Responses to AGA/APGA & AHRI Questions Regarding DOE NODA

The following lists responses to questions in stakeholder comments:

1) AGA/APGA - NODA Data Request: http://www.regulations.gov/#!documentDetail;D=EERE-2014-BT-STD-0031-0168
2) AHRI - Questions on NODA: Questions on NODA: http://www.regulations.gov/#!documentDetail;D=EERE-2014-BT-STD-0031-0167

Data Request: Additional information is needed from DOE to permit an understanding and evaluation of the updated or revised input parameters, values, and methodologies contained in the NODA LCC spreadsheet.

QUESTION 1: An updated version of input spreadsheet "rf_nopr_analysis_inputs_2014-02-06.xlsm" that was released with the NOPR LCC spreadsheet. The input spreadsheet contains key information on the LCC calculations and methodology for: contractor markups; implementation of the new AHRI shipment data; implementation of the new AEO forecast; implementation of the new EIA pricing data; implementation of updated NWGF input capacity percentiles.

RESPONSE: DOE will publish the updated version of the analysis input spreadsheet used for the NODA "Furnace_LCCinput_2015-09-29.xlsm". [http://www.regulations.gov/#!documentDetail;D=EERE-2014-BT-STD-0031-0173]

QUESTION 2: Supporting data and detailed descriptions of changes in building shell efficiency calculations in the NODA LCC spreadsheet as mentioned on page 16 of "Res Furnace_NODA_2015-09-04.pdf." This is currently referenced in general terms as "described in the LCC spreadsheet."

RESPONSE: The building shell efficiency factors for residential buildings come from EIA's AEO 2015 [reference case] data. (AEO 2015, Table 22. Residential Sector Equipment Stock and Efficiency. URL: http://www.eia.gov/beta/aeo/#/?id=30-AEO2015.) The building shell factors for commercial buildings come as an output of the EIA's NEMS model [reference case] data used to generate the AEO 2015 forecast (data provided to LBNL by EIA staff, more details about the NEMS model can be found at: http://www.eia.gov/forecasts/aeo/assumptions/).These values are used in the "Energy Use Adj Factors" worksheet of the LCC spreadsheet (cells B16:F27 and AN3:AS164).

QUESTION 3: Supporting data and detailed descriptions of changes in climate indices used to adjust energy use as mentioned on page 16 of "Res Furnace_NODA_2015-09-04.pdf." This is currently referenced in general terms as "described in the LCC spreadsheet."

RESPONSE: Climate indices come from HDD and CDD projections from EIA's AEO 2015 [reference case] data. (AEO 2015, Table 4: Residential Sector Key Indicators and Consumption and Table 5: Commercial Sector Key Indicators and Consumption. URLs: http://www.eia.gov/beta/aeo/#/?id=4-AEO2015 and http://www.eia.gov/beta/aeo/#/?id=5-AEO2015.) These values are used in the "Energy Use Adj Factors" worksheet of the LCC spreadsheet (cells B29:F33 and O3:AL68).

QUESTION 4: Supporting data and detailed descriptions of the "updated engineering analysis" that is referenced in the "*NODA Analysis Update"* sheet under the "Prod Price" changes.

RESPONSE: The engineering analysis was updated with the most recent raw materials and purchase parts cost data and updated to 2014$. Raw materials costs were updated using data from public sources (such as Producer Price Index (PPI) data from the U.S. Bureau of Labor Statistics (BLS)) and subscription-based sources (such as the American Metals Market), as well as non-public information obtained from manufacturers under non-disclosure agreements (NDA). Purchased part costs were updated using public sources (such as PPI data from the BLS) as well as non-public information obtained from manufacturers (under NDA).

QUESTION 5: Clarification as to whether or not changes have been made to the "*NWGF Switching"* sheet that was omitted from the descriptions of changes in the "*NODA Analysis Updates*" Sheet of the NODA LCC spreadsheet.

RESPONSE: No changes were made to "NWGF Switching" worksheet.

QUESTION 6: Describe the "bug" in the "AFUE Existing" assignment and what was done to correct the bug, with references to specific locations in the NODA LCC spreadsheet. (*Related question from AHRI: Can you provide additional explanation on the "bug" that has been fixed in the "AFUE (Existing)" worksheet?*)

RESPONSE: DOE corrected cells D6 and D7 in "AFUE Existing" worksheet so that the worksheet correctly displayed the regional ID for each sampled household.

QUESTION 7: Describe the methodology and rationale for choosing 1.3 vs. 1.7 oversizing factors in the "*Furnace & AC Sizing"* Sheet of the NODA LCC spreadsheet.

RESPONSE: The 1.7 and 1.35 oversizing factors were added to the NODA analysis in order to account for the potential downsizing that can occur from a separate small furnace standard. Based on the federal test procedure for furnaces, DOE assumed a 0.7 oversize factor to be the average for all US homes (see the referenced ASHRAE Standard 103-1993, section 11.2.8.2), which is equivalent to the 1.7 factor applied in the LCC spreadsheet. For the analysis of small furnaces, DOE assumed that consumers would "downsize" their equipment in order to be able to purchase a non-condensing 80% AFUE small furnace rather than purchase a condensing furnace with the same input capacity. For the downsizing methodology, DOE assumed that

consumers would downsize if the resulting input capacity was at least half of the existing 70% oversize factor (i.e., the oversizing factor would at least 0.35 which would be equivalent to the 1.35 factor being applied in the LCC spreadsheet). This is the higher end of what ACCA recommends in terms of the oversizing being between 0% and 40%. (see Expert Meeting Report: Achieving the Best Installed Performance from High- Efficiency Residential Gas Furnaces. URL: http://www.nrel.gov/docs/fy12osti/54267.pdf)

QUESTION 8: Describe the methodology used to arrive at the Net Cost percentages included in Tables III.2 and III.3 of "Res Furnace_NODA_2015-09-04.pdf."

RESPONSE: .The fractions in Tables III.2 and III.3 are derived by dividing the fraction of consumers impacted by the total fraction of furnace consumers including (consumers installing small furnaces). This fraction is calculated in column "W" of the "Summary" worksheet for each of the small furnace scenarios.

QUESTION 9: Describe methodology/logic of implementing dual standard scenario, and downsizing options.

RESPONSE: As described in section II.A.1 of the NODA notice, DOE assigned an input capacity for the existing furnace of each housing unit based on an algorithm that correlates the heating square footage and the outdoor design temperature for heating (i.e., the temperature that is exceeded by the 30-year minimum average temperature 1 percent of the time) with the distribution of input capacity of furnaces. The distribution of input capacity is based on shipments data by input capacity bins for the year 2000 provided by AHRI, formerly GAMA (Furnace and Boiler Shipments data provided to DOE for Furnace and Boiler ANOPR; January 23, 2002). The AHRI data was further disaggregated into 5-kBtu/h bins using the reduced models dataset from the NOPR analysis. Appendix 7B of the NOPR TSD provides details about furnace sizing method. DOE assumed that, for the new furnace installation, the input capacity would remain the same. DOE's analysis accounted for the typical oversizing of furnace capacity (i.e., the furnace is larger than it needs to be to fulfill the building heating load). Based on the federal test procedure for furnaces, DOE assumed a 0.7 oversize factor to be the average for all US homes (see the referenced ASHRAE Standard 103-1993, section 11.2.8.2), which is equivalent to the 1.7 over-sizing factor applied in the LCC spreadsheet.

If there is a separate standard for small furnaces, DOE expects that some consumers who would otherwise install a typically-oversized furnace would choose to downsize in order to be able to purchase a non-condensing furnace. For the NODA analysis, DOE identified those sample households that might downsize at the considered small furnace capacity limit. DOE first determined if a household would install a non-condensing furnace with an input capacity greater than the small furnace size limit without amended standards. In the standards case, DOE assumed that a fraction of such consumers would downsize to the input capacity limit for small furnaces.

QUESTION 10: The NODA LCC spreadsheet provides a dropdown box (see cell D23 in the Summary tab of the LCC spreadsheet) that provides options for various Standard Scenarios. The options in the dropdown box include Dual Standard selections for input capacities for small furnaces with thresholds of less than or equal to 70, 75, 80, 85 and 90 kBtus/hr. However, the tables included in the NODA do not include the LCC or the NIA spreadsheet results for these scenarios. Please provide the LCC and NIA spreadsheet results for each of these scenarios in a similar fashion that the other scenario results were presented in the NODA. (*Related question from AHRI: The recently issued Residential Furnace NODA analysis only looked at small furnace definitions for input limits up to 65kBtu/h. Yet the spreadsheet has options to define small furnace up to 90kBtu/h. As such the NODA only provides partial information on the concept of two classes of furnaces based on input rate. We request that DOE complete the analysis for at least the remaining optional definitions provided in the drop-down menu in the LCC spreadsheet. We ask that DOE also expand this analysis to include 95kBtu/h and 100 kBtu/h as possible defining limits.*)

RESPONSE: The LCC and NIA results for all the Dual Standard scenario options included in the dropdown box of the LCC spreadsheet (cell D23) are provided below.

Table 1: Share of Sample Households by Furnace Size (percent)

Furnace Size	Small Furnace Definition (kBtu/hour)										
	≤ 40	≤ 45	≤ 50	≤ 55	≤ 60	≤ 65	≤ 70	≤ 75	≤ 80	≤ 85	≤ 90
Large	94	92	86	85	68	62	57	47	35	35	28
Small	6	8	14	15	32	38	43	53	66	66	72
Total	100	100	100	100	100	100	100	100	100	100	100

Table 2: Average LCC Savings for Alternative Furnace Standard Level Combinations (2014$)

Minimum AFUE (%)		Average LCC Savings (2014$)*										
		Small Furnace Definition (kBtu/hour)										
Large	Small	≤ 40	≤ 45	≤ 50	≤ 55	≤ 60	≤ 65	≤ 70	≤ 75	≤ 80	≤ 85	≤ 90
90	80	$382	$383	$400	$400	$492	$484	$484	$489	$475	$475	$432
92	80	$461	$463	$478	$479	$553	$525	$536	$534	$507	$507	$479
95	80	$438	$439	$447	$449	$479	$437	$457	$453	$411	$411	$390
98	80	$361	$365	$372	$374	$388	$347	$362	$363	$316	$316	$304

* The average LCC savings only include those consumers who would be affected at a given standard level.

Table 3: Share of All Consumers Experiencing a Net Cost for Alternative Furnace Standard Level Combinations

Minimum AFUE (%)		% of Consumers Experiencing a Net Cost										
		Small Furnace Definition (kBtu/hour)										
Large	Small	≤ 40	≤ 45	≤ 50	≤ 55	≤ 60	≤ 65	≤ 70	≤ 75	≤ 80	≤ 85	≤ 90
90	80	17%	16%	13%	13%	8%	6%	6%	4%	2%	2%	2%
92	80	15%	14%	12%	12%	7%	5%	5%	4%	2%	2%	2%
95	80	19%	18%	16%	15%	10%	8%	8%	6%	4%	4%	3%
98	80	38%	37%	33%	33%	25%	23%	20%	16%	12%	12%	10%

Table 4: Share of All Consumers in the South Experiencing a Net Cost for Alternative Furnace Standard Level Combinations

Minimum AFUE (%)		% of Consumers Experiencing a Net Cost										
		Small Furnace Definition (kBtu/hour)										
Large	Small	≤ 40	≤ 45	≤ 50	≤ 55	≤ 60	≤ 65	≤ 70	≤ 75	≤ 80	≤ 85	≤ 90
90	80	25%	23%	19%	19%	9%	6%	6%	4%	2%	2%	1%
92	80	22%	21%	17%	17%	8%	5%	5%	3%	1%	1%	1%
95	80	27%	25%	21%	21%	12%	8%	8%	5%	3%	3%	2%
98	80	38%	35%	30%	29%	18%	14%	12%	8%	5%	5%	4%

Table 5: National Energy Savings for Alternative Furnace Standard Level Combinations (quads)

Min AFUE (%)		Small Furnace Definition (kBtu/hour)										
Large	Small	≤ 40	≤ 45	≤ 50	≤ 55	≤ 60	≤ 65	≤ 70	≤ 75	≤ 80	≤ 85	≤ 90
92	80	2.9	2.9	2.9	2.9	2.3	1.8	1.7	1.3	0.8	0.8	0.7
95	80	4.2	4.2	4.2	4.1	3.4	2.8	2.7	2.1	1.4	1.4	1.2
98	80	5.8	5.8	5.7	5.7	4.9	4.2	3.9	3.2	2.2	2.2	1.8

Table 6: National Net Present Value of Benefits for Alternative Furnace Standard Level Combinations at 7-percent Discount Rate (billion 2014$)

Min AFUE (%)		Small Furnace Definition (kBtu/hour)										
Large	Small	≤ 40	≤ 45	≤ 50	≤ 55	≤ 60	≤ 65	≤ 70	≤ 75	≤ 80	≤ 85	≤ 90
92	80	3.0	3.1	3.5	3.5	3.0	2.4	2.3	1.8	1.0	1.0	0.8
95	80	4.1	4.2	4.6	4.6	4.2	3.6	3.4	2.8	1.8	1.8	1.4
98	80	3.7	3.8	4.4	4.4	4.6	4.0	3.8	3.1	2.1	2.1	1.7

Table 7: National Net Present Value of Benefits for Alternative Furnace Standard Level Combinations at 3-percent Discount Rate (billion 2014$)

Min AFUE (%)		Small Furnace Definition (kBtu/hour)										
Large	Small	≤ 40	≤ 45	≤ 50	≤ 55	≤ 60	≤ 65	≤ 70	≤ 75	≤ 80	≤ 85	≤ 90
92	80	14.7	14.7	14.8	14.8	11.8	9.1	9.0	7.1	4.1	4.1	3.3
95	80	20.2	20.2	20.1	20.0	16.9	13.9	13.4	10.8	6.9	6.9	5.6
98	80	23.9	23.9	24.0	23.9	21.3	18.4	17.2	14.2	9.5	9.5	7.8