BEFORE THE

OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

UNITED STATES DEPARTMENT OF ENERGY

WASHINGTON, D.C.

Docket Number EERE-2014-BT-STD-0031/ RIN NO. 1904-AD20

COMMENTS OF THE AMERICAN PUBLIC GAS ASSOCIATION ON THE SUPPLEMENTAL NOTICE OF PROPOSED RULEMAKING

November 22, 2016

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Technical Analysis of DOE Supplemental Notice of Proposed Rulemaking on Residential Furnace Minimum Efficiencies, GTI-16/0002, and accompanying spreadsheets

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I. Introduction

The American Public Gas Association (APGA)[1] submits these comments regarding the Supplemental Notice of Proposed Rulemaking (SNOPR) issued in the above-referenced proceeding by the Office of Energy Efficiency and Renewable Energy, Department of Energy (DOE) and published in the Federal Register on September 23, 2016.[2] Accompanying these comments and incorporated herein are the Gas Technology Institute's (GTI) "Technical Analysis of DOE Supplemental Notice of Proposed Rulemaking on Residential Furnace Minimum Efficiencies" (GTI-16/0002) and accompanying spreadsheets (GTI SNOPR Report) and the GTI Topical Report (GTI-16/0003), "Empirical Analysis of Natural Gas Furnace Sizing and Operation" (GTI Topical Report).[3]

On July 10, 2015, APGA submitted comments (APGA NOPR Comments), accompanied by a technical report of GTI (GTI NOPR Report), regarding the Notice of Proposed Rulemaking

[1] APGA is the national association for publicly-owned natural gas distribution systems. There are approximately 1000 public gas systems in 36 states, and over 700 of these systems are APGA members.

[2] 81 Fed. Reg. 65720.

[3] These documents, which were posted on November 21, 2016, are located at the GTI web site (http://www.gastechnology.org/reports).

(NOPR) issued in this docket by DOE on March 12, 2015.[4] Those comments, along with the APGA comments of October 14 and November 12, 2015, regarding the Notice of Data Availability (NODA) issued by DOE on September 14, 2015,[5] are incorporated herein. The APGA NOPR and NODA comments took issue with a number of factual and legal assertions in the NOPR and the NODA. For the most part, the points made in the APGA NOPR and NODA Comments remain valid today as related to the SNOPR, as will be discussed in subsequent sections of these comments. For a host of reasons set forth herein and in the APGA NOPR and NODA comments, in the GTI NOPR and NODA Reports, and in the GTI SNOPR Report and GTI Topical Report accompanying these comments, the SNOPR should be withdrawn and a stakeholder or peer review process begun to discuss fixes for the significant errors and omissions discussed therein and below.

II. Background

The "Background" section of the APGA NOPR Comments (pp. 3-5), which addressed the salient events regarding residential furnace standards preceding the issuance of the NOPR, is supplemented below to account for subsequent events.

DOE issued the NODA on September 12, 2015, in which it indicated that it had "completed a provisional analysis of the potential economic impacts and energy savings that could result from promulgating amended energy conservation standards for residential non-weatherized gas furnaces (NWGFs) that include two product classes defined by input capacity …."[6] DOE asked for "comments, data, and information regarding this analysis,"[7] such comments to be filed by October 14, 2015.

On September 15, 2015, APGA and the American Gas Association (AGA) submitted a data request (Joint Request[8]), noting that filing meaningful comments "is impossible without

[4] 80 Fed. Reg. 13120.

[5] 80 Fed. Reg. 55038.

[6] *Id*.

[7] *Id*. at 55045.

[8] Http://www.regulations.gov/#!docketDetail;dct=FR+PR+N+O+SR;rpp=10;po=0;D=EERE-2014-BT-STD-0031-0168.

being provided additional data by DOE underlying and explaining the NODA and the accompanying spreadsheets, and then having a technical analysis to discuss the data." (Joint Request at 1.) The Joint Request asked DOE for an extension of time to review and analyze the requested data before filing comments.

DOE, without explanation, declined to provide the requested data or the additional time prior to the NODA comment date of October 14. Notwithstanding DOE's failure to respond timely to the Joint Request, GTI was able to do a limited "Technical Analysis of Furnace Sizing for the DOE Notice of Data Availability on Residential Furnace Minimum Efficiencies" (GTI NODA Report), which was attached to the APGA NODA comments filed on October 14.

On the morning of October 15, APGA was served electronically with a DOE email indicating that DOE "has issued a pre-publication *Federal Register* notice reopening the comment period regarding the Notice of Data Availability (NODA) concerning residential furnaces. The comment period is reopened for an additional 14 days after publication in the *Federal Register*. (October 15, 2015)." Much later on that same day, APGA was served electronically with a DOE email indicating that DOE was posting "documents regarding the notice of data availability for energy conservation standards for residential furnaces."

On November 6, 2015, APGA filed supplemental comments noting the above series of events, observing that DOE had declined to inform APGA/AGA (or the public generally) before the October 14 comment deadline that it was intending to provide the requested data and extend the comment deadline. DOE obviously knew well ahead of the October 14 deadline that it was going to produce additional data regarding the NODA in response to the Joint Request and to extend the deadline for comments, as such decisions are not made on the spur of the moment.[9] It also knew that given the October 14 deadline set forth in the NODA, parties like APGA, unless timely informed of an extension, would be spending their limited resources on legal and analytical input so that comments could be filed on the October 14 date designated in the NODA.

[9] Internal DOE documents secured by APGA under a Freedom of Information Request confirm that the draft data response prepared by the DOE contractor (Lawrence Berkeley National Laboratory (LBNL)) was in DOE's hands by October 1, 2015 (see attached), which meant that DOE had authorized it well before that date.

Yet, DOE remained silent (as least as to those parties seeking the data and seeking more time), knowing full well that its actions would prejudice those parties that filed comments timely.

Unfortunately, it appears to APGA that these actions by DOE were premeditated and, as noted, were highly prejudicial to APGA and like-situated parties; APGA has expressed these sentiments to the DOE Secretary in a letter dated October 22, 2015 (attached) and to the DOE Inspector General in a communication dated November 17, 2015 (attached). APGA determined that the expenditure of additional of its limited resources to respond to the NODA analyses using the data released on October 15 would not be an efficient use of its limited resources, as DOE appeared determined to pursue a pre-set course without regard to the data and views of those parties questioning DOE's proposals.

DOE has now issued the SNOPR proposing, *inter alia*, a 92% AFUE for residential furnaces and a small furnace exception (for furnaces at or below 55,000 Btu/hour input), to become effective in 2022. DOE has failed in the SNOPR to address, much less correct, the key technical flaws in the NOPR and NODA analyses; these same flaws also undermine the SNOPR analysis and outcomes. In addition, DOE is outlawing non-condensing furnaces above the 55,000 Btu/hour input level, in violation of the EPCA. DOE continues to ignore the facts showing that the furnace market is functioning as it should, with consumers choosing condensing furnaces in those areas of the country where the heating load results in meaningful operating cost savings and opting for non-condensing furnaces where the opposite is true. The SNOPR will therefore create market failures by forcing consumers to make uneconomic purchases or to switch to less efficient electric appliances, contrary to the letter and spirit of the EPCA.[10]

III. Threshold Legal Impediments

A. This Proceeding Is Easily and Properly Resolved If DOE Satisfies Its Statutory Obligation To Set a Separate AFUE Standard for Non-Condensing Furnaces.

The EPCA prohibits DOE from prescribing an efficiency standard if the standard is likely to result in the unavailability in the United States in any covered products of performance

[10] *E.g.*, 42 U.S.C. § 6295(f)(1)(B). DOE determined not to adopt a condensing standard in the 2007 Furnace Rule (72 Fed. Reg. 65136) due to, *inter alia*, fuel switching considerations in the South (*id.* at 65144); *see* APGA NOPR Comments at 3-4.

characteristics, features, sizes capacities and volumes that are substantially the same as those that are generally available today.[11] DOE's failure to adhere to this prohibition in the Direct Final Rule issued in 2011(DFR)[12] was specifically vacated by the Court of Appeals in its order issued April 24, 2014, in *American Public Gas Ass'n v. United States Department of Energy,* CADC No. 11-1485 (unreported). The law mandates that DOE prescribe separate standards to the extent necessary to preserve useful features.[13] DOE's failure to establish a separate efficiency standard for non-condensing furnaces in the SNOPR violates the EPCA as well as DOE's own precedent. If DOE corrects this threshold legal error in the SNOPR, then the subject proceeding is easily resolved as the only major outstanding issue, aside from the legal compliance date, is the correct AFUE for condensing furnaces.

1. APGA's NOPR Comments on Separate Standards

In response to the NOPR, APGA explained in detail the reasons that DOE cannot lawfully decline to establish a separate standard for non-condensing furnaces.[14] Specifically, APGA described:

- the unique features of non-condensing furnaces that provide utility to consumers, all of which would be eliminated under a 92% efficiency standard;[15]
- the applicable statutory requirements of EPCA Sections 325(o)(4) and 325(q)(1);[16] and
- DOE's precedent for establishing separate standards based on both installation features and venting features.[17]

APGA analyzed DOE's decision in the NOPR to not propose a separate standard for non-condensing furnaces.[18] APGA demonstrated that DOE's analysis of the issue was based on

[11] 42 U.S.C. § 6295(o)(4).

[12] 76 Fed. Reg. 37408; 76 Fed. Reg. at 67037.

[13] 42 U.S.C. § 6295(q)(1).

[14] APGA NOPR Comments at 39-50.

[15] *Id.* at 39-40; *see also* AGA NOPR Comments at 34-36.

[16] *Id.* at 41; 42 U.S.C. §§ 6295(o)(4) and (q)(1).

[17] *Id.* at 42-44.

[18] *Id.* at 44-50.

incorrect premises and that DOE otherwise failed to justify its decision.[19] APGA incorporates by reference herein its prior comments and focuses below on responding to DOE's discussion of the issue in the SNOPR.[20]

2. Analysis of the SNOPR

In the SNOPR, DOE continues to decline to establish separate efficiency standards based on the use of condensing versus non-condensing technology.[21] In doing so, DOE rehashes several points made in the NOPR, but it largely ignores APGA's responsive comments on the issue, and it fails to justify its departure from its own precedent.

DOE contends that "the consumer utility of a furnace is that it provides heat to a dwelling, and that the type of venting used for particular furnace technologies does not impact that utility."[22] Similarly, while admitting that venting "is a significant differentiator of condensing and non-condensing furnaces,"[23] DOE asserts that "venting methods do not provide unique utility to consumers beyond the basic function of providing heat, which all furnaces perform."[24]

As APGA previously explained, the DOE argument that it need only look to the "basic function" of a product (*e.g.*, providing heat) to determine whether a feature justifies a separate efficiency standard is flawed on its face.[25] The base level from which DOE must make appropriate product distinctions is "any group of covered products which have the same function or intended use."[26] The EPCA requires DOE to prescribe different standards if it finds that "covered products *within such group*" have certain distinguishing features.[27] In determining

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[19] *Id.*

[20] Specifically, APGA incorporates by reference Section V of its NOPR Comments (pp. 39-50).

[21] 81 Fed. Reg. at 65752-53.

[22] *Id.* at 65752.

[23] *Id.* at 65753.

[24] *Id.*

[25] APGA NOPR Comments at 47.

[26] 42 U.S.C. § 6295(q)(1).

[27] *Id.* (emphasis added).

whether a performance-related feature justifies the establishment of a higher or lower standard, DOE must consider factors such as "the utility to the consumer of such a feature."[28] In other words, even if all products in a group have the same function or intended use, DOE must prescribe separate standards for products within the group if there are useful features justifying different standards.

In direct contravention of this requirement, DOE proposes to rule that there is no need to prescribe different standards for non-condensing and condensing furnaces because all furnaces perform the "basic function of providing heat."[29] In so ruling, DOE would effectively nullify the standard-differentiation requirement of the EPCA. Under that logic, no covered product type could ever be subject to varying efficiency standards: All furnaces perform the function of providing heat, all dishwashers perform the function of washing dishes, all clothes dryers perform the function of drying clothes, and so on. Thus, such a reading of the EPCA "would subvert the statutory plan and contravene the elementary canon of construction that a statute should be interpreted so as not to render one part inoperative." *CSX Transp., Inc. v. Ala. Dep't of Revenue*, 562 U.S. 277, 291 (2011) (internal quotations omitted).

DOE summarily concludes that "[t]he possibility that installing a non-condensing furnace may be less costly than a condensing furnace due to the difference in venting methods does not justify separating the two types of NWGFs into different product classes."[30] In reaching this conclusion, DOE fails to address the line of contrary precedent that APGA brought to its attention.[31] On numerous occasions, DOE has established separate efficiency standards for

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[28] *Id.*

[29] 81 Fed. Reg. at 65753.

[30] *Id.* Of course, it is more than a "possibility"'; DOE's own data shows that on average, not to mention the maximum cases, the installation cost of a condensing furnace far exceeds that of a non-condensing furnace. *See* the Residential Furnaces Life-Cycle Cost and Payback Period Analysis Spreadsheet, Statistics Tab. Table 12 in the GTI NOPR Report (page 16) demonstrates, among other things, the substantial cost penalty that many homes would experience if forced to install a condensing furnace. DOE may not rely on "average" numbers to camouflage these real-world facts. *See also* Table 15 in the GTI SNOPR Report (page 22) for illustrative examples of the cost penalty associated with installing a condensing furnace.

[31] APGA NOPR Comments at 42-43.

products based on how or where the products are installed.[32] In fact, DOE has expressly relied on installation *costs* in determining that separate standards are necessary for products. For example, DOE found that the space-saving aspect of certain space-constrained residential heat pumps and air conditioners is beneficial precisely because it reduces installation costs:

> DOE believes that through-the-wall equipment intended for replacement applications can meet the definition of space-constrained products because they must fit into a pre-existing hole in the wall, and a larger through-the-wall unit would trigger a *considerable increase in the installation cost* to accommodate the larger unit.[33]

Similarly, in establishing separate standards for certain non-standard size commercial heating and air conditioning equipment, DOE explained that it was "concerned that, absent non-standard equipment, commercial customers could be forced to *invest in costly building modifications* to convert non-standard [wall] sleeve openings to standard size dimensions."[34]

In both instances noted above, DOE determined that separate standards for less-efficient products were justified due to the lower installation costs of such products. There is no rational basis for DOE to decline to establish separate standards for gas furnaces for the same reason, and it is no answer to dismiss relevant precedent on the ground that DOE makes such determinations "on a case-by-case basis,"[35] leaving DOE free to do as it pleases in any given case.[36] It is incontrovertible that a Category I (non-condensing) furnace may not be replaced with a Category IV (condensing) furnace *unless* the Category I venting system is removed and replaced with a

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[32] *Id.*

[33] *Energy Conservation Program: Energy Conservation Standards for Residential Furnaces and Residential Central Air Conditioners and Heat Pumps*, Direct Final Rule, 76 Fed. Reg. 37407, 37446 (June 27, 2011) (emphasis added).

[34] *Energy Conservation Program for Commercial and Industrial Equipment: Packaged Terminal Air Conditioner and Packaged Terminal Heat Pump Energy Conservation Standards*, Final Rule, 73 Fed. Reg. 58772, 58782 (Oct. 7, 2008) (emphasis added).

[35] 81 Fed. Reg. at 65782.

[36] Judicial precedent is quite clear that "where an agency departs from established precedent without a reasoned explanation, its decision will be vacated as arbitrary and capricious." *ANR Pipeline Co. v. FERC*, 71 F.3d 897, 901 (D.C. Cir. 1995). In other words, the agency "must provide a 'reasoned analysis indicating that prior policies and standards are being deliberately changed, not casually ignored.'" *Ramaprakash v. FAA*, 346 F.3d 1121, 1124 (D.C. Cir. 2003) (quoting *Greater Boston Television Corp. v. FCC*, 444 F.2d 841, 852 (D.C.Cir. 1970)).

Category IV venting system (plus condensate drain), often at very great cost,[37] which cost is magnified if, as is often the case, the Category IV installation orphans a gas water heater that was jointly vented with the Category I furnace. These very substantial costs associated with a Category IV replacement furnace will precipitate substantial consumer economic impact or fuel switching to less efficient alternatives, contrary to the letter and spirit of the EPCA,[38] and underscore the propriety and necessity of setting a separate standard for non-condensing furnaces.

The SNOPR asserts that "tying the concept of 'feature' to a specific technology, as suggested in the gas utility comments, would effectively lock in the technology existing at the time of such decision as the ceiling for product efficiency" and that "doing so would eliminate DOE's ability to address technological advances that could yield significant consumer benefits in the form of lower energy costs while providing the same functionality for consumers."[39] But as already explained, APGA is not suggesting that features be tied to specific technologies.[40] Rather, as the EPCA requires, DOE must consider "the utility to the consumer" in determining whether a particular feature justifies a separate standard. The unique features of non-condensing furnaces currently provide clear practical utility to consumers not offered by condensing furnaces. However, if and when the technology of condensing furnaces improves to the point where they can serve as replacements for non-condensing furnaces at little or no incremental cost,[41] then the requirements of the EPCA and relevant DOE precedents would be satisfied such

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[37] DOE Residential Furnaces Life-Cycle Cost and Payback Period Analysis Spreadsheet, Statistics Tab; *see* Table 12 in the GTI NOPR Report (page 16).

[38] DOE does not deny that fuel switching will occur; rather, it adopts a small furnace exception as a way to "reduce fuel switching" (81 Fed. Reg. at 65752), but as shown in the GTI SNOPR Report (compare Table 25 and Table 22), the proposed small furnace exception will not mitigate fuel switching to any meaningful extent and it certainly does not make the proposed rule economically viable (see subpart IV.A.5., below). If DOE is serious about mitigating fuel switching, it will decline to regulate non-small non-condensing furnaces out of the marketplace.

[39] 81 Fed. Reg. at 65752; *see also* 80 Fed. Reg. at 13138.

[40] APGA NOPR Comments at 47.

[41] DOE itself has recognized that "improvements in venting technology may soon allow a consumer to obtain the efficiency of a condensing furnace using the existing venting in a residence by sharing venting space with water heaters." 80 Fed. Reg. at 13138. *See* SNOPR, 81 Fed. Reg. at 65780-81.

that separate standards for the two furnaces types would not be required. Thus, the doomsday scenario postulated by DOE (*i.e.*, separate furnace standards forever) is without basis. But, in the meantime, DOE must, as it concedes, "base its approach on currently available data and cannot speculate as to future developments in advanced venting technologies."[42]

Finally, DOE maintains that setting separate standards for non-condensing furnaces would "undercut[] any possible energy savings that might be achieved by improving the efficiency standard for the condensing product class."[43] That is demonstrably untrue in both the short term and long term. DOE's own market data illustrates both the current high saturation of condensing furnaces and the *increasing* saturation of condensing furnaces over time,[44] all in the absence of any DOE mandate, which means that the introduction of more efficient condensing furnace standards will substantially enhance energy savings in the out years. And, of course, as noted, to the extent that technology enhancements make condensing furnaces suitable replacements for non-condensing furnaces in the long term, those energy savings will further escalate since all consumers will be using condensing furnaces.

Ironically, while in one breath DOE rejects the notion of separate standards for non-condensing and condensing furnaces, in the next breath it defends a small furnace exception under 42 U.S.C. § 6295(q).[45] Section 6295(q) provides for a higher or lower efficiency level for a class of covered products in two situations: first, where the differentiated class consumes a different kind of energy from that consumed by other covered products in the class;[46] and, second, where the differentiated class has "a capacity or other performance-related feature which other products within such type (or class) do not have and such feature justifies a higher or lower standard from that which applies (or will apply) to other products within such type (or class)." [47]

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[42] 81 Fed. Reg. at 65781.

[43] *Id.* at 65753.

[44] *See, e.g.*, TSD Appendix 8I, pages 8I-5 – 12. The corrected DOE market data shows even greater penetration of the market by condensing furnaces. GTI SNOPR Report at Figure 9; *see infra* at Sections IV.A.4.c. and IV.D.

[45] 81 Fed. Reg. at 65752.

[46] 42 U.S.C. § 6295(q)(1)(A).

[47] *Id.* at § 6295(q)(1)(B).

Presumably, since large and small furnaces burn the same "kind of fuel," DOE is not relying on the first standard in the statute to justify the small furnace exception. DOE's apparent rationale for meeting the second standard is that "establishing a less stringent standard for small furnaces would reduce fuel switching because they are more likely to be used in instances where there would otherwise be negative impacts due to a higher standard."[48] Putting to one side whether the factual predicate in that statement is accurate[49] and whether, assuming *arguendo* its accuracy, such statement satisfies the statutory standard, what is relevant about the statement for these purposes is that DOE understands that a condensing furnace standard will cause rule-driven fuel switching and that fuel switching is to be avoided under the EPCA. But DOE fails to connect the dots between venting and fuel switching – it is because of the very different venting requirements of condensing and non-condensing furnaces that the former are not replacements for the latter and hence that fuel switching will occur, especially in warmer climates where the operating cost savings of a condensing furnace do not justify the higher equipment and installation costs (driven largely by the venting challenges).[50]

Thus, while APGA applauds DOE's apparent desire to minimize fuel switching, APGA also points out that venting, which by DOE's own admission is "a significant differentiator of condensing and non-condensing furnaces,"[51] is the root cause of the fuel switching and that the only meaningful way to address the fuel switching is by recognizing the need and propriety of different standards for non-condensing and condensing furnaces generally, versus a limited exception for very small furnaces. The inability of the DOE small furnace exception to address meaningfully the fuel switching problem caused by the SNOPR 92% efficiency standard is discussed in Section IV.A.2, below.

B. DOE Has Not Met Its Peer Review Obligations

In APGA's NOPR Comments (at 5-8), APGA pointed out that in many important respects the 2007 peer review report relied upon by DOE, which was premised upon 2005 data

[48] 81 Fed. Reg. at 65752.

[49] That issue is addressed in Section IV.A.2., below.

[50] The fuel switching impacts of the SNOPR proposals on impacted consumers are shown in Table 22 of the GTI SNOPR Report (page 48), and they are dramatic, especially in the South.

[51] 81 Fed. Reg. at 65753.

and DOE procedures, "did not include critical components of the Crystal-Ball-driven spreadsheet analysis underlying the NOPR." The two most significant examples provided were DOE's reliance on random selection versus economic decision making in assigning condensing versus non-condensing furnaces among the 10,000 trial cases and the introduction of a new fuel-switching analysis; the significance of these errors is that GTI's correction eliminates the putative net benefits of both the NOPR and SNOPR proposals.[52] APGA made these same points in a June 14, 2016 letter to the Office of Management and Budget (attached).

DOE's response to these points, appearing in SNOPR section VI.L,[53] is borderline inscrutable and certainly inadequate to support its actions. Regarding random selection versus economic decision making, DOE does not even mention that issue directly; rather it states generically that "DOE has determined that the [2007] peer-reviewed analytical process continues to reflect current practice, and the Department followed that process for developing energy conservation standards in the case of the present NWGFs and MHGFs rulemaking."[54] If that statement is supposed to include random decision making under the umbrella of "peer reviewed analytical process,"[55] it is patently incorrect and disingenuous, since it is crystal clear from a review of both the February and March 2007 peer review reports that the reviewers, who were reviewing 2005 procedures, were not made aware of and did not address that important aspect of the DOE methodology.[56] The fact that DOE now argues on the merits for the first time that it is

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[52] *E.g.*, GTI NOPR Report at 9-36; GTI SNOPR Report at Tables 18, 19, 21, and 24; *see also infra* atSection IV.A.5.

[53] 81 Fed. Reg. at 65847-49.

[54] *Id.* at 65847; *see id.* at 65750; *see also* DOE Slide 52 of handout for October 17, 2016 technical conference.

[55] To the same effect, see slide 52 of the DOE power point presentation at the October 17, 2016 technical conference: "DOE has determined that the peer-reviewed analytical process continues to reflect current practice in the present rulemaking."

[56] The February 2007 peer review report is available at: http://energy.gov/eere/buildings/downloads/energy-conservation-standards-rulemaking-peer-review-report-0; the March 2007 peer review report is available at: http://energy.gov/eere/buildings/downloads/energy-conservation-standards-rulemaking-peer-review-report. In addition, the reviewers did not have the academic or professional qualifications to make such a review.

entitled to rely on random selection versus economic decision making is beside the point as to absence of peer review in 2007 and the need for such peer review today.[57]

DOE also chronicles its interactions with stakeholders in the furnace rulemaking. It was because of that interaction and the countless hours spent by GTI trying to understand the furnace selection process in the TSD spreadsheet that it became apparent that DOE was ignoring economics in its assignment of condensing versus non-condensing furnaces, and thus grossly overstating LCC savings.[58] If DOE is maintaining that these interactions somehow constituted peer review of its methodologies,[59] that is off-the-charts wrong. It was because of these interactions that parties learned for the first time of the serious errors embedded in the DOE spreadsheet approach – an approach that has not been peer-reviewed (except arguably, and unfavorably, by GTI and AHRI) but must be to comply with the applicable regulations. DOE by its own admission did not make any pre-SNOPR analysis of the substantial evidence submitted in response to the NOPR showing that the random assignment approach was fatally flawed and resulted in highly biased, pro-rule outcomes.[60] In fact, the only technical review of the use of random assignment was done in the GTI NOPR Report, which was later peer-reviewed and confirmed by AHRI,[61] and it shows that DOE's reliance on random assignment is without basis and irrational – a showing that is reinforced in the GTI SNOPR Report, which further illustrates both how unreasonable and internally inconsistent random assignment is and how proper furnace

[57] The fallacies of DOE's rationale for not using economic decision making in the selection process are addressed in detail in the GTI SNOPR Report (at sections 2.2, 2.3 and 4) and in Section IV.A.1 of these comments.

[58] *See, e.g.*, GTI SNOPR Report at Tables 8 and 9 (page 7) and Section IV.A.5., below.

[59] Slide 52 of the DOE power point presentation at the October 17, 2016 technical conference indicates that this is precisely what DOE is arguing: "In addition, there have been extensive interactions with stakeholder experts and detailed review by these parties of DOE's analytical models and data in the subject furnace standards rulemaking."

[60] October 17, 2016 technical conference, transcript page 110.

[61] The only other major stakeholder to critically review the DOE random assignment approach and the GTI critique of same is the Air-Conditioning, Heating and Refrigeration Institute (AHRI). AHRI's conclusion was that "there are severe logical problems with the LCC model, in particular in its assumption that purchasers pay no attention to economic results in the Base Case" and that "this random assignment of base case efficiencies makes no economic sense." AHRI June 22, 2016 Comments on Energy Conservation Standards for Commercial Packaged Boilers, Docket No. EERE-2013-BT-STD-0030, at pages 1 and 5.

assignment based on common-sense economic decision making can be readily accomplished based on existing data.[62]

Regarding the DOE fuel switching analysis, which GTI showed was seriously flawed in several respects, including not using the more granular data that was available to DOE (GTI NOPR Report at 18-22; *see* GTI SNOPR Report at sections 2.5 and 2.5), DOE, after referring to the stakeholder interaction process, proclaims inscrutably that: "As such, DOE's analysis, including the product switching analysis that is central to this rulemaking and was not included in the 2007 Peer Review Report, is ***not entirely inconsistent*** with the transparency and reproducibility requirements of OMB's government-wide Information Quality Guidelines, including pre-dissemination review requirements."[63] DOE then cross-references the sections of the SNOPR dealing with the product switching approach it used (which, as the GTI SNOPR Report, at pages 25-28, shows, is deeply flawed). The point is that the failure to have a "product switching analysis that is central to this rulemaking" peer-reviewed is a direct violation of the OMB and DOE regulations. The OMB Final Bulletin emphasizes that "Peer Review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community"[64] and notes that "[t]he National Academy of Public Administration suggests that the intensity of peer review should be commensurate with the significance of the information being disseminated and the likely implications for policy decisions."[65] Vague references to interactions with stakeholders are unquestionably not a substitute for peer review.

The random selection and fuel switching analyses relied upon by DOE are indisputably central to the DOE SNOPR rulemaking analysis and outcomes and hence demand to be peer-reviewed before being relied upon in a rulemaking. DOE's failure to conduct a peer review of these key analyses is arbitrary and capricious and undermines the integrity of the process. DOE's rationale for its failure is patently erroneous. To the degree that the analyses conducted

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[62] *See* Section IV.A.1., below.

[63] 81 Fed. Reg. 65848 (emphasis added). DOE slides 52 and 53 on peer review at the October 17, 2016 technical conference make no mention of the fuel switching analysis.

[64] 70 Fed. Reg. at 2665.

[65] *Id.* at 2668.

by GTI could be categorized as non-requested peer review, the GTI findings make clear the depth of the serious deficiencies in the DOE random selection and fuel switching methodologies.

C. Test Procedures

APGA pointed out in its NOPR Comments (at 8-9) that DOE had inappropriately issued the NOPR standards prior to finalizing the furnace test procedures, in violation of the EPCA and the DOE's regulations. DOE has since finalized its test procedures for furnaces,[66] and thus APGA withdraws this comment. However, APGA does believe that DOE's willingness to proceed with the NOPR prior to issuing the test procedures is emblematic of a systemic problem at DOE, namely the willingness to move ahead with rulemakings without adhering to its own regulations. This has occurred in numerous proceedings as it relates to test procedures,[67] and has also now occurred in this proceeding in the context of peer review. DOE's disdain for its own prescribed regulatory obligations must end.

D. DOE's Proposed 2022 Compliance Date Is Premature

APGA demonstrated in its comments on the NOPR that DOE's proposed compliance date for the 92% efficiency standard for residential non-weatherized gas furnaces fails to meet the six-year window between compliance dates for new appliance standards.[68] Nothing in the SNOPR justifies DOE's departure from this requirement.

Section 325(m)(4)(B) of the EPCA provides that "[a] manufacturer shall not be required to apply new standards to a product with respect to which other new standards have been required during the prior 6-year period."[69] In 2014 DOE issued new efficiency standards for furnace fans, including furnace fans for non-weatherized gas furnaces, that will apply to products manufactured on or after July 3, 2019.[70] As DOE expressly acknowledged in the NOPR, both

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[66] 81 Fed. Reg. 2628 (2016).

[67] *E.g.*, *Energy Conservation Standards for Residential Boilers*, 80 Fed. Reg. 17222 (2015); *Energy Conservation Standards for Commercial Water Heaters*, 81 Fed. Reg. 34,440 (2016).

[68] APGA NOPR Comments at 11.

[69] 42 U.S.C. § 6295(m)(4)(B).

[70] *Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnace Fans*, Final Rule, 79 Fed. Reg. 38129 (July 3, 2014).

the standard that it proposes in the instant proceeding and the furnace fan standard "*impact the same products (i.e., residential furnaces).*"[71] APGA therefore explained in its NOPR comments that any amended furnace standard resulting from the instant proceeding may not apply to products manufactured before July 3, 2025.[72]

In the SNOPR, however, DOE reverses course, claiming that it "did not intend nor does it believe Congress intended that the furnace fan standards are to be understood as a standard on residential furnaces, but instead, DOE has interpreted that statutory provision as authority to set standards for a separate covered product."[73] Not only does this new position contradict DOE's statement in the NOPR that the two standards "impact the same products (*i.e.,* residential furnaces)," but more importantly it is also inconsistent with the text and structure of the EPCA.

EPCA Section 322(a) sets forth the list of the 19 covered products.[74] Furnaces are on the list, while furnace fans are not.[75] Section 322(b) permits DOE to classify additional products as "covered products," but DOE did not, in issuing its furnace fan standards, make the determinations necessary to specially classify furnaces fans under that provision.[76] Rather, DOE expressly issued the furnace fan standards pursuant to EPCA Section 325(f)(4)(D), which mandates standards for "electricity used for purposes of circulating air through duct work."[77] Notably, Section 325(f)(4)(D) is part of Section 325(f), which is titled "Standards for furnaces and boilers,"[78] further underscoring that furnace fan standards are not standards for a separate covered product. *See Fla. Dep't of Revenue v. Piccadilly Cafeterias, Inc.*, 554 U.S. 33, 47 (2008) ("statutory titles and section headings are tools available for the resolution of a doubt about the meaning of a statute") (internal quotations omitted).

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[71] 80 Fed. Reg. at 13122 (emphasis added).

[72] APGA NOPR Comments at 11.

[73] 81 Fed. Reg. at 65747.

[74] 42 U.S.C. § 6292(a).

[75] *Id.*

[76] 42 U.S.C. § 6292(b).

[77] *Residential Furnace Fans*, 79 Fed. Reg. at 38134 (citing 42 U.S.C. § 6295(f)(4)(D)).

[78] 42 U.S.C. § 6295(f).

If Congress had intended for furnace fans to be a separate covered product, it would have defined them as such in EPCA Section 322(a) and mandated standards for them in a part of Section 325 other than Section 325(f). The fact that it did neither leads to the inescapable conclusion that the furnace fan standards are, as referenced in Section 325(m)(4)(B), "other new standards" applied to furnaces – and not standards for a separate covered product. Accordingly, under the six-year mandate of that provision, DOE cannot lawfully establish a compliance date for the 92% efficiency standard of earlier than July 3, 2025.

E. DOE May Not Omit Gas Utilities from Its Utility Impact Analysis

APGA pointed out in its NOPR Comments (at 12) that DOE regulations require as a predicate to a rule setting a new efficiency standard a Utility Impact Analysis, which "will include estimated marginal impacts on electric and gas utility costs and revenues." 10 C.F.R Part 430, Appendix A to Subpart C, section 4(a)(7)(v). The Utility Impact Analysis in the NOPR[79] was silent as to the impact of the proposed rule on gas utility costs and revenues, focusing entirely on the "effect on the power generation industry."[80]

DOE responds in the SNOPR that due to "an upward trend" in rate decoupling, gas utilities' revenues are insulated from change resulting from the actions by DOE in this proceeding.[81] APGA points out that rate decoupling is not a factor in most states and that very few of its over 700 members employ rate decoupling**.** Furthermore, rate decoupling does not insulate retail customers from higher rates as fixed costs are spread across reduced volumes due to fuel switching caused by the elimination of non-condensing furnaces with input levels larger than 55,000 Btu. This sort of rate escalation in turn affects both how new customers and existing customers view the viability of natural gas service. It is not sufficient to ignore this problem on the speculative ground that "with the modest degree of switching projected to result from the

[79] 80 Fed. Reg. at 13162.

[80] *Id.*

[81] 81 Fed. Reg. at 65810. The report referenced at note 187 of the SNOPR is dated 2010 and cites (at page 2) to 18 states with rate decoupling.

currently-proposed standards, such an outcome is highly unlikely."[82] DOE should do sensitivity analyses based on the fuel switching that its own analysis shows will occur as well as the fuel switching that will occur if the DOE analysis is corrected as suggested in the GTI SNOPR Report at pages 25-31, 63-65.

IV. Comments on the SNOPR, TSD, and Spreadsheet

A. The Significant Flaws Identified in the DOE NOPR LCC Analysis Have Not Been Corrected or Justified in the SNOPR; They Undermine Completely the Economic Justification for the SNOPR.

1. The use of random assignment produces skewed results that do not withstand analysis.

APGA showed in its NOPR Comments, which incorporated the GTI NOPR Report, that DOE's reliance on a random assignment methodology to assign Base Case furnace efficiency to each of the trial cases in the Crystal Ball simulation (versus reliance on economic decision making) was unprincipled, inconsistent with the economic analysis underlying the rest of DOE's LCC analysis, and produced significantly skewed results, grossly overstating the LCC savings associated with the proposed 92% AFUE furnace standard.[83]

DOE's reliance in the NOPR on random assignment resulted in a significant misallocation of furnaces, such that numerous homes that would have selected condensing furnaces absent a rule were assigned non-condensing furnaces, and vice versa, accounting for significant (but non-existent) LCC savings in the DOE NOPR analysis.[84] The DOE NODA analysis, which relies on "the same analytical framework" as the NOPR,[85] was similarly tainted.[86]

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[82] *Id.* The DOE fuel switching data, when viewed in the proper context of impacted consumers, shows that the fuel switching under its model is anything but modest (*see* GTI SNOPR Report at Table 22 (page 48) and Section IV.A.2., below, at pages 31-32.

[83] This flaw is discussed in the APGA NOPR Comments at 17-21 and in the GTI NOPR Report at 13-18.

[84] *E.g.*, GTI NOPR Report at 15-18 and Table 14 (at page 28).

[85] NODA, 80 Fed. Reg. at 13120.

[86] APGA NODA Comments at 3-4; GTI NODA Report at 1, 10, 11. In responding to the NODA, APGA and GTI were handicapped by the failure of DOE to provide timely data

DOE made no attempt to address, much less cure, this fatal flaw in the SNOPR.[87] The GTI SNOPR Report, which incorporates "a higher degree of granularity than was provided in the corresponding DOE LCC spreadsheet model output files and published results,"[88] shows that the perpetuation of this flaw results in grossly overstated LCC savings (discussed *infra* in subpart IV.A.5). As the GTI SNOPR Report (at page 18) observes:

> DOE's decision to use a random assignment methodology to assign base case furnace efficiency to each of the trial cases in the Crystal Ball simulation is a significant technical flaw with meaningful impact on the DOE SNOPR LCC results. A random assignment methodology misallocates a random fraction of consumers that use economic criteria for their decisions and results in higher LCC savings compared to rational economic decision making criteria. DOE's Base Case furnaces in the 10,000 Crystal Ball trial case homes are intended to be representative of the RECS survey furnace distribution across various locations and categories. Random assignment of the Base Case furnace does not achieve this key objective and is not a technically defensible proxy for rational residential decision making processes.

Examples of the DOE misallocation resulting from random assignment are shown in Tables 14 and 15 of the GTI SNOPR Report (at page 22). Thus, for example, as illustrated in

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responses (see discussion at Part II, above). Equipped with the SNOPR TSD, GTI has been able to determine definitively that the small furnace exception proposed by DOE does not result in positive LCC savings (and hence the SNOPR, like the NOPR, is not economically justifiable). *E.g.*, GTI SNOPR Report at Tables 18, 21, and 28 and Section IV.A.5., below.

[87] GTI SNOPR Report at page 18: "The DOE SNOPR LCC model includes economic criteria and a distribution of allowable cost recovery times in its trial standard level (TSL) furnace analysis and fuel switching decision algorithm. However, DOE's Base Case furnace assignment algorithm ignores economic decision making parameters for an individual trial case. Instead, the Base Case AFUE, which is the efficiency of the furnace that is chosen by an individual consumer without the influence of DOE's rule, is assigned randomly to each of the 10,000 trial cases in the DOE SNOPR LCC model. The economics of a particular efficiency level selection compared to other levels (e.g., 80% AFUE vs. 92% AFUE) are not considered in DOE's baseline furnace decision for any of the 10,000 Crystal Ball trial cases."

[88] GTI SNOPR Report at page 12. As explained in there: "To explore the impact of various parameters on LCC results, GTI analysts added Excel Visual Basic for Applications (VBA) code to the DOE LCC spreadsheet. The VBA code extracted outputs of interest from each of the 10,000 Crystal Ball trial cases and enabled a detailed analysis of the DOE LCC spreadsheet as well as GTI's parametric scenarios. The code that was used to extract outputs of interest did not affect any calculations in the DOE SNOPR LCC models or any of the GTI parametric runs that examined the Base Case, technology, and fuel switching decision making methodology, furnace sizing algorithms, input data modifications, and integrated scenarios." The GTI parametric analysis scenarios for the SNOPR are shown on Table 11 of the GTI SNOPR Report at page 16.

Table 14, DOE includes among the impacted homes those that incur a cost penalty of in excess of $1,000 by installing a non-condensing furnace; these homes, which would experience annual operating cost savings from installing a condensing furnace, would clearly not install a non-condensing furnace, and yet under the DOE random assignment methodology, these homes are shown as impacted and thus incorrectly included in DOE's net benefit column; in the GTI scenarios, relying on consumer economic decision making, these homes are shown as not impacted. Likewise, as Table 15 shows, DOE under its random assignment approach shows homes as not impacted even though the installation of a condensing furnace would be prohibitively expensive and even though the associated annual savings from such furnace would be negligible. These homes are correctly shown in the GTI scenarios as substantially impacted.

Table 16 provides comparative results of the base case furnace assignments using DOE's random assignment approach versus a rational economic and non-economic decision framework, revealing the following (GTI SNOPR Report at page 23; emphasis in original):

> Of all new installation trial cases in the DOE SNOPR LCC model, 69% (1732/2476) have a negative payback period (i.e., negative first cost premium divided by positive annual energy savings). Of the 1,732 cases with negative payback period, 62% (1000 cases) are assigned an 80% efficient furnace by DOE's random Base Case furnace assignment methodology and therefore are misallocated as "Net Benefit" cases instead of "No Impact" cases. These misallocated cases represent 42% of the total LCC savings projected by DOE under its proposed rule. Under the limited rational economic decision framework used in GTI Scenario Int-14, these cases would be considered "No Impact" because the market would choose a condensing furnace without the DOE rule. The similarly misallocated 284 replacement cases with negative payback account for another 13% of total LCC savings projected by DOE under its proposed rule. A total of 13% (1284/9717) of residential cases and 55% of DOE's claimed rule benefit comes from a combination of builders and consumers that DOE inexplicably claims would otherwise be willing to pay extra for lower efficiency furnaces. This results in excessive claims of benefits and avoided net cost that do not reflect a connection to reasonable and expected consumer behavior and rational decision making by builders or consumers.

The effect of random assignment on the DOE payback data is also highlighted by GTI (GTI SNOPR Report at page 24):

> The difference between the two [DOE versus GTI] analyses is that in DOE's random methodology a consumer who has a short payback period is as likely as one who has a long payback period to choose a high efficiency furnace. GTI's scenarios assume that consumers are more likely, but not guaranteed, to choose a high efficiency furnace when the payback period is short. This rational consumer economic decision methodology is supported by DOE's own data that shows the reasonable correlation between payback

time and shipment data. Figure 6 shows a clear relationship between condensing furnace market share and payback periods, with high market share being achieved when payback periods reach approximately 10 years.

Additional flaws in the DOE random assignment approach, in the context of furnace sizing, are discussed in the GTI SNOPR Report at pages 41-42 and illustrated in Table 17.[89] The bottom line is that random assignment produces nonsensical results that skew the LCC savings numbers in a pro-rule manner. DOE's reliance on random assignment is clear and harmful error that undermines the validity of the SNOPR.

In the SNOPR, DOE does not deny that its furnace assignment is done on the basis of random assignment,[90] though it claims erroneously that it is "not entirely random,"[91] nor does it attempt to rebut the impact numbers that result from its erroneous random assignment approach. In fact, it did not even make computer runs, much less build a consumer choice model, to determine what the effect would be of correcting its flawed methodology to account for economic decision making.[92] Rather, it tries in the SNOPR to justify random assignment; it fails, as discussed below.

First, as noted, DOE maintains that its assignment approach is "not entirely random," explaining that furnaces are assigned at the regional and building-specific level such that the overall market share numbers are consistent with historical shipment data.[93] The fact that mathematically there is a correlation between the number of condensing furnaces assigned in a region or on a building-specific basis has nothing to do with the misallocation of furnaces in a region or on a building-specific basis resulting from DOE's failure to use economic decision making to assign furnaces. DOE's mathematical equivalence justification was equally true of the NOPR furnace assignment process, which was also shown to have misallocated a substantial

[89] *See* discussion in subpart IV.A.3., below.

[90] 81 Fed. Reg. 65789-790.

[91] *Id.* at 65789.

[92] DOE October 17, 2016 technical conference at transcript page 110.

[93] 81 Fed. Reg. at 65789.

percentage (22%) of furnaces,[94] accounting for approximately 60% of the phantom LCC saving claimed in the NOPR.

DOE claims that as to the building-specific assignment, it is "not entirely random" because if an existing household furnace is "estimated to be a condensing gas furnace, the replacement furnace is assumed to be condensing as well."[95] There are two problems with this statement: first, it appears to be false[96]; and, second, even if it were true, what this statement conveniently omits is the fact that the original "estimate" as to whether a particular dwelling had a condensing furnace was based on random assignment, not consumer economics, and hence the replacement furnace assignment is necessarily as flawed as the original "estimate." In other words, this "explanation" as to why the DOE approach is "not entirely random" is both factually inaccurate and an exercise in misdirection.

On this same point, GTI observes as follow in the GTI SNOPR Report (at page 60):

> DOE's assertion that the base case furnace assignment is not entirely random is misleading and does not address the critical technical flaw in the DOE assignment methodology. In addition, the way DOE's LCC model results are calculated and displayed in the SNOPR masks this key technical flaw and meaningful disconnect with current and projected market behavior caused by the DOE random base case furnace assignment methodology.

The GTI SNOPR Report (at page 61) explains as follows:

> The DOE random assignment approach results in a quasi-deterministic number of buildings of a given type within each of the 30 RECS or 9 CBECS regions that are considered not impacted by the rule because of the furnace shipment fractions in that region. But whether a specific trial case building will be one of those not impacted cases is strictly and totally random, dramatically biasing the model results "per impacted building" toward rule benefit.
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> DOE does not consider economics for decision making associated with Base Case AFUE assignment. The shipment data projections affect the number of impacted

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94 GTI NOPR Report at pages ix, 17.

95 *Id.*

96 Base Case AFUE assignment appears independent of anything other than type, location, and a random number generator (*see* GTI SNOPR Report at Figure 4, page 20) . Existing AFUE does not come into it. If the AFUE of an existing home is 92%, it is just as likely to be assigned an 80% on a replacement as it is to be assigned a condensing furnace.

> buildings only on a per region and type basis, not the LCC savings per impacted home, within a certain region and type, caused by a rule. For a given region and type the LCC savings per impacted building will be the same regardless of the condensing furnace shipment numbers. (new/replacement, residential/commercial).

Next, in a massive understatement, DOE admits that its approach "may not fully reflect actual consumer behavior"[97] – in point of fact, its approach completely ignores consumer behavior, as discussed above, and thus erroneously labels buildings as "not impacted" when they clearly would be and erroneously labels buildings as "impacted" when they clearly would not be, resulting in grossly overstated LCC savings. DOE offers the rather shocking and wholly unsupported proposition that random assignment, while admittedly not based on economics, "may simulate actual behavior as well as assigning furnace efficiency based solely on imputed cost-effectiveness."[98] DOE offers zero support for this supposition, which is totally at odds with DOE's approach throughout the remainder of its LCC analysis and which is readily refuted by the numbers.[99] Rather, DOE relies on working papers and the like for the unremarkable proposition that consumers do not always act in a perfectly economically rational fashion, which, of course, is uncontroverted and is what the field of behavioral economics is all about. But the fact that there are "market failures," as DOE chooses to characterize them in this context,[100] does not undermine reliance on economic decision making in the first instance as the best representation of consumer behavior,[101] just as DOE relies on economic decision making at

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[97] 81 Fed. Reg. at 65790.

[98] *Id.*

[99] As discussed below (subpart IV.A.5), when either economic decision making alone or economic decision making along with consideration of non-economic factors are taken into account, the LCC savings numbers claimed by DOE under random assignment disappear. *E.g.*, GTI SNOPR Report at pages 44-55.

[100] 81 Fed. Reg. at 65789-90. This is a rather strange term for DOE to use since its proposed rule will cause massive market failures by requiring consumers either to purchase furnaces that do not make economic sense (*i.e.*, there is a net cost versus a net benefit) or to switch to products using a less efficient energy source (*see* GTI SNOPR Report at pages 14-21).

[101] In fact, as GTI observes: "DOE's citations used to support the contention that ignoring consumer decision making is as accurate as considering economic decision making do not support DOE's claims. Arguments in those citations align much more closely with the GTI CED framework, and make the point that many consumers aren't good at making decisions based on economics, especially long range economics or large purchases. Those citations refute rather

virtually every other step of its LCC analysis.[102] The DOE's excuses for ignoring economic decision making at the critical furnace assignment stage of the LCC analysis are transparently false and misleading and dramatize its ideology-driven, result-oriented approach to setting (and rationalizing) furnace efficiency standards.

Recognition that consumers do not always act rationally in terms of economic self-interest means that the use of economic decision making should be done with care, as GTI has done by developing an LCC model approach to address non-economic factors.[103] The existence of "market failures" does not permit, especially in the context of the EPCA's economic feasibility requirement, selective amnesia, *i.e.*, relying upon available economic data except where ignoring such data skews the LCC savings in a pro-rule fashion. That is the antithesis of reasoned decision making and is the hallmark of capriciousness.

As the GTI SNOPR Report (at page 61; emphasis in original) observes:

> DOE's assertion that "*the method of assignment, which is in part random, may simulate actual behavior as well as assigning furnace efficiency based solely on imputed cost-effectiveness*" is demonstrably false and disconnected from market behavior. The inherent result of the DOE SNOPR LCC model random assignment methodology is a finding of LCC savings in any region where LCC savings are present on average whether or not the shipment data projects a very high or very low rate of condensing furnace market share in the "no-new-standards" Base Case. For example, if market penetration of condensing furnaces is projected at 90% for a given region and type of home, and LCC savings associated with condensing furnaces is <u>on average</u> positive for the region, a net LCC savings due to rule would be determined by the model without consideration of the economics associated with the 10% of consumers impacted by the rule separate from the non-impacted group. This is a critical technical flaw in the model, as shown in Figure 20. The only way LCC savings on a national basis are affected by DOE's approach is by changing the number of impacted buildings based on region and type.

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than support DOE's contention that consumers do not think about economics at all when making decisions on large appliances, and therefore random assignment should be used instead of a CED framework." GTI SNOPR Report at page 67.

[102] *See, e.g.*, GTI SNOPR Report at page 43: "The SNOPR downsizing methodology assumes a rational consumer response to a market constraint to protect their economic interests. It appropriately employs rational consumer behavior methodology, and it is inconsistent with the random furnace sizing and baseline furnace efficiency assignment methodology used by DOE elsewhere in the SNOPR."

[103] *Id.* at 34-35.

This has the effect, as GTI further notes, of "causing the DOE model to 'find' LCC savings nationally as long as consumers on average benefit from condensing furnaces nationally. The model is a priori precluded from finding that, on average, the consumers that tend to benefit are the consumers that tend to purchase condensing furnaces,"[104] which point is demonstrated by a market penetration sensitivity scenario. Figure 22 in the GTI SNOPR Report "illustrates the total disconnect from market conditions, with high bias toward rule benefit, when using the DOE random assignment methodology."[105]

In the context of furnace assignment (versus, for example, its product switching analysis or furnace downsizing analysis), DOE claims that "it is far from clear that allocating the efficiency of furnaces based solely on estimated cost-effectiveness is likely to be any more accurate than the method currently used by DOE."[106] So, DOE is claiming, in the context of furnace assignment, it should reject an approach that is based on rational consumer behavior because the consumer does not always act rationally, in favor of an approach that we know is dead wrong but has the saving grace (from DOE's point of view) of skewing the results in a manner DOE finds appealing. That is not reasoned decision making; it is the very definition of arbitrary and capricious agency action taken to reach a preordained outcome – also known as agency bias.

The proper perspective for accounting for consumer behavior is set forth in the GTI SNOPR Report at page 18, as follows:

> Consumers make purchase decisions based primarily on economics, but consider factors other than economics as well, including product performance or reliability, manufacturer reputation, intangible societal benefits, and perceived risks and rewards associated with the decision. Table 13 characterizes consumer decision making related to condensing furnaces, including economic and non-economic factors, based on unregulated market factors, market transformations, and regulatory interventions. This is a more complete decision making analytical framework because it acknowledges the value consumers attach to differentiating attributes such as delivered air temperature or risk-based decisions due to unique financial circumstances. It is possible to monetize such consumer behavioral decisions, but

[104] GTI SNOPR Report at page 61.

[105] *Id.* at 62.

[106] 81 Fed. Reg. at 65790.

> DOE chose not to address non-economic factors in the DOE SNOPR LCC Base Case furnace assignment methodology. In response to a request for suggested options by DOE in the SNOPR, GTI was able to add a set of Parametrics in this report that estimate the relative impact of economic and non-economic factors in consumer purchase decisions within the LCC analysis CED framework.

DOE claims "it does not have a method to include site-specific economics as well as non-economic decision making criteria in the Monte Carlo simulation,…."[107] That is no longer the case, if it ever was.[108] It is also noteworthy that DOE does not have site-specific information regarding fuel switching, which did not deter it from relying on a "consumer choice" model there, which model (unlike the GTI approach to furnace assignment and fuel switching) does not account for the potential for illogical consumer behavior.[109] The same can be said for DOE's furnace downsizing analysis.[110] The very simple point is that a responsible regulatory agency declines to rely on an approach that is demonstrably inaccurate and instead relies on the most relevant information that it does have, and in this instance, as in the rest of the DOE LCC economic analysis, that is the consumer economic decision making data from which rational consumer behavior can and should be determined, with such adjustments as additional data and analysis can justify.

The fact of the matter, as DOE often points out and the fuel-switching data upon which it relies shows, consumers react to high up-front costs required for more efficient furnaces; and they react by looking for less expensive alternatives, even if those less expensive alternatives

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[107] *Id.*

[108] GTI, in addition to showing that the DOE random assignment approach is irretrievably broken, has provided DOE with an approach that properly accounts for economic and non-economic factors (GTI SNOPR Report at pages 14-19, 29-31, 34-35).

[109] In fact, as discussed in subpart IV.A.2., below, DOE could have used more granular end-use data available to it that would have made its fuel switching analysis more reflective of consumer behavior but has chosen to ignore that data (presumably because such data would have produced fuel switching and LCC results less favorable to the DOE-desired outcomes) (GTI SNOPR Report at pages 25-28).

[110] "DOE agrees with the Efficiency Advocates that in the case of a standard that allows small furnaces to use non-condensing technology, many consumers would have a financial incentive to downsize their furnace." 81 Fed. Reg. at 65771; *see* Table IV-12, *id.*; *see also* TSD Ch. 8 at 8-37—39.

have higher operating costs.[111] And the poorer the consumers, the more likely and quickly they will opt for the less expensive alternative.[112] And because new furnaces involve such a hefty up-front investment and because they are typically hidden from view, in a basement or other utility room, versus, for example, sitting in the owner's driveway or kitchen and thus potentially being affected by a need to "keep up with the Joneses," consumers are more likely to make economically logical decisions in replacing a furnace than many other products – specifically asking, "can I afford the incremental up-front cost and is it worth it in terms of monthly fuel savings." These are factors for which the information is available (and relied upon, albeit imperfectly, by DOE in its fuel switching analysis). The fact that perfect information on consumer behavior is not (and never will be) available was not considered a reason for not using the available data in the DOE consumer choice model underlying the fuel switching analysis,[113] nor is it a valid reason in the context of furnace assignment.

DOE should withdraw the SNOPR as its reliance on random assignment fatally taints it; DOE should call for a stakeholder or peer review process to determine the most accurate, reasonable, and efficient method of assigning furnaces such that consumer economics are the controlling factor, with the use of whatever other data on consumer behavior seems relevant and material to the furnace purchasing decision making process. It is no excuse for DOE to suggest that reflecting economics in furnace assignment is an issue "it intends to investigate,"[114] as there is ample data available in this record to demonstrate the illegitimacy of DOE's random

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[111] *E.g.*, "The short PBP for a more-expensive product indicates that in general, consumers place a relatively high importance on first cost differences." (TSD Ch. 8, p. 8-39) " From these data, DOE deduced that consumers would expect a payback period of 3.5 years or less for a more-expensive but more-efficient product. This reflects that in general, consumers place a relatively high importance on the first cost differences." TSD Ch. 8, p. 8J-2.

[112] This is shown most dramatically by the proprietary survey data that DOE elected (erroneously) not to use (GTI NOPR Report at pp. A-9--17; GTI SNOPR Report at Appendix A, pages A-5—A-10).

[113] "DOE acknowledges that different consumers are likely to use different criteria when considering fuel switching, but the survey used by DOE does not provide sufficient information to derive a distribution of required payback periods that is transferable to DOE's methodology. Commenters did not provide any additional data on this point, nor did they suggest a more suitable source. As DOE is not aware of any better data source, it maintained its existing approach for this SNOPR." 81 Fed. Reg. at 65792.

[114] 81 Fed. Reg. at 65790.

assignment approach and options presented to perform an economics-based assignment of furnaces. Additionally, if DOE believes it requires more time to perfect such an approach, it has that time since the record shows clearly that the market is working, such that consumers for which condensing furnaces make economic sense (usually due to the size of the heating load, especially in a replacement situation) are purchasing them in large numbers, and consumers for which condensing furnaces do not make sense (again usually due to the size of the heating load) are largely purchasing non-condensing furnaces.[115] Thus, there is no excuse for DOE to press ahead with a SNOPR that relies on an approach (random assignment) that is deeply flawed on its face and produces skewed and unreliable outcomes and for which there are superior alternatives available (and provided) to DOE.

2. DOE's fuel-switching analysis is premised upon a faulty algorithm and therefore produces unusable results

A fuel-switching analysis is critically important in a proceeding in which DOE intends to remove from the furnace marketplace all non-condensing furnaces with an input capacity above 55,000 Btu/hour. DOE asserts (in a different context) that the product switching analysis is "central to this rulemaking."[116] That is true, but unfortunately the fuel-switching analysis in the NOPR suffered from several serious flaws, which were identified in the APGA NOPR Comments (at pages 21-24) and the GTI NOPR Report (at pages 18-22) and which, when corrected, undermined the NOPR proposals. Those flaws have not been addressed in the SNOPR and thus also fatally taint the SNOPR analysis and proposals.[117]

To briefly summarize the APGA NOPR Comments and GTI NOPR Report referenced above, the DOE fuel switching analysis is flawed in a number of respects, including:

1. Since the DOE fuel switching analysis is based on an incorrect classification of affected and unaffected consumers, due to reliance on random assignment, the DOE conclusion that fuel switching enhances LCC savings is exactly the opposite of what happens under economic decision making, *i.e.*, reduced LCC savings.

[115] *E.g.*, SNOPR TSD at 8I-1--2, 8I-11--12, 10-8; GTI SNOPR Report at Figure 9, page 33; *see* Section IV.D., below.

[116] 81 Fed. Reg. at 65848.

[117] GTI SNOPR Report at pages 25-28, 44-46.

2. There are a number of easily identifiable flaws in DOE's selection and use of the average 3.5 year switching payback period (a term which DOE employs in a very confusing fashion). While DOE relied on AHCS consumer survey data to derive the 3.5 year switching payback period, it essentially ignored the associated AHCS data in assessing whether such an average number should be applied indiscriminately across the board or in a more granular fashion to the affected consumers.

3. The more granular data accompanying the AHCS survey results permitted GTI to develop the full distribution of switching payback times for each income group, calculated following the DOE methodology described in the TSD but for the whole distribution of data from the AHCS survey instead of an average.

4. The distribution of switching payback times showed DOE's reliance on an average 3.5 years switching payback period to be both inaccurate and misleading due to the wide variation in payback times for both high and low income consumers and to result in overstated LCC savings, particularly as to low income consumers.

5. Relying on the more granular AHCS data, GTI developed switching payback distributions by income group and tolerable switching payback periods for lower and higher income households, respectively. These data showed that the LCC savings claimed by DOE were non-existent.

The NOPR fuel switching flaws remain uncorrected in the SNOPR (GTI SNOPR Report at pages 25-27 and Appendix A, section A.2.2), even though the data to correct them was and remains available (GTI SNOPR Report at page 27 and Appendix A, section A.3.1).

DOE claims as follows in the SNOPR (81 Fed. Reg. at 65792):

> DOE acknowledges that different consumers are likely to use different criteria when considering fuel switching, but the survey used by DOE does not provide sufficient information to derive a distribution of required payback periods that is transferable to DOE's methodology. Commenters did not provide any additional data on this point, nor did they suggest a more suitable source. As DOE is not aware of any better data source, it maintained its existing approach for this SNOPR.

On the plus side, DOE is in effect acknowledging that different consumers are likely to use different criteria when considering fuel switching, which was obvious from the survey data and which undermines the "average" 3.5 years used by DOE; DOE is also acknowledging that a distribution of required payback periods would be preferable under these circumstances.[118] But the allegation that the survey used by DOE did not provide sufficient information to derive a distribution of required payback periods that is transferable to DOE's methodology and that commenters did not provide any additional data on this point are patently inaccurate and misleading.

First, the payback data used by GTI to derive the distributions came from the same source as the AHCS survey on which DOE relied to derive the 3.5 year average number in the NOPR and the SNOPR. DOE apparently did not solicit that data from Decision Analysts, the owners of the survey data, before issuing the NOPR. Why DOE or its consultants at LBNL did not request that data (assuming *arguendo* they did not) raises a host of ugly questions. Putting those questions aside, DOE's failure to acquire and rely upon such data after the NOPR comments were filed is inexcusable as DOE was fully on notice from the APGA NOPR Comments and the GTI NOPR Report that such data existed and could be used to develop the required distributions.

As GTI points out (GTI SNOPR Report at page 64), "[t]he necessary information was constructively available to DOE during its NOPR, NODA, and SNOPR development period, requiring only a brief supplemental interaction between LBNL and the study's author, Decision Analysts, after LBNL purchased the proprietary AHCS." Unquestionably, DOE was on notice of the availability of the consumer payback data from the GTI NOPR Report (*e.g.*, pages 21 and A-9).

As for DOE's assertion that it was not able to transfer the data to DOE's analytical framework, the GTI NOPR Report, specifically section A.3.2 – Parametrics D1, D2, and D3, "includes sufficient explanatory text to easily enable a shift from a deterministic value for switching payback to a distribution function based on income group if DOE wanted to develop

[118] This is consistent with DOE's recognition in the SNOPR (81 Fed. Reg. at 65738) that "[t]o account for uncertainty and variability in specific inputs, … DOE uses a distribution of values, with probabilities attached to each value."

such a distribution." GTI SNOPR Report at pages 64-65. GTI points out (*id.* at 65) that the distribution function based on income is important because:

> the distribution is highly skewed, with long switching payback periods for higher income consumers skewing the average result. This makes the single 3.5 year average switching payback period used by DOE insensitive to market conditions and biased toward rule benefit. GTI SNOPR Scenario 36, including Parametric D2, addresses this skewed distribution in a conservative manner by averaging the allowable switching payback period distribution available from the four AHCS surveys in 2006, 2008, 2010, and 2013.

The analysis in the GTI NOPR Report has been expanded in the GTI SNOPR Report "to use the amount consumers were willing to pay for efficiency improvements from the AHCS as well as how much consumers spent on space conditioning from the RECS database, both as a function of income." (*Id.* at 65.) Further,

> Table 32 shows the dramatic impact of using the full distribution of AHCS allowable payback periods on LCC analysis results. Incorporation of the full distribution of payback periods available within the AHCS data set drives poor economic decision making with respect to fuel switching which makes LCC savings negative across all groups. The data needed to incorporate the full distribution is included in data sets DOE already used for this analysis (AHCS and RECS). [*Id.*]

In brief, the data is available to derive a distribution of required payback periods, and such data are transferable to DOE's methodology. DOE's efforts to dance around these facts is unfortunately further testament to its determination to issue a rule regardless of the data, as opposed to letting the data determine whether a rule can be justified. Rather than being data driven, DOE is using the data to support outcomes that fit its agenda. Its findings and determinations in the SNOPR are, as discussed above, arbitrary and capricious; the SNOPR should be withdrawn and DOE should engage the stakeholders in constructive discussions on the issues identified above.

Further evidence of DOE's misuse of data to achieve desired outcomes is found in the DOE fuel switching statistics themselves. Whereas DOE now uses impacted consumers in its LCC savings analysis,[119] it uses all 10,000 homes in its fuel switching presentation, resulting in

[119] This switch to impacted consumers was made in the NODA and carried forward in the SNOPR. The comparative LCC savings and impact numbers from the NOPR, NODA, and SNOPR appear in Table 6 and Table 7, respectively, in the GTI SNOPR Report. Predictably, this switch in the denominator inflates the LCC savings numbers.

deceiving results.[120] For example, in Table V.3 (81 Fed. Reg. at 65813), DOE shows under TSL 6 a national fuel switching percentage of 6.9, whereas had it shown fuel switching by impacted buildings, the percentage would have been 17.2 – an almost three-fold increase (Table 22, GTI SNOPR Report at page 48). The numbers are even more dramatic if you look at fuel switching under TSL 6 per impacted buildings in the residential replacement market (20.0%) and residential replacement market in the South (26.9%). *Id.* This misleading reporting of fuel switching data by DOE is also discussed in the GTI SNOPR Report at page 69.

So, not only has DOE relied upon a fuel switching methodology that does not withstand analysis because of its failure to use available data to accurately portray the degree of fuel switching among affected consumer groups, but in addition it has presented its own flawed data in a deceptive manner to camouflage the fuel switching that is predicted to occur among impacted consumers under its own SNOPR proposals.

3. DOE's furnace sizing methodology is flawed as demonstrated by empirical data; the superior GTI furnace sizing methodology should be adopted

The algorithm used by DOE for furnace sizing has been controversial, as evidenced by the exchanges with stakeholders at the October 17, 2016 technical conference.[121] Commenters were critical of DOE's approach in the NODA,[122] but DOE has held fast to its approach in the SNOPR.[123] In response to the SNOPR, GTI has performed a more extensive review and analysis that not only substantiates the errors that DOE has made (*i.e.*, the very poor correlation between DOE metrics and heating load[124]) but also presents, using the Residential Energy Consumption Survey (RECS) database, an alternative approach to furnace sizing that correlates much better to

[120] The DOE's selective use of impacted homes versus all 10,000 buildings infects other areas of its analysis (for example, payback for NWGFs and MHGGs, as discussed in Section 4.5 of the GTI SNOPR Report; *see also* Appendix A at section A.8.

[121] *See* transcript pages 121-158 of the October 17, 2016 DOE technical conference.

[122] *See, e.g.*, GTI NODA Report at sections 2.2 and 2.3.

[123] 81 Fed. Reg. at 65770-73.

[124] GTI SNOPR Report at sections 2.9, 2.10, and 2.11.

heating load than the DOE approach.[125] DOE should abandon its flawed approach in favor of the GTI approach.

As the foundation of DOE's energy use analysis, the furnace sizing method is particularly crucial because the energy use analysis provides the basis for other analyses performed by DOE.[126] To determine energy consumption in a residential home, DOE established a sample of households using NWGFs from the EIA 2009 RECS database. DOE assigned an input capacity for the existing furnace of each housing unit based on an algorithm that correlates the heating square footage provided by RECS and the outdoor design temperature for heating based on the estimated location of the RECS household, with the distribution of input capacities of furnaces based on a reduced set of models from the 2013 AHRI residential furnace certification directory.[127] The RECS database does not include critical information on furnace size, monthly heating consumption, or monthly or annual heating load. In addition, DOE ignored the fact that furnace size in the southern U.S. is not solely a function of peak heating load but the furnace fan capacity linked to the air-conditioning system capacity, on the theory that fan size and associated furnace capacity would be neutralized by the furnace fan rule to take effect in 2019.[128] Additional market information and analytical methodologies are needed for this purpose.

In response to criticism that RECs lacks the data needed to perform such capacity assignments,[129] DOE conceded the shortcomings but determined that the data provides "a reasonable estimation of the capacity when combined with shipments data disaggregated by capacity."[130] The GTI SNOPR Report (at sections 2.10 and 2.11) shows that these shortcomings are fatal, and hence the reliance on the RECs data is unreasonable.

To address the RECS database shortcomings, GTI analysts examined detailed empirical data on house characteristics (*e.g.*, house size, age, monthly heating degree days, outdoor design

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[125] *Id.* at section 2.12

[126] 81 Fed. Reg. at 65769.

[127] *Id.* at 65770 & n.50.

[128] 81 Fed. Reg. at 65770.

[129] *See* GTI SNOPR Report at Section 2.11.

[130] 81 Fed. Reg. at 65770.

temperature, and hourly and monthly gas consumption) from natural gas company databases and GTI field data acquisition projects. In so doing, as explained below, GTI overcame the shortcomings in the DOE approach. DOE used square footage without regard to vintage/building shell efficiency.[131] Thus, the DOE approach required DOE to consider two homes of the same size but different vintages to be the same.[132] In fact, DOE's consultant LBNL affirmed at the October 17, 2016 technical conference that, in the real world, different "shell efficiency" would yield different sized furnaces.[133] As for the shipment data on which it relied, LBNL admitted that it "is the only real data that we actually have about what actually people are installing. The other data is just our analysis of what might happen after the standard."[134] Thus, not only did DOE use the wrong approach (building size versus heating load), its lack of rigor is facially evident.

The central flaw which GTI corrected is the very poor correlation between home size and required furnace capacity. DOE's approach is based on home size and design outdoor air temperature (as derived from the RECS database), and that is very poorly correlated with home heating consumption and furnace capacity required to meet peak heating and setback recovery loads. Figure 10 in the GTI SNOPR Report (page 37) shows annual heating load versus furnace size with a best fit line for all furnaces whether impacted by the rule or not, using the DOE SNOPR furnace sizing methodology; the correlation between heating load and furnace size using the DOE approach is very weak ($R^2 = 0.11$). As GTI points out (*id.* at 36):

> This [poor correlation] is an expected result because the DOE furnace sizing algorithm is based on home size modified by a small random term. Further, as shown by the "continuous operation" curves in Figure 10, the DOE furnace sizing algorithm results in furnace sizes in some instances that cannot meet the average heating load (cases to the right of the "continuous operation" curves). The lack of a strong relationship between heating load and furnace size helps explain the lack of a consistent trend in LCC savings with furnace size in the SNOPR.

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[131] Transcript pages 125, 151-158, and Slide 25 from the October 17, 2016 technical conference.

[132] *Id.* at 153:17-20.

[133] *Id.* at 153-154.

[134] *Id.* at 155:3-6.

Detailed empirical data described in the GTI Topical Report GTI-16/0003, "Empirical Analysis of Natural Gas Furnace Sizing and Operation,"[135] shows an exceptionally high correlation between annual heating consumption and house "UA" (a combination of thermal efficiency and envelope area), a strong correlation between required furnace capacity and house "UA," but a very poor correlation between home size and annual heating consumption or UA. *See* GTI SNOPR Report at page 38. Figures 11 and 12 in the GTI SNOPR Report reflect this strong correlation between furnace gas use and UA value and between furnace energy delivery and UA value, respectively (*id.* at 39). Figures 13 and 14 show the weak correlation between home size and UA value and between home size and furnace natural gas use, respectively (*id.* at 40).

To capture this reality, GTI developed its Parametric F1, which it explained as follows (GTI SNOPR Report at page 38):

> To examine an easily implemented alternative to the DOE furnace sizing methodology, GTI analysts developed a furnace capacity algorithm for each of the 10,000 trial cases based on the RECS database annual heating consumption rather than home size (Scenario F1 in Table 11). Figure 15 shows heating load vs. furnace size along with a best fit line for all furnaces, whether impacted by the rule or not, using the RECS annual heating consumption model furnace sizing methodology. The correlation between annual heating load and furnace size (R^2=0.69) is substantially better with the RECS annual heating consumption model than the correlation using the DOE furnace sizing methodology (R^2=0.11). This is an a priori expectation because annual heating consumption should have a fair to strong correlation with peak heating load, whereas home size has been demonstrated to have poor correlation with peak heating load for a variety of reasons. The RECS annual heating consumption model is also compatible with the furnace "downsizing" methodology used by DOE in the SNOPR proposed rule (TSL 6). It also provided the desired sensitivity to market conditions compared to the DOE methodology. The data in Figure 12 is net delivered energy (before efficiency losses) – not gross furnace input capacity.

GTI also has data indicating that peak space heating loads in southern climate zones may be relatively higher compared to equivalent size homes in colder northern climate zones because the southern structures are not as well insulated.[136] DOE's furnace sizing algorithm does not account for a smaller furnace unable to meet the peak heating needs of many southern homes,

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[135] Http://www.gastechnology.org/reports_software/Documents/Empirical-Analysis-of-Natural-Gas-Furnace-Sizing-and-Operation.pdf.

[136] GTI SNOPR Report at page 36.

especially in the middle of the country with relatively cold design heating temperatures as far south as Texas. *See* GTI SNOPR Report at section 2.10.

As noted, Figure 10 in the GTI SNOPR Report demonstrates that the correlation between heating load and furnace size using the DOE methodology is extremely weak. Other illogical results from the DOE flawed furnace sizing methodology are displayed in Table 17 of the GTI SNOPR Report (discussed therein at pages 41-42). Table 17, as discussed in more detail in the referenced margin notes below, illustrates additional flaws in DOE Base Case furnace assignment approach,[137] DOE's misapplication of the RECS database,[138] and DOE's errors in the

[137] Trial cases 8785, 8906, and 9467 were each assigned a condensing furnace under DOE's random Base Case furnace assignment methodology. In two of those cases (8906 and 9467), the extremely lengthy payback period caused by the extremely low annual gas consumption would have caused significant negative impacts (as shown in Table 15 for Case No. 9467). In the third case (8785), the condensing furnace was a rational choice because its installed cost was lower than the non-condensing furnace. Using the GTI CED methodology, that case was correctly assigned a condensing furnace, but for economic reasons, not because it was randomly assigned.

The DOE Base Case flaw extended into the proposed rule TSL6 as well, because the two cases that were incorrectly considered no impact under TSL 5 (8906 and 9467) could not show a benefit from the small furnace exemption, no matter what capacity DOE would select. This perversely undermined DOE's analytical ability to determine the consumer benefits of the exemption.

[138] DOE chose to replicate a single RECS database home several times to develop the 10,000 trial cases. In the example highlighted in Table 17, RECS home No. 8113 was replicated five times to create different trial cases from one home. All five trial cases are 3,613 SF, and all five (for unknown reasons) have virtually no gas heating consumption (0.97 MMBtu for all 5 cases vs. an average of 49.6 MMBtu in RECS Region 27). Extremely low gas heating consumption skews every aspect of the analysis, both in favor of and in opposition to the intent of the rule. It is highly questionable whether RECS home 8113 should have even been included in the LCC analysis, let alone replicated 5 times, with random AFUE assignments and poor furnace capacity assignments under the DOE base case and furnace sizing methodologies. Evaluating the benefit of a condensing furnace in a home that does not consume any gas for heating is an exercise in futility under a CED framework or even a random framework because it is not a representative situation for a payback calculation. Speculating on a cause is hazardous, but one possibility is a vacant home, skewing the results (5 times in this case) if that is a temporary or anomalous situation. Another possibility (especially for a propane furnace, but also for a gas furnace) is that the furnace is acting as a backup heat source, whose value is security rather than efficiency or conservation. In that case, there would need to be an additional consideration for the 5 highlighted cases (other examples exist in the RECS database as well). Failing that accommodation, DOE should have excluded these homes from the analysis.

furnace sizing methodology.[139] In brief, GTI Table 17 further demonstrates both the failures in the DOE approaches to these key issues and the manner in which GTI provides suitable fixes and thus rational results.

Further evidence of the relative merits of the GTI furnace sizing methodology versus DOE's approach is provided by the relative LCC savings of each approach as related to different furnace capacity limits. LCC savings should increase as a furnace gets larger because a larger furnace uses less gas to produce the same amount of heat.[140] Also, the incremental cost of obtaining a larger furnace does not increase strictly proportionally to furnace size as certain fixed costs are required for all sized furnaces. But, as Figure 17 in the GTI SNOPR Report (at page 58) shows, DOE's approach to furnace sizing does not result in increased savings as the furnace size gets larger; rather, it yields a consistent level of LCC savings whether the furnace is 40 kBtu/hr or 140 kBtu/Hr.

By contrast, under the GTI furnace sizing approach, LCC savings increase as the furnace gets larger, as shown in Figure 18 of the GTI SNOPR Report (at page 58). These results are explained by the poor correlation between home size and heating load (which is the basis for the DOE approach) versus the far greater correlation between annual heating load and furnace size (which drives the GTI approach). *See* GTI SNOPR Report at sections 2.10 – 2.13.

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[139] Trial cases 3848 and 9052 illustrate the impact of the DOE furnace sizing methodology flaw. In case 3848 (and 8785), condensing furnace cost savings are negative compared to the 80% AFUE furnace for unknown reasons (presumably due to incremental maintenance or other annual cost beyond the $1 gas consumption cost). This creates significant negative impact because 3848 and 9052 were randomly assigned 80% furnaces by DOE (and also assigned 80% furnaces under GTI's CED methodology). However, the additional flaw of assigning a large capacity furnace (120 kBtu/h) based on the 3,613 SF home size resulted in these homes remaining negatively impacted under TSL 6. In contrast, using the GTI consumption sizing methodology, all four remaining homes assigned an 80% furnace and impacted under TSL 5 were exempted under TSL 6 and became "No Impact" cases, illustrating the benefit of the small furnace exemption rule using the GTI methodology. The poor correlation using the DOE methodology assigns a furnace that is too large for the load, masking the benefits of the exemption. Of course, due to the interactive effects of the two poor methodologies, the overall impact is erroneous.

[140] The larger furnace savings result from the nonlinear installation and furnace capacity costs (twice as large only costs 80% more, so the twice as large savings are applied to relatively lower first cost penalty per Btu/h capacity increase). *See* GTI SNOPR Report at page 57.

4. DOE relied on lower quality and less reliable input data.

APGA pointed out in its NOPR Comments (at 24-28) that DOE was relying on incorrect and indefensible input data. DOE has continued to rely on inferior input data in the SNOPR despite the availability of superior data (publicly available market data, targeted surveys, construction and engineering principles, and persuasive anecdotal information) showing that the DOE inputs discussed below are qualitatively inferior to the inputs suggested in the GTI NOPR Report and now in the GTI SNOPR Report.[141] APGA urges DOE to modify these inputs accordingly.

a. Retail prices

The APGA NOPR comments and GTI NOPR Report demonstrated why reliance on complex, non-transparent tear-down analyses made no sense given real-world data showing that the DOE numbers are substantially off the mark. DOE is unable to rebut that showing in the SNOPR,[142] and yet continues to rely on its opaque tear-down analysis, which just happens to inflate LCC savings (as do virtually all of its choices where more reliable, more defensible alternatives have been presented for its consideration). DOE tries to excuse its reliance on non-transparent tear-down analysis by speculating that when a final rule issues mandating the use of condensing furnaces, "the markups incorporated into the sales price may change relative to current markups."[143] This ignores the un-rebuttable facts that condensing furnaces have been mass produced for years, constitute one of every two furnaces shipped today, and are projected by DOE, *without a rule*, to substantially dominate the northern furnace market in 2022 and to have a significant market presence in the South.[144] In brief, the DOE speculation about future reduced markups for condensing furnaces is just that, sheer speculation with no basis in record

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[141] *See* GTI SNOPR Report at section 2.7.

[142] Further, the discussion at the October 17, 2016 technical conference underscored the iffiness of the DOE approach of doing a bottom-up analysis of some 33 parameters based on data not available to the public and the end result of which is contradicted by real-world data available for all to see and assess (Tr. 58-66).

[143] 81 Fed. Reg. at 65764.

[144] *See* specifically TSD Tables 8.I.4.1 and 8.I.4.2 (pages 8I-6 - 7) and Section IV.D., below.

facts;[145] to the extent DOE seeks to hide behind non-disclosure agreements as a basis for its speculation,[146] that simply underscores the arbitrary and capricious nature of DOE's consistent selection of and reliance on input data that inflate LCC savings.

The GTI methodology, as described in the GTI SNOPR Report (at 31-32 and Appendix A, section A.5.1), "replaced DOE's retail furnace prices that are derived through a tear down analysis of furnaces with a data base of actual offered prices of furnaces." In its Parametric I2, "GTI tabulated retail prices provided in the 2013 Furnace Price Guide (https://www.furnacecompare.com/furnaces/price-guide.html), segregated models by efficiency level, adjusted the furnace prices for inflation and to account for the use of BPM motors in place of PSC motors, and used the adjusted 'delivered to home' furnace prices as inputs to the model." (*Id.* at 32). Where market data is available, it should be used in lieu of non-transparent engineering analyses that produce skewed results at odds with real-world facts; DOE's reliance on unfounded speculation regarding future markups to justify ignoring reliable and available market data (and thereby inflating LCC savings) is not reasoned decision making.

b. Marginal pricing

In Parametric I6,[147] GTI replaced the DOE NOPR LCC model marginal price factors with the marginal price factors developed by AGA using gas companies' tariff data. AGA, like DOE, relied on EIA residential natural gas sales and revenues by state (EIA 2014 NG Navigator), but in contrast to the DOE approach, AGA developed a fixed cost component of natural gas rates for each state and applied it to the EIA data to develop state level residential marginal price factors. AGA then weighted the state level data according to furnace shipments using the same approach as DOE to generate marginal rates for each region.

The AGA marginal price factors are conservative and traceable marginal rates based on tariffs with the monthly customer charge removed. DOE uses average monthly energy costs in

[145] This reliance on speculation in the context of furnace markups stands in stark contrast to DOE's statement, in another context, that it must "base its approach on currently available data and cannot speculate as to future developments…." 81 Fed. Reg. at 65753.

[146] 81 Fed. Reg at 65764.

[147] The facts discussed below are set forth in the GTI SNOPR Report at page 32 and Appendix A, section A.5.2.

RECS data multiplied by a marginal rate factor based on state-level EIA energy prices using a methodology they do not describe in the TSD, so it is both opaque and non-verifiable. The AGA methodology is sensitive to monthly gas consumption as well, so the resulting marginal price is more tightly tied to furnace gas consumption than the DOE seasonal factor. The AGA methodology provides a simple, defensible approach that required more data than DOE chose to use. DOE's assertion that state-level data is better than tariff data representing 90% of gas customers is disingenuous at best and again illustrates DOE's preference for inferior approaches so long as those inferior approaches enhance the appearance of LCC savings.

c. Shipment data

DOE relies on condensing furnace shipment forecasts that are lower than the long term historical trend from AHRI shipment data and should be replaced by the more reliable, defensible forecast data from the GTI analysis. GTI Parametric I13 uses NWGF condensing and non-condensing furnace shipment data trends provided to DOE by AHRI in 2015 to revise the DOE 2022 forecast of Base Case condensing furnace shipment fraction, as described in the GTI SNOPR Report (at 32; *see id.* at Appendix A, section A.5.3):

> For the SNOPR analysis, GTI analysts developed a trend line that aligned with AHRI 2014 data and historical shipment data from 1998 through 2005. The GTI trend line did not consider 2006 through 2013 shipment data to avoid concerns with observed perturbations caused by federal energy credits phased out in 2013 that may have influenced shipment numbers between 2006 and 2013. To create a 2022 forecast trend line that matched actual 2014 shipment data, GTI used 1998 to 2005 trending years. This combined approach resulted in a 2014 condensing furnace shipment fraction of 48%, which is slightly lower than the actual fraction of 48.5% reported by AHRI. Based on this trend line, Parametric I13 uses condensing furnace shipment fractions of 62.5% (National), 84.1% (North), and 38.6% (Rest of Country) for the 2022 baseline instead of DOE's 2022 furnaces shipment fractions of 53.1% (National), 73.7% (North), and 30.2% (Rest of Country).

By contrast, DOE used shipment data for a truncated three-year period (2012-2014) for forecasting condensing furnace market penetration for the years 2015 – 2050 in the SNOPR to avoid the market distortion associated with the 2005 tax credit, implemented in 2006 and expiring in 2011. The result was a flatter slope of annual change in forecasted condensing market share without the rule in DOE's LCC model compared to taking advantage of the entire available AHRI historical shipment data.

Clearly, the in-depth approach used by GTI is more robust than the truncated approach used by DOE and should be relied upon in any final rule. Not surprisingly, the more credible and defensible GTI approach shows that market penetration of condensing furnaces in 2022 (before any rule could take effect) will be greater than projected by DOE (and thus diminishes the need for the rule). *See* Figures 36 and 37 in the GTI SNOPR Report at page A-27.

d. Updated EIA data

In parameter I17, GTI replaced the 2015 EIA AEO forecasts and utility prices in the SNOPR LCC model with the current 2016 EIA AEO forecasts for energy price trends and updated gas and electric utility prices.[148] This appears to be consistent with what DOE has stated in the SNOPR it intends to do in the final rule,[149] so this change should not be controversial.

e. Discount rate

DOE uses all asset and debt classes to determine discount rates. In its comments on the NOPR, AHRI pointed out the numerous infirmities in the DOE approach, especially as it relates to low income consumers.[150] In response to the AHRI observations, DOE maintains that "the interest rate associated with the specific source of funds used to purchase a furnace (i.e., the marginal rate) is not the appropriate metric to measure the discount rate as defined for the LCC analysis." [151] Instead, DOE explains that it avoids the marginal rate because consumers are not restricted from re-balancing their debt and asset holdings (by redistributing debt and assets based on the relative interest rates available) over the entire time period modeled in the LCC analysis."[152] However, as GTI points out (GTI SNOPR Report at Appendix A, page A-23):

> Aggregating debt and equity together to determine a discount rate based on opportunity cost appears to ignore that the purchase of a furnace, particularly in the replacement market, is not likely well represented by an aggregate of all debt and equity for a particular consumer. A marginal rate that is specific to the financial instrument used to purchase the furnace would be a more defensible value. For example, a homeowner with

[148] GTI SNOPR Report at page 32.

[149] 81 Fed. Reg. at 65724, note 7.

[150] *Id.* at 65787; *see* GTI NOPR Report at Appendix A, section A.5.5

[151] 81 Fed. Reg. at 65787.

[152] *Id.*

> a mortgage of $100,000 and savings of $1,000 that needs to purchase a new furnace which costs $3,000 will not experience the weighted average rate of 99% mortgage interest rate and 1% savings interest rate. They will more likely experience a rate represented by 1/3 savings and 2/3 credit card, yielding a rate closer to 12% than to 3%.

DOE's head-in-the-clouds response to AHRI may (or may not) find theoretical support in some text book on economics, but it knowingly ignores the real world consequences of its actions by falsely assuming that consumers on average possess a sophisticated ability to manage their finances.[153] The typical, not to mention low income, consumer puts the bulk of this sort of unanticipated and substantial household purchase (usually made in an emergency atmosphere in the case of replacements) on his credit card and hopes to pay it off over a reasonable period of time; there is no thought given at the time of purchase or later to "rebalancing" such obligations as between debt and other asset holdings as in many cases there are no such other assets holdings with which to rebalance. As GTI pointed out in the GTI SNOPR Report (Appendix A at pages A-21--22):

> DOE's assertion that consumers can re-balance debt and equity over long periods of time ignores critical short term consumer decisions. HVAC contractors expect to be paid at the time of installation. In cases with high debt load, especially for low income consumers but also higher income consumers with high debt, the furnace purchase will incur additional debt at a much higher interest rate than the DOE SNOPR LCC model discount rate. In addition, the inclusion of the mortgage interest debt type may not be reasonable in all cases. Mortgages may be a reasonable debt type to consider when a furnace is included in the price of a new home, but it may not be reasonable to include it when considering replacements. Credit card debt, especially for emergency replacements, is likely to be a more reasonable debt type for consumers already experiencing significant personal debt that cannot be easily re-balanced.

Further, as Figure 34 in the GTI SNOPR Report shows, the DOE SNOPR LCC model analysis "used exceptionally low rates, currently at 50 year lows."[154] But, as GTI points out:

> Historically, rates have been much higher than the DOE SNOPR LCC model. Rates have been historically low due to recent Federal Reserve choices for quantitative easing policy coupled with very low inflation levels. There is very little expectation that rates will remain at 50 year lows for next several decades. The DOE SNOPR LCC model

[153] *See, e.g.*, Sofie E. Miller, "One Discount Rate Fits All? The Regressive Effects of DOE's Energy Efficiency Rule," *Policy Perspectives* Vol. 22.2015.

[154] GTI SNOPR Report at Appendix A, page A-23.

overstates resulting LCC savings compared to higher discount rates likely to prevail in the future. [[155]]

Since DOE did not provide sufficient time for comments, despite many requests for extensions, GTI was not able to modify the DOE model to account for higher rates for each replacement furnace. However, GTI did run parametric analyses with varying discount rates using the same distributions as DOE but with discount rates increased by 0.5% and 1%, such that, for example, a 5% rate is increased to 5.5% and 6%.[156] As shown in GTI Figure 35, "a truncated full normal distribution impacted the LCC savings significantly more than the DOE SNOPR LCC model limited distribution of discount rates. LCC savings decrease roughly linearly with increasing discount rate and drive LCC savings to zero at a discount rate below 18%, less than the rate charged by many credit cards."[157] The effects of incorporating modified discount rates in GTI Scenarios Int-14 and Int-14.55, using a truncated normal distribution with means of 5% and 10% and a standard deviation of 5%, are shown in Table 43 (page A-26).

DOE should "get real" as to its use of discount rates. As with other issues and areas discussed above, the DOE SNOPR analysis leaves the distinct impression that its only objective is to show LCC savings that justify its proposed rule, versus making realistic assumptions that reflect known facts, and letting the chips fall where they may. That must change.

5. Correcting for the flaws noted above undermines the economic feasibility of the SNOPR proposals

The critical flaws discussed above in subparts IV.A.1-4 are consequential and demand correction. Exposure of these flaws undermines the SNOPR proposals as theoretically infirm and economically unsupportable. The purpose of this section is to show the relative impacts on LCC savings of the individual flaws.

Table 18 of the GTI SNOPR Report (at page 45) shows the incremental impact on LCC savings of correcting in various ways for the random assignment and fuel switching flaws in the

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[155] *Id.*

[156] GTI SNOPR Report at Appendix A, page A-24 (explaining the GTI adjustments reflected in Figure 35).

[157] *Id.*

SNOPR. The table shows the effect of the incremental changes vis-à-vis the putative LCC savings under the DOE SNOPR, specifically TSL 5 (92% AFUE) and TSL 6 (92% AFUE, with small furnace exception at 55,000 Btu/hour). The incremental impact numbers are shown with and without the improved furnace sizing methodology discussed in subpart IV.A.3., above, and in the GTI SNOPR Report at sections 2.10 – 2.12.

Table 18 shows the incremental impact of addressing in a comprehensive fashion the critical random assignment and fuel switching flaws in the SNOPR analysis. As GTI points out, it is "important to identify and justify the alternative scenario or scenarios that produce credible and technically defensible results for comparison with DOE LCC model results." (GTI SNOPR Report at page 29.) GTI identified Scenario 24 as a "reasonable and technically defensible decision making scenario for use in the CED framework based on overall analytical constraints and assumptions." (*Id.*) GTI points out as follows regarding Scenario 24 (*id.*):

> It corrects the technically flawed DOE SNOPR LCC analysis random Base Case AFUE assignment by substituting rational consumer economic decision making, thereby avoiding extremely unlikely consumer behavior caused by the DOE random assignment. It also incorporates household income into the fuel switching decision based on analysis of data contained in the AHCS. Finally, it generates fuel switching fractions that are reasonably consistent with the DOE baseline fuel switching fractions as well as the 2014 builder and contractor fuel switching survey.
>
> The objective of Scenario 24 was to incorporate the CED framework into the LCC analysis for both baseline furnace assignment decisions and fuel switching decisions. Scenario 24 parametrics included substituting a distribution of switching payback periods for the single average 3.5 year switching payback period used by DOE (Parametric D2); assignment of Base Case furnace using regional shipment data and payback period rather than random assignment (Parametric D4); eliminating negative payback period trial cases from the LCC analysis (Parametric D5); and removing exceptionally rational fuel switching trial cases from the LCC analysis (Parametric D8).

The impact of correcting the random assignment and fuel switching errors in the DOE SNOPR analysis in accordance with the Scenario 24 parametrics (which are more fully explained in the GTI SNOPR Report at pages 29-30) is shown in Table 18 (Increment 10); the results are negative LCC savings for both DOE TSL 5 and TSL 6, with or without use of corrected furnace sizing.

Another scenario that GTI suggests as an acceptable alternative is Scenario 36, which uses a distribution function rather than a deterministic value for an individual home's payback

period. This accommodates the fact that consumer decisions are influenced by non-economic factors such as environmental stewardship, split incentives, imperfect information, and other non-monetary factors (GTI SNOPR Report at pages 30-31). Table 18 (Increment 9) shows that the impact of Scenario 36 is to turn TSL 5 and TSL 6 LCC savings either to negative or *de minimis* numbers. As Table 18 also indicates, GTI has used the more conservative Scenario 36 in its integrated analysis discussed below.

GTI also prepared an integrated scenario analysis that addresses both the random assignment and fuel switching flaws discussed above as well as the four input errors identified above. Scenario Int-14 was selected for comparison with the 92% AFUE single product class TSL 5 in the SNOPR to address the following issues (GTI SNOPR Report at pages 34-35):

- Base Case furnace assignment that aligns with AHRI condensing furnace fractions and economic decision making criteria,
- Application of American Home Comfort Study information for fuel switching decisions that results in reasonable alignment with DOE fuel switching fractions when using a CED framework for Base Case furnace assignment and fuel switching decisions,
- Improved data for furnace prices, condensing furnace fractions, and marginal gas prices,
- Incorporation of AEO 2016 Clean Power Plan Scenario forecast information for comparisons with anticipated DOE final rule benefits calculations, and
- Application of a time-horizon-based distribution function based on the DOE LCC model payback period for each of the 10,000 trial cases for consumer economic decision making that monetizes the impact of imperfect market and non-economic consumer decision making factors into the LCC analysis for comparisons within the GTI CED framework and gives consumers a limited ability to make economic decisions.

GTI also developed Scenario Int-14.55 to examine the impact of a 55,000 Btu/hour furnace capacity limit for non-condensing furnaces on rule benefits for direct comparison with DOE SNOPR proposed rule TSL 6. This scenario includes a furnace capacity algorithm for each trial case based on annual heating consumption rather than home size (since the latter is so weakly correlated with furnace size, as discussed in subpart IV.A.3 of these comments and in the GTI SNOPR Report) and uses the DOE "downsizing" methodology (*id.* at 35).

Table 19 (Increment 8) shows that the results of Scenarios Int-14 and Int-14.55, respectively, are substantial negative savings under TSL 5 and TSL 6. If Scenarios Int-12 and

12.55 are used (per Increment 9 in Table 19, as explained in the Appendix, section A.7.1 of the GTI SNOPR Report at sections 2.10 and 2.11) the LCC savings turn even more negative.[158]

The long and the short of the GTI analysis, in both the GTI NOPR Report and the GTI SNOPR Report, are that the DOE SNOPR analysis is critically flawed at its core and cannot withstand scrutiny under the arbitrary and capricious standard. The SNOPR is not the result of reasoned agency decision making as the "science" upon which it is based has been shown to be technically indefensible, and thus the SNOPR should either be abandoned or put on a shelf while a responsible stakeholder or peer review process can be initiated to assess these key technical flaws and determine how to proceed in a technically defensible manner.

B. The Record Does Not Support a Small Furnace Exception for Furnaces with an Input Capacity of 55,000 Btu or Less; and the Record Also Shows That Such an Exception Will Not Achieve the Stated Goals.

1. DOE's request for comments and proposal

DOE states that it "has tentatively concluded that the establishment of a small furnace class has merit."[159] Accordingly it "tentatively determined" that the small furnace product class for non-weatherized gas furnaces with a certified input capacity of less than or equal to 55 kBtu/h (for which a non-condensing 80% AFUE standard would apply) would be consonant with the Act.[160] Nevertheless, DOE specifically requested comment on whether it had appropriately analyzed the product class and "whether a cut-off of 60 kBtu/h (or other capacity) would be more appropriate than 55 kBtu/h."[161] APGA believes that DOE has not accurately analyzed the product class issue because its underlying sizing analysis is seriously flawed (as discussed in subpart IV.A.3, above). Neither does a separate small product class save the rule from costing consumers more than it benefits them (as discussed in subpart IV.A.5., above).

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[158] Additional tables showing the across-the-board impact on LCC savings of Scenarios Int-14 and Int-14.55 are located at pages [47-52] of the GTI SNOPR Report.

[159] 81 Fed. Reg. at 65752.

[160] *Id.* at 65755.

[161] *Id.* at 65851.

In suggesting a 55 kBtu/h small furnace class, DOE notes that it has "prioritized alleviating the most difficult installation problems and impacts on consumers in the South." [162] This claim is rather ironic given that if fuel switching is measured based on impacted consumers, DOE's own numbers show that, even with a small furnace exception, *the fuel switching in the South on average will be 22% and will be 27% in the replacement market in the South*.[163]

DOE also claims that the addition of this separate product class actually increases LCC savings. If there were no separate class, DOE claims that savings would be $75 lower; the share of consumers experiencing a net cost increase would be 6% higher; and national energy savings would increase because there would be less fuel switching to less efficient electric heat.[164] DOE relied upon its TSL 6. These numbers have been shown in subpart IV.A.5., above to be bogus once the serious flaws underlying the DOE science are identified and corrected.

The only point made by DOE to which APGA can subscribe is that its proposed rule is less bad with a small furnace exception than without; but as for the putative benefits of a 55 kBtu/h exception, they are non-existent. For a small furnace exception to benefit consumers, it must be set at a much higher threshold, as discussed below.

2. DOE's claims about the impact of small furnace exception are undermined by its flawed analytical approach

As detailed in the GTI SNOPR Report and as discussed above in subparts IV.A.1 – A.5., above, serious methodological flaws and reliance on low quality data inputs undermine the DOE LCC analysis. To summarize, the DOE analysis suffers from at least these key flaws (discussed in Section IV.A, above):

- Reliance on random assignment of furnaces to begin the LCC economic analysis instead of consumer economic decision making;
- Reliance on a fuel switching algorithm that ignored available consumer input data;
- Reliance on a furnace sizing methodology that did not match furnace size with heating load; and

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[162] *Id.* at 65755.

[163] GTI SNOPR Report at Table 22.

[164] 81 Fed. Reg. at 65755.

- Reliance on low quality data inputs for the LCC analysis.

3. GTI's improved analysis shows that there are no net benefits nationally of a rule with a 55 kBtu/h furnace exception

GTI's improved study results demonstrate that, when the flaws noted above are corrected, the proposed standard with a small furnace exemption does not yield positive LCC savings, contrary to DOE's claims. In fact, only 12% show a net benefit versus 15% experiencing a net cost, with 73% not affected. GTI SNOPR Report at Table 1. Tables 2 and 3 in the GTI SNOPR Report break down the impact numbers, with a small furnace exception (TSL 6) and without (TSL 5), by relevant market, demonstrating how devastatingly adverse the impact is, for example, on replacement and low income consumers. In short, DOE has not made a case for TSL 5 or TSL 6.

4. GTI's improved analysis shows that there are net benefits nationally of a rule with a small furnace exception only when the cutoff is much higher than 55 kBtu/h

After it corrected for the flaws in DOE's approach, GTI presented LCC savings for the 92% AFUE TSL under GTI Scenario Int-14 and compared that to the DOE SNOPR LCC savings analysis results for a separate product class based on furnace input capacity, with and without the DOE downsizing methodology. GTI compared the incremental and cumulative savings for different furnace capacity limits ranging from 40 kBtu/h through 140 kBtu/h using the DOE SNOPR furnace sizing methodology and its own approach keyed to the annual heating consumption (GTI Parametric F1). Table 31 shows these results. Under GTI's Integrated Scenarios, positive LCC savings occur on a cumulative basis only when the furnace size is 90 kBtu/h (in the case of 92% AFUE TSL with downsizing) and 115 kBtu/h (in the case of 92% AFUE TSL with no downsizing). This is depicted on Figure 19 of the GTI SNOPR Report. These results demonstrate that the exception level being proposed by DOE is insufficient to achieve its stated goals.

C. The Monetization of Emission Impacts Is both Highly Speculative and Irrelevant to the SNOPR Economic Analysis

DOE dedicates a section of its discussion on methodology to the subject of "monetizing carbon dioxide and other emissions impacts."[165] And the tables throughout the SNOPR are chock full of numbers purporting to show the benefits of emission reductions resulting from the SNOPR.[166] The first point to be made about these numbers, which purport to measure emission impacts through 2300,[167] is that they are highly speculative[168] and thus not reliable for purposes of determining the economic feasibility of a proposed energy efficiency standard. Further, of course, the typical cash-strapped consumer weighing the up-front costs of a new furnace and hoped-for operating cost savings over the near term is not considering potential societal benefits that may or may not occur decades hence, much less centuries hence.

The second point to be made is that DOE, properly in our view, is not relying on these speculative emissions impact numbers to justify the SNOPR proposals. DOE declares as follows: "To date, this accounting for environmental benefits has not had a decisive impact on the outcome of any standards rulemaking—i.e., DOE would have adopted the same standards even if environmental benefits had not been considered at all. The same is true for today's SNOPR."[169]

APGA construes this to mean that if the DOE LCC and payback analyses are flawed and thus do not support the SNOPR as economically feasible for consumers, DOE will not attempt to

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[165] 81 Fed. Reg. at 65805-10.

[166] *E.g.*, Tables I.6, I.7, I.8, I.9, I.10, V.40, V.46, V.47, V.48, VI.1.

[167] 81 Fed. Reg. at 65725.

[168] *E.g., id.* at 65805: "The estimates are presented with an acknowledgement of the many uncertainties involved and with a clear understanding that they should be updated over time to reflect increasing knowledge of the science and economics of climate impacts." *Id.* at 65806 (footnote omitted): "A report from the National Research Council points out that any assessment will suffer from uncertainty, speculation, and lack of information about: (1) future emissions of GHGs; (2) the effects of past and future emissions on the climate system; (3) the impact of changes in climate on the physical and biological environment; and (4) the translation of these environmental impacts into economic damages. As a result, any effort to quantify and monetize the harms associated with climate change will raise questions of science, economics, and ethics and should be viewed as provisional."

[169] *Id.* at 65750.

fall back on the speculative emissions impact numbers as nonetheless supporting its proposed rule. To do otherwise would be contrary to the plain meaning of the EPCA, which calls for, among other things, a determination of whether benefits of a proposed standard exceed the burdens through consideration of the "economic impact of the standard … on the consumers of the product subject to such standard."[170] The emissions impact data tells the affected furnace consumer nothing about the direct impact of the proposed rule on him or her.

In addition, switching gears as to economic justification would also violate the public's due process rights under the Administrative Procedure Act, which calls for notice and comment regarding both a proposed rule and the bases for the proposed rule.[171] As noted, the SNOPR makes quite clear that DOE is not relying on the emissions impact data to justify the SNOPR proposals.

D. The Record Shows That the Market Is Working Without a Rule

APGA showed in its NOPR Comments (34-37) that the furnace market was working quite well without a new furnace efficiency standards rule, as consumers were purchasing condensing furnaces in large numbers where the operating cost savings justified the extra expense and were purchasing non-condensing furnaces where the operating cost savings were more problematic. Thus, the effect of the NOPR would be market failures, namely forcing consumers either to make uneconomic purchases or to switch to less efficient alternatives (*see* GTI NOPR Report at pages 9-12).

The post-NOPR record underscores these points. TSD Tables 8I.4.1 and 8I.4.2 (page 8I-6--7) show that in 2022, the year the DOE asserts the proposed rule would become effective, condensing furnaces will already have a 95% saturation rate in residential replacements and new construction in CT, ME, NH, RI, VT, MA, PA, WI, IA, MN, ND, SD, HI, and WV, and a very high saturation rate in many other northern-tier and border states (such as DE, NY, IN, MI, IL, KS, NE, VA, DC, MD, and SC); and, as to be expected, non-condensing furnaces will dominate

[170] 42 U.S.C. § 6295(o)(2)(B)(i).

[171] 5 U.S.C. § 553. *See, e.g., Sierra Club v. Costle*, 657 F.2d 298, 397 n.484 (D.C. Cir. 1981) ("In general, factual or methodological information which is critical to a proposed rule should be available *in such a way as to provide an adequate opportunity for comment*.") (emphasis supplied), *rev'd on other grounds sub nom. Ruckelshaus v. Sierra Club*, 463 U.S. 680 (1983).

in the South and Southwest (for example, GA, FL, AR, LA, OK, TX, CO, AZ, NV, and NM). As pointed out in subpart IV.A.4.c., above, the DOE 2022 (and beyond) market penetration numbers are understated.

When these 2022 estimates are extended to 2050, again assuming *no rule*, saturation of condensing furnaces in the entire northern market will approach 90% and in the non-northern market will be almost 40% (TSD Figure 8I.5.1 at page 8I-12). Unfortunately, DOE did not provide a breakdown of these number for new construction and replacement or for residential and commercial. But the point is very clear in any event: economic incentives are working such that those for whom a condensing furnace makes economic sense are purchasing condensing furnaces and those for whom it does not, largely are not. DOE's attempt to interfere with a functioning market defies the data and should be abandoned.

DOE's presumed rationale for not letting the market function and thereby avoiding the market failures that will inevitably occur is that "no new regulatory action yields zero NES [national energy savings] and an NPV [net present value] of zero dollars,"[172] versus the large NES and NPV numbers that DOE advertises as resulting from the SNOPR.[173] The obvious fallacy in this logic, as pointed out in Section E, below, is that the data relied upon to show economic feasibility, specifically LCC savings and net benefits, are deeply flawed (as discussed in Section IV.A of these comments and the accompanying GTI SNOPR Report, *passim*), and hence the output of the integrated NIA-RIA spreadsheet relied upon by DOE to derive its large NES and NPV numbers is likewise without foundation. In short, there is no excuse for not letting the market function without DOE interference.

E. The National Impact Analysis Is Beside the Point

Based on its National Impact Analysis (NIA), DOE asserts that the SNOPR will result in substantial energy savings and emissions reduction. The obvious glitch in these rosy prognostications is that the NIA is premised upon data from the DOE LCC spreadsheet model, and since that data is seriously flawed in important respects, the NIA output is less than meaningless. This is the familiar story of garbage in, garbage out.

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[172] SNOPR TSD Ch. 17, page 17-4.

[173] *Id.* at Table 17.4.1, page 17-15; *see* 81 Fed. Reg. at 65845.

As pointed out in the GTI SNOPR Report (at page 70), the NEMS model used by DOE as the basis for the NIA "relies on assumptions for economic variables, including world energy market interactions, resource availability (which influences costs), technological choice and characteristics, and demographics. DOE's NIA spreadsheet summarizes the results of the NEMS model, but provides no opportunity to adjust impacts based on different LCC model results." Hence, parties are precluded from determining what the NIA output data would be if the input data from the LCC analysis were corrected to remove the critical flaws underlying it. Additionally, since the proposed rule is not economically sustainable, the NIA output is not relevant.

F. The SNOPR Will Lessen Competition

APGA has addressed the competition issue in comments to the Department of Justice (DOJ) dated November 8, 2016, which comments are appended hereto and incorporated by reference in their entirety. DOE's refusal thus far in the process to follow the data, regardless of where it leads, underscores the suggestion in APGA's comments to DOJ that DOE is intending to lessen competition to effectuate its deep decarbonization agenda versus following the clear requirements of the EPCA as regards amending existing efficiency standards.

V. Conclusion

APGA respectfully submits that the SNOPR contains fatal analytical flaws which, when corrected, demonstrate that the SNOPR proposals are not economically justifiable and thus do not pass muster under the EPCA. DOE has also erred in promulgating a standard that will eliminate non-small non-condensing furnaces from the marketplace in violation of the EPCA. And DOE has erred in several other important respects, including setting a premature compliance date and ignoring the peer-review requirements of its regulations. For each and all of these reasons, the SNOPR should be withdrawn and a stakeholder or peer review process begun to discuss fixes for these important errors and omissions.

Respectfully submitted,

AMERICAN PUBLIC GAS ASSOCIATION

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