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October 13, 2023

Ms. Julia Hegarty
U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Building Technologies Office, EE-5B
1000 Independence Avenue SW
Washington, DC 20585-0121

**Re: Notice of Proposed Rulemaking and Request for Comment:
*Energy Conservation Program: Energy Conservation Standards for
Consumer Boilers, EERE-2019-BT-STD-0036, RIN 1904-AE82, 88 Fed.
Reg. 55128 (August 14, 2023)***

Dear Ms. Hegarty:

The American Gas Association (“AGA”), American Public Gas Association (“APGA”) and National Propane Gas Association (“NPGA”), and Spire Inc., Spire Missouri Inc., and Spire Alabama Inc. (collectively, “Joint Commenters”) respectfully submit these comments in response to the above-referenced proceeding regarding the notice of proposed rulemaking and request for comment (“NOPR”) pertaining to energy conservation standards for consumer boilers issued by the U.S. Department of Energy (“DOE”).¹

I. Executive Summary

Joint Commenters support appliance energy efficiency standards that are technologically feasible, economically justified, and follow statutory requirements. Energy efficiency is an essential component to a successful emissions reduction plan and for consumer energy affordability. Unfortunately, however, DOE’s NOPR suffers from an array of economic, technical, procedural, and legal flaws that will render it harmful to consumers, American manufacturing, counterproductive to energy efficiency goals, and unlawful. These comments focus on DOE’s

¹ *Energy Conservation Program: Energy Conservation Standards for Consumer Boilers, EERE-2019-BT-STD-0036, RIN 1904-AE82, 88 Fed. Reg. 55128 (Aug 14, 2023) (“NOPR”).*

proposal related to gas-fired hot water boilers, *i.e.*, gas boilers, and as detailed in these comments, the NOPR includes, *inter alia*, the following issues:

- The proposed standard violates the unavailability provisions of the Energy Policy and Conservation Act (“EPCA”).
- The proposed standard for gas-fired hot water boilers is not economically justified, because DOE’s analysis seriously mischaracterizes the boiler market and there are fundamental errors in how DOE analyzed installation costs.
- DOE’s use of random assignment systematically skews the results of the economic analyses that underpin the proposal.
- DOE’s analysis is based on an unreasonable assessment of the facts relevant to boiler installations.
- DOE’s proposal will negatively impact American manufacturing and jobs.

Joint Commenters support and actively invest in energy efficiency. However, Joint Commenters do not support appliance efficiency standards that impose unjustified costs on consumers or that deprive consumers of gas products that are suitable for their needs. Such standards are not authorized by statute and would be harmful to customers.

II. Identity and Interest

AGA, founded in 1918, represents more than 200 local energy companies that deliver clean natural gas throughout the United States. There are more than 77 million residential, commercial, and industrial natural gas customers in the U.S., of which 96 percent — more than 74 million customers — receive their gas from AGA members. AGA is an advocate for natural gas utility companies and their customers and provides a broad range of programs and services for member natural gas pipelines, marketers, gatherers, international natural gas companies, and industry associates. Today, natural gas meets more than one-third of the United States’ energy needs.²

APGA is the trade association for more than 730 communities across the U.S. that own and operate their retail natural gas distribution entities. They include not-for-profit gas distribution systems owned by municipalities and other local government entities, all locally accountable to the citizens they serve. Public gas systems focus on providing safe, reliable, and affordable energy to their customers and support their communities by delivering fuel to be used for cooking, clothes drying, and space and water heating, as well as for various commercial and industrial applications.³

NPGA is the national trade association of the propane industry with a membership of about 2,400 companies, and 36 state and regional associations that represent members in all 50 states. Membership in NPGA includes retail marketers of propane gas who deliver the fuel to the end user, propane producers, transporters and wholesalers, and manufacturers and distributors of equipment, containers, and appliances. Propane gas fuels millions of installations nationwide for home and commercial heating and cooking, in agriculture, industrial processing, and as a clean air alternative engine fuel for both over-the-road vehicles and industrial lift trucks. Roughly 75% of

² For more information, please visit www.aga.org.

³ For more information, please visit www.apga.org.

NPGA’s members have fewer than 100 employees and are considered small businesses. The proposal directly addresses products which currently, and in the future, may rely on propane for fuel, and as such, the proposal has the potential to have a direct and significant impact on NPGA’s members.

Spire Inc., Spire Missouri Inc., and Spire Alabama Inc. (collectively “Spire”) are in the natural gas utility business. Spire Inc. owns and operates natural gas utilities that distribute natural gas to over 1.7 million residential, commercial, and institutional customers across Missouri and Alabama, and Spire Missouri Inc. and Spire Alabama Inc. are the largest natural gas utilities serving residential, commercial, and institutional customers in Missouri and Alabama, respectively.

Joint Commenters provide the energy needed to fuel consumer boilers, thus making them critical stakeholders.

III. Procedural History and Overview of the NOPR

According to the NOPR, on January 15, 2016, DOE prescribed the current energy conservation standards for consumer boilers manufactured after January 1, 2021.⁴ DOE published in the Federal Register a Request for Information that initiated an early assessment review to determine whether new or amended standards would satisfy the relevant requirements of EPCA for a new or amended energy conservation standard for consumer boilers.⁵

DOE published a preliminary analysis and technical support document (“preliminary TSD”) for the purpose of evaluating the need for amended energy conservation standards for consumer boilers on May 4, 2022.⁶ In the NOPR, DOE also notes it deviated from its own procedural rules (Appendix A) by publishing a preliminary analysis without a framework document.⁷ DOE held a public meeting webinar on June 16, 2022, on the preliminary TSD.⁸ On July 5, 2022, AGA, APGA and NPGA submitted materials in response to the preliminary TSD.⁹ 12, DOE held a virtual public meeting to discuss the proposed rule.

As applicable to these comments, in the NOPR, DOE is proposing gas-fired hot water boilers reach a minimum annual fuel utilization efficiency (“AFUE”) of 95%. If finalized the proposed standards in the NOPR are anticipated to become effective in 2030.¹⁰ The proposed efficiency level would require that natural gas-fired hot water boilers use condensing technology as compared to non-condensing technology.

IV. Comments Pertaining to Gas-Fired Consumer Boilers

⁴ NOPR, 88 Fed. Reg. at 55135. *See also* 81 Fed. Reg. 2320, 2416-2417 (Jan. 15, 2016).

⁵ NOPR, 88 Fed. Reg. at 55135, and 86 Fed. Reg. 15804 (Mar. 25, 2001).

⁶ *Id.*, *see also* 87 Fed. Reg. 26304 (May 4, 2022).

⁷ *Id.* at 55136.

⁸ *Id.* at 55135.

⁹ *Id.* at 55136 (noting the Joint Commenters as Utility Trade Associations). The comments of AGA, APGA and NPGA on the preliminary TSD are identified in the docket as document No. EERE-2019-BT-STD-0036-0038.

¹⁰ NOPR, 88 Fed. Reg. at 55161.

A. The “Unavailability” Provisions of the Statute Preclude the Adoption of the Proposed Standard for Gas Boilers

The proposed standard for gas boilers would require a minimum efficiency that only condensing products can achieve. This would be problematic for consumers, because condensing products are incompatible with the utility infrastructure in most existing homes with gas boilers. Most obviously, for reasons of safety and code compliance, condensing boilers cannot be vented by standard atmospheric systems. Because the proposed standards can only be met by condensing gas boilers, homeowners replacing existing non-condensing gas boilers would be forced to modify their homes to accommodate products for which they were not architecturally designed. While there are some cases in which the required modifications to accommodate condensing products would be limited and would not have undesired collateral impacts, there are many cases in which such modifications would have adverse impacts on the venting of other gas products in the home, would have undesired impacts on the occupied space or aesthetics of the home, or would substantially increase the time and expense associated with boiler replacement. In some cases, accommodating a condensing product simply would not – for practical purposes – be possible. Accordingly – by making non-condensing gas boilers unavailable – the proposed standard would leave many purchasers without gas boilers suitable for their needs. These issues have been discussed at length in previous submissions to DOE that are incorporated in these comments as Attachments A-D.¹¹

As also explained at length in previous submissions, EPCA precludes the adoption of standards that would leave purchasers without products suitable to their needs.¹² In particular, the statute includes provisions (hereafter the “Unavailability” provisions)¹³ that ensure the standards do not deprive purchasers of “product choices and characteristics, features, sizes, *etc.*,” and that energy savings are achieved “without sacrificing the utility or convenience of appliances to consumers.”¹⁴ In adopting these Unavailability provisions, Congress understood that buildings are commonly designed for standard appliance installations and sought to ensure that standards would not deprive consumers of the utility and convenience of products that can be installed without the need to modify their homes to accommodate them. Congress specifically intended that standards preserve “the availability of sizes that fit in standard building spaces.”¹⁵ Just as standards must preserve the availability of products that fit in standard appliance spaces, so must they preserve the availability of products that are compatible with the standard built-in venting systems and related infrastructure provided for such appliances. In both cases, the principle is the same: efficiency standards may not leave purchasers without the kinds of products that the utility infrastructure of their buildings was designed to accommodate. The same principle is reflected in the statutory

¹¹ March 1, 2019, Petitioner’s Comments in Support of Petition for Rulemaking, No. EERE-2018-BT-STD-18-0044 (Attachment A); September 9, 2019, Petitioners’ Comments in Support of Petition for Rulemaking September 9, 2019, No. EERE-2018-BT-STD-18-0080 (Attachment B); October 12, 2021, Petitioners’ Comments Opposing Proposed Reversal of Interpretive Rule No. EERE-2018-BT-STD-18-0140 (Attachment C); October 6, 2022, Comments of the American Gas Association, No. EERE-2014-BT-STD-0031-0405 (Attachment D) at 31-53.

¹² See *e.g.*, Attachment A at 3-5; Attachment B at 8-12; Attachment C at 10-11.

¹³ 42 U.S.C. §§ 6295(o)(4) (applicable to consumer products including consumer boilers) and 6313(a)(6)(B)(iii)(II)(aa) (applicable to certain commercial and industrial equipment).

¹⁴ H.R. Rep. No. 100-11 at 22-23 (1987).

¹⁵ *Id.*

provisions relating to separate product classes,¹⁶ under which “performance related features” requiring separate classes include features that make the equipment compatible with its intended use, including features that determine whether the product will function with the existing infrastructure in the buildings in which the products will be installed.¹⁷ DOE has recognized that this is true when standards would deprive purchasers of products that could not be installed without the need to expand the space provided for an appliance.¹⁸ Modifications of that kind generally pale in comparison to the modifications that would be required if purchasers were left without products that are compatible with standard atmospheric venting systems.

These issues were the subject of a rulemaking in which – after lengthy deliberation and development of a robust administrative record – DOE issued a final rule recognizing that the Unavailability provisions of the statute preclude the adoption of standards that would effectively ban non-condensing gas furnaces and similar products such as gas boilers.¹⁹ On the basis of that determination, DOE withdrew a pending proposal to adopt condensing standards for residential furnaces and commercial water heaters.²⁰ Less than twelve months after doing so, DOE issued an interpretive rule that summarily reversed its position on the basis of arguments it had presented in proposed rules issued five years earlier, before the development of the extensive record bearing on these issues.²¹ The NOPR relies upon the latter interpretive rule to disregard the Unavailability provision, and goes on to treat the issues raised by the unavailability of non-condensing boilers as a matter of “installation” costs to be addressed in its economic analysis.

The legal interpretation in the NOPR relies upon to circumvent the Unavailability provision is unreasonable and contrary to law. Pursuant to 42 U.S.C. §§ 6295(o)(4), Joint Commenters hereby request that any final rule in this proceeding include a written finding that interested persons have established by a preponderance of the evidence that the proposed standards are likely to result in the unavailability in the U.S. of consumer boilers with “performance characteristics (including reliability, features, sizes, capacities, and volumes) that are substantially the same as those generally available in the United States” on the date any such rule issues. As explained in detail in the record of the interpretive rule proceedings referred to above:

- The compatibility of a product with the standard utility infrastructure of existing buildings is a performance-related feature for purposes of the “Unavailability” provisions, and DOE’s arguments to the contrary are irreconcilable with the language and structure of the statute as a whole and run contrary to the basic principle that an agency may not interpret a statute in a way that nullifies a provision intended to limit its discretion (*see Hearth Patio*

¹⁶ 42 U.S.C. § 6295(q)(1) *see* 42 U.S.C. §§ 6295(o)(4) and 6313(a)(6)(B)(iii)(II)(bb).

¹⁷ *See, e.g.*, January 6, 2017 Comments, No. EERE-2014-BT-STD-0031-0309, a copy of which is incorporated in these comments as Attachment E, at 51-56.

¹⁸ *E.g.*, Notice of Partial Grant of Petition for Rulemaking and Proposed Interpretive Rule, Energy Conservation Standards for Residential Furnaces and Commercial Water Heaters, 84 Fed. Reg. 33011 at 33016, 33020 (July 11, 2019) (acknowledging the need to maintain the availability of “space constrained” appliances and citing examples in which DOE has done so).

¹⁹ *Energy Conservation Program for Appliance Standards: Energy Conservation Standards for Residential Furnaces and Commercial Water Heaters*, 86 Fed. Reg. 4776, 48052 (January 15, 2021).

²⁰ *Energy Conservation Program for Appliance Standards: Energy Conservation Standards for Residential Furnaces and Commercial Water Heaters; Withdrawal*, 86 Fed. Reg. 3873 (Jan. 15, 2021).

²¹ *Energy Conservation Program for Appliance Standards: Standards for Residential Furnaces and Commercial Water Heaters*, 86 Fed. Reg. 73947 (December 29, 2021).

& Barbecue Association v. DOE, 706 F.3d 499, 506 (D.C. Cir. 2013); *NRDC v. EPA*, 489 F.3d 1364, 1373 (D. C. Cir. 2007));²² and

- The material facts relevant to this issue are no different than they are in the context of residential furnaces and support the finding Joint Commenters request.²³

Consistent with the requested finding, DOE should recognize that the compatibility of a product with existing atmospheric venting systems is a “performance-related feature” that would require separate standards for condensing and non-condensing products if standards specific to condensing products are justified. In addition, information presented by boiler manufacturers at the public meeting and in written comment in this proceeding establishes that non-condensing boilers offer a level of reliability that condensing products cannot achieve, and that difference in “reliability” is a “performance characteristic” expressly protected by the Unavailability provisions. This provides an independently sufficient basis to conclude that the Unavailability provisions bar adoption of the proposed condensing-level standard for gas boilers.

B. The Proposed Standard for Gas-Fired Hot Water Boilers is Not Economically Justified

i. There are Fundamental Errors in DOE’s Assessment of Installed Costs in the Boiler Market

DOE’s analysis illustrates that the proposed standard for gas-fired hot water boilers is not economically justified. According to DOE, purchasers of gas-fired hot water boilers are already choosing products that meet the standard in the NOPR over 60% of the time; accordingly, DOE’s proposal is directed at the less-than 40% of consumers who are not choosing certain products on their own. While for some customers there may be economic benefits, for a large portion of customers DOE’s proposal is not economically advantageous.

DOE’s own numbers suggest that over 31% of potential investments in gas-fired hot water boilers efficient enough to satisfy the proposed standards (*i.e.*, “Standards-Compliant” boilers) are cases in which such products have a lower installed cost than less-efficient boilers and would thus be the low-cost option to start with. These are “windfall benefit” cases that provide efficiency benefits without the need for any “investment” at all, and they account for nearly 86% of the net life-cycle cost (“LCC”) savings claimed to justify the proposed standard. The remainder of DOE’s net LCC savings are attributed to an additional 7% of installations in which investments in Standards-Compliant boilers would pay off (and start generating net savings) within two years (in many cases, less than one year).²⁴ Conversely, DOE’s numbers suggest that about 40% of potential investments in Standards-Compliant boilers would not pay off for more than a decade, and that about a quarter of all potential installations would impose net costs, leaving consumers “in the red”

²² See *e.g.*, Attachment A at 3-5; Attachment B at 8-12; Attachment C at 10-11.

²³ See *e.g.*, Attachment A at 7-10; Attachment B at 19-23; Attachment C at 8-12.

²⁴ See Summary Analysis of DOE’s LCC Analysis for Gas-Fired Hot Water Burners, incorporated in these comments as Attachment F at Table 1.

even after DOE's entire assumed product life of 26.5-years.²⁵ In short, DOE's numbers suggest that over a third of potential investments in Standards-Compliant products are very good investments in economic terms and that about 40% range from economically unappealing to economically disastrous. After analyzing 10,000 trials using the LCC model and comparing them with the real-world market shares of condensing appliances used in DOE's analysis, the results indicate that consumers tend to over-value energy efficiency on an economic basis. By examining LCC outcomes of all trials set at the lowest efficiency and comparing them to the lowest condensing level, it was determined that only 51.1 percent of potential investments in Standards-Compliant boilers would yield any positive savings. It follows that – in a perfectly functioning market – the market share for Standards-Compliant boilers would barely exceed 50 percent. The actual market share exceeds 60 percent. This market share gap suggests that – according to DOE's model – consumers are already over-investing in Standards-Compliant boilers.

In view of these figures, it is not surprising that about 40% of consumers decline to invest in Standards-Compliant boilers. With all of DOE's net LCC benefits being attributable to conspicuously good investments consumers can overwhelmingly be expected to make on their own, it also seems obvious that a standard forcing the last 40% of consumers to make the investments they are currently declining would do those consumers more economic harm than good.

Nevertheless, DOE concludes that the proposed standard for gas-fired hot water boilers would provide average LCC savings of \$767.78 and are presumptively economically justified because investments in Standards-Compliant boilers have a simple payback period of 2.7 years. These conclusions are the product of numerous errors in DOE's analysis.

One of the more critical problems is that DOE's analysis seriously mischaracterizes the boiler market, dramatically overstating the prevalence of installations in which Standards-Compliant boilers tend to provide the largest economic benefits and dramatically understating both the prevalence and economic impact of cases in which investments in such products would have unreasonably high initial costs. Another problem is that – even if DOE's assessment of the range and distribution of economic impacts for investments in Standards-Compliant boilers were correct – its analysis employs a “random assignment” methodology that unreasonably credits standards with the benefits of efficiency investments consumers can overwhelmingly be expected to make on their own while unreasonably assuming that consumers would choose to accept the negative outcomes of bad efficiency investments that consumers would generally decline in the absence of a standard.

The use of boilers for residential heating was prevalent before common duct work for central heating and air conditioning became a standard feature in new home construction. Since that time, boilers generally have not been installed in new residential construction, with exceptions being largely confined to higher-end home construction in which higher total installed costs are considered acceptable. As a result, the market for boilers is overwhelmingly a replacement market centered on older homes and is disproportionately concentrated in the northeastern United States. This is reflected in the fact that over 63% of the 10,000 trial cases used in DOE's analysis represent

²⁵ *Id.*

installations in the six states in the Northeastern urban corridor from Philadelphia to Boston (*i.e.*, Pennsylvania, New Jersey, New York, Connecticut, Rhode Island, and Massachusetts). Just three of these states (New Jersey, New York, and Massachusetts) account for more than half of the net LCC benefits claimed to justify the proposed standard. The state with the largest LCC savings is Massachusetts, in which 301 trial cases representing investments in Standards-Compliant boilers occurring as a result of the proposed standard (almost 8% of the national total) provide \$581,129 in LCC savings (over 19% of the net LCC savings claimed to justify the proposed standard).²⁶

The fact that the boiler market is overwhelmingly a replacement market is important because the installed costs of Standards-Compliant boilers are substantially lower in the context of new construction. In short, new buildings can be designed to facilitate the installation of Standards-Compliant boilers, with the result that the installed cost of such products is frequently lower than the installed cost of a less-efficient boiler requiring a (generally more expensive) traditional atmospheric venting system. By contrast, boiler replacements in existing buildings – particularly installations in which a Standards-Compliant boiler would be incompatible with the atmospheric venting system already built into an existing building – can be considerably more expensive. According to DOE’s numbers, the average LCC benefits for Standards-Compliant products is over 3½ times higher in new construction cases than in replacement cases, and net cost outcomes occur in only 6% of such cases as opposed to nearly a third.²⁷

One of the major distortions in DOE’s analysis is that only about 79% of its rule outcome trial cases are characterized as replacements. There are two reasons for this. First, DOE’s analysis assumes that 10% of the boiler installations in every state represent new construction. This assumption is likely ten times too high on a national basis. Although the NOPR states that DOE assumed that base-case purchasers choose standards-compliant boilers nearly twice as often in new installations,²⁸ the result is that the percentage of rule outcome trial cases that represent new construction installations (almost 6.65%) is likely about 6 times too high. Second, DOE reclassified about 22% of all replacement cases as “new owner” cases ostensibly representing instances in which gas-fired hot water boilers are installed as replacements for oil-fired boilers or gas steam-fired boilers. While this appears to be an unreasonably high percentage to represent such replacements, the more serious problem is that the economic outcomes in these cases are not representative of replacement scenarios at all. To the contrary, the economic outcomes in these cases are *even better* than those in new construction cases: in 92% of these cases Standards-Compliant boilers have lower installed costs than less efficient boilers (as compared to 83.82% in new construction cases), and average LCC benefits are higher (\$1,852.62 for “new owner” cases as compared to \$1,724.37 for new construction cases and \$488.83 for other replacement cases).²⁹ This makes no sense at all. Part of the problem is that DOE appears to have assumed that Standards-Compliant boilers would have a higher effective efficiency in “new owner” cases as opposed to other replacements, based on an assumed 40° difference in return water temperature for which there is no valid technical basis.³⁰ More importantly, DOE assumed installation costs

²⁶ See Attachment F at 13, Table 7.

²⁷ See Attachment F at 7-10, Tables 4-5.

²⁸ NOPR, 88 Fed. Reg. 55166.

²⁹ See Attachment F at 9-10 Table 5.

³⁰ DOE simply assumed a return temperature of 120° in “new owner” cases and 160° in other replacement cases. This assumption – which matches the assumption DOE used in new construction cases – is not logical for cases involving replacements of oil-fired or gas steam boilers.

for “new owner” cases that are consistent with its costs for new construction installations instead of replacement installations (which is what all “new owner” cases are supposed to represent). As a result of these errors, about 21% of DOE’s rule outcome trial cases – accounting for almost 50% of the net LCC benefits claimed to justify the proposed standard – represent a type of installation (new construction) that likely comprises closer to one percent of all installations and (according to DOE’s assumptions) an even smaller percentage of the installations that can be expected to occur as a result of the proposed standard.

The impact of these errors is dramatic. In Massachusetts, the state with the largest net LCC benefits in the nation, only 172 of the 301 trial cases representing rule outcome investments in Standards-Compliant boilers are accounted for as replacements. The remaining 129 cases – nearly 43% of the total – have the favorable economics of installations in new construction that are unlikely to be representative of more than a handful of the installations in that State.³¹ Compounding this problem is the fact that DOE has substantially underestimated the costs associated with cases in which a Standards-Compliant (*i.e.*, condensing) boiler is replacing an atmospherically-vented boiler. Information previously submitted – including written input volunteered in response to a survey addressing the cost of residential furnace replacements with respect to residential furnaces³² – is equally applicable to boilers used for residential heating, except that some of the problems encountered are particularly common in the Northeast, where the use of boilers is most prevalent. As one installer explained:

“Here in the northeast we have houses with finished basements with the units in the middle of the house. To replace the unit you have to rip apart the basement for the venting and intake. Also many houses do not have the window clearance and/or ground clearance for direct vent. And the chimney can’t be lined for it because it is being used for multiple appliances.”³³

While DOE seeks to minimize the significance of such problems, real world experience indicates that “[s]ome installations, because we are a ‘basement’ area of the country will be VERY difficult/costly because of finished basements.”³⁴ This is not an atypical problem that occurs in a small percentage of cases. For example, “[t]here are many applications in the Boston area where a high efficiency condensing furnace is not possible without huge amounts of modifications to the building in order to vent outside”³⁵ and the same can be expected to be true in the context of residential boiler replacements.

DOE’s analysis of installation costs is arbitrary and dramatically understates the cost of replacements in which existing non-condensing boilers would need to be replaced with Standards-Compliant (*i.e.*, condensing) boilers. A survey of heating professionals found very different costs

³¹ See Attachment F at 13 Table 7.

³² See Attachment B at 22-23 & n.78. The survey is documented in a study (entitled “Survey of Furnace Installation Contractors” and dated June 2015) that was prepared by Shorey Consulting, Inc., and submitted as Appendix A to the AHRI Furnace Comments and included in Document No. EERE-2014-BT-STD-0031-0159. Written comments provided in response to the survey are included in Appendix C of that document.

³³ Attachment B at 23.

³⁴ Attachment B at 23 n. 85.

³⁵ Attachment B at 23 n. 84.

than DOE uses in their analysis.³⁶ Another problem is that the model does not reasonably account for the fact that differences in building characteristics can have a dramatic impact on the cost or even feasibility of such replacements. There are buildings – particularly in the context of multifamily housing – in which it can be difficult or impossible to install condensing products,³⁷ yet DOE’s analysis assumes that replacements are *always* feasible because every building can be modified at a reasonable cost. There are other common scenarios (*e.g.*, replacements of boilers located in finished basements, as discussed above) in which boiler replacements would be particularly expensive, yet DOE’s modeling approach makes no effort to assign such costs to trial cases representing the kinds of buildings in which those costs are likely to be experienced. Instead, DOE addressed differences in installation costs by randomly assigning various cost adders, including a purported “difficult installation” adder with a maximum of \$500 and an average of only \$242.38. That “difficult installation” adder is ostensibly designed to address problematic installations in “row houses, etc.,” but the adder is both inadequate to represent the cost of such installations and is assigned randomly to 12% of all cases representing replacements of existing baseline efficiency boilers instead of being assigned to replacements in the kinds of buildings in which such installations are likely to be problematic. As a result, the additional costs imposed in replacements of non-condensing boilers is grossly understated on a per-installation basis, are only accounted for in an unrealistically small percentage of cases, and are assigned in a manner that obscures the frequency and likely consequences of installation problems likely to arise due to, for example, the prevalence of installations in finished basements in the regions in which most boiler replacements occur.

To determine the extent to which DOE’s approach unrealistically homogenizes installation costs, DOE’s “difficult installation” cost-adder was applied to 10,000 trial cases to determine whether “difficult installations” affected any of the types of buildings modeled more or less than others. No pattern emerged even at this detailed level of building analysis. Other than mobile homes, all 4 out of 5 building types have essentially the same average difficult adder: \$262.12 for single family detached; \$256.36 for single family attached; \$267.45 for apartments with 2 to 4 units; and \$260.04 for apartments with 5 or more units. Mobile homes break the trend with an average cost of \$394.74 but only impact 16 out of 10,000 trials. As the above results show, detached and attached single-family homes are treated the same, as well as small and large multifamily buildings. Specific buildings sampled will come with inherent issues common to all buildings that that sample represents in the Residential Energy Consumption Survey (“RECS”) and Commercial Buildings Energy Consumption Survey (“CBECS”) surveys but are treated the same for purposes of DOE’s installation cost adders.

An average of \$242.38 for difficult installations, assigned to some trials but any building randomly, fails to account for the conditions likely to make installations difficult or to apply those costs to cases representing buildings in which such conditions are likely to exist. If a building needs to relocate gas appliances, pipes, electrical, and even repair walls to install condensing products some

³⁶ “Heating Professional Survey on the Lifecycle of Consumer Boilers” by heatinghelp.com, incorporated in these comments as Attachment G, available at https://heatinghelp.com/assets/documents/Boiler_Lifecycle_Survey_Results.pdf (last visited October 13, 2023). The survey results are in sharp contrast to DOE’s assumptions concerning installation costs, product life, and maintenance costs.

³⁷ *See, e.g.* Attachment B at 21-23.

percent of the time, the model ignores this situation and even randomly assigns condensing products when the installation of such products may not be reasonably possible. Moreover, the average cost adder of \$242.38 for installations characterized as “difficult” does not represent the cost of difficult installations. DOE’s model assumes favorable conditions; for example, it does not consider that some buildings cannot vent through the nearest wall and must vent through the farthest wall instead, and assumes easy low-cost solutions that fail to account for the practical difficulties encountered when boilers are located near the center of existing buildings (as is often the case in older homes and multifamily units). The approach taken could be improved by reevaluating the potential for worst-case outcomes that have nearly impossible results that far exceed the amounts modeled.

In any event, it is clear that DOE’s analysis substantially understates the installed cost of condensing boilers overall. Its conclusion that the average difference in installed costs between a baseline boiler and a Standards-Compliant boiler amounts to only \$329 is based on an unreliable methodology in which DOE “builds up” product and installation cost estimates on the basis of numerous parameter inputs for which adequate information is lacking.³⁸ Actual data on the installed cost of boilers is available; DOE simply declines to collect or consider it. Nevertheless, available evidence of actual installed costs suggests that DOE’s estimate is low by roughly a factor of ten. For example, readily available survey-based information suggests an average difference in installed cost is in the range of \$4,000.³⁹ This is a critical part of DOE’s analysis: a sensitivity analysis shows that more than half of all consumers affected by the proposed standard would experience net costs if DOE’s estimate of the installed cost of condensing boilers is low by 7%, and that the average LCC outcome for the proposed standard would be negative if DOE’s estimate is low by 11%.⁴⁰ Accordingly, there is no credible basis to conclude that the proposed standard would provide any economic benefits for consumers.

ii. DOE’s “Random Assignment” Methodology is Unreasonable

Gas-fired hot water boilers efficient enough to satisfy the proposed standards (i.e., “Standards-Compliant” boilers) are already well-established in the market and have captured a significant and ever-increasing share of the gas boiler market. DOE’s own numbers demonstrate that the economic consequences of investments in such products vary considerably based on individual circumstances, producing significant economic benefits in some cases and imposing significant costs in others. In these circumstances, a perfectly functioning market would not result in a 100% market share for Standards-Compliant products and a standard designed to achieve a 100% market share for such products would, at best, be an over-correction for any “market failures” alleged to exist. Moreover – where some investments in Standards-Compliant products would be economically beneficial and others would impose net costs – the economic impact of a standard necessarily depends on the extent to which purchasers acting in the absence of the standard have any significant tendency to make investments in Standards-Compliant products when it would be economically beneficial to do so or to decline such investments when they are economically unattractive. To the extent purchasers have such tendencies, the distribution of economic

³⁸ Attachment E at 71-73, 91-94.

³⁹ See “How much does a boiler replacement cost in 2020?” U.S. Boiler Company, [available at https://www.usboiler.net/how-much-does-a-boiler-replacement-cost-in-2020.html](https://www.usboiler.net/how-much-does-a-boiler-replacement-cost-in-2020.html). See also Attachment G.

⁴⁰ Attachment F at 17.

outcomes for investments in Standards-Compliant products would be different for the investments purchasers would choose to make on their own (*i.e.*, “base case” investments) than for those they would make only if a new standard left them no choice (*i.e.*, “rule outcome” investments). Specifically:

- The base case investments in Standards-Compliant products would disproportionately include investments with *attractive* economic outcomes;
- The rule outcome investments in Standards-Compliant products would disproportionately include investments with *unattractive* economic outcomes; and
- The average economic outcome for base case investments in Standards-Compliant products would be better – and *that for rule outcome investments would be worse* – than the average economic outcome for all potential investments in Standards-Compliant products.

It is absurd to suggest that the purchases of gas boiler consumers are making in the absence of standards do not reflect *any* significant consumer preference for economically beneficial investments in Standards-Compliant boilers or aversion to economically unattractive investments in such products. Nevertheless, DOE employs a “random assignment” methodology that assumes that such purchasing decisions are *never* influenced by the economic consequences of potential investments in Standards-Compliant products *regardless of the economic stakes involved*. DOE has never even claimed that this assumption is factually valid and – as discussed in numerous previous comment submissions – that assumption creates a basis for analysis that significantly overstates the potential for standards to produce favorable economic outcomes, significantly understates their potential to impose unfavorable economic outcomes, and thus systematically skews the results of the economic analyses DOE relies upon to justify new standards.⁴¹

1. The Mechanics of Random Assignment

DOE’s analysis is based on 10,000 “trial cases” that ostensibly represent the full range of scenarios in which Standards-Compliant products may be installed. The economic consequences of potential investments in Standards-Compliant products – as compared to investments in lower efficiency products – can be determined for each of these 10,000 trial cases. These consequences vary depending on the case-specific circumstances represented by each individual trial case and – as already indicated – typically include some cases with very favorable economic outcomes and others with very unfavorable outcomes. For example, DOE’s analysis indicates that individual investments in Standards-Compliant gas-fired hot water boilers can provide economic benefits of up to \$18,116 or impose net costs of up to \$6,786.⁴²

DOE accounts for the fact that a significant percentage of consumers already choose Standards-Compliant products by creating a base case in which that same percentage of trial cases are “assigned” Standards-Compliant products to start with. Having accounted for these “base case” investments in Standards-Compliant products, the remaining trial cases (in the case of gas-fired hot water boilers, 3,836 individual trial cases) are “assigned” lower efficiency products and used

⁴¹ See *e.g.*, Attachment B at 15-16; Attachment D at 54-67; Attachment E at 56-62.

⁴² These are DOE’s outcomes for trial cases 3686 and 9691, respectively.

to simulate the investments in Standards-Compliant products that would occur only if a new standard is imposed. DOE’s analysis of the economic impact of a standard is based on the economic consequences of replacing lower-efficiency products with Standards-Compliant products in the latter cases.

For purposes of this analysis, the percentage of trial cases “assigned” to represent base case investments in Standards-Compliant products (i.e., those investments that consumers are already making on their own) is based on the market share DOE expects Standards-Compliant products to capture if no new standard is imposed. In this rulemaking, DOE determined its market share percentages on the basis of state level data, with percentage adjustments in market share for cases representing new construction (as opposed to replacement scenarios) and building square footage.⁴³ However – whatever the market share percentage is – the *individual trial cases* assigned to represent base case investments in Standards-Compliant products are selected randomly (i.e., without regard to their economic outcomes), as though base case purchasers have no statistically significant preference for economically beneficial investments in Standards-Compliant products or aversion to economically unfavorable investments in such products regardless of the economic stakes involved.

2. Random Assignment Simulates Extreme and Unreasonable Purchasing Behavior

DOE offers a tepid acknowledgement that “economic factors may play a role” in purchasing decisions but claims that random assignment “simulates behavior in the boiler market, where market failures and other consumer preferences result in purchasing decisions not being *perfectly aligned* with economic interests.”⁴⁴ DOE then “emphasizes that its approach does not assume that all purchasers of boilers make economically irrational decisions,” pointing out that “[a]s part of the random assignment, some homes or buildings with large heating loads will be assigned higher-efficiency boilers, and some homes or buildings with particularly low heating loads will be assigned baseline boilers.”⁴⁵ However, as DOE is well aware:

- Economic considerations play a significant role in consumer purchasing decisions; and
- The fact that random assignment produces some apparently reasonable assignments by chance does not provide a basis to assert that it simulates a market in which *any* purchasing decisions are influenced by economic considerations.

a. Economic Considerations Do Influence Purchasing Behavior

DOE knows that economic considerations have a significant influence on consumer purchasing decisions. In the analysis supporting its proposed standards for non-weatherized gas furnaces, DOE included a “consumer choice” model that used economic criteria such as initial costs and payback periods to simulate purchasing behavior. While DOE used that model to address fuel

⁴³ NOPR, 88 Fed. Reg. at 55166-67.

⁴⁴ NOPR, 88 Fed. Reg. at 55167 (emphasis added).

⁴⁵ *Id.*

switching decisions rather than to replace its random assignment methodology for base case efficiency assignment, its model was based on survey-based data that “identified consumers’ willingness to purchase more-efficient space-conditioning systems.”⁴⁶ DOE acknowledged that this data addressed decisions to pay more up-front for more efficient products – not decisions to engage in fuel switching – but argued that “because the data reflect a trade-off between first cost and ongoing savings, it is reasonable to expect that the payback criterion is broadly reflective of the potential consumer behavior regarding switching.”⁴⁷ In short, DOE indicated that it was employing data demonstrating that economic considerations have a significant impact on purchasing behavior and – specifically – *on decisions to make or decline investments in more efficient products*. The source of that data was an earlier vintage of the same data source DOE is relying on for other purposes in this rulemaking: the American Home Comfort Studies (“AHCS”).⁴⁸ DOE’s insistence that it can reasonably ignore the impact that economic considerations have on consumer purchasing decisions flies in the face of such evidence.

Moreover, the fact that economic considerations have an impact on consumer purchasing decisions was confirmed by analysis of DOE’s own numbers in its rulemaking concerning standards for non-weatherized gas furnaces. As documented in comments submitted in that proceeding, DOE’s numbers show that there is a significant correlation between the regional market shares for condensing furnaces and regional differences in the economic outcomes of investments in such products. In particular:

- There was a correlation showing that the market share for condensing furnaces increased as the LCC savings for investments in such products increased; and⁴⁹
- There was correlation showing the market share for condensing furnaces decreased as the percentage of investments with net cost outcomes increased.⁵⁰

There is no reason to suggest that purchasing decisions for home heating appliances are influenced by economic considerations when the appliance is a furnace but are not when the appliance is a boiler. In any event, an analysis of DOE’s own numbers for gas boilers shows the same result: statistically significant correlations between the market shares for Standards-Compliant boilers and both the average LCC savings for such investments and the percentage of such investments that result in net costs.⁵¹ These results should surprise no one.

b. Random Assignment Assumes that Economic Considerations Never Matter

Random assignment does not “reflect[] the full range of consumer behavior” in the market for consumer boilers as the NOPR claims.⁵² To the contrary, it simulates a market in which some base case purchasers make economically advantageous purchasing decisions purely by chance, not a market in which any purchasing decisions are made *on the basis of economic considerations*. This

⁴⁶ 87 Fed. Reg. 40590 at 40647 (July 7, 2022).

⁴⁷ 87 Fed. Reg. at 40647 (July 7, 2022).

⁴⁸ See 87 Fed. Reg. 40590 at 40647 (July 7, 2022); 88 Fed. Reg. at 49114 n. 84.

⁴⁹ See Attachment D at 60-64.

⁵⁰ *Id.* at 64-67.

⁵¹ Attachment F at 15-16 Figures 1 and 2.

⁵² NOPR, 88 Fed. Reg. at 55166.

is obvious, because – if DOE assumed that *any* percentage of purchasing decisions are made on the basis of economic considerations – that percentage of trial cases would be assigned accordingly: *i.e.*, in those cases, the trial cases in which investments in Standards-Compliant products would be economically *favorable* would at least generally be assigned to represent base case investments in such products and those in which investments in Standards-Compliant products would be economically *unfavorable* would at least generally be assigned to represent rule outcome investments in such products. **DOE does not assign *any* trial cases in that way.**

The difference between random assignment and an approach that simulates any economic decision-making is substantial. For purposes of illustration, consider a very simplified example in which half of all potential investments in Standards-Compliant products – represented by 10,000 individual trial cases – would have “good” economic outcomes and the other half would have “bad” outcomes. Further assume that 50% of purchasers are already choosing Standards-Compliant boilers, in which case 5,000 trial cases would be assigned to represent base-case investments in Standards-Compliant products and the other 5,000 would represent rule-outcome investments in such products. The question is how the individual trial cases should be “assigned” to these two categories. With random assignment, the 5,000 trial cases representing base case investments in Standards-Compliant products are selected randomly, with the result that – statistically – they should include about 2,500 trial cases with “good” outcomes and 2,500 cases with “bad” outcomes. This would leave about 2,500 trial cases in which investments in Standards-Compliant products would have “good” outcomes and 2,500 cases in which such investments would have “bad” outcomes to represent the investments in Standards-Compliant products that would occur as a result of the standard.

If it is assumed that *half* of all purchasing decisions are the product of sound economic decision-making, 5,000 trial cases should be “assigned” accordingly: those in which investments in Standards-Compliant products would have “good” economic outcomes (about 2,500 cases) should be assigned to represent base case investments in such products, and those with “bad” outcomes (again, about 2,500 cases) should be assigned to represent investments that would occur as a result of the standard. The remaining 5,000 trial cases would then be assigned randomly (to simulate the 50% of cases in which economic considerations are completely ignored) with the result that the additional 2,500 trial cases representing base case investments in Standards-Compliant products should include about 1,250 cases with “good” outcomes and 1,250 cases with “bad” outcomes (leaving about 1,250 cases with “good” outcomes and 1,250 cases with “bad” outcomes to represent the investments that would occur as result of the standard).

The resulting difference in the distribution of economic outcomes is striking:

- Random assignment simulates a market in which economic considerations never matter, with the result that about half of the 5,000 trial cases representing rule-outcome investments in Standards-Compliant products would have “good” economic outcomes and the other half would have “bad” outcomes. As a result, the average LCC result for the standard would be squarely between “good” and “bad.”
- By contrast, simulation of a market in which half of all purchasing decisions are based on sound economic decision-making produces a result in which about 1,250 (25%) of the 5,000 trial cases representing rule outcome investments in standards-compliant products

would have “good” economic outcomes and the other 3,750 (75%) would have “bad” economic outcomes. As a result, the average LCC result for the standard would be “bad.”

This difference in outcome is not attributable any difference in the base case market share for standards-compliant boilers or in the range or distribution of economic outcomes for potential investments in standards-compliant products: it is solely a product of the difference between random assignment and a methodology that really does assume that some purchasing decisions are made on the basis of economic considerations and others are not.

3. Random Assignment Unreasonably Skews the Results of DOE’s Analysis

Because it simulates a world in which decisions to make (or decline) efficiency investments are never influenced by the economic consequences of such investments, random assignment treats too many good investments in Standards-Compliant products as outcomes that would occur only if a standard is imposed and too many bad investments in such products as the self-inflicted injuries of consumers acting on their own. The practical impact of this problem is significantly exacerbated by the fact that the average LCC outcome for DOE’s purported rule outcome investments (a figure on which DOE principally relies to justify standards) tends to be disproportionately influenced by a small percentage of trial cases with relatively extreme economic outcomes: precisely the kinds of cases in which economic considerations are most likely to drive purchasing decisions. Accordingly – while random assignment is unreasonable – it is most unreasonable as applied to the individual trial cases that matter most: those that have the most substantial economic consequences (good or bad) and thus the greatest impact on the results of DOE’s analysis. In short, random assignment can dramatically influence the results of DOE’s analysis by unreasonably crediting standards with the outsized benefits of conspicuously attractive efficiency investments that purchasers overwhelmingly choose to make on their own while unreasonably crediting base case purchasers with the outsized costs of conspicuously bad efficiency investments consumers would overwhelmingly decline in the absence of a standard.

This is unquestionably the case in DOE’s analysis for gas-fired hot water boilers. Although DOE claims that its proposed standard would provide average LCC savings of \$767.78, its analysis is hopelessly skewed by random assignment: most conspicuously by the unreasonable assignment of trial cases in which the economic outcome of investments in Standards-Compliant boilers are overwhelmingly likely to influence consumer purchasing decisions.

Perhaps the most egregious problem is that over 31% of the 3,936 individual trial cases DOE assigned to represent rule-outcome investments in Standards-Compliant boilers are cases in which such products have lower installed costs than less-efficient boilers *and would thus be the low-cost option*. The windfall economic benefits in these cases – which average over \$2,100 in LCC savings – account for *over 85% of the total LCC savings* attributed to the proposed standard.⁵³ There is no basis to suggest that standards are necessary to induce purchasers to choose more efficient products when they cost less to start with; indeed, the basic premise underlying the theory that standards can provide economic benefits for consumers – the premise that market failures might cause purchasers facing higher initial costs to forego investments that would benefit them over

⁵³ Attachment F at Table 1.

time – does not even apply. Yet these 1,233 trial cases were assigned to represent rule outcomes because random assignment absurdly assumed that – with consumers choosing not to invest in Standards-Compliant boilers about 40% of the time – about 40% of the purchasers presented with *these obvious opportunities to save money* would choose to pay more for less efficient boilers instead. In short, random assignment assumed that the probability that these windfall economic benefits would induce any consumers to purchase Standards-Compliant boilers is zero.

Conversely, over 27% of DOE’s 3,936 purported rule outcome trial cases have net cost economic outcomes: *i.e.*, outcomes *so bad* that consumers would still be left in the red – by an average of \$1,278.50 – at the end of the average 26.9-year life of the product.⁵⁴ However – because these randomly-selected trial cases should be representative of all 10,000 trial cases simulating potential investments in Standards-Compliant boilers – there should be closer to 2,700 trial cases (27% of the total) that have net cost outcomes. DOE assigned only 1,071 of those cases to represent rule outcomes because it absurdly assumed that – with consumers choosing Standards-Compliant boilers about 60% of the time – about 60% of the purchasers *facing investments with these conspicuously bad outcomes* would choose Standards-Compliant boilers anyway. In short, random assignment assumed that the probability that consumers considering Standards-Compliant boilers would be deterred by *even the worst possible* economic outcomes is zero.

The cumulative impact of these errors is significant. For example, if it is assumed that there are 3,200 trial cases in which Standards-Compliant boilers are the low-cost option and that consumers can be expected to make such investments 90% of the time, non-random assignment would leave 320 such cases to represent rule outcome investments in standards-compliant boilers. That would be 913 fewer than 1,233 cases DOE’s analysis accounted for.⁵⁵ It should be noted that it defies credulity to suggest that even 10% of purchasers presented with these windfall-benefit opportunities would decline the Standards-Compliant product, because these cases present simple decisions that are virtually immune to market failures. If these 913 cases are assigned to represent base case investments rather than rule outcomes, the total benefits claimed by DOE’s analysis would be reduced by \$1,917,300 (*i.e.*, 913 times the average LCC benefits for such cases of \$2,100). If it is also assumed that there are 2,500 trial cases in which investments in Standards-Compliant boilers would result in net cost outcomes and that consumers can be expected to decline such investments 80% of the time, non-random assignment would result in 929 more net cost rule outcomes than DOE’s analysis accounted for. This would reduce DOE’s claimed benefits by \$1,187,726.50 (*i.e.*, 929 times the average net LCC cost for these cases of \$1,278.50). The net effect of these two corrections would maintain essentially the same number of rule outcome trial cases overall (the reduction of 913 cases being slightly more than offset by the addition of 929 cases). However, the combined economic impact of these corrections would be a \$1,917,300 reduction in benefits plus an additional \$1,187,726.50 in net costs, for a total reduction in LCC savings of \$3,105,026.50: more than the total net LCC savings (\$3,021,997) claimed to justify the proposed standard.

These are just two specific examples of objectively absurd and disproportionately consequential “assignment errors” attributable to the assumption that purchasing decisions are *never* influenced by economic considerations *regardless of the economic stakes involved*. It is not reasonable to

⁵⁴ *Id.*

⁵⁵ *Id.*

believe that purchasers acting on their own would turn down so many obviously beneficial investments in Standards-Compliant products or make so many investments with catastrophically bad economic outcomes. As a result, random assignment produces an analysis of rule impacts that is based on *the wrong set of trial cases*: one that is representative of all potential investments in Standards-Compliant products rather than one that is representative of the investments that could reasonably be expected to occur *as the result of a standard*. The impact on the outcome of DOE’s economic analysis is obvious and substantial.

DOE’s failure to take any reasonable account of the impact that economic considerations are likely to have on purchasing decisions is unreasonable and particularly egregious in the case of the high-consequence trial cases – good and bad – that disproportionately influence the results of its economic analysis.

4. DOE’s Failure to Address the Errors Created by Random Assignment is Unreasonable

Interested parties have been pointedly challenging DOE’s random assignment methodology for a number of years, as demonstrated by numerous comments submitted in a variety of DOE rulemaking proceedings.⁵⁶ The issue was raised in *American Public Gas Ass’n v. DOE*,⁵⁷ – a challenge to DOE’s commercial packaged boiler standards – and the Court found that DOE had failed to respond to the “substantial concerns” about this “crucial part of its analysis” and that its “failure to engage the arguments raised before it . . . bespeaks a failure to consider an important aspect of the problem.”⁵⁸ The NOPR exhibits the same failing.

a. DOE’s Market Share Adjustments Are Non-Responsive

As already discussed, the core problem with random assignment is that it assigns individual trial cases to represent base case or rule outcome investments in Standards-Compliant products randomly, *i.e.*, without any consideration of the economic consequences of the particular investment and the influence those outcomes could be expected to have on purchasing decisions. DOE states that it “considered available data in determining whether any modifications should be made to the random assignment methodology.”⁵⁹ However, DOE failed to consider any available data indicating that the economic outcome of particular efficiency investments have an impact on the probability that consumers will make such investments. In particular, DOE considered data from the 2022 AHCS survey⁶⁰ but plainly did not consider the most directly-relevant AHCS survey data: data that – according to DOE – “identified consumers’ willingness to purchase more-efficient space-conditioning systems” and provides a basis to conclude that consumers generally make appliance investments that can be expected to pay off in less than three years.⁶¹ Moreover, DOE failed to consider *any approach* in which assignment would *not be* random: *i.e.*, in which the economic outcome of individual trial cases would have any bearing on their assignment. Instead

⁵⁶ See *e.g.*, Attachment B at 15-16; Attachment D at 54-67; and Attachment E at 58-62.

⁵⁷ 22 F.4th 1018 (D.C. Cir. 2022) (“*APGA v. DOE*”).

⁵⁸ *Id.*, 22 F.4th at 1027-28.

⁵⁹ NOPR, 88 Fed. Reg. at 55166.

⁶⁰ *Id.*

⁶¹ 87 Fed. Reg. 40590 at 40647 (July 7, 2022).

of considering the case-specific economic outcomes provided by its own analysis and assessing their likely impact on purchasing decisions, DOE focused its attention on “household characteristics” that are, at best, imperfectly correlated with economic outcomes and used them as a basis to adjust market shares (i.e., the percentage of trial cases assigned to represent base-case investments in Standards-Compliant products). These efforts are not reasonably designed to address the fundamental problems with random assignment and demonstrably failed to address their unreasonable impacts.

DOE made three specific kinds of market share adjustments. First, it calculated market shares (and thus the percentage of trial cases needed to represent base case investments in standards-compliant boilers) on a state-by-state basis. This approach assigns a higher percentage of trial cases to represent base-case investments in Standards-Compliant boilers in states in which the market share for such products is higher due to regional differences that tend to make the economics of such investments more favorable. However – while those regional differences are evidence that economic outcomes influence purchasing decisions⁶² – market share adjustments do not provide a reasonable means to account for that influence. In short, the problem with random assignment does not involve DOE’s determination of the *percentage* of trial cases assigned to represent base case investments in Standards-Compliant products (i.e., market share); it involves the question of *which individual trial cases* are assigned to represent such investments. An adjustment to the *percentage* of trial cases assigned to represent such investments is not responsive to the basic problem that – with random assignment – the *individual* trial cases assigned to represent those investments are selected without regard to their economic outcomes.

Again, DOE’s own numbers confirm that there is a correlation between the market share for Standards-Compliant boilers and the economic outcomes for such products (specifically, average LCC savings and the percentage of investments with net cost outcomes).⁶³

To illustrate, consider a state in which purchasers are already choosing Standards-Compliant products 90% of the time. In such a state, DOE would assign 90% of the trial cases to represent base case investments in Standards-Compliant products, leaving the remaining 10% to represent investments that would occur as the result of a new standard. In the real world, those rule outcomes would disproportionately include the trial cases with the worst economic outcomes in the state – and disproportionately *exclude* the trial cases with the best economic outcomes, because – in both cases – the probability that such outcomes would influence the purchasing decisions of consumers facing them significantly exceeds zero. By contrast, random assignment of these trial cases would produce a set of purported rule outcome trial cases in which the distribution of economic outcomes is the same as it is for all of the trial cases in the state, most of which represent economically attractive investments in Standards-Compliant products (as demonstrated by the fact that 90% of the purchasers in that state are already choosing such products on their own). Whatever the market shares for a given state are, the fundamental problem is the same: random assignment produces a set of purported rule outcome trial cases that is representative of all the potential efficiency investments in that state, not one that is reasonably representative of the efficiency investments consumers could be expected to decline in the absence of a new standard (i.e., the investments that would actually occur as a result of the standard). Accordingly, the claim that that “[t]he resulting

⁶² NOPR, 88 Fed. Reg. at 55166.

⁶³ Attachment F at 15-16 & Figures 1 and 2.

percentage shares within the sample match the market shares in the efficiency distributions”⁶⁴ is not responsive to the fundamental problem.

DOE’s second form of market share adjustment consists of adjustments based on a general correlation between building size (and thus presumably heating load and efficiency benefits) and the market share for Standards-Compliant products.⁶⁵ Once again, DOE took evidence that purchasing decisions are influenced by economic outcomes and – rather than considering the impact that the case-specific economic outcomes provided by its analysis could be expected to have on purchasing decisions – used market share adjustments to modify the percentages of cases that it randomly assigns to represent base investments in standards-compliant products. Because DOE’s approach focuses on building size criteria that are only imperfectly correlated with economic outcomes – rather than on the economic outcomes actually likely to drive purchasing decisions – it is only capable of addressing “weak correlations between boiler efficiency and household characteristics and economic factors” *other than actual “economic factors” such as economic costs and benefits*.⁶⁶ It is no surprise that “DOE did not find a significant correlation between input capacity and condensing boiler market share in a given region” despite the theory that larger buildings can be expected to have greater energy consumption,⁶⁷ because any correlation to individual economic outcomes would be indirect. By contrast, if DOE had looked for a correlation between the actual *economic outcomes* of investments in Standards-Compliant boilers and the market share for such products it would have found one.⁶⁸ In any event, an approach designed to address such correlations only through market share adjustments is inherently flawed because it preserves the fundamental problem created by random assignment: the fact that the individual trial cases selected to represent base case investments in Standards-Compliant products are selected randomly, as though their individual economic outcomes – no matter how good or bad – never influence purchasing decisions.

Finally, the NOPR indicates that DOE made a market share adjustment based on evidence that Standards-Compliant boilers are selected more frequently in new construction cases. Again, DOE chose to ignore the obvious point: consumers are substantially more likely to choose Standards-Compliant boilers in new construction installations because the economics of condensing boilers tend to be significantly better in that context. So – instead of concluding that economic outcomes should have a bearing on the assignment of individual trial cases – DOE simply changed the percentage of new construction trial cases that are randomly assigned to represent base case investments in Standards Compliant boilers. The results of this exercise include the kinds of absurdities that only random assignment can produce: most notably, DOE’s analysis assumed that 72% of the new construction cases in which consumers acting on their own would *decline Standards-Compliant products* are cases in which such products are *the low-cost option* and would provide LCC benefits averaging \$2,016. Consequently, almost 84% of the economic benefits DOE claimed in new construction cases rest on the premise that *standards are necessary to keep consumers from paying more up front for less efficient products*.⁶⁹

⁶⁴ NOPR, 88 Fed. Reg. at 55166.

⁶⁵ *Id.*

⁶⁶ *Id.* at 55167.

⁶⁷ *Id.*

⁶⁸ Attachment F at 15-16 & Figures 1-2.

⁶⁹ Attachment F at 9-10, Figure 5.

DOE's market share adjustments are fundamentally misdirected. To account for the impact that economic outcomes are likely to have on purchasing decisions, DOE must consider the economic outcomes themselves, not "building characteristics" that are imperfectly correlated with economic outcomes. DOE must look at its trial case outcomes to ensure that it is not crediting standards with the benefits of efficiency investments that consumers would overwhelmingly be expected to make on their own. It must also look at its trial case outcomes to ensure that efficiency investments with outcomes consumers would overwhelmingly reject are not unreasonably assigned to represent base case investments in Standards-Compliant products *instead of rule outcomes*. DOE's focus on market share adjustments reflects an unreasonable unwillingness to consider the impact that individual economic outcomes are likely to have on purchasing decisions and – in particular – to address the most unreasonable impacts of random assignment. The inadequacy of DOE's market share adjustments is demonstrated by the results of DOE's boiler analysis, which claims benefits that are almost entirely attributable to efficiency investments consumers can be expected to make on their own and unreasonably attributes most of the net cost outcomes likely to occur as a result of the proposed standard to base case purchasing decisions.

b. DOE's Arguments in Support of Random Assignment Are Non-Responsive

Concerns about the objectively absurd impacts of random assignment – particularly the random assignment of high consequence trial cases that have a disproportionate impact on the results of DOE's analysis – are nothing new. Specific objections to the random assignment of trial cases in which the Standards-Compliant product is the low-cost option were previously documented in comments on DOE's 2016 proposed standards for non-weatherized gas furnaces and has been the subject of pointed criticism ever since.⁷⁰ Nevertheless, DOE has provided no meaningful response to these issues.

Instead, DOE responds to criticisms of random assignment with claims that assignment "based solely on economic measures . . . most likely would not fully and accurately reflect actual real-world installations" because alleged market failures suggest that decisions to make efficiency investments "are unlikely to be *perfectly correlated* with energy use."⁷¹ DOE then claims that random assignment "simulates behavior in the boiler market, where market failures and other consumer preferences result in purchasing decisions not being *perfectly aligned* with economic interests more reliably than relying *only on apparent cost effectiveness criteria derived from the limited information in CBECS or RECS*."⁷²

As already discussed, economic considerations often have a significant influence on consumer purchasing decisions and there is no remotely credible basis to assume that they do not. This does not mean that such decisions are *always* "based solely on economic measures" or are "*perfectly correlated with energy use*," but it does mean that the core assumption embodied by random

⁷⁰ See Spire's January 6, 2017 Comments (Attachment E) at 60-61 and Attachment C to those Comments (Gas Technology Institute Report entitled Technical Analysis of DOE Supplemental Notice of Proposed Rulemaking on Residential Furnace Minimum Efficiencies (January 4, 2017)) at 23.

⁷¹ NOPR, 88 Fed. Reg. at 55167 (emphasis added).

⁷² *Id.* (emphasis added).

assignment – that base case purchasing decisions are *never* influenced by the economics of potential investments in Standards-Compliant products *regardless of the economic stakes involved* – is indefensible.

Again, random assignment is not a “reasonable approach” that “simulates behavior” in a market in which purchasing decisions are not “perfectly aligned” with economic interests; it is an approach that unreasonably assumes that economic considerations *never influence purchasing decisions at all*. That is the purchasing behavior DOE’s model simulates in the assignment of every trial case. DOE’s bare assertion that random assignment simulates purchasing behavior in the market for water heaters “more reliably than relying *only on apparent cost effectiveness criteria derived from the limited information in CBECS or RECS*” presents an irrelevant comparison, because the alternative to random assignment is not to rely “only” on “apparent cost effectiveness criteria derived from the limited information in CBECS or RECS.”⁷³ DOE need not rely *only* on economic criteria, and it certainly should not rely on “apparent cost effectiveness criteria derived from the limited information in CBECS or RECS.” Random assignment unreasonably fails to consider the impact that economic outcomes are likely to have on consumer purchasing behavior and – at least when investments in Standards-Compliant products provide economic benefits in some cases but impose economic harm in others – DOE cannot reasonably ignore the fact that the economic impact of a new standard depends on the investment decisions consumers can be expected to make on their own. As DOE is well aware, building characteristics do not provide a sufficient basis to determine case-specific economic outcomes, and it is those outcomes – which DOE’s individual trial case outcomes already provide – that must be considered in determining the impact that economic considerations are likely to have on individual purchasing decisions.

DOE’s extended discussion of theoretical market failures⁷⁴ is also non-responsive, for the simple reason that claims that consumers do not always make perfect economic decisions are facially insufficient to justify the assumption that purchasers are *never influenced by economic considerations at all*. For example, the NOPR cites one study for the proposition that a “significant subset of consumers appear to purchase appliances without taking into account their energy efficiency and operating costs at all,”⁷⁵ ignoring the fact that this proposition does not justify the assumption that *no* consumers consider such factors and that the study referred to concluded that – on average – consumers do consider such factors.⁷⁶ Indeed, the entire body of literature on market failures consists of efforts to identify and (in some cases) assess the impact of potential *exceptions to (or limitations on)* the general proposition that purchasers tend to act in their own economic interest.

DOE should also recognize that not all purported “market failures” represent “problems” that should – or in some cases can – be “corrected” by efficiency standards. As the study cited above found, the consumers most likely to prioritize initial costs over efficiency benefits are low-income consumers, and – as detailed in previous comments – it would be more cruel than wise to adopt

⁷³ *Id.*

⁷⁴ NOPR, 88 Fed. Reg. at 55166-70.

⁷⁵ *Id.* at 55168.

⁷⁶ Houde, S. “*How Consumers Respond to Environmental Certification and the Value of Energy Information*,” cited at 55168 n. 97.

standards designed to force such consumers to make efficiency investments they cannot afford.⁷⁷ Similarly, DOE should recognize that - at least in the case of appliances such as heating and water heating equipment - a tendency toward like-for-like replacements in “emergency replacements of essential equipment such as boilers”⁷⁸ is not a “market failure” at all, except in the sense that it does not prioritize energy efficiency over the consumer’s need to restore service quickly and with a minimum of disruption. In the context of such replacements, “like kind” refers not to efficiency as such, but to the compatibility of a boiler with the existing home and its utility infrastructure, which can have an enormous impact on the time, expense, and collateral issues required to restore service. In many cases, “like-kind” boiler replacements occur because they serve the consumers interests under the circumstances, not because they do not.

Alleged market failures must also be viewed in their appropriate context. The potential that market failures might cause consumers to choose the low-cost option when they might be better off investing in a more efficient product cannot justify the random assignment of cases in which the more efficient product *is the low-cost option*. Concerns that consumers might have trouble making perfect economic decisions in close or complicated cases provides no basis for random assignment of cases that are obvious “no brainers” from an economic standpoint. The fact that “[t]here are consumers who are willing to pay a premium for more energy-efficient products”⁷⁹ provides no basis to conclude that consumers have no statistically significant aversion to bad investments *regardless of the stakes involved* and certainly does not justify the random assignment of trial cases representing investments that, for example, have initial costs with an obvious potential to induce “sticker shock.” Because market failures are limited in both scope and impact, even demonstrated market failures in the relevant market would – at most – have incremental impacts insufficient to justify random assignment.

Although DOE claims that it “minimizes any bias in the analysis by using random assignment, as opposed to assuming certain market conditions that are unsupported given the available evidence,”⁸⁰ the opposite is true: random assignment creates a massive bias in DOE’s analysis by “assuming certain market conditions” that are unsupported by the available evidence. As a result, DOE’s analysis is arbitrary and insufficient to support the adoption of any standard.

5. Alternatives to Random Assignment

The obvious alternative to random assignment is to prepare a base case for analysis that reasonably represents actual market conditions and purchasing behavior. There are many ways in which this could be accomplished. For example, DOE could potentially conclude (as it did on the basis AHCS survey data in the fuel-switching analysis supporting its proposed residential furnace standards) that consumers will be willing to make appliance efficiency investments that can be expected to pay off within 3 years.⁸¹ As imperfect as this very simplistic approach might be, it would certainly simulate the market for consumer boilers “more reliably than” random assignment, though this is

⁷⁷ See Attachment E at 38-41 (detailing the adverse health and safety impact of such standards in the context of furnaces).

⁷⁸ NOPR, 88 Fed. Reg. at 55168.

⁷⁹ *Id.* at 55167.

⁸⁰ *Id.*

⁸¹ 87 Fed. Reg. at 40647.

admittedly faint praise. If this approach were applied in DOE's analysis for gas-fired hot water boilers, the results would show that the proposed standard is economically unjustified. In particular, 1,675 of DOE's 3,936 rule outcome trial cases - accounting for more than 112% of the net LCC benefits claimed to justify the proposed standard - would be reassigned to represent base case investments in Standards-Compliant boilers and would need to be replaced as rule outcomes by trial cases that would leave the average LCC outcome for the proposed standard in the red. In view of DOE's request for comment on alternatives to random assignment, discussion of a more sophisticated approach is warranted. For purposes of the following discussion, Joint Commenters will assume that DOE:

- Retains an LCC analysis based on 10,000 trial cases representing the range and distribution of scenarios in which standards-compliant products can be expected to be installed; and
- Continues to determine the percentage of these trial cases that should represent base-case investments in standards-compliant products.

The sole issue is how the individual trial cases representing base-case investments in standards-compliant products should be selected.

As a preliminary step, DOE should assign lower-efficiency products to all 10,000 trial cases for purposes of determining the economic outcome of investments in standards-compliant products in each of its 10,000 trial cases. This step is necessary to enable DOE to consider the impact that those economic outcomes are likely to have on base case purchasing decisions.

While the specific methodology for the assignment of individual trial cases should vary depending on the nature of the product, the range and distribution of economic outcomes for potential investments in standards-compliant products, and evidence of specific market failures and other relevant market conditions. However, there are at least two core principles that should govern DOE's approach.

First, market failures, by definition, are limited exceptions to the principle that consumers can generally be expected to act in their own economic interest. Accordingly – to the extent there are demonstrated market failures – their impact should be simulated in a way that accounts for the circumstances in which each such failure is likely occur and the way in which each failure can be expected to influence purchasing decisions.

Second – while purchasing decisions are not always based on *perfect* economic decisions – DOE should recognize that the probability that a purchasing decision will be made on the basis of economic considerations increases as the economic consequences of that decision (good or bad) increases.

The approach described below provides a general (and admittedly abstract) illustration of how issues might be addressed in a manner consistent with the above principles.

a. Accounting for Consumers Willing to Pay a Premium for Energy Efficient Products

If there is sound basis to conclude that some percentage of purchasers are so willing to pay a premium for more energy-efficient products (and so insensitive to costs) that they would generally purchase standards-compliant products regardless of the economic consequences, DOE could:

- Select that percentage of the 10,000 trial cases – without considering their economic outcomes – by choosing individual trial cases that appropriately represent cases involving such purchasers (*i.e.*, cases involving installations in buildings likely to be owned by higher-income consumers and governmental or institutional purchasers with policies requiring investment in high-efficiency products); and
- Assign those trial cases to represent base case investments in standards-compliant products, subject to appropriate exceptions to address individual cases in which problematic outcomes are likely to cause even those prepared to pay a premium for higher efficiency to decline investments in Standards-Compliant products.

This approach would account for relatively extreme cases in which consumers value efficiency over economic considerations: *i.e.*, cases in which purchasers can be expected to be particularly insensitive to negative economic outcomes. At the same time, it would recognize that there are factors (such as a level of “sticker shock”) that would cause many such purchasers to decline unreasonably costly efficiency investments (DOE should note that many institutional policies favoring higher-efficiency products provide exceptions for such cases). Such cases would represent limited exceptions to the expected behavior of purchasers who are generally prepared to pay a premium for higher efficiency products. The result would be that a randomly-selected percentage of trial cases would be assigned to represent base case investments in standards-compliant products, with the exception of cases with particularly negative outcomes (which would be assigned lower efficiency products to represent cases in which even purchasers prepared to pay a premium for more efficient products would be expected to balk).

Cases in which decisions are less dramatically influenced by a willingness to pay a premium for higher-efficiency products could be addressed through criteria reflecting imperfect economic decision-making (described below).

b. “Split Incentives”/Extreme Sensitivity to Initial Costs

If there is a sound basis to conclude that some percentage of purchasers would generally choose the product with the lowest installed cost regardless of any other considerations:

- DOE should select that percentage of trial cases – without considering their economic outcomes – by choosing individual trial cases that appropriately represent cases involving such purchasers (*i.e.*, cases involving installations in buildings likely to be owned by low-income consumers and owners of low-income housing); and
- For the base case, DOE should assign each of these trial cases the product with the lowest installed cost, subject to appropriate exceptions for cases in which small differences in initial costs or high operating costs would likely cause purchasers otherwise inclined to choose the low-cost option to invest in Standards-Compliant products instead (*e.g.*, cases in which a landlord could expect a relatively modest investment to pay off through improved tenant retention).

This approach is designed to appropriately account for the circumstances in which extreme sensitivity to initial costs is likely to occur and simulates the impact such sensitivity would be likely to have on purchasing behavior.

Again, cases in which purchasing decisions are less dramatically influenced by sensitivity to initial costs can be addressed through criteria reflecting imperfect economic decision-making (described below).

c. Informational Market Failures

In the case of professionally-installed appliances for which certified efficiency ratings are required and products are differentiated largely on the basis of their cost and efficiency, concerns about the ability of consumers to make sound economic decisions should be limited to cases in which the economic stakes are relatively small and difficult to assess. As a result, these concerns can be appropriately addressed through criteria reflecting imperfect economic decision-making (described below).

d. Imperfect Economic Decision-Making

To simulate imperfect economic decision-making, DOE should – after accounting for significant demonstrated market failures as appropriate – attempt to identify (1) categories of trial cases in which sound economic decision-making can be expected drive decisions, (2) categories of trial cases in which economic decision-making can be expected to drive decisions in a relatively large percentage of cases, and (3) categories of trial cases in which economic decision-making is significantly less likely to drive purchasing decisions.

The line drawing required for this purpose should be informed by the range and distribution of economic outcomes in DOE’s 10,000 trial cases, the percentage of consumers expected to purchase standards-compliant products in the absence of a new standard, and relevant data concerning consumer purchasing behavior. However, DOE should start with the assignment of the trial cases in which purchasing decisions are most likely to be made on the basis of economic considerations (generally those in which the economic stakes are highest) and progress to the cases in which economic considerations are least likely to be decisive (generally those in which the economic stakes are lowest). This approach appropriately prioritizes the reasonable assignment of the trial cases with the greatest impact on the results of DOE’s analysis, thereby reducing the potential impact of assignment errors. It should be noted that the approach described below assumes significant market failures as well as a significant disconnect between the kinds of outcomes DOE considers to be “economically beneficial” (*i.e.*, any investment that would provide non-zero LCC savings) and those consumers are likely to consider to be economically reasonable.

i. Cases in Which No “Investment” in Efficiency is Required

DOE should identify all trial cases in which the total installed cost of a Standards-Compliant product is lower than the total installed cost of a baseline efficiency product and would not impose

higher operating costs. DOE should assign all of these cases to represent base case investments in standards-compliant products, because – in a context in which initial costs and efficiency are the principal significant variables – there is no basis to believe that consumers acting on their own would choose to pay more up-front for a less-efficient version of a Standards-Compliant product.

ii. Investments with Very Obvious Economic Outcomes

DOE should identify and appropriately assign trial cases in which the economic consequences of investments in Standards-Compliant products are so obviously favorable or unfavorable that – in the absence of severe market failures of the kind already accounted for as described above – the economic consequences could not reasonably be expected to be overlooked or ignored.

For example, DOE could identify cases with very short payback periods (*e.g.*, simple payback periods that do not exceed one year) and assign all of those cases to represent base case investments in standards-compliant products.

Similarly, DOE could identify cases with very long simple payback periods (*e.g.*, simple payback periods exceeding the expected life of the product) and assign all of those cases to represent investments in standards-compliant products that would occur as a result of the standard.

The criteria used as examples above should be designed to identify trial cases in which economic outcomes are too obvious to be obscured by realistic informational market failures, and the economic stakes are high enough to ensure that purchasing decisions are unlikely to be swayed by preferences for more efficient products or sensitivity to initial costs less pronounced than that already accounted for as described above.

iii. Investments with Less Obvious Economic Outcomes

Purchasing decisions with less obvious economic outcomes can be expected to be driven by economic decision-making in some cases but not in others. As a result, such cases could appropriately be addressed through a combination of random and non-random assignment that accounts for the probability that particular categories of purchasing decisions would be based on economic decision-making.

Such an approach should start by identifying trial cases in which economic considerations are *likely* to be decisive in a large percentage of cases. For example, it would probably be reasonable to assume that a relatively large percentage of purchasers facing efficiency investments with simple payback periods of between one and three years would choose to make those investments on the basis of economic considerations.⁸² Conversely, it may make sense to assume that a large percentage of purchasers facing efficiency investments with simple payback periods of between ten years and the expected life of the product would decline to make such investments on the basis of economic considerations. For the trial cases defined by such criteria, the percentage of cases in which economic decision-making can be assumed should be selected randomly and assigned on

⁸² Again, the sequence in which different considerations are addressed is important. Here the impacts of cases involving significant market failures have already been addressed (*see* Section IV.B.ii.2, above), as have cases with simple payback periods *not exceeding one year* (*see* Section IV.B.i, above).

the basis of their economic outcomes (*i.e.*, with the cases with favorable economic outcomes being assigned to represent base case investments in standards-compliant products and those with unfavorable outcomes being assigned to represent investments that would occur as a result of the standard). The remaining percentage of the cases defined by such criteria should then be *assigned randomly*, simulating the result that – for reasons not already accounted for – it is assumed that purchasing decisions would not be based on economic outcomes.

Additional criteria could then be developed to define categories of trial cases in which economic considerations are likely to drive decisions in a lower percentage of cases. For each such category, the individual trial cases could again be assigned through a combination of random and non-random assignment that reflects the probability that purchasing decisions will be made on the basis of economic decision-making. A purely random approach to assignment would only be appropriate for cases in which the economic stakes of potential efficiency investments are so modest and difficult to assess that they are unlikely to have *any influence* on purchasing decisions.

iii. DOE’s determination that the standards are presumptively justified by a payback period of less than three years is arbitrary and contrary to law.

EPCA, 42 U.S.C. § 6295(o)(2)(B)(iii), provides that “there shall be a rebuttable presumption” that a standard “is economically justified” if “the additional cost to the consumer of purchasing a product complying with” the standard “will be less than three times the value of the energy . . . savings during the first year that the consumer will receive as a result of the standard.” The NOPR suggests that the proposed standard for gas-fired hot water boilers is presumptively justified because the simple payback period for investments in Standards-Compliant boilers is less than three years.⁸³ That determination is unreasonable for a variety of reasons.

First, as discussed in Section IV.B.i of these comments, DOE’s analysis is based on an unreasonable assessment of the facts relevant to boiler installations, with the result that DOE’s analysis dramatically overstates the frequency of installation scenarios that tend to produce highly favorable economic outcomes and substantially underestimates both the frequency and economic impact of installation scenarios that tend to produce unfavorable economic outcomes. As a result, the “trial cases” on which DOE’s analysis is based do not reasonably represent the range and distribution of economic outcomes for all potential investments in Standards-Compliant products, and the errors involved systematically overstate the potential for investments in Standards-Compliant gas boilers to provide economic benefits for consumers while understating the potential for such investments to impose net costs. In short, the 10,000 trial cases DOE uses to simulate potential investments in Standards-Compliant boilers significantly overstates the prevalence and magnitude of favorable investment outcomes while significantly understating the prevalence and magnitude on unfavorable investment outcomes.

Second, as discussed in Section IV.B.ii of these comments, DOE’s analysis is fatally undermined by a “random assignment” assumption that unreasonably overstates the extent to which consumers acting the absence of the proposed standard can be expected to decline highly favorable investments in Standards-Compliant boilers while unreasonably overstating the extent to which

⁸³ NOPR, 88 Fed. Reg. at 55185.

they can be expected to make economically unreasonable investments in such products. As a result – even if the range and distribution of economic outcomes for the trial cases DOE used to represent all potential investments in Standards-Compliant products had been reasonable – the range and distribution of economic outcomes for the subset of trial cases representing investments that would occur as a result of the proposed standard was not. Again, the errors involved systematically overstate the potential for investments in Standards-Compliant boilers to provide economic benefits for consumers while understating their potential to impose net costs. In short, the trial cases DOE uses to represent the efficiency investments that would occur *as a result of the proposed standard* include too many cases with highly favorable economic outcomes and too few cases with highly unfavorable outcomes.

Finally, DOE’s conclusion that its proposed standard is entitled to the rebuttable presumption specified in 42 U.S.C. § 6295(o)(2)(B)(iii) would be erroneous even if its analysis of the economic impacts of potential investments in Standards-Compliant boilers had been reasonable and the results of its analysis had not been fatally skewed by random assignment. In short, the reported results from DOE’s spreadsheet analysis indicates that, on average, “the additional cost to the consumer of purchasing a product complying with” the proposed standard is 21.6 times the first-year operating cost savings “that the consumer will receive as a result of the standard.” The simple payback period DOE relies upon (2.7 years) is the product of abstract calculations based on average input parameters that only reflect the maximum potential efficiency improvement resulting from the standard (*i.e.*, an improvement from lowest efficiency product available to a Standards-Compliant product). Unlike the figure provided by DOE’s spreadsheet analysis, this figure does not account for the range of individual economic outcomes consumers would actually experience “as a result of the proposed standard.” Accordingly, the rebuttable presumption does not apply.

iv. DOE Relied on Flawed Energy Price Assumptions in Its Analysis

In the NOPR, DOE is using an energy price forecast based on the Annual Energy Outlook (“AEO”) which has consistently overestimated future natural gas energy costs. AGA conducted a review of forecasted prices versus actual prices using historical AEOs back to 2010. The AEO reported higher prices 70% of the time for residential consumers and 86% of the time for commercial consumers nationally. The only years with higher actual versus forecasted prices are the most recent two years or 2021 and 2022 (“2022 and 2023 AEO”) which is heavily impacted by the COVID-19 economy. The consumer water heater rule uses the 2023 release year AEO.

While uncertainty is a major factor in any forecast, the statistically bias outcome towards higher prices in the AEO compared to what is actual reported historically presents a need for energy prices to be modeled based on a distribution of prices and not a forecasted mean. The figures below include a comparison between what the Energy Information Administration (“EIA”) reports as actual prices versus what was forecasted in each AEO.

Actual Residential Historical Prices vs Annual Energy Outlook Forecast

Historical Data	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2010	\$ 13.08	\$ 13.89	\$ 12.14	\$ 11.39	\$ 11.03	\$ 10.65	\$ 10.32	\$ 10.97	\$ 10.38	\$ 10.05	\$ 10.91	\$ 10.50	\$ 10.51	\$ 10.78	\$ 12.18	\$ 14.80
2011	\$ 13.42	\$ 13.87	\$ 11.72	\$ 11.21	\$ 12.32	\$ 12.71	\$ 11.81	\$ 11.74	\$ 11.89	\$ 11.99	\$ 12.03	\$ 12.10	\$ 12.18	\$ 12.30	\$ 12.42	\$ 12.62
2012		\$ 13.99	\$ 12.30	\$ 11.31	\$ 10.56	\$ 10.44	\$ 10.39	\$ 10.28	\$ 10.39	\$ 10.50	\$ 10.61	\$ 10.74	\$ 10.90	\$ 11.16	\$ 11.38	\$ 11.55
2013			\$ 12.25	\$ 11.36	\$ 10.65	\$ 10.78	\$ 10.69	\$ 10.38	\$ 10.56	\$ 10.61	\$ 10.67	\$ 10.80	\$ 10.94	\$ 11.11	\$ 11.42	\$ 11.76
2014				\$ 11.62	\$ 11.05	\$ 10.71	\$ 10.72	\$ 10.49	\$ 10.39	\$ 10.91	\$ 11.24	\$ 11.66	\$ 11.89	\$ 12.05	\$ 12.24	\$ 12.48
2015					\$ 11.22	\$ 10.69	\$ 10.62	\$ 11.44	\$ 11.24	\$ 10.92	\$ 11.25	\$ 11.71	\$ 11.88	\$ 11.85	\$ 12.06	\$ 12.16
2016						\$ 10.86	\$ 10.29	\$ 11.08	\$ 10.62	\$ 10.48	\$ 10.65	\$ 10.84	\$ 11.38	\$ 11.92	\$ 12.29	\$ 12.50
2017								\$ 10.58	\$ 10.22	\$ 10.91	\$ 10.92	\$ 11.06	\$ 11.20	\$ 11.31	\$ 11.39	
2018									\$ 10.30	\$ 11.17	\$ 10.77	\$ 11.19	\$ 11.47	\$ 11.59	\$ 11.69	
2019										\$ 11.18	\$ 10.79	\$ 10.71	\$ 11.00	\$ 11.08	\$ 11.24	
2020												\$ 10.80	\$ 10.39	\$ 10.53	\$ 10.45	
2021													\$ 10.54	\$ 10.81	\$ 10.74	
2022														\$ 12.15	\$ 12.60	
2023																\$ 14.29

*Red highlighted cells note forecasted prices that were higher than what was reported historically by EIA.

Actual Commercial Historical Prices vs Annual Energy Outlook Forecast

Historical Data	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2010	\$ 11.34	\$ 12.23	\$ 10.06	\$ 9.47	\$ 8.91	\$ 8.10	\$ 8.08	\$ 8.90	\$ 7.91	\$ 7.28	\$ 7.88	\$ 7.79	\$ 7.61	\$ 7.49	\$ 8.79	\$ 11.34
2011	\$ 11.53	\$ 12.29	\$ 9.31	\$ 8.92	\$ 10.01	\$ 10.36	\$ 10.20	\$ 10.14	\$ 10.28	\$ 10.38	\$ 10.40	\$ 10.46	\$ 10.53	\$ 10.65	\$ 10.76	\$ 10.96
2012		\$ 12.32	\$ 9.94	\$ 9.15	\$ 9.30	\$ 9.03	\$ 8.80	\$ 8.52	\$ 8.60	\$ 8.68	\$ 8.74	\$ 8.84	\$ 8.96	\$ 9.19	\$ 9.37	\$ 9.51
2013			\$ 10.06	\$ 9.32	\$ 8.82	\$ 8.90	\$ 8.86	\$ 8.67	\$ 8.82	\$ 8.82	\$ 8.85	\$ 8.94	\$ 9.06	\$ 9.21	\$ 9.49	\$ 9.79
2014				\$ 9.61	\$ 9.04	\$ 8.26	\$ 8.66	\$ 8.42	\$ 8.29	\$ 8.76	\$ 9.03	\$ 9.38	\$ 9.57	\$ 9.69	\$ 9.83	\$ 10.05
2015					\$ 9.16	\$ 8.29	\$ 8.49	\$ 9.29	\$ 9.11	\$ 8.91	\$ 9.21	\$ 9.62	\$ 9.76	\$ 9.70	\$ 9.90	\$ 9.97
2016						\$ 8.36	\$ 8.35	\$ 8.82	\$ 8.73	\$ 8.76	\$ 8.77	\$ 8.81	\$ 9.32	\$ 9.82	\$ 10.15	\$ 10.34
2017							\$ 9.24	\$ 7.92	\$ 7.46	\$ 7.93	\$ 8.54	\$ 9.19	\$ 9.58	\$ 9.67	\$ 9.76	
2018								\$ 8.28	\$ 7.42	\$ 8.14	\$ 8.69	\$ 9.33	\$ 9.96	\$ 10.07	\$ 10.14	
2019									\$ 7.50	\$ 8.11	\$ 7.96	\$ 8.33	\$ 8.69	\$ 8.88	\$ 9.08	
2020										\$ 8.12	\$ 8.01	\$ 7.94	\$ 8.14	\$ 8.26	\$ 8.44	
2021												\$ 7.80	\$ 7.43	\$ 7.58	\$ 7.60	
2022													\$ 7.51	\$ 7.95	\$ 8.20	
2023														\$ 8.76	\$ 9.13	
																\$ 10.99

*Red highlighted cells note forecasted prices that were higher than what was reported historically by EIA.

C. Miscellaneous Comments

i. Use of Outdated Data

Throughout the NOPR, DOE states that it relied upon data from the 2015 RECS to establish samples and calculate data.⁸⁴ DOE claims that the 2015 RECS is the most recent such survey that is currently available.⁸⁵ According to the EIA, the full 2020 RECS data was released on June 15, 2023, consistent with footnote 55 in the NOPR, and two months prior to publication of the NOPR.⁸⁶

Multiple commenters noted the use of outdated data for the preliminary TSD, and the flaws in the 2015 data used.⁸⁷⁸⁸ Rather than use the most recent and reliable data available, DOE chose to use outdated, inapplicable data for a significant amount of its calculations. DOE's use of outdated data questions the validity of its analysis. Rather than rely on questionable data, DOE should recalculate and reexamine its conclusions based on the best available, most current data.

⁸⁴ NOPR, 88 Fed. Reg. at 55155 (estimated energy use). NOPR, 88 Fed. Reg. at 55157 (heating load calculation).

⁸⁵ NOPR, 88 Fed. Reg. at 55155 (noting that DOE last accessed the data on January 3, 2023 and that full 2020 data was anticipated in June 2023).

⁸⁶ Residential Energy Consumption Survey (RECS) - Energy Information Administration (eia.gov), available at <https://www.eia.gov/consumption/residential/> (last accessed October 13, 2023).

⁸⁷ NOPR at 55155 (noting WMT's significant concerns with DOE's data quality).

⁸⁸ See also DOE Boiler Public Meeting, Sept. 12, 2023 at 11:32 AM (comments of Brendan O'Brian, and of WMT (11:18)).

The most important reason to use the 2020 survey is because it collected 3 times as many samples as the 2015 survey. In the case of the Consumer Boiler Rule, this would bring the total number of samples from 220 total buildings to as many 993. Unlike water heaters and central furnaces, boilers are much less common and less likely to be sampled in the first place. The continued use of the 2015 survey leaves many gaps in data coverage based on region and housing characteristics. Based on a sample size of 200, the margin of error without considering sampling bias could be as high as 7.1% for the nation, higher for sub regions and building types. Below are two pertinent examples:

- Example #1: Multifamily units within the New England region contribute to 19 percent of all rule affected multifamily trials in the country. The model was run 187 times across 14 survey samples total. One of these sampled buildings was only run once while another was run 58 times. For building sample number “2934”, the model was run 58 times, showing nearly the same energy consumption in all trials with varied installation costs because those factors are based on DOE’s predetermined probability distributions. 6 of the 14 buildings that represent multifamily buildings in New England were run 5 or fewer times total. 9 buildings account for almost 90% of all trials for this subset.
- Example #2: The MidAtlantic region is home to 2,453 rule affected trials or 62% of all rule affected trials in the country. 74% of the 2,432 residential trials are single family buildings and the model only uses 41 single family survey samples out of 95 totals for the entire region. The top 5 buildings modeled amount to half the net savings for all 41 buildings sampled.

Because the 2015 RECS survey boiler specific datasets offers so few data points compared to other rule makings, modeling the same building over and over has resulted in less variability and less of a chance for discovering possible bad outcomes for households.

ii. Errors Found in the Modeling File

Below are errors found in DOE’s model file that should be corrected:

- DOE has utilized single-year weather data when there is 10-year average data.
- DOE references on the tab “No-New Standards Case AFUE” an equation that adjusts the likelihood of more efficient appliances based on square footage. The model in writing has one equation but DOE has coded a different version that relies on larger square footage residences. This equation ultimately changes the randomly assigned baseline efficiency levels. Larger homes that use more energy might on average install more efficient appliances based on this equation.

Adjustment Range Used in T SD		Adjustment Range Used in Model	
Square Footage	Fraction	Square Footage	Fraction
<= 1650	-5%	<= 1650	-5%
1650 to 2650	0%	1650 to 3000	0%
2650+	5%	3000+	5%

iii. The NOPR Did Not Provide Adequate Opportunity to Comment

On August 14, 2023, DOE published in the Federal Register a proposed rule to revise energy conservation standards for consumer boilers. DOE provided stakeholders only 60-days or until October 13, 2023 to comment on the NOPR.

In the NOPR, DOE deviates from its own procedures, aka the “Process Rule,”⁸⁹ in a way that prejudice stakeholders. DOE determined to shorten the comment period because “the May 2022 Preliminary Analysis [for consumer boilers] already allowed stakeholders an opportunity to comment on the analytical methods and subsequent preliminary results.”⁹⁰ This is despite the fact that DOE has updated its analysis since then.⁹¹ Importantly, the Process Rule states that “[t]here will be not less than 75 days for public comment on the NOPR, with at least one public hearing or workshop.”⁹² It is unreasonable on its face for DOE to shave 15 days off of its own procedures when the statutory deadline has been exceeded not by days or months but by years. Joint Commenters and other stakeholders should not be prejudiced for DOE’s own administrative deficiency. It is an important tenet of administrative law that a federal agency adhere to its own policies, rules and regulations. Ad hoc departures are not proper, for such activities disrupt orderly processes and harm predictability, which are the hallmarks of lawful administrative action.⁹³

DOE has also issued various other proposed and final rules that warrant stakeholder attention and review.⁹⁴ Moreover, many stakeholders have limited staff available to review the various pending proposed rules and to provide meaningful comments during overlapping and concurrent comment periods. In the end a 60-day comment period for two rules is the functional equivalent of two

⁸⁹ *Energy Conservation Program for Appliance Standards: Procedures, Interpretations, and Policies for Consideration in New or Revised Energy Conservation Standards and Test Procedures for Consumer Products and Commercial/Industrial Equipment*, 86 Fed. Reg. 70892 (Dec. 13, 2021) (“Process Rule”). See also 10 C.F.R. Part 430, Subpart C, Appendix A.

⁹⁰ NOPR, 88 Fed. Reg. at 55136.

⁹¹ *Id.*

⁹² Process Rule at 70927; see Section 6(f)(2) of Appendix A. The Process Rule also states that “[t]he length of the public comment period for pre-NOPR rulemaking documents will vary depending upon the circumstances of the particular rulemaking, but will not be less than 75 calendar days.” Process Rule at 70926; see Section 6(d)(2) of Appendix A.

⁹³ See, e.g., *Reuters Ltd. v. FCC*, 781 F.2d 946, 950-51 (D.C. Cir. 1986) (“[I]t is elementary that an agency must adhere to its own rules and regulations. Ad hoc departures from those rules, even to achieve laudable aims, cannot be sanctioned . . . for therein lie the seeds of destruction of the orderliness and predictability which are the hallmarks of lawful administrative action. Simply stated, rules are rules, and fidelity to the rules which have been properly promulgated, consistent with applicable statutory requirements, is required of those to whom Congress has entrusted the regulatory missions of modern life.”); *Brock v. Cathedral Bluffs Shale Oil Co.*, 796 F.2d 533, 536 (D.C. Cir. 1986) (“It is axiomatic that an agency must adhere to its own regulations.”); *Mine Reclamation Corp. v. FERC*, 30 F.3d 1519, 1524 (D.C. Cir. 1994) (on its way to decision an agency must follow its own regulations).

⁹⁴ See e.g., *Energy Conservation Program: Energy Conservation Standards for Consumer Conventional Cooking Products*, 88 Fed. Reg. 50810 (Aug. 2, 2023) (comment period ending September 1, 2023); *Energy Conservation Program: Energy Conservation Standards for Consumer Water Heaters*, EERE-2017-BT-STD-0019, 88 Fed. Reg. 49058 (Jul. 28, 2023) (comment period ending September 26, 2023); *Energy Conservation Program: Energy Conservation Standards for Commercial Water Heating Equipment*, EERE-2021-BT-STD-0027 (prepublication final rule posted).

sequential 30-day comment periods. DOE should endeavor to provide stakeholders with sufficient time to meaningfully comment on all its proposals.

While the Administrative Procedure Act (“APA”) does not establish a minimum comment period for rulemakings, courts require that agencies provide a “meaningful” opportunity for comment.⁹⁵ In short, “[t]he opportunity for comment must be a meaningful opportunity” and “in order to satisfy this requirement, an agency must also remain sufficiently open-minded.”⁹⁶ Additional time was needed to meaningfully analyze and respond to the NOPR.

iv. Manufacturer and Related Supply Chain Burdens

DOE should take note of manufacturer opposition to this rulemaking. Manufacturers advocated for a separate product class for condensing boilers.⁹⁷⁹⁸ Manufacturers have also expressed their concern about safety concerns and reliability of condensing boilers.⁹⁹¹⁰⁰¹⁰¹ Further, manufacturers have expressed concern about DOE’s low values associated with manufacturing and installation of condensing boilers.¹⁰²¹⁰³

Finally, manufacturers have noted that the proposed rule would have a disproportionate effect on domestic manufacturers and foundries. Joint Commenters estimate that the production of cast-iron boilers will drop from 200,000 per year to 75,000 per year, which will not support the current number of foundries. Manufacturers have noted there will be a net loss of American jobs as a consequence of this proposed rule, which DOE acknowledges. Manufacturers note that while 90% of non-condensing boilers are manufactured in the United States, only 60% of condensing boilers are manufactured in the United States.¹⁰⁴¹⁰⁵ Simply put, the proposed rule seeks to export United States manufacturing jobs and capacity, and will have significant effects throughout the boiler supply chain.

v. Fuel Switching

DOE is proposing a standard that will cause entities to switch from natural gas-fired boilers to electric products. This is in conflict with EPCA’s fuel neutral intent. EPCA authorizes standards designed to conserve energy by means of improvements in the efficiency of the products subject

⁹⁵ See, e.g., *Rural Cellular Ass’n v. Fed. Commc’ns Comm’n*, 588 F.3d 1095, 1101 (D.C. Cir. 2009), *Gerber v. Norton*, 294 F.3d 173, 179 (D.C. Cir. 2002).

⁹⁶ *Rural Cellular Ass’n*, 588 F.3d at 1101.

⁹⁷ NOPR, 88 Fed. Reg. at 55142.

⁹⁸ See also DOE Boiler Public Meeting, Sept. 12, 2023 at 10:18 AM (comments of Phillip Stevens of Marley Company).

⁹⁹ NOPR, 88 Fed. Reg. at 55146, 55164.

¹⁰⁰ See also DOE Boiler Public Meeting, Sept. 12, 2023 at 12:04 PM (comments of Paul Silver of Crown Boiler regarding reliability).

¹⁰¹ See also DOE Boiler Public Meeting, Sept. 12, 2023 at 12:05 PM (comments of ECR noting the constant maintenance needed by condensing boilers and the lack of maintenance needed by non-condensing boilers).

¹⁰² NOPR, 88 Fed. Reg. at 55151, 55162.

¹⁰³ See also DOE Boiler Public Meeting, Sept. 12, 2023 at 10:46 AM, 10:58 AM (comments of Paul Silver of Crown Boiler).

¹⁰⁴ NOPR, 88 Fed. Reg. at 55176-77.

¹⁰⁵ See also DOE Boiler Public Meeting, Sept. 12, 2023 at 10:15 AM (comments of Paul Silver of Crown Boiler).

to those standards. EPCA requires that a standard for the improvement in energy efficiency of a covered product must be designed to be economically justified.¹⁰⁶ DOE should not force fuel switching without pointing to clear language in EPCA that authorizes the agency to do so.¹⁰⁷ Joint Commenters urge DOE to not use standards to promote fuel switching. EPCA does not permit standards for gas-fired boilers that would drive entities to switch to a different fuel.

vi. Executive Orders 12866 and 13563

The NOPR states that DOE emphasizes as well that the Executive Order (“E.O.”) 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible.¹⁰⁸ DOE has unequivocally failed to follow this E.O., as it has used outdated data to quantify present and future benefits and costs, when current and applicable data was available prior to publication. DOE’s extraordinary reliance on the 2015 RECS is a clear violation of E.O. 13563.

vii. Regulatory Flexibility Act

The proposed rule also fails to comply with E.O. 13272, “Proper Consideration of Small Entities in Agency Rulemaking.” DOE identified 24 original equipment manufacturers (OEMs),¹⁰⁹ of which, it only found 3 that satisfied the criteria to be considered small businesses.¹¹⁰ Further, two of the three of the small businesses which qualified did not produce condensing gas-fired boilers.¹¹¹ Based on its analysis, and the results of its interviews, DOE has only broad estimates unsupported by facts on the effect on small businesses who manufacture condensing gas-fired boilers.¹¹² DOE’s data on their redesign costs, product availability, or whether or not the proposed efficiency levels may force these manufacturers to leave the market. DOE’s failure to properly identify affected parties is a glaring informational liability in the rule, and must be addressed pursuant to E.O. 13272.

V. Conclusion

Joint Commenters thank you for your review and consideration of these comments. If you have any questions regarding this submission, please do not hesitate to contact the undersigned.

Respectfully submitted,

¹⁰⁶ 42 U.S.C. § 6295(o)(2)(A).

¹⁰⁷ *West Virginia v. Env’t Prot. Agency*, 142 S. Ct. 2587 (2022).

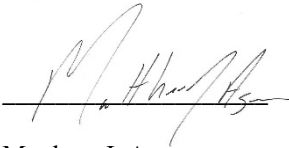
¹⁰⁸ NOPR, 88 Fed. Reg. at 55209.

¹⁰⁹ NOPR, 88 Fed. Reg. at 55210.

¹¹⁰ *Id.*

¹¹¹ NOPR, 88 Fed. Reg. at 55211.

¹¹² *Id.*



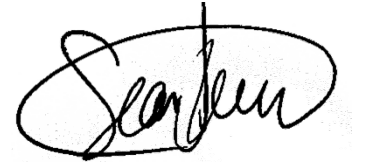
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Attachments A, B, C, D, E, F, G and H.