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**AGA/APGA's questions regarding the use of AHRI Shipment Data
in the LCC spreadsheet**

DOE: AGA/APGA have some questions regarding the use of AHRI Shipment Data in the LCC spreadsheet, to which we would appreciate prompt responses.

Overall QUESTION: Please explain the detailed methodology used in the TSD and LCC spreadsheet to determine the fractions of each efficiency level in the baseline (no rule) scenario. This includes the approach to:

Overall RESPONSE: The approach for estimating the base case efficiency distributions is explained in Chapter 8 (section 8.2.2.8), Appendix 8-I, and Chapter 10 (section 10.4) of the TSD (link: <http://www.regulations.gov/#!documentDetail;D=EERE-2014-BT-STD-0031-0027>). All calculations and raw data are available for review by stakeholders in the "Efficiency", "Efficiency Data", and "Shipment Data" worksheets of the Analysis Inputs spreadsheet (link: <http://www.regulations.gov/#!documentDetail;D=EERE-2014-BT-STD-0031-0020>). Also see page 243 to 262 of the Residential Furnace Transcript (Part 1) and pages 83 to 86 of Residential Furnace Transcript (Part 2) for further discussion and answers to stakeholder questions.

SUB-QUESTION A: Incorporating the 1994 through 2009 state-level AHRI condensing and non-condensing furnace shipment data available only to LBNL as confidential information,

RESPONSE A: These AHRI data are not confidential and are fully available in "Shipments Data" worksheet of the Analysis Inputs Spreadsheet. For the 2007 Furnace and Boiler Final Rule analysis, AHRI provided state-level condensing and non-condensing furnace shipment data from 1992 to 2003 (see cells B22 to AD76 in the "Shipments Data" worksheet of the Analysis Inputs spreadsheet). For the 2011 Furnace Direct Final Rule analysis, AHRI provided 2004 to 2009 condensing and non-condensing furnace shipment data disaggregated between the North and Rest of Country regions (see cells AF4 to AK20 in the "Shipments Data" worksheet of the Analysis Inputs spreadsheet). This data was aggregated into 30 regions to match the RECS 2009 regions used in this analysis (see cells BC4 to BN39 in the "Efficiency Data" worksheet of the Analysis Inputs spreadsheet).

AHRI did not provide state level data from 2004 to 2009. From 2004 to 2009, DOE used the 1992 to 2003 AHRI state level data together with the North and Rest of Country 2004 to 2009 AHRI data to come up with disaggregated data estimates for each of the 30 regions (see cells AW4 to BB39 in the "Efficiency Data" worksheet of the Analysis Inputs spreadsheet) as follows:

1. 1992 to 2003 AHRI state level data was used to calculate the average condensing fraction by the 30 regions used in the analysis as shown in cells D4 to D39 in the “Efficiency Data” worksheet of the Analysis Inputs spreadsheet.
2. 2004 to 2009 AHRI North and Rest of Country data was used to calculate adjustment factors for each region as shown in cells AW51 to BB52 in the “Efficiency Data” worksheet of the Analysis Inputs spreadsheet.
3. The fractions from (1) and (2) are multiplied to generate the final fractions by the 30 regions shown in cells AW4 to BB39 in the “Efficiency Data” worksheet of the Analysis Inputs spreadsheet.

SUB-QUESTION B: Bridging the current gap in state-level shipment data starting in 2010,

RESPONSE B: From 2010 to 2012, DOE used the 1992 to 2003 AHRI state level data together with 2010 to 2012 Energy Star data and 2004 to 2009 AHRI regional data to come up with estimates for each of the 30 regions (see cells AT4 to AV39 in the “Efficiency Data” worksheet of the Analysis Inputs spreadsheet) as follows:

1. 1992 to 2003 AHRI state level data was used to calculate the average condensing fraction by the 30 regions used in the analysis as shown in cells D4 to D39 in the “Efficiency Data” worksheet of the Analysis Inputs spreadsheet.
2. From 2010 to 2012 DOE used national Energy Star data on the national fraction of condensing furnaces (see cells AT58 to AV58 in the “Efficiency Data” worksheet of the Analysis Inputs spreadsheet) and the 2004 to 2009 AHRI North and Rest of Country data average ratios (see cells E6 to E7 in the “Efficiency Data” worksheet of the Analysis Inputs spreadsheet) was used to calculate adjustment factors by region as shown in cells AT51 to AV52 in the “Efficiency Data” worksheet of the Analysis Inputs spreadsheet.
3. The fractions from (1) and (2) are multiplied to generate the final fractions by the 30 regions shown in cells AT4 to AV39 in the “Efficiency Data” worksheet of the Analysis Inputs spreadsheet.

SUB-QUESTION C: Determining the fractions of each condensing furnace efficiency level (90, 92, 95, and 98% AFUE),

RESPONSE C: How DOE derived the fractions of condensing furnace efficiency level (90, 92, 95, and 98% AFUE) is described in section 8I.3 of Appendix 8I. DOE used a reduced model set of NWGF models based on the February 2013 version of the AHRI directory and furnace manufacturer input to come up with 2013 fractions for each of the efficiency levels.

The development of reduced model set is further described in Appendix 7-D. This is the same the reduced model set that was used for the 2014 Residential Furnace Direct Final Rule Analysis. The raw data of the models data used is available in the “Model Directory” worksheet of the Analysis Inputs spreadsheet (cells B3 to X399 for non-condensing models and cells Z3 to AV556 for condensing models). To create the

fractions of NWGFs by efficiency levels, DOE used the following criteria to process the reduced AHRI model directory data (a summary of the resulting fractions is available in cells AH5 and AJ9 in the “Efficiency” worksheet of the Analysis Inputs spreadsheet):

1. The 80-percent AFUE bin: includes 80-percent to 81-percent AFUE models
2. The 90-percent AFUE bin: includes 90-percent to 91-percent AFUE models
3. The 92-percent AFUE bin: includes 92-percent to 94-percent AFUE models
4. The 95-percent AFUE bin: includes 95-percent to 97-percent AFUE models
5. The 98-percent AFUE bin: includes 98-percent to 99-percent AFUE models

Based on furnace manufacturer input during the manufacturer interviews, DOE assumed that the fraction by furnace efficiency level varied by region (North and Rest of Country) and market segment (replacements and New construction) as follows (see cells W6 and Z9 in the “Efficiency” worksheet of the Analysis Inputs spreadsheet):

1. Replacements (North): Assumed to have the same distribution of efficiencies among the condensing units as in the reduced model set based on February 2013 AHRI Directory as described above.
2. Replacements (Rest of Country): Higher efficiency levels (AFUE of 95 percent and 98 percent) were assumed to have one third as much of the market share as in North replacement market, and the remaining two thirds was distributed to the lower efficiency levels (AFUE of 90 percent and 92 percent). DOE assumed that the fraction of 95-percent AFUE and above shipments would be higher (three times more) in the North compared to the Rest of Country because of furnace manufacturer input and the higher ENERGY STAR level in the North (95-percent AFUE) compared to Rest of Country (90-percent AFUE).
3. New Construction (North): Based on manufacturer input, higher efficiency levels (AFUE of 95 percent or 98 percent) in new construction were assumed to have one half as much of the market share as in North replacement market, and that the remaining half is distributed to the lower efficiency levels (AFUE of 90 percent and 92 percent).
4. New Construction (Rest of Country): Based on manufacturer input, higher efficiency levels (AFUE of 95 percent and 98 percent) in new construction were assumed to have one half as much of the market share as in replacement Rest of Country market, and that the remaining half is distributed to the lower efficiency levels (AFUE of 90 percent and 92 percent).

SUB-QUESTION D: Dis-aggregating state-level shipment data into new vs. replacement and residential vs. commercial,

RESPONSE D: The disaggregated state level data is grouped into the corresponding 30 regions for residential furnaces installed in residential applications for replacements (see cells V15 and Z44 of the “Efficiency” worksheet of the Analysis Inputs spreadsheet) and for new construction (see cells V49 and Z78 in the “Efficiency” worksheet in the Analysis

Inputs spreadsheet). The disaggregated state level data is grouped into 9 census divisions to map to CBECS 2003 data for residential furnaces installed in commercial applications for replacements (see cells AK15 and AO23 of the “Efficiency” worksheet of the Analysis Inputs spreadsheet) and new construction (see cells AK49 and AO57 in the “Efficiency” worksheet in the Analysis Inputs spreadsheet).

SUB-QUESTION E: Adjusting projected 2021 state level shipment data that was based on historical data trends (e.g., 5% non-condensing furnace limit if projected condensing furnace shipments exceeds 95% of the state shipments)

RESPONSE E: For the projected 2013 to 2050 market shares for each of the 30 regions used in the analysis, 1994 to 2004 trends were used (see cells AK4 to AS39 in the “Efficiency Data” worksheet in the Analysis Inputs spreadsheet). The maximum share of condensing shipments for each of the 30 regions is assumed to be 95 percent. In other words, at least five percent of NWGF furnace shipments will be non-condensing.