American Council for an Energy-Efficient Economy
Appliance Standards Awareness Project
Natural Resources Defense Council

November 20, 2014

Ms. Brenda Edwards,
U.S. Department of Energy,
Building Technologies
Program, Mailstop EE-5B,
1000 Independence Avenue, SW.,
Washington, DC 20585-0121.

RE: EERE-2014-BT-STD-0042 Commercial Water Heating Request for Information

Dear Ms. Edwards:

This letter comprises the comments of the American Council for an Energy-Efficient Economy (ACEEE), the Appliance Standards Awareness Project (ASAP), and the Natural Resources Defense Council (NRDC), on the Request for Information (RFI) for a proposed rulemaking or determination for commercial water heating equipment. In general, we support the Department pursing new standards for commercial water heating equipment but ask for its consideration of the issues raised below.

We open with general concerns and observations, and then move to specific **Issues** and related matters raised in the RFI.

General Notes

Processes. As noted in the RFI, these products are "ASHRAE Equipment." As such, under EPACT 1992, (42 U.S.C. 6313(a)(5)) as amended by AEMTCA 2012, (42 U.S.C. 6313(a)(6)(C)(vi)), the department is required to do a determination that the current standards for these equipment types do not need to be amended, or a notice of proposed rulemaking proposing amended energy conservation standards. Aspects of the Certification, Compliance, and Enforcement (CCE) Negotiated Rulemaking may be applicable, at least for hot water supply boilers. In addition, the new test method for residential water heaters will affect certain small 'commercial' water heaters suitable for use in residential applications (42 U.S.C. 6295(e)(5)(F)).

We note that efficiency advocates were actively involved in the processes that led to the water heater related provisions of AEMTCA 2012, the Negotiated Rulemaking, and development of the new federal test method, and fully support them.

Commercial Hot Water Use. The engineering community really knows very little about commercial hot water use, in general. Of course, there are exceptions, notably the outstanding research of the *Food Service Technology Center*[1] for commercial kitchens. As another example,

[1] www.fishnick.com

hot water use in two very different motels has been monitored in the ASHRAE-funded Research Project RP1544, now in review. Several groups have studied hot water use in larger multi-family apartment buildings with common hot water service. However, there has been little published research on the vast majority of commercial applications, particularly large and small office buildings, schools, etc.

In one exceptional case,[2] it was determined that some 90% of the total water heating energy use in a high school with a central gas hot water boiler and recirculating loop was pumping and loop losses. Since this school had little hot water use except in three clustered sets of lavatories, turning off the boiler and pump and replacing them with small "point-of-use" resistance water heaters greatly reduced hot water energy waste in the building, without affecting the service provided.

Based on discussions with experts working on building code service hot water issues, we suspect that many larger commercial buildings are using water heating boilers with recirculating loops to meet demands that are limited (e.g. office suites) to lavatories and break area sinks for dish washing.[3] This would result in huge losses, and thus, an argument could be made for a condensing standard (to reduce the generating losses) to encourage replacement with small point of use units that only heat to the required temp (95F or so for lavatories) and have virtually no standby losses. For larger buildings, small circulation or dead-leg systems with hot water generated by small HPWH using heat sources such as lavatory exhaust air or transformer closets as the source might make sense.

Unfortunately, the dearth of DOE-funded field research makes it difficult to seriously impact these sources of energy waste, so we must focus on what can be done by improving standards. In doing so, we recognize that there are some commercial applications that use large amounts of hot water, notably commercial kitchens, hospitality (hotels and motels), and process loads such as laundries, both coin-operated and institutional.

We also have a larger concern. As with most DOE standards proceedings, this one is only concerned with the next steps, the next standards rounds. DOE has complementary research activities that establish various roadmaps toward sustainability. We regret that DOE does not routinely, or in this case, call out any kind of long-term goals for the program, and reflect on its fit to larger processes (e.g, "net zero ready"). This rulemaking is part of a larger picture. All parties deserve to understand the Department's proposed path to the future.

Response to Specific Issues Raised in the RFI[4]

On page 8, Table 1, for unfired hot water storage tanks, the only requirement is insulation to R-12.5 for all sizes. In the course of the 2013 CCE Negotiated Rulemaking, it seemed that these

[2] Hiller, C, J. Miller, and D. Dinse, 2002. Field Test Comparison of Hot Water Recirculation-Loop vs. Point-of-Use Water Heaters in a High School. ASHRAE Paper no. HI-02-8-2.

[3] Klein, G, personal communication on improved service hot water distribution architecture for commercial buildings.

[4] At this point, all page number references are to the pre-publication version of the RFI.

devices can be roughly classified as relatively small and factory-insulated, vs. larger, engineered-to-order and shipped with (or without) insulation to be field-applied. We recommend evaluating whether a thermal loss requirement for units with factory insulation is feasible and would save energy. In contrast to the insulation R-value, a thermal loss measurement would encourage application of thermal breaks, heat traps, and other loss-reduction technologies where appropriate.

Issues 1, 3, & 4: On page 15, DOE states, "DOE will consider additional equipment classes for capacities or other performance-related features which inherently affect efficiency and justify the establishment of a different energy conservation standard." We urge DOE to work with stakeholders to develop and adopt a test procedure for commercial heat pump water heaters (HPWH). In contrast with the current rating method for residential HPWH, this *must* require testing at a relatively low ambient temperature representative of actual installations, to prevent these HPWH from functioning largely as resistance water heaters in winter months. In turn, this requires at least minimum field study or surveys to determine the distribution of application ambient conditions. Further, and again in contrast with DOE's approach to residential HPWH, DOE *must* include add-on commercial HPWH. At least formerly, these dominated the commercial market in areas like Hawaii. Whether or not a federal standard is required in the near future, a reliable rating method should stimulate this nascent market.[5] In particular, it opens the door wider for utility rebates, and allows sales groups to provide more credible savings estimates to potential customers.

Issue 3: We recommend that DOE *not* include commercial electric instantaneous water heaters, unless DOE establishes that there are significant numbers of *inefficient* commercial tankless water heaters on the market.

Issue 5: Air-source commercial HPWH must be included. For water-source HPWH, the situation is more complicated, because appropriate inlet water loop temperatures differ between "water-to-water" vs. "brine-to-water" (ground-source) units. A rating method is available.[6]

Issue 8: As we have emphasized in prior rule-making procedures, it is no longer valid to consider "Max-Tech" the best available technology in the US market today. DOE must consider the best available globally to understand what is going to be available in the domestic market in the future. As an example, high-capacity residential HPWH that use CO2 as the working fluid ("EcoCute" products) are available from many manufacturers. According to Wikipedia,[7] with utility incentives, cumulative sales by 2008 were more than 1.5 million units worldwide, from about two dozen manufacturers. CO2 HPWH are being actively investigated by NEEA, EPRI, and others in the US. We believe CO2 HPWHs are a minimum for consideration for "MaxTech."

Issue 9: We recognize the challenges to the Department's usual procedures for doing engineering analysis when the investigation is broadened to international comparisons. It

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[5] *See* Sachs, H.M. 2002. Market Opportunities for Commercial-Scale Heat Pump Water Heaters in New York State: Final Report, NYSERDA project 6299.

[6] ANSI/AHRI/ASHRAE 2012. Standard 13256-2 Water-to-Water and Brine-to-Water Heat Pumps — Testing and Rating for Performance.

[7] http://en.wikipedia.org/wiki/EcoCute. Checked on November 17, 2014.

will be harder to grapple with the cost of parts, labor, and even capital. However, we believe that the future competitiveness of the US industry requires using a global standard, so decision-makers in the US can prepare for competition.

Issue 10: DOE postulates that setting minimum standby thermal losses with a two variable (heat input and storage volume) equation presents problems, and proposes to consider adoption of a single-variable (plus intercept) approach with bins for the second variable. Because of discontinuities at the bin boundaries, we find this solution inherently problematic. What are the compensating advantages (in today's computation-friendly environment) over using a three factor approach (intercept, input capacity, volume)? One advantage over bins that we see is that it can avoid arguments about "nominal" vs. "measured" volume by allowing use of nominal for classification but measured for efficiency determination.

Issue 11: We do not claim to fully understand why some condensing water heaters have much lower standby losses than other condensing units and lower standby losses than non-condensing ones, but strongly suspect that the underlying question is different: Why do *some* condensing water heaters have standby losses as high as those of non-condensing units? We would guess that the standby standard was set on the basis of very good performance for atmospheric water heaters, and that any design (not just condensing) with a positive flue damper or equivalent, such as a flue fan, can have much lower standby losses. To the extent that this is true, the efficient solution is to set a standby standard that cannot be met without some form of effective vent closing feature when the burner is not lit. We favor such an approach, recognizing that there may need to be exceptions in certain cases, particularly for engineered-to-order equipment for specialized applications.

Issues 15-22: The overall method of determining water heating energy use proposed by the Department is probably the least weak alternative, relying as it does on CBECS, RECS, and ASHRAE and EPRI handbooks. At the same time, as expressed in our General Notes, above, the fact that so little data are available on what is installed and how it is used, and that so much of what is available is obsolete, is an indictment of the Department's research priorities, which have not included significant work on actual field use.

Issues 26-27: The Department proposes to use RS Means Facilities Maintenance Repair Cost Data and other sources to develop maintenance cost data. An issue that warrants consideration is the accuracy of these data. It might be worthwhile, for example, for DOE to survey a single metropolitan data for comparison with RS Means' metropolitan data as a calibration that might be useful for future rule-makings. We are aware (from boilers) of substantial regional variability, which is expected, but not aware of studies comparing R.S. Means with some independent calibration.

Issue 28: Since its introduction by Carl Hiller and others for estimating service lives of water-source heat pumps, Weibull survivorship has been widely adopted as an acceptable method. Of course, it's use requires a huge leap of faith, notably that changing water heater materials and manufacturing processes relative to water heaters that have already died will not affect the service lives of units to be manufactured in the future in response to standards that will be proposed. This assumption may not be valid, particularly for early generations of technologies that have not been produced in large quantities in the past, e.g. large commercial HPWH. To a lesser extent, this may also apply to more

sophisticated condensing water heaters. Still, the conservative approach is to assume that Weibull of existing products is the least bad option in a sea of uncertainty.

Issues 30, 34: Traditionally, the market for commercial water heaters has been rather fragmented, with natural gas predominant where available, and other sources (propane, oil, and electric) fighting for a share in the remaining market. We understand that the market has been dominated by least-efficient commodity products, too. Countervailing trends that would increase share for more efficient products begin to appear. At the smaller end, ENERGY STAR, custom or standard utility incentives. For specific market sectors, we call out the development of tools by the Food Service Technology Center. We also note that manufacturers are speaking of greater adoption of condensing as customers become more aware of options that save money. Still, the barriers to greater adoption are huge, particularly the under-capitalization of many restaurants and other large users of hot water among small businesses. Therefore, we believe that DOE must adopt a pathway toward condensing and heat pump technologies where feasible, together with great increases in field studies to identify the most efficient *systems* for buildings such as offices.

Issue 31, Rebound. Rebound is relevant if and only if the party benefitting from the energy service also makes or strongly influences the purchase decision. The classic example is the landlord who does not pay tenant energy bills having no incentive to purchase equipment beyond minimum efficiency for her tenants. This situation would be applicable to a large fraction of retail businesses, so more stringent standards will result in somewhat lower energy bills for these small business owners. We would expect little rebound (increased hot water use) from this marginal reduction in operating costs. If we consider the case of large tenant-occupied buildings, the calculus may differ with lease type, but it would be difficult to infer that more tenants will wash their hands longer because the hot water costs the building owner less. Thus, we feel that the likelihood of a strong rebound effect for this equipment class is very low.

Issue 33, Value of Commercial Floor Space. We suggest that the value of floor space is a poor proxy for actual decision parameters, both for new construction and for replacements. Consider new construction first, where the cost of marginal square feet, whether inside (e.g, mechanical room, work area of a laundry) or outdoors (e.g, outside a fast food restaurant) is likely to be small compared to the total cost of hot water supply with alternative distribution architectures. Were this not the case, the typical office building would be likely to use point-of-use resistance water heaters for lavatory service instead of central hot water boilers and an expensive pumped recirculating loop. The situation may be more nuanced for replacement water heaters, particularly in smaller commercial buildings. In such cases, slightly larger height or diameter will cause interferences – or fears of interferences – in some installations. More importantly, there will be situations in which vent changes (e.g, atmospheric to condensing) or the need for ducting cooled HPWH exhaust air will cause challenges. As often, the availability of the stream of cooled exhaust from the HPWH will be a net benefit to a commercial building, and we would see opportunities. For example, David Korn (Cadmus) considered the possibility of installing small HPWH in commercial building transformer closets, where the warmer ambient air would improve the HPWH efficiency and cool the transformer space. However, the point of our observation is that the cost of most commercial hot water systems, as a fraction of the total building cost, is low enough that the design consultants

spend little time on it, and would consider space only if they somehow learned that a relatively large saving were possible.

Conclusions

We appreciate the opportunity to comment on this RFI. We respect the work that DOE is doing as it prepares to decide whether to issue a Determination and accept the ASHRAE standards, or to proceed with a rule-making. The ways we heat water lead to discontinuities in possible standards levels, including the gap between atmospheric-non-condensing vs. condensing fossil-fuel water heaters, and the gap between resistance and heat pump water heaters. Making these jumps for minimum efficiency standards requires careful consideration of both gains and losses from requiring higher efficiency.

We are convinced that we must move to the more efficient technologies as quickly as possible, for both environmental and economic reasons. These include resilience in the face of oscillating 'fuel' prices. At the same time, we are troubled that there has been so little public investment in understanding the actual efficiency of commercial hot water systems, and not just because this underlies estimates of savings potential. As we have noted above, one critical question for commercial purchasers is not just what efficiency level, but what distribution architecture.

In general, the proposed (and customary) processes for developing a NOPR for commercial water heating products are reasonable. We do, as would be expected, have some concerns with particulars, such as international comparisons for "MaxTech", and we hope that DOE will respond constructively.

As always, we appreciate the opportunity to comment on these matters.

Sincerely,

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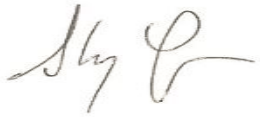
American Council for an Energy-Efficient Economy



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