CHAPTER 9: WATER HEATING

Energy costs for water heating can be as great as the costs for heating, for an energy efficient house, in a mild climate. Estimating hot water usage in a home is difficult because of the wide differences in water use habits. Estimates for a family of four, with one person at home, could be as high as 90 gallons of hot water used per day; a family of two, with both working, could use as few as 50 gallons per day. However, it is possible to cut the cost of water heating with conservation measures and water heating alternatives.

Water heaters come in a range of efficiencies, warranties, and fuel sources. Their efficiencies are measured by a rating known as the energy factor (EF). The energy factor is a measure of the overall efficiency of a water heater and includes recovery efficiency, standby losses, and cycling losses. The EnergyGuide sticker on a water heater can be used to compare the estimated annual energy cost for a specific water heater with comparable models. Chapter 10 describes the EnergyGuide sticker in more detail.
ENERGY CONSERVATION FOR WATER HEATING

No matter what type of energy source is used to heat water, be certain to take advantage of the savings from conservation measures:

- For new homes:
  - keep the length of the hot water pipe runs as short as possible. Careful planning can result in lengths of less than 30 feet.
  - consider a manifold plumbing system to reduce the size of hot water lines
- Use ENERGY STAR® appliances that reduce hot water requirements.
- Lower the temperature setting on the water heater to 120°F.
  - saves energy and provides plenty of hot water
  - reduces the risk of injury from scalding
  - if hotter temperatures are needed for dishwashing, select dishwashers with booster heaters
- Wrap the outside of the water heater tank with an insulation jacket, Figure 9-1.
  - simple to install—payback is less than 1 year
  - do not cover the relief or drain valve
  - for gas water heaters, do not block the air inlet to the burner or the flue vent on the top
- Insulate first four feet of all pipes connected to unit.
- Use low-flow showerheads that deliver water at 1.5 gallons per minute maximum. Well-designed fixtures deliver water at that rate and still provide plenty of force.
- Install heat traps. These will keep hot water from circulating freely out of the water heater.
- Install low-flow aerators on sink and lavatory faucets.
  - save on energy bills
  - kitchen sink may need a higher volume flow faucet for filling pots and pans more quickly
- Using the tank drain at the bottom of the tank, drain approximately one quart from the tank every 3 months (or as recommended by the manufacturer). This removes the sediment from the tank and increases the heating efficiency.
ENERGY STAR® gas water heaters will have energy factors over 0.62 when these ratings go into effect (see Table 9-1).

In addition to variations in insulation, gas water heater efficiency is also affected by burner design, the shape of the flue baffles that slow the hot exhaust gases down to increase heat transfer to the water, and the amount of surface area between the flue gases and the water.
Table 9-1  Energy Factors (EF) for ENERGY STAR® Gas Water Heaters

<table>
<thead>
<tr>
<th>Type</th>
<th>Energy Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Storage (ending 8/31/2010)</td>
<td>≥ 0.62</td>
</tr>
<tr>
<td>Gas Storage (beginning 9/1/2010)</td>
<td>≥ 0.67</td>
</tr>
<tr>
<td>Whole-home Gas Tankless</td>
<td>≥ 0.82</td>
</tr>
<tr>
<td>Gas Condensing Storage</td>
<td>≥ 0.90</td>
</tr>
</tbody>
</table>

Fuel-fired water heaters, located in a conditioned space, must be in a sealed mechanical room with fresh air inlets. To avoid the need for a sealed mechanical room, another option would be to use a fuel-fired water heater that includes provisions for outside combustion air, such as a direct-vent unit. These have a double flue pipe that includes both an intake for combustion air and a flue for exhaust gases.

Higher efficiency gas water heaters have blowers for venting and delivery of combustion air and more sophisticated energy features, such as electronic ignition, flue dampers, and condensing heat exchangers. These high efficiency gas water heaters can achieve energy factors over 0.90.

**ELECTRIC WATER HEATERS**

For electric water heaters, higher efficiency units have energy factors up to 0.97. Often, the additional cost of a high efficiency unit is quite low compared to the savings. ENERGY STAR® labeling for electric water heaters is not available because, beyond adding additional insulation to reduce standby losses, little can be done to improve efficiency. In general, electric hot water heaters are more expensive to operate than gas units; however, as energy prices change, this difference can be small. Because of the high cost of sealed combustion gas water heaters, some builders have elected to use electric water heaters, even though gas is available. A builder does this to avoid the need for a sealed, vented mechanical room.

**HEAT RECOVERY UNITS**

A heat recovery unit, also called a desuperheater, recovers excess heat from an air conditioner or heat pump to provide “free” hot water. The heat is captured from the refrigerant line between the outside condenser and the inside equipment (see description of how air conditioners work in Chapter 7). A heat exchanger mounted on this line extracts heat from the superheated, high pressure, refrigerant gas, which is hot enough to be able to lose some heat and still not begin to condense into a liquid.

During the summer, the desuperheater can usually provide 100% of the hot water needs of a family and improve the efficiency of the air conditioner or heat pump. In the spring and fall, with no heating or
cooling, the desuperheater is ineffective. In the winter, if connected to a heat pump, the desuperheater can still provide hot water more efficiently than a conventional electric water heater. The energy savings from a desuperheater connected to a central air conditioner depend on how often the air conditioner is used. Savings are typically 20% to 40% on annual water heating bills.

The size and efficiency of the water heater and cooling equipment will affect the performance of a desuperheater. Combining desuperheaters with new higher efficiency air conditioners or heat pumps, which have lower refrigerant temperatures, can reduce the energy savings. The HVAC system should be at least 2 tons in size to be used effectively with a desuperheater. Desuperheaters range in cost from $550 to $750 and save $50 to $180 annually. Before installing a unit, make sure it will not void warranties on mechanical equipment. Also, check on the water supply in the area to see if any buildup may occur in the desuperheater, reducing its effectiveness.

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**SOLAR WATER HEATERS**

Solar water heaters use a unique method for heating water that requires that a knowledgeable person design the roof slope, orientation and total system. Solar water heaters must be installed and maintained by someone in that field. See Chapter 12 for more information. With the current cost of other forms of energy and tax incentives at the state and federal level, solar water heaters can be a cost effective option. They can also be oversized and used to assist with heating a home, providing two options for savings.

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**ON DEMAND WATER HEATERS**

On demand water heaters use higher capacity electric coils or gas burners to heat cold water only when there is a need for hot water (see Figure 9-2). Electric units use a large amount of current and require special wiring. Electrical units also increase the demand on the local electrical system during the utilities’ peak. Care should be used when considering them because of the potential for time-of-day or demand charges for electrical power in residences in the future.

These water heaters save energy in two ways: they have no storage tank so there is no need to keep stored water continuously warm, and gas-fired units usually heat water more efficiently than gas tank type water heaters. Conventional water heaters keep 30 to 50 gallons of water at a constant temperature, 24 hours a day.

On demand units must be sized carefully for their planned use. A small unit may provide heating for only one faucet or appliance at a time, so a higher capacity model or several units are generally needed to provide hot water for conventional residential uses. By eliminating the standby losses and by increasing efficiency, on demand water heaters may save 10% to 20% of a household’s usual water heating bill.
Figure 9 – 2 On Demand Tankless Water Heater (Gas)