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

January 20, 2015

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

RE: Docket Number EERE–2013–BT–STD–0030/ RIN 1904–AD01: Preliminary Technical Support Document for Commercial Packaged Boilers

Dear Ms. Edwards:

This letter constitutes 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 preliminary technical support document (TSD) for commercial packaged boilers. 79 Fed. Reg. 69066 (November 20, 2014). We appreciate the opportunity to provide input to the Department.

We urge DOE to modify the test procedures to incorporate part-load performance. The current test procedure, which is based on BTS-2000, does not capture potential savings from modulation because it only measures full-load efficiency. ASHRAE authorized a proposed standard project (Standard 155P) in 1994, "Method of Testing for Rating Commercial Space Heating Boiler Systems," which would determine the steady state thermal efficiency, part load efficiency, and idling energy input rate of space heating boilers.[1] However, Standard 155P has yet to be completed. A report prepared for Pacific Gas and Electric Company in support of ASHRAE Standard 155P noted that "Standard 155P is sorely needed by the HVAC industry because there is no standard for rating the performance of commercial boilers at part load conditions (where most boilers operate most of the time) or at realistic entering water temperatures."[2]

The significance of the failure to incorporate part-load performance in the current ratings is well-illustrated by a field boiler retrofit study by Durkin.[3] For 10 originally steam-heated schools, the retrofitted low-temperature condensing boiler systems saved an average of 68% of their gas consumption (seasonally adjusted). Similarly, average savings for 10 high-temperature hot water systems converted to condensing systems were 49%. Paybacks at $1.00/therm were 1.4 and 3.5

[1] https://www.ashrae.org/standards-research--technology/standards--guidelines/titles-purposes-and-scopes#SPC155P.
[2] http://www.etcc-ca.com/sites/default/files/reports/ET11PGE5272_ATS%20Boiler%20Research%20Testing_12.21.12.pdf. p. 10.
[3] Durkin, T. H. 2006. Boiler System Efficiency. ASHRAE Journal, July, pp. 51-57.

years, respectively. We recognize that since Durkin retrofitted schools that had obsolete heating systems, the results of the study do not provide an estimate of the potential savings of low-temperature condensing systems relative to systems with non-condensing boilers that meet the current efficiency standards. However, these examples illustrate the difficulties faced by designers who want the best for their clients, but who have enormous challenges explaining to customers how much better condensing boilers can actually perform in the field.

We encourage DOE to modify the test procedures to incorporate part-load performance in order to better capture the potential savings of condensing boilers and to encourage boilers that provide modulation. In addition, a test procedure that incorporates part-load performance would provide better information to designers, customers, and others about the actual efficiency of commercial boilers in typical field installations.

We do not believe that natural draft boilers warrant a separate equipment class. In the preliminary TSD, DOE considered separate equipment classes for natural draft boilers.[4] However, the preliminary TSD does not explain why DOE believes separate classes for natural draft equipment are justified. We are not aware of any distinct consumer utility offered by natural draft boilers that is different from that of mechanical draft boilers. In addition, natural draft boilers are inherently less efficient than mechanical draft boilers, and a single equipment class would ensure that the maximum improvement in energy efficiency is achieved. We agree that natural draft boilers should be covered in this rulemaking but recommend that DOE utilize a single equipment class for natural draft and mechanical draft boilers. If DOE proposes in the NOPR to retain the separate classes for natural draft equipment, the Department must at least explain why it believes separate equipment classes are needed.

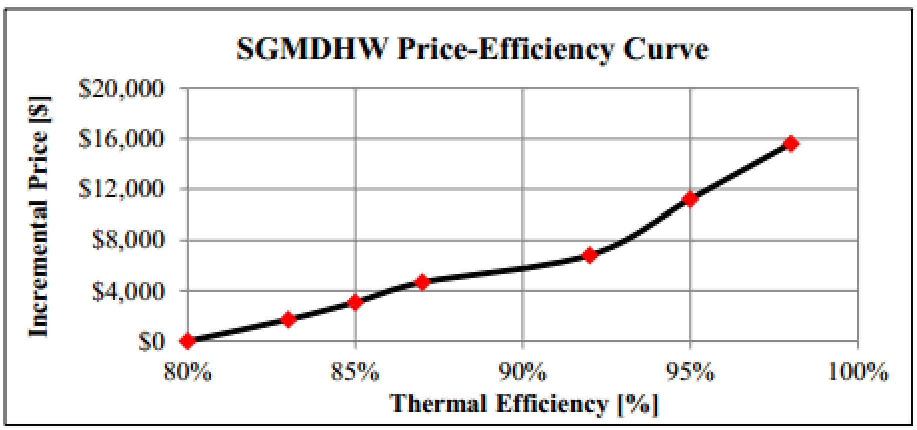
We encourage DOE to collect additional price data to supplement its current analysis. We are concerned that the price-efficiency curves in the preliminary TSD were developed using a limited data set that may yield inaccurate results. DOE notes in the preliminary TSD that price data collected through conversations with manufacturers, distributors, and mechanical contractors were largely restricted to small gas-fired, mechanical draft boilers. The limited amount of price data available for equipment other than small gas-fired, mechanical draft boilers forces DOE to rely on very uncertain extrapolations. We are also concerned that the preliminary TSD does not contain any information about the number of individuals surveyed, number of useful results, etc. Commercial boilers are engineered products built in relatively small numbers, variously specified, sold through diverse channels, and installed by a range of actors. In other rulemakings, DOE typically constructs cost estimates by conducting teardowns and generating a Bill of Materials (BOMs). In contrast, for the preliminary analysis for commercial boilers, DOE has not conducted any teardowns. In a contractor-installed system, such as a commercial boiler, prices are likely to be highly variable and may vary based on factors other than efficiency (e.g. labor costs).

DOE makes assumptions based on the limited data inputs that raise questions about the overall accuracy of the price-efficiency curves. For example, DOE states that for the equipment classes for large boilers, DOE was unable to collect a significant amount of pricing information and so in some cases considered the price of two small boilers having an input capacity of 1,500 kBtu/h

[4] Preliminary TSD. p. 3-5.

to match the 3,000 kBtu/h representative capacity for large boilers.[5] On the one hand, the large boiler will have only one burner, one heat exchanger, one shell, and one set of controls, possibly reducing prices. On the other hand, we postulate that there are far fewer 3,000 kBtu/h boilers sold than 1,500 kBtu/h boilers, so the allocation of design, testing, certification and other common costs will be much higher. We encourage DOE to collect additional data to validate its assumption that the price of two 1,500 kBtu/h boilers is an accurate proxy for the price of a 3,000 kBtu/h boiler.

Another example that raises questions about the overall accuracy of the price analysis is related to the slope and inflection points of the efficiency curve for small gas-fired, mechanical draft hot water boilers. DOE notes in the preliminary TSD that there is generally a step change in price from a non-condensing boiler to a condensing boiler.[6] While this statement seems logical, it is inconsistent with the price efficiency curve for small gas-fired, mechanical draft hot water boilers presented in the preliminary TSD and shown below.[7] For this equipment class, the slope of the price-efficiency curve going from the highest non-condensing level (87% thermal efficiency) to the lowest condensing level (92% thermal efficiency) is actually *lower* than the slope of both the non-condensing and condensing portions of the price-efficiency curve. There does not appear to be any explanation in the preliminary TSD for the reduced cost increment going from a non-condensing to a condensing level, which reduces our confidence in the price data overall.



We encourage DOE to collect additional price data including through interviews with and surveys of those who write specifications (consulting engineers and others) and those who bid on projects (mechanical contractors). DOE may also be able to obtain data on commercial boiler purchases by the Federal government. For the collected price data, we urge DOE to ensure that these data reflect the prices that customers are actually paying as opposed to "list" prices that are widely discounted in actual bids. We also urge DOE to ensure that the estimates of incremental prices only include the incremental price associated with the technology options required to meet a given efficiency level, and do not include the cost of auxiliary options that are often associated with premium products but are not associated with efficiency. For example, since the current test

[5] Preliminary TSD. p. 5-8.
[6] Preliminary TSD. p. 5-10.
[7] Preliminary TSD. p. 5-16. Figure 5.5.9.

procedure does not capture the efficiency benefits of advanced controls, the prices of these features should not be included in the incremental prices.

We encourage DOE to evaluate additional efficiency levels for mechanical draft oil-fired hot water boilers. Tables 1 and 2 below show the efficiency levels evaluated in the preliminary analysis for mechanical draft oil-fired hot water boilers for small and large equipment, respectively. For both equipment classes, there is a jump in either thermal or combustion efficiency of 9 percentage points between the level just below the max-tech level and the max-tech level. In both cases, the max-tech level (98% or 97% efficiency) is the only condensing level evaluated.

Table 1. Mechanical Draft - Small Oil-Fired Hot Water Commercial Packaged Boiler Efficiency Levels.[8]

Efficiency Level	Thermal Efficiency (%)
Efficiency Level 0 (Baseline)	82
Efficiency Level 1	83
Efficiency Level 2	84
Efficiency Level 3	87
Efficiency Level 4 (Max-Tech)	98

Table 2. Mechanical Draft - Large Oil-Fired Hot Water Commercial Packaged Boiler Efficiency Levels.[9]

Efficiency Level	Combustion Efficiency (%)
Efficiency Level 0 (Baseline)	84
Efficiency Level 1	86
Efficiency Level 2	88
Efficiency Level 3 (Max-Tech)	97

We encourage DOE to evaluate at least one additional condensing level for these two equipment classes at a level that could be considered "baseline" condensing equipment (i.e. efficiency levels at or just above 90%).

We encourage DOE to explore ways to estimate learning rates for condensing technology. In the preliminary TSD, DOE applied a constant price trend given the uncertainty in price trends for iron and steel prices.[10] The incorporation of learning rates in recent DOE rulemakings has allowed the analyses to reflect the observation that equipment prices tend to decrease over time. However, an improvement to the methodology would be to incorporate learning rates of the actual technologies that can be employed to improve efficiency. For this rulemaking, we encourage DOE to explore ways to estimate learning rates for condensing technology since we would expect the price of condensing boilers to decline faster than the price of all boilers.

We encourage DOE include a Trial Standard Level (TSL) in the NOPR that represents the maximum efficiency levels with a positive NPV at 3%. In recent rulemakings, DOE has

[8] Preliminary TSD. p. 5-7. Table 5.3.12.
[9] Preliminary TSD. p. 5-7. Table 5.3.13.
[10] Preliminary TSD. p. 8-15.

sometimes included in the NOPR a TSL that represents the maximum efficiency levels with a positive NPV at 7%. However, DOE must consider NPV at both 3% and 7% as directed in Office of Management and Budget (OMB) guidance to Federal agencies.[11] Further, the use of a 3% discount rate is appropriate when accounting for long-term societal benefits and costs. Therefore, we encourage DOE to include a Trial Standard Level (TSL) in the NOPR that represents the maximum efficiency levels with a positive NPV at 3%.

We encourage DOE to consider funding the development of a commercial boiler simulation engine, analogous to the DOE-ORNL "HeatPump" program for residential air conditioners and heat pumps. A simulation engine for commercial boilers would not only reduce the costs of innovation, particularly for smaller and specialty manufacturers, but also substantially reduce costs for certification for the typical small production runs and build-to-order units for large boilers.

Thank you for considering these comments.

Sincerely,

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American Council for an Energy-Efficient Economy

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[11] U.S. Office of Management and Budget, Circular A-4: Regulatory Analysis, 2003. http://www.whitehouse.gov/omb/Circulars_a004_a-4.