

# Electric Water Heaters for Residential Use

**AREN 4570**

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## **Executive Summary:**

Hot water is essential to the residential society to wash dishes, clothes, showers, and other applications. The following report summarizes the various electric hot water heaters for residential/small commercial applications. Due to various similarities in build and design across the many companies we researched, we utilized information from one particular company, Sears. The individual components and operation of an electric water heater will be discussed in detail. The different capacities, initial costs, and energy usage will show the variety of choices for residential installation. We will compare and contrast the application of electric to gas water heaters. This comparison will determine the best choice for residential usage.

## Electric Water Heater Description:

For this assignment we have picked 4 different electric hot water heaters, compared their capacity, components, features and cost. A summary of the four selected hot water heaters can be found below (Table 1).

**Table 1**

Model	Capacity (gallons)	Cost	Recovery @ 90 degree rise	KWh/year	Wattage @240V	KWh/year cost
Power miser 9	80	\$419.99	25 gph	5092	5500	\$428
Power miser 9	66	\$359.99	25 gph	5039	5500	\$423
Power miser 6	50	\$199.99	25 gph	5004	5500	\$420
Power miser 6	40	\$169.99	25 gph	4881	5500	\$410

Above is the data of common Electric water heaters for residential use.

The typical electric hot water heater for residential/small commercial use averages in capacity from 40 to 80 gallons. Selection of a particular capacity depends on family size and demand. The basic shape is a cylinder averaging five feet in height and two feet in diameter. Weight of these units range between 160-202 lbs, dependent primarily on the capacity of the tank. The basic components of the electric hot water heater include; glass or ceramic lined steel tanks to protect against corrosion, foam for insulating purposes, and low watt-density heating elements. Depending on the thickness and density of the foam the R-values range between 14.57 to 20 (hr\* $\text{ft}^2$ \*F)/Btu based on the electric hot water heaters we analyzed. Every hot water heater we have researched

requires single phase, 240-volt power supply. Depending on the load, 10-gauge electrical wiring is the minimum required with a maximum of a thirty-amp fuse. Another protective aspect on most hot water heaters is the placement of an anode inside the tank to attract free radicals preventing corrosion. See diagram below for basic components of a hot water heater (also see Appendix 1 for specific manufacturer data information.)

**Figure 1**

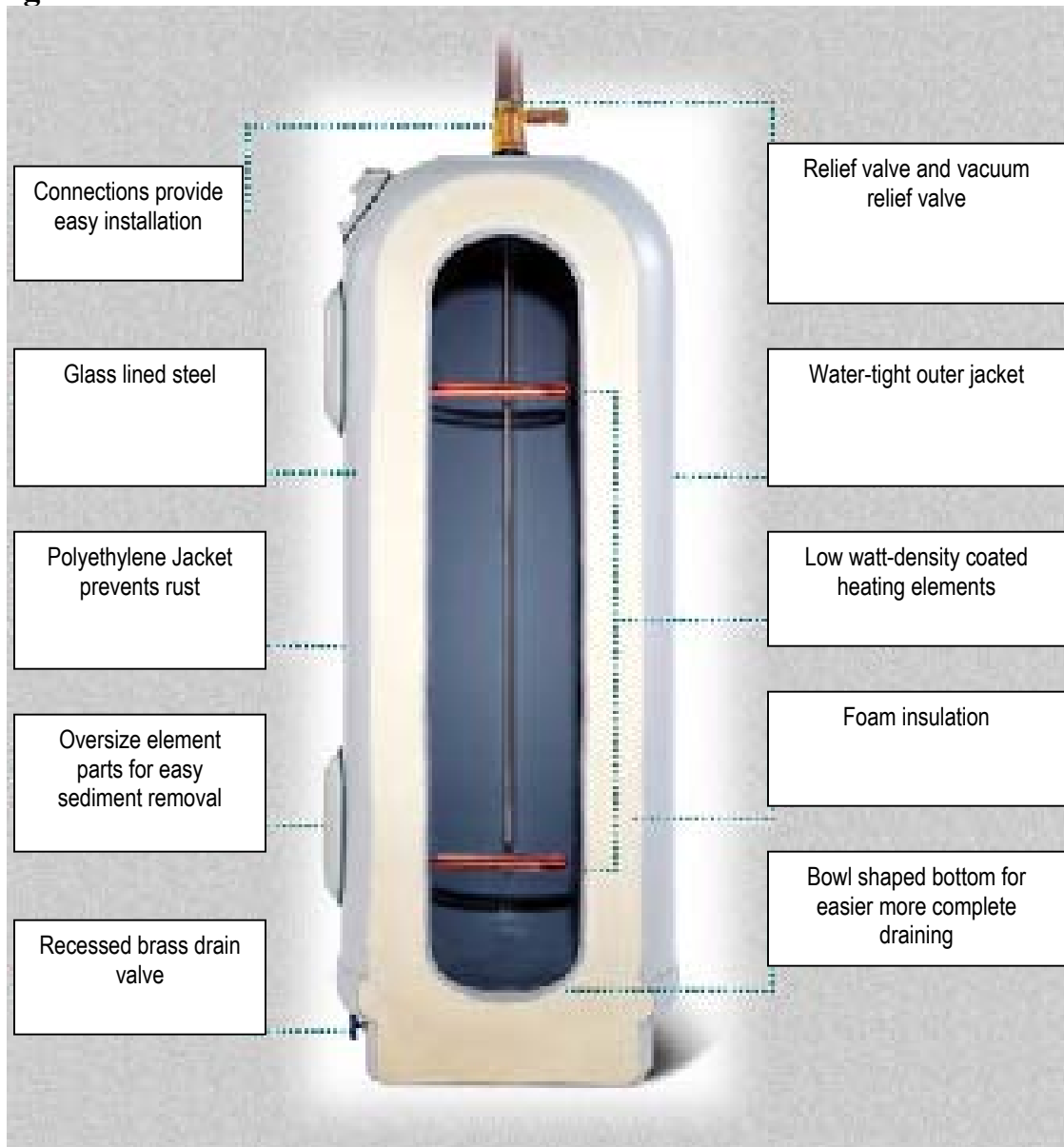


Diagram of typical electric hot water heater

Capacity of the hot water heater is what differentiates the models we have researched. Capacity refers to the water heater's ability to hold the heated water until distributed. Another aspect that set the units apart is the type of heating element installed. On some models the element is installed vertically in the center of the tank whereas on other models there are two horizontal elements installed at the top and bottom of the tank. And yet another aspect, which sets the units apart, is that of Recovery. Recovery is the amount of gallons per hour a hot water heater can produce based on a 90-degree increase in temperature. Temperature adjustment is attained by adjusting a dial through an easy access panel usually located in the front of the unit. Temperature settings range between "vacation" for the lowest temperature and "hot" for the highest temperature. On the lowest setting the temperature is the same as tap water, at the highest setting the water can reach 180 degrees Fahrenheit.

## **Alternative Energy Sources:**

Renewable energy sources such as geothermal and solar can be used to provide hot water to homes and small businesses. However, energy sources such as these are not only geographically dependent, but unfortunately also limited in application especially in the commercial sector. Based on this fact, the major alternative energy source for heating hot water is natural gas. In fact, in the majority of homes and small businesses where natural gas is available, natural gas is the fuel of choice. This is mainly due to the fact that the average operating cost per year (based on the US government appliance energy guide) for similar size hot water tanks is 59% less than those that are electric powered (please see table at the end of this section for a detailed breakdown).

The benefits of natural gas powered hot water heaters are offset somewhat by three main factors. The first factor is that the gas units of equivalent capacities have a higher initial cost, on average \$77.50 more. The second factor is that due to the combustion process (besides possible fire hazards) the building itself must accommodate fresh air intake requirements as well as a flue space for combustion gasses to exit the building. The third factor is that natural gas is not available in all areas, and even though hot water heaters can be adapted to propane fuel, electricity is still available in more areas of the country.

If we only consider the tangible costs (the increased cost of the unit itself) the energy savings alone per month offsets the more expensive unit in an average of four months, thus making natural gas powered water heaters a better choice. This fact is reflected in that most newer homes, businesses, and mechanical specifications for new construction do not use electricity, but natural gas to power their hot water heaters.

The table below outlines the initial costs, yearly energy costs (according the US government appliance energy guide), and the payback time for the more energy efficient natural gas to offset the higher unit cost. Comparable size units were used whenever possible and all units are from the same manufacturer (Kenmore).

### **Electric vs. Natural Gas Cost Analysis (40-80 gallon)**

Energy Source/ Capacity (gal)	Unit Cost (\$)	Operating Cost US government Energy Guide (\$)	First Year Total Cost (\$)	Payback Time Due to Higher Energy Efficiency- months
<b>Electric 80</b>	\$420.00	\$428.00	\$848.00	N/A
<b>Natural Gas 75</b>	\$430.00	\$174.00	\$604.00	Less than 1 Month
<b>Electric 66</b>	\$360.00	\$423.00	\$783.00	N/A
<b>Natural Gas 65</b>	\$370.00	\$172.00	\$542.00	Less than 1 Month
<b>Electric 50</b>	\$200.00	\$420.00	\$620.00	N/A
<b>Natural Gas 50</b>	\$360.00	\$172.00	\$532.00	8 Months
<b>Electric 40</b>	\$170.00	\$410.00	\$580.00	N/A
<b>Natural Gas 40</b>	\$300.00	\$167.00	\$467.00	7 Months

**Conclusion:**

In summary electric water heaters are used in a variety of common everyday household and commercial needs, from washing dishes to cleaning floors, hot water has a multitude of uses. Since the quality of materials and insulation values are generally the same for electric hot water heaters, selection is purely dependent on the demand for which the hot water is needed and space available for the unit. The components are comprised of a tank, heating element and insulation. Based on a comparative analysis the additional cost of buying a gas hot water heater as opposed to an electric hot water heater is well worth it with a payback period being eight months or less.

# Appendix 1

## Product Detail



(Image shown may differ from actual product appearance.)

### Kenmore Power Miser 6, 50 gallon Medium Electric Water Heater

**\$199.99**

Regular: \$229.99

You Save: \$30.00

Sale Ends 10/15/02

Sears Item #04231665000

Mfr. Model #31665



Features	Description
<b>Product Overview:</b>	
Series	Power Miser 6
Tank Capacity	50 gal.
Item Weight	145.0 lbs.
<b>Tank:</b>	
Anode	1
Dip Tube	PEX
Element, Lower Type	Limeguard™ DualWatt™
Elements, Number per unit	2
Element, Upper Type	Limeguard™
Insulation Material	Foam
<a href="#">Insulation R Value</a>	14.57
Insulation Depth	1-3/4 in.
<a href="#">Recovery at 90 Degree Rise</a>	25 g.p.h.
Tank Material	Glass lined steel

<b>Energy:</b>	
Kilowatt Hrs. per Year	5004
<a href="#">First Hour Rating</a>	62 gal.
<b>Controls:</b>	
Temperature Adjustment	Easy access panel
<b>Warranty:</b>	
Tank Warranty	6 year limited
Parts Warranty	6 year limited
<b>Alternate Dual Power:</b>	
Maximum Fuse Required	20 amps
Minimum Wire Size	12 gauge
Wattage at 240V	3800 Watts
<b>Dimensions:</b>	
Height	46-1/2 in.
Diameter	23 in.
<b>Power:</b>	
Wattage at 240V	5500 Watts
Maximum Fuse Required	30 amps
Minimum Wire Size	10 gauge

Includes a factory installed temperature and pressure relief valve and a long-life baked enamel exterior finish. An anode rod in the glass-lined tank helps prevent corrosion.

## Works Cited

1. "Appliance Product Summary." Sears Product Summary. 2002.

Online. 9 September 2002. <<http://www.sears.com/sr/products/summary>>

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Online. 9 September 2002. <<http://www.bradfordwhite.com/products>>

3. "Marathon Water Heater." Marathon Water Heaters. 2002.

Online. 23 September 2002. <<http://www.marathonheaters.com/marathon>>