from the tank to the heat trap, or to the first horizontal run (Figure 5). Insulation should be kept at least three inches from the draft hood and flue.

Heat traps. Heat traps may be natural or mechanical, and may reduce the amount of heat lost when water isn't being used by 12 percent. Some new heaters have them installed at the factory. The natural trap is a piece of tubing bent in the form of a "U." (Figure 6.) Mechanical traps are available with a ball type check valve.

GALLONS OF HOT WATER X TIMES USED = GALLONS

	USED PER ACTIVITY	IN ONE HOUR		PER HOUR
Shower	20	_____	=	_____
Bath	20	_____	=	_____
Shaving	2	_____	=	_____
Hand, face wash	4	_____	=	_____
Shampoo	4	_____	=	_____
Hand dish washing		_____	=	_____
Auto dish washing	14	_____	=	_____
Food preparation	5	_____	=	_____
Auto clothes washer	32	_____	=	_____
PEAK HOURLY DEMAND			=	_____

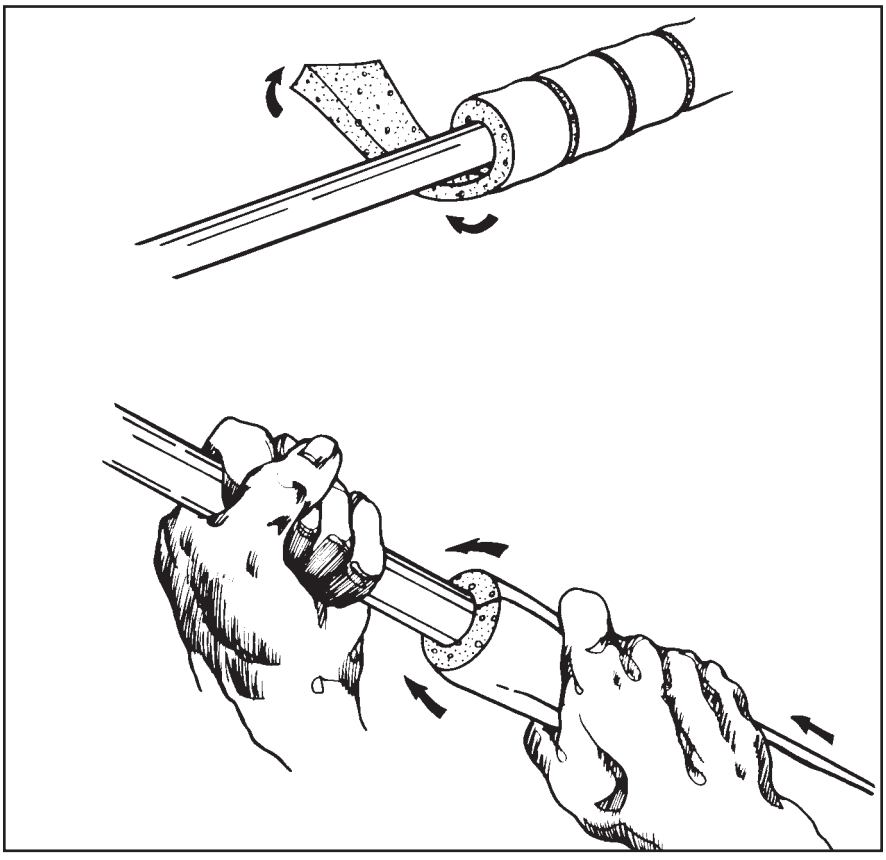

Figure 5
Pipe insulation

Water heaters without heat traps and with vertical pipes should have the traps installed on both the inlet and outlet pipes.

The heat trap should be as close to the tank as possible.

Tempering tanks. A tempering tank pre-heats water by absorbing heat from household air and is worth considering if an inexpensive source of space heat is available, such as a wood stove. These may also be used seasonally by using warm outdoor air to preheat the incoming water. Tempering tanks may be made from an old water heater with insulation removed, or a simple water storage tank.

Make sure the tank is clean and free of any toxic materials.

Using less hot water

Avoiding waste in using hot water is an effective way to reduce energy costs.

Fix leaky faucets. A hot water faucet leaking one drop a second will waste about 60 gallons of hot water a week. This could cost you up to $35 or more a year. Leaks can usually be fixed by replacing the tap washer. Turn off the water below the sink or tub (or at the main supply if you don't have a shut-off valve below the fixture), take the faucet apart, replace the bad washers, and put the faucet back together.

Install flow restrictors on faucets. Flow restrictors on faucets will save money on both the water bill and water heating costs. They reduce the amount of water you use for tasks that require flowing water without greatly changing the feel of the flow. Restrictors cost anywhere from less than a dollar to about $3. To install, simply unscrew the aerator at the end of the faucet and push the restrictor in. If you don't have aerators on your faucets, consider installing them. If you can do it yourself, it will be worth it in water and energy savings.

Install a water-saving showerhead. A typical showerhead uses between four and nine gallons of water a minute. A water-saving showerhead uses between two and three gallons per minute, which means it can save you one to seven gallons per minute; and most of the water is hot. If your water heater is set at 120°, and if your family takes two five-minutes showers a day, you can

lower your yearly gas bill by over $20 or you're your electric bill by about $40 (based on you saving two gallons of water per minute in your shower). If you save more than two gallons per minute, your savings will increase.

Other easy hot water savings tips. Wash only full loads of laundry, or adjust the water level for smaller loads. Use cold water whenever possible.

Run the dishwasher with full loads only. Don't use the hot rinse.

Use cold water to flush away food in your garbage disposal.

Turn off your water heater, or place it on its lowest setting, if you are going to be gone for a few days or more.

Don't let the hot water run when you are shaving, washing dishes by hand, or doing similar tasks.

If you have an electric water heater, check into "time-of-day rates." Some electric utilities offer very cheap electricity during times when there is little demand for it. If you can switch 60 percent or more of your electric use to this "off-peak" time (usually between 9 p.m. and 9 a.m.) you can probably save some money.

Summary

When looking at a new water heater, be sure to compare the energy efficiency of different models by checking the Energy Guide label. Higher initial cost for these features will save you money in the long run. Energy efficient units are better insulated, while high efficiency natural gas units now use less gas.

Buy the smallest size you can. Don't try to buy a water heater so you can shower, and wash clothes and dishes all at the same time without running out. Instead, plan your hot water use. This is especially important if you have a large family.

Locate the water heater as close as possible to where the largest volume of hot water is used. Since heat is constantly lost through hot water pipes, the shorter the pipe runs, the lower the heat loss.

Insulate the water pipes and install heat traps.

Take easy, low-cost or no-cost measures to avoid waste in using hot water.

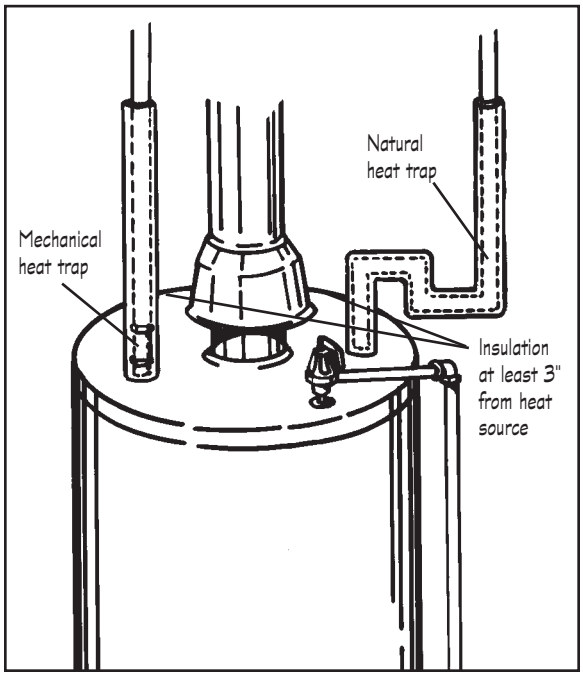

Figure 6
Pipe insulation and heat traps.

Preventing Combustion Air Problems

Recent research has identified serious combustion safety problems related to leaky ducts serving forced air heating systems. Air from the basement leaking into return ducts depressurizes basement areas, causing heaters to backdraft and exposing residents to toxic combustion products, including carbon monoxide. This problem is potentially worse in the summer due to a variety of conditions. Homeowners and contractors should consider thorough sealing of return air ducts in basements. In addition, it is essential that water heaters as well as furnaces and boilers have a source of air for proper combustion and exhaust.

For information on testing for and installing a combustion air supply in your home, call the Energy Information Center and ask for a copy of the guide on Combustion Air. The Energy Information Center also recommends that you purchase an electronic carbon monoxide detector. Make sure it is listed by the Underwriters Laboratory and has a digital display and a memory feature.

Don't set water temperature too high

Very hot water can cause scalding burns and be a severe hazard, especially to small children or the elderly. To reduce the danger of scalding, turn the temperature settlng down to 110° or 120°. In most cases, that will be low on the scale.

The water heater may not have a temperature control setting marked in degrees; Measure the temperature at the tap with a thermometer.