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

October 18, 2013

Ms. Brenda Edwards
U.S. Department of Energy
Building Technologies Office, Mailstop EE-2J
1000 Independence Ave SW
Washington DC 20585-0121

RE: Docket Number EERE-2013-BT-STD-0030/RIN 1904-AD01: Framework Document for Commercial Packaged Boilers

Dear Ms. Edwards:

This letter comprises the comments of the American Council for an Energy-Efficient Economy (ACEEE), Appliance Standards Awareness Project (ASAP), and Natural Resources Defense Council (NRDC) on the framework document for commercial packaged boilers. 78 Fed. Reg. 54197 (September 3, 2013). We thank DOE for the opportunity to participate in and contribute to the development of amended standards for commercial packaged boilers.

Below we first describe what we believe to be the most important issue at this stage of the rulemaking—the test procedure and efficiency metric—and then provide our responses to selected items for which DOE has requested comments.

Test Procedure and Efficiency Metric

As discussed in more detail below, we find it imperative that DOE adopt a better metric than the single steady-state, peak-load efficiency prescribed by BTS-2000. As outlined in our responses to **Items 3.1, 3.3, and 3.4**, this metric massively understates the efficiency difference between condensing and non-condensing boilers in well-designed systems. In turn, this difference makes it hard for designers to show savings for clients that would justify the incremental costs of condensing systems. Perhaps as important, it has made it very difficult for utilities and other efficiency program operators to design and show the value of incentive programs for condensing systems, despite the fact that these systems would very likely achieve cost-effective energy savings in the field.

Items on Which DOE Seeks Comments:

2-2 Extending Coverage to Electric Commercial Packaged Boilers

On the one hand, from a source energy standpoint, *all* electric resistance boilers are inefficient. At the same time, from a *site* energy standpoint, consider a 90% efficient, 300 kW electric boiler (1 million Btu/hr). Unless it was located outdoors, at full load the boiler would create a sizeable nuisance by

dissipating 100,000 Btu/hr inside a boiler room—enough heat to satisfy the load of a pretty large house on a pretty cold day. Under the circumstances, and given the cost of electricity, manufacturers have some incentive to do a reasonable job of minimizing losses by insulating fairly well. DOE *might* want to consider regulating electric boilers like certain large commercial water heaters: by simply requiring that the jacket insulation meet a high performance level. This may be appropriate to the extent that electric boilers are simple vessels and do not share the fire tube, water tube, or other specialized heat transfer approaches generally used in fossil-fuel boilers.

2-3 Standby and Off Mode

Standby and off mode power can consume a significant amount of energy, although this energy use will generally be a very small fraction of the total energy use of a commercial boiler. As DOE explores potential standards for standby and off mode, it will be important to consider how boilers are controlled, including safety devices and connections to building automation systems. It will also be important to understand how "boiler trains" (multiple, staged sets of boilers connected to the same heat distribution system) are controlled, and to determine whether potential standards for standby and off mode could inhibit innovations that would save much more gas or oil than the amount of electricity saved.

3-1 Test Procedures

The current test procedure, which is based on BTS-2000, is simply obsolete, since it obscures the huge annual energy savings potential of condensing boilers in commercial building applications. For historical reasons, BTS-2000 measures efficiency at peak load, using a minimum 100°F temperature rise between the boiler inlet and outlet, and requiring 180°F outlet temperature. BTS-2000 is a steady-state test that shows roughly a 10 point difference in efficiency between the best non-condensing equipment and very good condensing equipment, because it does not consider that the condensing unit can operate at much greater efficiency at part load, if the system design allows water to return to the boiler at condensing temperatures (<140°F) when loads allow. Durkin showed that replacement of non-condensing commercial packaged boilers with well-regulated condensing boiler systems in 10 schools in the Midwest saved an average of 49%, with a 3.5 year payback at $1.00/therm.[1]

Because BTS-2000 hides the efficiency savings potential of condensing systems, utility incentive programs and consulting engineers run into huge problems trying to justify the first cost of condensing boiler systems. At a minimum, for all boilers with modulating burners (including high/low fire), the rating method *must* incorporate some part-load efficiency measure. We suggest that an appropriate measure might be steady-state at the lowest return water temperature the boiler can sustain under its warranty, perhaps with some reasonable lower limit on temperature and upper limit on capacity (perhaps 2.5 – 5.0 MMBtu/hr).

3-3 Fair Comparisons of Efficiency Across Boiler Models

As described above (Item 3-1), BTS-2000 is misleading if it is used to estimate the potential energy savings of condensing boilers relative to non-condensing boilers. It is functionally obsolete and should not continue to be used, unless a measure of part-load efficiency is incorporated.

[1] Durkin, T.H. 2006. Boiler System Efficiency. ASHRAE Journal, July, pp. 51-57.

3-4 Alternative Test Methods

We have great respect for the efforts made to develop an alternative rating method in ASHRAE SSPC 155. However, a case has been made that for the relatively small volumes of some product classes that are sold in the market, the testing burden is greater than the potential benefits. We believe that incorporating an appropriate part-load test for modulating and condensing boilers can and must be done now. For the future, the work on AEDMs done by the ASRAC working group should empower industry to both reduce testing burden and provide better information to its customers, so they can waste less money and energy.

5-3 Equipment Classes

DOE notes in the framework document that if the outcome of the proposed determination of coverage confirms DOE's authority to cover natural draft commercial packaged boilers, DOE would create separate equipment classes for natural draft boilers. We are unaware of significant differences in utility, and encourage DOE to evaluate whether there is a specific utility of natural draft boilers in certain applications that would warrant separate equipment classes.

5-4 Technology Options

Increasingly, boilers (including moderate-sized commercial boilers) and their components (such as burners) are traded internationally. This has two implications:

- As for all other rulemakings, DOE's screening *must* be based on an international evaluation of technologies applied in products available in Europe, East Asia, and other competitive markets. These technologies, such as burners, are readily available as components for U.S. manufacturers, too.
- To the extent that U.S. standards lag behind those of competitor countries, our manufacturers suffer vulnerability to loss of market to offshore competitors hardened by market discipline in their home markets, and lose the ability to compete abroad.

8-1 Distribution Channels

For packaged boilers, as for much other specialized mechanical equipment, the role of the "manufacturer's representative" is critical. These firms typically sell products from many manufacturers, usually not with overlapping product lines. They sell for the manufacturer, but we believe that they generally do not actually buy and hold equipment, in contrast to wholesalers. It is of concern because this channel, which may be a significant part of many kinds of specialty equipment (not just HVAC) is extremely important in many sectors, but somehow missed completely in this effort to set up the analysis.

9-1 Energy Consumption

Thermal Efficiency by itself may not be well correlated with annual energy use because it measures only peak load. Since loads vary seasonally and since most boilers are said to be oversized, it is likely that few boilers (except in boiler trains) ever operate at full load for significant periods of time. We suggest that DOE adapt the "prototype buildings" simulation approach used to support ASHRAE 90.1 analyses, running representative buildings through hourly simulations.

9-3 Field Data

For field monitoring data, we suggest outreach to MNCEE, CEE, and NEEP. The latter two are regional efficiency organizations. Natural Resources Canada (Martin Thomas) may also be a resource.

9-8 Rebound Effect

For reasons identified by the manufacturers at the DOE Public Meeting on October 1, there is no reason to expect significant "rebound", that is, additional energy consumption when a more-efficient commercial packaged boiler replaces a less-efficient one.

10-4, 10-5 Installation, Maintenance and Repair Costs

We believe that condensing and non-condensing equipment may differ in terms of installation, maintenance and repair costs, but possibly in counterintuitive ways. For example, for some fraction of packaged commercial boiler replacements, substituting a condensing boiler (or boiler train) may *reduce* both installation and maintenance costs. This might well be true, for example, if the efficiency upgrade allowed abandoning a masonry chimney that otherwise requires repointing and annual inspection.

The 2011 ASHRAE Handbook, Chapter 37 (Owning and Operating Costs) notes some newer on-line resources for estimating these factors. In informal analyses based on earlier data, Sachs found that the distribution of maintenance cost frequencies was very asymmetric, looking Poisson or lognormal. This is not unsurprising (the fraction of buildings with very, very, high O&M costs, including energy, is small), but suggests caution in the distributions assumed in the Monte Carlo analysis.

10-6 Equipment Lifetimes

The 2011 ASHRAE Handbook, Chapter 37 (Owning and Operating Costs) notes some newer on-line resources for estimating expected service life for various equipment classes, but also stresses the uncertainties involved in estimates based on equipment designs and manufacturing processes that may have changed substantially.

Conclusion

We appreciate the opportunity to contribute thoughts at this framework stage of the rulemaking for commercial packaged boilers, and look forward to the future steps in the process. At this time, the most important issue to us is shifting to a rating method that incorporates a good part-load efficiency estimate, because the present BTS-2000 hides the efficiencies achievable in the field by well-designed and well-controlled condensing systems.

Thank you for your consideration.

Sincerely,

Harvey Sachs, Ph.D
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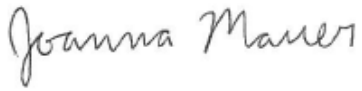
American Council for an Energy-Efficient Economy



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