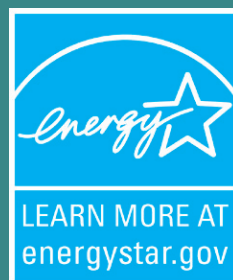


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U.S. DEPARTMENT OF ENERGY

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EXECUTIVE SUMMARY

The market for energy-efficient water heaters has grown rapidly in recent years

—from 625,000 units shipped in 2006 to 1 million units in 2009—even though the water heater market as a whole was shrinking over this time period. The ENERGY STAR® water heater program has helped fuel this growth. Since its launch in 2009, the program has given consumers independent validation of water heater efficiency claims and has helped manufacturers, distributors, plumbers, and retailers promote these products.

Water heating is the second largest energy use in homes, accounting for 17 percent of residential energy consumption. Although most water heater sales are replacements, efficient water heater shipments rose in the midst of plunging new home starts in 2007-2009. This growth in shipments is even more remarkable placed in the context of a dramatic decline in overall water heater shipments during the same period.

We have the recipe for enormous potential energy savings. Approximately 37 million residential water heaters will be replaced in the next five years. Because most of these water heaters just meet the original 1990 federal regulations, this is an opportunity for substantial energy savings. ENERGY STAR qualified water heaters consume 14 to 55 percent less energy than the standard-efficiency models available today, and can save a household \$40 to \$285 a year on its energy bills. Switching to solar and heat pump water heaters nationwide could reduce annual energy consumption by 1.85 quadrillion Btu per year, or 2 percent of the nation's total energy consumption. New water heaters also have the potential to lower peak demand, making them particularly attractive to most utilities.

ENERGY STAR qualified water heaters are widely available. As of September 1, 2010, 1,155 gas storage, gas tankless, heat pump, and solar water heater models had qualified for the ENERGY STAR label. They are available from major national retailers and from professional installers (plumbers). These outlets are also the primary points of influence and often the sole source of advice for many purchasers and decision-makers.

Utilities and other program sponsors are gaining experience in developing strategies to promote energy-efficient water heaters. More than two dozen utility-sponsored programs and 37 state programs are promoting ENERGY STAR qualified water heaters. Their experience, combined with market data, suggest that consumer needs, expert advice, information at point of purchase, and price are key factors to induce energy-efficient water heater sales. Opportunities abound.

INTRODUCTION

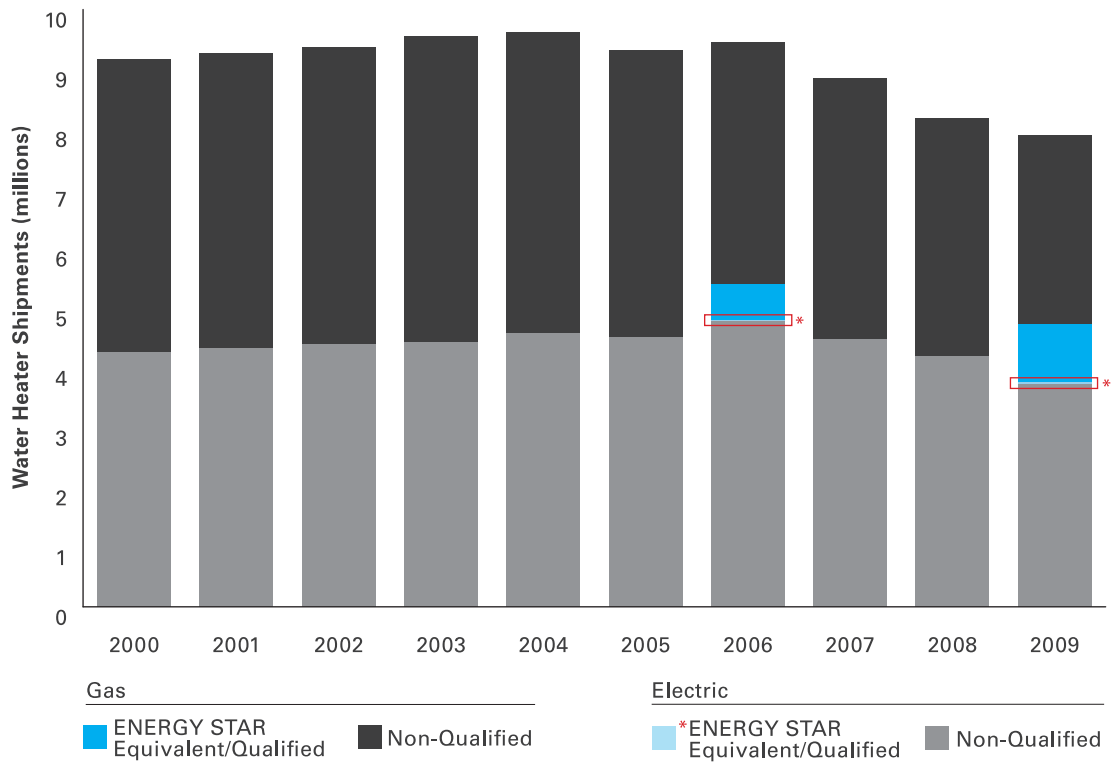
Water heating is the second largest energy use in homes, behind space heating and cooling. It accounts for 17 percent of residential energy consumption and can cost a household anywhere from \$200 to \$600 a year.¹ A total of 8 million residential water heaters were sold in the United States in 2009.² Storage water heaters are the most common type, with a 96 percent market share. Tankless water heaters, which serve a whole home or heat water at the point of use, accounted for the remaining 4 percent of sales, but are increasing in popularity.³

MARKET SIZE

The water heater market has risen and fallen over the last decade. The market declined steadily beginning in 2007, as new home construction plunged from mid-2007 through 2009. Shipments of efficient water heaters, however, grew dramatically in the midst of this decline.

In 2009, manufacturers shipped just under 8 million water heaters, down 18 percent from the peak in 2004. Compared to gas water heaters, electric water heaters accounted for more of both the expansion of shipments through 2004 and the contraction of shipments thereafter. This was largely due to new home construction being greatest in the South during that time, where building practice favors electric water heating.

Figure 1 | Water Heater Shipments, 2000 – 2009



The recent growth in shipments of energy-efficient water heaters is all the more remarkable in the context of the dramatic decline in overall water heater shipments during the same period. Of the products shipped in 2006, approximately 7 percent (625,000 units) would have met the ENERGY STAR criteria.⁴ In 2009, the first full year of the ENERGY STAR program, 13 percent of shipments (1.0 million units) were ENERGY STAR qualified units.⁵ The vast majority were in the gas storage category. As the minimum required energy factor^a (EF) for gas storage water heaters was raised on September 1, 2010, from 0.62 to 0.67, it is expected that ENERGY STAR market share will decline somewhat in the last quarter of 2010 from the reported 2009 levels.

Three of the four water heater types covered by the ENERGY STAR program, and which were available in 2006, posted higher shipments in 2009 than in 2006. Shipments of high-efficiency gas storage products increased 80 percent between 2006 and 2009, while the tankless water heater category grew by more than 30 percent. Heat pump water heaters shot up 630 percent from the 2006 baseline of 2,000 units. Of the eligible categories, only solar saw a decrease, though this is more likely due to an overestimation of products that would have qualified in 2006 and a lack of engagement from some solar manufacturers in becoming active within ENERGY STAR, rather than a reflection of declining sales of eligible products.

Figure 2 | ENERGY STAR Water Heater Market Share, 2006-2009

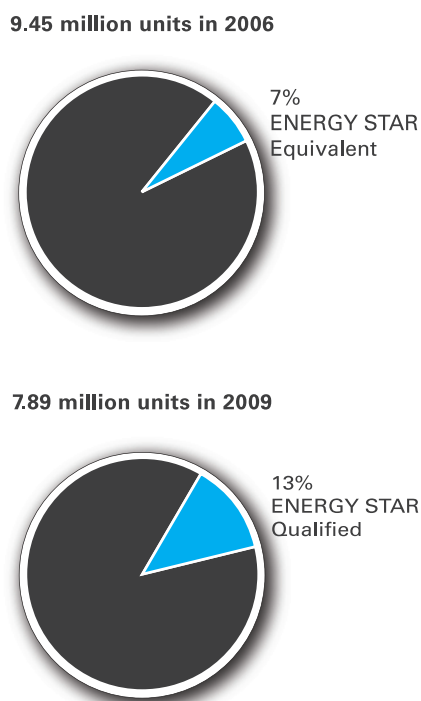
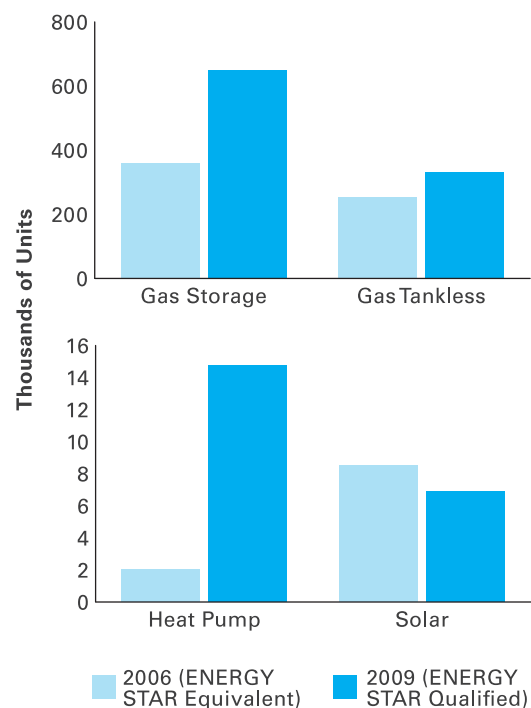


Figure 3 | ENERGY STAR Water Heater Shipments, 2006 and 2009



^a 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.

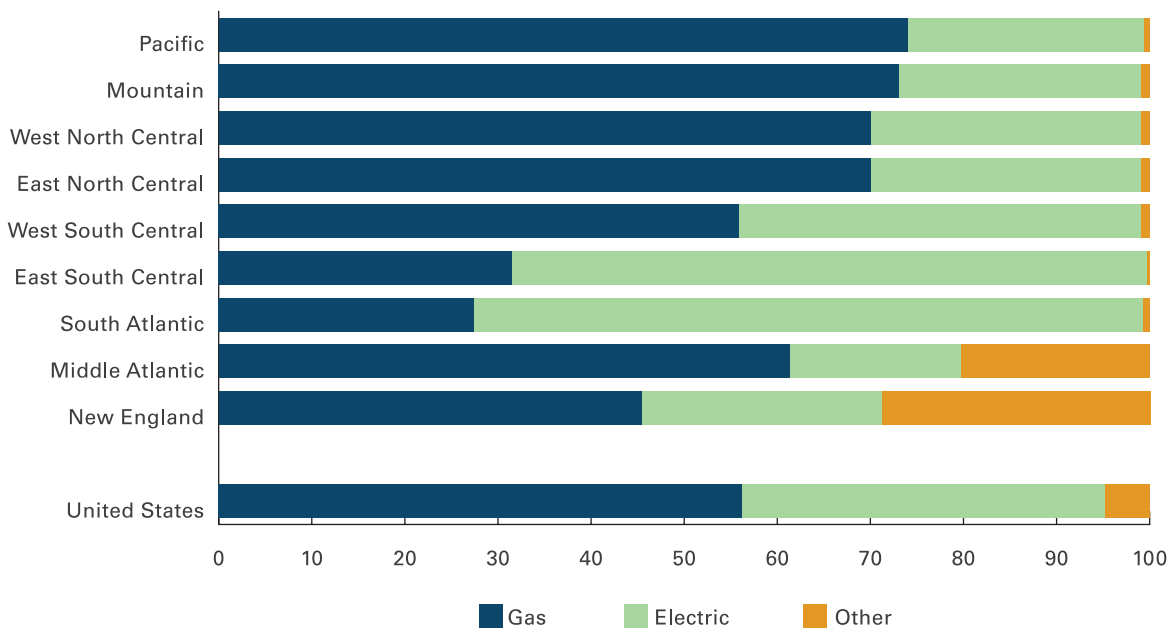
INSTALLED BASE

The 18 percent decline in water heater sales from 2006 to 2009, while substantial, is much smaller than the 75 percent decline in new housing starts because most water heater sales are replacements. Existing homes contain just over 100 million residential water heaters, 7 to 8 percent of which are replaced each year.

Residential water heaters are used in single-family, manufactured, and multifamily homes. Most are located in the 87 million single-family and manufactured homes, with 14 million in multifamily homes. Commercial water heaters provide hot water to the remaining 10 million multifamily units.⁶

Generally, residential water heaters use one of three fuels: natural gas, fuel oil, or electricity. Nationally, more than half of residential water heaters are gas water heaters, with most burning piped natural gas (53 percent) and a small proportion using bottled propane gas (4 percent). Most of the remaining water heaters are electric (39 percent). Regionally, however, the split between gas and electric can vary. Gas is the predominant water heating fuel in the West, Midwest, and Middle Atlantic, while in the Pacific Northwest and the South (with the exception of Texas) most water heaters are electric.⁷ A minority of homes in New England and the Middle Atlantic continue to use fuel oil. Figure 4 provides more detail.

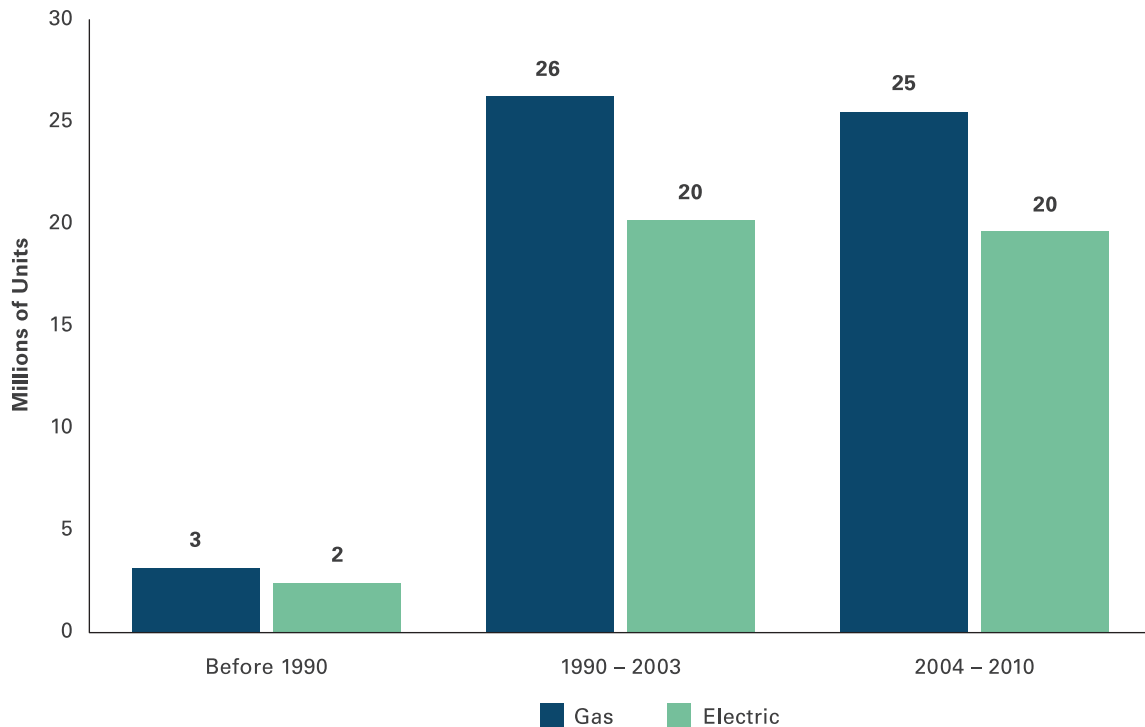
Figure 4 | Water Heating Fuel by Census Division, 2005



Note: “Gas” includes piped natural gas and bottled propane gas. “Other” includes primarily fuel oil, but also wood and solar. A map of census divisions is provided in the appendix.

Roughly half of residential water heaters in place today were installed between 1990 and 2003 and were designed to meet the 1990 federal efficiency standards. The other half was designed to meet the 2004 federal standards. An estimated 5 million units were built before federal standards took effect (Figure 5).

Figure 5 | Installed Base by Year of Manufacture



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

Water heaters are replaced on average every 13 years, although product lifetime depends on a variety of factors including the type of unit, the hardness of the water, and how the water heater is maintained.⁸ Considering the age of water heaters in the installed base and their average lifetime, approximately 37 million residential water heaters will be replaced in the next five years. Most of these water heaters just meet the original federal standards that took effect in 1990, creating an opportunity for large savings compared to the installed base of water heaters today.

ENERGY STAR CRITERIA AND FEDERAL STANDARDS

Traditionally, water heaters have been designed to only meet the federal standard. Congress first established efficiency standards for water heaters in 1987 that took effect in 1990. Updated federal standards that took effect in 2004 require higher minimum energy factors. The standard for the common 50-gallon tank size was set at 0.575 for gas water heaters and 0.904 for electric water heaters.

The initial ENERGY STAR criteria for water heaters took effect in January 2009. Five types of water heaters are eligible: gas storage, gas condensing, gas tankless, heat pump, and solar. Models meeting the criteria offer a range of energy performance improvement over standard water heaters, from 14 percent with relatively inexpensive improved gas storage products to more than 50 percent with heat pump and solar products. The criteria extend beyond basic energy efficiency to include minimum hot water delivery requirements, warranties, and safety standards.

Table 1 | ENERGY STAR Water Heater Criteria

Type	Minimum Energy Factor	Minimum First-Hour Rating** (gallons/hour)	Minimum Warranty	Safety
High-Efficiency Gas Storage	0.67	67	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	8 years on sealed system	Compliance with ANSI† Z21.10.1/CSA 4.1
Heat Pump	2.0	50	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 – (Energy Factor/ 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.

*** Hot water delivery from tankless water heaters is not measured by first-hour rating, but rather by the maximum flow rate that the heater can achieve while maintaining a particular temperature rise.

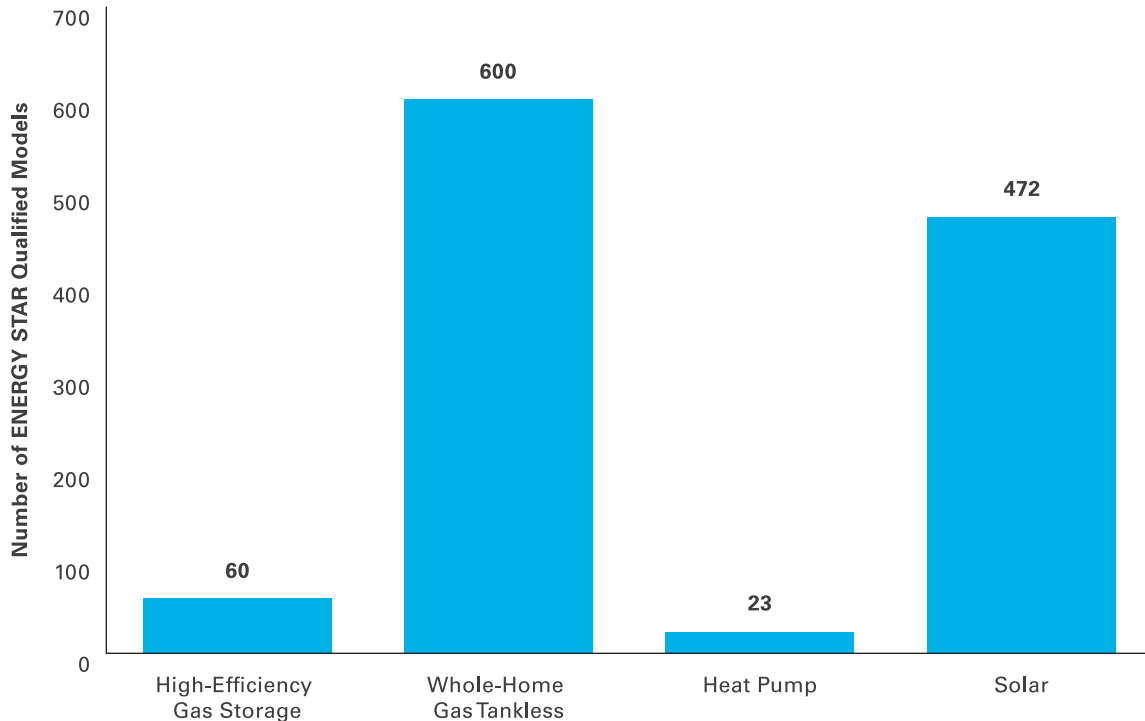
† The American National Standards Institute (ANSI) assists other organizations in developing safety standards for many different appliances, including gas water heaters. The Z21.10.1/CSA 4.1 standard applies to water heaters that burn at 75,000 Btu per hour or less and sets guidelines for safe operation. Gas water heaters with burners that operate at more than 75,000 Btu per 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.

As of September 1, 2010, 59 manufacturers had registered 1,155 ENERGY STAR qualified water heater models (Figure 6). An additional 352 models were disqualified on this date when the minimum energy factor for gas storage models increased from 0.62 to 0.67. There are not yet any gas condensing models that meet the ENERGY STAR criteria.

Figure 6 | ENERGY STAR Qualified Water Heater Models as of September 1, 2010



In April 2010, the U.S. Department of Energy (DOE) announced new, more stringent, federal standards to take effect in 2015.⁹ The minimum energy factor required by the new standards depends on fuel type and tank volume. For gas-fired and electric models under 55 gallons, the amended standards represent a 4- to 5-percent improvement in efficiency over the current federal standards.

For models with volumes larger than 55 gallons, the amended standards are significantly more aggressive. Larger gas-fired heaters will be required to be more than 30 percent more efficient than those manufactured today, while the efficiency of larger electric water heaters will increase by more than 120 percent. Heat pumps are the only current technology capable of meeting these electric water heater efficiency levels. Gas tankless water heaters will have to meet a new federal standard set at the current ENERGY STAR level, which is 32 percent above the current standard.

Table 2 | Federal Water Heater Standards Effective April 16, 2015

Type	Volume ≤ 55 Gallons	Volume > 55 Gallons
Gas Storage	$EF = 0.675 - (0.0015 \times \text{Volume})$	$EF = 0.8012 - (0.00078 \times \text{Volume})$
Electric Storage	$EF = 0.960 - (0.0003 \times \text{Volume})$	$EF = 2.057 - (0.00113 \times \text{Volume})$
Gas Tankless	$EF = 0.82 - (0.0019 \times \text{Volume})$	

Note: Gas tankless water heaters may store up to two gallons of water. In these cases, the minimum required energy factor is slightly lower than 0.82.

Figure 7 | Gas Storage Water Heater Efficiency Requirements

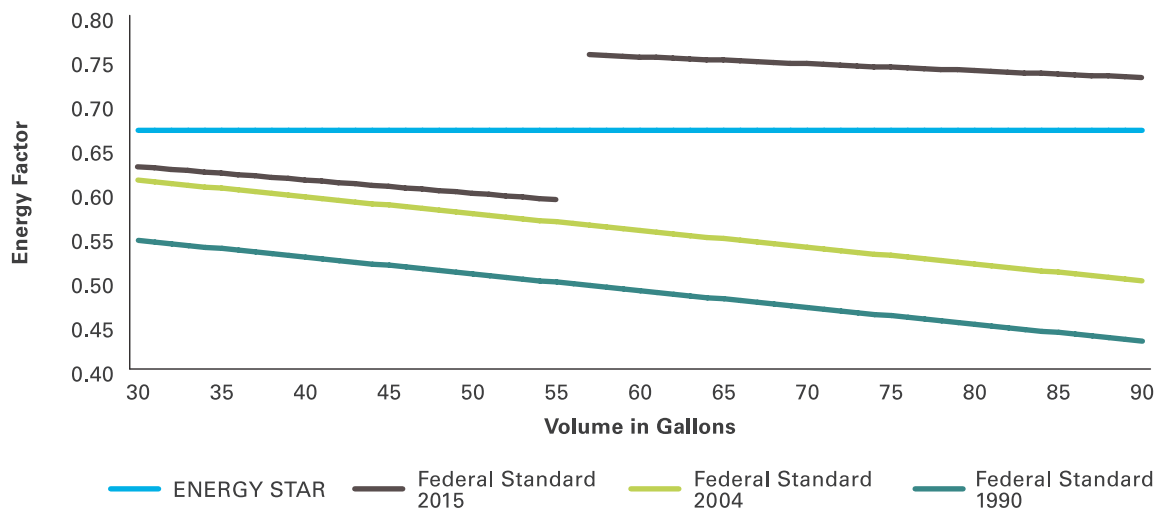


Figure 8 | Electric Storage Water Heater Efficiency Requirements

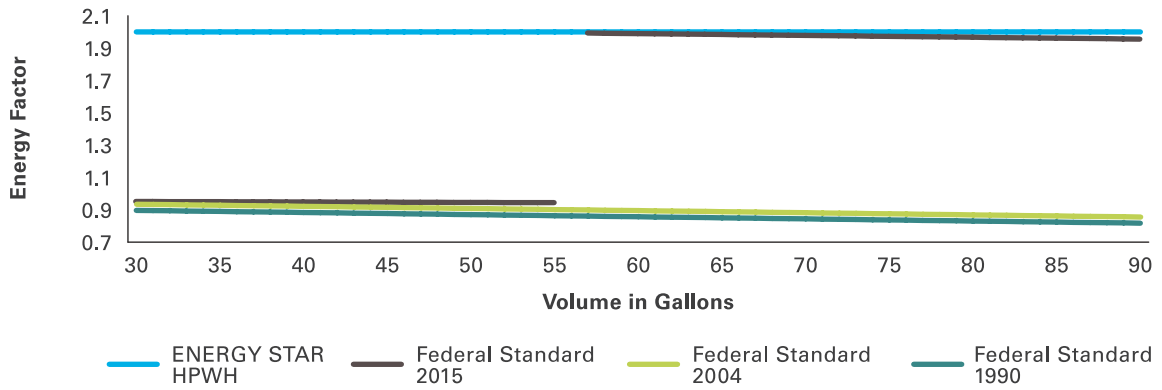


Figure 9 | Gas Tankless Water Heater Efficiency Requirements

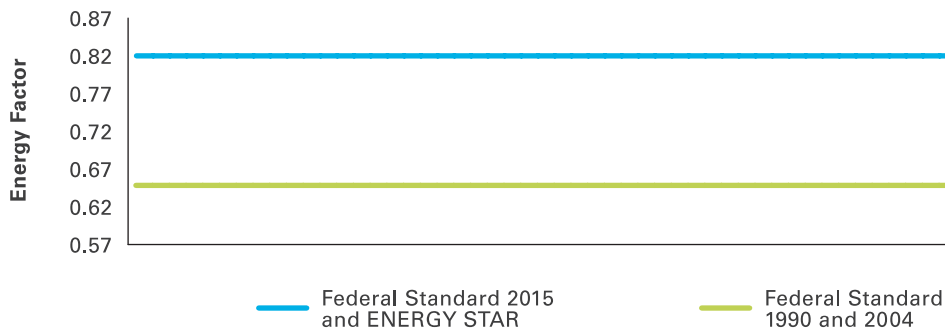


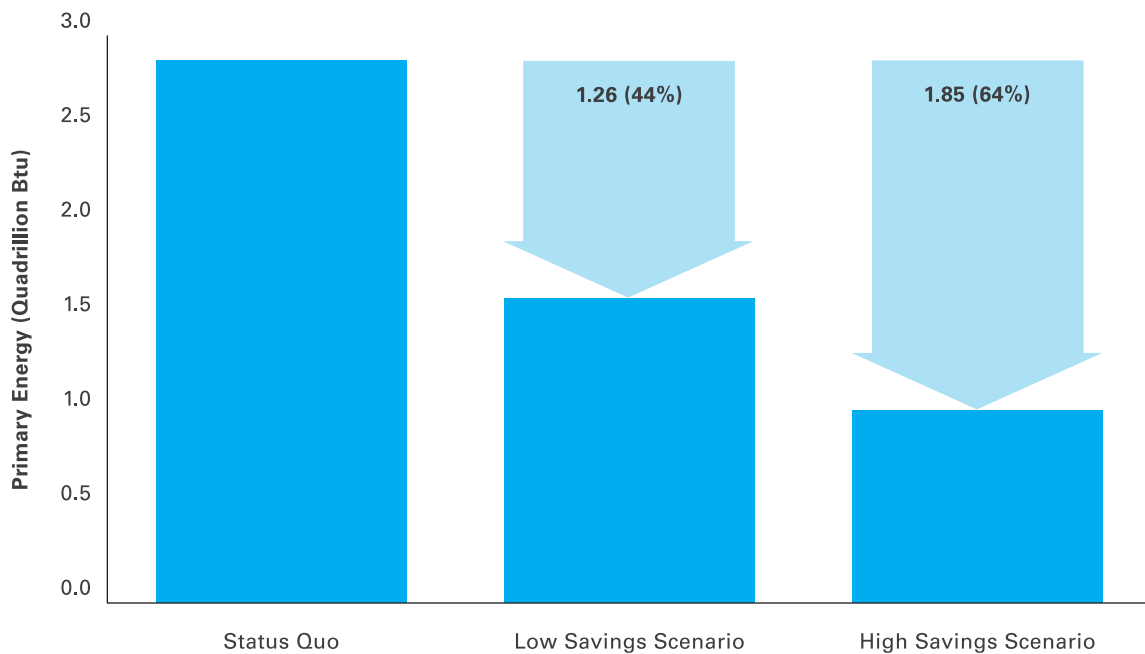
Table 3 | Minimum Energy Factor for Some Common Water Heater Sizes

Type	Storage Volume	Past	Present		Future
		Federal Standard (1990)	Federal Standard (2004)	ENERGY STAR Criteria	Federal Standard (2015)
Gas Storage	40 Gallons	0.544	0.594	0.67	0.62
	50 Gallons	0.525	0.575	0.67	0.60
	60 Gallons	0.506	0.556	0.67	0.75
Electric Storage	40 Gallons	0.877	0.917	2.0	0.95
	50 Gallons	0.864	0.904	2.0	0.95
	60 Gallons	0.851	0.891	2.0	1.99
	70 Gallons	0.838	0.878	2.0	1.98
	80 Gallons	0.824	0.864	2.0	1.97
Gas Tankless		0.62	0.62	0.82	0.82

ENERGY, DEMAND, AND COST SAVINGS

A relatively inefficient installed base, steady product turnover, new super-efficient water heaters, and an ENERGY STAR program that ensures quality and helps drive sales are a recipe for enormous potential energy savings. ENERGY STAR qualified water heaters accounted for just 13 percent of sales in 2009 and currently constitute less than 1 percent of the installed base.¹⁰ However, if all homes had ENERGY STAR qualified models, the United States could save 1.9 billion to 6.8 billion therms, 98 billion to 107 billion kWh, and \$13 billion to \$19 billion per year, depending on technology choices.^b This is 1.26 to 1.85 quadrillion Btu per year of primary energy, a 44- to 64-percent savings.¹¹

Figure 10 | Annual Energy Savings Potential from ENERGY STAR Qualified Water Heaters

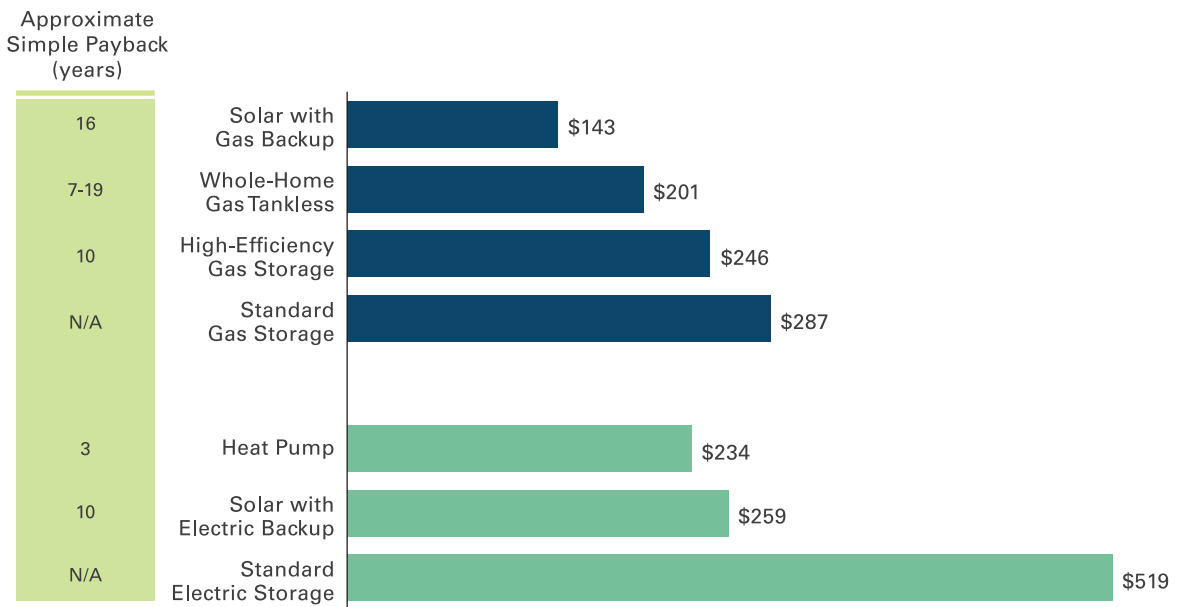


Note: Assumes 52.5 million gas homes acquire high-efficiency gas storage units (EF=0.67) in the low savings scenario and solar water heaters with gas backup in the high savings scenario. Assumes 40.3 million electric homes acquire solar water heaters with electric backup in the low savings scenario and heat pump water heaters in the high savings scenario. Estimates of primary energy savings potential assume a 3.18 site-to-source conversion factor for electricity.

^b 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 \$1.10/therm and \$0.1068/kWh.

An ENERGY STAR qualified water heater can save a household \$40 to \$285 a year on its energy bills compared to a new, non-qualified model (Figure 11). Consumers replacing pre-2004 models will see even greater savings. Qualified tankless and solar models can last up to 20 years, making them also more durable than their less efficient counterparts. Even though installation costs are higher in most cases, the simple payback period can be as short as three years for a heat pump water heater. The payback periods shown here do not account for consumer incentives such as tax credits and rebates. Consumers' actual payback periods could be considerably shorter in some cases, depending on fuel prices and the availability of financial incentives (discussed on p. 25).^c

Figure 11 | Annual Energy Expenditures for Different Water Heating Technologies



Note: All technologies analyzed here are ENERGY STAR qualified except Standard Gas Storage and Standard Electric Storage. Assumes national average utility rates of \$1.10/therm and \$0.1068/kWh.

^c See appendix for more information on energy consumption, costs, and savings for each water heater type.

New water heaters not only offer absolute energy savings, but also have the potential to lower peak demand (demand savings). Utility capacity requirements, particularly for electricity, are determined by peak demand, not overall energy savings, making measures that lower peak demand particularly valuable to most utilities. There are three ways that water heater replacement might affect peak demand:

1. Selection of an ENERGY STAR qualified electric water heater, which consumes less energy and is likely to draw less power during peak hours.
2. Selection of a “Smart Grid-ready” heat pump water heater, which switches to operating in heat pump-only mode in response to a signal from the utility.
3. Selection of a “Smart Grid-ready” standard water heater (not yet available), which can monitor and react to pricing information and turn itself off during some or all of a peak period with no likely impact on occupant comfort or convenience.¹²

Existing electric water heaters can also be retrofitted with load control switches. This could become an attractive option for utilities if consumers become disenchanted with current central air conditioning demand response programs, which cut off air conditioning on the hottest days of the year.

ENERGY STAR TECHNOLOGIES

HIGH-EFFICIENCY GAS STORAGE



Innovations	Improved insulation, more effective heat traps, less burner waste, less fuel in the combustion reaction
Energy Use	224 therms/year, 14% less than standard storage models
Advantages	Easy and inexpensive upgrade from standard-efficiency units; same methods, size, hook-ups
Disadvantages	Higher operating costs relative to other ENERGY STAR qualified models

WHOLE-HOME GAS TANKLESS



Innovations	Flow-sensor-activated heating mechanism, improved venting, no standby losses
Energy Use	183 therms/year, 30% less than standard storage models
Advantages	Provides continuous delivery of hot water; takes up less space because there is no storage tank
Disadvantages	Higher installation costs (two to four times greater than for conventional storage models); often requires a larger gas supply line and a larger vent than a typical gas storage model, which can make switching from a tank to a tankless system in an existing home difficult; requires more maintenance than storage models, particularly where water is hard

GAS CONDENSING



Innovations

Captures more heat from combustion

Energy Use

187 therms/year, almost 30% less than standard storage models

Advantages

Similar size as conventional storage models

Disadvantages

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

HEAT PUMP



Innovations

Instead of generating heat, uses electricity to move heat from surrounding air to the water

Energy Use

2,195 kWh/year, 55% less than standard storage models

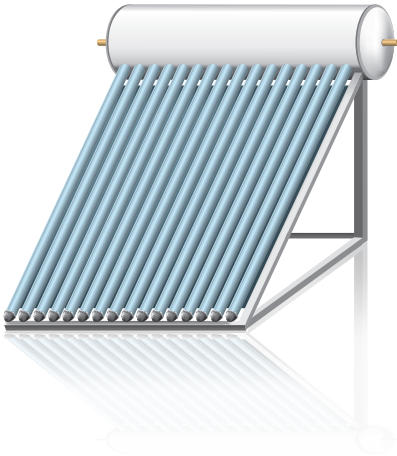
Advantages

Cools and dehumidifies the space in which it's installed, a benefit during the cooling season, especially in more humid climates

Disadvantages

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; generates noise similar to that of a dishwasher

SOLAR

	Innovations	Uses the sun's energy to heat water
	Energy Use	130 therms/year or 2,429 kWh/year for backup, both 50% less than standard storage models
	Advantages	Some models can work well in overcast conditions and operate in temperatures as low as -40°F; potential for "Prius effect" as a visible signal of green/energy security commitment
	Disadvantages	High initial cost; requires the use of a backup gas or electric water heater, usually a conventional storage model; may require more frequent maintenance

Recent Innovations

Advanced Flue Technology in Gas Storage

In September 2010, the ENERGY STAR criteria for gas storage water heaters changed to require a minimum energy factor of 0.67, up from 0.62. As of September 1, 60 models met the criteria. Ten of those models have an energy factor of 0.70, and all are based on the patented pressurized combustion system by A.O. Smith. These models push air into the combustion chamber to create a pressurized environment. This effect slows down the hot gas as it travels through the water heater, allowing for greater heat transfer and less energy waste.

Gas Tankless (with Condensing Technology)

An ENERGY STAR qualified gas tankless water heater must have an energy factor of 0.82 or higher. Of 600 qualified models, 88 have an energy factor of 0.90 or higher. Almost all of these models use "condensing" technology, which involves a second heat exchanger to capture and use heat that would otherwise be lost. Although these tankless water heaters use condensing technology, they are classified simply as "tankless" water heaters by ENERGY STAR, and should not be confused with ENERGY STAR qualified "gas condensing" water heaters, which are storage water heaters.

Gas Condensing Storage

The ENERGY STAR label is available only for residential gas condensing storage water heaters that have a heat input up to 75,000 Btu per hour. Manufacturers have not yet released any water heater models that qualify under the ENERGY STAR gas condensing criteria. Though there are many gas condensing models marketed for use inside homes, they are all considered commercial water heaters due to their high heat input. Manufacturers are working to develop gas condensing storage water heaters that meet the ENERGY STAR criteria.

An easy way to distinguish between residential and commercial models is by the energy efficiency metric: energy factor is used for residential models, while thermal efficiency is used for commercial models. The eligibility requirements for the federal tax credit specify a minimum energy factor of 0.82 or a thermal efficiency of 90 percent. Thus, tax credits are available for both residential and commercial gas condensing water heaters.

Spotlight on Heat Pump Water Heaters

Over the past year, the number of ENERGY STAR qualified heat pump water heater models has increased from 2 to 23. Heat pump water heaters are produced by several manufacturers, including A.O. Smith, Air Generate, GE, Rheem, and Stiebel Eltron. Only integrated models—where the tank and heat pump form a single unit—can qualify for the ENERGY STAR. Add-on models, which attach to an existing water heater, do not qualify.

Here are several factors to consider regarding heat pump water heaters:

- **Payback period is dependent on the conditions in each home.** Consumers want to know how long it will take to recoup the higher cost of a heat pump water heater. Unfortunately, payback period depends on the specific circumstances: installation location, air temperatures in that location, usage, and electricity prices. A heat pump water heater can pay back its price premium in as little as two years, but in some circumstances can take twice that long. In nearly all cases, however, a new product will repay its price premium within its operating lifetime.
- **Heat pump water heaters are best installed where there is sufficient vertical clearance and at least 1,000 cubic feet of surrounding air, they will not be exposed to weather, and the noise won't bother occupants.** In many homes, these conditions are met in the garage or an unheated basement. Water heaters commonly are installed in garages, basements, crawlspaces, or inside the house. Of those homes with electric water heaters, more than 18 million have a garage, basement, or both. Further, in most of these homes the water heater is located in either the garage or basement. Thus, these homes represent potential targets for heat pump water heaters.¹³
- **The Northwest Energy Efficiency Alliance (NEEA) has taken a special interest in ensuring successful installations in northern climates.** In October 2009, NEEA released its “Northern Climate Specification for Heat Pump Water Heaters,” which draws upon past experience with add-on water heaters to provide suggestions to manufacturers and consumers on the proper use of heat pump water heaters in the Northwest.¹⁴ To educate consumers about these products, NEEA developed a website that provides a description of the technology, instructions for proper use, and installation recommendations. NEEA is also partnering with top retailers to install point-of-purchase signage about heat pump water heaters. For more information, visit www.SmartWaterHeat.org.

There remain several important unanswered questions about heat pump water heaters:

1. Are garages, attics, or basements the most appropriate installation locations?
2. How do installations in conditioned spaces compare with those in unconditioned spaces?
3. Will residents detect and object to the cooling effect?
4. Will the heat pump water heater increase space heating costs?

The last two questions arise because heat pump water heaters cool and dehumidify ambient air in the process of extracting its heat. While some models can duct the cooler air outdoors, others cannot. The general consensus is that this cooling effect is a net benefit to residents in hot, humid climates and they will welcome this feature, but the impacts and reactions in cooler and drier climates are unknown.

To address these questions, the Electric Power Research Institute partnered with utilities across the country to conduct heat pump water heater demonstration projects in 200 single-family residential homes in various climates and with various types of installation. Installations began in April 2010, and the project is scheduled to end in December 2011.

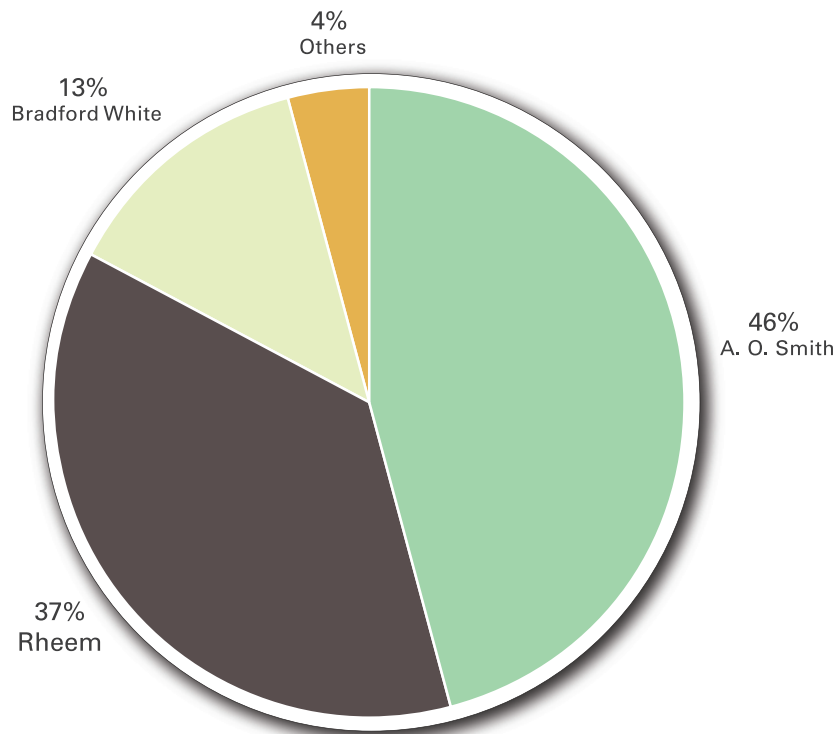


MANUFACTURE, DISTRIBUTION, AND PURCHASE

Manufacture

As of 2008, A.O. Smith, Rheem Manufacturing, and Bradford White made 96 percent of all residential water heaters,¹⁵ with the remainder manufactured by dozens of smaller companies. Many of these smaller companies are solar water heater manufacturers.¹⁶ A complete list of ENERGY STAR manufacturer partners can be downloaded from the ENERGY STAR website.¹⁷

Figure 12 | Water Heater Manufacturer Market Share, 2008



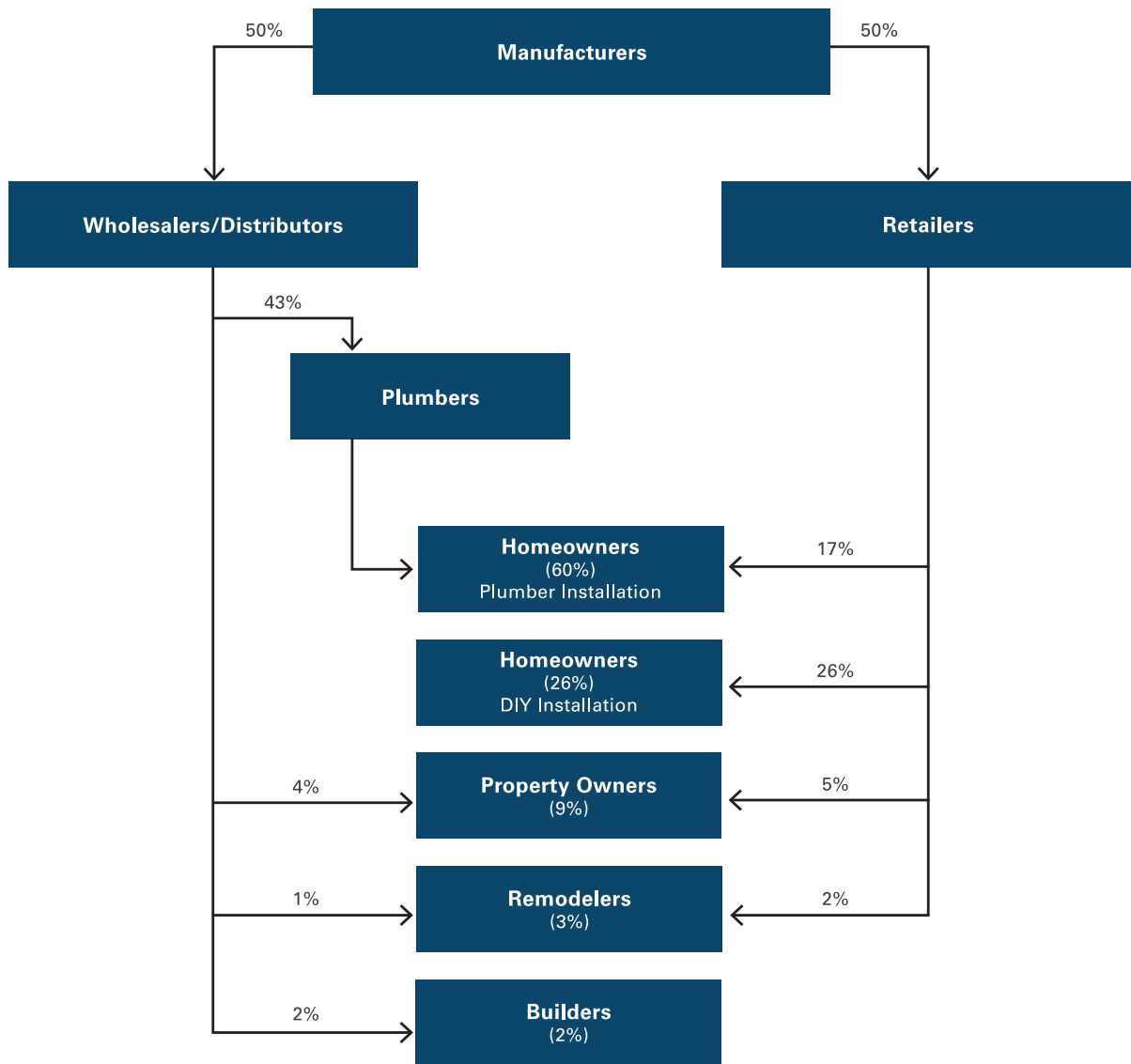
Distribution

Once manufactured, water heaters make their way into homes through several routes. Half pass through wholesalers and distributors, with most of these (87 percent) through plumbers to homeowners. The other half are sold through retailers, with most of these (85 percent) to homeowners or plumbers. Plumbers install at least 60 percent of all water heaters; homeowners install 25 percent. The remaining 15 percent are installed in remodels, new homes, and in multifamily residences, possibly in many cases by plumbers.¹⁸

The top three water heater retailers are Sears, The Home Depot, and Lowe's. There are also thousands of plumbing supply stores and other wholesalers and distributors nationwide. The three largest are Ferguson, Johnstone Supply, and Winnelson. Some manufacturers (such as Bradford White) sell only to wholesalers, while others (including A.O. Smith and Rheem) sell to wholesalers and retailers.¹⁹

Manufacturers have indicated that retail sales are weighted towards electric water heaters while wholesale/distributor sales are weighted towards gas, with a roughly 60-40 split in both cases. This is consistent with the data on who buys water heaters through each channel, as it is reasonable to expect that homeowners purchasing and installing a water heater themselves are more likely to install an electric water heater than a gas water heater.

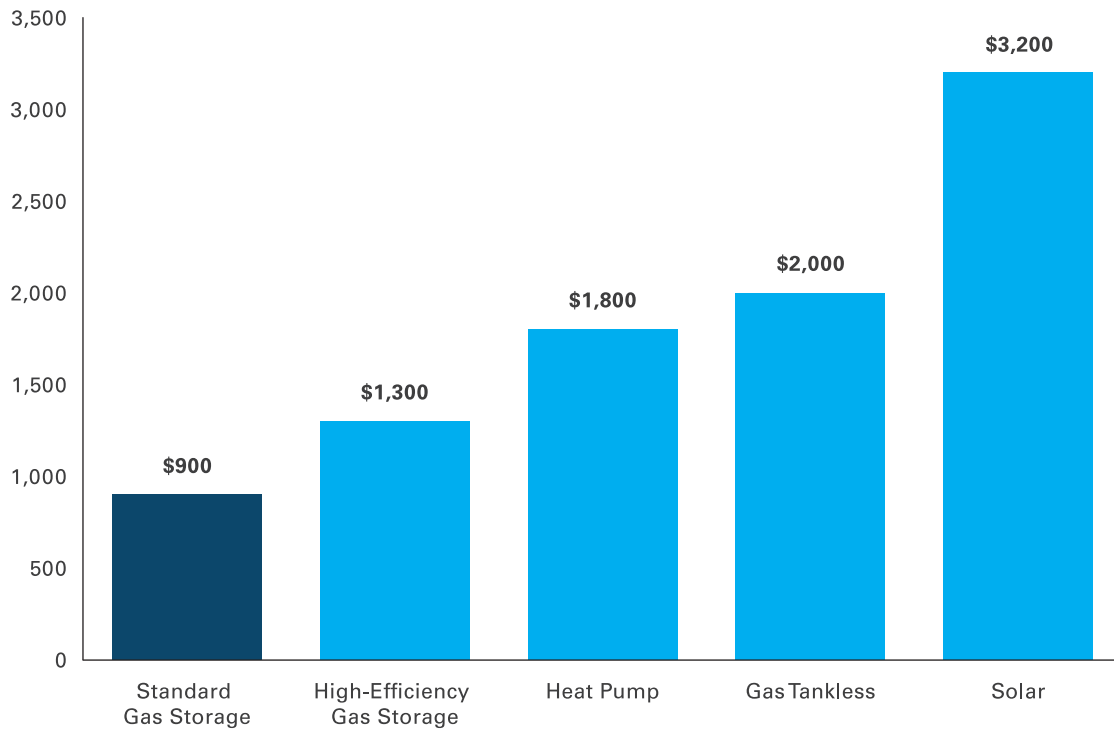
Figure 13 | Water Heater Distribution Channels



The Purchasing Decision

The ultimate question for program managers and policy makers interested in growing sales of energy-efficient water heaters is, “What are the best strategies for inducing more people to purchase them?” While there is no definitive answer yet, market data and initial program experience suggest that key influences are consumer needs, expert advice, information at point of purchase, and price.

Figure 14 | Typical Installed Costs

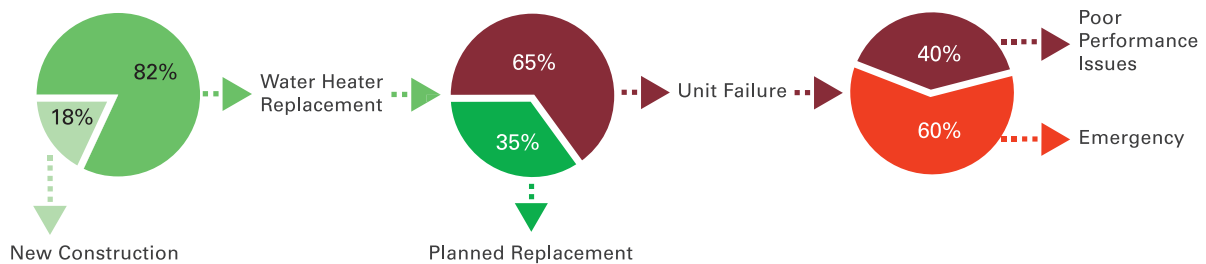


Note: Installed cost is equal to cost of equipment plus installation.

Speed and price are the critical decision factors in most water heater replacement sales. Half of water heater sales are emergency replacements caused by the complete or partial failure of the existing unit. As a result, few consumers have the time or interest to research product options. Their product options are thus entirely defined by what their plumber or retailer offers. In addition, their decisions will be strongly influenced by their plumber’s recommendation or retailer’s positioning and signage at point of purchase.

Figure 15 | Water Heater Purchase Motivators

ALL WATER HEATER SALES



Note: The market share shown for new construction is a historical average. New homes accounted for only 11 percent of water heater sales in 2009.

Programs experiencing early success have partnered with retailers, plumbers, distributors, and manufacturers. Retailers and plumbers directly influence consumers. Distributors determine what products are available to plumbers and are an efficient way to reach plumbers. Manufacturers provide most of the in-store signage and collateral materials found in national retailers.

GETTING STARTED

Program sponsors that are already promoting energy efficiency through appliance, new home, home improvement, or weatherization programs can significantly boost savings by promoting ENERGY STAR qualified water heaters. For gas savings, program sponsors can begin promoting readily available solar, gas tankless, and high-efficiency gas storage systems. With their special installation requirements, gas tankless might best be targeted at new construction. For electricity savings, program sponsors can begin promoting solar water heaters and add heat pump systems if they are a viable option in the service territory.

Table 4 | Adding Water Heaters to Existing Programs

Program	Program Design Options	Key Considerations
Appliances	<ul style="list-style-type: none"> Develop a rebate or upstream incentive program similar to existing appliance programs offered at retail. Consider tiered rebates for higher-efficiency models if consumers can easily identify such models through labeling, signage, or other means. Encourage retailers to expand the types of water heaters for sale. Place point-of-purchase advertising at retail locations. Encourage plumbers and distributors to stock ENERGY STAR qualified water heaters. Provide plumbers with savings estimates, brochures, and other tools needed to sell efficient water heaters. 	<ul style="list-style-type: none"> About one-third of water heaters are purchased because of an emergency. Half of all sales are through wholesalers/distributors and half are through retailers. Plumbers influence approximately 60 percent of all water heater sales.
New Homes	<ul style="list-style-type: none"> Include requirements or incentives to include ENERGY STAR qualified water heaters in new home programs. Increase savings by encouraging installation closest to where hot water is required (e.g., in the kitchen or master bathroom). A garage or basement is not always the most efficient location. 	<ul style="list-style-type: none"> The efficiency requirements of some new home 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.

Continued >

Program	Program Design Options	Key Considerations
Home Improvement or Home Performance with ENERGY STAR	<ul style="list-style-type: none"> • Allow ENERGY STAR qualified water heaters in whole-home rebate or loan programs. • Educate consumers on the energy and dollar savings associated with ENERGY STAR qualified water heaters. • Encourage planned, rather than emergency, replacement. • Partner with retailers and plumbers to reach consumers planning home renovations and provide incentives for the purchase of ENERGY STAR qualified water heaters. 	<ul style="list-style-type: none"> • Major renovation provides an opportunity for a comprehensive, whole-home approach to lowering energy usage and improving comfort. • The most frequent recommendations are HVAC upgrade or tune-up, home sealing, and insulation. Water heaters are typically outside the scope of most retrofit programs.
Weatherization for Low-Income Customers	<ul style="list-style-type: none"> • Educate contractors, community action agencies, and state regulators on the new ENERGY STAR options. • Require ENERGY STAR qualified water heaters as the only replacement option. 	<ul style="list-style-type: none"> • Weatherization practices include a wide range of energy efficiency measures and technologies for retrofitting homes and apartment buildings, including water heater replacement.

Partnering with Plumbers

Plumbers can be strategic partners for water heater rebate programs because they directly purchase or influence the purchase of about 60 percent of all water heaters. While plumbers may be ideal influencers in theory, in practice, recruiting wide participation may prove challenging. Water heater replacements typically make up only 10 to 20 percent of a plumber’s business, and most plumbers work independently or in small businesses and are fiercely independent. It is unclear whether there is a strong business case for a plumber to try to sell efficient water heaters. Many do not mark up the price of equipment and would rather avoid an involved sales process. It is easiest to persuade a consumer to simply replace a broken unit with a comparable new unit.²⁰

\$50 REBATE

from Puget Sound Energy on this
**ENERGY STAR qualified natural gas storage
water heater.**



Available to qualifying PSE
residential natural gas customers.
See associate for details.

PSE.com/Rebates



Spotlight on Puget Sound Energy

Puget Sound Energy (PSE) is a utility that serves 750,000 gas and 1,000,000 electric customers in Washington State. PSE's efficient water heater program began in 2005 with rebates for efficient gas storage water heaters and has since expanded to include rebates for ENERGY STAR qualified heat pump, gas storage, and gas tankless water heaters.

Speed and price are the driving factors for many water heater replacements. PSE quickly learned the importance of communicating the benefits of efficient water heaters concisely at the time and point of sale. It found that the best way to do this is to partner directly with plumbers, retailers, and manufacturers:

- Plumbers were invited to webinars and meetings at which PSE provided savings estimates and lifetime costs of efficient models and suggested strategies to increase sales. PSE also distributed brochures that plumbers then presented to customers.
- Point-of-purchase signage (pictured) was displayed at big-box retail stores to attract attention to efficient units at the time of purchase.
- Manufacturers of efficient water heaters paid for the opportunity to display their logos on bill inserts. The proceeds were used to buy radio and print ads.

For more information on PSE's program, visit www.pse.com/solutions/foryourhome/pages_rebatesOnWaterHeating.aspx.

Table 5 | Puget Sound Energy's
Water Heater Rebate Levels

Water Heater Type	Rebate Level (\$)
Gas Storage	50
Gas Tankless	150
Gas Tankless (Condensing)	200
Heat Pump Water Heater	250

Consumer Incentives

Financial incentives are available from several sources for the purchase of energy-efficient water heaters.

Federal income tax credits cover ENERGY STAR qualified gas tankless, heat pump, and solar water heaters. However, unless extended by Congress, the tax credit for the first two technologies will expire at the end of 2010. The solar water heater incentive will remain available through 2016.

The 2009 American Recovery and Reinvestment Act supports state-sponsored appliance rebate programs, most of which began in the first half of 2010 and conclude in the second half of 2010 or early 2011. Water heaters are included in 37 of these programs. Most states offered flat rebates, ranging from \$25 in New Jersey for a gas storage water heater with an energy factor greater than or equal to 0.62, to \$2,500 in Michigan for a solar water heater. A few states offered rebates equal to 20 to 30 percent of the price of a qualified unit. Table 6 summarizes these rebates.

Table 6 | State Energy Efficient Appliance Rebate Program Water Heater Rebates

Type		States/Territories Providing Incentives	Average and Range of Incentive Amounts
Gas Storage	(EF \geq 0.62)	22	\$181 (\$25 - \$1,400)
	(EF \geq 0.67)	11	\$196 (\$99 - \$300)
Gas Tankless		32	\$265 (\$100 - \$1,200)
Heat Pump		26	\$288 (\$50 - \$1,400)
Solar		18	\$587 (\$100 - \$2,500)

Notes: Required efficiency levels match those of the ENERGY STAR program. Reported rebate levels are current as of July 2010. More states may offer water heater rebates and rebate levels may change over time.

In addition to the Recovery Act-funded rebates administered by state energy offices, more than 50 water heater rebates are available from at least 30 utilities and energy efficiency organizations across the country. Many of these rebates are cataloged on the ENERGY STAR Water Heater Coalition's website, www.eswaterheaters.org. Additional incentives can be found in the Database of State Incentives for Renewables and Efficiency, www.dsireusa.org.

Lastly, Congress may enact legislation that provides further incentives for water heaters. For example, energy legislation passed by the U.S. House of Representatives in May 2009 included provisions for a new national program known as Home Star. This program would provide financial incentives for the purchase and installation of energy-efficient water heaters in existing homes, among other provisions.²¹ This legislation has not yet been voted on by the Senate as of the date of this report.

ENERGY STAR Resources

DOE and the U.S. Environmental Protection Agency offer a number of resources to help partners design an effective water heater program:

The ENERGY STAR Water Heater Partner Resource Guide features consumer messaging, profiles of the five water heater technologies, and tips for selecting the right one. This document is available in the Partner Resources section of the ENERGY STAR website.

ENERGY STAR Residential Water Heaters: Industry Guidelines provides water heater manufacturers with direction for partnering with ENERGY STAR.

Partner support includes assistance contacting other ENERGY STAR partners (i.e., manufacturers, retailers, and efficiency program sponsors) to coordinate promotional efforts and learn from the experience of others. Contact an ENERGY STAR account manager for details.

For more information, visit www.energystar.gov/products or e-mail waterheaters@drintl.com.

APPENDIX

Figure 16 | U.S. Census Regions and Divisions

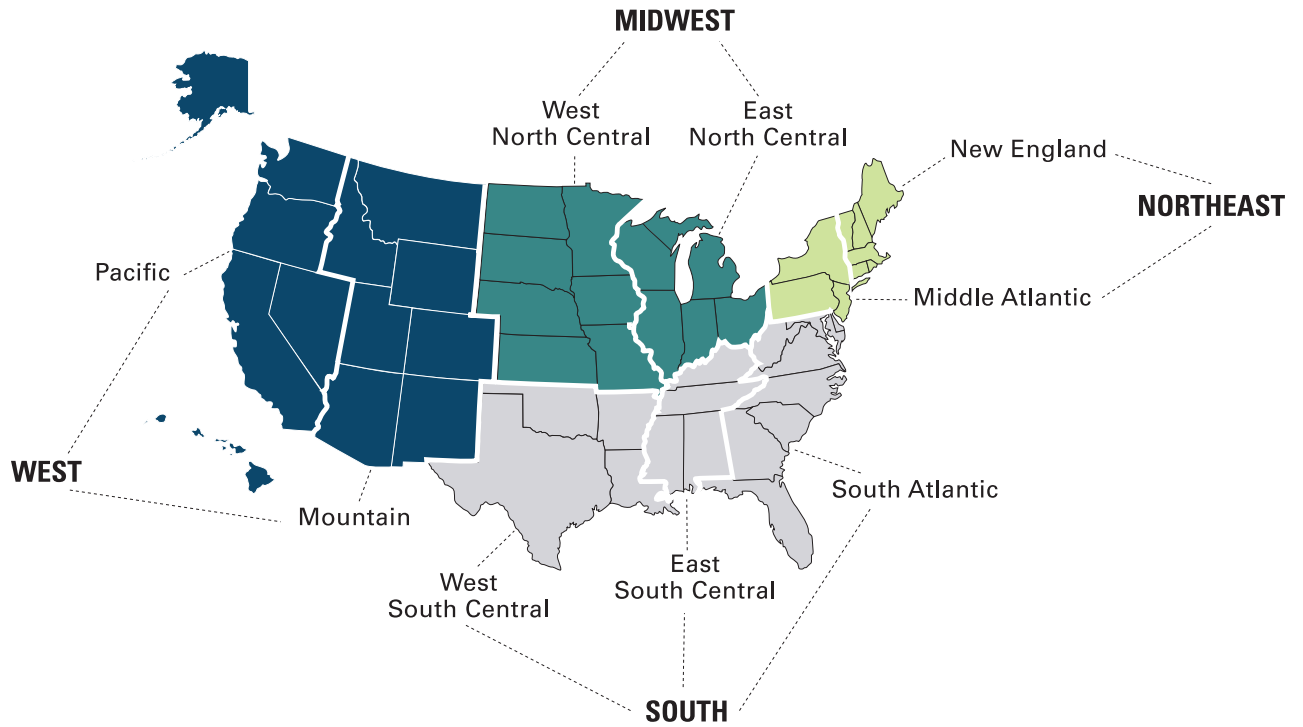


Table 7 | Energy and Cost Comparison for Gas Water Heating Options (50-gallon capacity)

	Non-Qualified	ENERGY STAR Qualified		
	Standard Gas Storage	High-Efficiency Gas Storage	Whole-Home Gas Tankless	Solar with Gas Backup
Energy Factor	0.575	0.67	0.82	1.2*
Annual Consumption (therms)	261	224	183	131
Annual Savings (therms)	–	37	78	130
Annual Operating Cost (\$)	287	246	201	143
Annual Savings (\$)	–	41	86	143
Life Expectancy (years)	13 ²²	13	20 ²³	20
Lifetime Savings (therms)	–	481	1,560	2,610
Lifetime Savings (\$)	–	528	1,713	2,866
Approximate Cost of Unit + Installation (\$)	865 ²⁴	1,265	1,470-2,500 ²⁵	3,200**
Approximate Price Premium (\$)	–	400	605-1,635	2,335
Approximate Simple Payback Period (years)	–	10	7-19	16
Approximate Units Sold in 2009 ²⁶	3.15 Million	650,000***	333,000	7,000

Notes: Annual energy use estimates are based on the DOE test procedure, which assumes 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. Thus, annual energy consumption in therms = (41,045 Btu/EF x 365)/100,000. Energy cost estimates assume a national average gas price of \$1.10 per therm.

* Solar energy factor is based on the Solar Rating and Certification Corporation's conversion formula: Solar fraction = 1 – (energy factor/solar energy factor), assuming a 0.6 energy factor for gas backup.

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

*** Includes gas storage models that are ENERGY STAR qualified with an energy factor of 0.67 and models that met the previous criteria level of 0.62.

Table 8 | 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 (\$)	519	494	234	259
Annual Savings (\$)	–	25	284	259
Life Expectancy (years)	13 ²⁷	13	10 ²⁸	20
Lifetime Savings (kWh)	–	3,055	26,620	48,570
Lifetime Savings (\$)	–	327	2,843	5,188
Approximate Cost of Unit + Installation (\$)	650	700	1,500 ²⁹	3,200 ^{30**}
Approximate Price Premium (\$)	–	50	850	2,550
Approximate Simple Payback Period (years)	–	2	3	9.5
Approximate Units Sold in 2009 ³¹	3.75 million		14,730	7,000

Notes: Annual energy use estimates are based on the DOE test procedure, which assumes 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. Thus, annual energy consumption in kWh = (12.03/EF) x 365. Energy cost estimates assume a national average electricity price of \$0.1068 per kWh.

* Solar energy factor is based on the Solar Rating and Certification Corporation’s conversion formula: Solar fraction = 1 – (energy factor/solar energy factor), assuming a 0.9 energy factor for electric backup.

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

ENDNOTES

- 1 Energy Information Administration, *Annual Energy Outlook 2009*, Table 4, and Energy Information Administration, "Residential Energy Consumption Survey 2005," Table WH8.
- 2 Presentation by Jim Lutz, Lawrence Berkeley National Laboratory (LBNL), at 2010 ACEEE Hot Water Forum.
- 3 ENERGY STAR shipment data collected by D&R International, Ltd. from ENERGY STAR partners.
- 4 "ENERGY STAR Residential Water Heaters: Final Criteria Analysis," April 1, 2008. Prepared by D&R International, Ltd. for the U.S. Department of Energy.
- 5 ENERGY STAR Shipment Data collected from ENERGY STAR partners. Total market from presentation by Jim Lutz, LBNL, at 2010 ACEEE Hot Water Forum.
- 6 Energy Information Administration, "Residential Energy Consumption Survey 2005," Table HC2.8.
- 7 Energy Information Administration, "Residential Energy Consumption Survey 2005," Table HC2.8, and analysis of micro data conducted by D&R International, Ltd.
- 8 Northwest Energy Efficiency Alliance, "Assessment of the Residential Water Heater Market in the Northwest," Report #E06-158, July 13, 2006.
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- 30 Energy Information Administration, "The National Energy Modeling System: An Overview 2003," April 2003.
- 31 D&R International, Ltd. communications with water heater manufacturers and a presentation by Jim Lutz, LBNL, at the 2010 ACEEE Hot Water Forum.

FIGURE SOURCES

- Figure 1 | Page 2:** Analysis by D&R International, Ltd. of data from "56th Annual Report: Statistical Review," *Appliance Magazine*, May 2009; "2009: Hope for Recovery," *Appliance Magazine*, January 2009; "ENERGY STAR Residential Water Heaters: Final Criteria Analysis," April 1, 2008, prepared by D&R International, Ltd. for the U.S. Department of Energy; and from ENERGY STAR manufacturer partners.
- Figure 2 | Page 3:** Analysis by D&R International, Ltd. of data from "56th Annual Report: Statistical Review," *Appliance Magazine*, May 2009; "2009: Hope for Recovery," *Appliance Magazine*, January 2009; "ENERGY STAR Residential Water Heaters: Final Criteria Analysis," April 1, 2008, prepared by D&R International, Ltd. for the U.S. Department of Energy; and from ENERGY STAR manufacturer partners.
- Figure 3 | Page 3:** Analysis by D&R International, Ltd. of data from ENERGY STAR manufacturer partners and from "ENERGY STAR Residential Water Heaters: Final Criteria Analysis," April 1, 2008, prepared by D&R International, Ltd. for the U.S. Department of Energy.
- Figure 4 | Page 4:** Analysis by D&R International, Ltd. of micro data from Energy Information Administration, "Residential Energy Consumption Survey 2005."
- Figure 5 | Page 5:** Analysis by D&R International, Ltd. of data from Energy Information Administration, "Residential Energy Consumption Survey 2005," Table HC2.8.
- Figure 6 | Page 7:** Analysis by D&R International, Ltd. of data from the lists of ENERGY STAR qualified water heaters available on www.energystar.gov.
- Figure 7 | Page 8:** Analysis by D&R International, Ltd. of data from 10 CFR 430.32(d); U.S. Dept. of Energy, "ENERGY STAR Program Requirements for Residential Water Heaters," January 5, 2009; and *Federal Register*, Volume 66, No 11, Section I.C, January 17, 2001, p. 4476.
- Figure 8 | Page 9:** Analysis by D&R International, Ltd. of data from 10 CFR 430.32(d); U.S. Dept. of Energy, "ENERGY STAR Program Requirements for Residential Water Heaters," January 5, 2009; and *Federal Register*, Volume 66, No 11, Section I.C, January 17, 2001, p. 4476.
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- Figure 10 | Page 10:** Analysis by D&R International, Ltd. using data from Energy Information Administration, "Residential Energy Consumption Survey 2005," Table HC2.8, and Energy Information Administration, *Annual Energy Outlook 2009*, Table 4.
- Figure 11 | Page 11:** Analysis by D&R International, Ltd.
- Figure 12 | Page 17:** "A Portrait of the U.S. Appliance Industry," *Appliance Magazine*, Sept. 2007, and A.O. Smith Water Products Company website.
- Figure 13 | Page 19:** D&R International, Ltd. based on interviews with water heater manufacturers.
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- Table 1 | Page 6:** U.S. Dept. of Energy, "ENERGY STAR Program Requirements for Residential Water Heaters," January 5, 2009.
- Table 2 | Page 8:** 10 CFR 430.32(d).
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- Table 4 | Page 22:** D&R International, Ltd.
- Table 5 | Page 24:** Puget Sound Energy
- Table 6 | Page 25:** Analysis by D&R International, Ltd. of data from the State Energy Efficient Appliance Rebate Program.
- Table 7 | Page 28:** D&R International, Ltd. except where noted otherwise.
- Table 8 | Page 29:** D&R International, Ltd. except where noted otherwise.



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