August 1, 2022

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

Submission via regulations.gov

Re: Office of Energy Efficiency and Renewable Energy, Department of Energy Notice of Proposed Rulemaking for Energy Conservation Standards for Commercial Water Heating Equipment *[Docket Number EERE-2021-BT-STD-0027]*

Dear Ms. Hegarty:

The American Gas Association ("AGA"), the American Public Gas Association ("APGA"), the National Propane Gas Association ("NPGA"), Spire Inc., Spire Missouri Inc., Spire Alabama Inc., and ONE Gas (collectively, "Commenters") appreciate the opportunity to provide comments in response to the Department of Energy's ("DOE") Notification of Proposed Rulemaking ("NOPR")[1] and affiliated data spreadsheets for commercial water heaters.

On June 16, 2022, APA, APGA, NPGA, Spire Inc., Spire Missouri Inc., and Spire Alabama Inc. requested an extension to the comment period.[2] On July 14, 2022, the same organizations submitted supplemental information to further support the extension request.[3] On July 15, 2022,

[1] *Energy Conservation Program: Energy Conservation Standards for Commercial Water Heating Equipment*, 87 Fed Reg. 30610 (May 19, 2022).
[2] Letter from Commenters to U.S. Department of Energy, Request Extension of Comment Period in Response to Office of Energy Efficiency and Renewable Energy's Request for Comment Pertaining to the Notice of Proposed Rulemaking for Commercial Water Heating Equipment Energy Conservation Standards (June 16, 2022).
[3] Letter from Commenters to U.S. Department of Energy, Supplemental Information Related to the Request Extension of Comment Period in Response to Office of Energy Efficiency and Renewable Energy's Request for Comment Pertaining to the Notice of Proposed Rulemaking for Commercial Water Heating Equipment Energy Conservation Standards (July 14, 2022).

DOE denied the request but extended the comment period by fourteen calendar days.[4] Commenters provide the energy needed to fuel gas-fired commercial water heaters, thus making them critical stakeholders to the NOPR. Unfortunately, DOE has not provided sufficient time for Commenters to review the NOPR and supporting materials and to develop comments in response to DOE's data analysis and decision-making.

Commenters support improved building and appliance energy codes and standards with the knowledge that natural gas distribution company customers have been the leaders in reducing both per capita and total greenhouse gas ("GHG") emissions in homes and businesses. Improvements in energy efficiency are typically the lowest-cost approach to reducing emissions and can have a significant impact while offering a range of benefits to customers, from reduced bills to increased comfort. Furthermore, AGA has identified improved energy efficiency as critical to any successful decarbonization plan. AGA is committed to supporting a continued reduction in U.S. GHG emissions, and energy efficiency is a cornerstone strategy to achieve ambitious decarbonization goals, including net-zero. [5]

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 95 percent — more than 73 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.

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.[6]

NPGA is the national trade association of the propane industry with a membership of about 2,500 companies, and 36 state and regional associations representing members in all 50 states. NPGA's membership includes retail marketers of propane gas who deliver the fuel to the consumer, propane producers, transporters and wholesalers, and manufacturers and distributors of equipment, containers, and appliances. Propane, or liquefied petroleum gas, is used in millions of installations nationwide for home and commercial heating and cooking as well as various other

[4] *Energy Conservation Program: Energy Conservation Standards for Commercial Water Heating Equipment; Reopening of Comment Period*, 87 Fed. Reg. 43226 (July 20, 2022).
[5] For more information, please visit www.aga.org.
[6] For more information, please visit www.apga.org.

agricultural, industrial, and transportation sectors.[7] The variety of appliances powered by propane include the commercial water heater appliances subject to the agency's proposal.

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, Alabama, and Mississippi, and Spire Missouri Inc. and Spire Inc. are the largest natural gas utilities serving residential, commercial, and institutional customers in Missouri and Alabama, respectively.

ONE Gas, Inc. provides natural gas distribution services to more than 2 million customers in Oklahoma, Kansas and Texas. ONE Gas is headquartered in Tulsa, Okla., and its divisions include Oklahoma Natural Gas, the largest natural gas distributor in Oklahoma; Kansas Gas Service, the largest in Kansas, and Texas Gas Service, the third largest in Texas, in terms of customers. Its largest natural gas distribution markets by customer count are Oklahoma City and Tulsa, Okla.; Kansas City, Wichita and Topeka, Kan.; and Austin and El Paso, Texas. ONE Gas serves residential, commercial, industrial, transportation and wholesale customers in all three states.[8]

A. DOE's Treatment of Venting Issues Raised by Condensing-Level Standards is Unreasonable and Contrary to Law

The NOPR would impose standards that only condensing products can achieve. Condensing commercial water heaters are readily available and have already captured a significant percentage of commercial water heater sales. However, condensing products are not suitable for all installations. As explained below, the imposition of standards that non-condensing products cannot achieve would raise significant practical, economic, and legal issues. The economic analysis in the NOPR fails to properly account for the necessary engineering relative to venting commercial water heaters or common venting of multiple appliances, including commercial water heaters. Cumulatively, inaccurate assumptions undermine the NOPR's economic evaluation, and its estimate of the market impacts the proposed standards would have.

1. The Significance of Condensing-Level Standards

Condensing products are an attractive option for many consumers. However, Energy Information Agency data shows that "more than half of all commercial buildings were constructed before condensing commercial water heaters were introduced to the market" and condensing products are incompatible with millions of these existing commercial buildings. The modifications required to alter these existing buildings to accommodate the use of condensing products are far more complicated, extensive, and burdensome than the NOPR assumes.[9] Millions of multi-level commercial buildings, including offices, mixed-use properties, and other commercial buildings,

[7] For more information, please visit www.npga.org.
[8] For more information, please visit www.onegas.com.
[9] *Energy Conservation Program for Appliance Standards: Energy Conservation Standards for Residential Furnaces and Commercial Water Heaters: Proposed Rule*, 84 Fed. Reg. 33,011 (July 11, 2019).

were built with mechanical rooms, chimneys, venting, and associated infrastructure designed for atmospherically-vented appliances and equipment. Non-condensing commercial water heaters have the unique ability to share a common atmospheric vent with other non-condensing products, like non-condensing water heaters. The heat and volumes of gases combine to create the conditions necessary to carry the gases out of the building without powered positive pressure systems. Therefore, the installation of non-condensing water heaters must be coordinated with the design configuration and functioning of other appliances. Additionally, many of the commercial structures designed with atmospheric venting lack existing plumbing systems to dispose of the condensate. The burdens required to transition from a non-condensing commercial water heater to a condensing water heater would be substantial in many cases.
Atmospheric venting systems allow the exhaust gases produced in combustion, which are under negative pressure, to exit a building through a vertical or nearly vertical chimney or conduit using the heat and buoyancy of the gases to carry them outside. Atmospheric venting has been used in the U.S. for generations and remains the primary exhaust gas venting system in millions of homes, apartments, and businesses. Many of these installations throughout the country have multiple vented gas appliances common vented into a single vent or chimney.

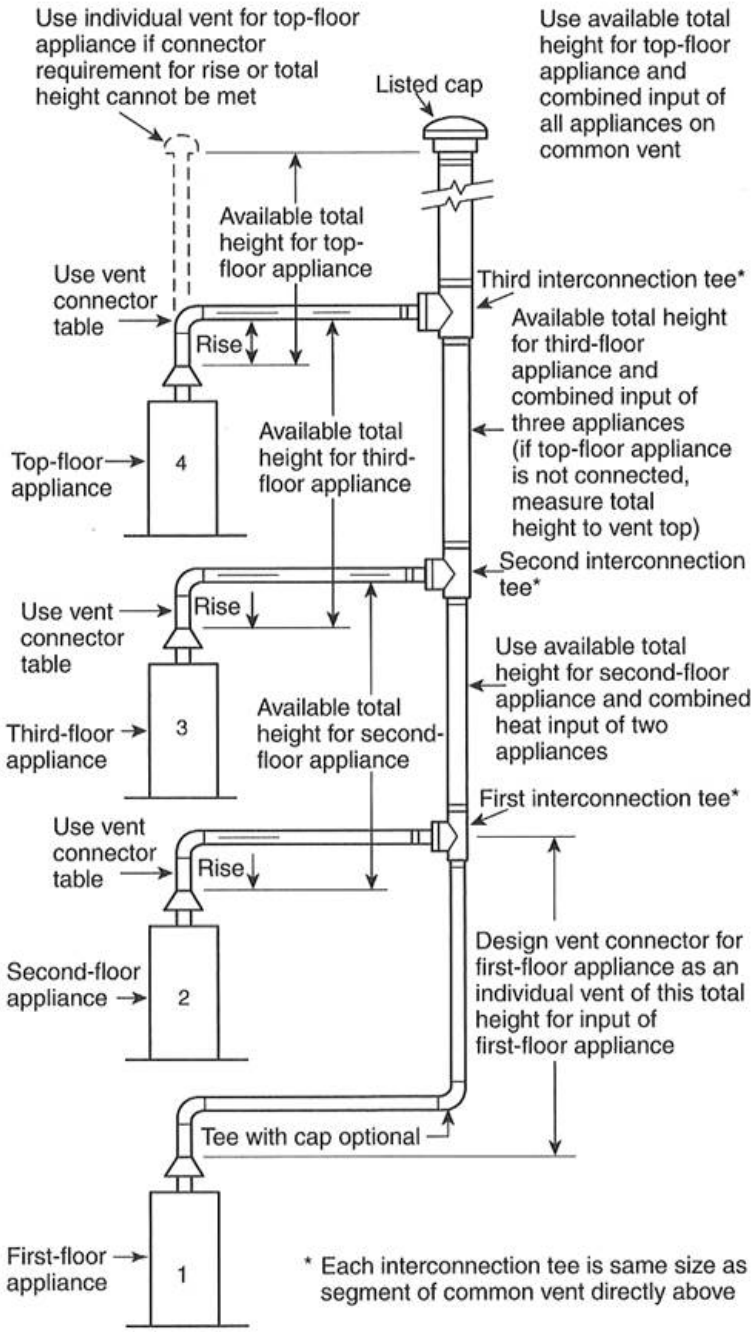
Atmospheric venting systems are commonly found in existing homes and buildings in urban areas with restricted exterior locations, thus limiting a building owner's options for the side wall venting required for condensing products when an appliance needs to be replaced. Additionally, there are interior considerations a purchaser must consider when replacing a non-condensing appliance with a condensing appliance, including accessibility to condensate drain lines and often extensive renovations to accommodate new venting systems.

In condensing appliances, the condensing process generates cooler exhaust gases that the appliances discharge into the venting system under positive pressure. Additionally, the condensing process generates liquid condensate that must be disposed. Because of these conditions, condensing products require positive pressure venting—generally through a horizontal conduit, powered by a fan or other additional electronic device—to generate sufficient pressure and flow to vent the gases. They also require plumbing drains to dispose of the condensate developed in the operation of the appliance. They lack sufficient buoyancy to exit a building through an atmospheric venting system and cannot be "common vented" with other appliances already connected to an atmospheric (non-positive) venting system.

Condensing water heaters are generally classified as either a power vent water heater or a direct vent water heater. A power vent water heater is typically vented horizontally and vents exhaust through a horizontal pipe that leads out of a building or home. An added fan/blower pushes the exhaust gases through this pipe. Extra power is required to power the blower, and this power source is separate from powering the water heater. A direct vent water heater uses special coaxial venting that has separate chambers for intake air and exhaust in a single assembled vent piece. The venting runs from the water heater through the side of a building or home. They pull and push air from outside to negate any back-drafting within the building or home.

Without non-condensing commercial gas-fired water heaters and their ability to utilize commonly vented category 1 venting systems, owners of a building designed with a common vent would often have no satisfactory options when it comes to replacing the commercial water heater. As noted, atmospherically vented buildings are typically located in urban centers. Multistory buildings can't utilize horizontal venting for the same reasons traditional vented dryers can't, as it is impossible to install and service vent terminations. In many cases, wall penetrations would compromise the structural integrity of the building. Additionally, on lower floors, terminations would have to be seven feet above public sidewalks and streets, which is often impossible in an urban area. Finally, removing one or more commercial gas water heaters would disrupt the venting systems of the other locations. Non-condensing commercial gas water heaters can offer "unique utility." They are the only suitable gas replacement option in many existing applications that utilize common venting or masonry chimneys. Furthermore, they are the only gas water heating option that can be installed without the necessity of disposing of condensate and without electrical systems are for the added load of electric commercial water heaters.

Principles of Design of Multistory Vents Using Vent Connector and Common Vent Design Tables.[10]



Replacing an existing non-condensing with a condensing water heater requires significant building renovations. At a minimum, a new horizontal venting system compatible with a

[10] Figure F.1(n), *National Fuel Gas Code*, ANSI Z223.1/NFPA 54, 2021 edition.

condensing water heater is required as well as a means to dispose of condensate. The existing vertical venting system simply cannot be used. Additional complications exist when two or more non-condensing appliances are common vented through a single vertical venting system. When one (or more) non-condensing appliance is replaced with a condensing appliance, the existing venting systems need to be redesigned and configured to account for the lower number of appliances.

Failing to recognize the differences between condensing and non-condensing products is inconsistent with how building and safety code experts treat these products. For example, the safety standard, *Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating or Instantaneous*, CSA/ANSI Z21.10.3:2019 • CSA 4.3:2019, defines water heater categories as:

> **Water Heater, Category** — water heaters of other than direct vent type, for installation in manufactured homes (mobile homes), for installation in recreational vehicles or for outdoor installation are divided into four categories based on the static pressure produced in the vent and the flue loss.
>
> > **Category I** — a water heater that operates with a non-positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.
> > **Category II** — a water heater that operates with a non-positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent.
> > **Category III** — a water heater that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.
> > **Category IV** — a water heater that operates with a positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent.

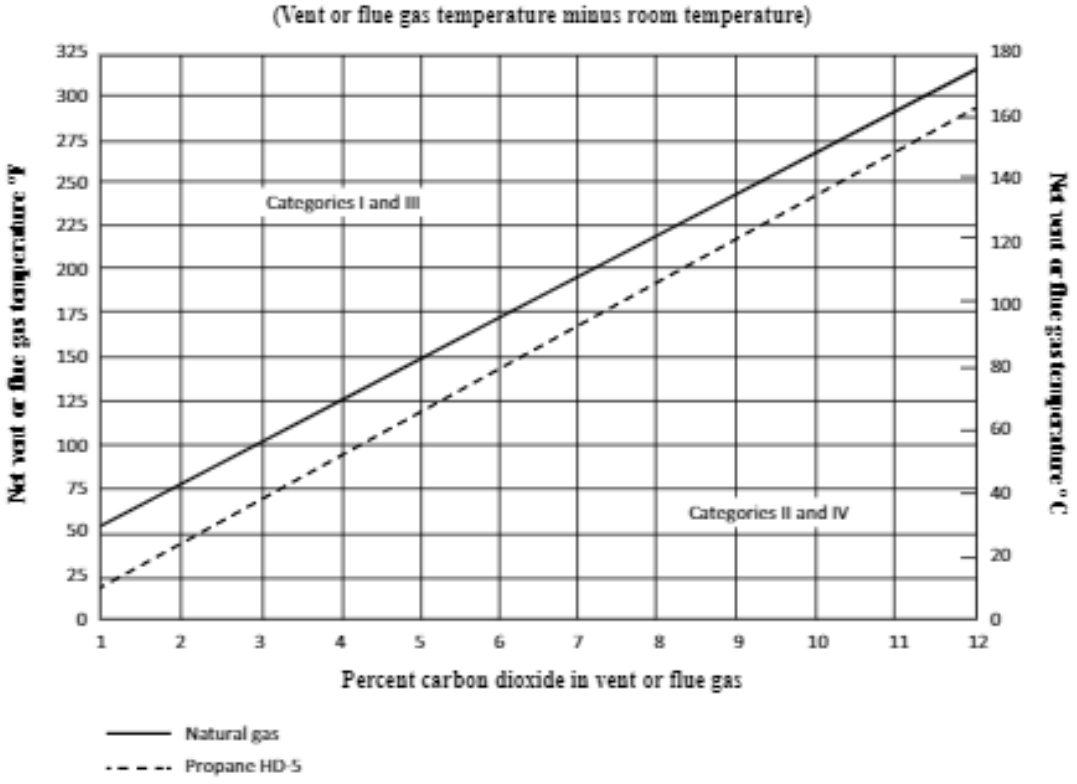
The Method of Test in Clause 5.5 of this standard determines the venting category required for the water heater. Table 12, *Determination of Category*[11], and Figure 7, *Chart for Determination of Water Heater Category*,[12] uses the test data produced to classify the necessary venting system as Category I, II, III or IV based on two specific results, the vent pressure and the net flue gas temperature.

[11] CSA/ANSI Z21.10.3:2019 • CSA 4.3:2019, *Standard for Gas-fired Water Heaters, Volume III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.*
[12] CSA/ANSI Z21.10.3:2019 • CSA 4.3:2019, *Standard for Gas-fired Water Heaters, Volume III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.*

Table 12
Determination of Category
(See Clause 5.5 of CSA/ANSI Z21.10.3:2019 • CSA 4.3:2019)

	Vent Pressure	**Net flue gas temperature °F (°C) (see Figure 7)**
Category I	Non-positive	On or above curve[1]
Category II	Non-positive	Below curve[1]
Category III	Positive	On or above curve1[1]
Category VI	Positive	Below curve[1]
[1] Reference American Gas Association Laboratories Report 1509 (Copyright © 1976) with curve based upon a 17 percent flue loss.		

Figure 7[13]
Chart of determination of water heater category
(See Clause 5.5 of CSA/ANSI Z21.10.3:2019 • CSA 4.3:2019)



[13] Table 7, Chart for the Determination of Vent Category, from CSA/ANSI Z21.10.1-2019•CSA 4.1:2019, is applicable to both natural gas and propane-fired appliances.

Further, when installing a venting system for a condensing water heater, the building owner must comply with existing fuel gas code provisions, which restrict the location of the vent terminations in relationship to:

- Clearance to operable windows and doors - 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW), 9 in (23 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 50,000 Btuh (15 kW), 12 in (30 cm) for appliances > 50,000 Btuh (15 kW).
- Clearance above grade – 6 inches.
- Clearance above a jurisdiction's expected snow line.
- Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance – 4 ft (1.2 m) below or to side of opening; 1 ft (300 mm) above opening.
- Clearance to a mechanical air supply inlet – 3 ft (91 cm) above if within 10 ft (3 m) horizontally.
- Clearance above paved sidewalk or paved driveway located on public property – 7 ft (2.13 m) for mechanical draft systems (Category I appliances). Vents for Category II and Category IV appliances cannot be located above public walkways or other areas where condensate or vapor cause a nuisance or hazard.

2. The Proposed Standards Would Violate The "Unavailability" Provision of EPCA

Condensing products are incompatible with the utility infrastructure provided in many of the existing buildings in which commercial water heaters are installed. Most obviously, condensing products cannot, for reasons of safety and code compliance, be served by standard atmospheric venting systems. Because the proposed standards can only be met by natural gas and propane products that use condensing technology, purchasers seeking to replace existing non-condensing commercial water heaters would need to modify their buildings to accommodate the use of products for which they were not architecturally designed. While there are cases in which the required modifications would be limited and would not have undesired collateral impacts, there are many cases in which the modifications required to accommodate a condensing product would have adverse impacts on other equipment, undesirable impacts on occupied space or building aesthetics, require notably more time for replacement resulting in excessive operational inconvenience and loss to businesses, additional installation services, involvement of non-typical industry trades, or would be completely impractical. Accordingly, standards that would make non-condensing products unavailable – as the proposed standards would do – would leave many purchasers without gas products suitable for their needs. These issues have been discussed at length in previous submissions incorporated by reference here and are well documented in the record.

As also explained at length in previous submissions, EPCA precludes the adoption of standards that would leave purchasers without products suitable to their needs.[14] In particular, the statute includes provisions (hereafter the "Unavailability Provisions")[15] 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."[16] 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 existing buildings to accommodate them. Congress intended for the standards to preserve "the availability of sizes that fit in standard building spaces."[17] Just as standards must preserve "the availability of sizes that fit in standard building spaces" provided for equipment and appliances, so must they also preserve the availability of products that are compatible with the standard built-in venting systems and infrastructure designed to serve such products. 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 provisions relating to separate product classes,[18] 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.[19] 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,[20] and 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.

Some of 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 for commercial water heaters that would effectively ban non-condensing products.[21] On the basis of that

[14] *See e.g.*, March 21, 2019, Comments in Support of Petition for Rulemaking at 3-5 (Attachment A); September 9, 2019, Comments in Support of Petition for Rulemaking at 8-12 (Attachment B); October 12, 2021, Comments Opposing Proposed Reversal of Interpretive Rule at 10-11 (Attachment C). *See also* October 12, 2021, Comments of AGA, *et al.*, Regarding the Proposed Reversal of Interpretive Rule (Attachment D).

[15] 42 U.S.C. §§ 6295(o)(4) and 6313(a)(6)(B)(iii)(II)(aa).

[16] H.R. Rep. No. 100-11 at 22-23 (1987).

[17] *Id.*

[18] 42 U.S.C. § 6295(q)(1) *see* §§ 42 U.S.C. 6295(o)(4) and 6313(a)(6)(B)(iii)(II)(bb).

[19] *See, e.g.*, Spire's January 6, 2017 Residential Furnace Comments, a copy of which is incorporated as Attachment E to these Comments, at 51-56.

[20] *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).

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

determination, DOE withdrew a pending proposal to adopt condensing standards for commercial water heaters.[22] Unfortunately, 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.[23] The NOPR relies upon the later interpretive rule and dismisses the "unavailability" issue without substantial discussion.[24] The NOPR goes on to inaccurately account for the venting-related issues raised by the unavailability of non-condensing products as a matter of "installation" costs addressed in its economic analysis.

As the foregoing discussion and the incorporated prior comments demonstrate, the legal interpretation the NOPR relies upon to avoid the Unavailability Provisions is unreasonable and contrary to law. Pursuant to 42 U.S.C. § 6313(a)(6)(B)(iii)(II)(aa), 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 commercial water heaters 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 this rulemaking proceeding and the interpretive rule proceedings referred to above:

- The compatibility of a product with the standard utility infrastructure of existing buildings is clearly 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 (s*ee Hearth Patio & 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));[25] and
- The material facts relevant to this issue are clear and support the finding Commenters request.[26]

Consistent with the finding requested, 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.

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

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

[24] 87 Fed. Reg. at 30632.

[25] *See e.g.*, March 21, 2019, Comments in Support of Petition for Rulemaking at 3-5; September 9, 2019, Comments in Support of Petition for Rulemaking at 8-12; October 12, 2021, Comments Opposing Proposed Reversal of Interpretive Rule at 10-11.

[26] *Id.*

Although the NOPR does not address the factual issues relevant to the requested finding as such, it makes assertions in the context of its economic justification that are addressed below.

3. DOE's Economic Analysis Grossly Underestimates the Costs Condensing-Only Standards Would Impose.

Having failed to recognize that the "Unavailability Provisions" of the statute preclude the adoption of standards that would make atmospherically-vented products unavailable, DOE grossly understates the costs that such standards would impose in the context of replacement scenarios. In particular – while the NOPR acknowledges 2016-vintage comments indicating that condensing standards would create serious problems in many replacement scenarios – it suggests that the problems are confined to "uncommon" building conditions and claims that commenters did not provide "data or evidence to substantiate the extent that these, unique, additional installation challenges occur."[27] In fact, the problems condensing standards would impose are *common,* and there is no credible basis to suggest that they are not.

The NOPR's assertion to the contrary appears to be based on a profound lack of understanding of the issues involved. For example, the NOPR states that "DOE conducted its analysis under the assumption that condensing CWH equipment would use the same chase for the venting system as the non-condensing CWH equipment that it replaces, "explaining that condensing product presents "no special limitations restricting vertical vent scenarios" and – apparently on that basis – asserting that "[i]n instances in which a building has a centrally-located mechanical room, relocation of this mechanical room should not be necessary to accommodate condensing CWH equipment."[28] There is no basis for any of this. To the contrary, interviews with installation contractors and engineers with substantial experience in commercial water heater replacements confirm that – for a variety of reasons – condensing commercial water heaters generally *are not* vented through an existing chase provided for atmospherically-vented products. One of the impediments is that venting for condensing products cannot simply be suspended in a vertical chase; it requires support at frequent intervals, which in turn requires that there be sufficient room inside the case for the required vent hangers as well as the vent itself (which may or may not be available) and often requires physical access to chase through the interior walls of the building. Another issue is that vent length limitations for condensing commercial water heaters substantially "restrict[] vertical venting scenarios," particularly in the case of high-rise buildings.

Similarly, the NOPR makes egregious factual errors in dismissing the issues involving replacements of commercial water heaters that are commonly vented with other atmospherically-vented products. The claim that "CWH equipment typically is not commonly vented with other, disparate gas-fired equipment (like furnaces)" is based on interesting logic,[29] but it does not reflect the reality on the ground. Common venting of commercial water heating equipment with central heating equipment was standard practice in the United States for more

[27] 87 Fed. Reg. at 30664.
[28] 87 Fed. Reg. at 30663.
[29] *See* 87 Fed. Reg. at 30665.

than a century, and – in buildings with atmospherically-vented commercial water heaters – it is still very common. The claim that common venting is non-problematic when water heaters are *commonly vented with each other* is no better. In short, the NOPR argues that commonly-vented water heaters "should have the similar expected lifetime and replacement cycle," that "building engineers will often replace all of the units at one time for sake of simplicity, time, cost, and risk avoidance," and that "the stranded cost of any naturally-drafted, non-condensing CWH equipment due to this NOPR would have marginal residual value, which often would have been relinquished regardless of this NOPR."[30] However, a creative argument is no substitute for factual inquiry. In fact, one of the common reasons to have multiple water heaters is to have a primary and back-up so that there will be no loss of service when a water heater needs to be replaced, and that purpose would be defeated if both units have to be replaced at the same time. Similarly, commercial water heaters are typically replaced when they need to be, and "when they need to be" can vary considerably, as DOE's analysis recognizes, and the "stranded cost" of prematurely scrapped products could be considerable. Accordingly – absent a renovation or other planned business interruption – commonly-vented commercial water heaters generally are not replaced all at once.

As a result of such errors, DOE erroneously concludes that its basic analysis of "installation costs" captures all but "outlier installation scenarios that involve uncommon building conditions that may further reduce or increase installation costs, "which cases it expects "would be small in number."[31] DOE then turns to "[t]he one source identified that could be used to quantify extraordinary vent costs "to justify the assumption that its assessment of venting costs is appropriate for 98% of all installations, with the remaining 2% of installations having installation costs one or two times higher than average:[32] an advocacy piece prepared in opposition to the Petition for Rulemaking urging DOE to recognize that condensing standards are precluded by EPCA's "Unavailability Provisions."[33] That Memo provided no data quantifying venting costs: it simply presented the opinions of fifteen individuals (which were contradicted by other evidence in the record).[34] Moreover, the Memo did not say what the NOPR suggests that it said. Instead, it:[35]

- Defined "significant modifications" as modifications in which the "installation cost" required to replace a non-condensing product with a condensing product "would be *more than double the total system cost of a typical retrofit*;" and
- Claimed that "fewer than 5% of installs" would impose such "significant modifications."

[30] *Id*.
[31] 87 Fed. Reg. at 30664.
[32] *See* 87 Fed. Reg. at 30665, citing NEEA, Northeast Energy Efficiency Partnerships, Pacific Gas & Electric, and National Grid. Joint comment response to the Notice of Petition for Rulemaking; request for comment (report attached—Memo: Investigation of Installation Barriers and Costs for Condensing Gas Appliances). Docket EERE–2018–BT–STD–0018 (the "Memo").
[33] See Attachment B at 22.
[34] *Id.* at 22-23.
[35] See Memo at 3.

DOE's far more modest "2% of installations" with costs "100-200% above *average installation cost*" comes from a table providing numbers for only one of the four identified categories of venting-related issues.[36]

Interviews with individuals with substantial experience in commercial water heater replacements indicate that DOE has dramatically underestimated both:

- The percentage of installations in which substantial additional costs would be required to replace non-condensing commercial water heaters with condensing products; and
- The magnitude of the costs involved in the most difficult cases.

One of the basic errors in DOE's analysis is its failure to recognize significant costs that are commonly imposed in commercial water heater replacements in which non-condensing products are replaced with condensing products. For example, such replacements generally require significant additional time, imposing both increased downtime and labor costs. Faced with comments questioning whether it had accounted for additional downtime and business disruption that would be imposed when non-condensing products need to be replaced with condensing products, DOE ignored the fact that many commercial water heater replacements occur on an emergency basis and nonsensically dismissed the issue by pointing to evidence that some businesses are able to plan ahead to *limit* the downtime required for equipment replacement.[37] Many replacements occur on an unplanned basis, and the fact that some entities plan to "limit" such downtime provides no basis to conclude that there will be no costs imposed by the additional down-time required to put a condensing water heater in a building designed for non-condensing products. Yet, "DOE did not account for the loss of business in its [life-cycle cost] analysis,"[38] In addition, DOE failed to recognize that increases in labor costs commonly are not increases in *standard labor costs*. For commercial establishments, water heater replacements are commonly scheduled to occur overnight, with purchasers paying a substantial (*e.g.*, 30%) premium on labor costs to avoid disruption during business hours. The premise that DOE's basic cost estimate addresses all but the most extreme scenarios in which substantial additional costs would be imposed simply isn't realistic.

B. DOE's Proposed Determination that the Standards are Economically Justified is Not Supported by Clear and Convincing Evidence

DOE only has the authority to impose the standards at issue if it makes a determination, supported by clear and convincing evidence, that the standards are economically justified, among other factors.[39] Despite claims that the proposed standards would provide seemingly significant economic benefits, DOE's own numbers indicate that consumers would barely exceed "break-even" on a life-cycle cost basis. In particular, the average life-cycle cost savings for the proposed

[36] Memo at 15.
[37] 87 Fed. Reg. at 30666.
[38] 87 Fed. Reg. 30777.
[39] 42 U.S.C. § 6313(a)(6)(A)(ii)(II).

standards are in the range of only 0.58% to 1.35% of total life-cycle costs. It is only the cumulative impact of numerous individual cases in which these small benefits are claimed that suggests that the proposed standards would provide substantial life-cycle cost savings. However, DOE's analysis is far too uncertain and lacks evidence to establish that the relatively small projected average life-cycle cost savings are reliable, let alone realistic. Indeed, DOE's artificially precise results are the product of an analysis that is too uncertain to distinguish small net benefits from small net costs reliably. This problem is exacerbated by the fact that there are numerous instances in which DOE appears to have resolved uncertainties with respect to key inputs to its analysis in a way that significantly overstates the potential for standards to provide positive life-cycle cost outcomes. In addition, DOE's analysis is based on the core assumption that consumers either do not make purchasing decisions based on economic factors or that DOE cannot accurately account for those decisions in its analysis. That core assumption systematically ignores negative economic consequences to consumers who would otherwise not invest in converting to products with condensing technology and overstates the potential for the standards to produce positive life-cycle cost savings. Accordingly, the results of DOE's analysis provide no credible basis to conclude that the standards would provide any average life-cycle cost savings at all; to the contrary – in view of clear errors in DOE's analysis – analytical results suggesting that the proposed standards would provide small average life-cycle cost savings strongly suggests that the standards are more likely to impose net costs. DOE's life-cycle cost analysis therefore provides no evidence – let alone clear and convincing evidence – that the proposed standards are economically justified.

1. The NOPR is Based on a Fundamental Misunderstanding of the Statutory Scheme

The NOPR proceeds on the presumption that DOE should impose more stringent standards if possible and is required to impose the most stringent standards it can justify. This approach reflects a fundamental misunderstanding of DOE's statutory charge. DOE may only impose more stringent standards if there is "clear and convincing evidence" that a new standard "would result in *significant* additional conservation of energy and "is technologically feasible and economically justified."[40] DOE may not impose more stringent standards simply because it *believes* the standards would result in significant conservation of energy or if there is less than clear and convincing evidence the standards would do so.

Commercial water heaters are subject to energy conservation requirements under the ASHRAE/EIS Standard 90.1, an American National Standards Institute standard that specifies minimum energy performance standards for buildings other than low-rise residential buildings. That standard is a globally recognized benchmark for minimum energy performance standards and provides the basis for the majority of state and local building codes for newly constructed commercial buildings in the United States. The standard is maintained by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, an independent standards-setting

[40] 42 U.S.C. § 6313(a)(6)(A)(ii)(II) (emphasis added).

organization now operating as "ASHRAE."[41] Numerous editions of the standard have been issued over time, and the standard has been subject to "continuous maintenance" – a process for continuous updates under which anyone can propose changes at any time – since 1999.[42] When the Energy Policy Act of 1992, Pub. L. No. 102-486, 106 Stat. 2776 (1992) expanded the scope of DOE's authority to include equipment such as commercial water heaters, Congress understood that many state and local jurisdictions had adopted code standards for such products based on the ASHRAE Standard and recognized the disruption that would result if there were national standards that conflicted with the ASHRAE Standard. Accordingly, the legislation imposed national standards consistent with the ASHRAE Standard and directed DOE to update those standards in response to relevant amendments to the ASHRAE Standard, presumptively by incorporating those amendments without change.[43] The only exception to the limited presumption that DOE must maintain consistency with the ASHRAE standard is when DOE determines "by rule" supported "by clear and convincing evidence" that a more stringent standard "would result in significant additional conservation of energy and is technologically feasible and economically justified."[44]

"This unusual framework creates an unusually strong bias in favor of the status quo."[45] Rather than presuming that more stringent standards would be desirable, DOE must presume that standards more stringent than the ASHRAE standards would *not be* desirable in the absence of clear and convincing evidence that they are justified. If the requirement for clear and convincing evidence means anything, it means that DOE must resolve doubts against the need for more stringent standards. In developing the NOPR, DOE has done the opposite.

2. DOE Lacks Critical Evidence Required for its Analysis

In a number of cases, DOE lacks the data required to provide or support critical inputs to its analysis. Rather than collecting the relevant data—or properly concluding that it lacked evidence necessary to support a determination that the proposed standards are economically justified—DOE repeatedly resorted to arbitrary assumptions to fill key data gaps necessary to evaluate properly whether the proposed standards would be economically justified. DOE's failure to provide sufficient time for public comment made it impossible for Commenters to identify all of the cases in which DOE relied upon arbitrary assumptions to supply the inputs for which it lacked credible evidence, but it is evident that such problems pervade much of DOE's analysis.

For example, DOE did not collect – and the proposal routinely seeks to dismiss – evidence of the actual prices purchasers pay for the covered products or their installation and related costs.

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[41] Information about the standard is available at: https://www.ashrae.org/technical-resources/bookstore/standard-90-1 (last visited August 1, 2022).

[42] Instructions for submitting proposed modifications are available at: https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-and-guidelines-under-continuous-maintenance (last visited August 1, 2022).

[43] 42 U.S.C. § 6313(a)(6)(A)(ii)(I).

[44] 42 U.S.C. § 6313(a)(6)(A)(ii)(II).

[45] *American Public Gas Association v. DOE*, 22 F.4th 1018, 1025 (D.C. Cir. 2022) ("*APGA v. DOE*").

Rather than focusing on direct evidence for these critical inputs for its analysis, DOE engages in a remarkably elaborate analyses to produce "built-up" cost estimates based on dozens of parameter inputs, many of which are supplied on the bases of inadequate information, arbitrary assumptions, or bare assertions entirely unsupported in the record (including parameter values supplied on the basis of undisclosed information from manufacturer interviews or tear-down analyses).[46]

The NOPR also relies on installation cost estimates that are based on inputs for which DOE lacked credible data. To fill in these information gaps, DOE generated numbers through arbitrary assumptions, in some instances appearing with no supportable origin. For example:

- With the stated excuse that no one had provided it with better numbers, DOE arbitrarily assumed that 25% of pre-1980 buildings have masonry chimneys and that only 25% of those chimneys would require relining;[47]
- DOE generated vent lengths crucial to its analysis of installation costs by using triangular distributions with arbitrary parameters; and
- DOE assumed the number of elbow bends, again critical to the analysis of installation costs, with no referenceable source or field observation.

Congress required DOE to support its conclusions with "clear and convincing evidence." DOE cannot rest on factual assertions unsupported by evidence in the record.[48] Nor can it excuse the fact that it lacked the information required for its analysis by claiming that "it did the best it could with the data it had."[49] Simply put, "[u]sing data ill-suited to the task is not excused by failure – even good faith failure – to locate suitable data . . . ."[50] Lacking clear and convincing evidence that its standards are economically justified, DOE has a statutory duty to resolve doubt against the need for new standards.

3. Due to the Uncertainties Underlying DOE's analysis, the Conclusion that the Proposed Standards Would Produce Small Life-Cycle Benefits Fails to Present Clear and Convincing Evidence that the Proposed Standards Would Provide Any Life Cycle Benefits

There is significant uncertainty associated with virtually all of the inputs to DOE's economic analysis. DOE's reliance on inherently less reliable "built-up" cost estimates in place of direct evidence of product and installation costs amplifies the uncertainties in the key inputs driving DOE's conclusions. As a result, there is considerable reason to doubt whether analytical results suggesting that standards would provide average life-cycle cost savings amounting to a very small

[46] For further discussion of these issues, *see* Attachment E at 71-73 and 66-67 (manufacturer interviews and tear-down analyses).
[47] 87 Fed. Reg. at 30665-66.
[48] *See, Ctr. For Auto Safety v. Fed. Highway Admin.*, 956 F.2nd 309, 314 (D.C. Cir. 1992).
[49] *APGA v. DOE*, 22 F.4th at 1027.
[50] *Id.* at 1029.

percentage of total life-cycle costs is credible evidence—let alone clear and convincing evidence—that the standards would provide any life-cycle cost savings.

DOE's life-cycle cost model is ostensibly a Monte Carlo Simulation: a type of analysis that is useful in predicting the probability of various outcomes when significant uncertainty exists. However, the quality and accuracy of any Monte Carlo analysis depends on the quality and accuracy of the assumptions that are used as inputs to the model and the probability distributions applied. That is a significant part of the problem with the NOPR. DOE's analysis generally does not seek to address the *uncertainties* in model inputs. In short, it is designed to account for some of the anticipated *variability* in the inputs for a particular parameter, not *uncertainties* as to the range and distribution of inputs for that parameter.[51] However, DOE's analysis does not merely fail to address uncertainty in many cases in which uncertainty is known to exist; there are key cases in which DOE's model uses a single parameter input (as opposed to a distribution of inputs) and thus fails to address both the known variability of that input and any uncertainty as to what the range and distribution of that input should be.

For example, DOE made an apparently deliberate decision to limit variability in venting costs. The technical support documents ("TSD")references the National Fuel Gas Code (NFGC - NFPA 54), which has numerous sections mentioning "combined venting" or "common venting" where more than one natural draft (Category I vent) appliance exhausts combustion products through the same venting system. However, DOE's LCC analysis does not address the redesign necessary in common vent applications where one appliance is removed.

Similarly, venting costs are significantly driven by the diameter of the venting, which is a function of the input rate of the appliance (i.e., BTUH listed on appliance nameplates). Although the TSD recognizes this fact in the venting appendix (8D.7), the LCC model utilizes only one "representative model" and hence vent diameter in each product category. The true variation of venting installation costs in the LCC analysis is therefore significantly understated.

The approach here stands in contrast to similar analysis in other rulemakings. For example, DOE appears to have recognized the importance of this cost in the 2016 Commercial Boiler TSD, as an equation is presented where the relationship between product input rate and vent diameter is provided (Equation 8D.1). DOE includes no reasonable explanation for why its analysis in this rule fails to account for variation in venting diameters and the associated costs.

There are many cases in which DOE failed to account for substantial variability or uncertainty in key parameter inputs. For example:

1. The costs associated with labor, for venting or any other part of installation, have inherent uncertainty, particularly over time, and DOE's analysis does not address this uncertainty at all.

[51] This is the difference between accounting for the fact that different purchasers would pay different prices and accounting for uncertainties as to what prices those purchasers pay.

2. Energy costs have a material impact on the economic outcomes of efficiency standards, and future energy costs are known to be uncertain. That uncertainty has been quantified (in Annual Energy Outlook ("AEO") retrospectives[52] for example), but is effectively ignored in DOE's analysis despite the fact that the AEO forecasts on which DOE relies have systematically overstated future energy costs to an extent likely to eliminate all LCC savings claimed to justify the proposed standards.

3. Equipment Lifetime – "DOE assumes that the lifetime distribution for a class of CWH unit is the same within an equipment category, across all efficiency and standby loss levels." Given that different efficiency requirements drive different materials choices, thickness, manufacturing processes, etc. and cause different levels of condensation and acid exposures this arbitrary assumption does not seem reasonable. It is worth mentioning that in section 83.3.1 DOE apparently does consider the lower reliability of heat exchangers in condensing units compared to non-condensing units. However, it also assumes, without reference or logic, that the cost of heat exchanger replacement, where possible, is one third of the total water heater replacement cost. It is just as likely that heat exchanger failure will cause a need for complete replacement of the water heating equipment, but the added negative economic impact of more frequent equipment outages on the business's operation is not considered.

4. Equipment Costs – The NOPR fails to consider any uncertainty or variables in its assessment of equipment costs either now or in future years. For example, the model considers markups on equipment to be different for new rather than replacement, or commercial rather than residential installations, but within any of these categories there is no variability. That is not reasonable because experience shows that markups can vary significantly.

DOE has included a variety of inputs in the cost of venting. One of these is a probability of "Extraordinary Venting Costs." As already discussed, DOE assumed a probability of 2% for such costs and that and that – in these cases – costs would increase by a multiple of between 2 and 3, and other assumptions applied during the calculation of venting costs that are arbitrary and subject to considerable uncertainty.

To illustrate how serious the impact of a single input assumption can be, another distribution of venting costs was developed and tested in the LCC model.[53] The figure below illustrates the distribution that DOE used for the assignment of "extraordinary" venting costs.

[52] https://www.eia.gov/outlooks/aeo/retrospective/

[53] Note that the point here is not that the tested distribution is correct, and the one DOE chose in incorrect. The point is that these distributions matter and the ones being used are arbitrary and almost certainly not correct.

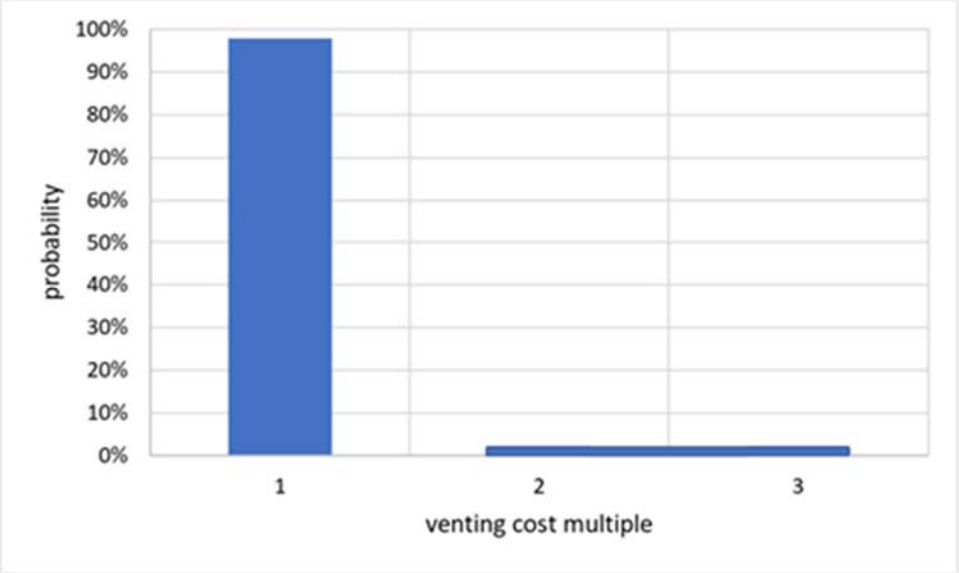


Figure 1: DOE LCC model distribution of venting costs. The multiple is applied to a theoretical calculation of what venting cost "should" be.

Replacing this with a lognormal distribution (illustrated below), which looks more like what you would expect for venting costs where most consumers are near the calculated level of costs but with a right-hand tail, yields significant changes to LCC savings, as shown in Table 1. Again, the point is not that these results are correct, it is that the correct LCC savings can only be determined accurately enough to determine whether or not they are actually slightly positive or slightly negative if essentially all of the inputs to the model are correct.

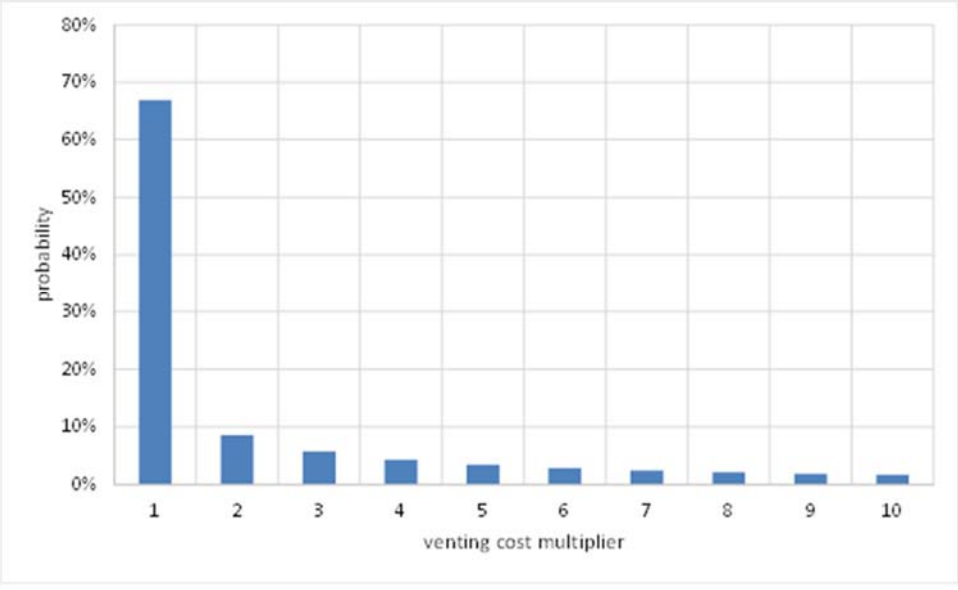


Table 1: Alternative lognormal distribution of multiples to theoretical venting costs.

Product	Average LCC savings (baseline DOE model)	Average LCC savings (using the illustrated lognormal distribution of venting costs)
CGIHWSB (TSL 3)	$1047	$695
CGITWH (TSL 3)	$63	**-50**
CGSWH (TSL 3)	$301	**-$203**
RDGSWH (TSL 3)	$90	**-$74**

Realistically, the only way to get these inputs (including equipment and labor costs) accurate enough to make the distinction when the LCC savings is this close to zero is through field work and data collection. This is not unreasonable as the equipment and installations in question are not theoretical devices but instead are ones that have been deployed at large scale.

Product	Average LCC savings (baseline DOE model)	Average LCC savings (using the illustrated lognormal distribution of venting costs)
CGIHWSB (TSL 3)	$1047	$695
CGITWH (TSL 3)	$63	**-50**
CGSWH (TSL 3)	$301	**-$203**
RDGSWH (TSL 3)	$90	**-$74**

In view of this general failure to address the considerable uncertainties in its model inputs, there is no basis to conclude that the results of DOE's life-cycle cost analysis are sufficiently accurate to distinguish small average life-cycle cost savings from small net life-cycle costs.

4. In View of the Impact of DOE's "Random Assignment" Methodology, Results Suggesting that the Proposed Standards Would Provide the Small Life-Cycle Cost Benefits is Strong Evidence that They Would Provide No Life-Cycle Benefits at All

Commercial water heaters are efficient enough to satisfy the proposed standards that are already well-established in the market and have captured a significant (and increasing) share of the market. -DOE's own numbers indicate that the economic consequences of investments in such products vary considerably based on individual circumstances, with some purchasers experiencing significant life-cycle cost savings and others experiencing significant net costs.- The economic impact of purchasing products that meet the standards depends on the extent to which purchasers invest in such products when it would be economically beneficial to do so or to decline such investments when they would impose net costs.- However, the standard would eliminate purchasers' ability to consider important aspects of these economic decisions. As a result:

- The percentage of investments with beneficial economic outcomes would be lower in the universe of investments that would occur as a result of the standards than in the universe of investments purchasers would make on their own;
- The percentage of investment with net cost outcomes would be higher in the universe of investments that would occur as a result of the standards than in the universe of investments purchasers would make on their own; and
- The average life-cycle cost outcome would be "worse" for investments occurring as a result of the standards than for the "base case" investments purchasers would make on their own.

Nevertheless, DOE's life-cycle cost analysis is based on a "random assignment" methodology that "assigns" particular efficiency investments to the "base" or "standards" case randomly, an approach that effectively assumes that purchasers of commercial water heaters have no preference for economically beneficial efficiency investments – and no aversion to net cost investments – regardless of the magnitude of the economic stakes involved. As explained in Section C and Attachment F[54] of these Comments, that assumption grossly overstates the potential for standards to produce lifecycle-cost benefits, and thus systematically skews the results of DOE's life-cycle cost analysis. Consequently, the fact that DOE's analysis produced very modest (and unquestionably overstated) average life-cycle cost benefits provides no basis to conclude that the standards would provide any life-cycle cost benefits at all. Indeed, it strongly suggests that – on average – the proposed standards would more likely impose net costs.

5. Energy Prices

DOE is using an energy price forecast based on the 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 customers and 86% of the time for commercial customers nationally. The only year with higher actual versus forecasted prices is the most recent year or 2021 ("2022 AEO") which is heavily impacted by the COVID-19 economy. The commercial water heater and boiler rule use the 2021 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 EIA reports as actual prices versus what was forecasted in each AEO.

DOE uses EIA historical price data to generate an estimate of what the first year of usage should be for any given appliance and customer. In the Monty Carlo simulation, with exception to the fuel prices, all costs are reported in $2020 dollars and either relies on 2020 or 2021 data. DOE did

[54] Attachment F is a Walkthrough of the Technical Issues with the Commercial Water Heater LCC Model, which is incorporated into these Comments.

not update fuel or marginal pricing to match other base year costs despite the data being available before the last update on March 25, 2022. DOE noted but did not explain why it cannot update prices with the following comment "2020 prices incomplete within NG Navigator", even though the data is accessible on the EIA website.

Actual Residential Historical Prices vs Annual Energy Outlook Forecast

Forecast Release Year Data	Historical Data	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
		$ 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	$ 12.24
	2010	$ 13.32	$ 13.87	$ 11.72	$ 11.21	$ 12.12	$ 12.21	$ 11.81	$ 11.74	$ 11.89	$ 11.99	$ 12.03	$ 12.10	$ 12.18	$ 12.30	$ 12.42
	2011		$ 13.99	$ 12.20	$ 11.31	$ 10.56	$ 10.44	$ 10.39	$ 10.28	$ 10.39	$ 10.50	$ 10.61	$ 10.74	$ 10.90	$ 11.16	$ 11.38
	2012			$ 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
	2013				$ 11.62	$ 11.05	$ 10.71	$ 10.72	$ 10.49	$ 10.39	$ 10.91	$ 11.24	$ 11.66	$ 11.89	$ 12.05	$ 12.24
	2014					$ 11.22	$ 10.69	$ 10.62	$ 11.44	$ 11.24	$ 10.92	$ 11.25	$ 11.71	$ 11.88	$ 11.85	$ 12.06
	2015						$ 10.86	$ 10.29	$ 10.80	$ 10.62	$ 10.48	$ 10.65	$ 10.84	$ 11.38	$ 11.92	$ 12.29
	2016								$ 11.08	$ 10.40	$ 9.70	$ 9.87	$ 10.28	$ 10.67	$ 11.08	$ 11.19
	2017									$ 10.58	$ 10.22	$ 10.91	$ 10.92	$ 11.06	$ 11.20	$ 11.31
	2018										$ 10.30	$ 11.17	$ 10.77	$ 11.19	$ 11.47	$ 11.59
	2019											$ 11.18	$ 10.75	$ 10.71	$ 11.00	$ 11.08
	2020													$ 10.80	$ 10.39	$ 10.53
	2021														$ 10.54	$ 10.81
	2022															$ 12.15

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

Actual Commerical Historical Prices vs Annual Energy Outlook Forecast

Forecast Release Year Data	Historical Data	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
		$ 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	$ 8.78
	2010	$ 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
	2011		$ 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
	2012			$ 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
	2013				$ 9.61	$ 9.04	$ 8.26	$ 8.66	$ 8.42	$ 8.29	$ 8.76	$ 9.03	$ 9.38	$ 9.57	$ 9.69	$ 9.83
	2014					$ 9.16	$ 8.29	$ 8.49	$ 9.29	$ 9.11	$ 8.91	$ 9.21	$ 9.62	$ 9.76	$ 9.70	$ 9.90
	2015						$ 8.36	$ 8.35	$ 8.82	$ 8.73	$ 8.76	$ 8.77	$ 8.81	$ 9.32	$ 9.82	$ 10.15
	2016								$ 9.24	$ 7.92	$ 7.46	$ 7.93	$ 8.54	$ 9.19	$ 9.58	$ 9.67
	2017									$ 8.28	$ 7.42	$ 8.14	$ 8.69	$ 9.33	$ 9.96	$ 10.07
	2018										$ 7.50	$ 8.11	$ 7.96	$ 8.33	$ 8.69	$ 8.88
	2019											$ 8.12	$ 8.01	$ 7.94	$ 8.14	$ 8.26
	2020													$ 7.80	$ 7.43	$ 7.58
	2021														$ 7.51	$ 7.95
	2022															$ 8.76

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

DOE uses EIA historical price data to generate an estimate of what the first year of usage should be for any given appliance and customer. In the Monty Carlo simulation, with exception to the fuel prices, all costs are reported in $2020 dollars and either relies on 2020 or 2021 data. DOE did not update fuel or marginal pricing to match other base year costs despite the data being available before the last update on March 25, 2022. DOE noted but did not explain why it cannot update prices with the following comment "2020 prices incomplete within NG Navigator", even though the data is accessible on the EIA website.

C. Random Assignment is a Fatal Flaw Underlying the NOPR

One of the most controversial issues in DOE standards rulemaking for gas products has been DOE's use of "random assignment" (*i.e.*, random base case efficiency assignment) in its life-cycle cost ("LCC") analysis. This issue has been raised in numerous previous submissions, including comments submitted in response to DOE's 2016 proposed commercial water heater standards.[55] DOE's failure to address this issue fatally undermines the NOPR.

[55] *See e.g.*, Attachment A at 11-12; Attachment B at 15-17; Attachment C at 13-14; Attachment E at 58-62.

1. DOE's Random Assignment Methodology is Unreasonable and Unreasonably Skews the Results of DOE's LCC Analysis

The problem posed by random assignment is straightforward. DOE's analysis uses ten thousand "trial cases" to represent the full range of scenarios in which the more-efficient products required by a standard ("Standards-Compliant" products) would be installed, each of which has an individual LCC outcome.[56] DOE divides these cases into base-case installations (in which purchasers would choose Standards-Compliant products on their own) and rule outcome installations (i.e., the investments in Standards-Compliant products that would occur only if the standard is imposed. DOE then calculates the average LCC outcome for the standard (*i.e.*, the average of the individual LCC outcomes for the rule-outcome installations). For purposes of this analysis, the percentage of trial cases assigned to the "base case" reflects the percentage of cases in which purchasers would already choose the more-efficient product on their own.[57] However – whatever that percentage is – the individual trial cases assigned to the base case are selected randomly, as though purchasers acting in the absence of a standard have no statistically significant preference for economically beneficial investments in Standards Compliant products – and no statistically significant aversion to economically unfavorable investments – regardless of the economic stakes involved. Because the trial cases *not* randomly assigned to the base case are treated as rule outcome cases, they – in effect – are randomly assigned to the standards case.

Random assignment presents obvious issues when Standards-Compliant products are well-established in the market and investments in such products produce a range of materially different individual LCC outcomes; particularly where investments in Standards-Compliant products provide substantial LCC savings in some cases but would impose substantial net costs in others (as is true with respect to all of the products subject to the NOPR). Under these circumstances, the basic problem is that a randomly-selected sample of 10,000 trial *should be reasonably representative of all 10,000 trial cases*. Accordingly, random assignment produces a "base case" in which the range and distribution of individual LCC outcomes for investments in Standards-Compliant products is about the same as it is for the (randomly "left over") trial cases representing rule outcome investment in such products, and – in both cases – the range and distribution of individual LCC outcomes would be about the same as it is for all 10,000 trial cases. As the basis for an analysis of the LCC impacts a standard would have, that outcome is facially absurd.

Purchasers obviously do have a statistically significant preference for good economic outcomes and—the more economically attractive individual efficiency investments are—the more likely it is that they will be made whether or not a standard is imposed. Conversely, purchasers have a statistically significant aversion to economically unattractive efficiency investments, and—the worse an individual LCC outcome is—the more likely it is to be declined unless a standard leaves the purchaser no choice. As a result—in the real world—the range and distribution of individual

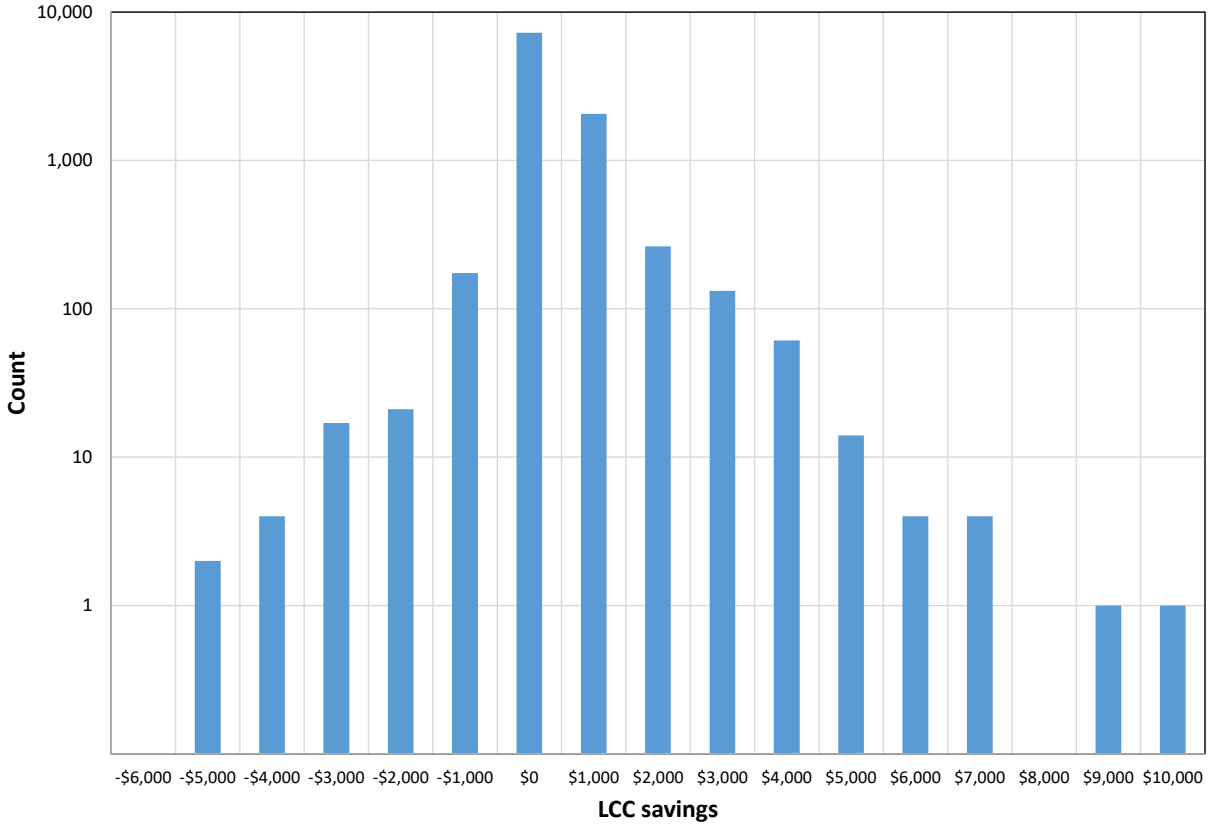
[56] 87 Fed. Reg. at 30659.
[57] 87 Fed. Reg. at 30671.

LCC outcomes for base-case investments in Standards-Compliant products would not be essentially the same as it is for the full range of potential investments in such products (*i.e.*, all 10,000 trial cases). Instead, it would include a higher percentage of economically beneficial investments and a lower percentage of economically unattractive outcomes, particularly as the magnitude of the individual economic consequences increases. Conversely, the range and distribution of individual LCC outcomes for investments that would only occur as the result of the standard would have a lower percentage of economically beneficial outcomes and a higher percentage of economically unattractive outcomes, particularly as the magnitude of the individual economic consequences increases. *Random assignment completely ignores this reality*. It, therefore, creates a base case for analysis that unquestionably overstates the potential for standards to produce LCC benefits and systematically skews the results of DOE's LCC analysis.

It is absurd to suggest that purchasers of commercial water heaters never consider the economics of potential investments in Standards-Compliance products regardless of the economic stakes involved, yet that is precisely what random assignment assumes. DOE has never claimed that this assumption is valid and has offered no evidence or argument that would remotely justify the conclusion that it is. However, the problem with random assignment is not simply the absurdity of what it assumes; it is the significance of its impact on DOE's LCC analysis.

The results of DOE's LCC analysis tend to be heavily influenced by a relatively small percentage of individual trial cases that have disproportionately large individual LCC outcomes. Because these are exactly the kinds of cases in which purchasing decisions are most likely to influence base case purchasing decisions, they are the cases for which random assignment is *most unreasonable*. In short, the most serious problem with random assignment is that it produces the most unreasonable "assignments" of individual trial cases in the specific cases that have the greatest impact on the results of DOE's analysis. To illustrate this problem, Figure 1 shows the distribution of LCC outcomes for the 10,000 trial cases in DOE's analysis for the proposed standard for gas-fired instantaneous tankless water heaters.

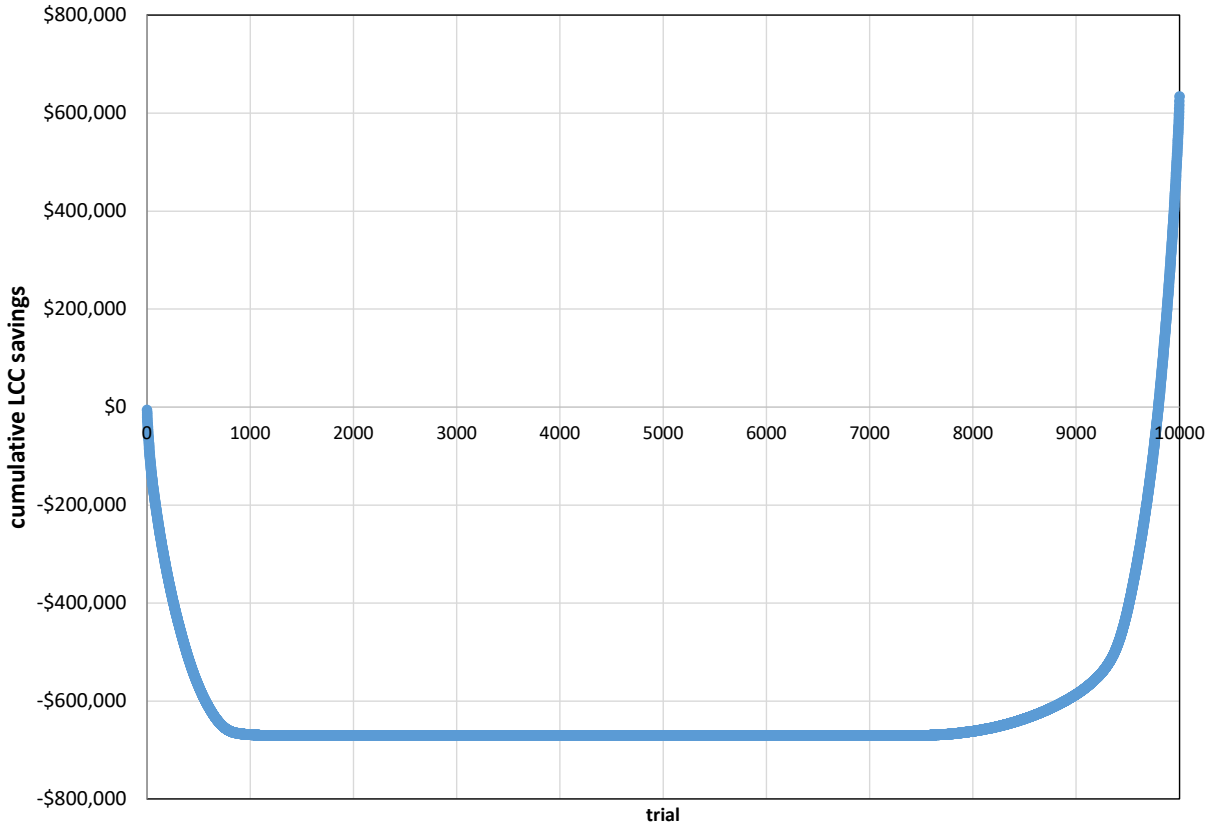
Figure 1: Distribution of LCC Outcomers for Gas-Fired Instantaneous Tankless Water Heaters



The y-axis "count" scale is logarithmic. The bar that includes outcomes with zero LCC savings includes the 62% of the 10,000 trial cases that represent "base case" installations, because DOE replaces the actual LCC outcomes for those cases with zero-benefit outcomes on the theory that base-case purchasers would not experience any costs or benefits as a result of the standard.

Figure 2 presents the same data, showing the individual outcomes—again from "worst" to "best"—with the cumulative total LCC impact of the standard. The base-case installations (presented by DOE as "no impact" outcomes) create the long flat line in the middle of the distribution.

Figure 2: Cumulative LCC Outcome for Gas-Fired Instantaneous Tankless Water Heaters



As this Figure shows, the average LCC outcome, in this case, is determined mainly by a relatively small percentage of individual trial cases with disproportionately large LCC impacts. In this case, the average LCC outcome only exceeds zero because of the *205 individual cases with the largest LCC savings*. If the assignment of those 205 cases as "rule outcomes" is unreasonable (and it unquestionably is, as discussed below), the standard would not provide any of the LCC savings relied upon to justify the proposed standard.

There are cases in which the results produced by random assignment are patently unjustified. The most obvious error produced by random assignment is that it credits standards with the economic benefits of efficiency investments in which Standards-Compliant products *are the low-cost option in terms of the initial investment*. Such cases typically occur when the additional cost of a Standards-Compliant product is offset by lower venting costs incurred in the context of new construction, and they tend to produce unusually high LCC benefits. However, there is no reasonable basis to suggest that standards are necessary to cause purchasers to make such investments. 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 time—does not even apply in such cases. Yet random assignment erroneously "assigns" the benefits of such trial cases to the standards case, producing spurious regulatory benefits that can dramatically impact the results of DOE's LCC analysis. This problem was previously documented in the case of DOE's

2016 analysis for residential furnace standards.[58] Review of DOE's spreadsheet analysis shows that such spurious benefits are claimed in the LCC analyses for three of the four proposed standards for gas products.[59] In the case of tankless instantaneous water heaters (illustrated above), such benefits account for over 75% of the total LCC benefits claimed for the standard. Without those spurious benefits, the average LCC outcome for DOE's proposed standard would be a *net cost* of $35.29. There is no justification for crediting efficiency standards with the economic benefits of trial cases in which the Standards-Compliant product is the low-cost option in terms of initial investment, and the problem is easy to correct: such cases should be assigned to the base case instead of being assigned randomly.

Random assignment also produces absurd results in cases where some initial investment would be required for a Standards-Compliant product. In such cases, there are two separate issues. First, there is no basis to suggest that purchasers have any significant tendency to decline efficiency investments that would provide obvious and substantial economic benefits; in such cases, businesses that sell commercial water heaters have an economic incentive to promote the sale of Standards-Compliant products and the decision purchasers face is a "no brainer." There is no reasonable basis for assigning trial cases with such outcomes randomly, as though such purchases would not overwhelmingly occur whether or not a standard is imposed. Yet *more than 58%* of the LCC savings claimed to justify DOE's proposed standard for gas-fired storage water heaters are benefits from cases in which Standards-Compliant products would pay for themselves and start providing net savings *in less than a year*. There is no credible justification for assigning such cases randomly.

Second, random assignment absurdly assigns *net cost* outcomes to the base case in the same proportion that it assigns them to the standards case, and it does so *no matter how bad* those individual outcomes are. There is no reasonable basis to suggest that purchasers have no aversion to efficiency investments that require a substantial initial investment that could never be expected to pay off, particularly in cases in which bad outcomes are driven by the additional costs presented in problematic replacement scenarios. Yet DOE's LCC analyses for three of the four categories of gas products at issue randomly assigns trial cases that impose *net LCC costs* that substantially exceed the *average installed cost of the Standards-Compliant product*, with the result that many such outcomes disappear into the base case instead of being treated as outcomes that should only be expected to occur if standards left purchasers with no choice.[60]

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[58] *See* Attachment E at 60-61 and Attachment C (Gas Technology Institute Report entitled Technical Analysis of DOE Supplemental Notice of Proposed Rulemaking on Residential Furnace Minimum Efficiencies (January 4, 2017)) at 23.

[59] Commenters have not had sufficient time to focus on DOE's analyses for other products, but there is no reason to believe that the same problems do not exist in those cases.

[60] The exception is the relatively small category of products variously described as "instantaneous water heaters and hot water supply boilers" and "gas-fired circulating water heaters and hot water supply boilers." For the other categories of gas products, Commenters have assumed the result random assignment suggests: that the range and distribution of individual LCC outcomes is about the same for base case trial cases as it is for the rule outcome cases (which include trial cases that impose net LCC costs that substantially exceed the average installed cost of the Standards-Compliant product.

The unreasonable impacts of random assignment have an even more dramatic impact in combination than they do individually. For example, if the cases with payback periods of less than one year are removed from the standards case and replaced with the worst net costs outcomes, the average LCC savings for gas-fired residential-duty water heaters would turn into an average net cost of $26.94 and the average LCC savings for gas-fired storage water heaters would be negligible ($8.49).

2. DOE's Failure to Address Meritorious Substantive Criticism of its Random Assignment Methodology is Arbitrary, and its Failure to do so in the NOPR Violates DOE's Basic Notice and Comment Obligations

Commenters have been raising concerns about random assignment for almost six years now, including in comments submitted at earlier stages in this rulemaking proceeding. The issue was raised in the challenge to DOE's commercial packaged boiler standards, and the Court found that DOE failed to respond to "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."[61]

Remarkably, the NOPR makes no mention of the relevant portion of the decision in *APGA v. DOE* and makes only one passing reference to previous comment on the random assignment issue in a section that does not address that issue (*i.e.*, "equipment efficiency trends").[62] DOE's response appears to suggest that the issue relates to the percentage of trial cases assigned to the base case and states that "[t]he selections in the LCC model, while random, are based on the distributions created from the best available data."[63] However – as already discussed – the random assignment issue does not relate to the DOE's determination of the *percentage* of trial cases assigned to the base case; it relates to the fact that individual trial cases are assigned to the base case randomly; *i.e.*, without any effort to account for the impact the economic consequences of individual efficiency investments could be expected to have on base case purchasing decisions. The NOPR then states that "[t]he issue of the random assignment of equipment in the no-new standards case is discussed specifically in section IV.F.2.i." and that "DOE uses this distribution in the LCC to model consumer choices that mirror the market."[64] Neither of these statements is true: as a word search will confirm, there is no other reference to random assignment anywhere else in the NOPR, and the problem with random assignment is that it does not even remotely cause DOE's LCC analysis to "model consumer choices that mirror the market."

It is no accident that Section IV.F.2.i does not even discuss random assignment as such, because it is completely non-responsive to the issue. The only argument presented is as follows:[65]

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[61] *American Public Gas Ass'n v. DOE*, 22 F.4th 1018, 1027-28 (D.C. Cir. 2022) ("*APGA v. DOE*").
[62] *See* 87 Fed. Reg. at 30681.
[63] *Id.*
[64] *Id*.
[65] 87 Fed. Reg. 30671.

> While DOE acknowledges that economic factors may play a role when building owners or builders decide on what type of CWH to install, assignment of CWH efficiency for a given installation, based solely on economic measures such as life-cycle cost or simple payback period, most likely would not fully and accurately reflect actual real-world installations. There are a number of commercial sector market failures discussed in the economics literature, including a number of case studies, that illustrate how purchasing decisions with respect to energy efficiency are likely to not be completely correlated with energy use, as described below.

The claim that assigning trial cases to the base case "based solely on economic measures such as life-cycle cost or simple payback period[] likely would not fully and accurately reflect actual real-world installations" provides no excuse for and alternative – random assignment – that grossly distorts real world base case conditions. The claim that "purchasing decisions with respect to energy efficiency are likely to not be completely correlated with energy use" is no better (and would not be better even if it referred to a correlation with LCC outcomes, which turn on more than just energy use). In short, claims that purchasers do not always make perfect economic decisions do not even remotely justify the assumption that they never consider economics at all, *regardless of the magnitude of the stakes involved*.

In reviewing DOE's LCC analysis, both the U.S. Court of Appeals and the National Academies of Science recognized that it defies credulity to suggest that purchasers – particularly purchasers of commercial equipment – do not generally act in their own economic interest.[66] DOE's literature review concerning market failures provides no basis to conclude otherwise; 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 general proposition that purchasers tend to act in their own economic interest. It does not help that DOE relies on papers that are dated or of dubious relevance to the U.S. market for commercial water heaters; nor does it help that it raises concerns about novel technology in the context of decades-old technology that has already captured a substantial proportion of the relevant product markets, or concerns about the availability of information for professionally installed equipment with certified efficiency ratings. But the more fundamental point is that none of the alleged market failures justify the random assignment of trial cases in which investments in Standards-Compliant equipment have economic consequences too substantial to go unmentioned without significant risk of allegations of fraud (in the case of economically disastrous installations) or negligence (in the case of installations with windfall economic benefits).

The kinds of LCC outcomes addressed above are largely if not completely immune to the impacts of potential market failures. That is true in the case of windfall benefit cases in which Standards-Compliant products are the low-cost option, as well as in cases with very short payback periods: in both cases, these are cases in which installation is easy and benefits are obvious. Conversely,

[66] *See APGA v. DOE*, 22 F.4th 1018 at 1027; National Academies of Sciences, Engineering, and Medicine, Review of Methods Used by the U.S. Department of Energy in Setting Appliance and Equipment Standards 77 (2021), available at http://nap.edu/25992 ("NAS Report") at 7.

the worst economic outcomes do not come easy: they frequently arise in difficult replacement scenarios where substantially easier, less costly "like-for-like" replacements would otherwise occur: in short, in cases in which standards would create what amounts to a reverse market failure by making it impossible for purchasers to avoid the bad economic outcomes.

None of this is new to DOE.[67] DOE simply chose to ignore the relevant issues. DOE cannot reasonably adopt a final rule without addressing these issues.[68]. Nor can it choose to wait until it issues a final rule before attempting to do so, because DOE has an obligation to disclose its evidence and argument in time to ensure that it is "exposed to refutation" through review and comment *during the rulemaking process.*[69]

D. Other Comments on DOE's LCC Analysis

1. Energy Equity and Justice: Disproportionate Impacts

The NOPR and related TSD materials fail to address or comment on the proposal's potential impact on businesses in geographic regions and economic segments that qualify within the Administration's Justice40 Initiative.[70] The agency has committed itself to assist these regions with energy equity through opportunities to improve energy infrastructure, grant programs, and assessments of codes and standards.[71] The agency's policy commitment appears not to extend to the rulemaking at issue. The potential negative ramifications of the proposal, if finalized as detailed in the NOPR, would present significant costs to businesses that the Administration's Justice40 Initiative intends to assist. Federal information resources such as the DOE's "Energy Justice Dashboard"[72] can provide DOE with insights on some of these disproportionate impacts. While this and other resources are intended to help assess disproportionate environmental impacts, their focus on energy and associated costs are directly relevant to consumers required to install Category IV systems as a consequence of TSL3 adoption. Commenters urge DOE to expand its analysis to include an assessment of these impacts on commercial business owners and operators.

Specifically, the NOPR does not address how business owners and operators that would have to replace atmospherically-vented CWH systems, under the terms of the NOPR, are disproportionally affected by the removal of products using those technologies from the commercial market generally through the promulgation of TSL3. This disproportionate impact is masked by DOE's averaging of consumer costs and benefits within its spreadsheet analysis of commercial consumer LCC savings and paybacks. Issues of "averaging away" market participant

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[67] *See, e.g.*, Attachment A.
[68] *APGA v. DOE*, 22 F.4th at 1028-29 ("Without a cogent and reasoned response to the substantial concerns the petitioners raised about this crucial part of its analysis, we cannot say it was reasonable for the DOE to conclude that clear and convincing evidence supports the adoption of a more stringent standard").
[69] *Owner-Operator Indep. Drivers Ass'n v. FMCSA,* 494 F.3d 188, 202 (D.C. Cir. 2007).
[70] Exec. Order No. 14008, 86 Fed. Reg. 197619 (Feb. 1, 2021).
[71] DOE, Promoting Energy Justice, https://www.energy.gov/promoting-energy-justice.
[72] https://www.energy.gov/diversity/energy-justice-dashboard-beta

impacts are discussed elsewhere in these comments. Overall, the DOE approach to treating this consumer segment works against the proper conduct of DOE analysis, which must conform to specific procedures discussed in the National Academy of Sciences peer review report and recommendations that the report makes regarding "welfare analysis."[73] However, neither the TSD and accompanying spreadsheets nor the NOPR discuss what, if anything, DOE has done to address these considerations.

Beyond this general issue, however, additional burdens borne by propane consumers is further disproportionately high if atmospherically-vented CHW products are no longer available as proposed through TSL3 due to two fundamental reasons:

Commercial propane users are typically small businesses according to the U. S. Small Business Administration (SBA) definition, more rurally located, and represent lower income-producing entities, which have more limited opportunity to invest in installation-related costs of changing venting systems.[6]

Commercial propane suppliers are not able to provide incentives to propane users comparable to natural gas utilities, which as regulated public utilities have some ability to pass on incentive costs through regulated rates.

Neither one of these constraints with respect to propane CWH equipment users and suppliers are addressed in the TSD or DOE consideration of TSL3. As such, the TSD is deficient in accounting for either financial capacity to fund CWH product replacement or actual impacts anticipated for propane consumers or suppliers. We strongly urge DOE to delay further rulemaking until the agency completes an analysis on the potential costs specifically to this category of businesses and provide a detailed explanation on how the proposal would abide by or undermine the Justice40 initiative with an opportunity for public comment.

2. Commercial Water Heater Life Cycle Cost Model

In its analysis, DOE evaluated four separate product classes, including gas-fired storage water heaters, gas-fired instantaneous water heaters, hot water supply boilers, and residential-duty gas-fired storage water heaters. Yet only one life cycle cost analysis was provided for all four products.

Each equipment class covered by the NOPR has distinct operating characteristics as defined in Title 10 CFR Part 431 Subpart G §431.102. A hot water supply boiler means a packaged boiler that has a rated input from 300,000 Btu/h to 12,500,000 Btu/h and of at least 4,000 Btu/h per gallon of stored water and is suitable for heating potable water. A gas-fired instantaneous water heater has a rated input both greater than 200,000 Btu/h and not less than 4,000 Btu/h per gallon of

[73] National Academies of Sciences, Engineering, and Medicine 2021. Review of Methods Used by the U.S. Department of Energy in Setting Appliance and Equipment Standards. Washington, DC: The National Academies Press. https://doi.org/10.17226/25992.

stored water. A gas-fired residential-duty commercial water heater is not designed to provide outlet hot water at temperatures greater than 180 °F and has a rated input of >105 Btu/h and a rated storage volume of >120 gallons. Gas-fired storage water heaters with a rated input both greater than 75,000 Btu/h and less than 4,000 Btu/h per gallon of stored water. Each of these products serves a unique utility and is exposed to different operating conditions and stresses. The assumption that all four equipment classes have identical life cycle costs is implausible. Commenters request that DOE perform an LCC analysis for each product class covered by the NOPR.

3. Lack of Specificity in Product Class Analysis

While DOE acknowledges and presents data for its separate product classes of gas-fired commercial water heating equipment, its analysis of LCC cost savings and paybacks across the trial standards levels does not accompany that product class treatment.[74] instead, it aggregates costs and benefits across two fundamentally different product classes: storage water heaters and instantaneous water heaters in the trial standards, specifically of concern LCC cost savings and paybacks associated with TSL3. In doing so, DOE "averages away" the contribution of venting system installation cost adders for replacement of storage water heaters where changes in the venting system and building structure need to be altered, specifically for replacements of Category I storage water heaters with the proposed required Category IV and venting system cost adders. In developing it average LCC savings and payback, DOE needs to break out its analysis for storage commercial water heater trial standards levels and instantaneous CHW trial standards levels. The published TSD and spreadsheet calculations do not accomplish this needed breakout regarding these two product classes. As a consequence, the true impact of installation cost adders associated with venting system cost adders and the "substantial evidence" case for TSL3 overall in undermined.

4. Residential Energy Consumption Survey

In the 2015 Residential Energy Consumption Survey ("RECS"), the end-use models follow an engineering approach, and the calibration—which follows a minimum variance estimation approach—is based on the relative uncertainties of and correlations between the end uses being estimated. The calibration improves upon simple proration by treating model estimates according to their assumed uncertainties, so the most uncertain estimates tend to receive the largest corrections while the least uncertain estimates tend to receive the smallest corrections.

- In statistics, a minimum-variance unbiased estimator or uniformly minimum-variance unbiased estimator is an unbiased estimator that has lower variance than any other unbiased estimator for all possible values of the parameter.
- RECS intent was therefore to reduce the scatter in the data in order to provide a "smoothed curve" for improved calculations and process. However, the actual variations in the data are needed in DOE's LCC analysis.

[74] 87 Fed. Reg. 30696 (May 19, 2022).

- 57.5% of 2015 RECS square foot data was estimated using the Predictive Mean Neighborhood ("PMN") hot-deck imputation method.
  - About 19% of the 2015 in-person surveys did not have sufficient square footage data. This can happen for several reasons: a respondent can refuse to have their home measured, the interviewer may not be able to measure all necessary dimensions (because of factors such as weather or lack of access to certain floors of the home), or EIA can decide that one or more measurements are incorrect during data quality checks.
- Imputation rates the overall imputation rate of the 2015 RECS household square footage variable is 65.6%.
- EIA to add(ed) a step to the 2015 RECS imputation process to remove unusually small or large outliers from the donor pool before the PMN imputation begins.

DOE appears to have recognized the importance of this cost in the 2016 Commercial Boiler TSD, as an equation is presented where the relationship between product input rate and vent diameter is provided (Equation 8D.1).

On July 6, 2022, the U.S. Energy Information Administration released the 2020 RECS survey results. The Commenters urge DOE to use the most current data available, and halt proceedings on this NOPR until the information is appropriately evaluated.[75]

E. Other Comments

1. DOE Should Follow ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings

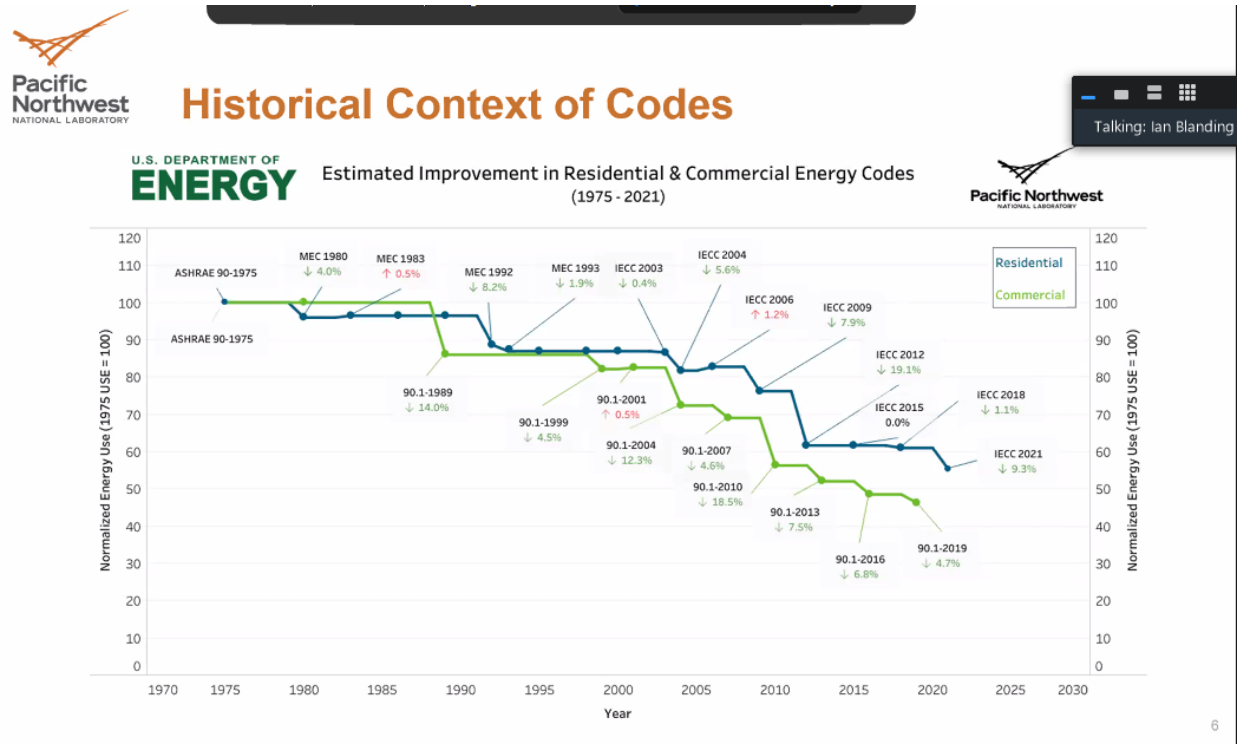
DOE is required under EPCA to periodically consider amendments to energy standards and to consider doing so whenever the American Society of Heating, Refrigerating, and Air Conditioning Engineers ("ASHRAE") amends the energy standards for products covered in the *Energy Standard for Buildings Except Low-Rise Residential Buildings*, ASHRAE 90.1, the standard that specifies minimum energy standards for building other than low-rise residential buildings.

ASHRAE 90.1-2019 is the benchmark for commercial building energy codes in the United States and has been a key basis for codes and standards around the world for more than 35 years. When the Energy Policy Act of 1992, Pub. L. No. 102-486, 106 Stat. 2776 (1992) expanded the scope of DOE's authority to include equipment such as commercial water heaters, Congress understood that many state and local jurisdictions had adopted standards for such products based on the ASHRAE Standard and recognized the disruption that would result if there were national standards that conflicted with the ASHRAE Standard. Accordingly, the legislation adopted national standards consistent with the ASHRAE Standard and directed DOE to update those

[75] U.S. Energy Information Administration 2020 Residential Energy Consumption Survey, https://www.eia.gov/consumption/residential/data/2020/index.php?view=state&src=%E2%80%B9%20Consumption%20%20%20%20%20%20Residential%20Energy%20Consumption%20Survey%20(RECS)-f1

standards promptly in response to relevant amendments to the ASHRAE Standard, presumptively by incorporating those amendments without change.[76] To date, the ASHRAE committee responsible for maintaining standard 90.1 has not considered an increase in the energy efficiency of these commercial water heaters in order to lower overall energy consumption.

According to the Pacific Northwest National Laboratory, the adoption of ASHRAE 90.1-2019 resulted in an estimated 4.7 percent reduction in energy usage in commercial buildings.[77] The adoption of each edition of ASHRAE 90.1 since 2004 has resulted in an energy use reduction.



2. Errors in Running the Worksheets

The NOPR, the related TSD, and underlying data spreadsheets are lengthy and complex documents that require careful consideration in order to develop meaningful comments. Additional time to provide comments in response to this NOPR is justified, and requests for an extension of the comment period were filed by various entities. DOE ultimately only granted a two-week extension. While the Commenters appreciate DOE's decision to provide two weeks to submit comments, additional time is still needed to evaluate the technical information, and the Commenters strongly recommend DOE delay further action on the rulemaking until it reviews, corrects, and republishes for public comment the technical documents.

[76] 42 U.S.C. § 6313(a)(6)(A)(ii)(I).
[77] 2022 National Energy Codes Conference, *The Intersection of Codes and BPSs,* Ian Blanding, PNNL.

For example, during the June 23, 2022, webinar held by DOE in this proceeding, Barton Day, counsel for Spire, indicated that there were numerous errors identified with DOE's commercial water heater spreadsheet analysis[78]and requested that DOE clean up its spreadsheet to give interested parties a better understanding of its analysis and provide additional time for public comment.

The model in question is an approximately 49 MB excel file that uses Oracle Crystal Ball to run a Monte Carlo Simulation within the LCC model. Substantial time and expertise are required to validate DOE's methods and output given the size and complexity of the model Moreover, the model version released to the public has the appearance of a draft given the number of identified errors and mislabels, which compounds the complexity of reviewing DOE's modeling approach and analysis. As a result, even individuals with considerable expertise have found it challenging to review and understand DOE's analysis. Specific difficulties identified thus far include:

- Over 11 million cell errors are reported in forecasted cells when the as-received model is run without modification. It is unclear how many errors are material to DOE's analysis. Still, this many errors indicates that significant additional troubleshooting should have been performed before the public release of the model. The failure to identify and correct these errors substantially increases the work for independent reviewers seeking to understand and evaluate DOE's analysis. Additionally, it calls into question the reasonableness of the model's results and DOE's reliance on them.
- In addition to the errors in the forecasted cells, there are formula errors throughout the model. Almost every tab of the spreadsheet has #N/A or #DIV/0! Errors, and in some cases many errors exist. Some locations are labeled "blank," but many are not. Again, these errors may or may not have material impacts on the results of DOE's analysis, and additional time is requested for an independent determination of the relevance of those errors.
- Some tables are either poorly labeled or not labeled, making it considerably more difficult to trace the model's logic and assumptions. For example:
    - The "Venting Costs" tab has a range of values and labels not clearly associated with other information – Row 170 and below in columns A through R.
    - The "Maint & Repair Costs" tab D122 to J 155.
    - The "EL.TSL.Mapping" tab
    - The "Bldg.Sample" tab, specifically row 363 to 390, but the entire tab in general.
    - The "RECS.WH" tab, columns HI to ID.
- This workbook contains forty tabs, and the formulas in one tab often refer to locations in other tabs. Having many tabs to organize information in something this complex is not necessarily surprising. However, the need to move back and forth between tabs to follow what could be one of one hundred formulas on a tab makes it extremely difficult and time-consuming to trace how the logic operates and to understand and evaluate DOE's analysis.
- Tracing formulas in Excel spreadsheets is normally a difficult process, and in this case the difficulties are compounded by the fact that there are thousands of formulas, including some

[78] DOE's spreadsheet analysis is identified in the docket as document EERE-2021-BT-STD-0027-0002_content.xlsm.

that are very long with dozens of variables that need to be tracked down and some that are nested IF statements that – though useful – are difficult to follow.
- The use of both Excel calculations and Visual Basic Code to perform some calculations in the model makes this process even more confusing without a clear description of the code.

For these reasons, the short comment period that DOE has allowed stakeholders to review the Proposed Rule is unreasonable and deprives stakeholders a meaningful opportunity to comment. DOE should correct the errors and allow stakeholders sufficient time to review DOE's models.

3. DOE Should First Finalize its Ongoing Proceeding Related to Residential-Duty Commercial Water Heater Test Procedures

On July 14, 2022, DOE published a supplemental notice of proposed rulemaking ("SNOPR") to amend the test procedure for consumer water heaters and residential-duty commercial water heaters[79]. Since this proposal will affect the efficiency test method for residential-duty commercial water heaters that are the subject of this rulemaking, it is imperative that additional time be allotted to assess the impact that those changes may have on the rating of residential-duty commercial water heaters. Specifically, the proposals presented in the SNOPR propose:

> additional amendments that would provide additional specificity regarding flow rate tolerances for water heaters with a rated storage volume of less than 2 gallons; allow for voluntary representations at certain additionally specified test conditions for heat pump water heaters; revise the proposed specifications regarding separate storage tank requirements for certain types of water heaters; provide instructions for testing certain water heaters that store water at a temperature higher than the delivery setpoint; establish a metric and method for determining the effective storage volume of certain storage-type water heaters; and update the proposed methodology for estimating the internal tank temperature of water heaters which cannot be directly measured.

These are extensive, proposed modifications to the efficiency test method, and it would be at a minimum prudent, if not required by the Process Rule, for DOE and stakeholders to evaluate the impact of these modifications on the efficiency ratings of commercial water heaters covered by the DOE appliance regulations. While we recognize the DOE extended the comment deadline for this Proposed Rule by fourteen calendar days, that is insufficient time to assess the impacts of the SNOPR on the current Proposal.

[79] *Energy Conservation Program: Test Procedure for Consumer Water Heaters and Residential-Duty Commercial Water Heaters*, 87 Fed. Reg. 42270 (July 14, 2022).

4. NASEM Recommendations

Additionally, it is important that DOE implement the recommendations from the recent National Academies of Sciences, Engineering, and Medicine ("NASEM report")[80] into all its appliance rulemakings, whether for test procedures or energy conservation standards. The NASEM report comprehensively evaluated the agency's appliance rulemaking process and identified several key areas in which DOE can improve its rulemaking process. Several of these recommendations align with suggestions the Commenters have made over the years regarding economic modeling and data availability that would greatly help all stakeholders better understand the agency's process and ensure that DOE is making its decisions on the most appropriate data and models. Some of the most pertinent recommendations include:

> **Recommendation 2-2:** DOE should pay greater attention to the justification for the standards, as required by executive orders and the EPCA requirement that standards be economically justified. DOE should attempt to find significant failures of private markets or irrational behavior by consumers in the no-standards case and should consider such a finding as being necessary to conclude that standards are economically justified.
>
> In a crucial shortcoming of the DOE proposal, it does not provide specific arguments of market failure or even qualitative estimates of their magnitude in distorting rational economic behavior.
>
> **Recommendation 3-5:** DOE should expand the Cost Analysis segment of the Engineering Analysis to include ranges of costs, patterns of consumption, diversity factors, energy peak demand, and variance regarding environmental factors.
>
> Specific to this recommendation, DOE inadequately considers the diversity of markets and associated energy use patterns of consumers of commercial water heating equipment.
>
> **Recommendation 4-1:** DOE should put greater weight on ex post and market-based evidence of markups to project a more realistic range of likely effects of a standard on prices, including the possibility that prices may fall. This would improve future analyses.
>
> DOE has neither addressed this recommendation nor proposed appropriate follow up measures to assess errors in its rulemaking assumptions.
>
> **Recommendation 4-13:** DOE should place greater emphasis on providing an argument for the plausibility and magnitude of any market failure related to the energy efficiency gap in its analyses. For some commercial goods in particular, there should be a presumption

[80] *Review of Methods Used by the U.S. Department of Energy in Setting Appliance and Equipment Standards*, NASEM (2021), available at https://www.nap.edu/read/25992/chapter/1.

that the market actors behave rationally, unless DOE can provide evidence or argument to the contrary.

In a crucial shortcoming of the DOE proposal, it does not provide specific arguments of market failure or even qualitative estimates of their magnitude in distorting rational economic behavior.

Recommendation 4-14: DOE should give greater attention to a broader set of potential market failures on the supply side, including not just how standards might reduce the number of competing firms, but also how they might impact price discrimination, technological diffusion, and collusion.

Beyond market failure impacts, DOE does not adequately assess competitive dynamics on manufacturers and suppliers meeting the definition of small businesses, which may be extraordinarily vulnerable when having to meet over-reaching minimum efficiency standards.

5. Fuel Switching

DOE is proposing a standard that will cause entities to switch from natural gas water heaters 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 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.[81] DOE should not force fuel switching without pointing to clear language in EPCA that authorizes the agency to do so.[82] Commenters urge DOE to not use standards to promote electrification. EPCA does not permit standards for natural gas water heaters that would drive entities to switch to a different fuel.

6. Duty to Respond

In these comments, the Commenters have raised a number of issues regarding faulty assumptions, unsupported data and assumptions, and other critical flaws with the proposal. As noted above, EPCA imposes a heightened standard on DOE. DOE must support the proposed rule with clear and convincing evidence. And where, like here, the Commenters have raised concerns about crucial parts of DOE's analysis, DOE must respond to those concerns with "a cogent and reasoned response" that itself is supported by clear and convincing evidence.[83] Several of the concerns raised here have permeated multiple efforts by DOE to address efficiency standards for commercial water heaters, including DOE's modeling assumptions, approach to consumer choice and economics, assumptions regarding installation costs, and

[81] 42 U.S.C. § 6295(o)(2)(A).
[82] *West Virginia v. Env't Prot. Agency*, 142 S. Ct. 2587 (2022).
[83] *See APGA v. DOE*, 22 F.4th at 1027-28.

others. Commenters note that failure to provide a reasoned, evidence-based response to these comments will render any final rule vulnerable to challenge.

F. Conclusion

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

Respectfully submitted,

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Enclosures – Attachments A to F.