AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE
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March 13, 2014

Ms. Brenda Edwards
U.S. Department of Energy
Building Technologies Program, MS EE-2J
1000 Independence Avenue, S.W.
Washington, D.C. 20585-0121

Re: NODA for Energy Conservation Standards for Residential Boilers

Docket No. EERE–2012–BT-STD–0047

Dear Ms. Edwards,

The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) is the trade association representing manufacturers of air conditioning, space heating, water heating and commercial refrigeration equipment. AHRI's membership includes all the major manufacturers of residential boilers (gas and oil fired) sold and installed in the U.S. We submit the following comments in response to the notice of data availability issued in the February 11, 2014 Federal Register. This notice provided the provisional analysis for amending the minimum efficiency standards for residential boilers. Our comments are presented in the order of the chapters contained in the Technical Support Documents (TSD) for the analysis.

Chapter 2. Analytical Framework, Comments From Interested Parties And Department Of Energy Responses.

We agree with the decision regarding the technology options that were not considered in the analysis.

On page 2-20, DOE indicates that it interprets near-condensing installations as meaning near-condensing products in the efficiency range of 86%-88% AFUE. We understand this statement to be specific to gas-fired boilers. In that case, it is not a correct interpretation. In the comments which AHRI submitted on March 28, 2013, we suggested that at AFUE ratings in the range of 83.5% to 87%, it should be assumed that a gas hot water boiler will require a Category II or IV vent system even though it is unlikely that there will be condensing in the heat exchanger. From the installation perspective, this is the near condensing range of efficiency. Since the analysis used a higher AFUE range, it has underestimated the increased installation cost for vent system rework or upgrade at the 84% and 85% AFUE levels for gas hot water boiler models.

On page 2-21, DOE summarizes its responses to comments which noted that the average lifetime of condensing gas boilers may be different than that of non-condensing boilers. DOE notes that boiler lifetimes were derived from a combination of shipment data, boiler stock and RECS data. As a general methodology, such analysis is reasonable. However, in the specific case of condensing gas boilers it is a flawed process. A key assumption of this methodology is that there is an established population of units in the field that reflect the full range of lifetimes that apply to the product. Stated another way, using shipment and field data to determine an average or median lifetime of X only provides a valid result if there is a sufficient population of units in the field that have lifetimes ranging from $X\text{-}Y_1$ to $X+Y_2$; the "Y" values representing the number of years above and below the average or median to define the full range of normal lifetimes. In the case of condensing gas boilers, the 22 years median lifetime used for all boilers in the analysis is an invalid assumption. This analysis was conducted in 2013. Going back 22 years, gets to the year 1991. A median lifetime of 22 years implies that half of the installed condensing boilers last 22 years or longer. As Figure 7-B.2.1 (Appendix 7-B) shows, the introduction of condensing gas hot water boilers was just beginning in 1991. In 1995, the Directory for the GAMA/IBR Residential Boiler Efficiency Certification Program had only 2 manufacturers listing a total of 7 condensing gas boiler models. It is not possible to conclude from field data that condensing gas boilers have a median lifetime of 22 years when the number of such units installed 22 years ago likely accounts for 1% or less of all residential gas boilers currently in use. Using Figure 7-B.2.1, a rough estimate can be made that half of all condensing gas boilers in use today were installed since 2005 or 2006. If half of the units in use are only about 8 years old, a median lifetime of 22 years cannot be considered as applicable to those units.

Chapter 3. Market and Technology Assessment

The inclusion of Table 3.2.4 showing efficiency bands in the United Kingdom is interesting, but unless those efficiency ratings can be accurately translated into a comparable AFUE rating, the information is irrelevant to the analysis.

The analysis indicates that a median lifetime of 22 years was used for all boilers. It would be useful to know what DOE estimates is the average lifetime of residential boilers.

Chapter 4. Screening Analysis

DOE indicates that burner derating and direct vent were included in the technology options considered for the analysis. Yet, in Tables 5.3.3 through 5.3.6, neither of these technology options are listed as an option applied to achieve a trial efficiency level. We had commented previously that neither of these options should be considered in this analysis since they are not currently practical ways to achieve higher levels of efficiency. The actual analysis appears to reinforce this point. Accordingly, we reaffirm our comment that these two design options should be removed from the analysis.

Chapter 5. Engineering Analysis

Table 5.3.1 indicates that the baseline gas hot water boiler is assumed to be equipped with a damper. A minor point; is it a flue damper or vent damper? More significant, this information in inconsistent with the statement on page 8-D-8 (Appendix 8-D) that the only non-condensing designs installed since the 1990s have been fan-assisted boilers. The statement in Appendix 8-D is incorrect. Although the baseline model as described in Chapter 5 appears to be used consistently in the analysis, it needs to be checked to assure that the incorrect statement of Appendix 8-D was not used anywhere in the analysis.

There is an inconsistency in the information provided about the units examined in the teardown analysis. On page 5-9 DOE explains that physical teardowns were conducted on four gas hot water boilers; 2 non-condensing models and 2 condensing models. Information on the bottom of page 5-15 notes that these two non-condensing models were cast-iron boilers at 85% AFUE. Yet, further down on page 5-9, it is stated that DOE selected baseline units for the teardown analysis to determine which technologies are incorporated to achieve the current minimum standard AFUE level. For gas hot water boilers that is 82%, not 85%. It appears that DOE did not physically tear down an 82% AFUE model. If this is true, it is a flaw in the analysis. The designs to achieve 85% AFUE are different than that to build an 82% AFUE model and it is not appropriate to do a virtual teardown of a baseline 82% AFUE model based on information developed by physically tearing down an 85% AFUE model. This assumes that the commonality of design between an 85% AFUE model and an 82% AFUE model is greater than it actually is.

Also, conducting only one physical teardown of an oil hot water boiler is inadequate for this analysis. We concur with DOE’s expressed intent to conduct additional teardowns.

On page 5-16, the analysis notes that 20% of gas hot water boilers with an AFUE of 82% have fan-assisted draft. The analysis assumes that this percentage will remain unchanged at each efficiency level. We disagree with that assumption. At those higher efficiency levels that are non-condensing, such as 84% and 85% for gas hot water boilers, the question of whether the manufacturer will utilize a fan assisted design will be considered anew if that higher level becomes the minimum standard. Our previous comments have noted the challenges that face manufacturers in trying to address the wide range of venting systems that are connected to existing residential boiler installations. Their models must be able to work safely and properly on existing venting systems that vary widely relative to the ideally sized and configured vent system. Today, the models that are available at 84% or 85% AFUE are offered by the manufacturer with the knowledge that in those cases where such models are not compatible with the existing vent system, lower efficiency models are available. Those lower efficiency models are more likely to be compatible with the existing vent system. If the minimum standard is raised to 84% or 85%, this current market situation is eliminated and manufacturers must reconsider the mix of models they offer. One obvious choice will be to increase the percentage of fan assisted models.

Chapter 6. Markups Analysis

The analysis assumes that 80% of all gas hot water boiler installations are replacements. We believe this assumption should be re-examined relative to the predominant market for these products and the geographic distribution of new housing starts in the U.S. The larger proportion of new housing starts in the U.S. is not in those areas where gas hot water boilers are most popular. Based on the 2009 RECS Final Housing Characteristics information (attached to these comments), from 2000 through 2009 15.6 million new housing units were built. Only 1.6 million of those new housing units were built in the Northeast region; 0.4 million in the New England area and 1.2 million in the Middle Atlantic area. The attached 2009 RECS Final Housing Characteristics data also shows that in the 2000-2009 period, a gas or oil boiler was installed in only 0.4 million new housing units nationwide. Based on information in Table 6.7.1 in the analysis, about 80% of all residential boilers are sold in the Northeast. Using 4 million as the approximate number of residential boilers shipped from 2000 through 2009, an estimate of the number of residential boilers sold in the Northeast during that period is 3.2 million. If all the 0.4 million new boiler installations from 2000 through 2009 were in the Northeast region that would be 12.5% of the 1.6 million new housing units in that region. This information strongly indicates that the 80% replacement estimate may be too low.

Chapter 7 Energy Use Analysis

There is a critical flaw in this energy use analysis which ripples through the entire analysis. Specifically, the analysis bases its estimated energy consumption on RECS 2009 and CBECS 2003 date. Under other circumstances, that may be appropriate to provide a valid estimate of energy consumption. In this case, the circumstance is that all baseline hot water boilers include a design feature that adjusts the outlet water temperature in relation to the inferred heating load. The estimates of the energy savings resulting from the use of this design feature range from 5% to 30%. For residential application we believe that an average 10% savings would be a reasonable estimate. Regardless of what savings is estimated, the analysis does not appear to have considered the benefit of this automatic means at all. This design feature, which is a prescriptive requirement, is found on current baseline models and all other hot water boiler models currently on the market. Furthermore, this design feature still will be required on models if a higher minimum AFUE level is specified.

The analysis of estimated energy use must be recalculated to account for the benefit of the automatic temperature reset means both for the baseline unit and the higher AFUE efficiency levels. We expect that this revised analysis will show a smaller incremental energy savings resulting from an increased AFUE rating.

The estimate of standby electricity consumption assumes that a residential boiler is in standby mode throughout the year. We do not agree with this assumption. The time in which the boiler is in standby should be limited to the heating season. The remainder of the year the boiler is "off". This analysis should be recalculated with this reduced standby time.

Chapter 8. Life-Cycle Cost and Payback Period Analysis

We recommend that the producer price index for this analysis be reevaluated and adjusted to reflect the residential boiler market. The analysis conducted for the furnace rulemaking and the PPI data for heating equipment from the Bureau of Labor Statistics are not directly transferable to residential boilers. The size of the residential furnace market and the general residential heating market in the U.S. is factors larger than the residential boiler market. The unique factors of the relatively small size of the residential boiler market and the relatively higher cost of residential boilers minimize the applicability of this generalized PPI value in this analysis.

Tables 8.4.1; .3; .5; and .7 show the life-cycle cost savings and payback period results of the analysis. Except for the payback period, which is shown as the median value, all other values are averages. It would be helpful to show the average payback period in these tables. Furthermore, it would be helpful if the analysis provided more discussion about the differences between the median and average payback periods for the various boiler classes.

The analysis acknowledges the existence of the rebound effect and estimates that this effect reduces the incremental energy savings of a higher efficiency model by 20%. However, the analysis then explains that this rebound effect is offset in the LCC and PBP analysis by an increase in the consumer's utility. There is no additional information provided in the TSD to explain what the increase in the consumer's utility is. In any case, the consumer's utility is not a quantifiable, monetary value and it does not affect the cost of operation of the boiler. Therefore, we recommend that the LCC and PBP analysis be redone with the incorporation of the energy saving reduction due to the rebound effect.

Chapter 9. Shipments Analysis

We have no comments on this chapter at this time.

Chapter 10. National Impact Analysis

Tables 10.5.3 and 10.5.4 show Standby National Savings. However, no information is provided on the baseline standby energy consumption to which this savings is compared. The lack of that information makes it difficult to properly assess the significance of this savings.

Also, standby energy consumption is electricity. The "full-fuel-cycle consumption" value for electricity is significantly higher than the primary energy consumption for electricity because of generation and distribution losses. Yet, in most cases the National Energy Savings values in Table 10.5.4 for each efficiency level are nearly the same as the corresponding entry in Table 10.5.3. This does not seem to reflect the greater full-fuel-cycle consumption of electricity.

We appreciate this opportunity to provide comments and participate in this rulemaking.

Respectfully submitted,

Frank A Stanonik

Frank A. Stanonik
Chief Technical Advisor

Attachment: Tables from 2009 Residential Energy Consumption Survey

Table HC2.3 Structural and Geographic Characteristics of U.S. Homes, by Year of Construction, 2009

Million Housing Units, Final

Structural and Geographic Characteristics	Total U.S.[1] (millions)	Year of Construction: Before 1940	1940 to 1949	1950 to 1959	1960 to 1969	1970 to 1979	1980 to 1989	1990 to 1999	2000 to 2009
Total Homes	113.6	14.4	5.2	13.5	13.3	18.3	17.0	16.4	15.6
Census Region and Division									
Northeast	20.8	5.6	1.3	3.4	2.6	2.6	2.2	1.5	1.6
New England	5.5	1.8	0.3	0.7	0.6	0.7	0.8	0.3	0.4
Middle Atlantic	15.3	3.8	1.1	2.7	2.0	1.9	1.4	1.1	1.2
Midwest	25.9	4.6	1.4	3.6	3.2	4.2	3.1	3.2	2.6
East North Central	17.9	3.5	1.1	2.6	2.4	2.7	2.0	2.1	1.5
West North Central	8.1	1.1	0.4	0.9	0.9	1.5	1.1	1.1	1.0
South	42.1	2.4	1.6	3.6	4.4	6.5	7.5	8.0	8.2
South Atlantic	22.2	1.3	0.8	1.6	2.1	3.1	4.3	4.5	4.4
East South Central	7.1	0.4	0.2	0.7	0.7	1.3	0.9	1.5	1.4
West South Central	12.8	0.7	0.5	1.3	1.6	2.1	2.3	1.9	2.4
West	24.8	1.9	0.9	3.0	3.1	4.9	4.2	3.8	3.1
Mountain	7.9	0.4	0.1	0.5	0.4	1.6	1.6	1.7	1.5
Mountain North	3.9	0.3	Q	0.3	0.2	0.8	0.8	0.7	0.6
Mountain South	4.0	Q	Q	0.2	0.2	0.8	0.8	1.0	0.9
Pacific	16.9	1.4	0.7	2.4	2.7	3.3	2.6	2.1	1.6
Urban and Rural[2]									
Urban	88.1	11.9	4.5	12.0	11.4	14.7	13.3	11.3	8.9
Rural	25.5	2.5	0.7	1.5	1.8	3.6	3.7	5.0	6.6
Metropolitan and Micropolitan Statistical Area									
In metropolitan statistical area	94.0	12.0	4.2	11.5	11.1	15.1	14.0	13.2	12.9
In micropolitan statistical area	12.4	1.5	0.6	1.4	1.5	2.0	1.9	1.8	1.7
Not in metropolitan or micropolitan statistical area	7.2	0.9	0.4	0.6	0.7	1.3	1.1	1.4	0.9
Climate Region[3]									
Very Cold/Cold	38.8	7.7	2.1	5.4	4.5	6.1	5.0	4.3	3.8
Mixed-Humid	35.4	4.5	1.7	3.7	3.9	4.9	4.8	6.0	5.9
Mixed-Dry/Hot-Dry	14.1	0.8	0.5	2.1	1.8	3.0	2.2	2.0	1.7
Hot-Humid	19.1	0.6	0.7	1.7	2.1	3.4	3.9	3.2	3.5
Marine	6.3	0.7	0.2	0.7	1.0	0.9	1.0	0.9	0.7
Housing Unit Type									
Single Family Detached	71.8	9.0	3.7	10.3	8.7	9.8	9.2	10.4	10.8
Single Family Attached	6.7	1.1	0.2	0.6	0.5	1.1	1.4	0.8	1.0
Apartments in 2 to 4 Unit Buildings	9.0	2.3	0.6	1.2	1.2	1.5	1.1	0.8	0.4
Apartments in 5 or More Unit Buildings	19.1	2.0	0.7	1.3	2.6	4.1	3.5	2.5	2.4
Mobile Homes	6.9	Q	Q	0.1	0.4	1.8	1.8	2.0	0.9

Table HC6.3 Space Heating in U.S. Homes, by Year of Construction, 2009

Million Housing Units, Final

Space Heating	Total U.S.[1] (millions)	Year of Construction							
		Before 1940	1940 to 1949	1950 to 1959	1960 to 1969	1970 to 1979	1980 to 1989	1990 to 1999	2000 to 2009
Total Homes	113.6	14.4	5.2	13.5	13.3	18.3	17.0	16.4	15.6
Space Heating Equipment									
Use Space Heating Equipment	110.1	14.2	5.0	13.1	12.7	17.5	16.4	16.0	15.2
Have Space Heating Equipment But Do Not Use It	2.4	0.2	Q	0.3	0.3	0.5	0.4	0.3	0.3
Do Not Have Space Heating Equipment	1.2	0.1	0.1	0.1	0.2	0.3	0.1	0.1	Q
Main Heating Fuel and Equipment[2]									
Natural Gas	55.6	8.5	3.1	8.3	7.3	8.1	6.6	7.0	6.7
Central Warm-Air Furnace	44.3	5.1	2.0	6.4	5.4	6.7	5.7	6.6	6.3
For One Housing Unit	42.5	4.7	1.9	6.2	5.1	6.4	5.5	6.4	6.2
For Two or More Housing Units	1.8	0.4	0.1	0.2	0.4	0.3	0.2	0.1	Q
Steam or Hot Water System	6.9	2.6	0.5	1.1	1.1	0.7	0.5	0.2	0.2
For One Housing Unit	3.7	1.5	0.2	0.6	0.5	0.2	0.3	0.2	0.1
For Two or More Housing Units	3.2	1.1	0.3	0.4	0.6	0.5	0.3	Q	Q
Built-In Room Heater	2.3	0.5	0.3	0.5	0.4	0.3	0.2	Q	Q
Floor or Wall Pipeless Furnace	1.2	0.2	0.2	0.3	0.2	0.2	0.1	Q	N
Other Equipment	0.9	0.1	Q	0.1	0.1	0.1	0.1	Q	0.2
Electricity	38.1	2.1	0.9	2.6	3.8	7.0	7.8	7.1	6.8
Central Warm-Air Furnace	19.1	0.6	0.3	1.0	1.6	3.5	4.0	3.8	4.3
Heat Pump	9.8	0.4	0.2	0.5	0.7	1.6	2.0	2.2	2.2
Built-In Electric Units	5.7	0.7	0.2	0.5	0.9	1.3	1.2	0.7	0.2
Portable Electric Heater	2.7	0.3	0.1	0.5	0.4	0.5	0.4	0.3	0.1
Other Equipment	0.9	0.1	Q	0.1	0.2	0.2	0.1	Q	Q
Fuel Oil	6.9	2.2	0.6	1.5	0.9	0.7	0.4	0.3	0.3
Steam or Hot Water System	3.9	1.5	0.3	0.7	0.5	0.3	0.2	0.1	0.2
For One Housing Unit	2.6	1.0	0.2	0.5	0.3	0.2	0.2	0.1	0.1
For Two or More Housing Units	1.3	0.5	0.1	0.3	0.2	0.1	Q	Q	Q
Central Warm-Air Furnace	2.7	0.7	0.3	0.6	0.3	0.4	0.2	0.1	0.1
Other Equipment	0.3	Q	Q	0.1	Q	Q	Q	Q	Q
Propane/LPG	5.6	0.7	0.2	0.3	0.3	0.9	0.9	1.2	1.1
Central Warm-Air Furnace	3.9	0.4	Q	0.2	0.2	0.5	0.7	0.9	0.9
Other Equipment	1.7	0.3	Q	0.1	0.1	0.3	0.2	0.3	0.2
Wood	2.8	0.4	0.2	0.3	0.3	0.6	0.6	0.3	0.3
Heating Stove	2.2	0.3	0.1	0.3	0.2	0.4	0.5	0.2	0.2
Other Equipment	0.6	0.1	Q	Q	Q	0.2	0.1	Q	Q
Kerosene	0.5	Q	Q	Q	Q	0.1	Q	Q	Q
Other Fuel	0.5	0.2	Q	Q	Q	Q	Q	Q	Q
Do Not Have or Use Heating Equipment	3.5	0.3	0.2	0.5	0.6	0.8	0.5	0.4	0.3