



May 29, 2007

Mr. Richard H. Karney, P.E.,
Manager, Energy Star Program
U. S. Department of Energy
1000 Independence Avenue SW
Washington DC 20585

Dear Richard:

Thank you for the opportunity to comment on the May 2, 2007 document, *ENERGY STAR® Residential Water Heaters: Draft Criteria Analysis*. This letter comprises the response of the American Council for an Energy-Efficient Economy (ACEEE). For reference, we have attached ACEEE's comments on the April 4, 2003 document, *Energy Star® Labeling Potential for Water Heaters*.

Background.

The American Council for an Energy-Efficient Economy is a nonprofit organization dedicated to advancing energy efficiency as a means of promoting both economic prosperity and environmental protection. ACEEE fulfills its mission by conducting in-depth technical and policy assessments; advising policymakers and program managers; working collaboratively with businesses, public interest groups, and other organizations; publishing books, conference proceedings, and reports; organizing conferences and workshops; and educating consumers and businesses.

ACEEE was involved in the NAECA and EPAct legislation establishing federal efficiency standards, and has been active in all rulemakings since then. We have also been very active in the Energy Star program, both in the technical aspects of setting performance criteria and in the field support of Energy Star program implementation. In these processes we have developed a strong sense of the technical, economic, market, and institutional issues involved in the Energy Star arena. We bring that broad experience to these comments.

ACEEE staff serve on ASHRAE T.C. 6.6 (water heating), has carried out market evaluations for commercial heat pump water heaters, and for other emerging technologies (including solar-assisted water heating, in our Emerging Technologies series). ACEEE also served on the SEGWHAI team, both as staff and as a member of the Advisory Committee, so we have some current knowledge of the industry and its challenges.

DOE's Introductory material.

Across the nation, water heating is the second largest site energy use in houses. Year round, more visitors to the ACEEE web site are seeking information on efficient water heaters¹ than any other buildings topic. ACEEE joins the Program Manager in concluding that many consumers want reliable information on the best available water heaters.

¹ <http://aceee.org/consumerguide/topwater.htm>.

With minor exceptions, this material is reasonable and unexceptional. We particularly like the overview of the market. We would quibble on a couple of points:

- The criteria bullet list will discourage those involved with emerging technologies such as solar-assisted and heat pump water heaters.
- We find no acknowledgement that the EF test procedure, which was designed for storage water heaters, gives quite different results for some other technologies. Nor does the criteria document recognize that the draw pattern of the test turns out to give biased results when efforts are made to use it for some advanced technologies.
- The 2003 precursor to this document included one goal that has been dropped from the 2007 document. It stated, “Validate and encourage early adopters and market leaders.” This is an important goal. For water heating market transformation to occur, either the emerging technologies sought by these consumers must be included, or a parallel program for “market leaders” must be implemented. As the Program Manager concludes in the 2007 document, the savings potential of conventional products on the market now does not warrant an ENERGY STAR program.

Summary of Recommendations

From our review of the May 2 *Draft Criteria Analysis*, we make the following recommendations, which are elaborated in the text that follows:

1. The savings potential of new residential water heating technologies at low market penetration rates dwarf those from modest improvements to existing storage technologies. Therefore, the focus of an Energy Star program should be transforming the market toward these new technologies.
2. Energy Star labels should embody sufficient performance improvement to make a difference to the consumer individually and the environment as a collective good. Empirically, we know of no Energy Star programs for which qualifying products save less than about 10% relative to baseline units. Therefore, we recommend that Energy Star water heaters should aim to improve performance by about 10% as a minimum. This specifically *excludes* conventional gas storage water heaters (e.g. EF 0.62) or resistance storage water heaters (EF 0.95). The savings are too small, in the range of 5% - 7%, relative to baseline products today. In this, ACEEE specifically supports the Department’s conclusion *not* to include these technologies.
3. ENERGY STAR programs with small savings not only save little energy, but they threaten to undermine the value of the Energy Star brand.
4. Since publication of the Department’s 2003 *Labeling Potential...* study, new technology paths for storage water heaters, both as concepts develop by the SEGWHAI team, and as products introduced into the market. Thus, ACEEE no longer recommends a program built around a 0.65 EF for storage water heaters.
5. Because the rating method anomalously increases Energy Factor (EF) ratings for tankless water heaters in ways that were not anticipated (relative to field performance), we recommend that the EF requirement for tankless water heaters be raised above 80%. Perhaps the number of models is now adequate to use a variant of the older ENERGY STAR criterion and 82% recovery efficiency for instantaneous units.
6. To accommodate the shifts in water heater technology and markets that could flow from a good Energy Star program, ACEEE recommends early publication of specifications.

7. In the time before launch, DOE should continue and expand a variety of approaches to promote deployment of advanced technologies. In particular, what combination of warranty and other requirements is likely to assure that consumer expectations for performance and reliability are likely enough to be met? Such requirements must be as consistent across technologies as possible, to avoid perceptions of bias.

ACEEE Opposes Energy Star for Resistive Water Heaters

Thorne and Egan (2002)² studied customer perceptions of the EnergyGuide label, in a study designed to propose improvements to the label design that would facilitate consumer understanding. As one part of the study, they carried out a “simulated shopping experience” involving over two hundred “customers.” These customers, who did not know the goal of the experiment, “shopped” for electric water heaters. Samples with realistic prices, feature lists, and different versions of the EnergyGuide label were displayed, and the consumers ranked their choices. The panel included one heat pump water heater (HPWH). For present purposes, the most important finding is that the consumers readily accepted the HPWH as just another form of water heater. Of the five models presented, it was rated second most likely to be bought (participants reported that price was a major barrier, but they understood its very attractive life cycle economics).

Since consumers “see” both kinds of electric water heaters as a single class of service-providing equipment, it is irrational to erect a separate class for resistive water heaters. This is particularly true since the best (50 gallon) resistance storage water heater on the market today has an EF of 0.95, and the 2004 minimum specification is 0.90. Consider the data of Table 1

Table 1. Estimated Annual Operating Costs of Electric Water Heaters with varying EF and electricity rates. Based on equation of p. 154 of GAMA Directory.

EF	Tariff, \$/kWh					
	\$0.06	\$0.08	\$0.10	\$0.12	\$0.14	\$0.16
2.5	\$105	\$141	\$176	\$211	\$246	\$281
0.95	\$277	\$370	\$462	\$555	\$647	\$740
0.94	\$280	\$374	\$467	\$561	\$654	\$747
0.93	\$283	\$378	\$472	\$567	\$661	\$755
0.92	\$286	\$382	\$477	\$573	\$668	\$764
0.91	\$290	\$386	\$483	\$579	\$676	\$772
0.9	\$293	\$390	\$488	\$585	\$683	\$781

For the average customer, a difference of 0.01 in EF corresponds to a saving of \$3/yr at \$0.08/kWh³. Across the entire range of 50 gallon resistive water heaters that were expected to be available in 2004, from EF 0.90 to 0.95, the energy cost difference is \$20/yr. The 5% difference between least efficient complying model (0.90) and best available resistive water heater (0.95) is

² Thorne, J. and C. Egan, 2002. *An Evaluation of the Federal Trade Commission's EnergyGuide Appliance Label: Final Report and Recommendations*. Report A021, American Council for an Energy-Efficient Economy, Washington, DC.

³ Using the formula from Gas Appliance Manufacturers Association [GAMA] APRIL 2003 Consumers Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment, p. 154. Arlington, VA. Available at <http://www.gamanet.org/consumer/certification/RWHApr03.pdf>

much less than the range in most other Energy Star programs. In comparison, the consumer would save \$140/yr by using a good HPWH (EF=2.0) relative to the *best* resistive water heater.

In addition, it would be very difficult to set an appropriate performance level for an Energy Star resistive water heater program. There are extremely small numbers of models available at EF=0.95, but about 40% of all models that will meet the 2004 minimum criterion have EF of 0.93 or better. This is too large for an Energy Star program designed to spotlight exemplary equipment. Furthermore, during the DOE water heater standards rulemaking, it became apparent that the EF of many high-efficiency resistance water heaters was exaggerated. DOE and the manufacturers have taken steps to address this problem, but DOE would need to verify that this problem is fully solved before considering these units for an Energy Star label.

ACEEE finds *no* compelling arguments in favor of an Energy Star program for instantaneous resistive water heaters, either. Their water heating capacity is too low for whole-house application in conventional houses. Their power requirements are extremely high, and use among houses within a subdivision is likely to show relatively low diversity during system peaks, so the utility load factor would be troubling.

Thus, the small savings potential within the resistive class and the tiny savings relative to the savings from a technology that consumers see as equivalent (HPWH) show why an Energy Star program for resistive water heaters threatens to erode the brand equity built up by Energy Star.

Energy Star for Fossil-fuel Storage Water Heaters

ACEEE recommends setting an Energy Star performance level at about 0.70 for near-condensing storage gas water heaters, and at about EF=0.80 for gas-fired condensing storage water heaters. This balances several factors. First, the 2004 minimum standard for (40 gallon) storage-type gas water heaters is 0.59, and the best available is 0.65 (with the exception of some combination space heating units around 0.86). Approaches to these performance levels have been outlined by SEGWHAI (www.segwhai.org). All of these approaches have the shared value of eliminating off-cycle induced draft, which prevents the entrainment of conditioned house air. This seems to be an important, but poorly understood, parameter, since it is not included in the EF test.

For all of these reasons and the relatively large savings that could be achieved by a program for storage type fossil fuel water heaters, ACEEE supports an Energy Star program with appropriately stringent specifications for these classes.

In 2003, ACEEE advocated in favor of ENERGY STAR for storage water heaters at EF=0.65. We have changed our position for two reasons. First, SEGWHAI and the market are showing that better performance can be made available. Second, a low-bar ENERGY STAR performance metric, such as 0.62, will inevitably harm the ability of better technologies to achieve market share; they just won't be able to get the ENERGY STAR Thresholds change in a timely manner as they enter and penetrate the market.

ACEEE expects that some will favor a low ENERGY STAR criterion for these products, such as EF = 0.62. The rationale seems to be that this is a level at which some utilities offer rebates today. From our experience working with utility program planners and others, we believe that the availability argument is irrelevant for water heaters, and should be ignored. Before the 2004 standards took effect, there was headroom for cost-effective rebate programs. A few utilities have continued these incentive programs, at the 0.62 or higher levels, but their value seems to be

very limited on the basis of economics. Given that these are just minor variants on mature technologies: they will not induce significant market change. Then why would such programs be offered? We guess that this level was adopted by some utilities as one with reasonable product availability, because there was no ENERGY STAR program. Indeed, we have found no national or coordinated utility program for storage water heaters today, at this or any other level.

ACEEE Supports Energy Star for Instantaneous Combustion Water Heaters

Based on the Department's analysis, ACEEE supports a program for these units. It should include a minimum RE of 82%. The technologies are mature; it is time to give the marketing support to manufacturers and vendors. This would give current manufacturers confidence that the market would be carried to larger sales levels by the Energy Star endorsement, justifying investments in better products and greater manufacturing capability. It might also encourage market entry by other firms. In this, we note that the current EF rating method gives results for instantaneous water heaters that are anomalously high relative to expected field performance; the test simply is not really applicable to the technology.

ACEEE Supports Energy Star for Heat Pump Water Heaters (HPWHs)

ACEEE strongly recommends launching a program for heat pump water heaters (HPWHs). As shown by the Department's own analysis, the potential savings, even at modest market penetration rates, dwarf those of other technologies. DOE has invested large sums in research and development funds to support market deployment of reliable units. Utilities and others have carried out noteworthy programs, and vendors are supporting their products. Energy Star should consider warranty requirements for the tank that are comparable to those of high quality resistive water heaters, and heat pump warranty requirements equivalent to those for premium grade central air conditioners. The program should be designed to give current manufacturers confidence that the market would be carried to larger sales levels by the Energy Star endorsement, justifying investments in better products and greater manufacturing capability. It might also encourage market entry by other firms. ACEEE believes that large-scale adoption of HPWH is more important than stretching their performance limits now, and would be comfortable with EF=2.0 for the roll-out of ENERGY STAR for these products.

ACEEE Supports Energy Star for Solar Water Heater Systems

We agree with the Program Manager on this issue. A program can build on the Solar Rating and Certification Council (SRCC) standard for solar water heaters, *OG-300, Certification of Solar Water Heating Systems*.⁴ However, the performance of solar systems depends strongly on local climate, and on the "balance of system" (parasitic loads and energy for back-up when solar heating is inadequate). It is not easy to deal with all of these factors, but inadequate attention to details will lead both to "gaming" and to large numbers of dissatisfied consumers – with concomitant damage to the Energy Star brand. Thus, ACEEE proposes that Energy Star be awarded for systems in which the manufacturer:

- Provides the solar collector, controls, pump(s), as *per* OG-300. This must include specifying the storage (capacity and EF) and back-up systems required to meet Energy Star levels.

⁴ <http://www.solar-rating.org/standards/ogdocuments/OG300SEP02.pdf>. Checked May, 2003

- Designates (using a standard system to be defined) the climate zones for which the system meets Energy Star performance criteria. The performance level to be required for the Energy Star program needs some additional study.

Together, these requirements may assure that the models designated as Energy Star-compliant will deliver performance in the field that warrants the appellation. Although the requirement of climate zone-specific rating introduces some complexity, the path for this has been blazed by the Energy Star windows program, with similar rationale: performance depends strongly on climate for both product classes.

Because the cost of installing solar water heating is much lower at time of construction than as a retrofit to existing houses, we strongly recommend that the Energy Star new homes program examine whether it gives as much credit as feasible for solar installations, and even for making houses “solar ready” with rough-in piping for solar water heaters (and rough-in wiring for photovoltaics).

Discussion

ACEEE appreciates the thoughtful effort of the Program Manager towards an Energy Star water heating standard; it will stimulate progress and much thoughtful discussion. We still conclude that:

- There should be no program for technologies where the range of available efficiency ratings is less than about 10%. The small potential savings for consumers from products in such categories threaten the Energy Star program’s brand equity as a symbol of products that provide significant energy savings.
- For this reason, ACEEE opposes an Energy Star program for conventional resistance and gas storage water heaters.
- A program for heat pump water heaters should be encouraged. Empirical study has shown that consumers see resistive and heat pump water heaters as equivalent water heating methods.
- An Energy Star program for fossil fuel storage water heaters can be justified if the performance levels chosen are sufficiently rigorous to bring attainable levels of improved product to the market. We support the Department’s decision to promote two levels of advanced storage water heaters, at about 0.70 and 0.80 EF for advanced non-condensing and for condensing, respectively.
- An Energy Star program for instantaneous combustion water heaters, at an appropriately stringent level, is worthwhile.
- Solar water heating *systems* deserve support. It should rate *systems*, not collectors, and be open to a variety of supplemental technologies.
- All advanced technologies, including tankless, require warranty and other confidence-building program elements to assure that consumer expectations are as likely as possible to be met.

Under the right circumstances, an Energy Star program for water heaters could help raise efficiency, reduce homeowner bills, and prevent pollution. Such an approach would have to emphasize the higher efficiency technologies (solar, heat pump water heaters) while recognizing current market limitations. The bottom line is that the savings associated with these technologies,

even at low levels of market penetration, are much greater than the best that can be hoped for by pushing conventional technologies as far as possible.

Again, perhaps the greatest danger is setting too low a threshold for inclusion in the Energy Star program, as by including resistive and conventional gas storage water heaters. The minimal savings attained and the large foregone savings would combine to seriously debase the value of the Energy Star brand.

Sincerely,

Harvey M. Sachs