Market-Focused Program Design to Accelerate Penetration of ENERGY STAR Water Heaters

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LEGAL NOTICE

Abbreviations and Acronyms

ACEEE	American Council for an Energy Efficient Economy
AFUE	Annual Fuel Utilization Efficiency
AHRI	Air Conditioning, Heating, and Refrigeration Institute
AQMD	Air Quality Management District
ARRA	American Recovery and Reinvestment Act
Btu	British thermal unit
CEC	California Energy Commission
CEE	Center for Energy and Environment
CPUC	California Public Utility Commission
DOE	Department of Energy
DHW	Domestic hot water
°C	Degrees Celsius
°F	Degrees Fahrenheit
EERE	Energy Efficiency and Renewable Energy
EF	Energy factor
EIA	Energy Information Administration
EPA	Environmental Protection Agency
gpd	Gallons per day
gpm	Gallons per minute
HP	Horsepower
HPWH	Heat pump water heater
IOU	Investor Owned Utility
kBtu/h	Thousand British Thermal Units per hour
kWh	Kilowatt-hour
LBNL	Lawrence Berkeley National Laboratory
MBtu	Million Btu
NAECA	National Appliance Energy Conservation Act
NEEA	Northwest Energy Efficiency Alliance
NOx	Nitrogen Oxide
PIER	Public Interest Energy Research
POS	Point of sale
RASS	Residential Appliance Saturation Survey
RECS	Residential Energy Consumption Survey
UPC	Uniform Plumbing Code
W	Watt

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EXECUTIVE SUMMARY

Nearly one-half million water heaters are sold in Northern and Central California each year. Last year, only one to two percent of customers who purchased a water heater received a PG&E rebate. This low participation rate is common to many utility water heater programs around the country because of the relatively high price of efficient products, consumers' ambivalence towards water heaters (until they fail), and the low incentive rates that have been historically justified for storage water heaters.

PROJECT GOAL

There are three key program objectives:

1. Targeting program resources at the right customer segments to cost-effectively increase the market penetration for water heaters that meet PG&E specifications.
2. Identifying new channel program designs that are more effective and efficient than today's and have the capacity to maximize the impact of new programs.
3. Formulating ways to optimize the performance of PG&E's sales and program management infrastructure to move more qualified products.

PROJECT DESCRIPTION

The residential water heating market in the U.S. is dominated by storage water heaters with 96 percent share and roughly equal sales for electric resistance and natural gas heat sources. Over the last half decade, two water heating technologies have entered the market place bringing significant improvements in energy efficiency, tankless water heaters and electric heat pump water heaters.

There are efficient water heater options, based on ENERGY STAR criteria that can drive significant energy savings for PG&E customers. Market barriers are greater than technology limitations in preventing rapid market growth. This project describes market conditions, assesses barriers such as product availability, and presents options to increase participation in PG&E's residential water heater program.

PROJECT FINDINGS/RESULTS

Because of the accessibility and affordability of natural gas, more than 90 percent of water heaters in PG&E's service territory use natural gas as fuel. Of the remaining water heater stock, less than 10 percent of the water heaters are electric and a small percentage use propane or solar as the heat source. PG&E has for over a decade promoted efficient water heaters to residential customers and recently has offered rebates from $30 to $50 per unit to encourage the purchase of the most efficient models available. In 2011, PG&E issued more than 5,000 rebate checks and 95 percent of these checks went to purchasers of natural gas water heaters.

There is still a significant opportunity to save energy with efficient water heaters as aging water heaters must be replaced and most units sold only meet existing Federal standards, which took effect in 2004. Voluntary ENERGY STAR specifications exceed the current mandatory federal standard and create the potential for PG&E's customers to save millions of dollars per year. The total possible energy savings, if all new water heaters were to meet

ENERGY STAR specifications, are tremendous; 20 million therms and 60 million kWh per year in PG&E's service territory.

While almost 30 percent of all models have ENERGY STAR certification, market penetration for these highly efficient models is less than 6 percent nationally. One of the biggest factors in the low penetration rate is price differential between standard models and energy saving models. Difficult economic conditions have also caused consumers to defer water heater replacement or to select lower priced, less efficient options.

More than two dozen utilities across the U.S. have instituted water heater rebate programs to help overcome the price barrier and deliver energy savings. While many programs have the low participation rates that PG&E has experienced, there are a few benchmark programs that show promise to grow the market for energy efficient water heating products.

There are additional barriers to achieving significant market penetration of efficient water heaters in California because of ultra-low NOx air emissions requirements. Even though there are nearly 250 gas-fired storage water heater models that satisfy these rules and in excess of 200 models that have the ENERGY STAR label, only a dozen natural gas models satisfy both sets of criteria. Transformation of the PG&E market is contingent on stocking qualified models, creating opportunities for incremental sales and profits for retailers and contractors, and timely promotion of the benefits of these models to consumers.

A retailer-centered program strategy offers excellent prospects for engaging customers, influencing manufacturers, and gaining insights into the contractor channel. Market concentration in the water heater industry provides retailers access to large segments of consumers and direct connections to manufacturing. Three leading water heater retailers, Home Depot, Lowe's, and Sears, have significant market share and are supplied by two manufacturers, A.O. Smith and Rheem, that produce more that 80 percent of residential water heaters.

Benefit to cost analyses indicate that a water heater program portfolio, spearheaded by ENERGY STAR natural gas and electric heat pump storage water heaters, has the potential to meet market challenges. The high energy savings benefits of these technologies more than offset major program costs of rebates and marketing. Rebates as a percentage of product prices have to be higher than those in previous water heater programs. Marketing efforts need to be closely coordinated with channel partners and account for typical emergency driven decisions. Preliminary conversations with potential retailer partners have provided insights into the level of incentives and types of promotions necessary to influence selection of products to display, promote, and sell in their stores.

PROJECT RECOMMENDATIONS

The recommended course of action is to execute a test program in 2013 that would prove techniques for overcoming market barriers. Tests would be focused efforts in targeted, retail markets that have a high propensity towards participation in rebate programs. Two measures are in the test program: electric heat pump water heaters and ENERGY STAR natural gas storage water heaters. The three leading retailers will be approached to be the channel partners and collaborators in program design. The marketing approach will accentuate creating urgency and value for the consumer while addressing two separate but related objectives; delivering information in an emergency purchase and driving purchasing behavior towards a planned purchase. Critical success factors for the test are to engage top three retail partners, increase the number of qualified products stocked in the stores, and produce measurable energy savings.

INTRODUCTION

PG&E's product development organization assesses and selects new measures for PG&E's energy efficiency and demand response programs. Water heating is one key technology area with unrealized energy saving potential. There is a broad selection of residential water heater technologies in today's marketplace; more selection than with most other household appliances. This wide range of product options along with changing efficiency standards, substantial price differences, and consumer indifference about water heaters have resulted in market penetration of ENERGY STAR qualified units that has been significantly lower than the market penetration of most ENERGY STAR labeled appliances. With respect to energy efficiency, water heaters present less of a technology challenge than a market challenge for manufacturers, retailers, plumbers, and utilities. PG&E's challenges are to build customer-focused energy-efficient water heater offerings based on highly-efficient available technology, to have well-defined channels to stock and deliver these products to the end-user, and to generate enough energy and demand savings to warrant the marketing investment.

TECHNOLOGY SUMMARY

The residential water heating market in the U.S. is dominated by storage water heaters with 96 percent share and roughly equal sales for electric resistance and natural gas heat sources. Over the last half decade, two water heating technologies have entered the market place bringing significant improvements in energy efficiency, tankless water heaters and electric heat pump water heaters.

WATER HEATER TYPES

Storage-tank heaters

In this type of water heater, water is heated by electric or natural gas energy and stored in a cylindrical, insulated tank. The tank is connected to the energy source, gas piping or a 240 volt circuit, as well as to water supply lines. Storage type heaters and all other types have a pressure-relief valve, a drain valve and a control unit for setting temperatures and, on gas models, for managing the pilot-light. Gas water heaters also require a flue to exhaust combustion gases, which in high-efficiency gas condensing water heaters provide additional thermal energy to help heat the water. The efficiency ratings of natural gas water heaters span a wide range, from less than 0.5 to higher than 0.7. Conventional electric resistance water heaters have the potential to become extinct when the next federal standards go into place and as market acceptance of new heat pump water heater technology takes hold.

Electric heat pump heaters

These hybrid water heaters have a conventional electric storage heater paired with a heat pump that takes heat from ambient air and uses it as the primary source of energy to heat the water. Heat pump units can save 50 percent or more compared to conventional electric storage water heaters and provide additional benefits of space cooling and dehumidification. Heat pump water heaters have special installation and maintenance requirements and can be noisier than standard electric storage heaters. The uniqueness of heat pump technology and total installed costs that are significantly higher than those of a basic electric heater are barriers to market acceptance and increased market share.

Tankless heaters

Tankless (instantaneous) water heaters are compact models that heat water on demand by using natural gas combustion or electric heating elements to heat water passing through a compact heat exchanger. This design eliminates issues with storage units such as the risk of tank failure and storage energy losses. Disadvantages of these water heaters include high installed costs and limitations on hot-water flow rates, which can be a problem in large families. This design has energy efficiency advantages in comparison to standard storage heaters and there are 869 models[1] that meet ENERGY STAR specifications. Because of the high penetration of high efficiency tankless heaters in the tankless segment, this technology is not part of the market assessment or a candidate for new water heater programs.

MARKET SUMMARY

Nationally, 52 percent of American homes use natural gas as the primary water heating fuel source, 41 percent of homes use electricity, and 7 percent use propane, fuel oil, or another fuel.[2] In PG&E's service territory, with its extensive natural gas distribution system and relatively low natural gas rates, gas-fueled models are the norm. Residential Appliance Saturation Survey (RASS) data[3] suggests that nearly 90 percent of PG&E customers use natural gas as the primary water heating fuel.

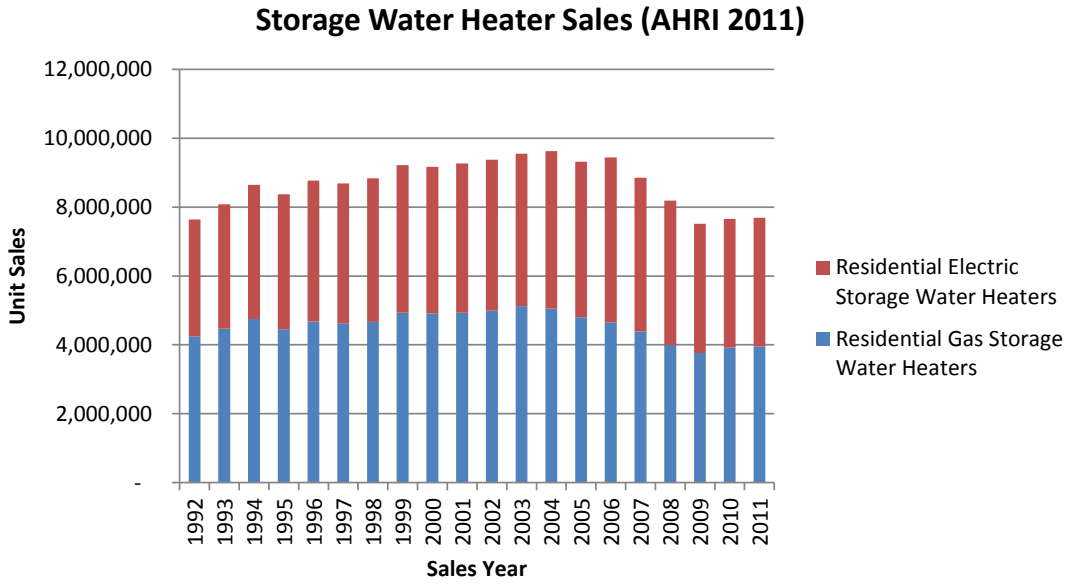

FIGURE 1 HISTORICAL WATER HEATER SALES THROUGH 2011

[1] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=WH

[2] Residential Energy Consumption Survey, U.S. Energy Information Administration (EIA), 2009.

[3] California Statewide Residential Appliance Saturation Study, http://websafe.kemainc.com/rass2009/

Sales of water heaters have been tempered by the economic doldrums of the last few years. Storage water heater sales reached a twenty year low in 2009. The decline in water heater sales since the peak in 2004 is mostly attributable to the drop in new home construction and secondly to deferment of planned water heater purchases.[4]

There are an estimated 5.3 million water heaters in the PG&E service area. The majority of this installed base of water heaters is storage units that have an average expected life of 12 years. At this replacement rate, new water heater sales should average more than 440 thousand units per year, which corresponds to about 5 percent of the U.S. market. Low sales over the last few years are expected to return to the mean as the economy recovers.

Three manufacturers – A.O. Smith, Bradford White, and Rheem – have the dominant share of the residential water heating market and they distribute these products through retailer and contractor channels. Sales of water heaters to residential consumers have been historically evenly distributed between these two sales channels.

PROGRAM CONCEPT SUMMARY

ENERGY STAR water heaters present significant energy savings opportunities for PG&E customers. The program concept captures these energy savings with a portfolio of water heater measures, delivered through appropriate channels, and promoted with targeted marketing.

	Natural Gas (90% of market)	Electric (<10% of market)	
ENERGY STAR Product	Storage water heaters with EF≥0.67	Heat pump water heaters with EF≥2.0	Test Program
High Efficiency Product (Non ENERGY STAR)	Storage water heaters with EF≥.62 &<.67	Resistance water heaters with EF≥.93	Legacy Program

TABLE 1 PROGRAM CONCEPT: PORTFOLIO OPTIONS

The concept addresses market barriers, which are greater than technology limitations, to achieve increased market penetration of highly efficient models. Three perceived market barriers are availability, awareness, and cost.

Availability

Products need to be available for immediate delivery to meet emergency demands of most water heater customers. The program concept is built on financial incentives and marketing efforts that are significant enough to drive demand and increase the stocking of the most efficient water heater.

Awareness

Consumers must be aware of the benefits of energy efficiency when faced with a choice between an efficient product and the alternative. Focus on ENERGY STAR products avails the program of high brand awareness and ENERGY STAR's marketing resources. At the point of purchase, the decision maker has to be quickly and clearly informed of the benefits

[4] Air Conditioning, Heating, and Refrigeration Institute, "Residential Storage Water Heaters Historical Data," http://www.ahrinet.org/residential+storage+water+heaters+historical+data.aspx

of a qualified product. The program approach relies on point of purchase messaging through signage and trained salespeople that relate to targeted customers.

Cost

The program concept addresses consumer, PG&E, and channel costs that impact success. The consumer faces the incremental cost of the efficient water heater, which is partially offset by the PG&E rebate. Rebates and program administration are important PG&E's costs. The retailer's cost of participation has to be returned through increased revenue and profits. Program design levers to simultaneously address these cost concerns are rebate amount and program timing. Additionally, PG&E's administrative costs and some of the retailer's cost of participation can be managed by leveraging existing water heater program plans, work papers, and field services infrastructure.

In the near term, a scaled down test program assesses different marketing tactics to prove market-focused concept and achieve market penetration goals. Retail channel engagement during test gets retailers' buy-in on the concept and input on program design. Since retailers sell installation services and have relationships with plumbing contractors, lessons learned from the retail effort apply to execution of a contractor channel program. Following proof of concept, the program can be directed at additional retail segments and market-focused design concepts can be extended to the contractor channel.

BACKGROUND

Water heating is a major energy use in most Californian's homes. It accounts for 49 percent of natural gas consumption and 3 percent of electricity use.

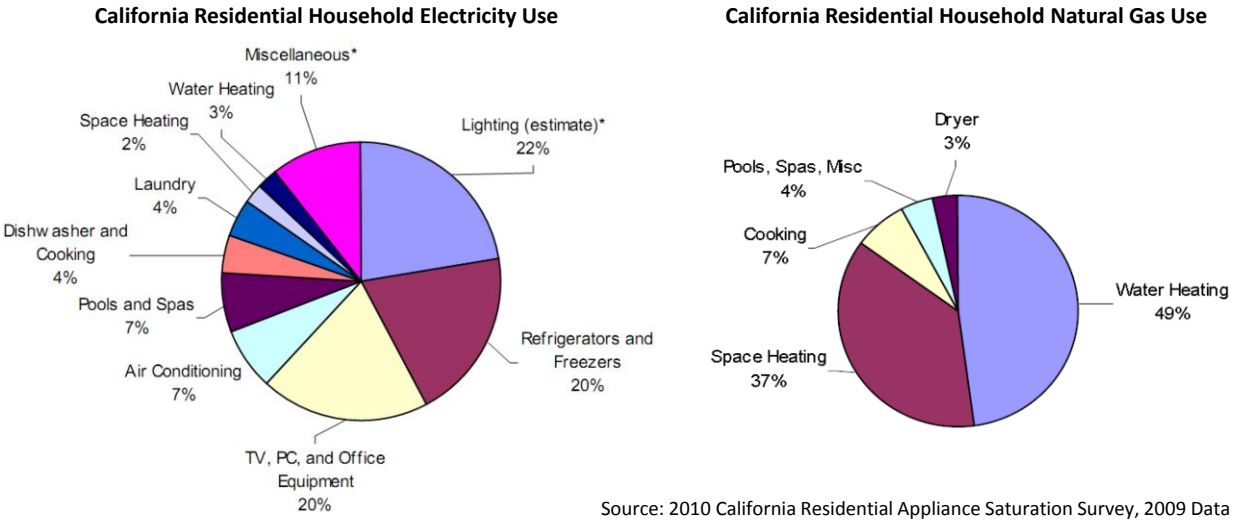

FIGURE 2 WATER HEATING ENERGY CONSUMPTION IN RESIDENTIAL HOUSEHOLDS

The installation and use of efficient electric and natural gas water heaters represents a unique and strategic opportunity for Investor-Owned Utilities (IOUs) to contribute to savings goals throughout the program cycle. Traditionally, energy efficient water heaters have been incented in the California market through downstream rebate programs, where consumers receive a rebate via mail-in application for qualifying water heater models.

Experiences to date in federal, state, and PG&E water heater programs provide background for the design of new program concepts. The following sections describe the development, implementation, and outcomes from several programs, including IOU rate-payer funded programs and ARRA-funded programs. Analysis of these outcomes and relevant general policy trends guides program design.

WATER HEATER INCENTIVE PROGRAMS

California Ratepayer-Funded Programs

In 2006-2008, as well as during the 2009 bridge period, water heaters were incented in California as part of the statewide single- and multi-family rebate programs. There was also an upstream third-party program for tankless water heaters during this time frame. In 2009, the transformational California Long Term Energy Efficiency Strategic Plan set the stage for achieving savings from water heaters, citing their significant contribution to household energy use. The same strategic plan, however, stopped short of providing any overarching guidance on the strategic value of a ramp-up of water heater installations.

In the 2010-2012 program cycle, IOUs offered rebates as part of the Statewide Home Energy Efficiency Rebate (HEER) program, a sub-program to the overall residential program. Qualifying water heater products were qualified from a list of Air Conditioning, Heating, and Refrigeration Institute (AHRI)-certified products. Products were rebated through on-line applications, mail-in applications, or point-of-sale (POS) rebates. In 2010 - 2011, water heater's contribution to total therm savings was about 7 percent for PG&E and averaged 10 percent for utility programs statewide in California.[5]

State Water Heater Programs

At the state level, an annual ENERGY STAR summary report on Appliance Recycling and Water Heater Programs summarizes program trends

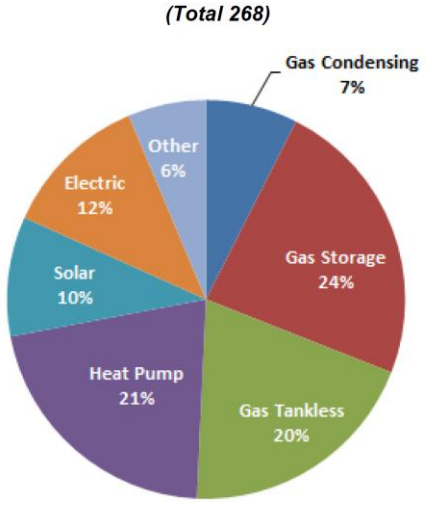

FIGURE 3 2010 ENERGY STAR WATER HEATER PROMOTIONS BY PRODUCT TYPE

[5] California Public Utilities Commission, "2010 – 2011 Energy Efficiency Annual Progress Evaluation Report," September 2012.

The report describes activities from nearly 125 energy efficiency implementers and program sponsors across the United States, compiling data from over 260 individual incentive and promotion programs for water heaters around the country. From a broad vantage point, the number of these types of programs has increased nearly 27 percent since the previous assessment, completed and published in 2011. Electric water heater programs have increased by 50 percent nationwide from the 2011 reporting period. [6]

Programs are almost overwhelmingly focused around mail-in rebates, tend to be concentrated in the Midwest region, and are likely to promote natural gas storage and heat pump units.

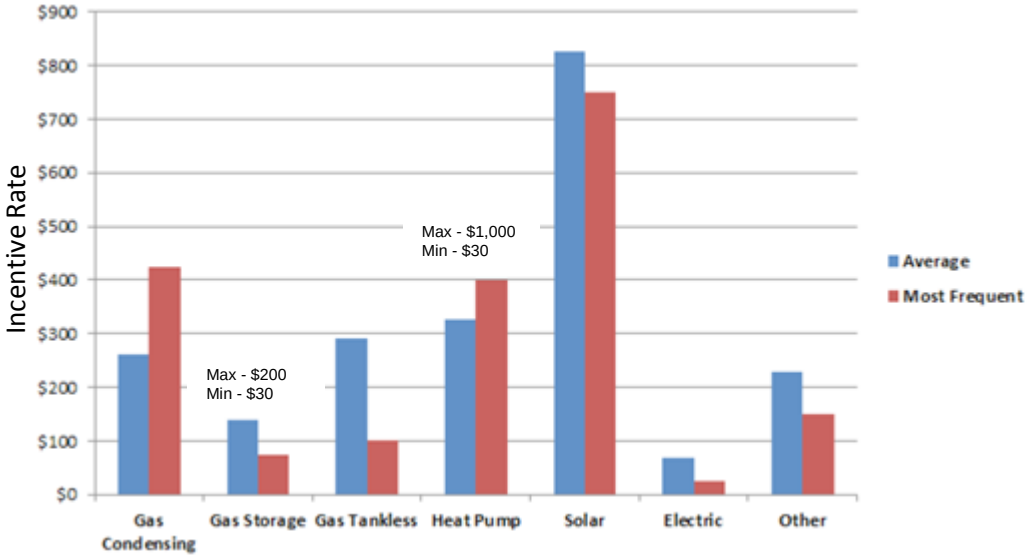

FIGURE 4 INCENTIVE RATES FOR ENERGY STAR WATER HEATER PROGRAMS

Incentive levels are wide ranging for these programs. For example, utility incentives for gas storage water heaters range from $30 to $200 per unit and from $30 to $1,000 per unit for heat pump water heaters. These variations are due to different program strategies, acceptable energy efficiency levels, local energy price and other factors. Various state tax incentives are also available for consumers, in addition to the more typical ratepayer-funded utility programs.

Though not specifically a utility-run program, a utility-sponsored initiative by the Consortium for Energy Efficiency (CEE) for residential natural gas water heating adopts and promotes specifications for energy efficient gas water heaters in the residential sector. Initiative participants "promote residential gas storage and tankless water heaters that meet or exceed CEE specifications. The initiative sets voluntary NOx emission requirements for each of the water heating product categories." CEE's current natural gas storage water heater specifications cover three tiers: EF≥0.62, EF≥.67, and EF≥0.82. Their NOx emission specification is a carbon copy of California Rule 1121. In 2009, CEE launched an educational initiative, Coalition for ENERGY STAR Water Heaters, with sponsorship by

[6] ENERGY STAR Summary of Appliance and Residential Water Heater Programs – September 2012, http://www.energystar.gov/ia/partners/downloads/2012_ENERGY_STAR_Summary_of_Appliance_and_Water_Heater_Programs.pdf

utilities, manufacturers, and ENERGY STAR. The Coalitions' website, www.eswaterheaters.com, has basic information for consumers and contractors, and has last been updated in 2010.

Federally Funded State Programs (ARRA)

On July 14, 2009, DOE announced that it was making $300 million from the American Recovery and Reinvestment Act (ARRA) available to states to promote the purchase of ENERGY STAR qualified appliances. Under this program, called the State Energy Efficient Appliance Rebate Program (SEEARP), states can give consumers rebates for replacing old appliances with new energy-efficient models. The purpose of SEEARP has been to save energy and stimulate the economy at the same time. The available funding was exhausted by the end of 2011.

A report conducted by the National Association of State Energy Officials examined programs receiving ARRA funding, including water heater programs. The study found that water heater rebates ranged from $35 to $425, with an extreme instance of one rebate for $640. Solar Water Heaters attracted considerably higher rates and wider ranges for incentives, from $199 to $2000. Programs funded by ARRA were largely successful in disbursing the funding. In Illinois, the first half of the program offered rebates on 4,350 water heater units and distributed $536,000 in rebates, which was 4 percent of the total Illinois budget. Water heaters did not garner the same level of interest as other appliance categories. An interim report of California's "Cash for Appliances" Rebate program shows similar low interest in water heaters with less than 1 percent of rebates going to this category.[7] Nationwide, only 2 percent of program rebates went to customers buying water heaters.

The limited availability of rebates created a demand that rapidly consume state's funds. Rebates in the first two phases of the Illinois program were distributed in less than 15 hours. In Iowa, the $2.8 million general appliance program's funds lasted seven hours, with 1.9 million calls and 4.6 million web hits in a single day.

The Midwest Energy Efficiency Association (MEEA) conducted a case study on the ARRA-funded SEEARP for Illinois. The case study notes that an important aspect to the program's success was a tiered approach, where water heaters were first promoted for nearly 30 days, followed by other brief periods of focused promotion of other appliances. Success of the program was, no doubt, due to the collaborative efforts among retailers and other energy efficiency stakeholders around the state, including the involvement of several energy efficiency proceeding interveners in the implementation of the program. MEEA describes the collaboration[8]:

> *Illinois Retail Merchants Association (IRMA), Conservation Services Group (CSG), and the Participating Energy Efficiency Contractor (PEEC) Network (managed by MEEA), each of which performed outreach and recruitment. Citizens Utility Board (CUB) was enlisted to carry out statewide consumer outreach and staff the program's call-center. Rounding out the team, Electric Gas Industries Association (EGIA) functioned as the program's rebate processor.*

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[7] California's "Cash for Appliances" Rebate Program, Interim Results through March 2012, http://www.cash4appliances.org/consumers/Summary_of_rebate_results.pdf.

[8] Midwest Energy Efficiency Association (MEEA) Energy Efficient Appliance Rebate—Illinois State Energy Efficient Appliance Rebate Case Study, p.2.

Lessons Learned from State Programs

An important lesson learned from the ARRA initiative is the value of time limited rebate offers. It also pointed out that water heater programs are not as sexy as appliance measures and therefore end up earning a small share of the total incentive budget. Also supportive of the PG&E's new water heater program strategy is the alignment of CEE efficiency and emission specifications with PG&E product qualifications.

PROGRAM-RELATED POLICIES, REGULATIONS, AND STANDARDS

General Policy Trends Related to Water Heaters

California Policy Trends

As the IOUs, California Public Utility Commission (CPUC) and its Energy Division strive to achieve deeper energy savings and overall market transformation to keep with the Commission's guidance in D.12-05-015, water heater programs become an attractive means to achieve both savings goals and overall energy efficiency policy objectives. In the guidance decision for the IOUs' 2013-2014 Energy Efficiency program portfolios, the Commission notes an increased interest in generally achieving a delicate balance between achieving market transformation and deeper energy savings while still meeting cost-effectiveness portfolio guidelines. Guidance offered in the Decision discusses an increase in behavior-based programs, scalable financing programs, and local government programs. It also discusses a reduction in the overall number and complexity of programs, a simplified and streamlined appliance program to maximize synergies with manufacturers and retailers and reduce administrative costs, and the advancement of market transformation toward Title 20 codes and standards changes. While water heater programs have historically been implemented primarily through the HEER program in California, D.12-05-015 additionally directs the IOUs to "maximize the appeal of a "whole house" upgrade to those homeowners replacing a faulty HVAC or water heating unit, so that more efficiency improvements in more households are undertaken at the same time," and cites a desire to minimize missed or lost opportunities in the residential sector.

The California Energy Commission (CEC) oversees the development of California's Building Energy Efficiency Standards. The most recent version of Title 24 standards is one way through which California has responded to Assembly Bill 32, the Global Warming Solutions Act of 2006. The 2008 standards represent enforceable codes related to the following water heater measures: Standard Water Heater - Storage Gas; Large Storage Gas; Storage Electric; Heat Pump Water Heater with storage; Instantaneous (Tankless) Gas; Instantaneous (Tankless) Electric; and Boiler.[9]

National Policy Trends

At a national level, the Department of Energy is charged with developing energy conservation standards for residential water heaters under section 325(e) (4) (B) of the Energy Policy and Conservation Act (EPCA). The most recent standards for residential water heaters were issued March 31, 2010 and will be applied starting April 16, 2015 for residential water heaters. The required energy factor (EF) varies depending on the type of water heater and the rated storage volume. For gas-fired and electric storage water heaters with a volume greater than 55 gallons, the standards effectively require heat pumps for

[9] http://www.energy.ca.gov/title24/2008standards/index.html.

electric storage products and condensing technology for gas storage products. According to the DOE, the standard will save 2.6 quads of energy and about $8.7 billion over 30 years.[10]

Program Design Implications of California Regulations

CPUC Direction

As the regulatory agency overseeing IOU energy efficiency programs, the CPUC offers some guidance related to the implementation of potential relevant program design elements that may be incorporated to a new water heater program. With regard to instant or point-of-sale (POS) rebates, the CPUC has historically found no issue with these types of programs – however, data requirements must be met to adhere to measurement and evaluation requirements. Still, many IOUs have been successfully running POS programs for years, including Southern California Gas Company, San Diego Gas & Electric, and a PG&E POS pilot with Sears. Another potential programmatic option, accelerated rebates, has precedent in the California Solar Initiative, where tiered incentives encourage customers to act quickly on a planned residential solar panel installation.

In D.12-05-015 and prior Energy Division guidance, IOUs are encouraged to add other appliances to their existing Appliance Recycling Programs. Future programs may be encouraged to include some type of on-bill financing or rebate programs; however, details on any such pilot are yet to be developed at this time.

The Energy Efficiency Policy Manual encourages statewide programs to maintain statewide consistency, however, targeted marketing is a fairly accepted practice to feed the energy efficiency savings "sales funnels" based on market potential data and segmentation studies. Finally, any program should logically account for prior measurement and evaluation feedback from other retailer-centered programs, such as the Business Consumer Electronics program.

Air Quality Regulations

Air Quality Management Districts (AQMDs) that are part of PG&E territory include the districts of Bay Area, San Joaquin Valley, North Coast, Siskiyou, Amador, Colusa, Great Basin, Mendocino, Northern Sierra, Northern Sonoma, San Luis Obispo, Tehama, El Dorado, Lake, Placer, Santa Barbara, Tuolumne, Butte, Feather River, Lassen, Monterey Bay, Sacramento, Shasta, Calaveras, Glenn, Mariposa, North Coast, Siskiyou, and Yolo-Solano. Most AQMDs have coordinated at a regional level to ensure guidelines for air quality emissions regulations for gas water heaters are similar to lesser the certification burden for manufacturers. In total, approximately 240 water heater models in California meet the requirements from these regional air quality entities. Because of the acceptance of this air quality rule throughout the state, it is possible that utility efforts to align air quality standard rules to Energy Star certifications in rebate programs could accelerate the introduction of energy efficient water heater models available for sale at retailers.

Without coordination of the water heater rules among the management districts, the AQMD certification process from each regional entity is unwieldy and time consuming. There has been success in aligning certification requirements for larger AQMDs, such as South Coast, Ventura, and Bay Area, but level of coordination among smaller AQMDs is not as consistent. Most notably, recertification "expiration" dates had appeared inconsistent and, at worst,

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10 http://www1.eere.energy.gov/buildings/appliance_standards/residential/heating_products_fr.html

required a manufacturer to submit certifications for the same qualifying model to multiple AQMDs.

Currently, the state AQMDs follow Rule 1121 promulgated by the South Coast Air Quality Management District. Rule 1121 applies to the control of Nitrogen Oxides from residential-type, natural gas-fired water heaters:

- no person shall manufacture for sale, distribute, sell, offer for sale, or install within the Air Quality Management District any gas-fired water heaters unless the water heater is certified pursuant to subdivision (d) to a NOx emission level of less than or equal to:

a. 10 nanograms of NOx (calculated as NO2) per joule of heat output (23 lb. per billion Btu of heat output); or
b. 15 ppmv at 3% O2, dry (17.5 lb. per billion Btu of heat input).

TABLE 2 AQMD NITROGEN OXIDES EMISSION RULES

Manufacturers are also prohibited from selling or installing any water heater subject to rules unless the water heater manufacturer brand name and model is certified to Air Pollution Control Officer. This certification is current for 3 years, after which recertification must be sought. Certifications can be used across AQMDs, in some cases. In the Bay Area Air Quality Management District, these rules were effective on January 1, 2011 for all residential water heaters with an input rating of 75,000 btu/hr or less.

ENERGY STAR Qualifications

Qualifying water heater specifications for the ENERGY STAR program are closely coordinated with the CEC's title 24 requirements and DOE's water heater federal standards. ENERGY STAR specifications are voluntary and their current energy efficiency criteria are more stringent than existing and planned mandatory standards set by California and the federal government. In addition to Energy Factor (EF), ENERGY STAR water heaters must meet First-Hour Rating, Warranty, and Safety criteria.

EF is the most important measure in a utility's energy efficiency program. Currently, ENERGY STAR's EF for natural gas storage water heaters is ≥0.67 and the EF for electric storage water heaters is ≥2.0, which only heat pump water heaters can satisfy. Whole house tankless water heaters with an EF ≥0.82 also qualify for ENERGY STAR. A list of current and historical ENERGY STAR specifications appears in Table 21 in the Appendix.

Manufacturers generally prefer voluntary efficiency standards like ENERGY STAR over mandatory programs as voluntary programs are believed to be the best mechanism to promote innovation in efficient product design.[11] Though stringent criteria can be a deterrent for some manufacturers and retailers, this does not completely explain the lack of sales of ENERGY STAR water heaters in California. An additional significant barrier to uptake of ENERGY STAR-compliant water heater models is the inherent tradeoff manufacturers make in designing water heater models which adhere to the AQMD regulations, Title 24 codes, and ENERGY STAR guidance. It is technologically possible for models to be both compliant with state and regional air quality regulations while also

[11] Consumer Electronics Association (CEA) Energy Efficiency & Environmental Policy, http://cea.aristotle.com/pages/energy.aspx?SID=7&AuthToken=null&participantguid=null&ind_guid=null.

meeting ENERGY STAR qualifications. Still, due to the challenge of designing systems to meet California criteria, only 12 units are both ENERGY STAR-qualified and AQMD-compliant as of August 2012.

	Number of Natural Gas Models			% of Compliant that are Rated
	AQMD Compliant	ENERGY STAR Rated	AQMD Compliant and ENERGY STAR Rated	
Storage	247	207	12	5%
Tankless	124	434	52	42%

TABLE 3 NUMBER OF GAS MODELS QUALIFYING FOR NEW PROGRAM DESIGN

Each of the three major water heat manufacturers – A.O. Smith, Bradford White, and Rheem – has at least one natural gas storage water heater that meets ENERGY STAR and California air quality criteria. Several of these models are available through retail channels. A.O. Smith and Rheem also offer about 40 percent of the ENERGY STAR qualified heat pump water heater models.[12]

BACKGROUND SUMMARY AND IMPLICATIONS

Water heating is one of the top energy using devices in a residence and there are untapped opportunities to save households energy and money. Hundreds of utility and state run programs have been implemented to encourage consumers to select energy efficient options. Program goals and objectives of these programs are guided by state and federal policies.

Program Design Implications

State and federal policies as well as water heater program implementation experience provide precedents and guidance on the design of market-focused programs.

Collaboration to expand market and manage costs

California air emission rules create a niche market for high efficiency, low NOx water heaters. The rules limit the availability of qualifying water heater products and further constrain PG&E's efforts to transform the market in its service territory. The proposed program design is to be adaptable by other utilities and creates opportunities for collaboration, which increases the market potential for advanced products and encourages manufacturers to produce more qualifying water heaters than are available today. A potential model for organizing a collaborative effort is CEE's water heater program, which directs its members to adopt water heater specifications that mirror the PG&E's qualifications. Collaboration also enables sharing of certain program costs.

Targeting emergency decision-makers

The majority of water heater purchases are made on an emergency basis. Marketing efforts, therefore, have to communicate the message of energy efficiency quickly and at the

[12] AHRI database, Navitas analysis.

point of purchase. A water heater test program can assess the effectiveness of different marketing strategies for targeted markets. For rebates to have an impact under these circumstances, incentives should be immediately available. Instant rebates or point of sale (POS) rebates are offered by some, but not all, channel participants primarily due to the cost of adapting point of sale data management systems. Another objective of a test program is to assess the impact of POS rebates on participation and calculate the retailer's benefits and costs to set up a POS system.

Shifting emergency decision-maker segment to planned purchaser segment.

Two program designs recognized by the CPUC have potential application to a market-focused water heater program: accelerated rebates and appliance recycling. Accelerated rebates create a sense of urgency and permit higher rebate values, both of which may motivate consumers to do advanced planning for a water heater purchase. Water heater recycling is a program option for early retirement of inefficient water heaters. With targeted marketing campaigns a recycling program could also shift a consumer decision to replace a water heater to a time well before failure. Consumer research during a test of these design options could reveal the impact of accelerated rebates or recycling incentives on changes in purchasing behavior.

Tracking performance for continuous improvement

Retailer participation in PG&E's Business and Consumer Electronics program is contingent upon the retailer submitting total category sales from which qualified products are identified and market penetration is calculated. PG&E uses this information for incentive payments, performance management, and program evaluation. Retailers better understand the business implications of program participation with these data as well as shelf survey data that PG&E's field services team collects. Total water heater sales reporting and store stocking surveys during the test program will allow program refinements and performance feedback to channel partners.

WATER HEATER MARKET EVALUATION

The water heater market is characterized by water heater technologies and products, sales trends, industry structure, and customer segments. The market evaluation includes an overview of the national market and a closer look at characteristics of the water heater market in PG&E's service territory.

RESIDENTIAL WATER HEATER PRODUCTS

Nationally, over 100 million residential water heaters are installed. More than half of these U.S. households have natural gas as the primary water heating fuel. In PG&E's service territory, there are an estimated 5.3 million water heaters and, because of the accessibility and affordability of natural gas, more than 90 percent of water heaters are gas-fired. On average, PG&E has almost a 5 percent share of the total U.S. water heater market and close to 10 percent of the natural gas storage water heater market.

The demand for residential water heaters has declined 20 percent over the last five years, reflecting the poor state of the economy. The difficult economic conditions have also caused consumers to defer water heater replacement until they need to make an emergency decision and to select lower priced, less efficient options. Economic conditions and the

absence of planning in a water heater purchase decision have likewise impacted the market penetration of ENERGY STAR storage models. Below average sales over the last few years are expected to return to the mean as the economy recovers.

The table below summarizes available and state-of-the-art water heater technologies and their advantages.[13] Technology options with energy savings versus standard models are, with the exception of point of use electric tankless water heaters, ENERGY STAR products. The energy efficiency feature of water heater is driven by federal energy standards and the voluntary ENERGY STAR criteria.

	Conventional Storage		Advanced Technologies			
	Gas	Electric	ENERGY STAR Gas (0.67–0.70 EF)	Gas Tankless	Condensing Storage	HPWH
Typical Efficiency	0.58–0.62 EF	0.90–0.95 EF	0.67–0.70 EF	0.80–0.95 EF	≥ 90% thermal efficiency	> 2.0 EF
Installed Cost (New)	Low	Low	Moderate	Moderate-high	Moderate-high	Moderate-high
Installed Cost (Retrofit)	Low	Low	Moderate-high	High (assuming gas line must be upsized)	Moderate-high	Moderate-high
Savings Versus Standard	N/A	N/A	For moderate to high loads, typically ≥ 10%	Typically ≥ 30%	For moderate to high loads, typically ≥ 30%	Typically ≥ 40% (versus electricity) depending on climate loads, installation details
Hot Water Delivery Performance	Immediate; good recovery capacity	Immediate; moderate recovery capacity	–	Cold start delay; minimum flow rate; cold water sandwich; endless hot water	Immediate; generally high recovery capacity	Immediate; relatively low heat pump recovery capacity
Maintenance	Minimal	Minimal	Minimal	If hard water area, can be significant	Generally minimal	Some (air filter)
User Interactions	None	None	None	Generally see change in behavior from users versus standard gas storage water heater	None	Mode, set points, and hot water loads affect performance and backup heating

TABLE 4 WATER HEATER TECHNOLOGY OPTIONS

Since natural gas storage water heaters have 90 percent of the PG&E market, small changes in energy efficiency can significantly impact energy use in the region. Over the period from 2008 to 2012 (during this time, two ENERGY STAR specifications were issued), the weighted average energy factor of available models has increased from 0.60 to 0.62. Figure 5 illustrates the progression of water heater efficiency over this period. The increase in average energy factor is a result of the sharp rise in number of water heater models satisfying the most recent ENERGY STAR specification, energy factor ≥0.67.

[13] M. Hoeschele, D. Springer, A. German, J. Staller, and Y. Zhang, "Strategy Guideline: Proper Water Heater Selection," Alliance for Residential Building Innovation (ARBI), August 2012, p.8.

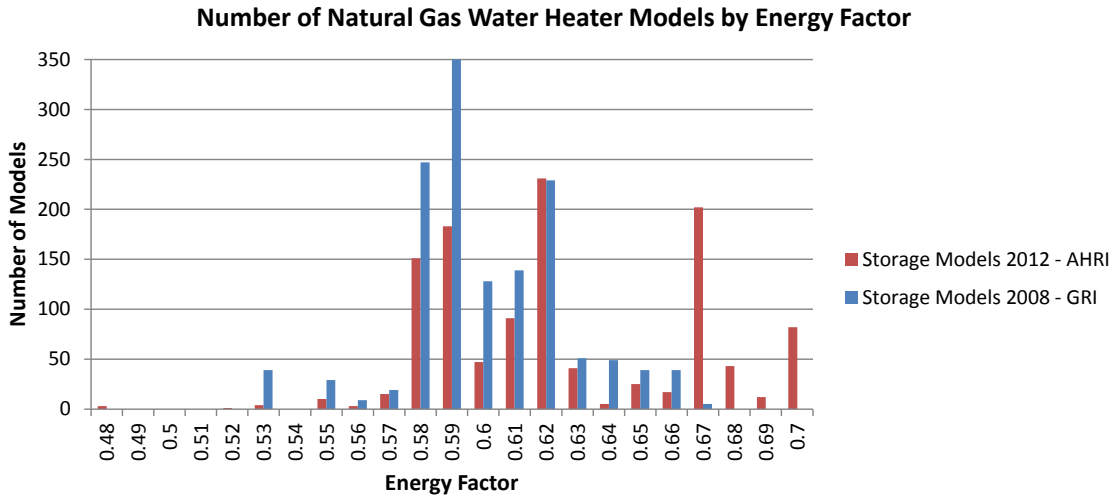

FIGURE 5 DISTRIBUTION OF RESIDENTIAL NATURAL GAS WATER HEATER MODELS BY ENERGY FACTOR

90 percent of electric storage water heater has an energy factor greater than 0.9, Figure 6. The most recent ENERGY STAR specification for electric water heaters has an energy factor ≥2.0 and applies only to heat pump water heaters.

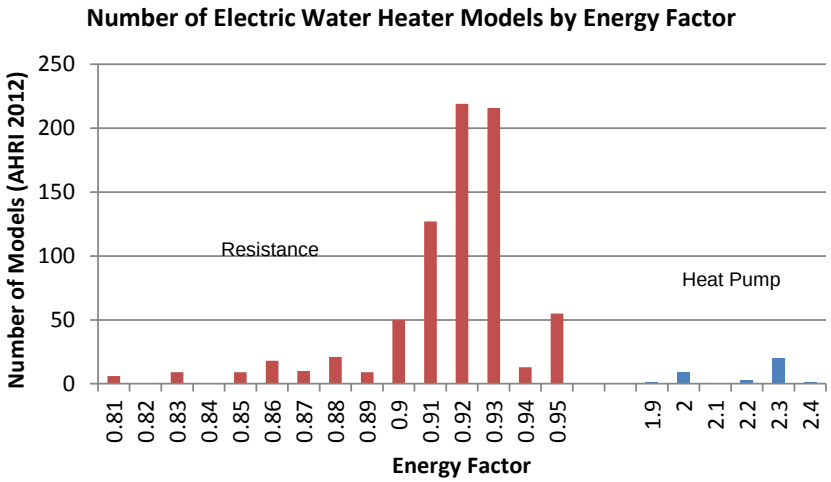

FIGURE 6 DISTRIBUTION OF RESIDENTIAL ELECTRIC WATER HEATER MODELS BY ENERGY FACTOR

RESIDENTIAL WATER HEATER MARKET STRUCTURE

Market structure, or value chain, connects the manufacturer of a water heater with the ultimate end user. There are two main channels that bring the products from manufacturer to the consumer, the retail channel and the wholesale channel. The wholesale channel, plumbing contractors and builders, serves replacement as well as new construction demand.

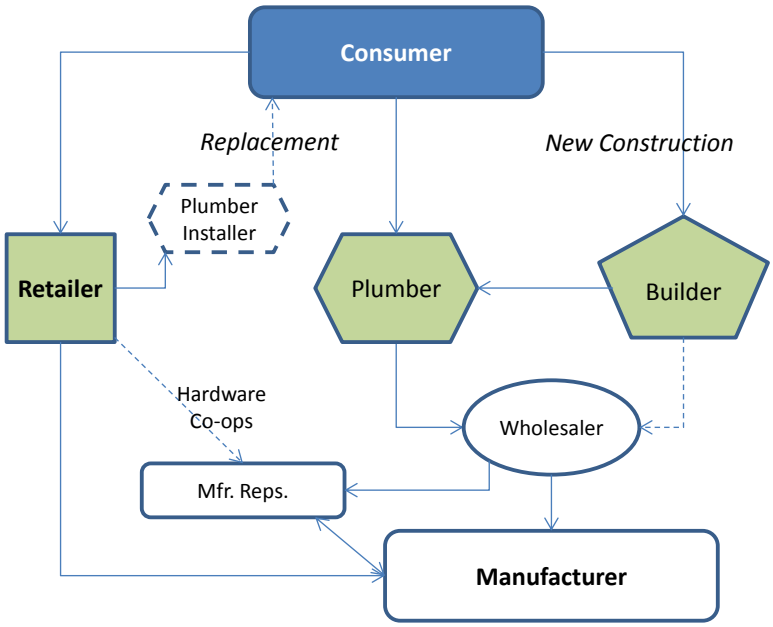

FIGURE 7 WATER HEAT MARKET STRUCTURE

Manufacturers

Three manufacturers – A.O. Smith, Bradford White, and Rheem – have more than 95 percent of the residential water heating market.[14] Sales of residential water heaters have been historically evenly distributed between retail and wholesale (contractor) sales channels. A.O. Smith and Rheem distribute these products through retailer and contractor channels. Bradford White products are sold exclusively by contractors.

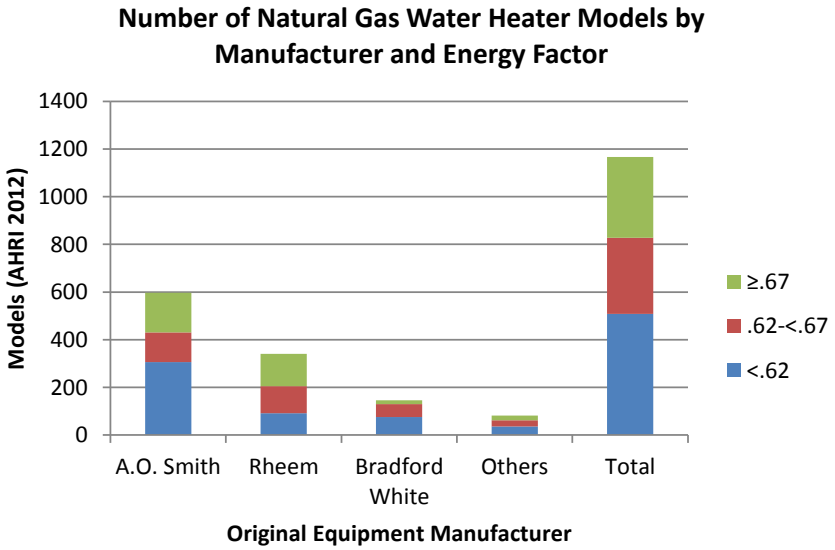

FIGURE 8 NATURAL GAS WATER HEATER MODELS BY MANUFACTURER AND ENERGY FACTORS

[14] ENERGY STAR Water Heater Market Profile, September 2010.

Rheem and American Water Heater are also leading electric resistance water heater manufacturers. American Water Heater is the OEM for Kenmore, Whirlpool and dozens of other electric heater brands.

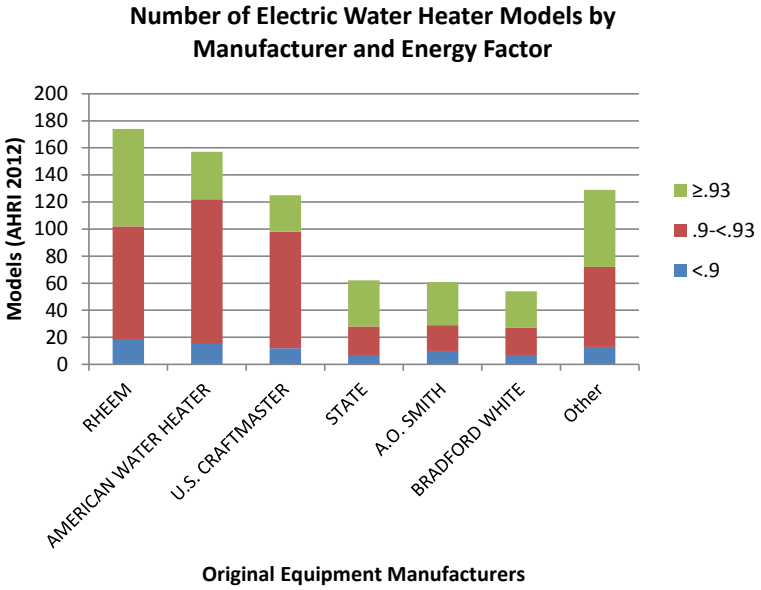

FIGURE 9 ELECTRIC RESISTANCE WATER HEATER MODELS BY MANUFACTURER AND ENERGY FACTOR

Eleven original equipment manufacturers produce 32 electric heat pump models, according to AHRI database of certified water heaters. A.O. Smith and Rheem have nearly 40 percent of these models.

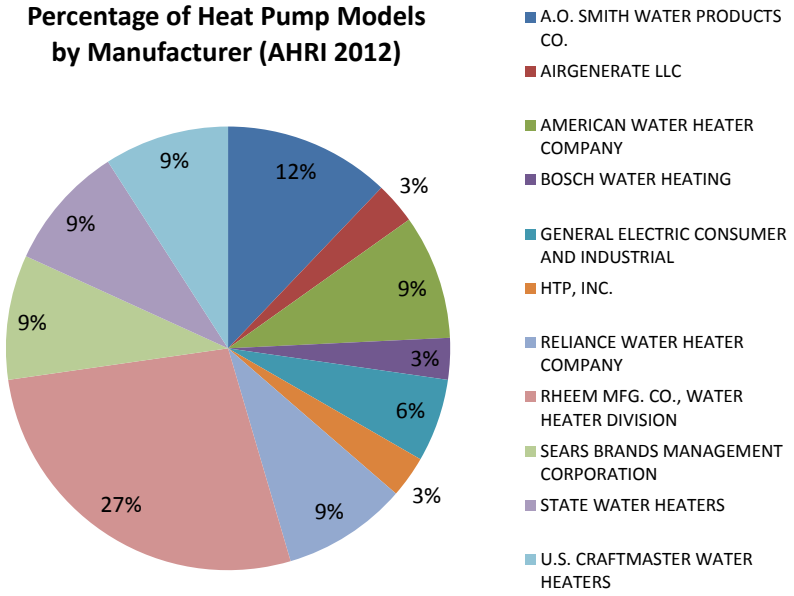

FIGURE 10 ELECTRIC HEAT PUMP WATER HEATERS BY MANUFACTURER

Retailers

The Home Depot, Lowe's, and Sears are the leading retailers of residential water heaters. They sell directly to consumers who do the installation themselves or use one of the retailer's installation service providers. These retailers also sell to the construction and plumbing trades. In PG&E's service territory, the three leading retailers have 217 stores. Table 5 shows the distribution of these stores in PG&E's designated areas.

PG&E Areas		Channels (Count)				
Code Number	Population Center	Plumbing HVAC Contractors	Distributors	Home Depot Stores	Lowe's Stores	Sears Stores
AREA1	San Francisco	392	10	5	3	2
AREA2	Oakland	553	15	16	7	10
AREA3	San Jose	577	12	16	5	9
AREA4	Fresno	581	2	19	10	14
AREA5	Stockton	363	14	11	8	12
AREA6	Sacramento	833	27	24	12	17
AREA7	Napa	399	13	7	2	8
Total		3,724	93	98	47	72

TABLE 5 PG&E DISTRIBUTION CHANNEL FIRMOGRAPHICS[15]

Wholesale distributors and contractors are not as concentrated as retailers. There are nearly 100 distributors and thousands of installation contractors. More than 70 percent of the contractors are small business establishments with fewer than 10 employees.

WATER HEATER CUSTOMERS

Customers for replacement residential water heaters are homeowners and rental property owners and managers; builders are the primary customers in new construction markets. In the current economy with low rates of new home construction, about 90 percent of water heater sales are for replacement of old units.[16] Water heaters are replaced every 10 years or so, therefore most people will only have a couple customer experiences with water heaters in their lifetimes. Furthermore, water heaters are "low touch" or "out of sight – out of mind" products, unlike refrigerators and other durable goods with which customers interact regularly. These factors have implications on customer purchasing behavior related to energy efficient water heaters and related marketing strategies.

DECISION MAKING

In a market-focused water heater program, a critical factor for success is an understanding of the purchase process from the homeowner's point of view. The fundamental buying

[15] Sources: U.S. Census, PG&E, Reference USA, Retailer web sites.

[16] Verinnovation Inc., "2011 Water Heater Market Update," REPORT #12-234, Northwest Energy Efficiency Alliance, January 16, 2012, p. 7.

process, defined by Kotler more than two decades ago, defines five decision making stages: Problem Recognition, Information Search, Evaluation of Alternatives, The Purchase Decision, and Post-purchase Behavior.[17] For water heaters, as with most products, the potential customer moves through all stages of the process.

Problem Recognition

A home owner or someone in the household typically notices one of five issues with their water heater.

- A Lack of or Inadequate Hot Water
- Discolored Water
- Odor
- Noise
- Leaks

The sources of these problems generally are in three areas: corrosion, sediment buildup, or part failure. The decision phase for water heaters is complicated by the severity of the problem, many of which can be remedied by maintenance if detected early enough and others that require water heater replacement.[18]

Energy efficiency is, by itself, not a problem, but can be an after-the-fact justification for replacement. For consumers with a working water heater, the primary reasons include[19]:

- It was getting old and it was time to replace it before it broke (43 percent)
- We wanted a more efficient unit (25 percent)
- We were doing a remodel, which included a new water heater (9 percent)
- We wanted a different type of water heater (6 percent).

A challenge in marketing energy efficient water heaters is making the prospective customer aware of the connection between the recognized problem and energy efficiency.

Information search

After the home owner identifies the problem, the next stage is to more actively search for information to help diagnose the problem and look for a solution. Water heater problems usually need to be addressed in a hurry. Water heaters often break down at the most inconvenient time and there is little time to research solutions, to identify all product options, or to comparison shop.

The first question to be asked is, "Do I need to replace my water heater or can it be repaired?" If the water heater needs replacement, then the next question is, "Where can I get one?" Other important questions relate to water heater selection such as fuel source, capacity, and size or installation constraints. The internet is a growing source of data to answer these types of questions. Participants in water heater rebate programs rely on the internet most often for information gathering according to one survey, Figure 11 Methods of Gathering Water Heater Information. Type "water heater" into a search engine and the top

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[17] P. Kotler, Marketing Management: Analysis, Planning, Implementation, and Control, Prentice Hall, 6th Edition, 1988, pp. 194-203.

[18] "Hot Water Heater Problems: A Broad Survey," http://www.elocalplumbers.com/blog/water-heater-problems-3220.

[19] KEMA Inc., "ASSESSMENT OF THE RESIDENTIAL WATER HEATER MARKET IN THE NORTHWEST," Northwest Energy Efficiency Alliance, July 13, 2006, p. 8-4.

ten URLs will be leading retailers and local plumbers. Many websites including ENERGY STAR, the U.S. DOE, utilities, manufacturers, retailers, and do-it-yourself magazines have guidance on water heater selection.

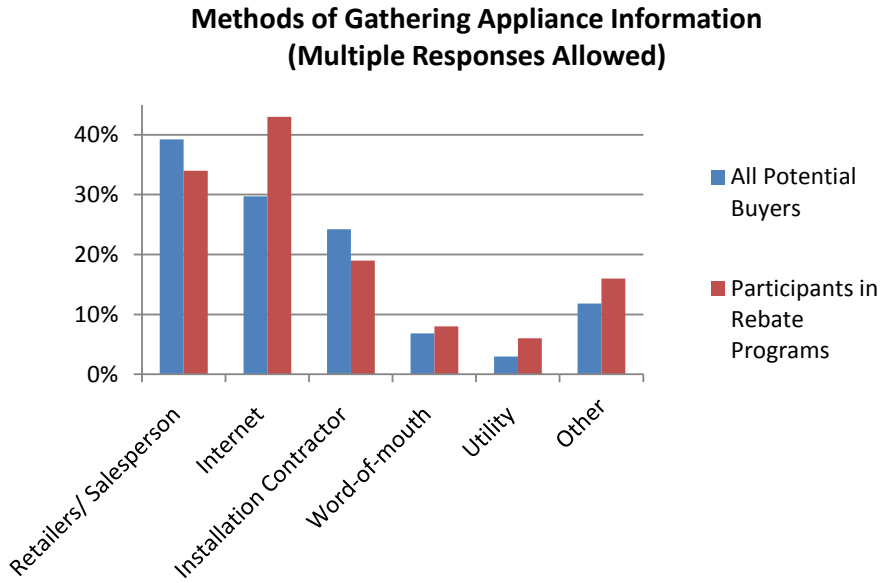


FIGURE 11 METHODS OF GATHERING WATER HEATER INFORMATION[20]

During the information search, the potential buyer learns about retailers or contractors who supply the products as well as the features of water heater brands. The outcome of this phase is typically a short list of product purchase options and suppliers.

Evaluation of alternatives

When potential buyers have gathered information about different options for water heater replacement, they evaluate options against their needs. The evaluation is quite different depending if the starting point is "need hot water now" or "need to take care of my old water heater". During this phase, several factors will be weighed against each other, such as product availability, price, installation cost and timing, hot water delivery, operating cost, reliability, reputation of supplier, etc.

Special features that add to the water heater price, such as energy efficiency, are assessed by the buyer in a rational economic way where benefits (cost savings) pay for extra costs. Most consumers do simple payback estimations during the evaluation and residential customers expect a payback of less than three years for their energy efficiency investments.[21] Research has shown that consumers who understand how to make the

[20] Research-in-Action, Opinion Dynamics Corporation, "2011-2012 GENERAL HOUSEHOLDS POPULATION STUDY IN CALIFORNIA," Study# SCE0321, August 30, 2012, p. 46.

[21] H. Granade, J. Creyts, A. Derksch, P. Farese, S. Nyquist, K. Ostrowski, "Unlocking Energy Efficiency in the U.S. Economy," McKinsey & Company, July 2009, p. 9.

benefit-to-cost calculations for durable goods like water heaters are more likely to buy an energy efficient product than those who cannot.[22]

The Purchase decision

After the evaluation of alternatives, and with input and recommendations from the retailer or contractor, the homeowner forms purchase intentions. Situations may arise causing the buyer to modify, postpone or avoid the final decision. These could be sticker shock (affordability), availability, or uncertainty about product or vendor reliability. The ultimate purchase will not only include a decision about the product and vendor, but also decisions about when to take deliver and how to pay for the product.

Post-purchase behavior

After the purchase and installation of the water heater, there continues to be interaction between supplier and customer. The interaction concerns the customer's satisfaction with the purchase and installation process and the performance of the product. Satisfaction is a function of how well the product's perceived performance meets expectations. A higher priced or premium product like high efficiency water heaters creates higher expectations that for a standard product. Dissatisfaction will lead to product returns or complaints, while satisfaction can result in word of mouth promotions and repeat business.

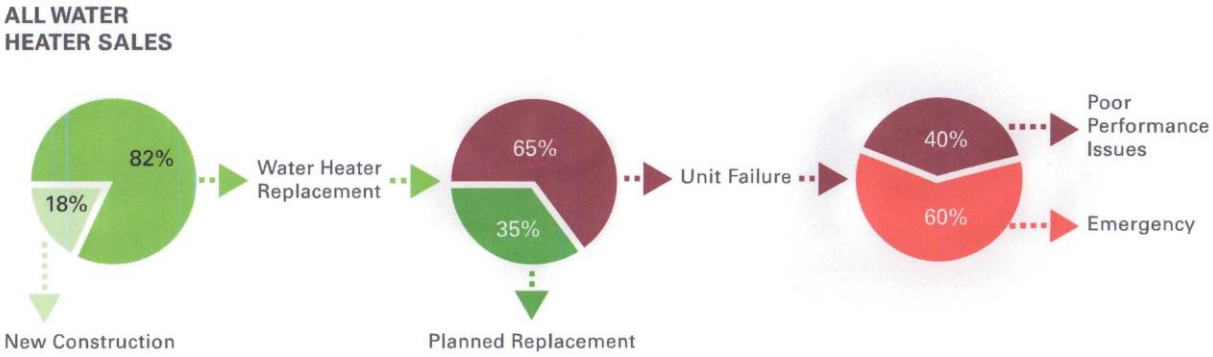
The speed of the water heater purchase decision depends on whether the decision is an emergency or planned.

EMERGENCY VERSUS PLANNED DECISIONS

The definition of an emergency purchase depends on if the perspective is as a buyer or a seller. In a 2011 customer survey, recent water heater purchasers stated that 43 percent of purchases resulted from an emergency. A supplier survey at the same time reported that suppliers believed that 61 percent of their sales and installs addressed emergency replacements[23]. For consumers, "emergency replacements" definition only includes a sudden failure. Suppliers consider an emergency any unit failure, either for poor performance or sudden emergency.

[22] D. A. Houston, "Implicit Discount Rates and the Purchase of Untried, Energy-Saving Durable Goods, JOURNAL OF CONSUMER RESEARCH, Vol. 10, September 1983.

[23] Verinnovation Inc., "2011 Water Heater Market Update," REPORT #12-234, Northwest Energy Efficiency Alliance, January 16, 2012, p. 15.



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.

FIGURE 12 WATER HEATER PURCHASE DECISIONS

ENERGY STAR analysis of water heater purchase motivators also illustrates this definition conflict, Figure 12.[24]

In a true emergency, there is little time for the home owner to gather information on product options. Most buyers rely on plumber or retailer input in this situation and the product options are limited to the immediately available stock. Plumbing contactors on emergency calls often carry a few units most often requested by homeowners. Some contractor firms specialize in the emergency 24-hour repair business to meet the needs of consumers who need service during non-business hours.[25]

Program Design Implications

The peculiarities of the water heater purchase decision process have significant implications on the design of the marketing components of a program. The two major decision motivators – emergency or planned purchase – call for two separate but interrelated marketing strategies to promote energy efficient water heaters. Emergency decisions demand on a channel marketing strategy and planned decisions require a more consumer-focused approach.

CUSTOMER SEGMENTS

Market segmentation aggregates prospective buyers into groups that have common needs and will respond similarly to a marketing action. It can assist in the design of a water heater program that more closely matches residential customer, retailer, and contractor needs and marketing campaigns that can successfully motivate the targeted segments to purchase energy efficient water heaters. Segmentation also allows an estimation of addressable and achievable markets from the total potential market.

Segmentation can be done in a number of ways. Two segments are defined by the water heater decision making process – emergency buyers and planned buyers. Geographic,

[24] ENERGY STAR Water Heater Market Profile, September 2010, p.21.

[25] Verinnovation Inc., "2011 Water Heater Market Update," REPORT #12-234, Northwest Energy Efficiency Alliance, January 16, 2012, p. 15.

demographic, and psychographic criteria are among the many other ways to segment a market.

In 2009, Opinion Dynamics Corporation (ODC) identified five unique segments for the CPUC and IOU outreach efforts. ODC developed these segments with demographic and energy efficiency preference information to permit strategic and tailored branding as well as to guide statewide marketing and outreach strategy.[26] This study was repeated in 2011 and information was presented on the shares of these segments in PG&E's service territory.[27]

- Leading Achievers (27%): Older homeowners with high level of education and highest incomes. High awareness and likely participation.
- Practical Spenders (22%): Older homeowners with high incomes and moderate levels of education. Low awareness and somewhat likely participation.
- Striving Believers (24%): Younger residents with moderate incomes and high education. Split between homeowner and renter. High awareness and less likely participation.
- Thrifty Conservers (13%): Older homeowners with lower incomes. Low awareness and less likely to participate.
- Disconnected (14%): Younger residents with the lowest incomes. Mostly renters. Low awareness and less likely to participate.

PG&E Residential Water Heater Market Segments

PG&E divides its service territory into geographic areas for operational, service and other management reasons. Data related to these areas are used to segment and characterize the population of PG&E's mass market customers.

[26] Opinion Dynamics Final Segmentation Report_121009

[27] Research-in-Action, Opinion Dynamics Corporation, "2011-2012 GENERAL HOUSEHOLDS POPULATION STUDY IN CALIFORNIA," Study# SCE0321, August 30, 2012, p. 46.

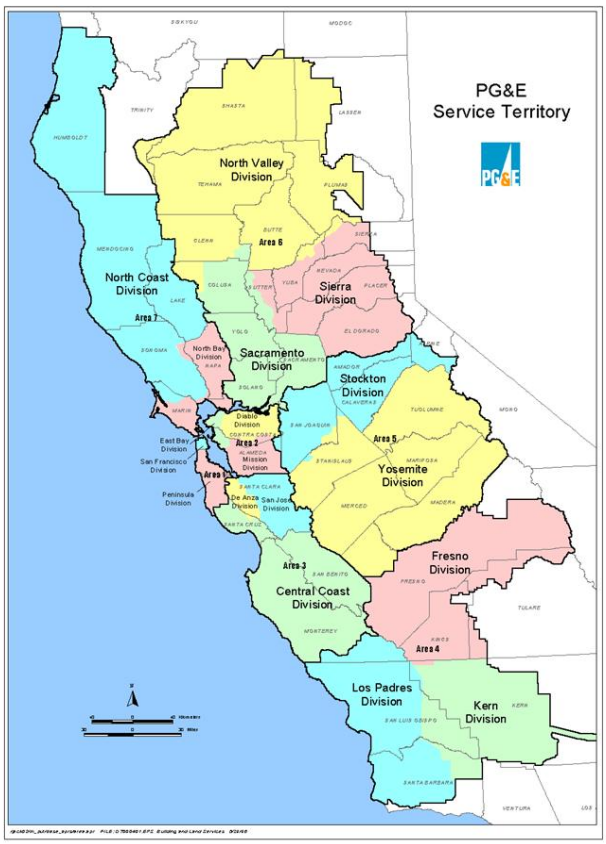


FIGURE 13 PG&E GEOGRAPHIC SEGMENTS

Analysis of 2010 and 2000 U.S. Census data and zip code information has resulted in a mapping of Northern and Central California population into the seven different PG&E Areas (Figure 14). The demographic characteristics are housing type, income and households. The number of households roughly corresponds to PG&E's customer count. The Areas also represent different climate zones.

PG&E Area Code	Population	Population in owner-occupied housing units	Population in renter-occupied housing units	Demographics Median household income in 1999 -- Owner occupied	Demographics Median household income in 1999 -- Renter occupied	Households	Owner-occupied housing units	Renter-occupied housing units	Average Age of Housing (Years)
AREA1	1,581,429	789,230	752,851	85,650	48,172	624,664	288,147	336,517	54
AREA2	2,560,125	1,528,902	983,503	73,694	37,767	920,871	543,426	377,445	41
AREA3	2,439,674	1,367,805	1,017,822	85,656	48,751	812,485	461,792	350,693	38
AREA4	2,894,847	1,564,670	1,226,926	47,964	24,627	907,119	519,397	387,722	34
AREA5	1,801,249	1,030,970	725,501	49,063	25,560	574,831	347,703	227,128	32
AREA6	3,225,132	1,950,887	1,206,599	55,964	28,500	1,182,638	730,254	452,384	31
AREA7	1,309,738	774,735	501,002	64,359	35,323	509,312	309,681	199,631	39
None	73,751	26,332	37,973	52,207	18,371	24,758	10,070	14,688	32
Total	15,885,945	9,033,531	6,452,177	64,657	35,432	5,556,678	3,210,470	2,346,208	38

FIGURE 14 PG&E DEMOGRAPHIC DATA BY AREA SEGMENTS

The water heater population in PG&E geographic region has been calculated using the Census data and the results of the 2009 Residential Appliance Saturation Survey (RASS). RASS estimates total water heater population for all water heater types. Electric heat pump population is less than 1 percent of the total. Because of this small sample size, heat pumps have not been included in the segmentation analysis. The water heater population analysis places the water heater stock by water heater type into the geographic segments. Table 6 also includes the distribution of PG&E's 2011 water heater rebates by Area segment.

	Total Gas Water Heater Stock	Tankless Gas Water Heater Stock	Total Electric Water Heater Stock	HIGH EFF WTR HTR (GAS) >=0.65 TIER 2 Rebate Count	HIGH EFF WTR HTR (GAS) >=0.62 <0.65 TIER 1 Rebate Count	HIGH EFF WTR HTR (ELECT) >.93 Rebate Count	Total 2011 Rebate Count
AREA1	581,105	19,831	44,580	105	408	18	531
AREA2	807,223	26,838	74,112	177	823	24	1,024
AREA3	739,735	19,014	62,989	176	723	37	936
AREA4	776,392	30,568	89,207	47	235	30	312
AREA5	454,441	14,479	56,379	52	250	33	335
AREA6	878,210	30,508	135,222	202	1,015	81	1,298
AREA7	395,389	25,024	67,438	89	480	42	611
None	20,988	959	2,662	1	1	-	2
Total	4,653,482	167,221	532,589	849	3,935	265	5,049

TABLE 6 PG&E WATER HEATER DATA BY AREA SEGMENTS

Segmentation data for PG&E's population (Table 6), water heater stock (Table 6), and channel presence (Table 5) are used to identify market segments on which to focus in the water heater program design.

MARKET-FOCUSED PROGRAM DESIGN APPROACH

Increasing the market penetration of ENERGY STAR water heater and the participation in PG&E's water heater program is a marketing challenge and not a technology problem. There are water heater options, high efficiency gas storage water heaters and electric heat pump water heaters – both meeting ENERGY STAR criteria, which can deliver significant energy savings to PG&E customers. Given the market conditions, perceived and actual market and regulatory barriers, and lessons-learned from recent water heater programs, there is a portfolio of measures and marketing options to meet the marketing challenge to increase participation in PG&E's residential water heater program.

Portfolio Element Qualifications	*Initial Market Target*	*Primary Channel*	*Marketing Approach*
ENERGY STAR Gas Storage Water Heaters. Ultra Low NOx burners.	High gas usage Suburban home owners	Retail	High rebate Active channel participation Targeted marketing
ENERGY STAR Heat Pump Water Heaters	High electricity usage Suburban home owners	Retail	High rebate Active channel participation Targeted marketing
Efficient Natural Gas storage water heaters - Energy Factor ≥.65 & <0.67. Ultra Low NOx burners.	Broad offering to all PG&E customers	Contractor/Retail	Current rebate ($50) Inform through PG&E website
Efficient Natural Gas storage water heaters - Energy Factor ≥.62 & <0.65. Ultra Low NOx burners.	Broad offering to all PG&E customers	Contractor/Retail	Current rebate ($30) Inform through PG&E website Discontinued after 2012
Efficient electric resistance storage water heaters - Energy Factor ≥0.93	Broad offering to all PG&E customers	Retail/Contractor	Current rebate ($30) Inform through PG&E website Discontinued after 2012

TABLE 7 MARKET-FOCUSED WATER HEATER PROGRAM CONCEPT OVERVIEW

RESIDENTIAL WATER HEATER MEASURES

The measures for this program are single technologies and not a water heating system that includes water heaters as well as components of a hot water distribution system such as pipe insulation and shower heads. There are five individual water heater measures to be analyzed and tested with customers. These are summarized in Table 7, which shows qualifying criteria and channel options.

The five measures are grouped into two categories – Test Measures and Legacy Measures. Test Measures represent the newest, highest efficiency water heating technologies. A qualifying criterion for these measures is ENERGY STAR certification. They currently have high costs, limited availability, and low market penetration. These measures will be the subject of tests of new marketing approaches to uncover ways to lower barriers to market acceptance. Two work papers have been prepared to establish baselines for natural gas and electric water heater measures:

- Work Paper PGECODHW104, Gas Storage Water Heater, Revision #3: "Gas Storage Water Heater > 0.62EF, >0.65 EF, <75 kBtu/h input. Measure Codes: H721 and H722 (downstream), HA58." 6/20/2012.
- Work Paper PGECODHW106, Electric Storage and Heat Pump Water Heater, Revision #3: "Electric Storage Water Heater > 0.93EF, <75 gallon; Heat Pump Water Heater Measure Code H154, HA47 (for HPWH)." 6/20/12.

A longer term goal is to address total water system energy savings opportunities. Additional measures related to a water heating system such as condensing water heaters, hybrid water heaters, water heater controls, pipe insulation, and flow control are proposed to be investigated following successful completion of the current test program. Marketing methods proven to increase the market penetration of the core water heater technologies will be applicable to system type measures.

QUALIFYING PRODUCTS

There are two categories of qualifying products: listed products and available products. Table 8 includes listed products, which have been tabulated from AHRI's database of certified models, ENERGY STAR's qualified product lists; South Coast Air Quality Management District certified products, and retailers' available products. Available products are models that the channel has available for sale through the show room and in-stock or special order and on-line. Available models have been identified through web searches of PG&E retail stores and through shelf survey samples.

	Measure	Number of Qualify Water Heater Models by Tier			
		Total Qualifying (AHRI)	Lowe's	Sears	The Home Depot
Legacy Measures	Natural Gas (≥.62 & <.65)	54	1	2	4
	Natural Gas (≥.65 & <.67)	10	0	0	0
	Electric (≥.93)	284	8	11	3

	Measure	Number of Qualify Water Heater Models by Tier			
		Total Qualifying (AHRI)	Lowe's	Sears	The Home Depot
Test Measures (ENERGY STAR)	Natural Gas (≥.67)	12	2	0	1
	Electric (≥2.0)	32	3	3	2

TABLE 8 QUALIFYING WATER HEATERS

Natural Gas Water Heaters

The two specifications allow a natural gas water heater to qualify for the proposed test program: ENERGY STAR rated (EF≥0.67) and AQMD compliant (Certified @ 10 ng/J Nox pursuant to Rule 1121). AHRI's Water Heater Directory of Certified Product Performance lists 1,166 active natural gas water heater storage models.

OEM	Brand	AQMD Certified Models	Estar Qualified
A.O. Smith	A.O. Smith	11	0
A.O. Smith	American Water Heater	9	2
A.O. Smith	Lochinvar	2	0
A.O. Smith	Penfield	2	0
A.O. Smith	Reliance	17	0
A.O. Smith	Sears	24	0
A.O. Smith	State	15	0
A.O. Smith	U.S. Craftmaster	10	0
American Standard	American Standard	28	0
Bradford White	Bradford White	42	3
Rheem	GE	21	1
Rheem	Hotpoint	1	0
Rheem	Rheem	19	2
Rheem	Rheem Professional	7	0
Rheem	Richmond	17	2
Rheem	Ruud	15	2
Rheem	Ruud Professional	7	0
Total		247	12

TABLE 9 NATURAL GAS STORAGE MODELS BY OEM AND BRAND

Almost 20 percent of 1,166 models are on ENERGY STAR's qualified product list and twelve of these natural gas models meet the AQMD rules. A.O. Smith's product literature and the AHRI Directory mentions two models that would qualify for the test program (GPNH-40 and GPNH-50), which are not currently on the ENERGY STAR qualified product list.

Sears

Internet and in-store surveys have been conducted to inventory natural gas storage water heaters in PG&E's service territory. The internet survey counted storage waters on Sears' website with a San Jose store location. As of October 2012, Sears' web site has seven water heater models under the Kenmore brand that comply with the AQMD rules (Table 2), but does not have a product that satisfies the natural gas qualifying product specifications. Conversations with Sears' management indicate that a qualifying product may be available in calendar year 2014. One store survey has counted six additional models that do not appear on Sears' web site.

Ultra Low Nox Water Heaters in PG&E Service Territory - Sears Retail							
Brand	Capacity	Warranty	EF	Fuel	Item #	Model #	Price
Kenmore	40	12	0.62	Natural Gas	4233028000	33028	$669.99
Kenmore	50	12	0.62	Natural Gas	4233029000	33029	$699.99
Kenmore	30	6	0.61	Natural Gas	4233020000	33020	$509.99
Kenmore	40	6	0.59	Natural Gas	4233022000	33022	$559.99
Kenmore	40	9	0.59	Natural Gas	4233025000	33025	$594.99
Kenmore	50	6	0.58	Natural Gas	4233023000	33023	$619.99
Kenmore	50	9	0.58	Natural Gas	4233027000	33027	$649.99

Source: http://www.sears.com/appliances-water-heaters-select-california-markets/s-1023000, 10/01/12

TABLE 10 SEARS PG&E NATURAL GAS STORAGE WATER HEATERS

Lowe's

Internet and in-store surveys have been conducted to inventory natural gas storage water heaters in PG&E's service territory. The internet survey counted storage waters on Lowe's website with a San Jose store location. As of October 2012, the web site has seven water heater models primarily under the Whirlpool brand that comply with the AQMD rules (Table 2), and has two products that satisfy the natural gas qualifying product specifications. One store survey has counted nine models one of which does not appear on Lowe's web site.

Ultra Low Nox Water Heaters in PG&E Service Territory - Lowe's Retail							
Brand	Capacity	Warranty	EF	Fuel	Item #	Model #	Price
Whirlpool 6th Sense	50	12	0.7	Natural Gas	330874	PCG2J5040T3NOV 100	$894.85
Powerflex Direct*	40	6	0.67	Natural Gas	369275	PDVG62-40T42-NV	$896.74
Whirlpool 6th Sense	40	6	0.62	Natural Gas	333591	NU40T62-403	$497.00
Whirlpool 6th Sense	30	6	0.61	Natural Gas	333575	NU30T61-303	$397.00
Whirlpool 6th Sense	40	6	0.59	Natural Gas	333578	NU40T61-403	$418.00
Whirlpool 6th Sense	40	12	0.59	Natural Gas	333573	NU40T121-403	$598.00
Envirotemp	40	3	0.59	Natural Gas	353633	UG1A4040T3NV	$399.00
Whirlpool 6th Sense	50	12	0.58	Natural Gas	333574	NU50T121-403	$696.00
Whirlpool 6th Sense	50	6	0.58	Natural Gas	333576	NU50T61-403	$498.00
Whirlpool 6th Sense	50	9	0.58	Natural Gas	333572	NU50T91-403	$587.00
Whirlpool**	50	12	0.62	Natural Gas	333572	NU50T122-403	$662.00

Source: www.lowes.com, Central San Jose, 10/01/12 Qualified *Need to confirm if qualified, **In-store only

TABLE 11 LOWE'S PG&E NATURAL GAS STORAGE WATER HEATERS

The Home Depot

Internet and in-store surveys have been conducted to inventory natural gas storage water heaters in PG&E's service territory. The internet survey counted storage waters on The Home Depot's website with a San Jose store location. As of October 2012, the web site has 12 water heater models under the GE brand that comply with the AQMD rules (Table 2) and has one model that satisfies the natural gas qualifying product specifications. One store survey has counted eight models all of which appear on their web site.

Ultra Low Nox Water Heaters in PG&E Service Territory - The Home Depot Retail							
Brand	Capacity	Warranty	EF	Fuel	Item #	Model #	Price
GE	50	6	0.67	Natural Gas	286929	GG50T06TXT	$798.00
GE	40	12	0.64	Natural Gas	170156	SG40T12TXK00	$598.00
GE	50	12	0.62	Natural Gas	170910	SG50T12TXK00	$662.00
GE	28	6	0.62	Natural Gas	160605	GG28T06AXK00	$397.00
GE	40	6	0.62	Natural Gas	169845	GG40T06TXK00	$497.00
GE	38	6	0.6	Natural Gas	163385	GG38T06AXK00	$418.00
GE	38	9	0.6	Natural Gas	159020	PG38T09AXK00	$518.00
GE	38	6	0.6	Natural Gas	157938	GG38S06AXK00	$429.00
GE	50	6	0.58	Natural Gas	183717	GG50T06AVH00	$418.00
GE	48	6	0.58	Natural Gas	152357	GG48T06AXK00	$487.00
GE	48	9	0.58	Natural Gas	168007	PG48T09AXK00	$587.00
GE	60	12	0.56	Natural Gas	474007	SG60T12YXS10	$728.00

Source: www.homedepot.com, San Jose #1861, 10/01/12 Qualified

TABLE 12 THE HOME DEPOT PG&E NATURAL GAS STORAGE WATER HEATERS

Heat Pump Water Heaters

There are thirty six ENERGY STAR certified water heaters on EPA's qualified product list under 20 different brand names. Eight of these models are available from three leading retail stores in PGE&E's service territory. GE's GeoSpring product is available at two retailers.

ENERGY STAR Heat Pump Water Heaters in PG&E Service Territory - Sears Retail							
Brand	Capacity	Warranty	EF	Fuel	Item #	Model #	Price
Kenmore Elite*	60	10	2.4	Electric	4232116000	32116	$1,599.99
Kenmore Elite*	80	10	2.3	Electric	4232118000	32118	$1,999.99
GE GeoSpring	50	10	2.4	Electric	4232200000	GEH50DEEDS	$1,199.99

Source: www.sears.com, San Jose, 10/01/12 Qualified *On-line only

TABLE 13 SEARS PG&E HEAT PUMP WATER HEATERS

ENERGY STAR Heat Pump Water Heaters in PG&E Service Territory - Lowe's Retail							
Brand	Capacity	Warranty	EF	Fuel	Item #	Model #	Price
Whirlpool	80	10	2.3	Electric	89263	HPE2K80HD045V	$1,959.80
GE GeoSpring*	50	10	2.4	Electric	386797	GEH50DEEDSR	$999.00
Whirlpool	60	10	2.4	Electric	89263	HPE2K60HD045V	$1,488.09

Source: www.lowes.com, Central San Jose, 10/01/12 Qualified *Temporary price reduction ($200)

TABLE 14 LOWE'S HEAT PUMP WATER HEATERS

ENERGY STAR Heat Pump Water Heaters in PG&E Service Territory - Home Depot Retail							
Brand	Capacity	Warranty	EF	Fuel	Item #	Model #	Price
Rheem EcoSense	50	12	2	Electric	542117	HP50ES	$1,598.00
Rheem EcoSense	40	12	2	Electric	607988	HP40ES	$1,498.00
Source: www.homedepot.com, San Jose #1861, 10/01/12				Qualified			

TABLE 15 THE HOME DEPOT PG&E HEAT PUMP WATER HEATERS

BENCHMARK PROGRAMS

Experiences in energy efficient water heater programs provide best practices and lessons learned for a new program design. American Council for an Energy-Efficient Economy (ACEEE) and ENERGY STAR are venues for sharing information and compile useful statistics about programs across the nation (see Figure 4).

More than two dozen utilities in the U.S. have instituted water heater rebate programs to help overcome price barriers and deliver energy savings. While many programs have the low participation rates that PG&E has experienced, there are a few benchmark programs that show promise to accelerate the market penetration of ENERGY STAR products. Recent success in heat pump water promotions, which have been a collaboration of utilities, retailers, and manufacturers, are demonstrating the importance of engaging all stakeholders. Similarly the success of state appliance rebate programs under the federal American Recovery and Reinvestment Act have demonstrated how a significant, time limited rebate can change consumer purchase behavior and deliver value to channel partners. It is believed that natural gas water heaters, which make up 90 percent of the PG&E market, and heat pump water heaters could also be advanced with a customer-focused program.

Heat Pump Water Heater Programs

Technology advances in heat pumps have overcome product performance barriers and targeted utility programs are attempting to overcome market barriers to this high efficiency electric water heater option. While the efficiency gains with heat pump water heaters allow relatively short payback of the price premium, the incremental costs are still a barrier. Many of the successful promotional programs focus on significantly reducing the incremental cost. Sears has been working with utilities and manufacturers to co-market heat pump water heaters.[28] Co-marketing leverages the brand and financial resources of the retailer, utility and manufacturer. An Eastern utility partnered with Sears for a limited time promotion of a General Electric Heat Pump water heater. The combined utility, retailer, and manufacturer rebates reduced the product's price by $900. Marketing communication included all three brands and used utility and retailer communication channels. This effort increased sales by fivefold for the promotional period.

High Efficiency Natural Gas Water Heater Programs

Southern California Gas Company (SoCal Gas) is the largest natural gas utility in the United States and has been involved in water heater programs for decades. Their experience in

[28] Maureen Alto, "Heat Pump Water Heater – Co-Branded Marketing," ENERGY STAR Partners Meeting, October 2012.

high efficiency water heater provides insights for a success program.[29] They acknowledge the significant market barriers to ultra-low NOx, high-efficiency water heaters:

Customer

- Resistance to early retirement of inefficient models

Marketplace Acceptance

- Higher incremental cost
- Cost: Energy Star storage WH = Tankless Water Heater
- Product availability (Ultra-low NOx, Southern California)

Retailer

- Hard to find retailer contact
- Limited model availability at retailers – special order
- Retailer controls rebate
- Retailer profit vs. Utility rebate
- Retailer marketing vs. Utility marketing
- Utility reporting compromised due to proprietary customer information

Utility Programs

Annually, ACEEE hosts a Hot Water Forum, which brings together manufacturers; water, gas, and electric utilities; government and other program and other policy specialists; and other industry representatives to learn from each other and explore the potential of increasing efficiency of hot water equipment. The program generally includes reports from utilities about their work in promoting efficient technologies. Best utility practices have been summarized, underscoring efforts to overcome first cost barriers, Table 16.

Best Practice	*Georgia Power*	*Great River Energy*	*Hawaiian Electric*	*Missouri Gas Energy*	*Portland General Electric*
Reduce first cost barrier	X	X	X	X	X
Nurture local contractors	X		X		X
Promote early replacement	X	X		X	X
Promote non-energy benefits	X	X	X		X
Make it easy for customer & contractors	X			X	X

[29] Southern California Gas Company Building Effective Relationships with Retailers, Harvey Bringas, Southern California Gas Company

Best Practice	*Georgia Power*	*Great River Energy*	*Hawaiian Electric*	*Missouri Gas Energy*	*Portland General Electric*
Measure results carefully		X	X	X	

TABLE 16 ACEEE BEST UTILITY PRACTICES[30]

Many utilities have been partnering with Marathon Water Heater Company, who uses utilities as a sales channel. Marathon has coordinated efforts with utilities to promote the most efficient water heater products and has developed programs to educate customers about the importance of selecting an energy efficient water heater before they actually need to replace it. In one four-month program in 2008, there were concerted activities to reach customers and engage the installation channel. The promotion included a variety of promotional activities including a sweepstakes give-away of two Marathon water heaters with free installation by Roto-Rooter, bill stuffers, printed flyers, and an article in the utility newsletter. The focused campaign allowed the utility to exceed its goal by 200 percent.[31]

International experience on water heater programs also provides evidence for a market focused water heater program. Research of water heater incentive programs in Australia has found that Australian program designs appear to succeed primarily with households that make planned decisions to replace a water heater rather than with households that purchased a water heater on an emergency/urgent basis. Similar to the recommendations of program implementers in the U.S., results of this research suggest that program designs that educate or provide incentives to plumbers, who play a large role in the emergency situations, may be an important channel to help improve the effectiveness of future rebate offerings.[32]

Recent national activity with ARRA appliance rebates provides insights about performance of water heater programs on a larger scale than an individual utility program

ARRA U.S. water heater results show the difficulty in advancing high efficiency water heaters. Nationally, water heater rebates fell short of their goal and achieved only 2 percent of all appliance rebates issued, Figure 15.[33] In California, the results were worse with only 0.2 percent of appliance rebates reaching water heater buyers, Figure 16.[34] In the U.S. and California, the majority of incentive dollars went to clothes washer, refrigerator, and dishwasher rebates.

[30] Johnson, Hendershot, Naleway, Pope, Willoughby, and Webster, "Staying Out of Hot Water: Best Practices in Implementing Electric and Gas Water Heating Programs," 2011 Hot Water Forum, ACEEE, Berkeley, CA, May 11, 2011.

[31] Residential Electric Water Heater Program: Case Study, Market Development Group, http://www.johnsonconsults.com/case_PGERheem.pdf

[32] The Influence of Rebate Programs on the Demand for Water Heaters: The Case of New South Wales, Nada Wasi and Richard T. Carson, October 2011, UC Center for Energy and Environmental Economics Working Paper Series.

[33] State Energy Efficient Appliance Rebate Program, Results through December 31, 2011.

[34] CALIFORNIA CASH FOR APPLIANCES REBATE PROGRAM, Interim Results through March 2012.

The big difference in the volume of rebates to appliances in comparison to water heaters is related to the availability of ENERGY STAR products. In a store survey of ENERGY STAR products, close to 90 percent of clothes washer and dishwasher models, and almost 80 percent of refrigerators are ENERGY STAR compliant. In California, only 5 percent of natural gas storage water heaters have the ENERGY STAR label.

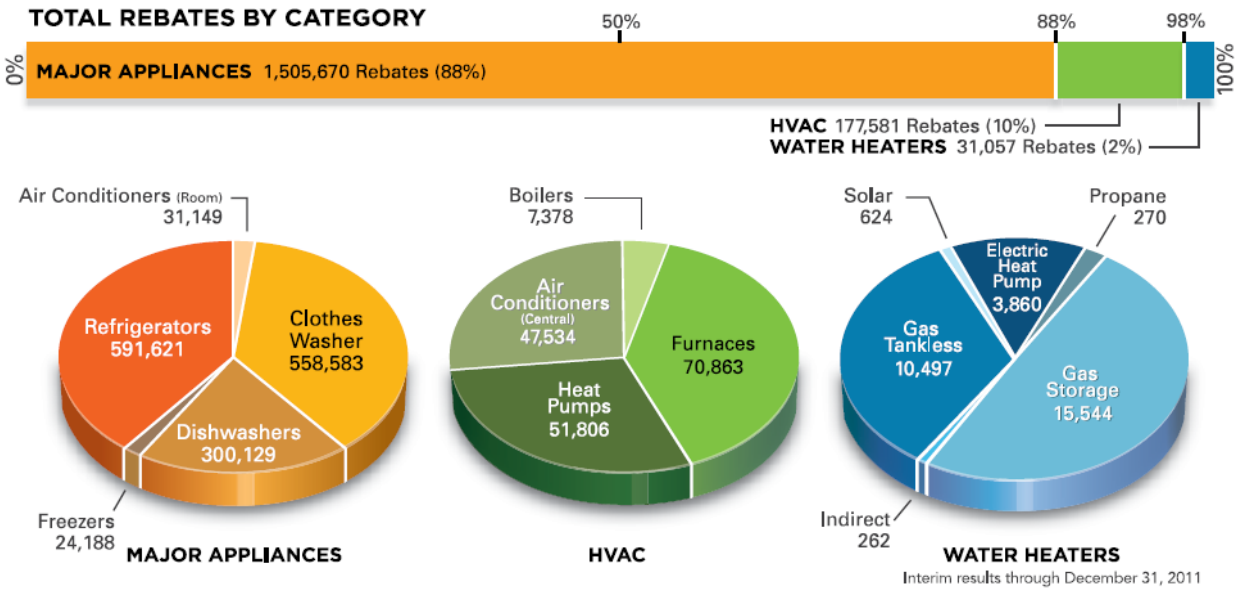


FIGURE 15 ARRA APPLIANCE REBATE PROGRAM - NATIONAL INTERIM RESULTS

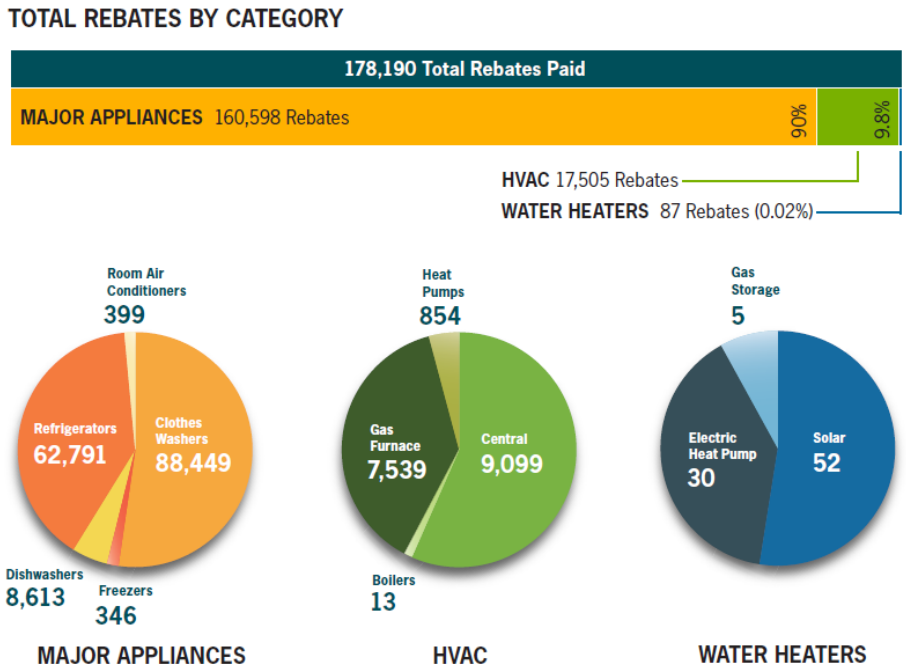


FIGURE 16 ARRA APPLIANCE REBATE PROGRAM - CALIFORNIA INTERIM RESULTS

National and local points of reference for water heater programs show the importance of collaborating with channel partners to:

- bring the highest price reduction possible to the customer;
- have of high percentage of ENERGY STAR qualified water heaters in stock;
- inform customers about limited time opportunities to participate in a program.

BARRIERS TO ENERGY STAR WATER HEATER SALES

Fundamentally, the barriers to increasing sales of ENERGY STAR water heaters in PG&E's service territory are supply and demand. Retailers and manufacturers currently do not perceive that there is sufficient consumer demand for qualifying water heaters. Consequently they have exerted minimal efforts to stock these models. At the same time, consumers do not perceive the sum total of benefits from an efficient water heater justify its price and the transaction costs.

In a rational economic market, an appropriate water heater price should drive desired levels of supply and demand, but today's high prices only satisfy the needs of a small segment of consumers and limit the availability of qualified products. Utility intervention with financial incentives is one requirement for expanding the market for ENERGY STAR water heaters.

Four factors are embedded in this supply and demand conundrum that accentuates market barriers: High Percentage of Purchase Decisions is Emergency Decisions, Channel Indifference to High Efficiency Products, "Out-of-Sight-Out-of-Mind" Purchases, and Regulatory Requirements.

High Percentage of Purchase Decisions is Emergency Decisions

Almost two-thirds of water heater purchases are undertaken because of some kind of emergency, Figure 12. Decision making for water heater purchases does not follow the ideal economic model because homeowners view hot water as an essential commodity and often make sub-optimal decisions in an emergency when a water heater has failed. From the consumer's perspective, the least risky decision in an emergency situation is to replace a failed water heater with a nearly identical one. Fortunately, most water heater failures are not catastrophic and purchase decisions need not be instantaneous. Intervention at the point of purchase is necessary to explain the near term and long term benefits associated with an energy efficient product purchase. The sales person has to be equipped with adequate messaging to simplify the discussion of higher efficiency alternatives and eliminate confusion about water heaters.

Channel Indifference to High Efficiency Products

Sales will always come down to price and "what is on-the-truck or in-stock". A retailer's or distributor's product assortment and stocking decisions are based on what has been selling and what the anticipated consumer buying behavior will be in the near future. Stocking is not done on hope and speculation because there is a cost associated with carrying inventory and displaying products. Water heaters are expensive to display and inventory because of their sheer bulk. Once a water heater is out of the box and on-display, it then becomes a used product, cannot be sold as new, and causes a financial loss. Retailers and distributors seek profits and market share and are indifferent to a specific product feature if it does not contribute to these business objectives. Thus, utility interventions to increase demand for high efficiency products or to stock a greater number of efficient models are needed to cease the perpetuation of trucks and stores stocked with inefficient, non-complying products.

"Out-of-Sight-Out-of-Mind" Purchases

Most homeowners make one or two water heater purchases in their lifetime. After the purchase is made, the water heater goes into the basement, garage, or closet and is almost never seen again. Water heaters are low-touch or "Out-of-Sight-Out-of-Mind" purchases and high efficiency models carry a premium price. Premium pricing also tags many high-touch, high-efficiency appliances – white goods and space conditioning equipment, which, unlike water heaters, have premium features (e.g., comfort, aesthetics, image, and enhanced functionality) that can be leveraged by retailers or distributors to up-sell high-efficiency products. Because a typical storage-type water heater is hard to differentiate, it becomes commoditized and the most important feature is price. This commoditization creates significant marketing challenges for high efficiency water heating products. There are precedents for addressing these marketing challenges, however; consider, for example, the success Owens-Corning's pink insulation. Utility knowledge of local markets and reputation as a trusted energy advisor are important contributions to marketing campaigns that can convert water heaters into a high-touch product.

Regulation Driven Costs

Manufacturers report that there are water heater designs that simultaneously meet ultra-low NOx and ENERGY STAR specifications in a PG&E program. As with all high efficiency water heaters, these products will have a price premium compared with standard efficiency, ultra-low NOx water heaters. Furthermore, to meet California ultra-low NOx emission requirements and Energy Star specifications, a qualifying water heater would need to be power vented or require electrical supply to operate a flue damper or a power burner. In a typical California single-family home, water heaters are installed in the garage. Electrical receptacles are always present in a garage, but they are not necessarily near the water heater. Simple design adjustments are possible to allow an electrical receptacle to be located near the water heater. If vent and electric hookup installation are required, additional costs can be as high as $400 to $500. Utility interventions to offset high installed costs or to train installers on the safest, lowest cost installation methods would go a long way in overcoming barriers connected to regulatory requirements.

Overcoming Market Barriers

Most of the benchmark water heater programs cite product price and availability as major barriers to increasing sales of efficient water heaters. In a market focused program, price and availability are actually key success factors to overcoming market barriers. Critical to achieving an appropriate price and sufficient product supply is strategic collaboration with retailers and manufacturers to identify price reducing options, including: attractive pricing of qualified products; rebate amount; retailer or manufacturer price promotions. Retailers have recommended water heater incentive levels that would be consistent with their business objectives including a gas water heater incentive that is at least 20 percent of the product price and a heat pump incentive that exceeds $350.

Working closely with retailers is also necessary to stock qualifying products. Timely communication of program specifications enables channel partners to make assortment choices that meet qualified product specifications and to build some competitive advantage by creating special ENERGY STAR assortments for PG&E.

RESULTS AND ANALYSIS

ENERGY SAVINGS POTENTIAL

There is still a significant opportunity to save energy with efficient water heaters as aging water heaters must be replaced. While almost 30 percent of all models meet the ENERGY STAR specification, market penetration for these highly efficient models is less than 6 percent nationwide[35] and less than 1 percent in California.

The CPUC periodically commissions an energy efficiency potential study to assist IOUs in setting program goals. A study published in 2012 provides an estimate of the maximum achievable market potential for water heaters. The "maximum achievable" or incremental market potential is defined as the "amount of additional new energy savings forecasted to be delivered by IOU programs each year based on past program and market evaluations and the most recent planning assumptions and forecasts."[36]

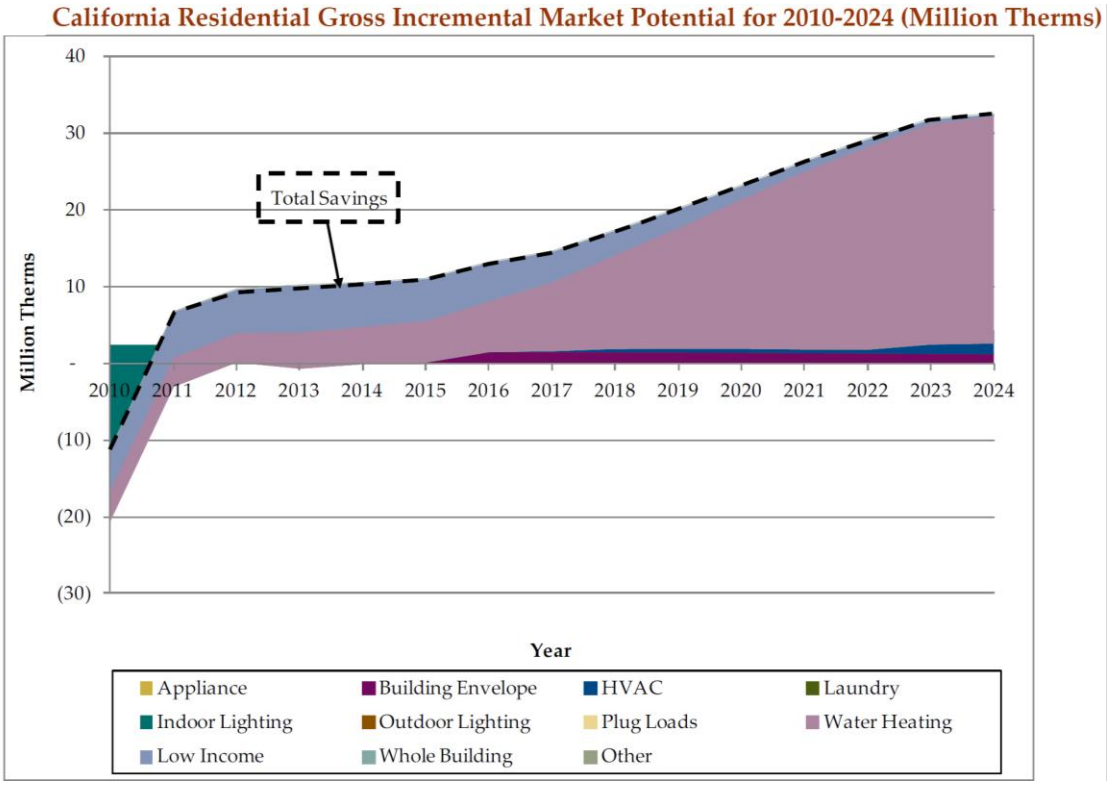


FIGURE 17 ESTIMATED MARKET POTENTIAL FOR WATER HEATER ENERGY SAVINGS

[35] ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2011 Summary, p. 7.

[36] Navigant Consulting, "Analysis to Update Energy Efficiency Potential, Goals, and Targets for 2013 and Beyond, Track 1 Statewide Investor Owned Utility Energy Efficiency Potential Study," prepared for California Public Utilities Commission, May 8, 2012, p. 4.

PG&E's savings from all residential water heater measures are projected to grow from approximately 2 million therms in 2013 to more than 15 million therms in 2024, (PG&E accounts for roughly 47 percent of the therms in Figure 17). This level of savings represents less than 0.5 percent of the technical potential for water heater savings in 2013 and more than 3.5 percent of the technical potential in 2024. Growth in water heater energy savings is primarily due to expected decline in prices for the most efficient water heaters beginning in 2016.[37]

Slow ENERGY STAR water heater adoption rates are evidenced by the difference between technically feasible and realistically achievable savings estimates in the potential study. These differences depend on cost effectiveness of technology options as well as on consumers' specific preferences for product attributes other than energy efficiency.

Benefit to Cost Evaluations

The economic feasibility of high efficiency technology is measured by the Total Resource Cost (TRC) test. TRC calculations present the net benefits accrued by ratepayers when an efficient water heater is purchased and implemented by a customer. The benefits are the value of avoided or deferred energy supplies. TRC costs include incentive costs and the customer's incremental cost of a water heater installation as well as the costs expended by the program administrator for program related activities.

TRC tools are useful in the evaluation of various program scenarios. The objective of a scenario analysis is to identify program options or a portfolio of program options that meet benefit to cost goals, typically a TRC value greater than 1. The results of the evaluation show that there are conditions under which each of the program options makes economic sense.

	Natural Gas Measures	Electric Measures
Future Program: ENERGY STAR Products	Storage water heaters with EF≥0.67 • Incentive Rate <$200 per unit • Minimum number of annual incented units – 1,500	Heat pump water heaters with EF≥2.0 • Incentive Rate <$500 per unit • Minimum number of annual incented units – 250
Legacy Program: High Efficiency Products (Non ENERGY STAR)	Storage water heaters with 1) EF≥.62 &<.65 Not feasible 2) EF≥.65 &<.67 • Incentive Rate = $50 per unit • Minimum number of annual incented units – 300	Resistance water heaters with EF≥.93 • Incentive Rate = $30 per unit • Minimum number of annual incented units – 300

TABLE 17 CONDITIONS FOR ECONOMICALLY FEASIBLE WATER HEATER MEASURES

[37] Energy Efficiency Potential Study, pp. 86-87.

PG&E has designed a Cost Effectiveness Calculator (based on the E3 Calculator for the 2010 – 2012 program) to estimate the benefit/cost ratio for a program using inputted costs, energy savings, and estimates market adoption. Inputs to this model for the current analysis are in Table 18.

		Electric		Natural Gas	
		Legacy	Test	Legacy	Test
Costs					
Incentive (per unit)					
	Incentive Payment to Participant (per unit)	$ 30	Varies	$ 30/50	Varies
	Direct Labor and Material Cost (per unit)	$ 7	$ 7	$ 7	$ 7
	Total Incentive (per unit)	$ 37	Varies	$ 37	Varies
Adminstrator Costs					
	Product Development Cost	$ 30,000	$ 40,000	$ 30,000	$ 40,000
	Annual Costs	$ 20,000	$ 61,000	$ 20,000	$ 61,000
	# of Years	3	3	3	3
	Incentive not offsetting IMC/"Distributor Cost"	$ -	$ -	$ -	$ -
	Total Administrator Cost	$ 90,000	$ 223,000	$ 90,000	$ 223,000
Savings					
kWh Saving/Unit (annual)		325	1,725		
kW Saving/Unit (annual)		0.03	0.42		
Therm Saving/Unit (annual)				17	56
Market Adoption					
Units per Year					
2011		Varies	500	Varies	1,500
2012		Varies	500	Varies	1,500
2013		Varies	500	Varies	1,500
	Total 3-Year Market Adoption	Varies	1,500	Varies	4,500

Processing:	$4.83 per unit
Inspection:	2% of Installation at $105.47/inspection
Product Development:	$100,000 for four measures
Program Management:	$20,000/measure/year. If this is not allocate, then TRC increases by an average of 5% over incentive
Marketing (only Test program):	$15K per Test program
Detailing (only Test program):	$40/Store, 6 times per year, 217 stores, 2
Net to Gross:	".62-.65" legacy gas = .23, ".65-.67" legacy gas and ".93" legacy electric = .55, ENERGY STAR measures = .7

TABLE 18 TRC ANALYSIS INPUTS

The charts below are outputs from the Calculator and provide insights on how variations in incentive rates and annual unit incentivized impacts benefit to cost ratio. Overall insights from the analysis are:

- In all cases, TRC is most sensitive to changes in Net-to-Gross. Net-to-Gross is fixed for each measure in this analysis using information from approved work papers, but this number can change during a program evaluation.
- Higher incentive per unit decreases TRC because savings per unit is static.
- Increasing the number of units incentivized raises the TRC because fixed development, management, and marketing costs are spread across more units. If additional marketing expenses or higher incentive rates are necessary to increase sales, then there will be a corresponding decline in benefit-to-cost.
- ENERGY STAR measures have acceptable TRCs for targeted annual sales and consistent with channel partner advice.

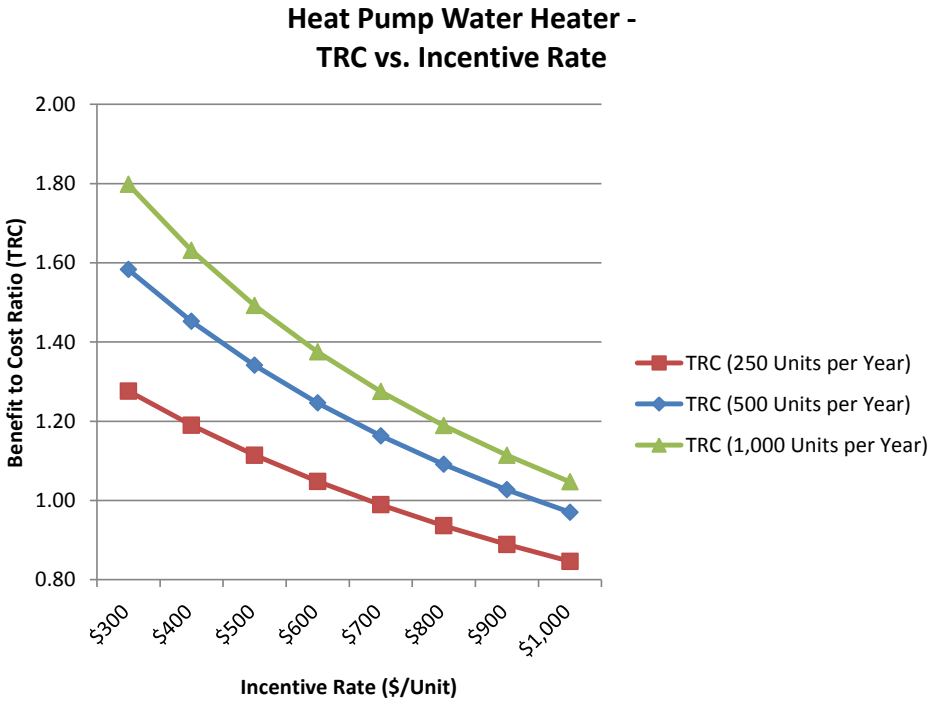


FIGURE 18 TRC ANALYSIS HEAT PUMP WATER HEATERS

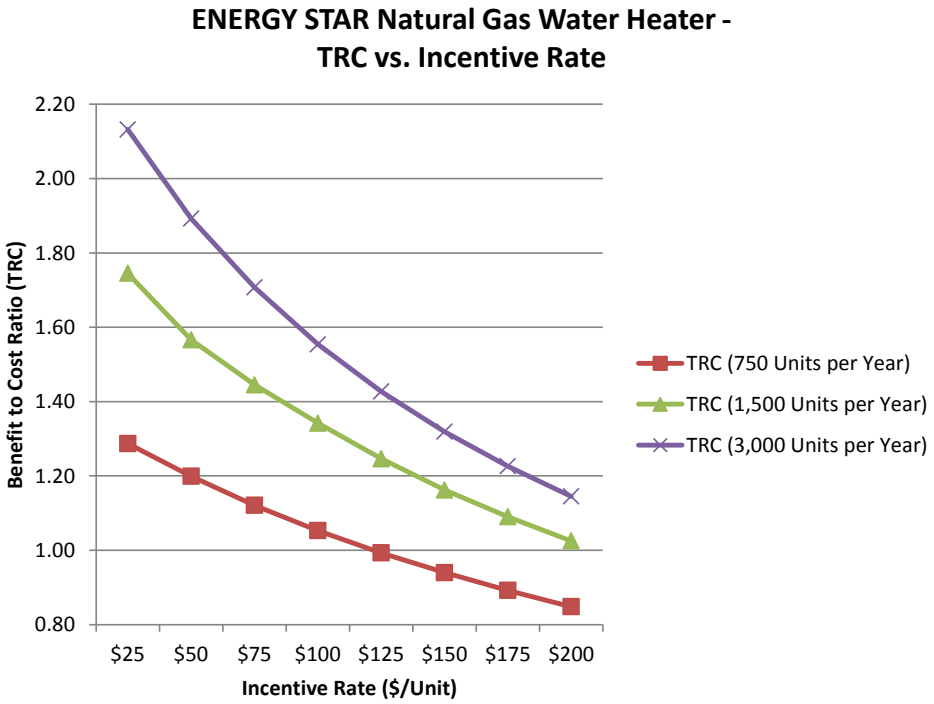


FIGURE 19 TRC ANALYSIS ENERGY STAR WATER HEATERS - NATURAL GAS, STORAGE-TYPE

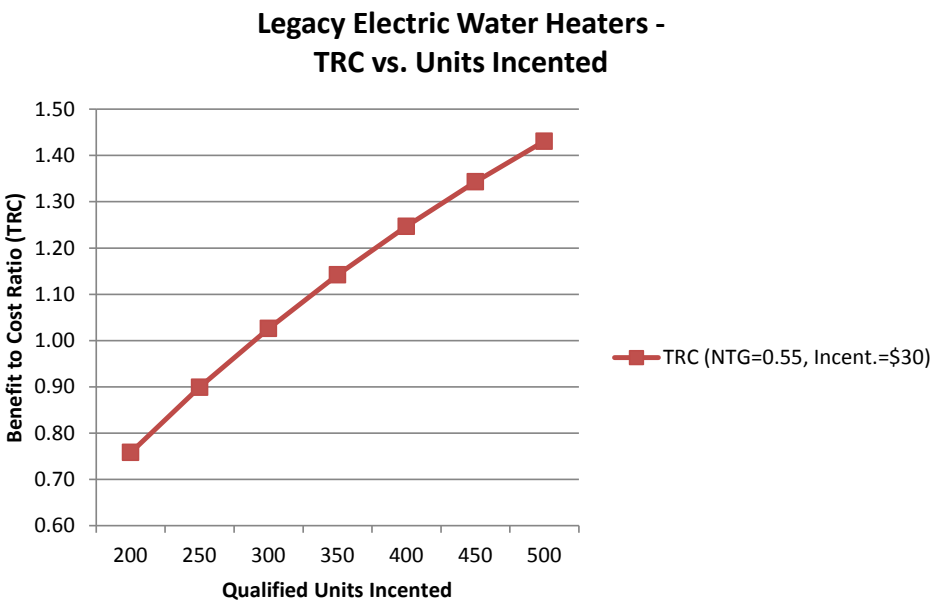


FIGURE 20 TRC ANALYSIS HIGH EFFICIENCY WATER HEATERS - ELECTRIC, STORAGE-TYPE

Low unit energy savings for legacy gas water heater measures make the benefit-to-costs unacceptable or marginal for these programs. The exception is when there are high annual sales for the most efficient measure.

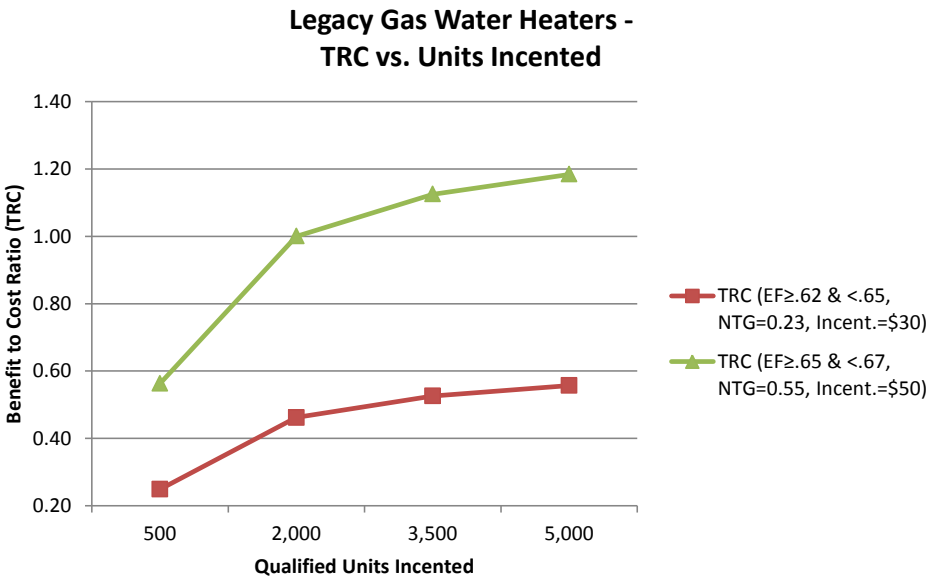


FIGURE 21 TRC ANALYSIS HIGH EFFICIENCY WATER HEATERS - NATURAL GAS, STORAGE-TYPE

TRC Scenario Analysis Conclusions

PG&E's TRC Calculator provides an economic assessment and prioritization of program possibilities. The outputs point to initiating ENERGY STAR measures and to continuing the legacy electric storage water heater program as well as the high efficiency legacy gas measure. Introduction of market factors and other externalities into the analysis modifies this overall conclusion and suggests discontinuing all Legacy Programs after 2012

In the legacy electric program analysis, total annual incented sales are small and have a minimal contribution to overall portfolio saving goals. Marketing investments to significantly increase sales would cause benefit to cost ratio to become unacceptable. Furthermore, this measure is subject to evaluation risk because a large fraction of available water heater models are at or near an EF of 0.93 (see Figure 6) and they have low incremental measure costs. These factors expose the legacy electric water heater measure to free ridership and potential net-to-gross reductions.

In the legacy natural gas program evaluation, the high EF option shows promise for annual unit sales exceeding 2,000. Unfortunately, retailers do not carry any models that meet these qualifying criteria; see Table 10 through Table 12.

Acceptable benefit to costs and accessible models in the retail channel suggest a program design exclusively built around ENERGY STAR labeled products.

Recommendations

Program Design

PG&E's water heater program is a mid-stream program design where PG&E's program management team interfaces with retailers and distributors to design and implement the program. These mid-stream interactions allow for coordination of resources and expertise to address the needs of mutual residential customers.

Benchmark water heater programs results emphasize that residential customers need price discounts and adequate information in order to make the right decision to purchase a high efficiency water heater. The PG&E incentive can be applied as a rebate to the customer in order to lower the effective price. A portion of the incentive can be delivered to the channel partner to encourage stocking of the most efficient products.

The program will be rolled out in phases to most effectively meet the market needs and satisfy PG&E's energy saving goals. The initial phase will be a test of market-focused program design elements and will focus on ENERGY STAR storage water heaters sold through retail channels. The test program is intended to prove the concepts for overcoming market barriers. After successful proof-of-concept, the program will be extended to other channel partners, to all customer segments, and to include other components of a water heating system.

Table 19 summarizes PG&E's market-focused water heater program design.

Program Measures	*Initial Market Target*	*Channel*	*Promotion*
ENERGY STAR Gas Storage Water Heaters. Ultra Low NOx burners.	High gas usage Suburban home owners	Retail Channel initially in Test Program Distributor Channel follows	$200 incentive Active channel participation Targeted marketing
ENERGY STAR Heat Pump Water Heaters	High electricity usage Suburban home owners	Retail Channel initially in Test Program Distributor Channel follows	$500 incentive Active channel participation Targeted marketing

TABLE 19 MARKET-FOCUSED WATER HEATER PROGRAM DESIGN SUMMARY

Program Design Elements

PG&E's water heater program implementation experience, benchmark water heater program at the state and national levels, and CPUC policies provide precedents and guidance on the design of market-focused programs. Program design elements address collaboration, targeted marketing, and performance management.

Collaboration

A market-focused program design has to provide benefits to all participants in the water heater value chain. Financial, organizational, and implementation elements of the design have to be sensitive to the needs of manufacturers, distributors, retailers, PG&E, and the ultimate customers. Channel and partner management activities involve these stakeholders in the program design process. It is expected that channel partners will contribute resources that will drive sales of qualified products, such as product discounts, store associate training, and coordinated advertising.

Collaboration encompasses other stakeholders such as ENERGY STAR and other utilities. The proposed program design is to be adaptable by other utilities, which increases the market potential for advanced products and encourages manufacturers to produce more qualifying water heaters than are available today. Collaboration also enables sharing of certain program costs.

Targeted Marketing

The overall market strategy is to segment the market along geographic and sociographic boundaries and then target these segment with marketing promotions aligned with the segments' needs. PG&E's data and regional demographic information indicates geographic areas for future water heater promotions. For the test program, the following PG&E areas are appropriate targets:

Water Heater Type	PG&E Service Areas	Segmentation Drivers
Gas Storage	2, 3 & 6	• More than 50% of gas water heater stock in these areas • About 65% of historical gas rebates to customers in these areas • More than 50% of retailers' PG&E stores in these areas.
Electric Storage	5, 6, & 7	• Almost 50% of electric water heat stock in these areas • About 60% of historical PG&E electric rebates to customers in these areas • Almost 50% of retailers' PG&E stores in these areas

TABLE 20 TARGETED SEGMENTS FOR TEST PROGRAM PROMOTIONS

The majority of water heater purchases are made on an emergency basis. Marketing efforts, therefore, have to communicate the message of energy efficiency quickly and at the point of purchase. The peculiarities of the water heater purchase decision process have significant implications on the design of the marketing components of a program. The two major decision motivators – emergency or planned purchase – call for two separate but interrelated marketing strategies to promote energy efficient water heaters. Emergency decisions demand on a channel marketing strategy and planned decisions require a more consumer-focused approach. Marketing objectives to address common segment needs are:

- Co-branding with retailers
- Leveraging ENERGY STAR resources
- Messaging for a planned purchase
    - Age of water heater
    - Safety
- Accessible web research and promotion
    - Education and referral
    - Geo-targeted promotions

Performance Management

Critical to PG&E's program management and for a channel partner's business management are data for qualified product sales. Total water heater category sales data allow for measurement of qualified product market share and understanding of the impact of the program on overall retailer sales. Total sales are also used for incentive payments, performance management, and program evaluation. Total water heater sales reporting and store stocking surveys during the test program will allow program refinements and performance feedback to channel partners.

Test program objectives and specifications

The primary objective of test program is to measure the effectiveness of a market driven design for different channels and technology types. A key success factor in the test program is the engagement of three leading water heater retailers. Sears, Lowe's and Home Depot sell almost 70 percent of water heaters delivered through the retail channel. Their active partipation will be a validation of the concept.

Preliminary discussions with these retailers has established pieces of the test program plan:

- Time limited promotional periods are more effective than ongoing promotions
- Point of sale systems are not available from all retailers, allowing the impact assessment of the impact of instant rebates
- Retailers have historical sales data that may be accessible for targeted communications
- Retailers welcome opportunity to participate in test program design as it allows for timely product and assortment planning.
- Three retailers have product assortments and organizational structures that allow the assessment of program performance by technology type and channel.

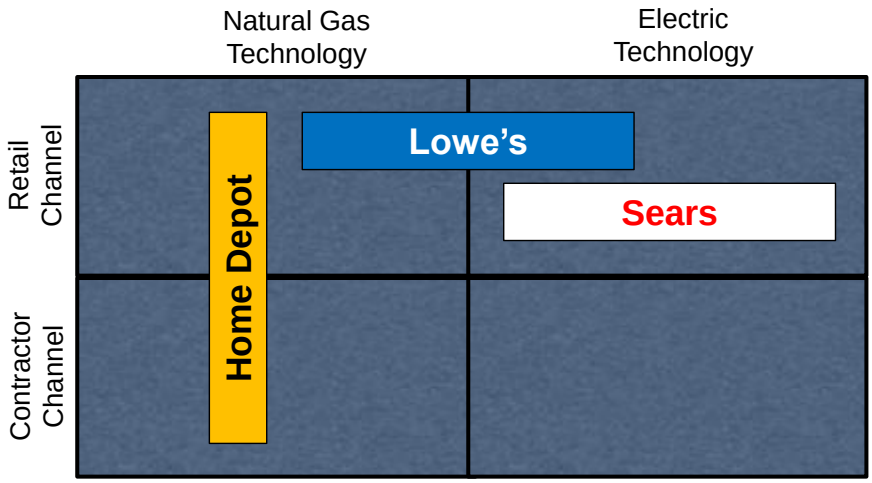


FIGURE 22 TEST PROGRAM PARTICIPATION MAP

NEXT STEPS

The near term program activities are centered on designing and executing a market-focused water heater test program. Following successful proof-of-concept, the design will be adapted to a more extensive program to be rolled out to all PG&E residential customers.

1) Finalize test program design and schedule
    a. Establish test goals and key performance measures
    b. Determine incentive rates and allocations
    c. Incentive delivery: downstream rebates, mid-stream stocking incentives, or combination

   d. Coordinate program schedule with retailer buying and promotion cycles

2) Engage retail channel partners
   a. Communicate goals and timing
   b. Execute participation agreements
   c. Coordinate with ENERGY STAR

3) Develop marketing and launch plan
   a. Create messaging for targeted markets and communication channels
   b. Design and product Point of Purchase materials, media, training materials, etc.
   c. Establish processes and procedures for program management, data collection, and payment
   d. Initiate test program

4) Data Collection and performance measurement
   a. Calculate market penetration for qualified product
   b. Measure performance against baseline
   c. Assess proof-of-concept

5) Prepare options for distributor channel program
   a. Evaluate incentives
   b. Prepare training materials

6) Evaluate program full program roll out and extension strategies
   a. Water heater systems
   b. Water heater financing

APPENDIX

ENERGY STAR Residential Water Heaters — Eligible Product Types	
High-Efficiency Gas Storage	A nominal input of 75,000 BTU/hour or less and a rated storage volume from 20 to 100 gallons.
Gas Condensing	
Heat Pump Water Heaters	A maximum current rating of 24 amperes, voltage no greater than 250 volts, and a transfer of thermal energy from one temperature to a higher temperature level for the purpose of heating water. Unit must have "integrated" or "drop-in" configuration.
Whole-Home Gas Tankless	A nominal input of over 50,000 BTU/hour up to 200,000 BTU/hour and a rated storage volume of 2 gallons or less.
Solar Water Heaters	OG-300 rating from the SRCC. Auxiliary tank must be residential-class.

ENERGY STAR Criteria

A water heater model must meet all of the identified criteria to be labeled as ENERGY STAR.

High-Efficiency Gas Storage				
ENERGY STAR Criteria	**Energy Factor**	**First-Hour Rating**	**Warranty**	**Safety**
Gas Storage (Ending 8/31/2010)	EF >= 0.62	FHR >= 67 gallons per hour	Warranty >= 6 years on sealed system	ANSI Z21.10.1/CSA 4.1
Gas Storage (Beginning 9/1/2010)	EF >= 0.67	FHR >= 67 gallons per hour	Warranty >= 6 years on sealed system	ANSI Z21.10.1/CSA 4.1

Gas Condensing				
ENERGY STAR Criteria	**Energy Factor**	**First-Hour Rating**	**Warranty**	**Safety**
Gas Condensing	EF >= 0.8	FHR >= 67 gallons per hour	Warranty >= 8 years on sealed system	ANSI Z21.10.1/CSA 4.1

Heat Pump Water Heaters				
ENERGY STAR Criteria	**Energy Factor**	**First-Hour Rating**	**Warranty**	**Safety**
Heat Pump Water Heaters	EF >= 2.0	FHR >= 50 gallons per hour	Warranty >= 6 years on sealed system	UL 174 & UL 1995

Whole-Home Gas Tankless				
ENERGY STAR Criteria	**Energy Factor**	**Gallons-Per-Minute**	**Warranty**	**Safety**
Whole-Home Gas Tankless	EF >= 0.82	GPM >= 2.5 over a 77°F rise	Warranty >= 10 years on heat exchanger and 5 years on parts	ANSI Z21.10.3/CSA 4.3

Solar Water Heaters			
ENERGY STAR Criteria	**Solar Fraction**	**Warranty**	**Safety**
Solar Water Heaters	SF >= 0.5	Warranty >= 10 years on solar collector, 6 years on storage tank, 2 years on controls and 1 year for piping and parts	OG-300 Certification from the SRCC

TABLE 21 ENERGY STAR WATER HEATER SPECIFICATION SUMMARY