Consortium for Energy Efficiency

High-Efficiency Residential Gas Water Heating Initiative

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1. Background

Water heating represents a major use of energy in North American homes with the potential for significant natural gas savings. In the U.S., water heating accounts for approximately 15 percent of residential energy consumption, making it the third largest energy end-use in homes behind space heating (47 percent) and lighting and appliances (24 percent).[1] It is estimated that 54 percent of U.S. water heaters are heated with natural gas, 38 percent are heated with electricity, 4 percent are heated with oil and less than 3 percent are heated with LPG.[2] Gas-fired storage water heaters are installed in approximately 58.2 million homes in North America.[3] In Canada, water heating is estimated to be the second largest residential energy end-use behind space heating, accounting for nearly 22 percent of household energy consumption. It is estimated that 35 percent of Canadian water heaters are fueled by electricity and 59 percent are fueled by natural gas, with oil and propane accounting for the remaining 6 percent.[4]

Residential gas-fired storage water heaters are defined as having a nominal input of 75,000 Btu/hour or less and a rated storage volume from 20 to 100 gallons and residential gas-fired tankless water heaters are defined as having a nominal input between 50,000 and 200,000 Btu/hour and a rated storage volume of 2 gallons or less.[5] Minimum efficiency standards for residential storage and tankless water heaters in the U.S. fall under the National Appliance Energy Conservation Act (NAECA) of 1990, with small revisions in 1991. Revisions to these energy conservation standards became effective January 2004. The standards specify a minimum Energy Factor (EF) to which water heaters must adhere, depending on their size. U.S. manufacturers are required by federal law to determine the EF for all residential products and to label all products with this information. Canada’s previous standards for domestic water heaters came into effect in February 1995. Amendments to these regulations followed in September 2004. These requirements are in the form of minimum EF values and maximum allowable standby losses, and are dependent on the size of the storage water tank. Electric storage tank regulations refer to maximum allowable standby losses, while gas and oil heater regulations refer to minimum energy factors.[6]

This Initiative seeks to build a market for highly energy efficient water heating among North American consumers by providing a common definition of high-efficiency water heating equipment. This version focuses on gas-fired storage and tankless water heaters. Using this common definition, energy efficiency programs can promote the adoption of high-efficiency models. Despite the wide variety of fuel sources used for water heating,

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[1]Energy Information Administration, 2001. *Residential Energy Consumption Survey.*

[2] Ibid.

[3] Valley Energy Efficiency Corporation, 2006. *Super Efficient Gas Water Heater Appliance Initiative*. California Energy Commission, PIER Energy ‐ Related Environmental Research Program.

[4] Canadian Building Energy End-Use Data and Analysis Centre, 2005. *Domestic Water Heating and Water Heater Energy Consumption in Canada*.

[5] Department of Energy, 2004. Title 10, Code of Federal Regulations, Chapter 11, Part 430, Subpart B, Appendix E. Energy Conservation Program for Consumer Products: Energy Conservation Standards for Water Heaters

[6] National Resources Canada Office of Energy Efficiency, 2007. *Residential Water Heating*. Website: http://oee.nrcan.gc.ca/equipment/english/page51.cfm?Text=N&PrintView=N.

this Initiative focuses on residential natural gas-fired water heating technologies because they offer high potential energy savings in the short term. As we build awareness of energy efficiency among consumers, we will explore the inclusion of other advanced and highly efficient water heating technologies using other fuel sources.

2. Initiative Goal and Objectives

The long term goal of the Initiative is to increase the market penetration of high-efficiency water heaters. This goal will be achieved when:

- High-efficiency equipment is requested by customers;
- High-efficiency equipment is promoted to consumers by plumbing contractors, builders and retailers; and
- High-efficiency equipment is available from manufacturers, wholesalers and distributors.

The Initiative's primary objectives in pursuit of the long term goals are to:

- Increase the number of high-efficiency models available;
- Increase the percentage of sales of high-efficiency equipment;
- Build a market of sufficient size to help achieve the scale of production that will allow manufacturers to offer high-efficiency equipment at an attractive price to consumers; and
- Increase the number of plumbing contractors, builders, retailers, distributors and wholesalers who promote high-efficiency equipment.

3. Market Overview

3.1. Market Trends

Storage units dominate both the gas-fired and electric water heater markets, with shipments of over 8.8 million units for gas and electric units combined in the U.S in 2007.[7] The percentage of gas-fired and electric resistance storage water heater shipments was nearly equal, with electric resistance units having slightly more market share than gas-fired units (4.38 million units and 4.47 million units, respectively). Storage water heaters account for over 95 percent of the market share for water heaters in North America.[8] Tankless water heaters accounted for approximately 2.6 percent of the total market.[9] Solar and heat pump water heaters account for a small minority of annual sales. There is indication that the percentage shipments of tankless water heaters may be growing quickly. Unit sales of gas tankless water heaters are reported to be 254,600 in 2006.[10] Below is a table highlighting U.S. residential water heater shipment data for storage water heaters from 1994 to 2006.

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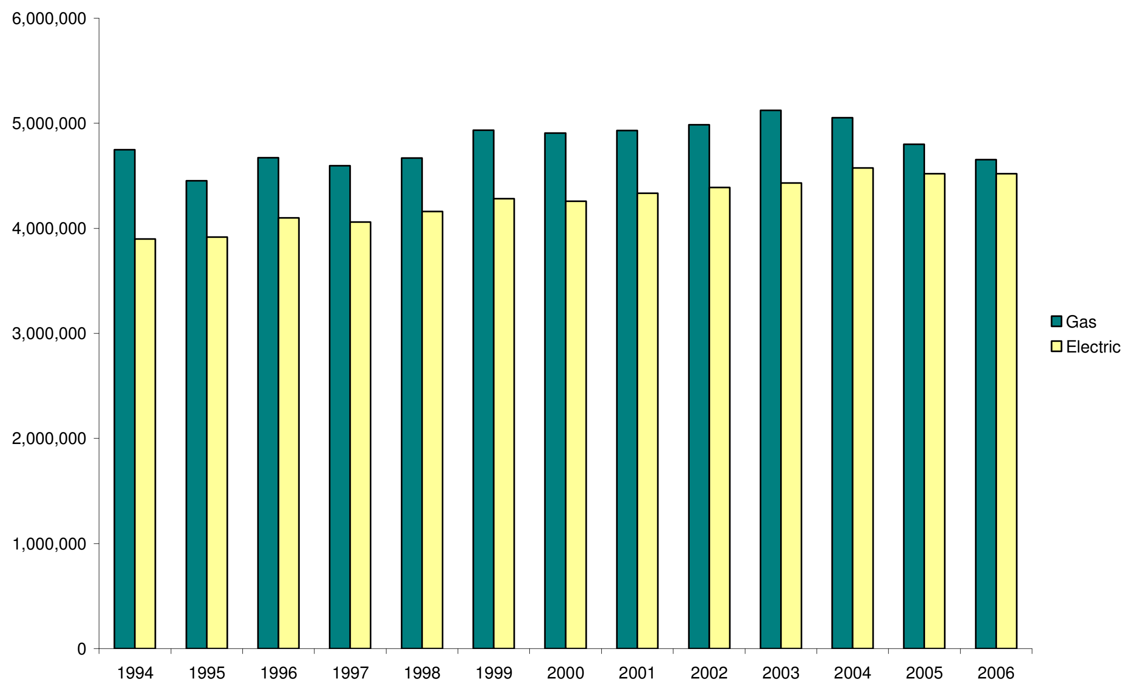
[7] AHRI, 2008. Statistics for the month of December, 2007. Issued February 10, 2008.
[8] Anecdotal information provided by water heater manufacturing contacts.
[9] Department of Energy, 2007. "ENERGY STAR Residential Water Heaters: Second Draft Criteria Analysis and Proposal."
[10] Ibid.

Storage Water Heater Shipments



Source: GAMA, 2006. *Statistical Highlights for the Month of December 1995-2006*.

As of 2005, data indicates that water heating market share in Canada favors gas (59%) over electric (37%) water heaters.[11] Previous data had indicated that the market favored electric over gas, but cited that the trend was declining over time and increasing for gas. [12] The general trend in Canada is for new homes to increasingly use natural gas as opposed to electricity for their water heating needs. Regional trends within Canada illustrate that primary fuel sources can differ significantly by province due to availability, efficiency, equipment cost and price. Preliminary evidence from the Canadian EnerGuide for Houses Database shows that in retrofit situations fuel switching from gas to electric is not very prevalent on the whole, but can differ significantly by province.[13]

Fuel type varies by region both within the U.S. and Canada due to fuel prices, availability and building stock. In the U.S., the Northwest is thought to have a higher share of electric water heaters due to the low cost of electricity in comparison to gas. In the Northwest, 57 percent of the retrofit market was for electric water heaters. However, the same study indicated that in newer homes the share of electric water heaters was closer to the national average of 48 percent.[14] In California, the market is

[11] Canadian Building Energy End-Use Data and Analysis Centre, 2005. *Domestic Water Heating and Water Heater Energy Consumption in Canada*.
[12] Natural Resources Canada Office of Energy Efficiency, 2004. *EnerGuide for Houses*.
[13] Ibid.
[14] KEMA, 2006. *Residential Water Heater Market*. Prepared for the Northwest Energy Efficiency Alliance (NEEA).

weighted towards gas water heating as it accounts for 44 percent of residential natural gas use, and of the twelve million households in the state, ten million use natural gas.[15]

Currently, the majority of residential gas-fired water heater sales in both the U.S. and Canada are for minimum-efficiency tank-type models with Energy Factors of 0.58 and 0.59. Sales and availability of high-efficiency units are in the minority, but major manufacturers are slowly beginning to produce these units in larger quantities and retailers and plumbers are offering these units on a more frequent basis.[16]

3.2. Market Structure

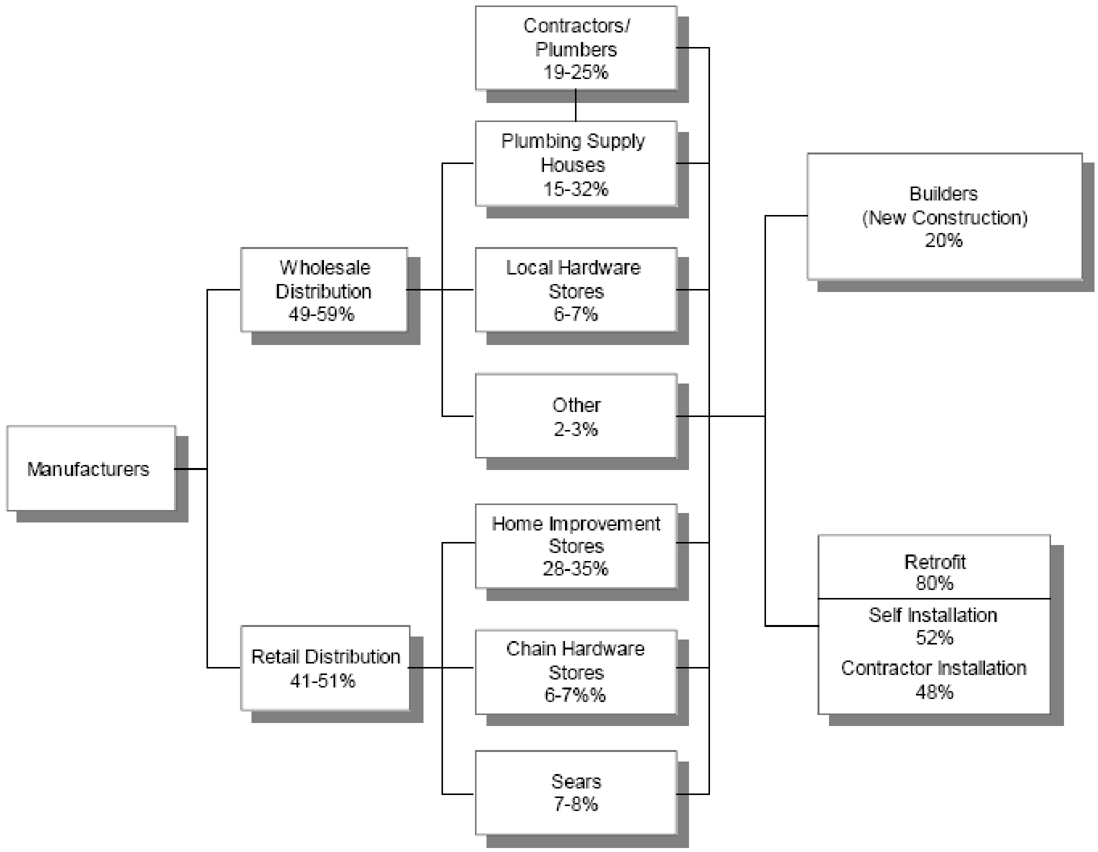
Water heaters are sold to consumers either by contractors who purchase from wholesale distributors or through retail outlets. Sales are split relatively equally between wholesalers and large retailers, with most manufacturers selling to both market channels. Wholesale distributors sell water heaters to plumbing contractors, builders and developers, local hardware stores or homeowners.

Large retailers typically sell water heaters to homeowners, but plumbing contractors are also known to purchase from this market channel. Bradford White distributes exclusively through wholesalers, while some manufacturers reserve their flagship brands for wholesalers but sell other brands directly to consumers through retailers. For example, A.O Smith markets its A.O. Smith brand through wholesalers but sells its other brands through a variety of market channels, including large retailers. The flow chart below is from the "Residential Water Heater Market Study" prepared by KEMA for the Northwest Energy Efficiency Alliance based on 2001 distribution information. It depicts the percentage of water heaters flowing through each market channel.

[15] Valley Energy Efficiency Corporation, 2006. *Super Efficient Gas Water Heater Appliance Initiative*. California Energy Commission, PIER Energy ‑ Related Environmental Research Program.

[16] Anecdotal information based on CEE staff-conducted 2007 telephone survey of major manufacturers, big-box retailers, distributors, wholesalers and plumbers.

Residential Water Heater Distribution Channels



Source: KEMA, 2006. *Residential Water Heater Market*. Prepared for the Northwest Energy Efficiency Alliance (NEEA). Used by permission.

3.2.1. Storage Water Heater Manufacturers

Storage water heaters, also known as tank-type water heaters, are the most common type of water heater manufactured in the U.S. Storage water heaters account for the vast majority of water heaters manufactured and sold. Most gas-fired storage units currently sold are at the federal minimum standard for efficiency. Models with higher Energy Factors are produced by all of the major manufacturers but in smaller quantities than the models meeting the federal minimum standard for efficiency. Roughly 100,000 water heaters with Energy Factors of 0.65 and above were sold in 2006.[17] The goal of this initiative is to increase the market share and availability of high-efficiency water heaters.

The three largest manufacturers in Canada are also the three largest in the U.S., accounting for nearly 99 percent of the market. These manufacturers include A.O. Smith with 42 percent of the market share, Rheem/Ruud with 40 percent, and Bradford White with 17 percent of the market share. All other manufacturers account only for 1 percent of the market, including manufacturers such as

[17] Department of Energy, 2007. "ENERGY STAR Residential Water Heaters: Second Draft Criteria Analysis and Proposal."

Lochinvar and Giant. In 2006, A.O. Smith bought American Water Heater's parent company, GSW Inc., a Canadian water heating and building products manufacturer. Up to that point, American Water Heater had accounted for 17 percent of the water heating market share. Manufacturers sell their storage water heaters under a wide variety of brands. For example, Maytag, State, Reliance, and American are A.O. Smith brands, and Richmond and GE are Rheem/Ruud brands.

Manufacturer	Estimated Market Share of Storage Water Heaters	Brands
Rheem/Ruud	40%	Rheem, Ruud, GE, Richmond
A.O. Smith	42%	A.O. Smith, American, Apollo, GSW, Maytag, Reliance, State, Kenmore, U.S. Craftsmaster
Bradford White	17%	Bradford White, Bradford White Canada, Laars, NST
Other Manufacturers	1%	

Source: A.O. Smith, 2006. "A.O. Smith Completes Acquisition of GSW." Press release; and KEMA, 2006. *Residential Water Heater Market*. Prepared for the Northwest Energy Efficiency Alliance (NEEA). Used by permission.

3.2.2. Tankless Water Heater Manufacturers

In 2004, 129,000 tankless water heaters were sold: a growth of 57 percent over the prior year. [18] This figure rose to 254,600 in 2006.[19] Some of the tankless manufacturers selling in North America include Rinnai, Takagi, Noritz, CEC/Bosch and Rheem/Ruud, a subsidiary of Paloma Industries. The current tankless water heater market share is approximately between 1 to 2 percent in the U.S. Most of the tankless water heaters available on the market today are produced outside of the U.S.[20]

3.2.3. Plumbing Wholesalers and Distributors

Wholesalers and distributors are one of the two primary distribution channels. Approximately 50 percent of all water heaters initially flow through this distribution channel. Some manufacturers use independent wholesalers exclusively, some own all of their wholesale operation, and others use a combination of both. In most cases wholesalers work mainly with installers, but

[18] Davis Energy Group, 2007. Residential Feasibility Assessment of Gas Tankless Water Heaters in PG&E Service Territory. Prepared for Pacific Gas and Electric Company.
[19] U.S. Department of Energy, 2007. *ENERGY STAR Residential Water Heaters: Second Draft Criteria Analysis and Proposal*
[20] Davis Energy Group, 2007. Residential Feasibility Assessment of Gas Tankless Water Heaters in PG&E Service Territory. Prepared for Pacific Gas and Electric Company.

occasionally work directly with consumers or with local distributors to supply products to the various market channels. There are many wholesalers acting in the market with no clear leader, and no wholesaler making up more than 5 percent of water heater sales.[21]

3.2.4. Retailers

Retailers are the second primary distribution channel that manufacturers utilize. Large retailers account for 50 percent of sales,[22] while ten years ago they only accounted for 40 percent of primary distribution sales. Retailers either sell directly to consumers, using their own affiliated contractors for installation, or provide referrals, as most states require licenses for installation of gas equipment. In some instances they also sell products to plumbing contractors and builders and developers. Lowes, Home Depot, and Sears are the major retailers in the market. Ace Hardware and True Value are smaller retailers that also supply water heaters. In many cases, manufactures supply specific brands of water heaters for a given retailer. For instance, GE storage water heaters, a Rheem/Ruud brand, are sold exclusively through The Home Depot.

3.2.5. Plumbing Contractors

Plumbers are also known as installers or plumbing contractors. In general, there are three types of plumbers: 1) independent plumbing contractors who install water heaters in addition to other services, 2) franchise plumbers or water heater installation specialists and 3) plumbing contractors who are also distributors. Plumbers are a key link in the sales chain because they have direct contact with the end-users and have the opportunity to influence equipment purchases because of the nature of water heater purchases. Most water heaters are replaced on an emergency basis, with few consumers having the time to do research themselves. Plumbers often make suggestions or decisions for a homeowner on either replacement units or new installations. Most plumbers receive their water heaters through distributors (although some work with retailers as well) and market their services through the phone book or the internet.[23]

3.2.6. Builders/Developers

Homebuilders and developers are important players in the water heater distribution channel because they sell equipment to customers as part of home purchases. They often make suggestions or decisions for homeowners on new installations and home renovations. Builders often buy water heaters exclusively from wholesalers for new construction.

3.3. Market Barriers to and Opportunities for Improved Efficiency

The key barriers and opportunities to increasing market penetration of efficient, gas-fired tank-type and tankless water heaters are listed below.

[21] KEMA, 2006. *Residential Water Heater Market*. Prepared for the Northwest Energy Efficiency Alliance (NEEA).
[22] Ibid.
[23] Ibid.

3.3.1. Plumbers Contractors, Builders, Developers and Retailers often do not have the appropriate marketing tools or do not see the value in selling high-efficiency equipment. The water heating equipment sales industry is strongly driven by lowest-bid quotes. However, plumbers, builders, developers and retailers have an opportunity to sell high-efficiency equipment (which can be a higher value and profit opportunity) by educating consumers about the life-cycle benefits of that investment. These sales channels can lack the training and tools to effectively educate the consumer and promote the benefits and cost-effectiveness of high-efficiency equipment. Incorporating the concept of selling efficiency into training sessions and outreach activities is one effective way to influence the market channel.

3.3.2. Consumers are unaware of the benefits of investing in high-efficiency equipment. The majority of water heating sales take place in the replacement market where equipment often needs to be installed quickly. Consumers often lack information to make informed decisions on equipment and rely on the plumbing contractor or retailer as an expert to guide them through the purchase. Water heaters are a low-involvement product area where consumers do not often take the time to research different options or learn about how efficiency can relate to lower overall cost. More high-efficiency water heaters might be sold if plumbing contractors or retailers were to inform consumers of the option of installing energy efficient models at the time of installation.

3.3.3. Potential for higher upfront cost. High-efficiency water heaters can be more expensive initially in comparison to traditional tank-type water heaters. Despite lower annual operating costs, the initial purchase price can deter potential buyers. The addition of increased insulation, power venting, or condensing technologies can add significant cost to tank-type water heaters, and tankless water heaters are, on average, more costly than minimum-efficiency water heaters. In addition, installation costs for high-efficiency water heaters may be higher than minimum efficiency water heaters in retrofit situations. If high-efficiency water heaters were to establish a stronger market presence with more units manufactured and sold per year, economies of scale may produce cost savings and lead to further sales through more competitive offerings.

3.3.4. Split incentives – builders and developers versus homebuyers. Homebuilders often choose water heating equipment on a low first-cost basis. They do so to reduce the overall price of a house, increase profit margins, and allow money to be spent in areas more visible to consumers, such as kitchen or bath features. If builders and developers were to be incentivized, or if consumers knew to ask for energy efficient models, it might be possible to increase the number of new installations of high-efficiency water heaters.

3.3.5. Lack of reliable and objective sources of information regarding water heating options. It can be difficult for consumers as well as trade allies to determine what water heater model is the right choice for a given application. Reliable sources of information on this subject will help create more clarity. Field testing to understand the true efficiency, reliability or cost-effectiveness of tankless water heaters will also help consumers and program administrators compare technologies based on performance.

4. Energy Savings Potential

The following subsections detail the technology behind tank-type and tankless water heaters and the potential energy and monetary savings of these various types of equipment.

4.1. Gas-Fired Residential Storage Water Heaters

Storage water heaters are also commonly referred to as tank-type water heaters. The majority of gas-fired residential storage water heaters sold have an input of 75,000 Btu per hour or less and a rated storage volume from 20 to 100 gallons.[24] They often have a glass-lined steel tank, foam insulation, a heat exchanger coil or flue running through the center of the tank, and a gas burner at the bottom of the tank. The water heater is activated when a gas burner is ignited. Combustion takes place in the burner when incoming air mixes with gas. The hot gases from the combustion process ascend through the flue or heat exchanger coil and transfer heat to the surrounding water in the tank. The heated water rises to the top of the tank and is then transferred through a hot water outlet to the tap.

Storage water heaters with higher levels of efficiency often have increased insulation, advanced valves, or direct vent technologies which control drafts and minimize airflow through the use of a draft inducer fan. High-efficiency units can also come equipped with power venting technologies that use a small fan to exhaust flue gases. Anti-convection valves, flue baffling, heat traps or sealed combustion designs are other technology improvements that can increase the efficiency of the water heater by improving combustion efficiency or limiting standby heat losses.[25, 26] On average, high-efficiency tank-type water heaters can save between 7 percent and 14 percent in energy used per year in comparison to minimum efficiency tank-type water heaters.[27] If half of the storage water heaters sold were raised from 0.58 EF to 0.62 EF, approximately 35 million therms will be saved per year. If just 5 percent of the market were converted to 0.67 EF storage water heaters, almost 8 million therms will be saved per year.

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[24] Department of Energy, 2004. Title 10, Code of Federal Regulations, Chapter 11, Part 430, Subpart B, Appendix E. Energy Conservation Program for Consumer Products: Energy Conservation Standards for Water Heaters

[25] Canadian Building Energy End-Use Data and Analysis Centre, 2005. *Domestic Water Heating and Water Heater Energy Consumption in Canada*.

[26] Department of Energy, 2007. "ENERGY STAR Residential Water Heaters: Second Draft Criteria Analysis and Proposal."

[27] This savings information is based off the DOE test procedure measuring energy consumption per year. The standard equation is (41,045 Btu/EF x 365)/100,000

4.2. Gas-fired Residential Tankless Water Heaters

Tankless water heaters are also commonly referred to as demand or instantaneous units. Gas-fired residential tankless units have a nominal input of over 50,000 Btu per hour but less than 200,000 Btu per hour and a rated storage volume of 2 gallons or less.[28] Gas-fired tankless models are based on the same principles as a traditional storage water heater, but do not store water in a tank. The burner in tankless water heaters is activated when a minimum water draw occurs. Once a hot water tap is turned on and a flow sensor is triggered, the burner begins to heat a heat exchanger. Cold water enters the unit and ascends through the heat exchanger where heat is transferred to the water. Once the water reaches its set point temperature, it exits the unit ready for consumption.

The efficiency rating of tankless water heaters is typically higher than the rating for tank-type water heaters. The efficiency improvements occur in part because there are no stand-by losses of heat to the surrounding environment as would typically be found with a tank-type water heater. Tank-type units are designed to maintain water stored in the tank at a constant temperature, and heat is lost through the tank when hot water is not being demanded. This heat loss is also called standby loss. Tankless water heaters only heat water as it is needed, avoiding these standby losses and improving efficiency. The reduction in standby losses and other efficiency improvements translate into a potential yearly energy savings of about 30 percent in comparison to minimum efficiency tank-type water heaters. This can result in lower annual operating costs and lower life-cycle costs for consumers.[29]

While this large potential gain in efficiency is attractive to energy efficiency programs, in certain applications tankless water heaters could be a poor choice for a customer. The burners on tankless water heaters activate when a minimum water draw occurs. Many tankless units have a minimum flow requirement of 0.6 to 0.8 gallons per minute. In low-volume water applications such as hand washing or even showering with a low-flow shower head, an insufficient amount of water could be drawn to activate the burner. This means either that a consumer gets no hot water for the desired use or that they use a greater volume of water overall for the same end use. Tankless units can provide an endless supply of hot water because there is no storage tank to re-heat as is the case with tank-type water heaters. If the hot water supply does not run out, homeowners may be encouraged to increase their overall consumption of hot water. If this occurs, expected gas-bill savings may not be realized with the tankless water heater. Finally, gas utilities have been concerned about consumers experiencing problems with levels of gas service. Tankless water heaters may require larger gas lines and may not function appropriately in areas with low gas pressure.

[28] Department of Energy, 2004. Title 10, Code of Federal Regulations, Chapter 11, Part 430, Subpart B, Appendix E. Energy Conservation Program for Consumer Products: Energy Conservation Standards for Water Heaters

[29] This savings information is based off the DOE test procedure measuring energy consumption per year. The standard equation is (41,045 Btu/EF x 365)/100,000

Efficiency programs considering rebates and incentives for tankless water heaters should consider consumer education programs to help address these service issues and to identify where tankless water heaters would be most appropriately installed. Installer education programs may also be beneficial to consumer experience and efficiency, since it is critical to size and set up these water heaters properly to avoid diminished level of service and unintended increases in gas and water consumption. CEE is also working on a field test to further investigate in-field performance of tankless water heaters. When supported by appropriate educational efforts, tankless water heaters may indeed be part of an effective portfolio of efficient water heating technologies.

If gas-fired tankless water heaters deliver expected efficiencies and doubled their current sales, additional savings could amount to nearly 18 million therms compared to minimum efficiency storage water heaters.

5. Initiative Approach

This initiative seeks to encourage the purchase of energy-efficient water heaters. To achieve the savings and overcome the market barriers described above, the initiative consists of four major components: efficiency specifications and three awareness-building aspects. Common technical specifications will help to provide some consistency to market players and will signal that efficiency programs are willing to support advanced technologies as they come to market. Efficiency programs can also provide a credible, third party source of information to both consumers and installers. Working within these common technical specifications, efficiency programs can design programs to meet the needs of the geographical territories they serve, but CEE can also provide common educational materials for member use.

5.1. Efficiency Specifications

Widespread promotion of a common performance specification provides a consistent definition of high-efficiency to all market actors. This initiative is designed to compliment the anticipated ENERGY STAR Program for Residential Water Heaters by encouraging the support and adoption of the ENERGY STAR platform. CEE's performance tiers seek to identify meaningful levels of additional savings.

	Residential Storage ≤75,000 Btu/h[30]
Tier 0	≥0.62 EF
Tier 1	≥0.67 EF
Tier 2	≥0.80 EF

[30] Department of Energy, 2004. Title 10, Code of Federal Regulations, Chapter 11, Part 430, Subpart B, Appendix E. Energy Conservation Program for Consumer Products: Energy Conservation Standards for Water Heaters
- Volume III, Storage Water Heaters with Input Ratings above 75,000 Btu per Hour, Circulating and Instantaneous

Tier 0 represents readily available, existing products in the market today. These products are most suited to replacement and emergency installations for which higher unit and labor costs would be prohibitive for the conversion to a higher efficiency model. It is CEE's anticipation that Tier 0 will be abandoned quickly once a basket of market conditions has been filled. These market conditions could include increased market share of super high-efficiency tankless or storage water heaters, increased federal minimum standards, or the reduction in price of super high-efficiency tankless or storage water heaters. Tier 1 represents a significant performance enhancement that is technically feasible, but is not widely available and represents a large increase in unit cost and potentially cost of installation. Tier 2 represents a further investment in performance that may be technically feasible, and potentially cost-effective, but not yet so. At the time this Initiative description was written, all known technologies meeting Tiers 1 and 2 may be more economical in new construction and in extensive renovations rather than emergency replacement situations.

	Residential Tankless >50,000 and <200,000 Btu/h[31]
Tier 1	≥0.82 EF (w/ electronic ignition)

Tankless water heaters, like Tiers 1 and 2 for the storage, represents a significant performance enhancement that is technically feasible, but is not widely available and represents a large increase in unit cost and potentially cost of installation. Tankless water heaters may also be more economical in new construction and extensive renovations rather than emergency replacement situations. As mentioned above, it is very important that tankless water heaters are sized and set up correctly to ensure proper and appropriate operation. We specify electronic ignition as an added efficiency and safety measure that eliminates the need for a standing pilot. We understand that it is technically viable to go beyond 0.82 EF, and CEE is open to considering the appropriateness of adopting a Tier 2 for tankless water heaters once more information is available on the performance and economic potential of these models. Additionally, a voluntary NOx requirement has been included in the initiative for both storage and tankless units. These Optional Criteria NOx emissions are mandatory where required by law. [32]

Optional Criteria NOx Emissions

Residential Storage ≤75,000 Btu/h	10 ng per joule of heat output or 15 ppm at 3% O_2
Residential Tankless >50,000 and <200,000 Btu/h	40 ng per joule of heat output or 55 ppm at 3% O_2

[31] Department of Energy, 2004. Title 10, Code of Federal Regulations, Chapter 11, Part 430, Subpart B, Appendix E. Energy Conservation Program for Consumer Products: Energy Conservation Standards for Water Heaters

[32] This is a requirement in South Coast Air Quality Management District (SCAQMD) in California. Website: http://www.aqmd.gov/

These specifications apply only to water heaters that have been approved for residential use, meet all applicable codes and standards and have been installed in compliance with local code.

5.2. Plumbing Contractor and Builder/Developer Training

CEE recommends a program component that enlists support of energy-efficient water heaters by frontline influencers such as contractors and plumbers. Water heater purchases by consumers are often made on an emergency, unplanned basis. Consequently, the consumer purchase is influenced a great deal by what models plumbers have available on short notice. Providing educational training to contractors and plumbers on the value of and ways to market energy efficiency can amplify the impact of efficiency program outreach efforts. Training programs can help plumbers and contractors assist their customers in making more efficient decisions and help them make a higher value sale. There are many factors such as gas pressure, water quality, usage pattern, location of water heater relative to major points of use, and many other variable characteristics of that affect which technologies are most appropriate for each individual home. Installers should be trained to help guide consumers through the selection of appropriate efficient technologies.

5.3. Distributor, Wholesaler and Retailer Outreach

Even when consumers are already motivated to make more efficient choices, high-efficiency water heaters can be difficult to obtain. In addition to educational efforts targeting plumbers and contractors, seeking to influence distributors', wholesalers', and retailers' stocking efforts and support for high-efficiency products can promote the penetration of efficient water heaters.

5.4. Consumer Education and Awareness

Utility companies and efficiency programs have access and credibility with consumers and can help move the market towards efficient choices. Consumer awareness of water heater efficiency can be raised through general efficiency programs, in-bill mailings, and targeted early-replacement efforts. There are many factors such as gas pressure, water quality, usage pattern, location of water heater relative to major points of use, and many other variable characteristics of that affect which technologies are most appropriate for each individual home. Consumers should be aware that there are many factors that should affect their purchasing decision.

6. Initiative Participation

As with all CEE initiatives, participation in the High-Efficiency Residential Water Heating Initiative by efficiency programs is voluntary. Supporting the goals of this Initiative (outlined above) will require efforts to increase the general level of awareness of efficient gas-fired water heating options among consumers and contractors and to support the introduction of new highly-efficient water heating technologies. Therefore, to be considered an initiative participant, the following are required:

- **Incorporate the CEE efficiency specifications for water heaters in an incentive-based program at Tier 0, Tier 1, or Tier 2; and**

- **Undertake the awareness-building aspects of the initiative, making use of communication messages developed by CEE committee**

Adoption of the NOx emission specification is optional for initiative participation (except where required by state law), though it is encouraged.

7. CEE's Role in Initiative Promotion

In response to a growing interest in energy-efficient water heating, CEE has developed a water heating initiative for its North American members. CEE will support this initiative by encouraging members to adopt water heating specifications, opening discussions with market channels, and assisting with awareness-building efforts.

CEE will work to achieve a consistent message and, if members deem it appropriate, develop promotional materials on energy-efficiency in water heating for use with consumers, plumbers, wholesaler distributors, and other channel partners. Promotional materials developed by CEE could include common brochures, educational curricula, and other materials. Once developed, this common message may be incorporated into participation requirements.

In addition, CEE will manage a qualified products list for tank-type and tankless water heaters for members and consumers reference. CEE works closely with manufacturers and industry associations to make information about equipment efficiency available to members and the general public.

References

AHRI, 2008. *Statistics for the month of December, 2007.* Issued February 10, 2008.

American National Standards Institute (ANSI), 2004. U.S Residential Gas Water Heater National Standard: ANSI Z21.10.1-2004/CSA4.1-2004. Gas Water Heaters Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less.

American National Standards Institute (ANSI), 2004. U.S Commercial Gas Water Heater National Standard: ANSI Z21.10.3-2004/CSA4.3-2004 Gas Water Heaters Volume III, Storage Water Heaters with Input Ratings above 75,000 Btu per Hour, Circulating and Instantaneous

A.O. Smith, 2006. "A.O. Smith Completes Acquisition of GSW." Press release.

Canadian Building Energy End-Use Data and Analysis Centre, 2005. *Domestic Water Heating and Water Heater Energy Consumption in Canada*.

Davis Energy Group, 2007. *Residential Feasibility Assessment of Gas Tankless Water Heaters in PG&E Service Territory*. Prepared for Pacific Gas and Electric Company.

Department of Energy's Office of Energy Efficiency and Renewable Energy, 2001. *National Appliance Energy Conservation Act: Energy Conservation Standards for Water Heaters*.

Department of Energy, 2004. Title 10, Code of Federal Regulations, Chapter 11, Part 430, Subpart B, Appendix E. Energy Conservation Program for Consumer Products: Energy Conservation Standards for Water Heaters

Department of Energy, 2007. "ENERGY STAR Residential Water Heaters: Second Draft Criteria Analysis and Proposal." Website: http://www.energystar.gov/index.cfm?c=new_specs.water_heaters

Energy Information Administration, 2001. *Residential Energy Consumption Survey.*

GAMA, 2006. *Statistical Highlights for the Month of December 1995-2006.*

GAMA, 2007. *Statistical Highlights for the Month of April, 2007.* Issued June 4, 2007.

KEMA, 2006. *Residential Water Heater Market*. Prepared for the Northwest Energy Efficiency Alliance (NEEA).

NRCan Office of Energy Efficiency, 2004. *EnerGuide for Houses*. Website: http://oee.nrcan.gc.ca/publications/infosource/Pub/home/contractorsguide.cfm?attr=12

NRCan Office of Energy Efficiency, 2007. *Residential Water Heating*. Website: http://oee.nrcan.gc.ca/equipment/english/page51.cfm?Text=N&PrintView=N

U.S. Building Data Book, 2006. *Residential Energy Consumption by Fuel Type.* Website: http://buildingsdatabook.eren.doe.gov/docs/1.2.3.pdf

Valley Energy Efficiency Corporation, 2006. *Super Efficient Gas Water Heater Appliance Initiative*. California Energy Commission, PIER Energy ‑ Related Environmental Research Program.