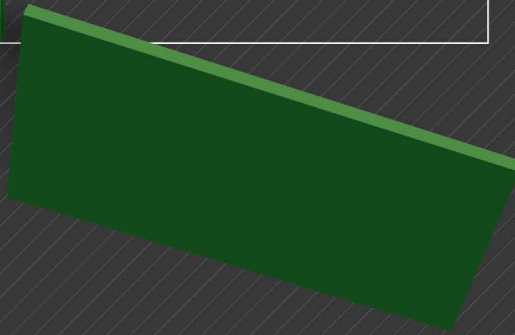


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# NEW TECHNOLOGIES NEW SAVINGS



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## Water Heater Market Profile | 2009

U.S. Department of Energy



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## EXECUTIVE SUMMARY

This document is designed to help ENERGY STAR partners understand the unique savings potential of residential water heaters and develop effective water heater programs.

Revolutionary changes in water heater technology coupled with the yearly replacement of roughly one out of every 13 water heaters create a tremendous opportunity to increase energy efficiency in the residential sector. With most American households containing conventional water heaters barely more efficient than the ones sold 20 years ago, energy efficiency program sponsors can achieve significant, cost-effective savings by adding ENERGY STAR qualified water heaters to their program portfolios.

**Water heating is the second largest energy end use in homes**, behind space heating and cooling. It accounts for 16.8 percent of residential energy consumption and can cost a household anywhere from \$200 to \$600 a year.

**Almost every U.S. household has at least one water heater, and many of them are old.** About 27 million households have water heaters that are more than 10 years old and are therefore nearing the end of their functional lives.

**Each year, about 8 percent of households replace their water heaters.** Between 7 million and 7.8 million water heaters are replaced in the United States annually. Another 1.2 million to 2 million units are installed in new homes.

**ENERGY STAR qualified water heaters are much more efficient than standard technologies.** Most units sold today just meet the current Federal standards, which took effect in 2004. ENERGY STAR qualified models consume 7 to 55 percent less energy than standard-efficiency models and can save a household \$30 to \$300 a year on its energy bills.

**While ENERGY STAR qualified water heaters are more expensive, consumers will recover the price premium within the product's expected lifetime.** When installation costs are included, the price premium over standard-efficiency units ranges from a low of about \$70 for high-efficiency gas storage models to a high of about \$2,500 for solar water heaters.

**ENERGY STAR qualified water heaters are already widely available.** At least 922 gas storage, gas tankless, heat pump, and solar water heater models have already qualified for the ENERGY STAR label. Qualified gas condensing water heaters are expected in 2010.

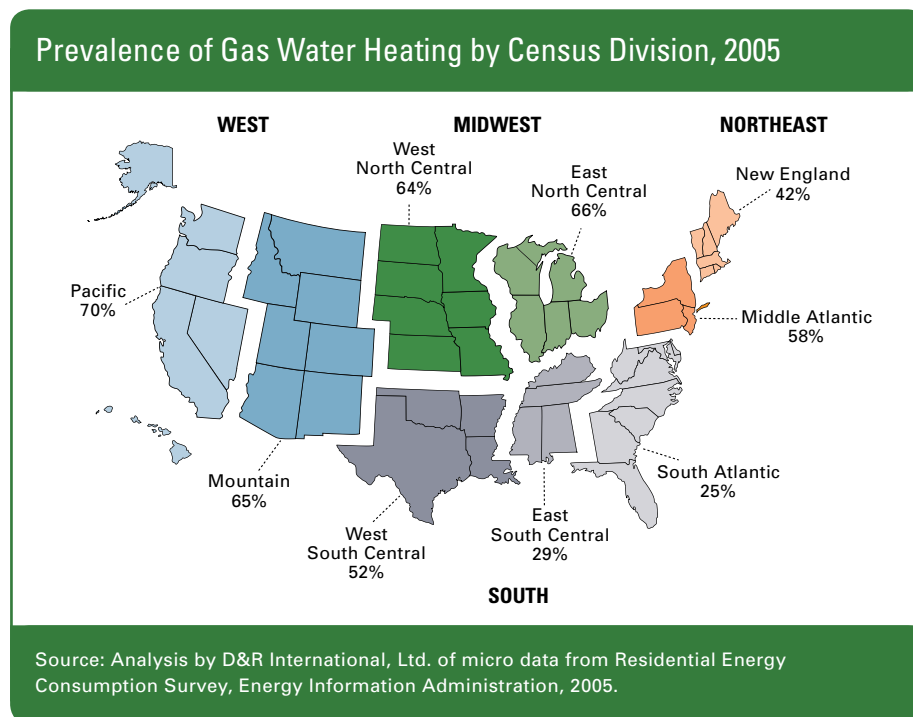
**Government incentives will make purchasing ENERGY STAR qualified water heaters more attractive to consumers.** Program sponsors can boost savings by leveraging current Federal tax credits for high-efficiency water heaters. In addition, rebates may be available from State governments in some parts of the country due to funding provided through the American Recovery and Reinvestment Act of 2009.

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## INSTALLED BASE

Residential water heaters supply hot water to almost all of the 79 million single-family homes and approximately 21 million multi-family and manufactured homes in the United States. As some single-family homes contain more than one working water heater, there are approximately 103 million residential water heaters in service nationwide.<sup>1</sup> At least 27 million of these water heaters are more than 10 years old and therefore are nearing the end of their functional lives.<sup>2</sup>

Just over half of all homes (53 percent) are served by gas water heaters; most of the rest are served by electric (40 percent). Other energy sources for water heating include fuel oil (used primarily in the Northeast), propane, wood, and solar.<sup>3</sup> Gas is the dominant water heating fuel in the West, Midwest, and Middle Atlantic. Electric water heaters are more common in the East South Central and South Atlantic census divisions and in the Pacific Northwest.

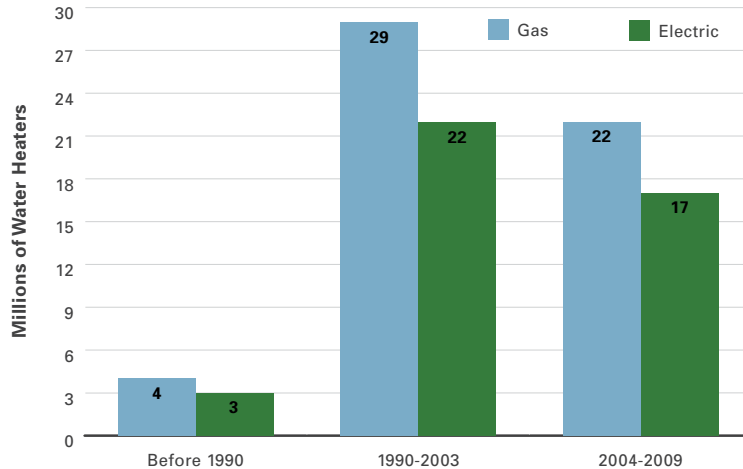


Water heating accounts for 16.8 percent of home energy use, measured at the site, and can cost a household anywhere from \$200 to \$600 a year, depending on the amount of hot water used and fuel prices.<sup>4</sup> To help control energy consumption, Congress established minimum efficiency standards for water heaters in 1987 based on fuel and capacity. The original standards, which took effect in 1990, required a minimum energy factor (EF)<sup>5</sup> of 0.525 for gas water heaters and 0.864 for electric water heaters with a 50-gallon tank. The current standards, which took effect in January 2004, require a minimum EF of 0.575 for gas water heaters and 0.904 for electric water heaters with a 50-gallon tank. The U.S. Department of Energy (DOE) is developing amended minimum efficiency standards that are expected to take effect in 2013.<sup>6</sup>

A water heater will last 10 to 20 years, depending on the type of unit and the hardness of the water. The average age at replacement is 13 years.<sup>7</sup> Thus, most of the installed base has turned over since standards took effect in 1990.

About 40 million units in the installed base were manufactured after the January 2004 standards took effect. Another 50 million units were manufactured between 1990 and 2003. The remaining 7 million units pre-date the Federal standards. Most units sold since 1990 have just met the prevailing efficiency standards.<sup>8</sup>

### U.S. Installed Base by Year of Manufacture



Note: Secondary water heaters are not included in the installed base in this analysis.

Source: Analysis by D&R International, Ltd. of data from Residential Energy Consumption Survey 2005, Energy Information Administration, Table HC2.8.

### Minimum Energy Factor for a Fifty-Gallon Water Heater

Fuel	Federal Standard			ENERGY STAR Criteria*
	Effective 1990	Effective 2004	Effective 2013	
Gas	0.525	0.575	TBD	0.62 to 1.2
Electric	0.864	0.904	TBD	1.8 to 2.0

\* Solar water heaters are required to have a solar fraction of at least 0.50. This is equivalent to an energy factor of 1.2 for systems with gas backup and 1.8 for systems with electric backup.

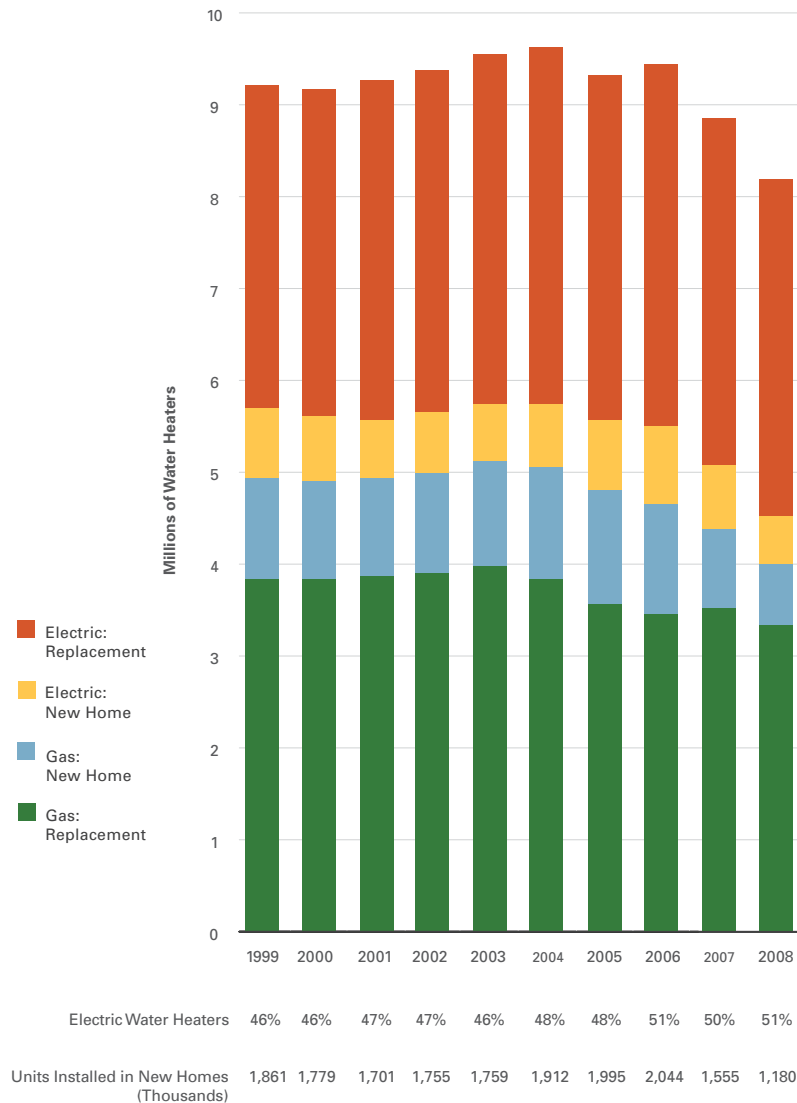
Source: "Energy Conservation Program for Consumer Products: Energy Conservation Standards for Water Heaters; Final Rule," *Federal Register*, Jan. 17, 2001 (66 FR 4474).

## WATER HEATER MARKET

### Annual Shipments

Water heater shipments averaged 9.2 million units per year over the last 10 years. The market is evenly split between electric and gas. Electric units have gained market share in recent years because new housing construction was concentrated in the South, where electric water heating predominates. Roughly 80 percent of new units replace old units; the remaining 20 percent are used in new construction. Sales in 2008 totaled 8.2 million units, down 15 percent from the peak in 2004, due largely to contraction in the home construction industry.<sup>9</sup>

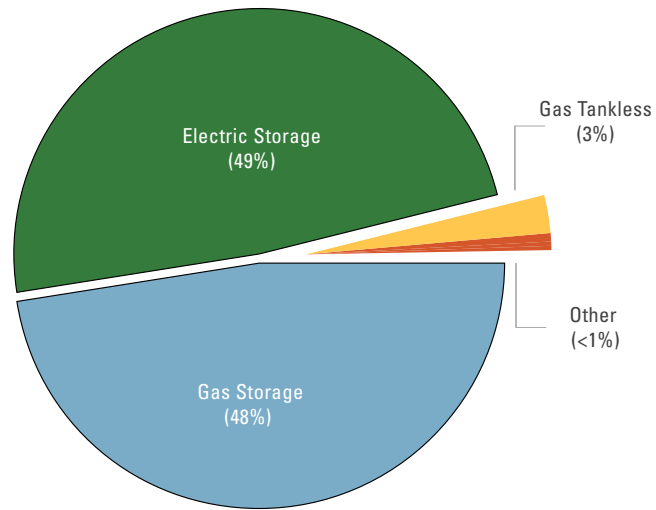
Water Heater Shipments, 1999-2008



Sources: "56<sup>th</sup> Annual Report: Statistical Review," *Appliance Magazine*, May 2009, and analysis by D&R International, Ltd. of data from the U.S. Census Bureau on new home construction and placements of manufactured homes.

Traditional storage water heaters (tank style) make up about 97 percent of the market. Tankless (also called “instantaneous” or “demand”) models are slowly gaining market share, with gas tankless models accounting for 3 percent of all units sold in 2006. All other technologies together accounted for less than 1 percent of the market.<sup>10</sup>

### Water Heater Market by Fuel and Technology, 2006



Source: “ENERGY STAR Residential Water Heaters: Final Criteria Analysis,” U.S. Department of Energy, April 1, 2008.

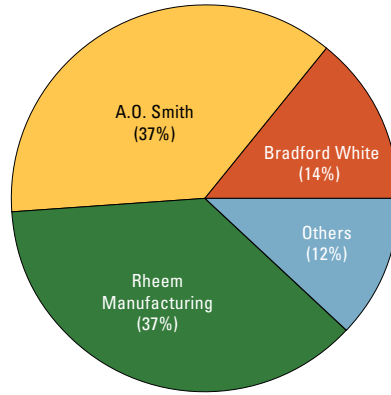
Note: The most recent market data available is from 2006.

## Manufacture and Distribution

A.O. Smith, Rheem Manufacturing, and Bradford White manufacture 88 percent of residential water heaters. More than two dozen companies manufacture the remaining 12 percent. Rheem leads the market for tankless units, selling more than half of all models. Solar water heaters are sold largely by smaller companies.<sup>11</sup> See [www.energystar.gov/waterheaters](http://www.energystar.gov/waterheaters) for a complete list of ENERGY STAR manufacturer partners.<sup>12</sup>

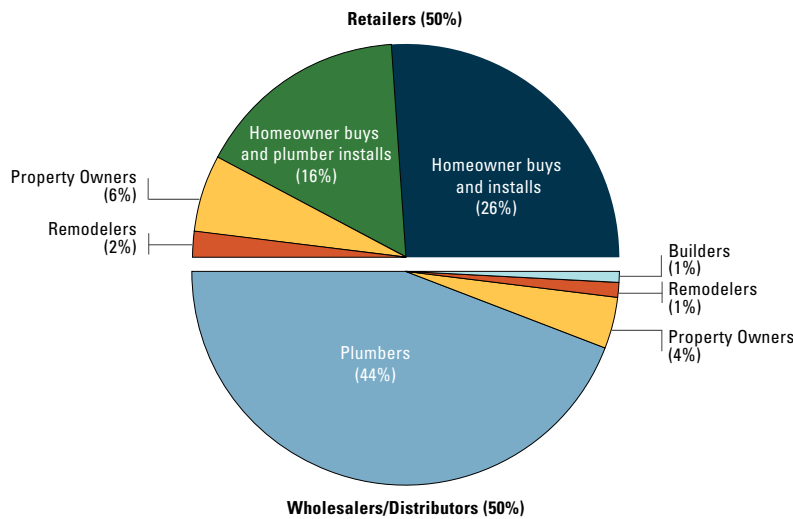
Retailers, wholesalers, distributors, and plumbers make up the water heater distribution chain. Wholesalers and distributors account for half of water heater sales; plumbers buy 87 percent of these, mostly for resale to homeowners. Retailers account for the remainder of water heater sales; homeowners buy 85 percent of these. Together, homeowners and plumbers purchase 86 percent of all water heaters. Commercial property owners, remodelers, and builders buy the remaining 14 percent. Of those purchased by homeowners at retail, almost two-thirds are installed by the homeowner, while plumbers install the rest.<sup>13</sup>

### Water Heater Manufacturer Market Share, 2006



Sources: "A Portrait of the U.S. Appliance Industry," *Appliance Magazine*, Sept. 2007, and A.O. Smith Water Products Company homepage, [www.aosmith.com/prod/wpc.htm](http://www.aosmith.com/prod/wpc.htm).

### Water Heater Distribution Channels



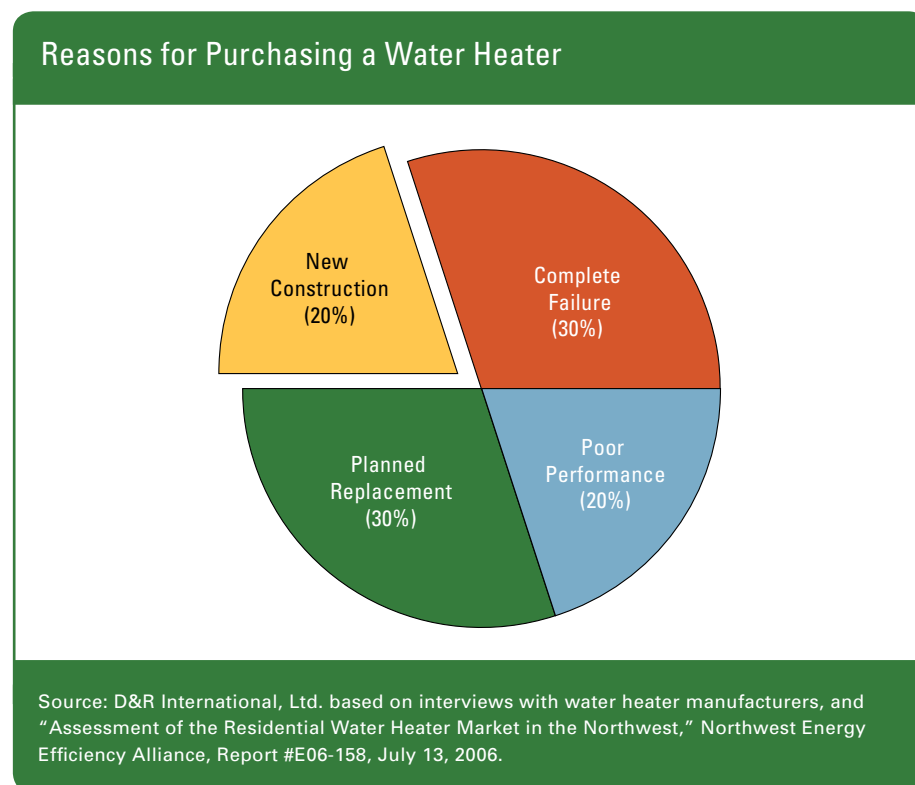
Source: D&R International, Ltd. based on interviews with water heater manufacturers.



The top three water heater retailers are Sears, The Home Depot, and Lowe's. Together, they are responsible for almost 43 percent of retail sales. Among the thousands of wholesalers and distributors nationwide, the three largest are Ferguson, Johnstone Supply, and Winnelson. Some manufacturers sell only to wholesalers, while others sell to retailers and wholesalers.

### Purchase Drivers

Homeowners replace water heaters for three major reasons: 1) the unit fails completely, 2) the performance of the unit becomes unacceptable, or 3) the homeowner decides it's time for a new one. In a 2005 survey of consumers in the Northwest who planned their water heater replacement, 43 percent said "it was getting old and it was time to replace it before it broke." Another 25 percent said "we wanted a more efficient unit."<sup>14,15</sup>



The factors most likely to influence a consumer's water heater selection are fuel type; tank size; warranty; price; and, especially in the case of emergency replacement, speed of procurement and installation. Recommendations from salespeople, friends, or family and the way retailers and plumbers present the options also strongly influence the product choice.<sup>16</sup>

## EFFICIENCY AND SAVINGS

### ENERGY STAR Criteria

The energy efficiency of the installed base is likely to rise steadily, possibly dramatically, over the next 10 years with the arrival of ENERGY STAR qualified water heaters. In April 2008, DOE announced final ENERGY STAR criteria, which apply to five types of water heaters. They range from improved versions of the dominant gas storage design, which cut energy consumption by about 7 percent, to super-efficient technologies that use half the energy of conventional models.

The ENERGY STAR criteria, which took effect in January 2009, include minimum requirements for energy efficiency, first hour ratings, warranties, and compliance with certain safety standards. As of August 25, 2009, 922 ENERGY STAR qualified water heater models were on the market.

ENERGY STAR Water Heater Criteria				
Type of Water Heater	Minimum Energy Factor	Minimum First Hour Rating**	Minimum Warranty	Safety
High-Efficiency Gas Storage	0.62 until 8/31/10; 0.67 thereafter	67 gallons per hour	6 years on sealed system	Compliance with ANSI† Z21.10.1/CSA 4.1
Whole-Home Gas Tankless	0.82	2.5 gallons per minute at a 77°F rise	10 years on heat exchanger and 5 years on parts	Compliance with ANSI† Z21.10.1/CSA 4.1 or ANSI Z21.10.3/CSA 4.3, depending on burner size
Gas Condensing	0.8	67 gallons per hour	8 years on sealed system	Compliance with ANSI† Z21.10.1/CSA 4.1
Heat Pump	2.0	50 gallons per hour	6 years on sealed system	Compliance with UL†† 174 and UL 1995
Solar	0.50 Solar Fraction*	—	10 years on solar collector, 6 years on storage tank, 2 years on controls, and 1 year on piping and parts	OG-300 certification from SRCC†††

Notes: \* Based on the Solar Rating and Certification Corporation's (SRCC) conversion formula: Solar Fraction =  $1 - (\text{Energy Factor}/\text{Solar Energy Factor})$ , assuming a 0.6 or 0.9 energy factor for gas or electric backup, respectively.

\*\* The first hour rating is the amount of hot water in gallons the heater can supply in the first hour starting with a tank full of hot water.


† The American National Standards Institute (ANSI) assists other organizations in the development of safety standards for many different appliances, including gas water heaters. The Z21.10.1/CSA 4.1 standard applies to water heaters that burn at 75,000 BTU per hour or less and sets guidelines for safe operation. Gas water heaters with burners that operate at over 75,000 BTU/hour must comply with the Z21.10.3/CSA 4.3 standard.

†† Electric water heaters, such as heat pump water heaters, are tested under Underwriters Laboratories (UL) 174. This standard is a set of guidelines for proper functioning and design of electric water heaters.


††† SRCC's OG-300 standard outlines minimum quality and operational requirements for solar water heaters.

## Profiles of ENERGY STAR Water Heater Technologies


### High-Efficiency Gas Storage

	<b>Innovations</b>	Improved insulation, more effective heat traps, less burner waste, less fuel in the combustion reaction
	<b>Energy Consumption</b>	242 therms/year, 7% less than standard storage models (224 therms/year, 14% less than standard storage models starting in Sept 2010)
	<b>Advantages</b>	Easy and inexpensive upgrade from standard-efficiency units; same methods, size, hook-ups
	<b>Disadvantages</b>	Higher operating costs relative to other ENERGY STAR qualified models
	<b>Availability</b>	320 models as of August 25, 2009

### Whole-Home Gas Tankless

	<b>Innovations</b>	Flow-sensor-activated heating mechanism, improved venting, no standby losses
	<b>Energy Consumption</b>	183 therms/year, 30% less than standard storage models
	<b>Advantages</b>	Provides continuous delivery of hot water; takes up less space because there is no storage tank
	<b>Disadvantages</b>	Higher installation costs (two to four times greater than for conventional storage models); often requires a wider gas supply line and a larger vent than a typical gas storage model, which can make changing from a tank to a tankless system in an existing home difficult in some cases
	<b>Availability</b>	440 models as of August 25, 2009

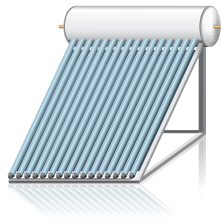
### Gas Condensing

	<b>Innovations</b>	Captures more heat from combustion
	<b>Energy Consumption</b>	187 therms/year, almost 30% less than standard storage models
	<b>Advantages</b>	Similar size as conventional storage models
	<b>Disadvantages</b>	May require the installation of a powered vent and/or a condensate drain, making emergency replacement of a standard model with this type difficult in some cases
	<b>Availability</b>	Expected in 2010

Continued

## Profiles of ENERGY STAR Qualified Water Heater Technologies

### Solar



<b>Innovations</b>	Uses the sun's energy to heat water
<b>Energy Consumption</b>	130 therms/year or 2,429 kWh/year for backup, both 50% less than standard storage models
<b>Advantages</b>	Visible indication of one's commitment to reducing energy consumption; some models can work well in overcast conditions and operate in temperatures as low as -40°F
<b>Disadvantages</b>	High initial cost; requires the use of a backup gas or electric water heater, usually a conventional storage model; may require more frequent maintenance
<b>Availability</b>	160 models as of August 25, 2009

### Heat Pump



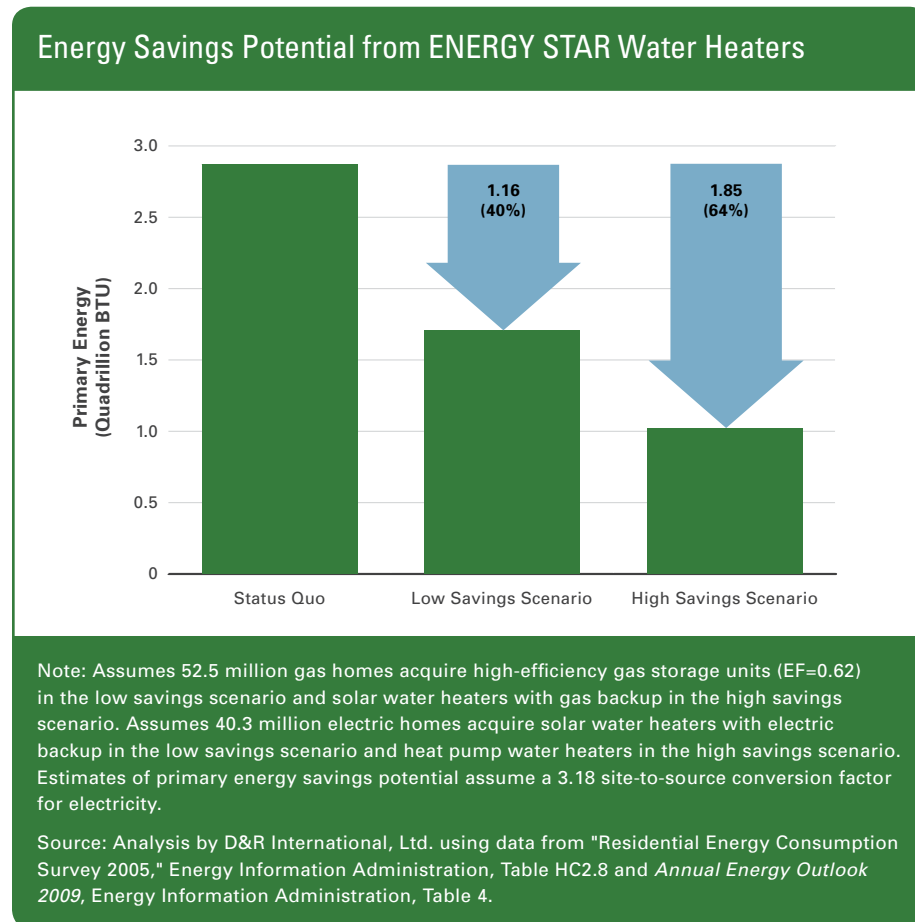
<b>Innovations</b>	Instead of generating heat, uses electricity to move heat from surrounding air to the water
<b>Energy Consumption</b>	2,195 kWh/year, 55% less than standard storage models
<b>Advantages</b>	Cools and dehumidifies the space in which it's installed, a benefit during the cooling season, especially in more humid climates
<b>Disadvantages</b>	Installation is complicated and requires a trained professional; requires a condensate drain and periodic air filter cleanings; cools and dehumidifies the space in which it's installed, a disadvantage during the heating season if installed in conditioned space
<b>Availability</b>	2 models as of August 25, 2009

Note: More detailed profiles of the five technologies are included in DOE's 2009 "ENERGY STAR Water Heater Partner Resource Guide."

## National Savings Potential

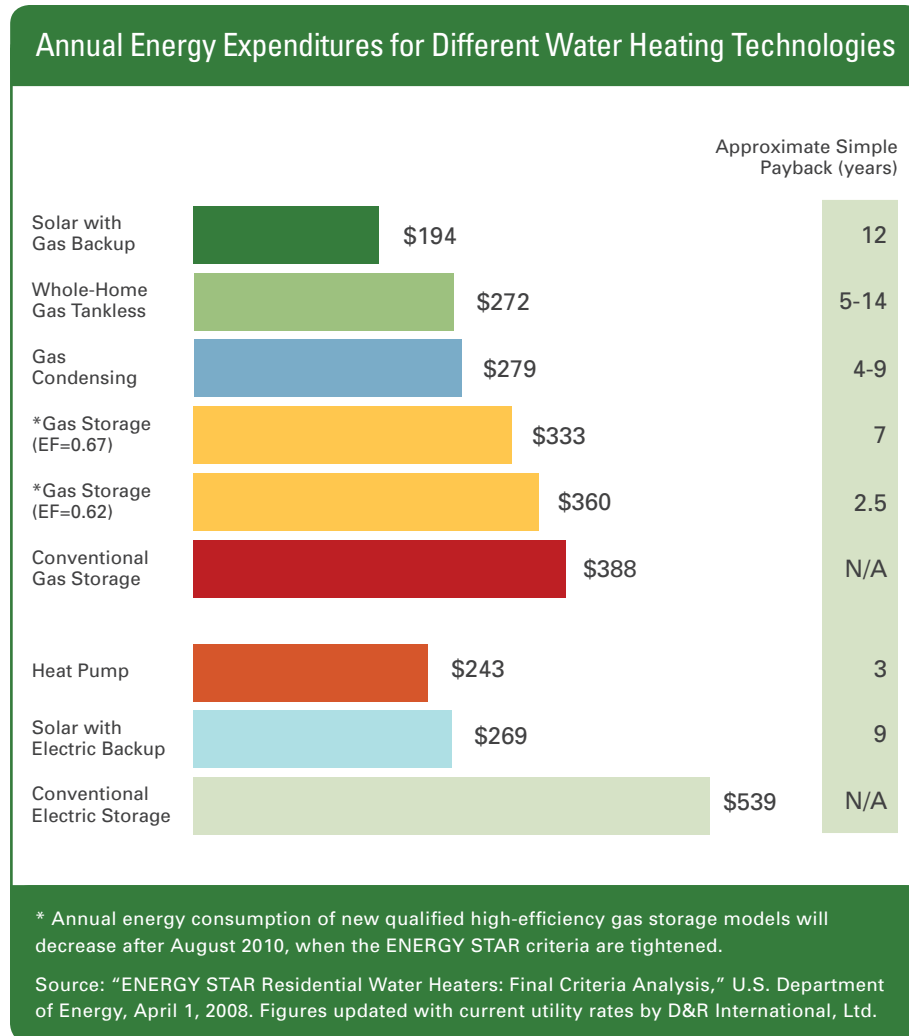
Revolutionary changes in water heating technology coupled with the yearly replacement of roughly one out of every 13 water heaters create a tremendous opportunity to increase energy efficiency in the residential sector.

ENERGY STAR qualified water heaters currently account for only 6 to 7 percent of sales and less than 1 percent of the installed base.<sup>17</sup> If all homes had ENERGY STAR qualified models, the United States could save 1 billion to 6.8 billion therms, 98 billion to 107 billion kWh, and \$12 billion to \$22 billion, depending on technology choices.<sup>18</sup> This is 1.16 to 1.85 quadrillion BTU per year of primary energy, a 40 to 64 percent savings.<sup>19</sup>



## Household Savings

An ENERGY STAR qualified water heater can save a household \$30 to \$300 a year on its energy bills. Qualified tankless and solar models can last up to 20 years, making them more durable than their less efficient counterparts. Although installation costs are higher for some models, particularly heat pump and gas condensing units, the simple payback period can be as short as three years.<sup>20</sup>



## GETTING STARTED

Program sponsors that are already promoting energy efficiency through appliance, new homes, home improvement, or weatherization programs can significantly boost savings with ENERGY STAR qualified water heaters.

**For gas savings,** begin promoting readily available solar, gas tankless, and high-efficiency gas storage systems. With their special installation requirements, gas condensing and gas tankless might best be targeted at new construction.

**For electricity savings,** begin promoting solar water heaters, adding heat pump systems as they become more widely available.

### Program Design Options

The following table shows how water heaters can be added to four common types of efficiency programs.

Program	Program Design Options	Key Considerations
<b>Appliances</b>	<ul style="list-style-type: none"> <li>Develop a rebate or upstream incentive program similar to existing appliance programs offered at retail.</li> <li>Consider tiered rebates for higher-efficiency models.</li> <li>Encourage retailers to expand the types of water heaters for sale.</li> <li>Encourage planned, rather than emergency, replacement.</li> <li>Conduct outreach to plumbers to encourage them to stock ENERGY STAR qualified water heaters for emergency replacement.</li> </ul>	<p>One-third of water heaters are purchased because of an emergency. Half of all sales are through wholesale distribution; 87 percent of wholesale distribution is to plumbers.</p>
<b>New Homes</b>	<ul style="list-style-type: none"> <li>Include requirements or incentives for using ENERGY STAR qualified water heaters in new homes programs.</li> </ul>	<p>The efficiency requirements of some new homes programs are more stringent than ENERGY STAR's. These programs need to incorporate a wide variety of products, including water heaters, to meet aggressive savings targets.</p>
<b>Home Improvement or Home Performance with ENERGY STAR</b>	<ul style="list-style-type: none"> <li>Allow inclusion of ENERGY STAR qualified water heaters in whole-home rebate or loan programs.</li> <li>Educate consumers on the energy and dollar savings associated with ENERGY STAR qualified water heaters.</li> <li>Encourage planned, rather than emergency, replacement.</li> <li>Partner with retailers and plumbers on renovation outreach activities and provide incentives for the purchase of ENERGY STAR qualified water heaters.</li> </ul>	<p>Major renovation provides an opportunity for a comprehensive, whole-home approach to lowering energy usage and improving comfort.</p> <p>The most frequent recommendations are HVAC upgrade or tune-up and home sealing and insulation. Water heaters are outside the current scope of most existing retrofit programs.</p>
<b>Weatherization for Low-Income Customers</b>	<ul style="list-style-type: none"> <li>Educate contractors and State implementers on the new ENERGY STAR options with training modules for weatherization contractors and training centers.</li> <li>Require ENERGY STAR qualified water heaters as the only replacement option.</li> </ul>	<p>Weatherization practices include a wide range of energy efficiency measures and technologies for retrofitting homes and apartment buildings. Almost two-thirds of weatherized homes receive some sort of improvement to their water heating systems. Storage-type water heaters are the most common water heating system installed.</p>

## Federal Tax Credits and State Rebates

Federal income tax credits are available to purchasers of ENERGY STAR qualified gas tankless, heat pump, and solar water heaters. There is also a credit for gas condensing units, but to be eligible the models must meet an efficiency level more stringent than ENERGY STAR, i.e., an EF of 0.82 for the tax credit compared to 0.80 for ENERGY STAR. In addition, the American Recovery and Reinvestment Act of 2009 provided funds to support State-sponsored appliance rebate programs, some of which are likely to include water heaters. Each State will decide which types of products it will promote, so rebate offerings will vary across the country. DOE anticipates awarding the Recovery Act funds to States by November 30, 2009, and State programs should be in place by early 2010<sup>21</sup>.

### Tax Credits for ENERGY STAR Qualified Water Heaters

Type of Water Heater	Tax Credit Amount	Notes
<b>Gas Tankless</b>	30% of installed cost up to \$1,500 for all improvements combined	Must be placed in service in an existing home in 2009 or 2010
<b>Heat Pump</b>	30% of installed cost up to \$1,500 for all improvements combined	Must be placed in service in an existing home in 2009 or 2010
<b>Solar</b>	30% of installed cost, no maximum	Must be placed in service in an existing home by Dec. 31, 2016

Source: U.S. Department of Energy and U.S. Environmental Protection Agency, "Federal Tax Credits for Energy Efficiency," [www.energystar.gov/index.cfm?c=tax\\_credits.tx\\_index](http://www.energystar.gov/index.cfm?c=tax_credits.tx_index), accessed August 26, 2009.

## Additional Resources

DOE offers a number of resources to help partners design an effective water heater program, including:

- "ENERGY STAR Water Heater Partner Resource Guide," featuring consumer messaging, profiles of the five technologies, and tips for selecting the right technology. This document is available in the Partner Resources section of the ENERGY STAR Web site.
- "ENERGY STAR Guide to Residential Water Heater Programs," featuring a complete list of water heater incentives offered by utilities and other energy efficiency program sponsors. This guide is available from your ENERGY STAR account manager.
- Assistance contacting other ENERGY STAR partners, including manufacturers, retailers, and other program managers. Contact your ENERGY STAR account manager for details.

For more information, visit [www.energystar.gov/waterheaters](http://www.energystar.gov/waterheaters) or e-mail [waterheaters@drintl.com](mailto:waterheaters@drintl.com).



## Energy and Cost Comparison for Gas Water Heating Options (50-gallon capacity)

	Non-Qualified	ENERGY STAR Qualified				
		Gas Storage		Whole-Home Tankless	Gas Condensing	Solar with Gas Backup
		Federal Standard	High Efficiency*			
Energy Factor	0.575	0.62	0.67	0.82	0.8	1.2**
Annual Consumption (therms)***	261	242	224	183	187	130
Annual Savings (therms)	—	19	37	78	74	130
Annual Operating Cost (\$)	388	360	333	272	279	194
Annual Savings (\$)	—	28	55	116	109	194
Life Expectancy (years)	13 <sup>22</sup>	13	13	20 <sup>23</sup>	15	20
Lifetime Savings (therms)	—	247	481	1,560	1,110	2,610
Lifetime Savings (\$)	—	364	715	2,320	1,638	3,880
Approx. Cost of Unit + Installation (\$)	865 <sup>24</sup>	935	1,265	1,470-2,500 <sup>25</sup>	1,300-1,800 <sup>26</sup>	3,200****
Approx. Price Premium (\$)	—	70	400	605-1,635	435-935	2,335
Approx. Simple Payback Period (years)	—	2.5	7	5-14	4-9	12
Approx. Units Sold in 2006 <sup>27</sup>	4.7 million	350,000	10,000	254,600	N/A	8,500

Source: "ENERGY STAR Residential Water Heaters: Final Criteria Analysis," U.S. Department of Energy, April 1, 2008.

Notes: Annual energy use estimates are based on the DOE test procedure and calculated assuming an inlet water temperature of 58°F, a set point of 135°F, daily hot water demand of 64.3 gallons, and 365 days of use per year. Energy cost estimates assume the national average gas price of \$1.49 per therm.

\* Gas storage water heaters with an energy factor of 0.62 or greater may earn the ENERGY STAR through August 2010, but thereafter must have an energy factor of 0.67 or greater.

\*\* Solar Energy Factor is based on the SRCC conversion formula: Solar Fraction = 1 – (Energy Factor/Solar Energy Factor), assuming a 0.6 energy factor for the gas backup.

\*\*\* Energy consumption is estimated using the DOE test procedure and is based on the following formula: (41,045 BTU/EF x 365)/100,000.

\*\*\*\* Cost varies widely because most installations are customized. The average cost is reported here.

## Energy and Cost Comparison for Electric Water Heating Options (50-gallon capacity)

	Non-Qualified		ENERGY STAR Qualified	
	Federal Standard	High Efficiency	Heat Pump	Solar with Electric Backup
Energy Factor	0.904	0.95	2.0	1.8*
Annual Consumption (kWh)**	4,857	4,622	2,195	2,429
Annual Savings (kWh)	—	235	2,662	2,428
Annual Operating Cost (\$)	539	513	243	269
Annual Savings (\$)	—	26	296	270
Life Expectancy (years)	13 <sup>28</sup>	13	10 <sup>29</sup>	20
Lifetime Savings (kWh)	—	3,055	26,620	48,570
Lifetime Savings (\$)	—	338	2,952	5,386
Approx. Cost of Unit + Installation (\$)	650	700	1,500 <sup>30</sup>	3,200 <sup>31***</sup>
Approx. Price Premium (\$)	—	50	850	2,550
Approx. Simple Payback Period (years)	—	2	3	9
Approx. Units Sold in 2006	4.8 million <sup>32</sup>		<2,000 <sup>33</sup>	8,500 <sup>34</sup>

Source: "ENERGY STAR Residential Water Heaters: Final Criteria Analysis," U.S. Department of Energy, April 1, 2008.

Notes: Annual energy use estimates are based on the DOE test procedure and calculated assuming an inlet water temperature of 58°F, a set point of 135°F, daily hot water demand of 64.3 gallons, and 365 days of use per year. Energy cost estimates assume the national average electricity price of \$0.1109 per kWh.

\* Solar Energy Factor is based on the SRCC conversion formula: Solar Fraction =  $1 - (\text{Energy Factor} / \text{Solar Energy Factor})$ , assuming a 0.9 energy factor for electric backup.

\*\* Energy consumption is estimated using the DOE test procedure and based on the following formula:  $(12.03 / \text{EF}) \times 365$ .

\*\*\* Cost varies widely because most installations are customized. The average cost is reported here.

## Endnotes

- <sup>1</sup> "Residential Energy Consumption Survey 2005," Energy Information Administration, Table HC2.8.
- <sup>2</sup> "Residential Energy Consumption Survey 2005," Energy Information Administration, Table HC2.8.
- <sup>3</sup> "Residential Energy Consumption Survey 2005," Energy Information Administration, Table HC2.8 and analysis of micro data conducted by D&R International, Ltd.
- <sup>4</sup> *Annual Energy Outlook 2009*, Energy Information Administration, Table 4, and "Residential Energy Consumption Survey 2005," Energy Information Administration, Table WH8.
- <sup>5</sup> Energy factor (EF) is a measure of a water heater's overall energy efficiency, based on the amount of hot water produced per unit of fuel consumed over a typical day. The higher the energy factor, the more efficient the water heater. The ENERGY STAR criteria specify a different minimum energy factor for each qualified technology except solar, for which a minimum solar fraction of 0.50 is required.
- <sup>6</sup> Energy Conservation Program for Consumer Products, Energy Conservation Standards Rulemaking for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters, Framework Document Public Meeting presentation slides, U.S. Department of Energy, Washington, DC, January 16, 2007. The final rule is due in March 2010; manufacturers typically have three years to transition to new standards.
- <sup>7</sup> "Assessment of the Residential Water Heater Market in the Northwest," Northwest Energy Efficiency Alliance, Report #E06-158, July 13, 2006.
- <sup>8</sup> "Residential Energy Consumption Survey 2005," Energy Information Administration, Table HC2.8.
- <sup>9</sup> "56<sup>th</sup> Annual Report: Statistical Review," *Appliance Magazine*, May 2009 and analysis by D&R International, Ltd. of data from the U.S. Census Bureau on new home construction and placements of manufactured homes.
- <sup>10</sup> "ENERGY STAR Residential Water Heaters: Final Criteria Analysis," U.S. Department of Energy, April 1, 2008.
- <sup>11</sup> Air-Conditioning, Heating, and Refrigeration Institute.
- <sup>12</sup> A list of manufacturers of ENERGY STAR qualified water heaters can be accessed from the right hand side of the landing page for any one of the ENERGY STAR water heater technologies on the ENERGY STAR Web site at [www.energystar.gov/waterheaters](http://www.energystar.gov/waterheaters).
- <sup>13</sup> Analysis by D&R International, Ltd. with input from water heater manufacturers.
- <sup>14</sup> "Assessment of the Residential Water Heater Market in the Northwest," Northwest Energy Efficiency Alliance, Report #E06-158, July 13, 2006.
- <sup>15</sup> D&R International, Ltd., based on interviews with water heater manufacturers.
- <sup>16</sup> D&R International, Ltd. communications with industry experts and observations of point-of-purchase materials in retail stores.
- <sup>17</sup> Analysis by D&R International, Ltd. of sales data for 2006 from Air-Conditioning, Heating and Refrigeration Institute and water heater manufacturers.
- <sup>18</sup> Assumes 52.5 million gas homes and 40.3 million electric homes acquire ENERGY STAR models, no fuel switching, and national average utility rates of \$0.1109/kWh and \$1.49/therm.
- <sup>19</sup> Analysis by D&R International, Ltd. of *Annual Energy Outlook 2009*, Energy Information Administration, Table 4.
- <sup>20</sup> The appendix provides more information on energy consumption, costs, and savings for each water heater type.
- <sup>21</sup> U.S. Department of Energy, "DOE Announces Nearly \$300 Million for Energy Efficient Appliances," July 14, 2009, [http://apps1.eere.energy.gov/news/daily.cfm/hp\\_news\\_id=178](http://apps1.eere.energy.gov/news/daily.cfm/hp_news_id=178).
- <sup>22</sup> "How to Buy an Energy-Efficient Gas Water Heater," Federal Energy Management Program, September 2004.
- <sup>23</sup> "Tankless Gas Water Heaters: Oregon Market Status," Energy Trust of Oregon, December 2005.
- <sup>24</sup> Based on survey data collected for the Super Efficient Water Heating Appliance Initiative, "PIER Draft Final Project Report," California Energy Commission, March 2007 (CEC-500-05-010).
- <sup>25</sup> Based on information in "Tankless Gas Water Heaters: Oregon Market Status," Energy Trust of Oregon, December 2005, and survey data collected for the Super Efficient Water Heating Appliance Initiative, "PIER Draft Final Project Report," California Energy Commission, March 2007 (CEC-500-05-010).
- <sup>26</sup> Based on information in Super Efficient Water Heating Appliance Initiative, "PIER Draft Final Project Report," California Energy Commission, March 2007 (CEC-500-05-010), and "Emerging Technology and Practices," American Council for an Energy Efficient Economy, 2004.
- <sup>27</sup> Gas Appliance Manufacturers Association and D&R International, Ltd. communications with water heater manufacturers.
- <sup>28</sup> "How to Buy an Energy-Efficient Electric Water Heater," Federal Energy Management Program, September 2004.
- <sup>29</sup> "Durability Testing of a Drop-In Heat Pump Water Heater," Oak Ridge National Laboratory, April 2004.
- <sup>30</sup> "Residential Heat Pump Water Heaters: Energy Efficiency Potential and Industry Status," Vermont Energy Investment Corporation, November 2005.
- <sup>31</sup> "The National Energy Modeling System: An Overview 2003," Energy Information Administration, April 2003.
- <sup>32</sup> Gas Appliance Manufacturers Association.
- <sup>33</sup> D&R International, Ltd. communications with water heater manufacturers.
- <sup>34</sup> Based on comments from the California Solar Energy Industries Association to the U.S. Department of Energy in response to draft criteria for ENERGY STAR water heaters.



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