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6450-01-P

DEPARTMENT OF ENERGY

10 CFR Part 460

EERE-2009-BT-BC-0021

RIN 1904-AC11

Energy Conservation Program: Energy Conservation Standards for Manufactured Housing

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Final rule.

SUMMARY: The U.S. Department of Energy ("DOE" or "the Department") is publishing a final rule to establish energy conservation standards for manufactured housing pursuant to the Energy Independence and Security Act of 2007. This document presents standards based on the 2021 version of the International Energy Conservation Code ("IECC") and comments received during interagency consultation with the U.S. Department of Housing and Urban Development, as well as from stakeholders. The adopted standards would provide a set of "tiered" standards based on size that would apply the 2021 IECC-based standards to manufactured homes, except that single-section manufactured homes would be subject to less stringent building thermal envelope requirements compared to multi-section manufactured homes.

DATES: The effective date of this rule is **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**. Compliance with the adopted standards established for manufactured housing in this final rule is required on and after

[**INSERT DATE 1 YEAR AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***].

The incorporation by reference of certain publications listed in this rule is approved by the Director of the Federal Register on **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*].**

FOR FURTHER INFORMATION CONTACT: Mr. John Cymbalsky, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program (EE-2J), 1000 Independence Avenue, S.W., Washington, DC, 20585; Telephone: 202-287-1692; Email: *appliancestandardsquestions@ee.doe.gov*.

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SUPPLEMENTARY INFORMATION: This final rule incorporates by reference into 10 CFR part 460 the following industry standards:

ANSI/ACCA 2 Manual J–2016 (ver 2.50) ("ACCA Manual J"), Manual J - Residential Load Calculations, Eight Edition, Version 2.50, Copyright 2016.

ANSI/ACCA 3 Manual S–2014 ("ACCA Manual S"), Manual S - Residential Equipment Selection, Second Edition, Version 1.00, Copyright 2014.

Copies of Manual J and Manual S may be purchased from Air Conditioning Contractors of America Inc., (ACCA), 2800 S. Shirlington Road, Suite 300, Arlington, VA 22206, Telephone: 703-575-4477. *www.acca.org*/.

HUD User No. 0005945, Overall U-Values and Heating/Cooling Loads–Manufactured Homes, February 1992.

A copy of Overall *U*-Values and Heating/Cooling Loads–Manufactured Homes may be purchased from HUD User, 11491 Sunset Hills Road, Reston, VA 20190-5254 or *www.huduser.org/portal/publications/manufhsg/uvalue.html*. Telephone: 800-245-2691.

See section V.M of this document for further discussion of these standards.

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I. Summary of the Final Rule

The Energy Independence and Security Act of 2007 ("EISA," Pub. L. 110-140) directs the U.S. Department of Energy ("DOE" or in context, "the Department") to establish energy conservation standards for manufactured housing ("MH").[1] (42 U.S.C. 17071) Manufactured homes are constructed according to a code administered by the U.S. Department of Housing and Urban Development ("HUD Code"). 24 CFR part 3280. See also generally 42 U.S.C. 5401-5426. Structures, such as site-built and modular homes that are constructed to the state, local or regional building codes are excluded from the coverage of the HUD Code.[2]

EISA directs DOE to base the standards on the most recent version of the International Energy Conservation Code ("IECC") and any supplements to that document, except in cases where DOE finds that the IECC is not cost-effective or where a more stringent standard would be more cost-effective, based on the impact of the IECC on the purchase price of manufactured housing and on total life-cycle construction and

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[1] The National Manufactured Housing Construction and Safety Standards Act of 1974, as amended, defines "manufactured home" as "a structure, transportable in one or more sections, which in the traveling mode is 8 body feet or more in width or 40 body feet or more in length or which when erected on-site is 320 or more square feet, and which is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air-conditioning, and electrical systems contained therein; except that such term shall include any structure that meets all the requirements of this paragraph except the size requirements and with respect to which the manufacturer voluntarily files a certification required by the Secretary [pursuant to 24 CFR 3282.13] and complies with the standards established under this title [24 CFR part 3280]; and except that such term shall not include any self-propelled recreational vehicle." 42 U.S.C. 5402(6).
[2] *See* 42 U.S.C. 5403(f). See also 24 CFR 3282.12.

operating costs. (See 42 U.S.C. 17071(b)(1)) Standards shall be established after notice and an opportunity to comment by manufacturers of manufactured housing and other interested parties, and consultation with the Secretary of Housing and Urban Development ("HUD"), who may seek further counsel from the Manufactured Housing Consensus Committee. (42 U.S.C. 17071(a)(2)) The energy conservation standards established by DOE may: (1) take into consideration the design and factory construction techniques of manufactured homes, (2) be based on the climate zones established by HUD rather than the climate zones of the IECC, and (3) provide for alternative practices that result in net estimated energy consumption equal to or less than the specified standards. (42 U.S.C. 17071(b)(2)).

On June 17, 2016, DOE published in the *Federal Register* a notice of proposed rulemaking ("NOPR"), including proposals recommended by the negotiated rulemaking working group for manufactured housing. 81 FR 39756 ("June 2016 NOPR"). DOE also issued a comprehensive technical support document. *See* Document ID EERE-2009-BT-BC-0021-0136.[3] The agency also issued for public review and comment a draft Environmental Assessment ("EA") pursuant to the National Environmental Policy Act. In conjunction with the draft EA, DOE issued a request for information that would help it analyze potential impacts of the proposed standards on the indoor air quality of manufactured homes. *See* Draft Environmental Assessment for Notice of Proposed Rulemaking, "Energy Conservation Standards for Manufactured Housing" With Request

[3] Available at: *www.regulations.gov/document?D=EERE-2009-BT-BC-0021-0136*.

for Information on Impacts to Indoor Air Quality, 81 FR 42576 (June 30, 2016) ("2016 EA-RFI"). DOE received nearly 50 comments on the proposed rule during the comment period. In addition, DOE also received over 700 substantively similar form letters from individuals. DOE also received 7 comments to the 2016 EA-RFI during its comment period.

During DOE's interagency consultation with HUD, HUD expressed concerns about the adverse impacts on manufactured housing affordability that would likely follow if DOE were to adopt the approach laid out in its June 2016 NOPR. A variety of commenters also expressed concerns over the potentially negative impacts on the affordability of manufactured housing flowing from increased consumer costs resulting from DOE's approach in the June 2016 NOPR. In December 2017, the Sierra Club filed a suit against DOE in the U.S. District Court for the District of Columbia, alleging that DOE had failed to meet its statutory deadlines for establishing energy efficiency standards for manufactured housing. On August 3, 2018, DOE published a Notice of Data Availability ("NODA"). 83 FR 38073 ("August 2018 NODA"). In the August 2018 NODA, DOE stated it was examining a number of possible alternatives to those proposed in the June 2016 NOPR on which it sought further input from the public, including the first-time costs related to the purchase of these homes. In November 2019, the court in the above-referenced litigation entered a consent decree in which DOE agreed to complete the rulemaking by stipulated dates.

After evaluating the comments received in response to the June 2016 NOPR and the August 2018 NODA, DOE published a supplemental NOPR ("SNOPR") on August 26, 2021, in which DOE proposed energy conservation standards for manufactured homes based on the 2021 IECC. 86 FR 47744 ("August 2021 SNOPR"). In the August 2021 SNOPR, DOE also proposed that the standards would be based on the current HUD zones. DOE's primary proposal in the August 2021 SNOPR was a "tiered" approach, based on the 2021 IECC, wherein a subset of the energy conservation standards (based on retail list price) would be less stringent for certain manufactured homes in light of the cost-effectiveness considerations required by statute. DOE's alternate proposal was an "untiered" approach, wherein energy conservation standards for all manufactured homes would be based on certain thermal envelope components and specifications of the 2021 IECC. Both proposals replaced the June 2016 NOPR proposal. *Id.* DOE sought comment on these proposals, as well as alternate thresholds, including a size-based threshold (*e.g.*, square footage, number of sections) and a region-based threshold, and alternative exterior wall insulation requirements (R-21) for certain HUD zones. *Id.*

On October 26, 2021, DOE published a NODA regarding updated inputs and results of corresponding analyses presented in the August 2021 SNOPR (both tiered and untiered approaches), including a sensitivity analysis regarding an alternate sized based tier threshold and an alternate exterior wall insulation requirement (R-21) for certain HUD zones. 86 FR 59042 ("October 2021 NODA") In addition, DOE reopened the public comment period on the August 2021 SNOPR through November 26, 2021. DOE explained that it would consider the updated inputs and corresponding analyses, as well

as comments on the inputs and analyses, as part of the rulemaking. In addition, DOE stated it may further revise the analysis presented in this rulemaking based on any new or updated information or data it obtains and encouraged stakeholders to provide any additional data or information that may inform the analysis. *Id*

On January 14, 2022, DOE published a draft environmental impact statement ("DEIS") for proposed energy conservation standards for manufactured housing (DOE/EIS-0550D). (87 FR 2359) ("January 2022 DEIS") DOE prepared the January 2022 DEIS in support of the August 2021 SNOPR and October 2021 NODA.

DOE invited input on the January 2022 DEIS for 45 days (through February 28, 2022). In January 2022, DOE held two public meetings for the DEIS and invited oral comments. Upon issuance of the January 2022 DEIS, DOE reopened the public comment period on the SNOPR through February 28, 2022, to invite public comments under the rulemaking process on how the January 2022 DEIS should inform the final energy conservation standards. January 14, 2022 (87 FR 2359) Relevant comments on the January 2022 DEIS and those submitted in the concurrent comment period for the SNOPR were considered by DOE in preparing the final Environmental Impact Statement ("FEIS"), to help inform DOE's decision-making process for establishing energy

conservation standards for manufactured housing. The Notice of Availability for the FEIS (DOE/EIS-0550) was published on April 8, 2022.[4] (87 FR 20852).

In this final rule, DOE codifies the energy conservation standards in a new part of the Code of Federal Regulations ("CFR") under 10 CFR part 460, subparts A, B, and C. Subpart A presents generally the scope of the rule and provides definitions of key terms. Subpart B would establish new requirements for manufactured homes that relate to climate zones, the building thermal envelope, air sealing, and installation of insulation, based on certain provisions of the 2021 IECC. Subpart C would establish new requirements based on the 2021 IECC related to duct sealing, heating, ventilation, and air conditioning ("HVAC"); service hot water systems; mechanical ventilation fan efficacy; and heating and cooling equipment sizing.

Under the energy conservation standards, the stringency of the requirements under subpart B would depend on the size of the manufactured home for the tiered approach. Accordingly, two sets of standards would be established in subpart B (i.e., Tier 1 and Tier 2). Both Tier 1 and Tier 2 incorporate building thermal envelope measures based on certain thermal envelope components subject to the 2021 IECC that DOE, over the course of this rulemaking, determined applicable and appropriate for manufactured homes. Tier 1 applies these building thermal envelope provisions to single-section manufactured homes, but, for the reasons discussed in section III of this document, only

[4] The draft and final EIS documents are available at *www.ecs-mh.evs.anl.gov/.*

includes components at stringencies that would increase the incremental purchase price by less than $750. Tier 2 applies these same building thermal envelope provisions to multi-section manufactured homes but at higher stringencies specified for site built homes in the 2021 IECC, with alternate exterior wall insulation requirement (R-21) for climate zones 2 and 3 based on consideration of the design and factory construction techniques of manufactured homes, as presented in the August 2021 SNOPR and October 2021 NODA. Further, the energy conservation standards for both tiers also include duct and air sealing, insulation installation, HVAC and service hot water system specifications, mechanical ventilation fan efficacy, and heating and cooling equipment sizing provisions, based on the 2021 IECC.

DOE is adopting a compliance date such that the standards would apply to manufactured homes starting one year after the publication date of the final rule in the *Federal Register*. As discussed in sections I.F and III.A of this document, DOE has concluded that this approach is cost-effective based on the expected total life-cycle cost ("LCC") savings for the lifetime of the home associated with implementation of the energy conservation standards.

A. Benefits and Costs to Purchasers of Manufactured Housing

As explained in greater detail in section IV.A of this document and in chapter 9 of the final rule technical support document ("TSD"), DOE estimates that benefits to manufactured home homeowners -- in terms of LCC savings -- of the requirements outweighs the potential increase in purchase price for manufactured homes.

Table I.1 and Table I.2 present the average purchase price increase of a manufactured home as a result of the energy conservation standards. This does not include any potential testing or compliance costs.

Table I.1 National Average Manufactured Housing Purchase Price (and Percentage) Increases under Tier 1 Standard (2020$)

	Single-Section	
	$	***%***
Climate Zone 1	$627	1.1%
Climate Zone 2	$627	1.1%
Climate Zone 3	$719	1.3%
National Average	**$660**	**1.2%**

Table I.2 National Average Manufactured Housing Purchase Price (and Percentage) Increases under Tier 2 Standard (2020$)

	Multi-Section	
	$	***%***
Climate Zone 1	$4,131	3.8%
Climate Zone 2	$4,438	4.1%
Climate Zone 3	$4,111	3.8%
National Average	**$4,222**	**3.9%**

Table I.3 presents the estimated national average LCC savings and energy savings for the compliance year that a manufactured homeowner would experience under the standards compared to a manufactured home constructed in accordance with the minimum requirements of existing HUD Manufactured Home Construction and Safety Standards ("HUD Code") at 24 CFR part 3280 *et. seq*. Table I.3 and Figure I.1 present the nationwide average simple payback periods (purchase price increase divided by first year energy cost savings). The methods and information used for these analyses are discussed more in section IV.A. of this document.

Table I.3 National Average Per-Home Cost Savings*

	Tier 1 Standard	Tier 2 Standard
Lifecycle Cost Savings (30-Year Lifetime)	$1,594	$3,573
Lifecycle Cost Savings (10-Year Lifetime)	$720	$743
Annual Energy Cost Savings in 2020$	$177	$475
Simple Payback Period (Years)	3.7	8.9

* negative values in parenthesis.

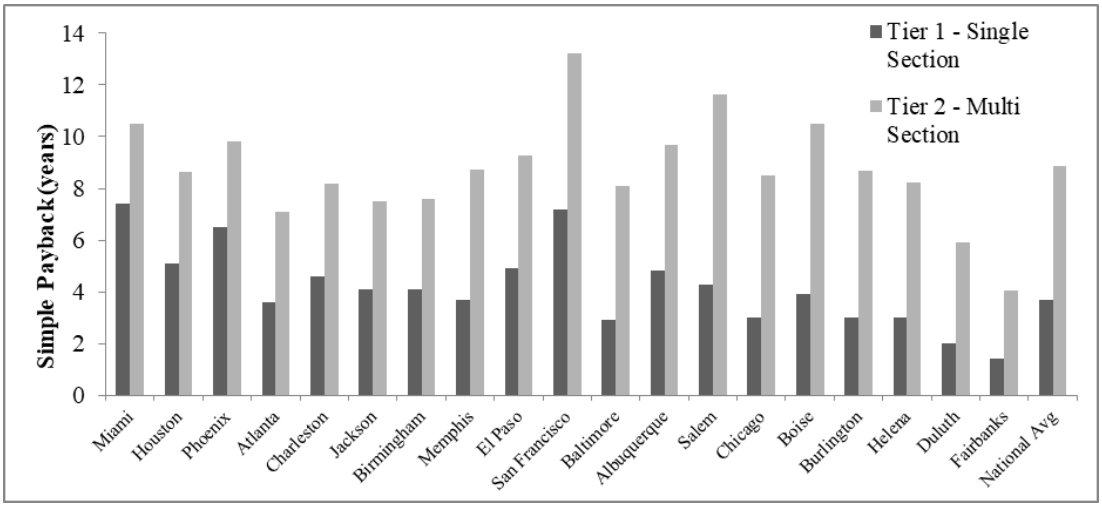

Figure I.1: Simple Payback Period of the Standard

B. Impact on Manufacturers

As discussed in more detail in section IV.B of this document and chapter 12 of the final rule TSD, the industry net present value ("INPV") is the sum of the discounted cash flows to the industry from the reference year (2022) through the end of the analysis period (2052). Using a real discount rate of 9.2 percent, as discussed in section IV.B.2 of this document, DOE estimates the INPV under a no-regulatory-action alternative, which would maintain energy conservation requirements at the levels established in the existing HUD Code, to be $15.0 billion. Under the updated standard, the change in INPV would

range from -1.4 percent to 1.3 percent. Industry would incur total conversion costs of $29.5 million. Conversion costs are one-time investments, as described in section IV.B.1 of this section.

C. Nationwide Impacts

As described in more detail in section IV.C of this document and chapter 11 of the final rule TSD, DOE's national impact analysis ("NIA") projects a net benefit to the nation as a whole under the standard, in terms of national energy savings ("NES") and the net present value ("NPV") of expected total manufactured homeowner costs and savings compared with the baseline. In this case, the baseline is manufactured homes built to the minimum standards established in the HUD Code. As part of its NIA, DOE has projected the energy savings, operating cost savings, incremental costs, and NPV of manufactured homeowner benefits for manufactured homes sold in a 30-year period from the compliance year of 2023 through 2052. The NIA builds off the LCC analysis by aggregating results for all affected shipments over a 30-year period. All NES and percentage energy savings calculations are relative to a no-regulatory-action alternative, which would maintain energy conservation requirements at the levels established in the existing HUD Code.

Table I.4 illustrates the cumulative NES over the 30-year analysis period under the standards on a full-fuel-cycle ("FFC") energy savings basis. FFC energy savings apply a factor to account for losses associated with generation, transmission, and distribution of electricity, and the energy consumed in extracting, processing, and transporting or distributing primary fuels. NES differ among the different climate zones

because of varying energy conservation requirements and varying shipment projections in each climate zone. All NES and percentage energy savings calculations are relative to a no-regulatory-action alternative, which as discussed would maintain energy conservation requirements at the levels established in the existing HUD Code. DOE estimates that under the updated standards, 1.88 quads of FFC energy would be saved relative to the baseline over the 30-year analysis period.

Table I.4 Cumulative Full-Fuel-Cycle National Energy Savings of Manufactured Homes Purchased 2023–2052 with a 30-Year Lifetime

	Single-Section quadrillion Btu (quads)	Multi-Section (quads)	Total (quads)
Climate Zone 1	0.123	0.542	0.665
Climate Zone 2	0.100	0.463	0.563
Climate Zone 3	0.239	0.408	0.648
Total	**0.462**	**1.414**	**1.876**

Table I.5 and Table I.6 illustrate the NPV of consumer benefits over the 30-year analysis period for a discount rate of 7 percent and 3 percent, respectively, the percentages are used in accordance with Office of Management and Budget guidance, as discussed in section IV.A.1.d of this document. The NPV of consumer benefits differ among the three climate zones because of differing initial costs and corresponding operating cost savings, as well as differing shipment projections in each climate zone.

Table I.5 Net Present Value of Consumer Benefits for Manufactured Homes Purchased 2023-2052 with a 30-Year Lifetime at a 7% Discount Rate

	Single-Section ***billion 2020$***	**Multi-Section** ***billion 2020$***	**Total** ***billion 2020$***
Climate Zone 1	$0.15	$0.31	$0.46
Climate Zone 2	$0.13	$0.20	$0.33
Climate Zone 3	$0.40	$0.32	$0.73
Total	**$0.68**	**$0.84**	**$1.52**

Table I.6 Net Present Value of Consumer Benefits for Manufactured Homes Purchased 2023-2052 with a 30-Year Lifetime at a 3% Discount Rate

	Single-Section ***billion 2020$***	**Multi-Section** ***billion 2020$***	**Total** ***billion 2020$***
Climate Zone 1	$0.40	$1.17	$1.58
Climate Zone 2	$0.35	$0.89	$1.24
Climate Zone 3	$1.10	$1.15	$2.25
Total	**$1.85**	**$3.21**	**$5.06**

D. Nationwide Energy Savings and Emissions Benefits

As discussed in section IV.C of this document and in the NIA included in chapter 11 of the final rule TSD, DOE's analyses indicate that the standards would reduce overall demand for energy in manufactured homes and other unquantified energy security benefits. Further, the standards would produce environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with electricity production.

DOE estimates reductions in emissions of six pollutants associated with energy savings: carbon dioxide (CO_2), mercury (Hg), nitric oxide and nitrogen dioxide (NO_X), sulfur dioxide (SO_2), methane (CH_4), and nitrous oxide (N_2O). These emissions reductions are referred to as "site" emissions reductions. Furthermore, DOE estimates reductions in emissions associated with the production of these fuels (including

extracting, processing, and transporting these fuels to power plants or manufactured homes). These emissions reductions are referred to as "upstream" emissions reductions. Together, site emissions reductions and upstream emissions reductions account for the FFC.

Table I.7 lists the emissions reductions under the rule for both single-section and multi-section manufactured homes. (In this table and elsewhere in this document, the "E" format notes a multiplier of a power of ten, e.g., "2.92E-02" means 2.9 x 10^{-02}, which is 0.029.)

Table I.7 Emissions Reductions Associated with Electricity Production for Manufactured Homes Purchased 2023-2052 with a 30-Year Lifetime

Pollutant	Single-Section	Multi-Section	Total
Site Emissions Reductions			
CO_2 (million metric tons)	19.5	53.8	73.3
Hg (metric tons)	2.92E-02	9.60E-02	1.25E-01
NO_X (thousand metric tons)	10.9	26.6	37.5
SO_2 (thousand metric tons)	7.2	20.4	27.6
CH_4 (thousand metric tons)	1.03	3.11	4.14
N_2O (thousand metric tons)	0.21	0.57	0.78
Upstream Emissions Reductions			
CO_2 (million metric tons)	2.01	5.05	7.06
Hg (metric tons)	1.48E-04	4.45E-04	5.93E-04
NO_X (thousand metric tons)	25.4	64.8	90.2
SO_2 (thousand metric tons)	0.21	0.47	0.67
CH_4 (thousand metric tons)	127	354	481
N_2O (thousand metric tons)	0.011	0.026	0.037
Total Emissions Reductions			
CO_2 (million metric tons)	21.5	58.9	80.4
Hg (metric tons)	2.93E-02	9.64E-02	0.13
NO_X (thousand metric tons)	36.3	91.4	127.7
SO_2 (thousand metric tons)	7.44	20.9	28.3
CH_4 (thousand metric tons)	128	357	485
N_2O (thousand metric tons)	0.23	0.59	0.82

DOE estimates the value of climate benefits from a reduction in greenhouse gases using four different estimates of the social cost of CO_2 (SC-CO_2), the social cost of

methane (SC-CH_4), and the social cost of nitrous oxide (SC-N_2O). Together these represent the social cost of greenhouse gases (SC-GHG). DOE used interim SC-GHG values developed by an Interagency Working Group on the Social Cost of Greenhouse Gases (IWG).[5] The derivation of these values is discussed in section IV.D of this document. For presentational purposes, the climate benefits associated with the average SC-GHG at a 3-percent discount rate are estimated to be $3.3 billion. DOE does not have a single central SC-GHG point estimate and it emphasizes the importance and value of considering the benefits calculated using all four SC-GHG estimates.[6] DOE estimated the monetary health benefits of NO_X and SO_2 emission reduction, also discussed in section IV.D of this document. Table I.8 provides the NPV of monetized climate and health benefits from reduction in emissions.

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[5] See Interagency Working Group on Social Cost of Greenhouse Gases, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide. Interim Estimates Under Executive Order 13990, Washington, D.C., February 2021. Available at: *www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf* (last accessed March 17, 2022).

[6] On March 16, 2022, the Fifth Circuit Court of Appeals (No. 22-30087) granted the federal government's emergency motion for stay pending appeal of the February 11, 2022, preliminary injunction issued in *Louisiana v. Biden*, No. 21-cv-1074-JDC-KK (W.D. La.). As a result of the Fifth Circuit's order, the preliminary injunction is no longer in effect, pending resolution of the federal government's appeal of that injunction or a further court order. Among other things, the preliminary injunction enjoined the defendants in that case from "adopting, employing, treating as binding, or relying upon" the interim estimates of the social cost of greenhouse gases—which were issued by the Interagency Working Group on the Social Cost of Greenhouse Gases on February 26, 2021—to monetize the benefits of reducing greenhouse gas emissions. In the absence of further intervening court orders, DOE will revert to its approach prior to the injunction and presents monetized benefits where appropriate and permissible under law.

Table I.8 Net Present Value of Monetized Climate and Health Benefits from Emissions Reductions

	Discount Rate %	Net Present Value *million 2020$*	
Monetary Benefits*		**Single-Section**	**Multi-Section**
Climate Benefits**	3	881.3	2,425.9
Health Benefits†	3	1,503.5	4,088.2
	7	508.1	1,386.3

* Monetized values do not include other important unquantified effects, including certain climate benefits and certain air quality benefits from the reduction of toxic air pollutants and other emissions

** Climate benefits are calculated using four different estimates of the social cost of carbon (SC-CO2), methane (SC-CH4), and nitrous oxide (SC-N2O) (model average at 2.5 percent, 3 percent, and 5 percent discount rates; 95th percentile at 3 percent discount rate), as in Table IV.22 through Table IV.24. Together these represent the global SC-GHG. For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown, but the Department does not have a single central SC-GHG point estimate. See section IV.D of this document for more details. On March 16, 2022, the Fifth Circuit Court of Appeals (No. 22-30087) granted the federal government's emergency motion for stay pending appeal of the February 11, 2022, preliminary injunction issued in *Louisiana v. Biden*, No. 21-cv-1074-JDC-KK (W.D. La.). As a result of the Fifth Circuit's order, the preliminary injunction is no longer in effect, pending resolution of the federal government's appeal of that injunction or a further court order. Among other things, the preliminary injunction enjoined the defendants in that case from "adopting, employing, treating as binding, or relying upon" the interim estimates of the social cost of greenhouse gases—which were issued by the Interagency Working Group on the Social Cost of Greenhouse Gases on February 26, 2021—to monetize the benefits of reducing greenhouse gas emissions. In the absence of further intervening court orders, DOE will revert to its approach prior to the injunction and presents monetized benefits where appropriate and permissible under law.

† Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for NO_x and SO_2) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. See section IV.D.2 of this document for more details.

E. Total Benefits and Costs

Table I.9 summarizes the monetized benefits and costs expected to result from the amended standards for manufactured homes. There are other important unquantified effects, including certain unquantified climate benefits, unquantified public health benefits from the reduction of toxic air pollutants and other emissions, unquantified energy security benefits, and distributional effects, among others.

Table I.9 Summary of Monetized Benefits and Costs to the Nation under the Adopted Standards

	Net Present Value *billion $2020*
3% discount rate	
Consumer Operating Cost Savings	10.2
Climate Benefits*	3.3
Health Benefits**	5.6
Total Benefits	19.1
Consumer Incremental Product Costs†	5.1
Net Benefits	**14.0**
7% discount rate	
Consumer Operating Cost Savings	3.9
Climate Benefits*	3.3
Health Benefits**	1.9
Total Benefits†	9.1
Consumer Incremental Product Costs††	2.4
Net Benefits	**6.7**

Note: This table presents the costs and benefits associated with manufactured housing shipped in 2023−2052. These results include benefits to consumers which accrue after 2052 from the products shipped in 2023−2052.

* Climate benefits are calculated using four different estimates of the social cost of carbon (SC-CO2), methane (SC-CH4), and nitrous oxide (SC-N2O) (model average at 2.5 percent, 3 percent, and 5 percent discount rates; 95th percentile at 3 percent discount rate), as shown in Table IV.22 through Table IV.24. Together these represent the global SC-GHG. For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown, but the Department does not have a single central SC-GHG point estimate. See section. IV.D of this document for more details. On March 16, 2022, the Fifth Circuit Court of Appeals (No. 22-30087) granted the federal government's emergency motion for stay pending appeal of the February 11, 2022, preliminary injunction issued in *Louisiana v. Biden*, No. 21-cv-1074-JDC-KK (W.D. La.). As a result of the Fifth Circuit's order, the preliminary injunction is no longer in effect, pending resolution of the federal government's appeal of that injunction or a further court order. Among other things, the preliminary injunction enjoined the defendants in that case from "adopting, employing, treating as binding, or relying upon" the interim estimates of the social cost of greenhouse gases—which were issued by the Interagency Working Group on the Social Cost of Greenhouse Gases on February 26, 2021—to monetize the benefits of reducing greenhouse gas emissions. In the absence of further intervening court orders, DOE will revert to its approach prior to the injunction and presents monetized benefits where appropriate and permissible under law.

** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for NO_x and SO_2) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. See section IV.D.2 of this document for more details.

† Total and net benefits include those consumer, climate, and health benefits that can be quantified and monetized. For presentation purposes, total and net benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 3-percent discount rate, but the Department does not have a single central SC-GHG point estimate. DOE emphasizes the importance and value of considering the benefits calculated using all four SC-GHG estimates.

†† The incremental costs include incremental costs associated with principal and interest, mortgage and property tax for the analyzed loan types. Further discussion can be found in chapter 8 of the TSD.

The benefits and costs of the standards for manufactured housing sold in 2023–2052 can also be expressed in terms of annualized values. The monetary values for the total annualized net benefits are (1) the savings in consumer operating costs, minus (2) the increases in product installed costs, plus (3) the value of the climate and health benefits of emission reductions, all annualized.[7] The national operating cost savings are domestic private U.S. consumer monetary savings that occur as a result of purchasing the covered housing and are measured for the lifetime of manufactured housing shipped in 2023–2052. Total Benefits for both the 3-percent and 7-percent cases are presented using the average social costs with 3-percent discount rate. Estimates of SC-GHG values are presented for all four discount rates in section IV.D of this document. Table I.10 presents the total estimated monetized benefits and costs to manufactured housing homeowners associated with the standard, expressed in terms of annualized values.

[7] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2020, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur (e.g., 2020 or 2030), and then discounted the present value from each year to 2020. The calculation uses discount rates of 3 and 7 percent for all costs and benefits. Using the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year, which yields the same present value.

Table I.10 Annualized Monetized Benefits and Costs to the Nation under the Adopted Standard

	Million $2020		
	Primary Estimate	**Low-Net-Benefits Estimate**	**High-Net-Benefits Estimate**
	3% discount rate		
Consumer Operating Cost Savings	551	478	627
Climate Benefits*	169	155	180
Health Benefits**	285	263	303
Total Benefits†	1005	896	1110
Consumer Incremental Product Costs††	277	255	294
Net Benefits	**728**	**641**	**816**
	7% discount rate		
Consumer Operating Cost Savings	361	322	402
Climate Benefits*	169	155	180
Health Benefits**	153	143	161
Total Benefits†	682	620	742
Consumer Incremental Product Costs††	221	213	231
Net Benefits	**461**	**407**	**511**

Note: This table presents the costs and benefits associated with manufactured housing shipped in 2023−2052. These results include benefits to consumers which accrue after 2052 from the products shipped in 2023−2052. The Primary, Low Net Benefits, and High Net Benefits Estimates utilize projections of energy prices from the AEO2020 Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental product costs reflect a medium decline rate in the Primary Estimate, a low decline rate in the Low Net Benefits Estimate, and a high decline rate in the High Net Benefits Estimate. The methods used to derive projected price trends are explained in sections IV.A and IV.C of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.

* Climate benefits are calculated using four different estimates of the SC-GHG (see section IV.D of this document). For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown, but the Department does not have a single central SC-GHG point estimate, and it emphasizes the importance of considering the benefits calculated using all four SC-GHG estimates. On March 16, 2022, the Fifth Circuit Court of Appeals (No. 22-30087) granted the federal government's emergency motion for stay pending appeal of the February 11, 2022, preliminary injunction issued in *Louisiana v. Biden*, No. 21-cv-1074-JDC-KK (W.D. La.). As a result of the Fifth Circuit's order, the preliminary injunction is no longer in effect, pending resolution of the federal government's appeal of that injunction or a further court order. Among other things, the preliminary injunction enjoined the defendants in that case from "adopting, employing, treating as binding, or relying upon" the interim estimates of the social cost of greenhouse gases—which were issued by the Interagency Working Group on the Social Cost of Greenhouse Gases on February 26, 2021—to monetize the benefits of reducing greenhouse gas emissions. In the absence of further intervening court orders, DOE will revert to its approach prior to the injunction and presents monetized benefits where appropriate and permissible under law.

** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for NO_x and SO_2) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. See section IV.D.2 of this document for more details.

† Total benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 3-percent discount rate, but the Department does not have a single central SC-GHG point estimate.

†† The incremental costs include incremental costs associated with principal and interest, mortgage and property tax for the analyzed loan types. Further discussion can be found in chapter 8 of the TSD.

DOE's analysis of the national impacts of the standards is described in sections IV.C, IV.D, and IV.E of this document.

F. Conclusion

DOE has determined that the conservation standards in this final rule are cost-effective when evaluating the impact of the standards on the purchase price of a manufactured home and on the total life-cycle construction and operating costs. As discussed in section III.A of this document, the tiered standards adopted in this final rule provide positive average LCC savings over the life of the manufactured home (i.e., 30-years) in every city for which the standards are analyzed, as well as nationally. Additionally, DOE has also determined that the benefits to the Nation of the standards (energy savings, consumer LCC savings, positive NPV of consumer benefit, energy security, and emission reductions) outweigh the burdens (loss of INPV, LCC increases for some homeowners of manufactured housing. and price-sensitive consumers who do not purchase manufactured homes).

II. Introduction

This section addresses the legal and factual background to date regarding DOE's efforts to establish energy conservation standards for manufactured housing. By statute, DOE is obligated to set standards for manufactured housing in consultation with HUD

and to consider certain specific factors when establishing these standards. DOE is also obligated to update these standards within a prescribed period of time.

A. Authority

Section 413 of EISA directs DOE to:

- Establish standards for energy conservation in manufactured housing;
- Provide notice of, and an opportunity for comment on, the proposed standards by manufacturers of manufactured housing and other interested parties;
- Consult with the Secretary of HUD, who may seek further counsel from the Manufactured Housing Consensus Committee ("MHCC"); and
- Base the energy conservation standards on the most recent version of the IECC and any supplements to that document, except in cases where DOE finds that the IECC is not cost-effective or where a more stringent standard would be more cost-effective, based on the impact of the IECC on the purchase price of manufactured housing and on total life-cycle construction and operating costs.

  (42 U.S.C. 17071(a) and (b)(1))

Section 413 of EISA also provides that DOE may:

- Consider the design and factory construction techniques of manufactured housing;

- Base the climate zones on the climate zones established by HUD[8] rather than the climate zones under the IECC; and
- Provide for alternative practices that, while not meeting the specific standards established by DOE, result in net estimated energy consumption equal to or less than the specific energy conservation standards.

  (42 U.S.C. 17071(b)(2))

DOE is directed to update its standards not later than one year after any revision to the IECC. (42 U.S.C. 17071(b)(3)) Finally, under EISA, a manufacturer of manufactured housing that violates a provision of Part 460 "is liable to the United States for a civil penalty not exceeding 1 percent of the manufacturer's retail list price of the manufactured housing." (42 U.S.C. 17071(c))

B. Background

1. Current Standards

Section 413 of EISA requires DOE to regulate energy conservation in manufactured housing, an area of the building construction industry traditionally regulated by HUD. HUD has regulated the manufactured housing industry since 1976, when it first promulgated the HUD Code. (42 U.S.C. 5401 *et seq.*; 24 CFR part 3280 *et seq.*) The purpose of the HUD Code includes protecting the quality, durability, safety, and affordability of manufactured homes; facilitating the availability of affordable

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[8] The statute uses the term "climate zones" in reference to the HUD requirements (42 U.S.C. 17071(b)(2)(B). HUD has not established "climate zones" but has established "insulation zones." See, *U/O Value Zone Map for Manufactured Housing* at 24 CFR 3280.506. DOE understands the statutory reference to "climate zones" in this context to mean the established insulation zones at 24 CFR 3280.506.

manufactured homes and increasing homeownership for all Americans; protecting residents of manufactured homes with respect to personal injuries and the amount of insurance costs and property damages in manufactured housing; and ensuring that the public interest in, and need for, affordable manufactured housing is duly considered in all determinations relating to the Federal standards and their enforcement. (42 U.S.C. 5401(b))

The HUD Code includes requirements related to the energy conservation of manufactured homes. Specifically, Subpart F of the HUD Code, entitled "Thermal Protection," establishes requirements for U_o of the building thermal envelope. U_o is a measurement of the heat loss or gain rate through the building thermal envelope of a manufactured home; therefore, a lower U_o corresponds with a more insulated building thermal envelope. The HUD Code contains maximum requirements for the combined U_o value of walls, ceilings, floors, fenestration, and external ducts within the building thermal envelope for manufactured homes installed in different zones. 24 CFR 3280.506(a).

The HUD Code also provides an alternate pathway to compliance that allows manufacturers to construct manufactured homes that meet adjusted U_o requirements based on the installation of high-efficiency heating and cooling equipment in the manufactured home. 24 CFR 3280.508(d). Moreover, Subpart F of the HUD Code establishes requirements to reduce air leakage through the building thermal envelope. 24 CFR 3280.505.

Subpart H of the HUD Code, entitled "Heating, Cooling, and Fuel Burning Systems," establishes requirements for sealing air supply ducts and for insulating both air supply and return ducts. 24 CFR 3280.715(a). *R*-value is the measure of a building component's ability to resist heat flow (thermal resistance). A higher *R*-value represents a greater ability to resist heat flow and generally corresponds with a thicker level of insulation. The HUD Code contains no requirements for fenestration solar heat gain coefficient ("SHGC"), mechanical system piping insulation, or installation of insulation.

The statutory authority for DOE's rulemaking effort is different from the statutory authority underlying the HUD Code. EISA directs DOE to establish energy conservation standards for manufactured housing without reference to existing HUD Code requirements that also address energy conservation. However, EISA also requires DOE to consult with HUD. (42 U.S.C. 17071(a)(2)(B)) Such consultations have informed DOE in development of the regulations finalized in this document, and DOE remains cognizant of the HUD Code, as well as HUD's Congressional charge to protect the quality, durability, safety, affordability, and availability of manufactured homes. Compliance with the DOE requirements adopted in this final rule would not prevent a manufacturer from complying with the requirements, including energy conservation requirements, set forth in the HUD Code. Section III.G of this document provides a crosswalk of the energy conservation standards in this rule with the standards in the HUD Code. Moreover, as discussed further in section III, DOE considered the potential impact on manufactured home purchasers resulting from costs associated with additional energy efficiency measures.

2. The International Energy Conservation Code (IECC)

The statutory authority for this rulemaking requires DOE to base its standards on the most recent version of the IECC[9] and any supplements to that document, subject to certain exceptions and considerations. (42 U.S.C. 17071(b)(1)) The IECC is a nationally-recognized model code, developed under the auspices of and published by the International Code Council ("ICC"). Many state and local governments have adopted the IECC[10] in establishing minimum design and construction requirements for the energy efficiency of residential and commercial buildings, including site-built residential and modular homes.[11] The IECC is developed through a consensus process that seeks input from a number of relevant stakeholders and is updated on a rolling basis, with new editions of the IECC published approximately every three years. The IECC was first published in 1998, with the most recent version, the 2021 IECC, being published in January 2021.

The 2021 IECC is divided into two major sections, with provisions for both residential and commercial buildings. The manufactured housing energy conservation standards and test procedure are based on the requirements for residential buildings. The residential building requirements of the 2021 IECC, however, are not specific to manufactured housing.

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[9] The website of the IECC is *https://shop.iccsafe.org/international-codes/iecc-references.html*.
[10] The current status of the adoption of the IECC is provided at *www.energycodes.gov/status-state-energy-code-adoption*.
[11] Modular homes are generally excluded from the coverage of the National Manufactured Housing Construction and Safety Standards Act and constructed to the same state, local or regional building codes as site-built homes. *See* 42 U.S.C. 5403(f); 24 CFR 3282.12.

Chapter 4 of the residential section of the 2021 IECC sets forth specifications for residential energy efficiency, including specifications for building thermal envelope energy conservation, thermostats, duct insulation and sealing, mechanical system piping insulation, heated water circulation system, and mechanical ventilation. To the extent that the HUD Code regulates similar aspects of energy conservation as the 2021 IECC, the 2021 IECC is generally considered more stringent than the corresponding requirements in the HUD Code, given that many areas of the HUD Code have not been updated as frequently as the IECC.

DOE notes that the IECC is designed for building structures that have a permanent foundation. Manufactured housing structures, however, are not built on permanent foundations but are built on a steel chassis to enable them to be moved or towed when needed. As a result, because they present their own set of unique considerations that the IECC was not intended to address, some aspects of the IECC are unable, or highly impractical, to be applied to manufactured housing. Instead, consistent with the considerations required by EISA (e.g., 42 U.S.C. 17071(b)(2)(A)), these adopted standards utilize aspects of the IECC that are appropriate for manufactured housing as the basis for the standards, thereby accounting for the unique physical characteristics of manufactured housing.

3. Development of the Initial Proposal and Responses

Based on the 2019 American Housing Survey ("2019 AHS"), manufactured housing accounts for approximately six percent of all homes in the United States.[12] Because the purchase price of manufactured homes often is lower than similarly-sized site-built homes, manufactured homes serve as affordable housing options, particularly for lower to median income families. However, using the data from the 2019 AHS, the median energy burden (median cost of electricity, gas, fuel oil and other fuel as a percentage of median household income) is approximately 5 percent for manufactured home residents compared to 3 percent for all homes. Further, the same data suggests the per square foot utility cost for manufactured homes ($0.15 per square foot; median $178 for 1140 square feet) is higher than single-family homes ($0.14 per square foot; median $249 for 1800 square feet). As such, the energy burden as measured on a square foot basis, is significantly higher for residents of manufactured homes.

Establishing improved energy conservation requirements for manufactured homes results in the dual benefit of reducing manufactured home energy use and enabling owners of manufactured homes to experience lower utility expenses over the long-term. Improved energy conservation standards are also expected to provide nationwide benefits of reducing utility energy production levels that would in turn reduce greenhouse gas emissions and other air pollutants.

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[12] U.S Census Bureau, American Housing Survey 2019–National Summary Tables. Available at *www.census.gov/programs-surveys/ahs/data.html*.

DOE published an advance notice of proposed rulemaking ("ANOPR") to initiate the process of developing energy conservation standards for manufactured housing and to solicit information and data from industry and stakeholders.[13] *See* 75 FR 7556 (February 22, 2010). DOE also consulted with HUD in developing the requirements and in obtaining input and suggestions that would increase energy conservation in manufactured housing, while maintaining affordability. In addition to meeting with HUD on multiple occasions, DOE attended three MHCC meetings, where DOE gathered information from MHCC members. DOE also initiated discussions with members of the manufactured housing industry following the issuance of the ANOPR.[14] A summary of each meeting is available at *www.regulations.gov/docket?D=EERE-2009-BT-BC-0021*. The June 2016 NOPR provides more details on the comments received in response to the ANOPR. 81 FR 39755 (June 17, 2016)

On June 25, 2013, DOE published a request for information ("RFI") seeking information on indoor air quality, financing and related incentives, model systems of enforcement, and other studies and research relevant to DOE's effort to establish energy conservation standards for manufactured housing. 78 FR 37995 ("June 2013 RFI"). The June 2016 NOPR provides more details on the comments received on the RFI. 81 FR 39765 (June 17, 2016).

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[13] The ANOPR comments can be accessed at: *www.regulations.gov/#!docketDetail;D=EERE-2009-BT-BC-0021*.

[14] These included discussions with the Manufactured Housing Institute ("MHI") and several of its member manufacturers, the California Department of Housing and Community Development, the Georgia Manufactured Housing Division, three private-sector third-party primary inspection agencies under the HUD manufactured housing program, and one private-sector stakeholder familiar with manufactured housing.

After reviewing the comments received in response to the ANOPR, the June 2013 RFI, and other stakeholder input, DOE ultimately determined that development of proposed manufactured housing energy conservation standards would benefit from a negotiated rulemaking process. On June 13, 2014, DOE published a notice of intent to establish a negotiated rulemaking manufactured housing working group ("MH working group") to discuss and, if possible, reach consensus on a proposed rule. 79 FR 33873. On July 16, 2014, the MH working group was established under the Appliance Standards and Rulemaking Federal Advisory Committee ("ASRAC") in accordance with the Federal Advisory Committee Act and the Negotiated Rulemaking Act. 79 FR 41456; 5 U.S.C. 561-570, App. 2. The MH working group consisted of representatives of interested stakeholders with a directive to consult, as appropriate, with a range of external experts on technical issues in developing a term sheet with recommendations on the proposed rule. The MH working group consisted of 22 members, including one member from ASRAC, and one DOE representative. 79 FR 41456. The MH working group met in person during six sets of public meetings held in 2014 on August 4-5, August 21-22, September 9-10, September 22-23, October 1-2, and October 23-24. 79 FR 48097 (Aug. 15, 2014); 79 FR 59154 (Oct. 1, 2014).

On October 31, 2014, the MH working group reached consensus on energy conservation standards for manufactured housing and assembled its recommendations for DOE into a term sheet that was presented to ASRAC. Public docket EERE-2009-BT-BC-0021-0107 ("Term Sheet"). ASRAC approved the term sheet during an open meeting on

December 1, 2014, and sent it to the Secretary of Energy to develop a proposed rule.

On February 11, 2015, DOE published an RFI requesting information that would aid in determining proposed solar heat gain coefficient ("SHGC") requirements for certain climate zones. 80 FR 7550 ("February 2015 RFI"). Following preparation and submission of the term sheet by the MH working group, DOE also consulted further with HUD regarding DOE's proposed energy conservation standards. In addition to meeting with HUD, DOE prepared two presentations to discuss the proposed rule with MHCC members, which were designed to gather information on development of the proposed standards.[15]

On June 17, 2016, DOE published a NOPR for the manufactured housing energy conservation standards rulemaking. 81 FR 39755. ("June 2016 NOPR") DOE posted the NOPR analysis as well as the complete NOPR TSD on its website.[16] In response to comments on the 2013 RFI, DOE also published the 2016 EA-RFI to accompany the 2016 NOPR. The draft EA drew no conclusions regarding the potential impacts on the indoor air quality of manufactured homes as a result of implementing any final energy conservation standards for these structures. DOE held a public meeting on July 13, 2016, to present the June 2016 NOPR, which included the proposed prescriptive and performance requirements, in addition to the LCC, NIA, manufacturer impact analysis

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[15] Available at *www.regulations.gov/document?D=EERE-2009-BT-BC-0021-0069* and *www.regulations.gov/document?D=EERE-2009-BT-BC-0021-0058*.
[16] The NOPR analysis, NOPR TSD, and NOPR public meeting information are available at *www.regulations.gov* under docket number EERE-2009-BT-BC-0021.

("MIA"), and emissions analyses. DOE received a number of responses to its June 2016 NOPR. Further, in December 2017, the Sierra Club filed a suit against DOE in the U.S. District Court for the District of Columbia, alleging that DOE had failed to meet its statutory deadlines for establishing energy efficiency standards for manufactured housing. *Sierra Club v. Granholm*, No. 1:17-cv-02700-EGS (D.D.C. filed Dec. 18, 2017).

In response to concerns related to potential adverse impacts on price-sensitive, low-income purchasers of manufactured homes from the imposition of energy conservation standards on manufactured housing, DOE sought additional information from the public regarding these impacts by publishing the August 2018 NODA. *See* 83 FR 38073 (August 3, 2018). That NODA indicated that DOE had re-examined its available data and re-evaluated its approach in developing standards for manufactured housing. *See* 83 FR 38073, 38075. These discussions with HUD, along with a concern over the initial first-cost impacts that DOE's earlier proposal would have on low-income buyers, led DOE to examine a potential tiered proposal that would set varying levels of energy efficiency performance with specified increases in incremental upfront costs that would still improve the overall energy efficiency of manufactured homes. *See* 83 FR 38077. In November 2019, the court in the above-referenced litigation entered a consent decree in which DOE agreed to complete the rulemaking by stipulated dates.

On August 26, 2021, DOE published a supplemental NOPR ("SNOPR") for the manufactured housing energy conservation standards rulemaking. 86 FR 47744 ("August 2021 SNOPR"). In response to comments to the June 2016 NOPR and August 2018

NODA, DOE proposed two standards, one being the primary "tiered" proposal and the other being the alternate "untiered" proposal. DOE's primary proposal was the "tiered" approach, based on the 2021 IECC, wherein a subset of the energy conservation standards would be less stringent for certain manufactured homes in light of the cost-effectiveness considerations required by EISA. DOE's alternate proposal was the "untiered" approach, wherein energy conservation standards based on the 2021 IECC would apply to all manufactured homes without a subset of less stringent standards for certain manufactured homes. Under the tiered proposal, two sets of standards would be established in proposed 10 CFR part 460, subpart B (*i.e.,* Tier 1 and Tier 2). Tier 1 would apply to manufactured homes with a manufacturer's retail list price of $55,000 or less, and incorporate building thermal envelope measures based on certain thermal envelope components subject to the 2021 IECC, but would limit the incremental purchase price increase to an average of less than $750. Tier 2 would apply to manufactured homes with a manufacturer's retail list price above $55,000, and incorporate building thermal envelope measures based on certain thermal envelope components and specifications of the 2021 IECC (*i.e.,* the Tier 2 requirements would be the same as those under the proposed single, "untiered" set of standards). 86 FR 47744, 47746. Both proposals replaced DOE's June 2016 proposal. Additionally, DOE noted in the August 2021 SNOPR that it had considered, and was still considering, tiers based upon metrics other than manufacturer's retail list price such as size (e.g., square footage, number of sections) and regional variations, and requested feedback on the use of these other bases for the tier thresholds. *Id.* at 86 FR 47760-47761. Further, DOE also considered in the August 2021 SNOPR the impacts on the LCC savings of requiring less stringent exterior wall

insulation for Tier 2 climate zones 2 and 3 (at R-21 instead of R-20+5) to remove the continuous insulation requirement. *Id.* at 86 FR 47802-47803. DOE held a public meeting on September 28, 2021, to present the August 2021 SNOPR.

On October 26, 2021, DOE published a NODA regarding updated inputs to the August 2021 SNOPR and results of corresponding analyses, including certain sensitivity analyses. 86 FR 59042 ("October 2021 NODA") The updated inputs resulted, in part, in raising the threshold between Tiers 1 and 2 to $63,000. Also, as contemplated in the August 2021 SNOPR and based on feedback from stakeholders and HUD, the additional analyses in the NODA included analysis and impacts of a sized-based tier threshold (based on number of sections) and analyses of alternative exterior wall insulation requirements (R-21) for climate zones 2 and 3. DOE reopened the public comment period on the SNOPR through November 26, 2021, and sought comment on the updated $63,000 tier threshold, the size-based tier threshold, and alternate exterior wall insulations requirements. In response to the August 2021 SNOPR and the October 2021 NODA, DOE received public comments from a variety of stakeholders. DOE also received over 900 substantively similar mass mail campaign letters from organizations and individuals in response to the August 2021 SNOPR, and over 300 in response to the October 2021 NODA. Further, DOE also received a number of comments from individual commenters.[17] All of the comment submissions are available in the docket for this rulemaking.

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[17] DOE has not identified each and every individual commenter in the Table II.2 of this document, but has included and addressed their comments in this final rule

On January 14, 2022, DOE published the draft environmental impact statement for proposed energy conservation standards for manufactured housing (DOE/EIS-0550). 87 FR 2430 ("January 2022 DEIS") DOE prepared the January 2022 DEIS in support of the August 2021 SNOPR. The January 2022 DEIS analyzed price-based alternatives based around the $63,000 threshold for manufacturer retail list price and different wall insulation requirements. It also analyzed the alternatives based on the size of the manufactured housing (single sections and multiple sections with differences in wall insulation requirements), untiered alternatives with only differences in wall insulation requirements, and a "no action" alternative (i.e., no DOE standard). Accordingly, DOE published a notice re-opening the comment period on the rulemaking proceeding to consider how the January 2022 DEIS should inform the final energy conservation standards for manufactured housing. January 14, 2022 (87 FR 2359)

In response to the January 2022 DEIS, DOE received additional public comments from a variety of stakeholders as to how the DEIS should inform the final rule. In this final rule, DOE is only including and addressing comments as the comments relate to the energy conservation standards. As such, DOE is not including or addressing comments on the discussion and analyses presented in the January 2022 DEIS; those comments are addressed as part of the environmental impact assessment process. DOE also received over 300 substantively similar form letters from individuals in response to the January 2022 DEIS. All of the comment submissions are available in the docket for this rulemaking. The comments and DOE's responses are discussed in sections III, IV, and V

of this document.

Table II.1 presents a summary of all the written comments received for the August 2021 SNOPR, October 2021 NODA, and the January 2022 DEIS, as it relates to the energy conservation standards.

Table II.1 Summary of Written Comments*

Organization(s)	Reference in this Final Rule	Organization Type
Alliance to Save Energy, American Council for an Energy-Efficient Economy, E4TheFuture, Earth Advantage, Elevate Energy, Environmental and Energy Study Institute, Institute for Market Transformation, National Association of Energy Service Companies, National Association of State Energy Officials, Next Step Network, Natural Resources Defense Council	Joint Commenters	Efficiency organization
Adventure Homes	Adventure Homes	Manufacturer
American Chemistry Council's Foam Sheathing Committee	ACC FSC	Trade association
American Council for an Energy-Efficient Economy	ACEEE	Efficiency organization
American Homestar	American Homestar	Manufacturer
American Public Gas Association, The Aluminum Association, American Chemistry Council, American Exploration & Production Council, American Farm Bureau Federation, American Fuel & Petrochemical Manufacturers, American Gas Association, American Highway Users Alliance, American Iron and Steel Institute, American Petroleum Institute, American Public Gas Association, American Public Power Association, Associated Builders and Contractors, Associated General Contractors of America, Council of Industrial Boiler Owners, The Fertilizer Institute, Independent Petroleum Association of America, National Association of Manufacturers, National Lime Association, National Mining Association, National Rural Electric Cooperative Association, Portland Cement Association, U.S. Chamber of Commerce	APGA et. al.	Trade association
Arizona Department of Housing	ADOH	State Government
American Society of Heating, Refrigerating and Air-Conditioning Engineers	ASHRAE	Trade association

Organization(s)	Reference in this Final Rule	Organization Type
Attorneys General of NY, IL, ME, MN, NV, NJ, NM, OR, VT, WA, MA, and NY	State Attorneys General	State Government -- State Attorneys General
Blount County Habitat for Humanity	Blount County Habitat for Humanity	Non-profit
C2ES, Institute for Policy Integrity at NYU Law, Sierra Club, Union of Concerned Scientists	C2ES et. al.	Environmental Non-profit
California Energy Commission	CEC	Efficiency Organization
CASA of Oregon	CASA of Oregon	Non-profit
Cavco Industries	Cavco	Manufacturer
Champion Home Builders Inc.	Champion Home Builders	Manufacturer
Clayton Home Building Group	Clayton Homes	Manufacturer
Connecticut Manufactured Home Owners Alliance	CMHOA	Non-profit
Community Housing Partners	CHP	Affordable Housing and Community Development Non-profit
E4TheFuture	E4TheFuture	Efficiency Organization
Earthjustice & Prosperity Now	Earthjustice and Prosperity Now	Efficiency Non-profit
Fahe	Fahe	Community Development Financial Institution
Habitat for Humanity of Greater Los Angeles	Habitat for Humanity of LA	Non-profit
Idaho Manufactured Housing Association	IMHA	Non-profit/Trade association
Indiana Manufactured Housing Association/Recreation Vehicle Indiana Council	IMHA/RVIC	Trade association
International Code Council	ICC	Codes organization
Kansas Manufactured Housing Association	KMHA	Non-profit/Trade association
LifeStyle Factory Homes LLC	LifeStyle	Manufacturer
Local Initiatives Support Corporation	LISC	Non-profit
Manufactured & Modular Home Association of Minnesota	MMHA	Trade association
Manufactured Housing Association for Regulatory Reform	MHARR	Trade association
Manufactured Housing Consensus Committee	MHCC	Advisory committee
Manufactured Housing Institute	MHI	Trade association
Michigan Manufactured Housing Association	Michigan MHA	Non-profit/Trade association
Mississippi Manufactured Housing Association	Mississippi MHA	Non-profit/Trade association
Modular Lifestyles, Inc.	Modular Lifestyles	Manufacturer
National Association of Home Builders	NAHB	Trade association
National Association of State Energy Officials	NASEO	Non-profit
National Manufactured Home Owners Association	NMHOA	Non-profit
National Rural Electric Cooperative Association	NRECA	Electric cooperative
Natural Resources Defense Council	NRDC	Efficiency organization
Network for Oregon Affordable Housing	NOAH	Non-profit
New Building Institute	NBI	Non-profit
New Jersey Manufactured Housing Association	NJMHA	Trade association

Organization(s)	Reference in this Final Rule	Organization Type
New York State Energy Research and Development Authority	NYSERDA	State corporation
Next Step Network, Inc.	Next Step	Efficiency organization
North American Insulation Manufacturers Association	NAIMA	Trade association
Northwest Energy Efficiency Alliance	NEEA	Efficiency organization
Northwest Power and Conservation Council	NPCC	Interstate Compact Agency
Ohio Manufactured Homes Association	OMHA	Non-profit
Oliver Technologies Inc.	Oliver Technologies	Manufacturer
PA Department of Community and Economic Development	PA-DCED	Government
Pennsylvania Manufactured Housing Association	PMHA	Trade association
PathStone Corporation	PathStone	Not-for-profit organization
People's Self-Help Housing, Inc.	People's Self-Help Housing	Non-profit
Pleasant Valley Homes, Inc.	Pleasant Valley	Manufacturer
Redwood Energy	Redwood Energy	Designers
ReFrame Foundation	ReFrame Foundation	Non-profit
Responsible Energy Codes Alliance	RECA	Efficiency organization
Rural Community Assistance Corporation	RCAC	Non-profit
Schulte, Philip	Schulte	Individual
Skyline Champion Corporation	Skyline Champion	Manufacturer
Texas Manufactured Housing Association	TMHA	Trade association
Trellis	Trellis	Non-profit
Members of Congress of the United States (David Kustoff, Larry Bucshon, Bill Huizenga, Lance Gooden, William Timmons, Bryan Steil, Gary Palmer, Bill Johnson, Tim Walberg, Greg Pence, Ann Wagner, John Rose, French Hill, Debbie Lesko, John Joyce, H. Morgan Griffith, Barry Loudermilk, Tom Emmer, Andy Barr	Select Representatives of Congress	Government
University of Arizona and Arizona State University	University of Arizona and Arizona State	University
University of Colorado Boulder	UCB	University
University of Colorado Denver	UCD	University
University of Colorado Law School	UC Law School	University
Urban Habitat Initiatives Inc.	UHI	Sustainability Consultant
Verde	Verde	Non-profit
Vermont Energy Investment Corporation	VEIC	Efficiency organization
Vermont Law School	Vermont Law School	University
Virginia Manufactured and Modular Housing Association	VAMMHA	Trade association
West Indianapolis Development Corporation	WIDC	Trade association
Western Manufactured Housing Communities Association	WMA	Trade association
Westland Distributing	Westland	Distributor

Organization(s)	Reference in this Final Rule	Organization Type
Wisconsin Housing Alliance	WHA	Trade association
*DOE received a number of comments in response to the January 2022 DEIS that were almost identical in substance to comments submitted by the same commenters in response to the August 2021 SNOPR or October 2021 NODA. Accordingly, for the purposes of this notice, DOE is only referencing the submission ID of the first submission of comments with identical content.		

On April 8, 2022, DOE published the notice of availability for the final EIS (DOE/EIS-0550). 87 FR 20852. ("April 2022 FEIS") The final EIS includes the information presented in the January 2022 DEIS as well as further analyses developed in response to public comments on the January 2022 DEIS. Elsewhere in this issue of the *Federal Register*, DOE has issued its record of decision ("ROD") pursuant to its obligations under NEPA. The ROD finalizes DOE's considerations of the environmental impacts under the NEPA process and memorializes DOE's determinations and approach chosen consistent with this final rule. Further discussion of the final EIS, the ROD and the NEPA process may be found in section V.D. of this document.

The comments and DOE's responses are discussed in sections III, IV, and V of this document.

C. Abbreviations

The abbreviations used in this document, other than abbreviations of the names of commenters listed in Table II.1, Summary of Written Comments, are defined as follows:

ACCA: Air Conditioning Contractors of America.

ACH: Air changes per hour.

ACH_{50}: Air changes per hour at 50 Pascals pressure difference between the inside and outside of the home.

AEO: Annual Energy Outlook.

AFUE: Annual fuel utilization efficiency.

AHS: American Housing Survey.

AMI: Area median income.

ANOPR: Advance notice of proposed rulemaking.

BECP: Building Energy Codes Program.

CCE: certification, compliance, and enforcement.

CDFI: Community Development Financial Institutions.

cfm: Cubic feet per minute.

CFR: Code of Federal Regulations.

DEIS: Draft environmental impact statement.

DHP: Ductless heat pump.

DOE" or in context, "the Department: U.S. Department of Energy.

DTI: Debt-to-income ratio.

E.O.: Executive Order.

EA: Environmental Assessment.

EAP: Equity Action Plan.

EEM: Energy efficiency measure.

EGUs: Electric generating units.

EIA: U.S. Energy Information Administration (within DOE).

EIS: Environmental impact statement.

EISA: Energy Independence and Security Act of 2007.

EPA: U.S. Environmental Protection Agency.

EPCA: Energy Policy and Conservation Act.

ERI: Energy Rating Index.

ERV: Energy recovery ventilator.

FEIS: Final environmental impact statement.

FFC: Full-fuel-cycle.

FHA: Federal Housing Administration (within HUD).

FRFA: Final regulatory flexibility analysis.

GRIM: Government Regulatory Impact Model.

GSE: Government-sponsored enterprise.

HAP: Hazardous air pollutants.

HoF: ASHRAE Handbook of Fundamentals.

HRV: Heat recovery ventilator.

HSPF: Heating seasonal performance factor.

HUD Code: HUD Manufactured Home Construction and Safety Standards.

HUD: U.S. Department of Housing and Urban Development.

HVAC: Heating, ventilation, and air conditioning.

IECC: International Energy Conservation Code.

INPV: Industry net present value.

IRFA: Initial regulatory flexibility analysis.

IWG: Interagency Working Group on the Social Cost of Greenhouse Gases

LCC: Life-cycle cost.

MATS: Mercury and Air Toxics Standards.

MH: Manufactured home or manufactured housing.

MHCSS: Manufactured home construction and safety standards.

MHI: Manufactured Housing Institute.

MHS: Manufactured Housing Survey.

MIA: Manufacturer impact analysis.

NAAQS: National Ambient Air Quality Standards.

NAICS: North American Industry Classification System.

NEMS: National Energy Modeling System.

NES: National energy savings.

NIA: National impact analysis.

NODA: Notice of Data Availability.

NOPR: Notice of proposed rulemaking.

NPV: Net present value.

OIRA: Office of Information and Regulatory Affairs (within OMB).

OMB: Office of Management and Budget.

PBP: Payback period.

PITI: Principal, interest, taxes, and insurance.

$PM_{2.5}$: Fine particulate matter (with an aerodynamic equivalent diameter of 2.5 micrometers (microns)).

PUF: Public use file.

RFI: Request for information.

SBA: U.S. Small Business Administration.

SC: Social cost.

SEER: Seasonal energy efficiency ratio.

sf: Square foot or square feet.

SHGC: Solar heat gain coefficient.

SNOPR: Supplemental notice of proposed rulemaking.

TSD: Technical support document.

UMRA: Unfunded Mandates Reform Act of 1995.

U_o: Overall thermal transmittance.

III. Discussion of the Standards

A. The Basis for the Standards

EISA requires DOE to base standards for manufactured housing on the IECC. However, application of the IECC standards is also subject to a number of considerations set forth by the statute in order to ensure standards will be appropriately tailored for manufactured homes and the manufactured home market. Specifically, EISA requires that DOE establish energy conservation standards for manufactured housing that are "based on the most recent version of the [IECC], except in cases in which [DOE] finds that the [IECC] is not cost-effective, or a more stringent standard would be more cost-effective, based on the impact of the [IECC] on the purchase price and on total life-cycle construction and operating costs." (42 U.S.C. 17071(b)(1))

In addition to the required cost-effectiveness considerations, EISA explicitly allows DOE to consider the differences in design and factory construction techniques of

manufactured homes, as compared to site-built and modular homes. (42 U.S.C. 17071(b)(2)) As noted in section II.B.2, the 2021 IECC applies generally to residential buildings, including site-built and modular housing, and is not specific to manufactured housing. Additionally, EISA requires DOE to consult with HUD, which may seek further counsel from the MHCC, prior to establishing the standards. 42 U.S.C. 17071(a)(2)(B). EISA also allows DOE to base the standards on climate zones established by HUD, and to provide for alternative practices that result in net estimated energy consumption equal to or less than the specified standards. 42 U.S.C. 17071(b)(2)) As discussed more in section III.F, DOE has opted to base its standards on the climate zones established by HUD. Additionally, DOE's standards provide two methods by which to achieve compliance with the building thermal envelope requirements of Subpart B: a prescriptive pathway (which utilizes the components specified by DOE) and an overall *Uo* performance pathway (which allows for compliance based on the overall thermal performance of the manufactured home). The latter approach, i.e., the *Uo* method, gives manufacturers the flexibility to use any combination of energy efficiency measures as long as the minimum *Uo* is met. Manufacturers do not need to meet both the prescriptive and the performance method; rather they have the option to only meet one.

The energy conservation standards in this final rule are based on specifications included in the 2021 IECC while also accounting for the unique aspects of manufactured housing. DOE carefully considered the following aspects of manufactured housing design and construction in developing the standards:

- Manufactured housing structural requirements contained in the HUD Code;

- External dimensional limitations associated with transportation restrictions;
- The need to optimize interior space within manufactured homes; and
- Factory construction techniques that facilitate sealing the building thermal envelope to limit air leakage.

In DOE's view, the language Congress used in instructing DOE to set standards for these structures is broad and does not require the imposition of requirements for manufactured homes that are identical to those that IECC provides for site-built structures. The use of the phrase "based on" readily indicates that Congress anticipated that DOE would need to use its discretion in adapting elements of the IECC's provisions for manufactured housing use, including whether those elements would be appropriate in light of the specific circumstances related to the structure. Congress also provided that DOE has discretion to depart from the IECC to the extent it is not cost-effective, or a more stringent standard could be more cost-effective. Finally, Congress required DOE to consult with HUD, the primary regulator of manufactured housing, for input prior to establishing the DOE standards.

Pursuant to this discretion afforded by Congress, DOE is establishing tiered standards based on the 2021 IECC. Specifically, DOE is finalizing a tiered standard whereby single-section manufactured homes ("Tier 1" manufactured homes) would be subject to different building thermal envelope requirements (subpart B of 10 CFR part 460) than all other manufactured homes ("Tier 2" manufactured homes). Both tiers are based on the 2021 IECC in that both tiers have requirements for the building thermal

envelope, duct and air sealing, installation of insulation, HVAC specifications, service hot water systems, mechanical ventilation fan efficacy, and heating and cooling equipment sizing provisions consistent with the 2021 IECC. In light of the first-cost concerns raised during the EISA-required consultation with HUD and the MHCC, and in comments from stakeholders, Tier 1 provides tailored improvements in efficiency with regard to building thermal envelope components based on the 2021 IECC, which are projected to result in an average incremental price increase of less than $750 for single-section homes. Tier 2 focuses on the building thermal envelope, duct and air sealing, insulation installation, HVAC specifications, service hot water systems, mechanical ventilation fan efficacy, and heating and cooling equipment sizing provisions, at stringencies consistent with those for site-built homes in the 2021 IECC, and is estimated to result in an average incremental price increase of $4,100 - $4,500 for multi-section homes.

Further, with regards to the aspects of manufactured housing design and construction, DOE considered the range of efficiency measures originally identified by the MH working group as appropriate for manufactured home design, which included the following: exterior ceiling R-22 to R-38; exterior wall R-11 to R-21+5; exterior floor R-11 to R-30; window U-factor U-1.08 to U-0.30; and window SHGC 0.7 to 0.25. (See chapter 5 of the final rule TSD) Accordingly, based on the information provided by the MH working group, DOE did not include several of the 2021 IECC requirements,

including the more stringent ceiling R-value requirements (greater than R-38)[18] and requirement for the exterior ceiling insulation to be of uniform thickness or uniform density, given the space constraints of manufactured homes.

DOE determined that the energy conservation standards in this final rule are cost-effective by evaluating the impact on the purchase price of a manufactured home and on the total lifecycle construction and operating costs. Both Tier 1 and Tier 2 are cost-effective for the 30-year period that was analyzed. Specifically, section I.A presents the benefits and burdens to purchasers of manufactured homes, with Table I.1 and Table I.3 presenting the total incremental purchase price under the standards, and Table I.3 presenting the estimated national average LCC savings. The incremental purchase price was determined by calculating the difference in the energy efficiency measure ("EEM") costs of DOE-compliant and minimally compliant HUD homes. These incremental costs correspond to the purchase prices seen by the homeowner, and thus account for manufacturer and retail markups. The LCC savings accounts for the energy cost savings and purchase costs (including down payment, mortgage and taxes based on incremental purchase price) over the entire analysis period discounted to a present value. As presented in Table I.3, there are positive national average LCC savings over the life of the manufactured home (i.e., 30-years). In addition, the positive 30-year LCC savings carries through to every climate zone and city analyzed. (See Chapter 8 of the TSD for results.)

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[18] Specifically, manufactured homes typically have a lower overall height compared to site-built homes, which leads to constrained space, and therefore limited ability to increase exterior ceiling insulation.

Finally, Table I.3 presents the national average simple payback period to be 3.7 years and 8.9 years for single- and multi-section homes respectively.

As noted previously, in establishing standards for manufactured housing, Congress directed DOE to: (1) consult with the Secretary of HUD (42 U.S.C. 17071(a)(2)(b)), and (2) base the standards on the most recent version of the IECC, except in cases in which the Secretary finds that the code is not cost-effective, or a more stringent standard would be more cost-effective, based on the impact of the code on the purchase price of manufactured housing and on total life-cycle construction and operating costs. (42 U.S.C. 17071(b)(1)) Relatedly, the Secretary of HUD is mandated to establish standards for manufactured housing that, in part, "ensure that the public interest in, and need for, affordable manufactured housing is duly considered in all determinations relating to the Federal standards and their enforcement." (42 U.S.C. 5401(b))

In this consultative role, HUD raised concerns with the potential adverse impacts on manufactured housing affordability that could result from additional energy efficiency standards proposed for manufactured homes in the June 2016 NOPR and the August 2021 SNOPR. More specifically, HUD noted concerns that increases in the purchase prices for manufactured homes resulting from the costs of requiring to meet standards based upon the IECC could result in prospective manufactured homeowners being unable to purchase a manufactured home. With this concern in mind, DOE reviewed the 2021 Consumer Financial Protection Bureau report, "Manufactured-Housing Finance: New Insights from the Home Mortgage Disclosure Act Data (HMDA)," (hereinafter, "2021

CFPB Report")[19], and in the October 2021 NODA, presented updated analyses based on this report and sought comment on the report and these updates. 86 FR 59042, 59044.

DOE's review of the 2021 CFPB Report", presented the following key findings:

- Manufactured homes represent an affordable housing option for millions of Americans because they cost less on average than site-built homes and are one of the least expensive forms of housing available without government subsidies.

- Manufactured home homeowners tend to have lower incomes (median is $52,000 for manufactured home homeowners with chattel (*i.e.,* personal property) loans and $53,000 for those with mortgage loans) and less net worth than their counterparts who own site-built homes (median is $83,000);

- Borrowers who own their land can either finance their home purchase with a chattel loan or a mortgage, whereas those who do not own their land are typically only able to finance with a chattel loan.

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[19] CFPB report, 2021. https://*files.consumerfinance.gov/f/documents/cfpb_manufactured-housing-finance-new-insights-hmda_report_2021-05.pdf*

- Manufactured home loan amounts for (1) chattel loans range from $40,500 (25th percentile) to $80,785 (75th percentile), with median at $58,672; (2) mortgage loans range from $90,330 (25th percentile) to $172,812 (75th percentile), with median at $127,056. Comparatively, site-built home loan amounts range from $162,011 (25th percentile) to $342,678 (75th percentile), with median at $236,624.

- Of the manufactured housing loans acquired, the percentage of chattel loans nationally is estimated to range from 42 percent (from the 2019 HMDA, which includes new and used homes) to 76 percent (from 2019 Manufactured Housing Survey, which includes new homes only).

Compared to mortgages for site-built homes, MH mortgages tend to have smaller loan amounts, higher interest rates, fewer refinances, and less of a secondary market, patterns that are even more acute for chattel loans. Additionally, chattel loans have shorter loan terms than mortgages for either MH or site-built homes. A key reason for this difference is that the vast majority of manufactured housing stock is titled as chattel (*i.e.*, personal property), and, as a result, is eligible only for chattel financing. Chattel financing is typically offered to purchasers at a significantly higher interest rate than the rates offered to site-built homeowners. While most manufactured homeowners who also own the land on which the manufactured home is sited may be eligible for mortgage financing, there is a tradeoff between lower origination costs with significantly higher

interest rates (chattel loans) and higher origination costs with significantly lower interest rates and greater consumer protections (mortgage). 2021 CFPB, pp. 33-34.

In response to the affordability concerns raised by HUD and commenters regarding purchasers and renters who may live in these homes, and the general financial circumstances for manufactured housing occupants, DOE is finalizing a tiered standard in this final rule that would mitigate first-cost impacts for purchasers at the lower end of the manufactured home price range. To the extent that manufactured home purchasers are cost-driven, in conjunction with the lower median income and net worth of these purchasers, consumers at the lower end of the manufactured home purchase price range are generally likely to be more sensitive to increases in purchase price. DOE's considerations of affordability and cost-effectiveness in establishing these standards, and associated responses to comments, are discussed more below in sections III.A.1 and III.B.

Finally, the standards established in this final rule are based on the climate zones of the HUD Code. EISA also allows DOE to base standards on the climate zones of the HUD Code instead of the IECC. (42 U.S.C. 17071(b)(2)(B)) There are differences in the number and boundaries of the HUD zones as compared to the IECC climate zones. For example, under the 2021 IECC climate zone map, California is divided into five climate zones (including zone variation based on moisture regimes), with four of the zones subject to SHGC maximums (0.40 applicable to climate zones 4 and 5, and 0.25 applicable to climate zones 2 and 3). Under the HUD zone map, all of California is within a single zone. Developing energy conservation standards based on the HUD

zones, as permitted under EISA, necessitates deviating from the IECC. DOE has determined that aligning the climate zones between the DOE requirements and the HUD Code would reduce the complexities and burden faced by manufacturers of compliance with the DOE standards. The updated standards would establish thermal envelope requirements, as does the 2021 IECC, but setting the values for those requirements necessitates that DOE develop standard levels different than those in the 2021 IECC to account for the difference in the number of climate zones. Use of the HUD zones in DOE's standards is discussed more in section III.F.2.a. of this document.

As discussed more in sections III.C and D, DOE is not addressing a test procedure, or compliance and enforcement provisions for energy conservation standards for manufactured housing in this document. DOE notes that HUD has an established design approval, monitoring and enforcement system, defined in 24 CFR part 3282, that is robust and provides compliance and enforcement of the manufactured housing industry standards. Moreover, manufacturers must comply with referenced standards incorporated by HUD in its regulations. DOE continues to consult with HUD about pathways to address testing, compliance and enforcement for these standards in a manner that may leverage the current HUD inspection and enforcement process so that such testing, compliance and enforcement procedures are not overly burdensome or duplicative for manufacturers, and are well understood by manufacturers and consumers alike.

In response to the August 2021 SNOPR proposal and the October 2021 NODA, DOE received a number of comments regarding the statute, IECC and the rulemaking in general, which are summarized and addressed in the following sections.

1. Affordability

Multiple commenters stated that the proposed energy requirements fail the EISA statutory requirement of cost-effectiveness and the proposal will eliminate manufactured housing as an affordable housing option for families. Additionally, they commented that the proposal ignores the unique features of factory-built housing, to the point that many parts of the proposal are simply not feasible from a construction and transportation standpoint. Further, they stated that the development of the rule was not compliant in any meaningful way with the EISA requirement to consult with HUD or MHCC and does not follow an accurate cost-benefit analysis as the statute requires. (MMHA, No. 995 at p. 4); (Michigan MHA, No. 1012 at p. 2-3); (WHA, No. 1025 at p. 2); (PMHA, No. 1165 at p. 3); (Westland, No. 1263 at p. 2); (Pleasant Valley, No. 1307 at p. 2); (American Homestar, No. 1337 at p. 2-3); (Oliver Technologies, No. 1350 at p. 3); (KMHA, No. 1368 at p. 2); (Adventure Homes, No. 1383 at p. 3); (NJMHA, No. 1451 at p. 3); (WMA, No. 1452 at p. 2); (IMHA/RVIC, No. 1466 at p. 2); (Cavco, No. 1497 at p. 3); (Skyline Champion, No. 1499 at p.2); (Mississippi MHA, No. 1588 at p. 4); (Clayton Homes, No. 1589 at p. 3) The campaign form letter(s) stated that the proposed rule will eliminate a significant source of affordable housing for hundreds of thousands of American families and, in many cases, it would be simply impossible to construct and transport homes built with the requirements. Commenters stated that increased costs will never be recouped by

the homeowner, and for many buyers the increased cost will pose a barrier to homeownership in the first place. In addition, commenters stated that DOE's energy conservation standards must balance affordability with energy efficiency, which commenters alleged the proposed rule did not. (Campaign Form Letter, Multiple submissions at p. 1) An individual commenter would not support the proposed rule unless modified because of affordability issues. (Wangelin, No. 975 at p. 1) Another individual commenter stated that the cost of the new energy standards might outweigh the effects it will have on the environment because manufactured homes are made to be affordable. (Heidbreder, No. 940 at p. 1) Another individual commenter suggested that either tier would be a big upgrade from current requirements. (Major, No. 1023 at p. 1)

MHI commented that the higher home cost associated with the proposed standards will make manufactured housing far more expensive, excluding potential buyers and reducing total manufactured housing sales. MHI also commented that DOE's own analysis shows the proposal will increase costs for homebuyers without reciprocal energy savings, and many households will simply be priced out of homeownership due to this proposal. MHI's survey of manufacturers found that it is unlikely that a buyer purchasing a new home and financing 90 percent of the purchase price would recover these upfront costs at a future sale, and while there are several reasons contributing to this, the fact that homebuyers usually sell their homes within the first 7-10 years is the most relevant. (MHI, No. 1592 at p. 3, 4) Further, MHI stated that the proposal could jeopardize homeownership for millions of Americans at a time when there is an affordable housing shortage. MHI further stated that this increase will have a

disproportionate impact on minority communities, who face the most significant burden in obtaining affordable homeownership, and that this would be in direct contrast to the Administration's goal of achieving racial equity in homeownership. (MHI, No. 1592 at p. 3, 23); (Clayton Homes, No. 1589 at p. 14)

MHARR stated that it opposed the proposed standards because they are a baseless and useless burden on both moderate and lower-income consumers and will lead to a decrease in homeownership and higher levels of homelessness. (MHARR, No. 1388 at p. 2-3); (MHARR, No. 1974 at p. 2) UCB stated that the rule will eliminate affordable housing for many low-income people. They stated that although DOE says the initial cost increase will be paid back over the life of the home from energy savings, most owners will not see this payback. (UCB, No. 1405 at p. 1) An individual commenter stated that the proposed changes would very likely eliminate hundreds of thousands of buyers from the market during a time when housing is in short supply, and that, if adopted, the new energy standards would dramatically increase the cost of manufactured homes and likely eliminate many of the design features that make manufactured homes livable (high ceilings, overhead HVAC ducts, etc.). Moreover, this commenter stated that the upfront cost from higher down payments would disqualify many home buyers for a mortgage, and any future utility cost savings would take decades to recoup. (Individual Commenter, No. 1496 at p. 1)

IMHA stated that the proposal is fundamentally flawed and will eliminate manufactured housing as an affordable housing option for families throughout Idaho.

Further, they were concerned that DOE's cost analysis assumptions and the average tenure of a manufactured homeowner will result in a situation where the homeowner will never recoup the additional costs of these measures with energy savings. They stated that imposing these standards on manufactured homes built in Idaho (or elsewhere) will rob their industry of seeking out those amendments that make the energy code best fit the construction practices of a manufactured home, and that this will add to costs and complications that will certainly price homeowners out of the market. (IMHA, No. 1453 at p. 1)

NRECA commented that the proposed standards in the SNOPR could put home ownership out of reach for those who cannot afford site-built homes, thus denying them the potential opportunity to attain this milestone for themselves and their families. They stated that their members have explored and implemented many different initiatives to improve energy efficiency for their consumer-members and that they are doing so in a way that balances costs and benefits. Therefore, they urged DOE to reconsider the proposal in its SNOPR to balance affordability of manufactured housing with common-sense, proven methods at improving their energy efficiency. (NRECA, No. 1406 at p. 2) ADOH was concerned that the proposed changes will equate to a price point that is either out of reach for a potential purchaser of a manufactured home, or will eliminate or prevent a manufactured home from being an affordable housing option. ADOH recommended continued reliance on the existing standards in the National Manufactured Housing Construction and Safety Act. (ADOH, No. 1459 at p. 1)

Select Representatives of Congress were concerned that the proposed rule would require manufacturers to redesign most (if not all) of their existing floorplans to comply with standards concerning thermal systems and air and duct sealing. Select Representatives of Congress stated that this would result in a significant price increase that would delay or prevent some potential manufactured homebuyers – whose median annual household income is around $33,000 – from buying a home. They urged DOE to analyze closely the effective cost and impact of any proposed energy efficiency standards on those who are pursuing affordable homeownership. (Select Representatives of Congress, No. 1445 at p. 1)

UC Law School stated that the purchase price for manufactured homes should not factor into the cost-benefit analysis because DOE did not deliver economic considerations and integrated efforts with other agencies to secure affordability to the manufactured homes. Instead, they suggested that only the social cost of carbon and GHG emissions should be factored into the cost-benefit analysis, based on the Interagency Working Group (IWG). (UC Law School, No. 1634 at p. 11, 13, 14) UCB stated the SNOPR should consider the emissions costs associated with not implementing stricter energy efficiency standards for manufactured homes over a 30-year lifetime, which, in the commenter's view, would create a good comparison to show how much of a difference these standards would make. (UCB, No. 1618 at p. 17)

NAHB urged DOE to continue to facilitate consumer choice by ensuring any new energy conservation standards and regulatory reform efforts do not favor manufactured homes over other types of residences, leading to consumer confusion and unfair

competition in the marketplace. (NAHB, No. 1398 at p. 3) An individual commenter stated that a consumer should have the freedom to choose a less energy efficient, but less expensive, window, door, or construction method for the home they are building, and that absorbing the SNOPR proposed requirement expenditure is quite difficult. (Hoover, No. 1566 at p. 1)

In light of the concerns it noted, MHARR stated that DOE must withdraw the proposed manufactured housing energy standards as being inappropriate for MH, excessively costly in violation of applicable law, destructive of the affordable MH market, not cost-justified and fundamentally arbitrary, capricious and an abuse of discretion in violation of the federal Administrative Procedure Act, federal MH law and the EISA of 2007. (MHARR, No. 1640 at p. 9) MHARR commented that the average MH energy costs for all fuel types tracked by the U.S. Census Bureau are already lower than those for much more costly site-built homes, none of which are subject to the 2021 IECC. MHARR also stated that alleged climate benefits of the proposed standards would be miniscule in relation to the economic costs, and that newer data published in the 2019 AHS shows that manufactured homes have lower median monthly energy costs than site-built homes in all major fuel categories. MHARR also suggested that DOE should reject cost comparisons based on a "per-square foot" energy usage and should instead consider "whole-house" energy usage. (MHARR, No. 1388 at p. 3, 5-6); (MHARR, No. 1974 at pp. 5-6; 11-12)

Multiple commenters suggested that the most appropriate code to utilize to update energy standards for manufactured homes is the HUD Code, and to instead include new

energy efficiency standards as part the HUD Code. (MMHA, No. 995 at p. 4); (Michigan MHA, No. 1012 at p. 2); (WHA, No. 1025 at p. 2); (PMHA, No. 1165 at p. 3); (Westland, No. 1263 at p. 2); (Pleasant Valley, No. 1307 at p. 2); (American Homestar, No. 1337 at p. 2); (Oliver Technologies, No. 1350 at p. 2); (KMHA, No. 1368 at p. 2); (Adventure Homes, No. 1383 at p. 2); (NJMHA, No. 1451 at p. 2-3); (WMA, No. 1452 at p. 2); (IMHA/RVIC, No. 1466 at p. 2); (Cavco, No. 1497 at p. 2); (Skyline Champion, No. 1499 at p.2); (Mississippi MHA, No. 1588 at p. 2) ; (Skyline Champion, No. 1612 at p. 3); (Cavco, No. 1622 at p. 2); (VAMMHA, No. 1624 at p. 2); (Champion Home Builders, No. 1639 at p. 4); (IMHA, No. 1453 at p. 2); (MHI, No. 1592 at p. 4-6, 25) MHI believes the most appropriate code to utilize to update energy standards for manufactured homes is the HUD Code. (MHI, No. 1592 at p. 25)

Alternatively, NASEO stated that failure to update the standards in a manner consistent with EISA will only increase the difficulty of meeting future standards and unnecessarily leaves manufactured home residents with homes built to decades-old standards and high energy bills. (NASEO, No. 1565 at p. 3) Another individual commenter commented that although the rule would incur some upfront costs, there is long-term benefit in the rule related to reducing carbon emissions. (Anonymous, No. 593 at p. 1; (Anonymous, No. 781 at p. 1) Another individual commenter suggested that although the tiered system of cost implementation creates significantly more administrative responsibility, it is a more equitable and desirable means of accomplishing the aforementioned agency goals. They suggested that the proposed rule by DOE seems adequately supported by reasonable inquiries into emission reduction, energy efficiency,

and cost allocation for thermal requirements of manufactured homes. (Gustafson, No. 778 at p. 1) NAIMA supported the updates recommended as a good faith attempt of the 2021 IECC while recognizing unique construction challenges. NAIMA also stated that a home's energy efficiency and affordability is not an either/or proposition. (NAIMA, No. 1017 at p. 1) NYSERDA supported DOE's two-tier approach to address the affordability concerns. (NYSERDA, No. 1620 at p. 1)

In addition, Schulte stated that ENERGY STAR-certified homes represent a significant market share of home production especially in Zone 2 States and this fact would support that manufactured home purchasers are willing to purchase more expensive and energy efficient homes that save them money in the long run. Also, Schulte stated that there is no evidence from sales figures that enhanced thermal standards reduced the demand of manufactured homes from 1990-1999. Finally, Schulte stated that adopting Tier 1 standards would substantially reduce the price hike for additional energy investments. However, it would also mean that utility bills would remain high for many manufactured home purchasers who tend to have lower incomes than the median family income. (Schulte, No. 1028 at p. 14, 15, 18 & 22)

ACEEE suggested that the impact on affordability should consider energy burden (i.e., energy cost as a percentage of income) and housing cost burden (i.e., total housing costs as a percentage of income). In their comment and analysis, they interpreted high energy burden to be energy bills exceeding 6 percent of the income and high housing burden to be total housing costs exceeding 30 percent of the income. They stated that based on the 2019 AHS, for residents of manufactured homes, the median energy burden

(i.e., the energy cost as a percentage of income) is 5.3 percent compared to 2.9 percent for all homes, and 44 percent of manufactured home residents face a high energy burden. They stated that setting stronger efficiency standards can improve the affordability of these homes by lowering their occupants' high energy burdens. (ACEEE, No. 1631 at pp. 2-3) NRDC recommended using a more reasonable cost effectiveness metric, such as a present value analysis using a defensible discount rate, such as the 3 percent real rate that DOE employs in appliance efficiency analysis, over the observed lifetime of the home. (NRDC, No. 1599 at p. 5, 7)

Next Step commented that manufactured homes are a critical component of America's affordable housing stock, and the need for increased energy efficiency in housing is particularly acute for low-income homebuyers. (Next Step, No. 1617 at p. 1) They commented that based on the median income of manufactured home owners and renters and the HUD definitions for what constitutes "low-income,[20]" manufactured housing serves households below 60 percent median income for low-income owners and below 50 percent median income for very low-income renters.[21] (Next Step, No. 1617 at p. 2) Further, they commented that based on a 2020 Urban Institute study,[22] the monthly housing costs for manufactured home occupants falls within 30 percent of monthly

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[20] Next Step cited the following HUD program definitions: 50% median income = $33,761 = Very Low Income; 80% Median Income = $54,017 = Low Income;

[21] In their review, they stated that manufactured homes are a portfolio of housing that serves a median income of $38,087 for owners and $28,280 for renters. Based on the federal low-income housing definitions, 60 percent median income (which is a multifamily tax subsidy income limit) amounts to $40,513 (in 2020 dollars) and 50 percent median income (which is the very low income limit) amounts to $33,761.

[22] Choi, J.H., and Goodman, L. (2020, August). 22 Million Renters and Owners of Manufactured Homes Are Mostly Left Out of Pandemic Assistance. The Urban Institute. *https://www.urban.org/urban-wire/22-million-renters-and-owners-manufactured-homes-are-mostly-left-out-pandemic-assistance*.

income, which is defined as "cost-burdened" based on HUD's housing cost burden metric.[23] Accordingly, they supported increased energy efficiency standards, arguing that data suggest that the incremental costs for energy efficiency upgrades (added to other housing costs) keep manufactured housing affordable and accessible to low-income homeowners earning less than 60 percent of median income. (Next Step, No. 1617 at p. 1)

Finally, Next Step also commented that Freddie Mac's research analyzed energy efficient homes rated between 2013 and 2017 and found the following: (1) From the property value analysis, rated homes are sold for, on average, 2.7 percent more than comparable unrated homes; (2) Better-rated homes are sold for 3-5 percent more than lesser-rated homes; (3) From the loan performance analysis, the default risk of rated homes is not, on average, different from unrated homes (once borrower and underwriting characteristics are considered). Loans in the high debt-to-income ("DTI") bucket (45 percent and above) that have ratings, however, appear to have a lower delinquency rate than unrated homes. (Next Step, No. 1617 at p. 6) Further, Next Step noted Freddie Mac's GreenCHOICE program, which weighs energy efficiency into its underwriting and covers manufactured housing. *Id*

EISA directs DOE to establish energy conservation standards for manufactured housing. (42 U.S.C. 17071) Further, EISA directs that cost-effectiveness is determined

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[23] HUD defines spending more than 30 percent of income on housing costs as cost-burdened. Spending more than 50 percent of income on housing costs is considered severely cost-burdened.

based on the impact of the IECC on the purchase price of manufactured housing and on total life-cycle construction and operating costs. (42 U.S.C. 17071(a) and (b)(1))

In response to the affordability concerns raised by HUD and commenters on first cost impacts, and the general financial circumstances for manufactured housing owners, DOE is finalizing a tiered standard, based on the 2021 IECC, that would alleviate first-cost impacts for purchasers at the lower end of the manufactured home price range. Tier 1 would apply to single-section manufactured homes, and incorporate building thermal envelope measures based on certain thermal envelope components subject to the 2021 IECC and would increase the incremental purchase price increase by less than $750 for single-section homes. This lower incremental cost would allow those first-cost sensitive purchasers, assumed to be those with lower median income and net worth, to still purchase a new manufactured home with improved energy efficiency measures that will generate cost savings to the purchaser over time. Accordingly, Tier 1 limits the incremental purchase price such that a purchaser would, on average, realize a positive cash flow within Year 1 of the standard based on the down payment, incremental loan payment, and energy cost savings. See Table III.4 for results.

Tier 2 would apply to multi-section manufactured homes, and incorporate building thermal envelope measures based on certain thermal envelope components and specifications of the 2021 IECC**,** with alternate exterior wall insulation requirement (R-21) for climate zones 2 and 3 (see section III.F.2.b which includes further discussion on wall insulation). Otherwise, DOE notes that the adopted Tier 2 requirements in this final rule will only update the window U-factor requirements for all climate zones compared to

the term sheet agreed upon by the MH working group (window U-factor of 0.35 and 0.32; to 0.32 and 0.30, respectively), which is the same as what was proposed in the August 2021 SNOPR. The window U-factors were updated consistent with the 2021 IECC. Adopting R-21 instead of R-20+5 also resolves issues regarding shipping width that the stakeholders commented on, which is discussed in section III.F.2.b. of this document.

The total life-cycle construction and operating costs of the home is calculated based on the total expected lifetime of the home, which is 30 years. Both Tier 1 and Tier 2 standards would provide benefits in energy savings to the consumer which, over the span of the payback period ("PBP"), would offset the increase in purchase price. Under the tiered proposal, manufactured homes that would be subject to the Tier 1 standards would, in all cases, have a PBP less than 10 years, with a range of 1.4 years to 7.4 years amongst all cities analyzed, and a national average of 3.7 years. This is well within the range suggested by MHI in which first homeowners often sell their manufactured homes. Further discussion on these results is provided in section IV.A.2. of this document.

DOE estimates in this final rule the number of households no longer able to purchase a manufactured home from the pool of households planning to purchase a manufactured home (which is much smaller than the total number of American households). DOE estimates the final rule would result in a loss in demand and availability because of the increase in upfront home price for each tier. Therefore, DOE includes in the analysis a price elasticity of demand. Price elasticity is typically

represented as a ratio of the percentage change in quantity relative to a percentage change in price. DOE considered a price elasticity of -0.48 based on a study by Marshall and Marsh[24] and considered an additional price elasticity as part of a scenario analysis (See appendix 11A for further information).

In the study published in the Journal of Housing Economics by Marshall and Marsh, the authors conclude that national and local programs that cause small price increases in manufactured housing units (*e.g.*, increasing energy efficiency) will not necessarily deter thousands of low-income families from purchasing manufactured homes and that such consumers are likely to be willing to accept incrementally higher prices from improvements in energy use and cost efficiency. Specifically, the study states that these consumers are not nearly as price-sensitive because "the cost of a manufactured home still ranges from 21 to 65 percent of the cost of a site built home and low- and moderate-income families have few low-cost choices for home ownership."[22] Costs provided by a 2021 manufactured housing industry overview fact sheet developed by MHI suggests that in 2019, on average, the average sales price of a manufactured home compared to a new single-family site built home is about 27 percent (without land).[25]

As such, DOE estimated the final rule would result in a loss in demand and availability of about 31,975 homes (single section and multi-section combined) for the tiered standard using a price elasticity of demand of -0.48 for the 30-year analysis period

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[24] See Marshall, M.I. & Marsh, T.L. Consumer and investment demand for manufactured housing units. J. Hous. Econ. 16, 59-71 (2007).
[25] Manufactured Housing Institute. 2021 Manufactured Housing Facts: Industry Overview.

(2023-2052). Out of the 31,975 homes in the tiered standard, the majority of the reduction is in Tier 2 (80 percent) vs. Tier 1 (20 percent). Within Tier 1, DOE estimates a 0.55 percent reduction in demand and availability of single-section homes for low-income purchasers due to Tier 1 standards. DOE assumes that low-income consumers generally purchase lower priced manufactured homes (i.e., many single section homes) based on data that shows single-section homes, on average, have householders with lower to median incomes, as opposed to multi-section homes (see conclusions in section III.B.1). Accordingly, DOE concludes that low-income consumers would not be priced out by the Tier 1 standards adopted in this final rule.

Finally, for those manufactured home purchasers that buy new homes, even with the incremental costs, DOE notes that the median purchase price of a manufactured home would continue to be significantly lower than site-built homes (per 2019 AHS, the median purchase price of manufactured homes is $32,000 vs. a single-detached home is $158,000). Costs provided by a 2021 manufactured housing industry overview fact sheet developed by MHI suggests that in 2019, on average, the average sales price of a manufactured home compared to a new single-family site built home is about 27 percent (without land).[26] Additionally, the 2021 CFPB Report[27] states that manufactured homes represent an affordable housing option for millions of Americans because they cost less

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[26] Manufactured Housing Institute. 2021 Manufactured Housing Facts: Industry Overview.
[22] Consumer Financial Protection Bureau. Manufactured Housing Finance: New Insights from the Home Mortgage Disclosure Act Data (2021).

on average than site-built homes and are one of the least expensive forms of housing available without government subsidies.

In conclusion, based on the input received from HUD during consultation and input from commenters, DOE believes that access to affordable housing and reducing energy burdens of the purchasers are of the utmost importance in the manufactured housing market. The tiered standard adopted in this final rule addresses both of these concerns. Both tiers within the tiered standard reduce energy costs and provide positive LCC savings for homeowners over the life of the average manufactured home (i.e., 30-years). Further, Tier 1 of the tiered standard mitigates first-cost impacts for purchasers at the lower end of the manufactured home price range, and would provide, on average, a positive cash flow within Year 1 of the standard based on the down payment, incremental loan payment, and energy cost savings. Accordingly, as discussed further, DOE has adopted the tiered approach in this final rule.

2. Loan Qualification

MHARR stated that neither the NODA nor the original DOE SNOPR considers, or accounts in any way, for the impact that regulatory-driven purchase price increases, attributable both directly and indirectly to the proposed rule, would have on the ability of lower and moderate-income consumers to access financing for, and purchase, mainstream manufactured homes. (MHARR, No. 1640 at p. 4, 5) Several commenters stated that the proposed standards ignore the large number of homebuyers who will no longer be able to buy a MH because they no longer qualify for an FHA, Fannie Mae, or Freddie Mac

mortgage loan due to the impact of increased mortgage payments on debt-to-income ratios. (Westland, No. 1263 at p. 2); (Pleasant Valley, No. 1307 at p. 3); (American Homestar, No. 1337 at p. 3); (Oliver Technologies, No. 1350 at p. 3); (Adventure Homes, No. 1383 at p. 3); (Champion Home Builders, No. 1639 at p. 5); (MHI, No. 1592 at pp. 3, 11) MHI stated that FHA's customary DTI requirement is 43 percent, and therefore any homebuyer at the edge of this 43 percent DTI requirement will no longer qualify for an FHA loan because of the higher price caused by the new energy standards. (MHI, No. 1592 at p. 3, 11) MHARR stated that the higher level of loan rejection rates within the chattel or personal property loan sector will disproportionately impact and harm "Hispanic white, Black and African-American and American Indian and Alaska Native borrowers" and will have a racially-disproportionate impact. (MHARR, No. 1640 at p. 5)

Separately, NASEO stated that by failing to establish cost-effective baselines of energy efficiency in the lowest-cost homes, DOE increases the likelihood that the residents of these homes will require federal and state public assistance from the Weatherization Assistance Program, Low-Income Home Energy Assistance Program, or other bill payment assistance programs in the future. (NASEO, No. 1565 at p. 2)

LISC recommended the federal government ensure there is flexibility in federally insured and guaranteed home mortgage program regulations to permit an increase in debt to income ratios when paired with reductions in energy costs. In addition, they suggested that the federal government should proactively market these programs and other potential

assistance to help with incremental cost increases, including ENERGY STAR tax credits and other financing vehicles that factor in future energy savings. (LISC, No. 1233 at p. 3) NRECA suggested DOE could incentivize dealers to showcase ENERGY STAR-qualified manufactured homes on their lots by providing rebates for the price difference to the dealers so that the price difference does not force the consumer to make a choice between affordability and home ownership. They commented that such action would improve the overall efficiency of new manufactured homes up front in such a way that would not jeopardize home ownership potential for consumers. (NRECA, No. 1406 at p. 1, 3)

UCB stated that DOE should be working with HUD to come up with subsidies and offsets/ways to pay for extra insulation, and that the previous DOE claim that there is no authority to provide this is incorrect. (UCB, No. 1405 at p. 2) They recommended that for low-income purchasers, the DOE front the chattel loans in a government program similar to other federal agencies programs -- HUD, the U.S. Department of Veteran Affairs, and the USDA's rural housing service -- to provide lower interest rates and additional consumer protections that could cover the cost of better insulation. They also stated that, although the tiered standards are more cost-effective overall for homebuyers, the cost of these homes should still be subsidized, and loan programs should be created by the DOE in collaboration with HUD. Finally, they noted that DOE should consider providing a renter's tax credit targeted at certain MH buyers. (UCB, No. 1618 at p. 9-11) Schulte advised that in the coming years, DOE may want to work with EPA and other agencies to encourage more utilities to provide rebates for energy efficient manufactured

homes, because these rebates can help offset part of the cost increases. (Schulte, No. 1028 at p. 16)

UC Law School commented that DOE should subsidize the costs of low-income participants who might be directly impacted by the Final Rule, including consideration of financing, tax credits, or other financial incentives or assistance for consumers of manufactured housing. (UC Law School, No. 1634 at pp. 5, 9, 10) UCB stated that DOE should consider policies that would reinforce anti-discrimination housing laws and support novel lending practices to involve people of color who may not otherwise be eligible for a traditional loan while making certain the sustainability of their loan protects the investment of equity. (UCB, No. 1618 at p. 9)

Next Step commented that the incremental costs for energy-efficiency upgrades do not price out manufactured home residents. They noted that manufactured housing is often considered a source of Naturally Occurring Affordable Housing (defined as unsubsidized housing that meets the affordability standard for households making 60-80 percent of area median income, or AMI). They commented that two of the most prominent affordable housing, new construction programs (the HOME Program and the Low-Income Housing Tax Credit Program), are used for individual and family household incomes below 60 percent AMI. In their evaluation of Tier 2 of the proposed standard, they used CFPB's median loan data in conjunction with DOE's average incremental cost increase and concluded that loans will remain affordable to those at 60 percent of median income ("AMI"), even when accounting for increased energy efficiency upgrades. (Next Step, No. 1617 at pp. 5, 7-9) Finally, Next Step commented that the Federal Housing

Administration ("FHA") and other government-backed lenders, conventional lenders, and Community Development Financial Institutions ("CDFIs") generally underwrite manufactured home loans to ensure affordability by using a housing ratio of 29 percent of gross monthly income applied to housing costs, which includes the principal, interest, taxes, and insurance ("PITI"). However, The FHA's Energy Efficient Mortgage absorbs energy savings for efficient homes and stretches the ratio to 31 percent, and Freddie Mac's GreenChoice Program weighs energy efficiency into its underwriting and includes manufactured housing. (Next Step, No. 1617 at p. 6)

The State Attorneys General stated that analyses performed by Next Step, a member of the federal advisory MHCC with expertise in affordable housing, confirm that despite potential increases in purchase price due to incremental construction costs associated with improved efficiency requirements, a manufactured home built to DOE's proposed IECC-based standards would remain affordable to even the most price sensitive consumers due to the availability of federal and state tax incentives, and loan and down-payment assistance programs to assist low income home buyers. (State Attorneys General, No. 1625 at p. 5)

The 2021 CFPB report provides some data on borrower characteristics for manufactured homes. As suggested by the commenters, DOE confirmed that the standard FHA guidelines allow for a DTI up to 43 percent on the back end, but allow for higher ratios based on compensating factors like residual income, cash reserves, good credit

score, etc.[28] The back-end DTI ratio refers to the ratio of the applicant's total monthly debt to the total monthly income. Table 7 of the 2021 CFPB summarizes that the median debt-to-income DTI ratio for chattel loans is 35.7 percent, and for mortgage loans is 38.9 percent. DOE notes the DTI data presented are not separated for new manufactured homes, so DOE presumes the ratio is for all manufactured homes. Further, Table 3 of the 2021 CFPB shows that chattel loans, despite being potentially eligible for FHA loans, are seldom FHA for manufactured housing; 0.7 percent of chattel loans are FHA loans and 39.4 percent of mortgage loans are FHA loans. The 2019 AHS also estimates that only 16 percent of all MH homeowners with at least one regular mortgage[29] report having FHA insurance. Therefore, DOE concludes that FHA loans may not be as prevalent for consumers for manufactured homes because of the low percentage of borrowers presented in both the 2021 CFPB and the 2019 AHS, and therefore amended energy conservation standards may not have as much of an impact as commenters are suggesting.

As discussed, Tier 1 in the final rule responds to concerns on first-cost impacts for low-income consumers. As presented in Table I.1, the national average incremental housing purchase price for Tier 1 single-section homes is $660. As such, the Tier 1 standard would slightly increase the monthly debt portion of the DTI ratio; assuming chattel rate at 9 percent with 23-year loan term and a down-payment of 10 percent (see chapter 8 of the final rule TSD for further discussion on these assumptions), this would

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[28] *https://fhalenders.com/fha-debt-to-income-ratio/.*
[29] This figure includes home-equity lump sum mortgages, but excludes home-equity credit lines and reverse annuity mortgages.

increase monthly payments by approximately $6. Table 7 of the 2021 CFPB suggests a median income of $52,000 for chattel loans, which can be used to calculate the original median monthly debt of $1,547 (35.7 DTI * 52,000/12). All else equal, with the increase in monthly payments of approximately $6 for single-section homes resulting from this final rule, DTI can be recalculated as 35.8 DTI, which increases the DTI by 0.1 and is still under the standard 43 DTI limit for the small portion of consumers for manufactured homes that use FHA loans (although as noted previously, this ratio can be higher based on certain compensating factors). Considering average household income of single-section homeowners (approximately $40,000 based on the 2019 AHS), the incremental monthly payments of approximately $6 would increase the DTI to 35.9, which is 0.2 above the median DTI ratio for chattel loans presented in the 2021 CFPB and well under the 43 DTI limit. Further, DTI does not take into account any reduction in energy costs from the standards established in this final rule. Finally, DOE only considered the effect of DTI on the Tier 1 standard because commenters were focused on how the energy conservation standards could affect DTI on low-income consumers who have higher DTIs and affordability concerns. Accordingly, DOE concludes that the final rule will not have the impact on loan qualification that the commenters suggest, and to the extent there are such impacts, Tier 1 of the final rule helps mitigate them because of the lower first-costs.

Finally, as mentioned by Next Step, Freddie Mac has a GreenChoice Mortgage® program which facilitates the financing of energy efficient home improvements and energy efficient homes, including manufactured homes. This program is specifically also

meant for borrowers who want to qualify for greater purchasing power despite their higher DTI and housing expense-to-income for manually underwritten loans. With respect to commenters' suggestions that DOE provide forms of financial assistance or other aid to assist manufactured home purchasers, EISA does not authorize DOE to provide such assistance in establishing the standards for manufactured housing. However, DOE will work with other Federal agencies within its statutory authorities to assist homeowners, including manufactured homeowners, in achieving energy burden reductions in an affordable and equitable manner.

3. IECC

Multiple commenters stated that that the IECC does not take into consideration all the construction aspects unique to manufactured housing, and its application to manufactured housing would require the industry to comply with a building code that was developed for commercial and site-built residential buildings. (MMHA, No. 995 at p. 3); (Michigan MHA, No. 1012 at p. 2); (WHA, No. 1025 at p. 2); (PMHA, No. 1165 at p. 3); (Westland, No. 1263 at p. 2); (Pleasant Valley, No. 1307 at p. 2); (American Homestar, No. 1337 at p. 2); (Oliver Technologies, No. 1350 at p. 2); (KMHA, No. 1368 at p. 2); (Adventure Homes, No. 1383 at p. 2); (NJMHA, No. 1451 at p. 2); (WMA, No. 1452 at p. 2); (IMHA/RVIC, No. 1466 at p. 2); (Cavco, No. 1497 at p. 2); (Skyline Champion, No. 1499 at p.2); (Mississippi MHA, No. 1588 at p. 3); (Mississippi MHA, No. 1588 at p. 4); (Skyline Champion, No. 1627 at p. 2); (Campaign Form Letter, Multiple submissions at p. 1-2) NRECA commented that they are concerned that the 2021 IECC standard and the other features of the SNOPR could ultimately price many

consumers out of the market and urged DOE to consider alternatives. (NRECA, No. 1406 at p. 3) Accordingly, NRECA questioned the use of the 2021 IECC standard for manufactured housing in the SNOPR, while most states are still following the 2009 IECC standard for site-built homes. They suggested that DOE look to other iterations of the IECC standard which could better balance efficiency and affordability, while still including an efficient building envelope as part of the standard. (NRECA, No. 1406 at p. 4)

Clayton Homes stated that they believe that requiring the industry to comply with the IECC is not an appropriate solution. (Clayton Homes, No. 1589 at p. 16) The MHCC stated that they believe the energy efficiency requirements from the 2021 IECC, as currently proposed, are not the appropriate resource to be used in updating manufactured housing energy requirements, as the 2021 IECC was not developed or intended for these homes. (MHCC, No. 1600 at p. 6) TMHA stated the IECC was never intended to apply to HUD-Code manufactured homes and as proven in Texas it poses significant issues to the factory-built home manufacturing process at affordable price points. TMHA stated that they believe that DOE, in concert with HUD and the MHCC, should reach an agreement on which elements from the Code deliver the most energy conservation gains while minimizing the increase in construction cost to protect low-income consumers and the supply of affordable housing. (TMHA, No. 1628 at p. 3) MHARR commented that manufactured homes have never previously been subject to any version of the IECC. Thus, for manufactured homes, the increase in costs entailed in implementing the 2021 IECC would not be an "incremental" or marginal increase over and above the cost of the

2018 IECC, but the total, cumulative costs of implementing all elements of the IECC incorporated within its 2021 iteration, dating back to the very first version of that code. (MHARR, No. 1640 at p. 8)

Alternatively, Earthjustice and Prosperity Now stated that DOE must adopt standards based on the most recent version of the IECC, except as expressly permitted by EISA. They stated that the language of EISA makes clear that DOE must analyze the IECC's cost effectiveness on a provision-by-provision basis. (Earthjustice and Prosperity Now, No. 1637 at p. 1, 2) Further, ASHRAE stated that the most recent edition of their standard ANSI/AHSRAE/IEC 90.2-2018 includes manufactured housing within scope and because Standard 90.2 is an industry-based standard, it allows manufacturers credit for energy savings from a wider variety of measures than are used in other model codes such as the IECC prescriptive standards, including the use of higher efficiency heating and cooling equipment, and also solar panels. Accordingly, they recommended that DOE evaluate whether ASHRAE 90.2-2018 would be more cost-effective than the proposed standard, and for DOE to consider Standard 90.2 alongside or in place of the 2021 IECC. (ASHRAE, No. 1373 at p. 2) NRDC also recommended the use of ASHRAE 90.2-2018 as a starting point to set the standards at a higher level. NRDC stated that the one known method of reducing default risk is to increase energy efficiency and require disclosable energy ratings/quality assurance. NRDC stated that ASHRAE 90.2 accomplishes both goals, and urged DOE to evaluate this standard as well as the IECC 2021 code as the basis for its standards for manufactured housing, since ASHRAE 90.2 requirements have been demonstrated to be cost-effective. (NRDC, No. 1599 at p. 5-7)

As described in section II.A, EISA mandates that the manufactured housing energy conservation standards be based upon the most recent IECC, except in cases in which the Secretary finds that the IECC is not cost-effective, or a more stringent standard would be more cost-effective, based on the impact of the IECC on the purchase price of manufactured housing and on total life-cycle construction and operating costs. (42 U.S.C. 17071(b)(1)) As noted previously and discussed more below in section IV, DOE has found today's final rule, which is based on the 2021 IECC, to be cost-effective. Accordingly, DOE evaluated the requirements of the IECC along with the other considerations enumerated by EISA in establishing these standards. In DOE's view, the directive that these standards "shall be based on" the most recent version of the IECC indicates Congress' intent that DOE exercise discretion in establishing these standards and does not require these standards for manufactured homes to be an identical or verbatim equivalent of the IECC, especially in light of the other considerations DOE must make under the statute (*i.e.*, the design and construction techniques of manufactured homes, cost-effectiveness, etc.).

Additionally, DOE disagrees with Earthjustice and Prosperity Now's comment that DOE must analyze the cost-effectiveness of the IECC on a provision-by-provision basis. Nothing in section 413 of EISA suggests that Congress intended for DOE to conduct a provision-by-provision cost-effectiveness analysis of the IECC. If Congress wanted DOE to take such a granular approach, it would have specified such a requirement. Moreover, while DOE disagrees with the commenters' assertion, DOE nonetheless has engaged in an analysis to determine which IECC provisions are

appropriately applied to manufactured housing and which impact first-cost and affordability considerations, consistent with the considerations enumerated in EISA. But, unlike the analysis commenters suggest, DOE's evaluations have been in the context of the whole home, rather than considering individual provisions in isolation, which is more consistent with the approach for which manufactured housing has met current HUD energy conservation requirements via a *Uo* for the entire home. Considerations regarding the design and construction of manufactured homes were a main focus of the MH working group while developing the recommendations that DOE has considered in this rulemaking. For example, section R402.2.4 of the 2015 IECC (which was considered by the MH working group) and the 2021 IECC (which is the latest version of the IECC) include a specification for vertical doors that provide access from conditioned to unconditioned spaces to meet certain fenestration insulation requirements. However, internal doors that separate conditioned and unconditioned space rarely are relevant to manufactured homes. Therefore, the MH working group recommended that this provision be removed from the energy conservation standards as it was deemed not relevant to manufactured housing design and construction. Further, DOE did not incorporate requirements for uniform thickness or a uniform density for the exterior ceiling insulation given that the space between the roof and exterior ceiling is limited in a manufactured home as compared to a site-built home, particularly at the eaves, and as such uniformity of thickness may not be possible at the insulation levels established in this final rule. Because the IECC is specific to site-built structures, the approach finalized in this document would establish requirements using modified versions of those related IECC provisions that can be adapted for manufactured homes.

With respect to ASHRAE Standard 90.2-2018, DOE notes that, while commenters provided some information regarding the cost-effectiveness of Standard 90.1-2018 to site-built homes, they did not provide information regarding the cost-effectiveness of 90.2-2018 as applied to manufactured homes. Moreover, the commenters did not provide information on how 90.2-2018 applies to manufactured homes relative to the 2021 IECC-based requirements DOE proposed in the August 2021 SNOPR and finalized in this rule. EISA does allow DOE to base its manufactured housing energy conservations standards on a code other than the IECC to the extent that the IECC is not cost-effective, or the alternate code is more stringent and more cost-effective. At this time, DOE is declining to make such determinations for Standard 90.2-2018. Instead, DOE has elected to maintain the 2021 IECC as the basis for this final rule, consistent with the considerations of EISA section 413 and the recommendations of the MH working group and other stakeholders. DOE remains open to consideration of Standard 90.2-2018 or other building energy codes that may be appropriately applied to manufactured housing and meet the increased stringency and cost-effectiveness requirements of EISA section 413 in future rulemakings for these standards.

B. Final Standards

DOE is finalizing tiered standards that would prescribe cost-effective energy conservation requirements based on requirements in the 2021 IECC. The Tier 1 standards would apply to single-section manufactured homes. The Tier 1 requirements incorporate IECC-based building thermal envelope component measures that result in an incremental purchase price increase less than $750 for single-section homes. In other

words, the Tier 1 requirements address many of the same thermal envelope components of a home as the IECC (after accounting for the design and factory construction considerations under EISA discussed previously), but with lesser stringencies to address the affordability concerns raised by HUD during consultation and in stakeholder comments. The Tier 2 standards would apply to multi-section manufactured homes. The Tier 2 standards would be based on the most recent version of the IECC with similar stringencies for thermal envelope components, taking into consideration the design and factory construction techniques of manufactured homes. Tier 2 includes the alternate exterior wall insulation requirement (R-21) for climate zones 2 and 3, as presented in the August 2021 SNOPR and October 2021 NODA. Tier 2 is estimated to result in an average incremental price increase of $4,100 - $4,500 for multi-section homes. Both Tier 1 and Tier 2 standards also include requirements that are applicable to manufactured homes related to ducts; HVAC; service hot water systems; mechanical ventilation fan efficacy; and heating and cooling equipment sizing. These requirements are also based on the 2021 IECC after accounting for the design and factory construction considerations under EISA, and are applicable to all manufactured homes (single-section and multi-section).

1. Size-based Threshold

In this final rule, DOE is finalizing standards based on home size instead of the August 2021 SNOPR proposed manufacturer's retail list price. DOE initially considered a retail-price threshold to address the affordability concerns expressed by HUD and other stakeholders. 86 FR 47744, 47760. DOE received a number of comments against using

manufacturer's retail list price, and alternate suggestions to use a size-based threshold instead, as discussed in section III.B.3 of this document. DOE noted in the August 2021 SNOPR that it had considered a size-based threshold and requested comment on the use of a size-based threshold, or other alternate threshold, in place of the retail list price threshold. *Id.* at 47760-47762. DOE also performed a sensitivity analysis regarding an alternate sized-based tier threshold in the October 2021 NODA.[30] 86 FR 59042.

The manufactured housing survey ("MHS") 2020 public use file ("PUF") data, provides estimates of average sales prices for new manufactured homes sold or intended for sale by geographical region and size of home.[31] Table III.1 summarizes the average, minimum and maximum sales prices based on census region and section.

Table III.1 MHS PUF 2020 Census Region and Sales Price Data

Census Region	Single-section Sales Price (*2020$*)			Dual-section Sales Price (*2020$*)		
	Average	**Minimum**	**Maximum**	**Average**	**Minimum**	**Maximum**
Northeast	$57,916	$35,600	$95,000	$107,951	$56,000	$233,000
Midwest	$56,983	$33,200	$79,000	$104,987	$54,000	$184,000
South	$56,798	$31,400	$79,000	$106,942	$58,000	$170,000
West	$61,748	$34,100	$117,000	$118,282	$64,000	$236,000
All	**$57,233**	**$31,400**	**$117,000**	**$108,583**	**$54,000**	**$236,000**

Further, the MHS also summarizes average manufactured home sales price by state.[32] Table III.2 presents the average sales prices in 2020 per HUD zone based on the

[30] DOE also evaluated a sized-based threshold among the alternatives for both the January 2022 DEIS and April 2022 FEIS. 87 FR 2430; 87 FR 20852
[31] Manufactured Housing Survey, Public Use File (PUF) 2020. *www.census.gov/data/datasets/2020/econ/mhs/puf.html*
[32] Manufactured Housing Survey, Annual Tables of New Manufactured Homes: 2014 – 2020; *www.census.gov/data/tables/time-series/econ/mhs/annual-data.html*

MHS data discussed previously and manufactured home shipments published by Manufactured Housing Institute.[33]

Table III.2 MHS Average Sales Price Data by HUD Zone

HUD Zone	Single-section Average Sales Price (*2020$*)	Dual-section Average Sales Price (*2020$*)
1	$57,124	$107,003
2	$57,290	$111,208
3	$56,207	$109,147

As presented in Table III.1 and Table III.2, the average, minimum and maximum sales price for single-section homes are significantly lower than the same for multi-section homes.

The 2019 AHS separately provides data relating household income to manufactured housing size. On average, the household income for households in single-section homes ($39,331) is lower than that of multi-section homes ($51,358). The 2019 AHS also provides data relating the poverty status[34] (using the federal poverty level thresholds[35]) to size of home. Table III.6 summarizes that a larger portion of single-section homes have residents at poverty levels less than 100 and 200 percent of the Federal Poverty Level compared to multi-section homes.

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[33] Manufactured Housing Institute, Annual Production and Shipment Data; *www.manufacturedhousing.org/annual-production/*

[34] In the AHS tables, poverty status was determined by comparing the combined income of the individuals living in the household to the appropriate size-based poverty threshold (i.e., two-person poverty threshold, three-person poverty threshold, etc.). Further details on the definition for poverty status is found in the AHS definitions handbook (*www2.census.gov/programs-surveys/ahs/2019/2019%20AHS%20Definitions.pdf*)

[35] U.S. Census Bureau. Poverty Thresholds. *www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html*

Table III.3 2019 AHS Poverty Level Summary Data

Poverty level	Number of units (*thousands*)		Percentage of units (%)	
	Single-wide	Double-wide	Single-wide	Double-wide
Less than 100 percent	1109	506	29%	17%
Less than 200 percent	2278	1307	60%	45%

Accordingly, DOE concludes that single-section homes, on average, have lower sales prices than multi-section homes. Further, DOE concludes that single-section homes, on average, have householders with lower to median incomes than multi-section homes. To the extent that manufactured home purchasers are cost-driven, in conjunction with the lower average income, consumers at the lower end of the manufactured home purchase price range generally would be more sensitive to increases in purchase price. Based on the relationship between home size and cost, DOE has determined that, similar to the retail list price-based threshold, the size-based threshold addresses affordability concerns. However, as noted by commenters, the size-based threshold would not be susceptible to fluctuations in pricing due to changing market conditions or consumer customization that could impact the applicability of standards (see the discussion in section III.B.3 of this document). The size-based threshold therefore provides greater certainty for manufacturers and consumers as to the applicability of standards to individual manufactured homes and reduces opportunities for gaming. Accordingly, DOE is finalizing a tiered standard with the Tier 1 standard applicable to single-section homes and the Tier 2 standard applicable to multi-section homes.

2. Tiered Standard

DOE developed the Tier 1 standard with the lower incremental purchase price in response to concerns from HUD and other commenters regarding the incremental purchase price of a manufactured home built to a DOE standard, and the current ability of the first homeowner/purchaser of these homes to recoup the increase in purchase price and realize the savings offered by the greater energy efficiency of a Tier 1 manufactured home. The Tier 1 standard includes requirements for thermal envelope components similar to those of the 2021 IECC, but at lesser stringencies than the 2021 IECC to lower the incremental purchase price in order to address the affordability concerns raised by HUD and other stakeholders.

In determining the energy efficiency measure ("EEM") combinations included in Tier 1, DOE ensured that the performance-based overall thermal transmittance (*Uo*) for these combinations would be more stringent than the current HUD requirements. DOE's objective in defining the Tier 1 incremental purchase price threshold was based on implementing efficiency improvements by which -a low-income buyer purchasing a single-section home (using typical loan terms currently available to these homebuyers, primarily chattel loans with higher interest rates) would, on average, realize a positive cash flow within Year 1 of the standard based on the down payment, incremental loan payment, and energy cost savings. DOE believes this approach addresses the concerns raised by HUD and other stakeholders regarding affordability as low-income purchasers, whom DOE considered in developing Tier 1 standards, would begin to quickly realize the energy cost savings of the standards. As such, DOE determined that an incremental

purchase price of less than $750 for a set of energy efficiency measures provided a beneficial financial outcome for these consumers given lifecycle cost savings and energy cost savings, while minimizing first cost impacts in the manner noted above. Specifically, for single-section manufactured homes, DOE determined the set of energy efficiency measures with an average incremental purchase price of $660 (as presented in Table I.1) with a 10 percent down payment (using a chattel loan) would, on average, result in a positive cash flow within the first year, as presented in Table III.4. Further discussion on the LCC inputs to this subgroup calculation are presented in section Chapter 9 of the TSD.

Table III.4 Tier 1 LCC Sub-Group National Results

Single-section only; 30-year analysis period; National Results	**Tier 1**
Incremental cost	$660
Incremental down-payment (10%)	$66
Yearly Incremental Loan Payment	$67
First Year Incremental Payment (Down-payment + Loan)	$133
Yearly Energy Cost Savings	$177
First Year Savings (Energy Cost Savings - Incremental Payment)	**$44**

The Tier 2 standard would apply the same thermal envelope EEMs to multi-section homes, but at similar stringencies as the 2021 IECC, with consideration of cost-effectiveness and design and factory construction techniques of manufactured homes taken into account. (42 U.S.C. 17071(b)(1); 42 U.S.C. 17071(b)(2)(A)) Tier 2 also incorporates the alternate exterior wall insulation requirement (R-21) for climate zones 2 and 3, as presented in the August 2021 SNOPR and October 2021 NODA. DOE notes that Tier 2 requirements adopted in this final rule will update only the window U-factor requirements for all climate zones compared to the term sheet agreed upon by the MH

working group (window U-factor: 0.35 and 0.32; to 0.32 and 0.30 respectively). The window U-factors were updated consistent with the 2021 IECC, while the other updates were not included because of the design and factory construction of a manufactured home or cost-effectiveness considerations (see further discussion in section III.F.2.b of this document). Otherwise, the remaining Tier 2 EEMs are consistent with the recommendations from the MH working group, except based on the three HUD zones (as opposed to the four climate zones recommended in the Term sheet). Further discussion of the climate zones may be found in section III.F.2.a. of this document.

The required building thermal envelope requirements for both tiers are presented in section III.F.2.b of this document.

3. Comments on the August 2021 SNOPR Proposal and the October 2021 NODA

DOE received a number of comments regarding whether a tiered or the alternative untiered approach should be considered.

Multiple commenters supported single-tier (*i.e.*, untiered) standards for energy conservation based on the 2021 IECC standards. They stated that all manufactured homes should be as efficient as would be cost-effective, considering the construction costs, energy costs, and financing over the life-cycle of the homes. They also commented that homebuyers purchasing homes in Tier 1 should not be subjected to the pitfalls of lower-quality, inefficient homes, which would also reduce resale value. The commenters also noted that a two-tiered approach would further stratify the growing homeownership gap for underserved communities, depriving individuals and families from quality, energy-

efficient housing choices. (CASA of Oregon, No. 925 at p. 1-2) (Verde, No. 928 at p. 1-2), (Trellis, No. 974 at p. 1-2), (NOAH, No. 976 at p. 1-2), (PathStone, No. 1013 at p. 1-2), (Habitat for Humanity of LA, No. 1015 at p. 1-2), (WIDC, No. 1016 at p. 1-2), (RCAC, No. 1183 at p. 1-2), (UCD, No. 1030 at p. 1-2), (LISC, No. 1233, at p. 2-3); (CHP, No. 1384 at p. 1-2); (Blount County Habitat for Humanity, No. 1417 at p. 1-2); (ReFrame Foundation, No. 1424 at p. 1-2); (People's Self-Help Housing, No. 1591 at p. 1); (Fahe, No. 1572 at p. 1-2); (NBI, No. 1404 at p. 1-2); (NPCC, No. 1567 at p. 2); (E4TheFuture, No. 1374 at p. 1); (Next Step, No. 1617 at p. 10, 11); (UHI, No. 1026 at p. 1); (E4TheFuture, No. 1976 at p. 1); (ICC, No. 1979 at p. 2); (NYSERDA, No. 1981 at p. 1); (Next Step, No. 1984 at p. 1, 2) UHI stated that lower-quality, less efficient homes will be less comfortable and subject residents to potential health and safety hazards from poor ventilation, poor insulation, and a lesser ability to withstand extreme weather conditions. (UHI, No. 1026 at p. 1) VEIC recommended that DOE pursue a single standard for all manufactured homes that is based on the 2021 IECC and incorporate all measures that are cost-effective based on total lifetime costs of the home, including energy costs. (VEIC, No. 1633 at p. 3) NMHOA stated that while establishing a tiered system may somewhat address the issue of the higher upfront costs associated with purchasing a home, doing so fails to address the core purpose of the proposed rule: addressing the ongoing costs of ownership. (NMHOA, No. 1635 at p. 3) UC Law School stated the untiered approach makes the most sense from a climate perspective, provided DOE could solve the affordability problem. (UC Law School, No. 1634 at p. 6, 7, 10) NBI commented that proposed Tier 2 energy conservation standards missed significant

energy savings by not applying the entire scope of the 2021 IECC to manufactured homes. (NBI, No. 1404 at p. 1-2)

ACEEE commented that the proposed Tier 1 standards are illegal. The authorizing statute (42 U.S.C. 17071) requires DOE to set the standards based on the most recent version of the IECC (currently the 2021 IECC) except when that code is not cost-effective or a more stringent standard would be more cost-effective. It specifies that cost-effectiveness is based on "the purchase price… and on total life-cycle construction and operating costs." Thus, they stated that DOE must base any change from the 2021 IECC on cost-effectiveness, including total life-cycle energy costs. (ACEEE, No. 1631 at p. 4) ACEEE also expressed concern that the proposed Tier 1 would not help low-income residents, that there may be cheaper savings not included in the draft standard. (ACEEE, No. 1498 at p. 1) ACEEE also commented that tiered standards will reinforce inequitable outcomes. Setting weaker standards for cheaper homes will result in inequitable access to the benefits of higher quality, more efficient construction, and will create a dangerous precedent by setting standards that are targeted according to consumer income level. (ACEEE, No. 1631 at p. 3) Instead, ACEEE commented that untiered standards will ensure that all residents benefit equitably from the same strong, cost-effective efficiency standards. They stated that the proposed threshold for Tier 2 is arbitrary and subject to gaming and the use of manufacturer's retail list price is a notional amount that can be manipulated. (ACEEE, No. 1631 at p. 4-6) Further, ACEEE also stated that the untiered standards are justified based on legal requirements, cost-effectiveness, and environmental impacts without consideration of the economic or other impacts from greenhouse gas

reduction, and thus, the recent injunction[36] on the use of the social cost of carbon should not delay this standard. (ACEEE, No. 1988 at p. 3) Finally, ACEEE stated that the EIS confirms that the untiered standards deliver the highest 30-year LCC savings to residents and provides the greatest climate, environmental justice, socioeconomic, and health benefits. In addition, they stated the untiered standards deliver the largest reduction in ongoing energy costs, which is an essential part of preserving the affordability of manufactured housing and lowering high energy burdens for its residents. (ACEEE, No. 1988 at p. 1)

Vermont Law School commented that DOE lacked the legal authority to adopt the proposed less energy efficient tiered standards based on a manufactured home's retail list price or number of sections because the 2021 IECC does not base any of its provisions on a home's list price, number of sections, "first cost impacts on purchasers," or 1-10 year payback periods, and DOE has not affirmatively found that the 2021 IECC standard is not cost effective. (Vermont Law School, No. 1638 at p. 2-4) Vermont Law School reiterated their concern that the tiered approach was not cost-effective, nor consistent with the 2021 IECC, then went on to acknowledge that "DOE has, however, explicitly and affirmatively found that the untiered approach, which is based on the IECC, is cost-effective." Vermont Law School also commented that the untiered approach goes much further than the tiered approach in addressing the financial, health, and energy burdens

[36] *Louisiana v. Biden*, No. 21-cv-1074-JDC-KK (W.D. La.)

faced by low-income residents, and will reduce the energy burden of all new residents of manufactured homes. (Vermont Law School, No. 1991 at p. 1-3)

The CEC urged DOE to adopt the untiered approach that applies the 2021 IECC to all manufactured housing, regardless of retail cost or size. They stated that adopting either tiered approach (retail cost-based or size-based) would impede the nation's and individual states' efforts to address climate change in a just and equitable way. CEC also stated that, because DOE may not deviate from establishing standards based on the IECC for all manufactured housing unless it makes a finding that the code is not cost-effective, DOE must finalize the untiered approach. (CEC, No. 1629 at p. 2, 3) While CEC acknowledged that to make the standards meaningful, DOE has discretion to adopt standards based on the IECC rather than identical IECC standards, they disagreed with DOE's conclusion that this discretion extends to the bifurcated application of IECC standards based on cost or configuration in a way that reduces energy savings, utility savings, or greenhouse gas emissions. This interpretation would effectively render the statutory requirement meaningless. (CEC, No. 1629 at p. 3) Finally, CEC commented that they were concerned regarding equity considerations and the disproportionate impact the tiered proposals would have on low-income residents. (CEC, No. 1629 at p. 4) Next Step commented that by sacrificing energy-efficiency features in lower-cost manufactured homes, the proposed DOE rule will adversely impact lower-income communities – including immigrant communities and communities of color, and that the rulemaking should be considered under President Biden's January 20, 2021, Executive Order on Advancing Racial Equity and Support for Underserved Communities Through

the Federal Government. (Next Step, No. 1617 at p. 7, 11) In April 2022, DOE released its Equity Action Plan (EAP) to implement this Executive order: *https://www.energy.gov/equity*. As directed by the Executive order, the EAP lays out a roadmap for how DOE will incorporate equity considerations in procurement, financial assistance, and stakeholder engagement across DOE programs. In developing this rule, DOE has taken equity impacts into account and the Administration's comprehensive approach to advancing equity. Moreover, the FEIS provides a detailed analysis of socioeconomic and environmental justice considerations.

Earthjustice, Prosperity Now, and Sierra Club urged DOE to abandon the proposed tiered approach and to apply a strengthened version of the proposed Tier 2 standards to all new homes. They stated that DOE has entirely failed to consider the beneficial impacts of stronger standards on renters of new homes, and therefore has ignored an important aspect of the affordability problem it claims to be addressing. (Earthjustice and Prosperity Now, No. 1637 at pp. 1, 5, 6, 8); (Earthjustice, Prosperity Now, and Sierra Club, No. 1992 at p. 2) Further, they commented that (1) the Tier 1 standards are not based on 2021 IECC and DOE has not shown that standards based on the 2021 IECC are not cost-effective; and (2) the tiered approach raises significant equity concerns. (Earthjustice and Prosperity Now, No. 1637 at p. 3) In addition, they stated by prescribing weaker energy efficiency standards for the lowest cost homes as DOE has proposed, these commenters assert that DOE would limit access to the benefits of higher quality, more efficient construction, particularly for families renting a manufactured home and those who own a home and rent a lot in a manufactured housing community, in

which a significant share of lower-cost homes are placed. (Earthjustice and Prosperity Now, No. 1637 at p. 6) Finally, they noted that there is ample evidence in the record to support DOE's nationwide adoption of standards that are far stronger and more comprehensive than the requirements included in the proposed Tier 2 standards, even if the economic impacts of avoiding greenhouse gas emissions are completely ignored. (Earthjustice, Prosperity Now, and Sierra Club, No. 1992 at p. 9)

RECA urged DOE to take the untiered approach proposed in the SNOPR because it is the only proposed alternative consistent with the relevant statute, and it is the most equitable long-term solution because it recognizes that reducing utility bills is just as important (and likely more important) for low-income households as it is for higher-income households. RECA stated that, unless DOE has specifically found a lack of cost-effectiveness or a more stringent cost-effective measure than what is contained in the IECC, the 2021 IECC should be the standard for energy conservation in manufactured housing. (RECA, No. 1570 at pp. 1, 2, and 7)

NASEO commented that DOE and HUD are proposing energy efficiency standards for Tier 1 homes which are or will soon be less efficient than the efficiency codes and standards in place in the various states, and which states are unable to supersede due to federal pre-emption. NASEO was particularly concerned that it has been nearly 30 years since the last update to MH standards. NASEO stated that establishing a two-tiered standard that excludes the lowest cost homes from energy efficiency saddles those residents with high energy bills for the 30-40 year average lifetime of a manufactured home. (NASEO, No. 1565 at p. 2)

NEEA strongly opposed a two-tier approach for four reasons: (1) those who buy a Tier 1 home may have a lower first cost, but future buyers will have to bear higher life-cycle and energy costs; (2) the 2-tier approach based on retail list price will shift market pricing practices to keep advertised price low while adding higher priced dealer options at the point of sale; (3) park owners will continue to purchase less efficient Tier-1 homes since rent is set on market rates and energy bills will be paid by the tenants; and (4) a 2-tier approach introduces complexity into this code and sets a bad precedent for other product categories. NEEA commented that DOE must recognize the landlord-tenant relationship (where landlords are not incentivized to invest in energy efficiency because they are not paying the utility bills) and implement single tier, strong energy conservation standards for manufactured housing. (NEEA, No. 1601 at pp. 2, 3, 6, 8, and 9)

The State Attorneys General urged DOE to prescribe the requirements set forth in DOE's untiered proposal. They commented that a tiered approach is inconsistent with the IECC. Were DOE to adopt a tiered approach, it would do so in violation of 42 U.S.C. § 17071(b)(1), which provides that DOE's standards for manufactured housing "shall be based on" the IECC. Accordingly, they stated that DOE should adopt standards based on the 2021 IECC and make them applicable to all manufactured homes, regardless of home cost or size. They argued that DOE's untiered proposal is a significant improvement over the current HUD Code, but DOE should still adopt a more stringent set of requirements to fully comply with EISA. (State Attorneys General, No. 1625 at pp. 2, and 4-6) Further, they commented that the tiered approach would create a double standard that will perpetuate persistent poverty and inequality. (State Attorneys General, No. 1625 at p. 4)

UC Law School stated that the untiered approach is the most cost-effective when the cost-benefit analysis factors in only the social cost of carbon and the emissions reductions into the equation. (UC Law School, No. 1634 at p. 11, 13, 14).

University of Arizona and Arizona State strongly endorsed the application of minimum standards for energy conservation based on the 2021 IECC for all new manufactured homes sold (as in, did not endorse the tiered standards) in order to reduce future health and financial vulnerabilities among manufactured housing residents. They stated that manufactured homes also provide housing for high concentrations of heat-sensitive populations, including older adult, low-income and minority groups, and that new standards for manufactured housing energy-efficiency are long overdue and should be issued and implemented as soon as possible. (University of Arizona and Arizona State, No. 1379 at p. 1-2)

MHI also supported a single-tier standard, albeit not with the requirements that DOE proposed in the untiered approach. MHI recommended less stringent component and U_o requirements for the single-tier standards (which are discussed further in section III.F.2.b). (MHI, No. 1990 at p. 14-17)

On the other hand, NAHB did not support the untiered standards and thus supports the adoption of a tiered approach to allow builders and manufacturers to have options when implementing building thermal envelope requirements. They stated that the "tiered" approach provides options for builders and manufacturers when implementing building thermal envelope requirements. However, they also stated that it is unclear if

using the manufacturer's retail price is an appropriate metric for the two tiers. (NAHB, No. 1398 at p. 2) An anonymous commenter offered its support for the tiered standards as a way to strike a balance between increased energy efficiency and affordable housing. (Anonymous, No. 1446 at p. 1, 2) Clayton Homes commented that the untiered proposal is not cost-effective in general or for low-income consumers. (Clayton Homes, No. 1589 at p. 16)

UC Law School stated that the untiered approach risks making manufactured homes unaffordable for low-income consumers. First, under the untiered standard, purchase price increases could represent a significant portion of the average consumer's annual income while those customers are likely already living paycheck to paycheck. Second, under the untiered approach, the dramatic increase in purchase price will increase the amount of chattel or real property loan taken out by the buyer to obtain a manufactured home. Third, DOE stated in the SNOPR that various factors contribute to consumers of manufactured homes being more price-sensitive to changes that would impact the cost of a manufactured home. Accordingly, they suggested that DOE should consider this when evaluating the tiered and untiered approaches for this proposed rule, as only the tiered approach considers the financial hardship the rule will pose to low-income consumers. (UC Law School, No. 1634 at p. 7, 8)

An individual commenter stated that the proposed rule is a necessary step in reducing U.S. energy usage and increasing manufactured housing efficiency, and that the "tiered" approach to regulating homes' thermal envelopes would help to reduce overall energy consumption while also keeping home costs relatively unchanged. (Kurfman, No.

941 at p. 1) Another individual commenter suggested that although the tiered system of cost implementation creates significantly more administrative responsibility, it is a more equitable and desirable means of accomplishing the aforementioned agency goals. They suggested that the proposed rule by DOE seems adequately supported by reasonable inquiries into emission reduction, energy efficiency, and cost allocation for thermal requirements of manufactured homes. (Gustafson, No. 778 at p. 1) NYSERDA supported DOE's two-tier approach to address the affordability concerns. (NYSERDA, No. 1620 at p. 1)

Further, DOE also received a number of comments on the tiered approach, specifically as it relates to the proposed threshold (i.e., manufacturer's retail list price), which are summarized in the following paragraphs.

Multiple commenters suggested that the $55,000 low-income threshold for the eligibility for streamlined energy efficiency requirements for the tiered standard should be eliminated (or significantly increased), and that it is incorrect that homes above $55,000 are not affordable to low-income homebuyers. (MMHA, No. 995 at p. 4); (Michigan MHA, No. 1012 at p. 2); (WHA, No. 1025 at p. 2); (PMHA, No. 1165 at p. 3); (Westland, No. 1263 at p. 2); (Pleasant Valley, No. 1307 at p. 2); (American Homestar, No. 1337 at p. 2); (Oliver Technologies, No. 1350 at p. 2); (KMHA, No. 1368 at p. 2); (Adventure Homes, No. 1383 at p. 2); (NJMHA, No. 1451 at p. 2-3); (WMA, No. 1452 at p. 2); (IMHA/RVIC, No. 1466 at p. 2); (Cavco, No. 1497 at p. 2); (Skyline Champion, No. 1499 at p.2); (Mississippi MHA, No. 1588 at p. 2) ; (Skyline Champion, No. 1612 at

p.2); (Cavco, No. 1622 at p. 2); (VAMMHA, No. 1624 at p. 2); (Champion Home Builders, No. 1639 at p. 4); (IMHA, No. 1453 at p. 2); (MHI, No. 1592 at p. 4-6, 25)

MHARR stated that the $55,000 dividing line between Tier 1 and Tier 2 standards selected by DOE is fundamentally arbitrary and would limit the applicability of the proposed Tier 1 standards to a mere 17.3 percent of the total HUD Code market notwithstanding the fact that all manufactured housing is identified and protected as affordable housing under applicable federal law. MHARR also objected to any threshold set so low, including the updated $63,000 price threshold, because it would subject a significant majority of all manufactured homes and all manufactured homeowners to prohibitively costly energy standards. MHARR further stated that the inflationary and supply chain pressures will increase the threshold amounts by the time of the implementation of any such standard. (MHARR, No. 1640 at p. 2-4) NBI stated that establishing a price threshold for manufactured homes that must meet lower energy efficiency requirements will no doubt risk gaming of the threshold by manufacturers and inadvertently shift more of the market to less efficient manufactured homes. (NBI, No. 1404 at p. 1-2)

If DOE keeps the tiered proposal, multiple commenters commented that the $55,000 low-income price cap threshold for streamlined energy efficiency requirements should be eliminated or significantly increased to at least $110,260. (Westland, No. 1263 at p. 1); (Pleasant Valley, No. 1307 at p. 2); (American Homestar, No. 1337 at p. 2); (Oliver Technologies, No. 1350 at p. 2); (Adventure Homes, No. 1383 at p. 2); (NJMHA, No. 1451 at p. 3); (WMA, No. 1452 at p. 2); (IMHA/RVIC, No. 1466 at p. 2); (Cavco,

No. 1497 at p. 3); (Skyline Champion, No. 1499 at p.2); (Mississippi MHA, No. 1588 at p. 4); (MHI, No. 1592 at p. 17); (Cavco, No. 1622 at p.3); (Champion Home Builders, No. 1639 at p. 4) Clayton Homes recommended that the $55,000 low-income price cap threshold should be either eliminated or increased to at least $110,000 for a single section and $140,000 for a multi-section home to better reflect today's affordable housing market. (Clayton Homes, No. 1589 at p. 13, 15, 16, 18)

MHI commented that if a tiered system based on price is used, the price point in Tier 1 must be significantly increased to at least $110,260, and must be updated annually to reflect actual costs, which can change dramatically. MHI says that as of now, the $55,000/$63,000 threshold is arbitrary, and it excludes significant numbers of low income manufactured housing homebuyers. (MHI, No. 1592 at p. 2, 17) MHI stated that home price is determined by the retailer based on the home features selected by the consumer, and requiring approval of every floorplan after consumer choices are made (which would determine the retail price) would mean every house would have to be approved separately, adding astronomical costs and slowdowns to the process. (MHI, No. 1592 at p. 7, 22, 23, 25) In addition, MHI and Clayton Homes suggested that the Tier 2 definition should not have a threshold price; instead, a Tier 2 home should be defined as "A manufactured home that is not qualified as a Tier 1 home." (MHI, No. 1592 at p. 30); (Clayton Homes, No. 1589 at p. 21)

MHCC stated that they do not believe a tiered approach based on manufacturer's retail list price is appropriate. Using manufacturer's retail list price as a basis for thresholds could lead to situations where, for a single model, multiple plan sets may need

to be generated leading to multiple plan review and approvals. (MHCC, No. 1600 at p. 3, 4) Schulte recommended that if DOE wishes to use the Tier 1 method, the price limit should be closer to the anticipated average sales price in 2022 (e.g., $75,000) to cover 68 percent of the single wide market as stated in the proposed value. However, they stated that the manufactured home production costs are very likely to increase due to rising component, construction labor, financing and transportation costs, and therefore the price baseline could rapidly become obsolete. (Schulte, No. 1028 at p. 5, 22) Further, they commented that the differing parts and components of the two tiers of homes will make compliance with the published designs and components of the quality assurance system even more challenging than it already is. (Schulte, No. 1028 at p. 21)

Skyline Champion commented that the $55,000 low-income price cap threshold for streamlined energy efficiency requirements should be eliminated. Skyline Champion strongly disagreed with any tiered system. Skyline Champion stated that they believe a single set of requirements based on value and affordability that offers the customer a clear path to a cost benefit is the best solution. (Skyline Champion, No. 1612 at p. 3) They suggested for the untiered standard, adjusting the tier 1 values slightly upward to improve requirements of ceiling insulation for thermal zones 2 and 3 along with floor insulation on thermal zone 3. (Skyline Champion, No. 1612 at p. 3)

TMHA stated that the price increase considerations that were appropriately made by DOE regarding the Tier 1 standards need to be applied to all HUD-Code homes regardless of their price. TMHA stated that they do not believe that a price threshold should be used at all, and the HMDA data for low-income manufactured home purchases

provides evidence that HUD-Code homes across the price distribution deserve cost-effectiveness consideration as intended under 42 U.S.C. 17071(b)(1), which makes no mention of segmenting manufactured housing by price and instead only states that HUD zones be used for any differentiation. If DOE decides to use a price threshold still, TMHA recommended that DOE at least apply the 70th percentile calculation to the entire set of home prices as opposed to limiting the data used to only single-section homes. (TMHA, No. 1628 at p. 1, 2) TMHA stated that the entire range of manufactured housing property values that went to these low-income households is a better representation of affordable home values and should be considered for the same cost-effectiveness protection. (TMHA, No. 1628 at p. 2)

While MHI does not believe a price threshold is at all appropriate, MHI suggested that if used there absolutely needs to be an index to increase the price over time. The proposed rule should establish the Federal agency tasked with providing the annually adjusted threshold values. Whether it is HUD or the DOE, MHI suggested that a single adjusted value must be provided to ensure consistency across the industry. Also, MHI stated the application of the AEO to the adjustment of home price needs to be standardized and established in the rule for the purposes of enforcement. (MHI, No. 1592 at p. 16, 23) UCB stated that DOE should use the untiered standards if they are to choose a price-based alternative, but otherwise consider other potentially effective options for determining energy efficiency thresholds. (UCB, No. 1618 at p. 3, 10-12)

Alternatively, ACC FSC commented that DOE should consider thresholds based on square footage instead of retail price. They stated that a square footage threshold is

more objective than a manufacturer's suggested retail price and should be more reliably implemented and enforced, and would still target the affordable housing market. They suggested that Tier 1 should only apply to single-section homes. (ACC FSC, No. 1364 at p. 1) UCB suggested using different monetary standards for tiers, size-based tiers, or location-based tiers. (UCB, No. 1405 at p. 3) Clayton Homes urged DOE to consider other thresholds such as square footage (recommending 1650 sq. ft. of living space) or a measure that differentiates based on location where the home will be sited, rather than price. (Clayton Homes, No. 1589 at p. 15) MHI stated DOE must seriously consider an alternative tier approach such as square footage or sections. (MHI, No. 1592 at p. 2, 17) MHCC stated that if DOE moves forward with a tiered approach, single- or multi-section would be the most appropriate metric. (MHCC, No. 1600 at p. 3, 4) ACEEE supported a metric that is harder to manipulate (such as home floor area) if DOE insisted on creating multiple tiers. ACEEE also stated that disclosure prior to initial sale or rental should clearly identify lower-tier homes and inform buyers and renters that they are likely to pay higher energy bills and may face other problems. (ACEEE, No. 1631 at p. 4-6)

As discussed previously, in response to feedback from stakeholders and based on the statutorily required consultation with HUD, DOE proposed the "tiered" approach in the August 2021 SNOPR to mitigate the potential adverse impacts of increased costs on manufactured housing affordability for low-income consumers that may arise from increasing the stringency of energy efficiency requirements applied to manufactured homes. In this final rule, DOE is finalizing a size-based tiered approach as it mitigates the potential adverse impacts of increased first-costs on manufactured housing affordability

from increasing the stringency of energy efficiency requirements applied to manufactured homes.

In response to comments opposing the tiered approach, the tiered approach is "based on" the 2021 IECC, as DOE interprets the statute. As noted previously in DOE's reading, the language Congress used in instructing DOE to set standards for these structures does not require the imposition of requirements for manufactured homes that are identical to those that IECC provides for site-built structures. Instead, DOE reads the language of the statute as readily indicating that Congress anticipated that DOE would need to use its discretion in adapting the IECC's provisions for manufactured housing use, including whether those elements would be appropriate in light of the design and factory construction techniques of manufactured homes and to the extent the IECC is not cost-effective. As noted previously, the IECC does not apply to manufactured homes, and the IECC's provisions could not be transferred verbatim to manufactured homes because of differences in these structures. Moreover, Congress directed DOE to "establish standards for energy efficiency in manufactured housing" that are "based on" the IECC. Congress could have, but did not, require DOE to establish standards that are "equivalent to" those in the IECC, "the same as" those in the IECC, or similar such language that would indicate a lack of discretion. Therefore, it is DOE's reading of the statute that Congress provided DOE with ample discretion to adapt the IECC to the unique design, manufacturing, transportation, and cost characteristics of manufactured homes and the associated market.

In addition, because DOE does not read "based on" as being "identical to," there is no reason to make a finding that the IECC is not cost-effective, which is required only when DOE is not basing its standards on the IECC (or, alternatively, utilizing more stringent standards than found in the IECC). Here, DOE is basing its standards on the IECC, but necessarily adapting these standards to the unique features of manufactured housing. If, in EISA, Congress did intend for "based on" to be "identical to" (contrary to DOE's interpretation), then DOE would necessarily have to conclude that the IECC is not cost-effective because it is impracticable to copy standards for site-built housing to manufactured housing. Thus, DOE still would adopt the standards adopted in this final rule because they promote the energy efficiency of manufactured housing based on the criteria set forth by Congress.

The tiered approach in this final rule is "based on" the 2021 IECC. As noted in the August 2021 SNOPR, both tiers are based on the 2021 IECC in that both tiers have requirements for the building thermal envelope, duct and air sealing, installation of insulation, HVAC specifications, service hot water systems, mechanical ventilation fan efficacy, and heating and cooling equipment sizing provisions consistent with those of the 2021 IECC. 86 FR 47757. In other words, both tiers in this final rule regulate the same components of a home as the 2021 IECC, with modifications made by DOE to account for the design, construction, transportation and cost-effectiveness considerations for manufactured homes required by EISA, and as agreed upon by the MH working group. Pursuant to the discretion afforded DOE by Congress, neither the tiered nor the untiered standard (i.e., Tier 2) replicates the 2021 IECC as it would apply to site built

homes. Rather, both tiers adopted in this final rule are “based on” the 2021 IECC. Even if DOE had opted against tiering of standards in this rule, the standards adopted still would not be identical to the 2021 IECC (as alternatively proposed in the SNOPR), because, as repeatedly noted, it is not possible to impose standards developed for site-built structures to manufactured homes.

DOE also disagrees with commenters suggestion that the Tier 1 requirements are inconsistent with section 413 of EISA because DOE tentatively found the proposed untiered standard to be cost-effective, or otherwise did not show that the untiered standard was not cost-effective. First, as noted previously, the tiered standard is based on the 2021 IECC and is cost-effective, and is therefore consistent with the statute. Second, the only differences between the tiered standard and the untiered standard are the lesser stringencies of the building thermal envelope components for Tier 1 homes that DOE incorporated in order to address the first-cost and affordability concerns raised by HUD in the EISA-required consultation, as well as other stakeholders throughout the rulemaking process. (See section III.C of this document for more discussion on DOE's consultation process with HUD) As the primary regulator of manufactured homes for nearly 50 years, HUD has significant expertise in the unique design, construction, transportation and cost characteristics of manufactured homes. In requiring consultation under EISA, Congress intended for DOE to benefit from this expertise. To ignore the advice and concerns voiced by HUD would render the statutory consultation requirement meaningless.

Moreover, as noted previously, DOE estimates a 0.55 percent reduction (essentially no reduction) in demand and availability of single-section homes for low-income purchasers due to Tier 1 standards. Given that low-income consumers generally purchase lower priced manufactured homes (i.e., many single section homes), DOE concludes that low-income consumers would not be priced out by the Tier 1 standards adopted in this final rule. In contrast, as noted in the October 2021 NODA, DOE estimated a 2.8 percent reduction in shipments due to the untiered standard (2.1 percent reduction for the untiered standard using the R-21 wall insulation in Climate Zones 2 and 3).[37] *See* 86 FR 59060. DOE believes the tiered standard adopted in this final rule better addresses the affordability concerns raised by HUD during consultation, and other stakeholder comments, because it will ensure continued availability for the homes most often purchased by low-income purchasers (single-section homes) with little change to the current market, while providing energy cost savings that provide positive cash flow within 1 year of purchase. Accordingly, DOE incorporated the tiered structure into its rule in order to ensure that HUD's first-cost and affordability concerns were addressed.

With respect to comments regarding equity concerns related to the tiered approach, DOE understands and acknowledges that, under the tiered approach, purchasers of some single-section homes (which are more likely to be low-income individuals) will not obtain the same long-term energy savings benefits as purchasers of multi-section homes. However, the tiered standards adopted in today's final rule, in

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[37] In the October 2021 NODA, DOE estimated that the untiered standard would result in a reduction in shipments of 70,203 homes (single and multi-section combined), and 53,185 homes for the untiered standard using the alternative R-21 wall insulation in Climate Zones 2 and 3. 86 FR 59060.

addition to increasing energy efficiency relative to the current HUD code, will help mitigate first-cost impacts to prospective manufactured home purchasers. With respect to comments that the standard--tiered or untiered--should not be based on the IECC, as described previously, EISA requires DOE to base the standards on the latest version of the IECC, which in this case is the 2021 IECC, unless the standards based on the IECC would not be cost-effective. 42 U.S.C. 17071(b)(1). As discussed previously, the tiered standards are based on the 2021 IECC, and DOE has found them cost-effective consistent with the other considerations contained in EISA. Thus, DOE is finalizing a tiered standard based on the 2021 IECC.

With respect to comments regarding the threshold for the tiered standard, based on further review and consideration of the comments received, DOE is not establishing the tier threshold based on the proposed manufacturer's retail list price, and is instead finalizing tiers based threshold on manufactured home size (single-section and multi-section). DOE agrees with commenters that a price-based threshold may be difficult to implement. DOE notes that applicability of the size-based threshold, as compared to a retail-list-price based threshold, would be impacted less by variations within a specific model that may change the retail list price. Further, DOE notes that a manufacturer is able to determine the size of the home they are manufacturing prior to distribution in commerce for sale or installation in the field. As such, basing the tiers on size would provide greater certainty as to the applicability of standards for specific manufactured home models, reducing the potential for "gaming," as well as reduce the complexity of any potential enforcement of the standards.

In addition, as discussed in III.B.1 of this document, DOE understands that affordability is directly tied with manufactured home size, in that single-section homes are consistently less expensive than multi-section homes. To the extent that manufactured home purchasers are cost-driven, in conjunction with the lower median income and net worth of these purchasers, these purchasers would tend to buy less expensive homes, and generally would also be more sensitive to increases in purchase price. Accordingly, given the relationship between home size and cost, basing the standards on the home size still responds to first-cost impact concerns, while allowing for a less burdensome and more objective mechanism for manufacturers to comply with standards and achieving significant energy savings relative to the HUD code. Therefore, DOE is finalizing a size-based tiered standard in this final rule.

C. Rulemaking Process

As part of developing energy conservation standards for manufactured housing, DOE has undertaken a multi-stage process providing numerous opportunities for public comment and engagement, as discussed in further detail in section II.B.3 of this document. For this rulemaking, EISA requires DOE to "consult with the Secretary of HUD, who may seek further counsel from the Manufactured Housing Consensus Committee". 42 U.S.C. 17071(a)(2)(B). Pursuant to the statutory requirement, DOE has consulted with HUD throughout the development of these standards, as discussed in section II.B.3. of this document, DOE met with HUD multiple times during the preliminary stages of the proposed rule, as well as throughout the rest of the rulemaking process, and consulted HUD in the development of the August 2021 SNOPR, the October

2021 NODA and this final rule. As EISA expressly states that the Secretary of HUD may engage with the MHCC with regard to this rulemaking, DOE has attended three MHCC meetings, most recently in June of 2021, to gather further information and input on the rule. This rule addresses comments submitted by the MHCC (MHCC, No. 1600), which mirrored comments from other individual stakeholders. A number of other stakeholders, including industry stakeholders, have also provided information, data, and opinions regarding the rule.

In response to the August 2021 SNOPR and the October 2021 NODA, DOE received several comments regarding the rulemaking process used by DOE in developing these energy conservation standards.

MHI commented that DOE's proposal failed to comply with the statutory requirement to consult with HUD. (MHI, No. 1592 at p. 10) MHI also stated that many of the changes conflict with current HUD Code requirements, and no direction is given as to how the two differing standards should be integrated, which will result in complicated, overlapping requirements. (MHI, No. 1592 at pp. 6-7) MHARR commented that DOE should rescind the SNOPR and pursue a legitimate rulemaking based on the unique nature, construction and affordability of MH using the pre-existing Federal manufactured home construction and safety standards ("MHCSS") and statutory HUD manufactured housing consensus process. (MHARR, No. 1388 at p. 2-3) Select Representatives of Congress were concerned that the proposed rule may conflict with statutory obligations contained within the National Manufactured Home Construction and Safety Standards

Act, which establishes HUD as the primary regulator of construction and safety standards for manufactured housing. To change energy efficiency standards for manufactured housing, they stated that DOE is required by EISA to consult with HUD, which in turn can seek further counsel from the MHCC. Select Representatives of Congress requested that DOE develop the proposed rule and a subsequent implementation strategy in consultation with HUD and MHCC, in line with statutory requirements. (Select Representatives of Congress, No. 1445 at p. 1, 2) PA-DCED stated that it would be more appropriate to review existing requirements within the MHCSS and to modify those standards through submissions to the MHCC for possible revisions rather than a separate agency implementing a totally new standard(s). (PA-DCED, No. 1485 at p. 2) Clayton Homes also recommend that DOE work with HUD and MHCC to evaluate the energy standard improvements that will add the most value in energy savings and account for the cost impact to consumers. (Clayton Homes, No. 1589 at p. 4)

As stated earlier, DOE is conducting this rulemaking pursuant to the statutory provisions in EISA that direct DOE to establish energy conservation standards for manufactured housing. This statutory directive is separate from the 1974 National Manufacturing Housing Construction and Safety Standards Act that governs HUD's authority in promulgating regulations for manufactured housing. Additionally, DOE demonstrates in section III.F of this document how the standards do not conflict with those established by HUD. Furthermore, this discussion and related supporting analyses together present the analytical approach used by DOE in evaluating the relevant information and on which DOE based its determinations regarding the proposed

requirements in accordance with the directives in EISA, the Administrative Procedure Act and the Negotiated Rulemaking Act. Accordingly, as discussed previously, in preparation for the prior negotiated rulemaking that produced the June 2016 NOPR, DOE set up a negotiated rulemaking process in accordance with the Federal Advisory Committee Act and the Negotiated Rulemaking Act, which included a broad and balanced array of stakeholder interests and expertise, and included a representative from MHARR. 79 FR 41456 (July 16, 2014). Further, as stated previously, DOE has consulted both with HUD and engaged with the MHCC with regard to this rulemaking, and has incorporated information and considerations provided by HUD and the MHCC into this final rule.[38]

D. Test Procedure

DOE published a test procedure NOPR for manufactured housing on November 9, 2016. 81 FR 78733 (November 2016 test procedure NOPR). The November 2016 test procedure NOPR proposed applicable test methods to determine compliance with the following metrics that were included in a June 2016 NOPR: the *R*-value of insulation; the *U*-factor of windows, skylights, and doors; the SHGC of fenestration; *U*-factor alternatives to *R*-value requirements; the air leakage rate of air distribution systems; and mechanical ventilation fan efficacy. The November 2016 test procedure NOPR proposed test methods that would dictate the basis on which a manufactured home's performance is represented and how compliance with the energy conservation standards would be

[38] DOE presented to the MHCC on December 3, 2014, August 18, 2015, and June 10, 2021. The minutes of these meetings can be found at *www.hud.gov/program_offices/housing/rmra/mhs/mhccom*

determined. DOE notes that a number of the test methods that were proposed were consistent with test methods from the IECC, which includes test methods for *R*-value of insulation, *U*-factor and SHGC of fenestration, duct leakage and mechanical fan efficacy.

The November 2016 test procedure NOPR provided stakeholders an opportunity to comment on the proposed test procedure for manufactured housing. In response to the August 2021 SNOPR, DOE received some comments on the test procedure.

MHI stated that testing requirements for each of the systems being modified in the proposal are not included and must be addressed before any rule is published. If testing is required to be performed by a third-party or in cases where the installer is not capable of performing the testing, the additional cost of testing could be $600 or more. For example, MHI questioned whether the duct testing will require every unit to be tested thus requiring each manufacturer to hire one individual to test the ducts in line. Further, if each multi-section home will need to be tested on-site, they stated it will cost around $1,000 per unit, assuming the duct system passes the first time. Also, although MHI supports efforts to limit duct leakage, they believe such tests should be limited to testing of duct systems in the factory only, where such testing provides the best value to consumers. (MHI, No. 1592 at pp. 20, 22, and 28) Clayton Homes said DOE must not propose a rule without including the required testing requirements, so any analysis can include the true impact. (Clayton Homes, No. 1589 at pp. 3-5)

ICC stated that testing and inspection should be conducted under the purview of either a state program or third-party entities with the requisite knowledge and procedures

to assure the results. In states without state programs, third-party providers should be permitted to conduct testing and inspection. DOE should require third-party providers be accredited to ISO/IEC 17020, which ensures the competence of inspection bodies, their impartiality, and the consistency of their inspection activities. (ICC, No. 1621 at p. 3)

As discussed previously, DOE is not addressing a test procedure in this rulemaking. DOE will consider the comments related to test procedures, including an analysis of any related costs, in any future action on test procedures.

E. Certification, Compliance, and Enforcement

In the November 2016 test procedure NOPR and in the August 2021 SNOPR, DOE did not propose a system of certification, compliance, and enforcement ("CCE"), instead indicating those items would be addressed in a separate rulemaking. At this time, DOE is not addressing CCE issues in this rulemaking, but may do so in the future. DOE received a number of comments regarding CCE implementation and costs.

UCB stated that compliance and implementation need to be included in the rule since it will make a large difference on how the standard is enforced, and suggested that DOE should work with HUD not only outside of the rulemaking, but also as part of the rulemaking. (UCB, No. 1405 at p. 1) NEEA urged DOE to move quickly to address compliance and enforcement of the standards with opportunity for stakeholder input. (NEEA, No. 1601 at p. 15) An anonymous commenter stated that DOE should expand the proposed rule to include the projected regulatory compliance and implementation of the proposed rule, because the current proposal does not consider additional regulatory

costs that will occur with a change in the regulatory policy. (Anonymous, No. 1446 at p. 1, 2) Clayton Homes commented that the rule does not include energy testing or compliance costs, which would further exacerbate homeownership affordability challenges in the wake of the recent escalation of home prices, and could amount to $600 or more. (Clayton Homes, No. 1589 at p. 6) MHI stated that DOE's proposal is based on improper calculations and methodologies, including not considering the costs of testing procedures and compliance. (MHI, No. 1592 at pp. 4-6, 25) MHARR stated that the analysis does not include additional purchase price impacts due to costs related to enforcement, testing, and regulatory compliance. (MHARR, No. 1640 at pp. 2-4) Campaign Form Letter commented that failure to implement a comprehensive compliance path creates competing regulations (HUD and DOE) would both cause uncertainty in quality assurance processes, and cause delays in production, which in turn would harm the industry and consumers who are eagerly seeking the affordable housing the manufactured homes provide. (Campaign Form Letter, Multiple submissions at p. 2)

Regarding compliance approach, Schulte stated that DOE staff should work directly with HUD so that both agencies can meet their separate statutory responsibilities. Initially, they stated that DOE may wish to visit the primary inspection agencies, manufacturing plants to see the factory inspection process in action along with the inspection process for the placement of the homes. In Schulte's view, doing this will give DOE the opportunity to evaluate the current HUD regulatory process and whether DOE wants to participate in the current enforcement system managed by HUD rather than instituting a separate compliance process under 10 CFR part 429. They suggested that

HUD and DOE should publish amendments to 10 CFR part 460 and 24 CFR part 3280 to reflect the final standards issued by both agencies. (Schulte, No. 1028 at p. 28, 32) Schulte also stated that the HUD Code already contains a number of certification documents which can be modified to accommodate many different items and therefore the cost of updating these certifications will be negligible and have no real impact on the life-cycle cost analysis. (Schulte, No. 1028 at p. 31) Skyline Champion stated that HUD already has a well-established system for enforcement which is working effectively, and Skyline Champion strongly encouraged the use of this established system with any final rule created. (Skyline Champion, No. 1627 at p. 3); (Champion Home Builders, No. 1639 at p. 3) MHI and Clayton Homes stated that it is unnecessary for DOE to develop a new enforcement mechanism because the HUD Code is an already-established enforcement mechanism that mandates a uniform standard for design, construction, and installation, including federal requirements for safety, durability, and energy efficiency. Accordingly, they urged DOE to work with HUD to utilize the compliance and enforcement provisions already in place today. (Clayton Homes, No. 1589 at p. 6, 7); (MHI, No. 1592 at p. 10)

ICC commented that DOE should coordinate any compliance verification processes it mandates with the existing program in place at HUD. Overlapping or disjointed requirements would create process inefficiencies for manufacturers and inspection agencies, potentially raising costs. Finally, ICC encouraged DOE to consider the 2021 IECC pathways to achieve compliance in the rulemaking. Should DOE consider options that require verification onsite, post transport, they stated that DOE should be mindful of the scope of local building officials' inspection authority with respect to

manufactured housing. (ICC, No. 1621 at p. 3) NMHOA stated that HUD should be the lead agency in implementing the new rules. They stated that compliance should be addressed in the final rule to ensure DOE and HUD efforts and coordinated, and that HUD's regulatory and inspections processes appear to be the most appropriate mechanism for ensuring compliance without creating a new, complicated system of two-party inspections. (NMHOA, No. 1635 at p. 4)

Separately, NAIMA commented that new manufactured homes should carry a label that details all relevant information related to energy efficiency standard compliance, similar to the 2021 IECC permanent certificate which includes insulation R-values, U-factors of fenestration, duct leakage testing results, and types and efficiencies of heating, cooling and water heating equipment. They stated that requiring the same certification on manufactured housing will promote owner/occupant awareness and help ensure manufacturer compliance with the standard. (NAIMA, No. 1017 at p. 1) ACEEE stated that DOE should ensure that buyers, owners, and renters have understandable and usable information on the overall efficiency or energy use of each home and on its efficiency features, and recommended that disclosure in the sales process and a permanent label could provide the information. (ACEEE, No. 1631 at p. 16)

DOE notes that many of the requirements in the standards would require minimal compliance efforts (e.g., documenting the use of materials subject to separate Federal or industry standards, such as the R-value of insulation or U-factor values for fenestration), and therefore such efforts would result in minimal additional costs to manufacturers. However, DOE acknowledges that it has not fully enumerated testing and enforcement

costs at this time. DOE continues to work with HUD on potential approaches for compliance, enforcement and labeling that may leverage the existing HUD inspection and enforcement process to ensure manufacturer compliance with the standards in a manner that is not overly burdensome or costly to manufacturers. Accordingly, DOE has also not included any potential associated costs of testing, compliance or enforcement at this time. DOE will consider the comments related to CCE, testing and labeling received in this rulemaking and will continue to consult with HUD in any future actions.

F. Energy Conservation Standards Requirements

This section discusses in detail the energy conservation standards in this final rule. DOE is codifying in a new part of the CFR under 10 CFR part 460 subparts A, B, and C.

Subpart A provides the scope of the standards, definitions of key terms, and other commercial standards that are incorporated by reference into this part. The subpart also would establish a compliance date of one year following the publication of the final rule.

Subpart B would include the energy conservation standards requirements associated with the building thermal envelope of a manufactured home according to the tier and climate zone in which the home is located. DOE bases its standards on the three HUD zones. Manufacturers would be able to choose between two pathways to comply, with each one ensuring an appropriate level of thermal transmittance through the building thermal envelope. The first pathway relies on prescriptive requirements for components

of the building thermal envelope. The second pathway relies on performance requirements, under which a manufactured home is required to achieve a maximum U_o in addition to fenestration *U*-factor and SHGC requirements. Manufactured homes would be required to comply with one of these two pathways. Subpart B would also establish prescriptive requirements for insulation and sealing the building thermal envelope to limit air leakage.

Subpart C includes requirements related to duct leakage, HVAC thermostats and controls, service water heating, mechanical ventilation fan efficacy, and equipment sizing.

1. Subpart A: General

a. §460.1 Scope

Section 413 of EISA directs DOE to establish energy conservation standards for manufactured housing. (42 U.S.C. 17071(a)(1)) In this final rule, §460.1 would (1) restate the statutory requirement and introduce the scope of the requirements, and (2) require manufactured homes that are manufactured on or after one year following publication of the final rule to comply with the requirements established, consistent with the August 2021 SNOPR.

In response to the August 2021 SNOPR, multiple commenters stated that these standards for manufactured housing energy-efficiency are long overdue and should be issued and implemented as soon as possible. (CASA of Oregon, No. 925 at p. 1); (Verde,

No. 928 at p. 1), (Trellis, No. 974 at p. 1), (NOAH, No. 976 at p. 1), (PathStone, No. 1013 at p. 1), (Habitat for Humanity of LA, No. 1015 at p. 1), (WIDC, No. 1016 at p. 1), (RCAC, No. 1183 at p. 1), (UCD, No. 1030 at p. 1), (LISC, No. 1233, at p. 3); (CHP, No. 1384 at p. 1-2); (Blount County Habitat for Humanity, No. 1417 at p. 1-2); (ReFrame Foundation, No. 1424 at p. 2); (NPCC, No. 1567 at p.2); (Fahe, No. 1572 at p. 1); (People's Self-Help Housing, No. 1591 at p. 1) (Joint Commenters, No. 1630 at p. 1). UC Law School stated that DOE should consider a 1-year lead time as sufficient for compliance with the DOE standards for the purposes of the HUD certification process. (UC Law School, No. 1634 at p. 15) Next Step stated that HUD and the manufactured housing industry should implement the law within one to two years, with allowance for exceptions. (NextStep, No. 1617 at p. 12) ACEEE commented that a one-year lead time before compliance is required should be sufficient. They stated that if particular provisions of the standards cannot be met in that timeframe, then DOE could allow temporary exceptions or waivers (as for appliance standards) or could set a later compliance date for those provisions. (ACEEE, No. 1631 at p. 15) NYSERDA encouraged DOE to move as swiftly as possible to finalize the rulemaking. (NYSERDA, No. 1620 at p. 2); (NYSERDA, No. 1981 at p.2) Schulte commented that moving forward with a final rule in 2022 would give consumers, especially low- to moderate-income Americans the benefits of lower energy bills and increased comfort. (Schulte, No. 1028 at p. 10) Further, they commented that due to HUD's performance-based code and the efficiencies inherent in factory production based on approved designs, manufactured home producers are nimble and can adjust relatively quickly to new standards. (Schulte, No. 1028 at p. 18)

On the other hand, Clayton Homes stated that the proposed rule would impose more extreme changes than the industry can absorb in one code cycle, and recommended that the implementation period should be 5 years. The ICC updates building codes such as the IECC in three-year cycles, and States normally consider adoption on similar three-to-five-year cycles. The commenter believes the best first step should be to improve the minimum standards that are currently in place that are workable in the present market environment, and then continue to evaluate additional improvements to the standards over time. (Clayton Homes, No. 1589 at p. 3); (Clayton Homes, No. 1986 at p. 3-5) NAHB also supported allowing for a longer time than the proposed 1-year timeframe so that manufacturers have enough time to adjust procurement, design, and production practices while managing their limited resources. (NAHB, No. 1398 at p. 3) NMHOA commented that the proposed one-year lead time to implementation is not sufficient given the changes required to the production process, inspections process, and more than likely, the other public policy changes that would be required to make the higher upfront costs work for consumers and suggested that a three-year time frame seems more appropriate. (NMHOA, No. 1635 at p. 4) Champion Home Builders urged DOE to provide the industry with ample time of 3-5 years to properly implement the adopted energy conservation standards once they are finalized. (Champion Home Builders, No. 1983 at p. 3, 4) MHI stated that when DOE makes changes to appliance standards there is generally a five-year compliance period. Given that the process for manufacturing homes is at least as complex as appliances, the same time period should apply. (MHI, No. 1592 at p. 24); (MHI, No. 1990 at p. 4) MHCC commented that major changes to the manufacturer's

process, facilities, home designs, and supply chains would be required to comply with the DOE standards and a more realistic time frame for implementation would be a minimum of 5 years. (MHCC, No. 1600 at p. 5) TMHA requested that any effective date consider having backlogs and supply-chains to have returned to normal. (TMHA, No. 1628 at p. 4)

DOE notes that the industry has experience with the means to comply with the performance requirements (i.e., *Uo*), as they have had to comply with HUD *Uo* requirements previously. Further, many manufacturers have complied with ENERGY STAR Version 2 efficiency requirements for homes produced on or after June 1, 2020, which includes both component specific and overall *Uo* requirements. Finally, certain manufacturers have been complying with the NEEM program (i.e., NEEM+ certification), which also includes component specific and overall *Uo* requirements. Therefore, DOE believes that many manufacturers already have experience complying with efficiency requirements similar to what DOE is requiring in this final rule.

DOE notes that section 413 requires DOE to update the manufactured home standards within one year following an update to the IECC. (42 U.S.C. 17071(b)(3)(B)) This one-year rule development time period provides DOE the time to evaluate industry compliance with the standards prior to DOE's consideration of updates to the IECC in 2024, as required by the statute. The one-year rule development time period would also minimize the lag time between updates to the IECC and any potential updates to the DOE standards, ensuring that manufactured home purchasers are receiving energy savings based on the most recent model energy codes.

DOE recognizes that compliance with the DOE energy conservation standards may require manufacturers to update designs required under the HUD Code. However, EISA requires DOE to base the energy conservation standards for manufactured homes on the latest edition of the IECC, with considerations made for cost-effectiveness. As discussed in detail in section I.A of this document, while manufacturers may incur costs to update designs to meet the proposed standards, DOE's analysis indicates these costs are outweighed by the benefits gained in energy savings by manufactured home purchasers as a result of the standards, as discussed in section III.A of this document.

b. §460.2 Definitions

In this final rule, DOE is finalizing all definitions proposed in the August 2021 SNOPR, except DOE is modifying the definition for "whole-house mechanical ventilation system" based on a comment received. Accordingly, DOE is finalizing the definitions for the following terms proposed in the August 2021 SNOPR in §460.2: "access (to)," "air barrier," "automatic," "building thermal envelope," "ceiling," "climate zone," "conditioned space," "continuous air barrier," "door," "dropped ceiling," "dropped soffit," "duct," "duct system," "eave," "equipment," "exterior ceiling," "exterior floor," "exterior wall," "fenestration," "floor," "glazed or glazing," "insulation," "heated water circulation system," "2021 IECC," "manufactured home," "manufacturer," "manual," "opaque door," "*R*-value (thermal resistance)," "rough opening," "service hot water," "skylight," "skylight well," "solar heat gain coefficient (SHGC)," "state," "thermostat," "*U*-factor (thermal transmittance)," "U_o (overall thermal transmittance)," "ventilation,"

"vertical fenestration," "wall," "window," and "zone."

In response to comments received to the August 2021 SNOPR, DOE is updating the definition for the term "whole-house mechanical ventilation system" as follows: means an exhaust system, supply system, or combination thereof that is designed to mechanically exchange indoor air with outdoor air when operating continuously or through a programmed intermittent schedule to satisfy the whole house ventilation rates.

The following paragraphs summarize the comments received in response to the August 2021 SNOPR regarding the definitions and the discussion regarding the "whole-house mechanical ventilation system" definition update.

MHI recommended that the definition of "whole-house mechanical ventilation system" must be revised to include "to satisfy the whole house ventilation rates" at the end of the definition. They stated that as proposed in the August 2021 SNOPR, the definition would include all exhaust fans including bath fans and range hoods, systems that MHI stated that they do not believe should be included. (MHI, No. 1592 at pp. 16, 21) In reviewing section R202 of 2021 IECC, DOE notes that the definition is in line with the MHI recommendation, in that it includes "to satisfy the whole house ventilation rates" at the end of the definition. Further, the MH Working Group also recommended including the full definition of the term from the 2015 IECC, which included "to satisfy the whole house ventilation rates" at the end of the definition. Term Sheet, No. 107 at p. 11. DOE notes that the definition remained unchanged in the 2021 IECC update.

Therefore, to be consistent with the 2021 IECC and the MH Working Group recommendation, DOE is updating the definition to be finalized as follows: means an exhaust system, supply system, or combination thereof that is designed to mechanically exchange indoor air with outdoor air when operating continuously or through a programmed intermittent schedule to satisfy the whole house ventilation rates.

NEEA commented that improved clarity on what is considered interior conditioned space is needed. NEEA stated that the space under the floor but above insulation should not be considered conditioned space. (NEEA, No. 1601 at p. 15) DOE received the same exact comment from NEEA in response to the June 2016 NOPR. In response to this comment, DOE recognized that there was an error regarding the "conditioned space" definition proposed in the June 2016 NOPR and instead, proposed in the August 2021 SNOPR that the definition be updated to match the 2021 IECC definition. DOE stated that under the proposed definition, the space under the floor but above the insulation is considered conditioned space, and because DOE is proposing the term as defined in the IECC, the term is appropriately understood by industry. 86 FR 47744, 47767. As such, in this final rule, DOE is finalizing the same proposed definition for "conditioned space," consistent with the August 2021 SNOPR and the 2021 IECC.

NEEA also recommended that "skylight wells" be defined as exterior walls, to clearly indicate that they require insulation to at least exterior wall insulation levels. (NEEA, No. 1601 at p. 16) Again, DOE received the same exact comment from NEEA in response to the June 2016 NOPR. In response to this comment, DOE agreed with

NEEA's suggestion to define skylight well and proposed the following definition: the exterior walls underneath a skylight that extend from the interior finished surface of the exterior ceiling to the exterior surface of the location to which the skylight is attached. DOE also proposed to specify that skylight wells are exterior walls by updating the definition of "exterior wall" to include skylight wells. 86 FR 47744, 47767. DOE did not receive any other comments on this proposal. As such, in this final rule, DOE is finalizing the same proposed definition for "skylight well," consistent with the August 2021 SNOPR.

NEEA also commented that a clearer definition of "access" should be included. (NEEA, No. 1601 at p. 15) In the August 2021 SNOPR, DOE discussed that the 2021 IECC replaced "accessible" with "access (to)" within the code. As the definition of the word "access" was found in the 2021 IECC, DOE proposed to include a definition for this term. Further, to prevent confusion, DOE proposed to revise the regulatory text to incorporate the use of the word "access" instead of "accessible," similar to the updates in the 2021 IECC. 86 FR 47744, 47767-47768. DOE did not receive any other comments on this proposal. As such, in this final rule, DOE is finalizing the same proposed definition for "access (to)," consistent with the August 2021 SNOPR.

ACC FSC commented that the prescriptive R-value requirement in the proposed standards includes a continuous insulation component that is not adequately described or explained in the currently proposed Tier 2 provisions for HUD Zones 2 and 3. Therefore, they stated that continuous insulation is directly and indirectly a part of the proposed

standards and a definition is needed together with a table footnote explaining the insulation components such as cavity insulation and continuous insulation where they are combined. Accordingly, they recommended DOE include the IECC definition for continuous insulation: insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior, or is integral to any opaque surface, of the building envelope. (ACC FSC, No. 1364 at p. 4) In this final rule, DOE is no longer including the exterior wall continuous insulation requirement and instead is finalizing an R-21 exterior wall insulation for Tier 2 climate zones 2 and 3; comments and discussion related to this topic are provided in section III.E.2.b of this document. Therefore, because continuous insulation is no longer included as part of the requirements, a definition for the same is not necessary in this final rule.

VEIC recommended that DOE adopt the IECC definition for "high-efficacy light sources". (VEIC, No. 1633 at p. 6) Because the regulatory text adopted in this final rule does not use the term "high-efficacy light sources," DOE is not defining this term. Further discussion on lighting is provided in section III.F.2 of this document.

Finally, Clayton Homes recommended that DOE adopt a proposed definition for "Manufacturer's retail list price." (Clayton Homes, No. 1986 at p. 9) In addition, Clayton Homes recommended language revisions to§ 460.4(b) and (c) regarding the tiered system proposed in the August 2021 SNOPR. (Clayton Homes, No. 1986 at p. 10) In this final rule, DOE is adopting tiered energy conservation standards based on home size, and not

based on manufacturer's retail list price. Because the threshold based on manufacturer's retail list price is no longer applicable, DOE is not including a definition for manufacturer's retail list price in this final rule.

c. §460.3 Materials incorporated by reference

In this final rule, DOE is not incorporating the 2021 IECC by reference. The 2021 IECC serves as the basis for the regulations proposed in this document, with the proposed requirements addressing technical issues specific to manufactured homes, relying on the HUD zones, and addressing issues related to health and safety, as well as the need to preserve the affordability of manufactured homes.

Further, DOE is incorporating by reference Air Conditioning Contractors of America ("ACCA") Manual J; ACCA Manual S; and "Overall *U*-Values and Heating/Cooling Loads–Manufactured Homes" by Conner and Taylor (the Battelle Method). DOE is incorporating by reference ACCA Manuals J and S in §460.205 of the regulatory text and would relate to the selection and sizing of heating and cooling equipment. In addition, PNL-8006 ("Overall U-values and Heating/Cooling Loads–Manufactured Homes"), or the Battelle Method, is an industry standard methodology for calculating the overall thermal transmittance (*Uo*) of a manufactured home and is also currently referenced in the HUD Code for calculation of overall thermal transmittance. DOE is incorporating by reference the Battelle Method to determine the same (*Uo*).

DOE received a number of comments regarding the materials incorporated by reference. DOE also received technical comments regarding the application of ACCA Manuals S and J for manufactured housing, which are discussed in section III.F.3.e of this document.

MHI recommended deleting the reference to the specific sections of the 2021 IECC in the proposed regulatory text §460.102 through §460.204. (MHI, No. 1592 at pp. 17 through 21) Conversely, the ICC requested that in referencing the IECC, DOE ensures it has respected the Code Council's rights as a copyright holder. Referencing Office of Management and Budget ("OMB") Circular A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities, Revised," ICC commented that in order to meet the minimum requirements, DOE must "(a) expressly acknowledge that the IECC is a copyright protected document, published and owned by ICC; (b) explicitly state that any reproduction or copying of the standard (other than for personal, non-commercial purposes) requires express written permission or license from ICC; and (c) state that copies of the IECC are available for purchase from ICC at its website, www.iccsafe.org." Accordingly, the ICC encouraged that DOE incorporate by reference the copywritten material from the IECC. (ICC, No. 1621 at p.2)

Subject to copyright law, DOE acknowledges that the IECC is a copyright protected document, published and owned by the ICC, and that reproduction or copying of the IECC requires written permission or license from the ICC. As noted previously,

copies of the IECC are available for purchase at *www.iccsafe.org*. They may also be viewed for free on ICC's public access website at: *https://codes.iccsafe.org/public/collections/I-Codes*. As discussed previously, DOE and the manufactured housing working group evaluated the 2015 IECC, and DOE subsequently evaluated the 2018 and the 2021 IECC. The MH working group recommendations and the June 2016 NOPR were based on the 2015 IECC, but as explained throughout this document, modifications are necessary to address technical issues that are specific to manufactured housing, as opposed to site-built housing, which is the focus of the IECC. As such, this final rule is (1) based directly on certain IECC sections, (2) based on other sections of the IECC with modification, and (3) does not include certain other sections as they were either not pertinent to manufactured housing or not needed to establish energy conservation standards.

2. Subpart B: Building Thermal Envelope

The requirements in subpart B relate to climate zones, the building thermal envelope, installation of insulation and building thermal envelope leakage for manufactured homes. The following sections provide further details, a discussion of comments on the August 2021 SNOPR and October 2021 NODA relevant to subpart B and responses to any such comments. As discussed previously, for the tiered standards, Tier 1 manufactured homes (i.e., single-section homes) would be subject to different building thermal envelope requirements than all other manufactured homes (Tier 2 manufactured homes; i.e., multi-section homes). The requirements are discussed in the following sections.

a. §460.101 Climate zones

Pursuant to EISA, DOE may base its energy conservation standards on the climate zones established by HUD rather than on the climate zones contained in the IECC. (42 U.S.C. 17071(b)(2)(B)) The potential for climatic differences to affect energy consumption supports an approach in which energy conservation standards account for geographic differences in climate. In this final rule, DOE aligns with the HUD zones.

As indicated in Figure III.1, the HUD Code divides the United States into three distinct climate zones for the purpose of setting its building thermal envelope requirements, the boundaries of which are separated along state lines. By contrast, as indicated in Figure III.2, section R301 of the 2021 IECC divides the country into nine climate zones, the boundaries of which are separated along county lines. The 2021 IECC also provides requirements for three possible variants (dry, moist, and marine) within certain climate zones, as indicated in Figure III.2. The HUD Code zones were developed to be sensitive to the manner in which the manufactured housing industry constructs and places manufactured homes into the market. The IECC climate zones are separated along county lines to reflect a more granular overview of climate distinctions within the United States, and to facilitate state and local enforcement of the IECC for residential and commercial buildings, including site-built and modular construction.

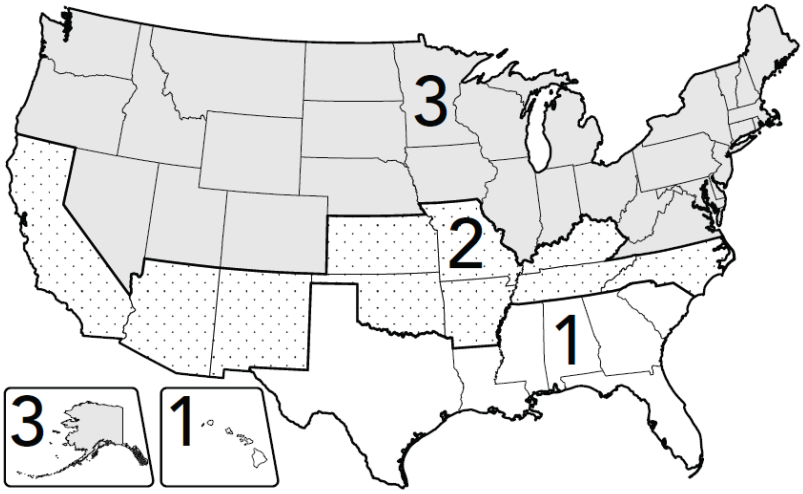

Figure III.1 U_o Zones in the HUD Code

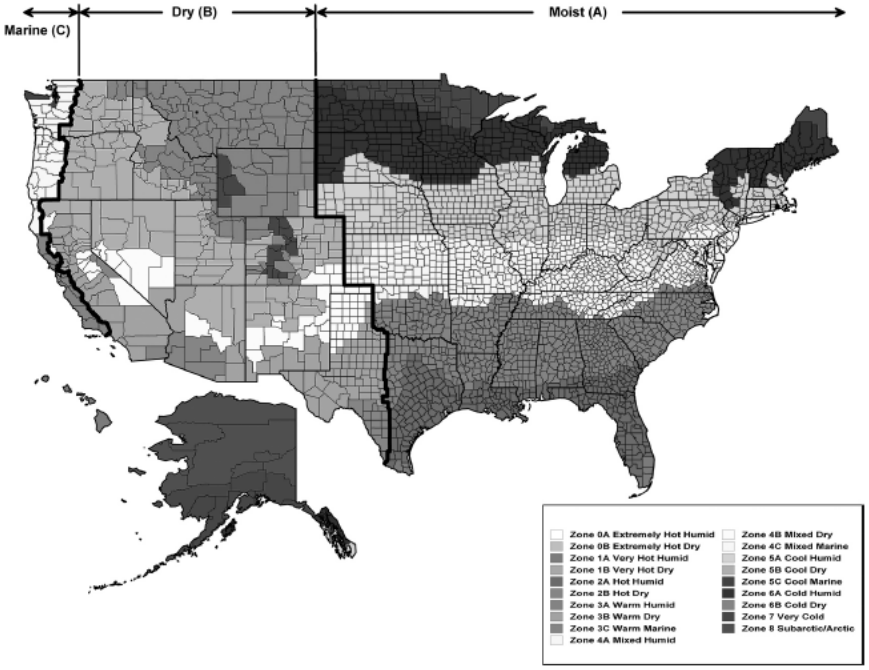

Figure III.2 Climate Zones in the 2021 IECC

In the August 2021 SNOPR and October 2021 NODA, DOE proposed three climate zones consistent with the HUD zones. DOE received several comments regarding climate zones.

UCB suggested that DOE should consider different climate zone maps that are more representative of actual U.S. climate variability. They commented that the zones do not accurately reflect areas of similar weather and climate for the country. Accordingly, they stated that a more complex climate zone map that accounts for different areas of climate variability would be more sufficient in determining these different levels of efficiency standards, and therefore DOE should create a new climate zone map based on the IECC zones. (UCB, No. 1618 at p. 3, 12-14) On the other hand, MHI appreciated DOE's use of the HUD Code zones to match manufacturing practices more appropriately. (MHI, No. 1592 at p. 17) MHCC and Clayton Homes also strongly supported using the current HUD zones for the purpose of this standard. (MHCC, No. 1600 at p. 6); (Clayton Homes, No. 1589 at p. 16) Schulte stated that while there are similarities in the proposed insulation requirements for components for zones 1 and 2 walls and floors, the climates of temperate zone states are sufficiently different from those of warm states to justify a separate thermal zone. (Schulte, No. 1028 at p. 12)

As already discussed, EISA explicitly permits the use of HUD zones. (42 U.S.C. 17071(b)(2)(B)) The HUD zones were developed with specific consideration of the manner in which the manufactured housing industry constructs and places manufactured homes into the market. The HUD zone boundaries are separated along state lines. Aligning the climate zones between the DOE requirements and the HUD Code would reduce the complexities and burden faced by manufacturers of compliance with the DOE standards. Additionally, it would reduce the potential for confusion of manufactured

home purchasers by allowing them to rely on a single map to determine whether a manufactured home would be appropriate for a given location, as opposed to requiring them to consult one map under the HUD Code and a different map under the DOE requirements. As such, in this final rule, DOE maintains the three climate zones, consistent with the HUD zones. DOE understands that the HUD code may be updated in the future to adopt more representative HUD zones. Should HUD update those zones, DOE would move in a timely manner to consider adopting aligning changes in its own code in future rulemakings for manufactured housing as DOE understands the importance of harmonization and reducing complexities for manufacturers.

b. §460.102 Building Thermal Envelope Requirements

For the standard, Tier 1 would incorporate building thermal envelope measures based on the 2021 IECC but would limit the incremental purchase price increase to an average of less than $750 for single-section homes. For Tier 2, the building thermal envelope measures are based on those proposed in the June 2016 NOPR, updated to reflect the HUD zones and cost-effective measures based on the 2021 IECC requirements. Further, Tier 2 includes alternate exterior wall insulation requirement (R-21) for climate zones 2 and 3, as presented in the August 2021 SNOPR and October 2021 NODA.

Consistent with the August 2021 SNOPR, DOE is including §460.102 in the regulatory text to establish requirements related to the building thermal envelope, including the materials within a manufactured home that separate the interior conditioned

space from the exterior of the building or interior spaces that are not conditioned space. Further §460.102(a) would provide manufacturers the option of choosing one of two pathways for compliance to ensure that the building thermal envelope would meet more stringent energy conservation levels. These two pathways are known as the prescriptive approach and the performance approach. Consistent with the recommendation of the MH working group, DOE will allow manufacturers to choose between these two pathways for compliance, which would result in cost-effective energy savings for homeowners while providing for flexibility within the manufactured housing industry. Term Sheet, No. 107 at pp. 3-4. This approach is also consistent with the 2021 IECC, which provides a climate zone-specific prescriptive building thermal envelope component pathway (R402.1.2) and an alternate pathway to compliance, which allows for a home to be constructed using a variety of materials as long as the entire building thermal envelope has a maximum, singular total UA value[39] (R402.1.5).

Further, consistent with the August 2021 SNOPR and the October 2021 NODA, DOE continues to include prescriptive requirements that would establish specific component minimum R-value, maximum U-factor, and SHGC requirements, providing a straightforward option for construction planning. The prescriptive requirements would be under §460.102(b), with the building thermal envelope requirements under §460.102(b)(1). The compliance option based on performance requirements, on the other hand, would allow a manufactured home to be constructed using a variety of materials

[39] UA is the *U*-factor multiplied by area.

with varying thermal properties so long as the building thermal envelope achieved a required level of overall thermal performance. The performance requirements thus would provide manufacturers with greater flexibility in identifying and implementing cost-effective approaches to building thermal envelope design. The U_o requirements would be determined by applying the adopted prescriptive building thermal envelope requirements to manufactured homes using typical dimensions and construction techniques and then calculating the resulting U_o.

In developing the set of Tier 1 energy efficiency measures, DOE considered measures for building elements of manufactured homes based on building components subject to the 2021 IECC (*i.e.*, exterior floor, exterior walls, exterior ceiling, and fenestration). DOE evaluated different combinations of energy efficiency measures and stringencies for exterior floor, wall, ceiling, and windows (fenestration). DOE compared the potential energy savings for each of the different combinations analyzed and determined the optimal set of energy efficiency measures that would yield an incremental cost increase less than $750.

In developing the set of Tier 2 energy efficiency measures, DOE first mapped the June 2016 NOPR requirements (based on four climate zones) to HUD zones (based on three climate zones). DOE used the manufactured home national shipment percentages for each of the cities analyzed,[40] and the corresponding HUD zone and the June 2016

[40] DOE used shipments for 2020 from the annual production and shipment data provided by MHI. See Manufactured Home Shipments by Product Mix, Manufactured Housing Institute (2020).

NOPR climate zone identifiers for each of the cities. DOE then summed the shipment percentages of the cities with the same June 2016 NOPR proposed climate zones within each of the HUD zones. According to which of the June 2016 NOPR-proposed climate zones showed the maximum shipment weight per HUD zone, DOE incorporated those proposed June 2016 NOPR requirements for that HUD zone.

As part of the energy efficiency measures, DOE considered the updates to the 2021 IECC. In reviewing Section R402.1 of the 2021 IECC, DOE determined the following relevant updates are merited when compared to the 2015 IECC that the MH working group had considered:

- The maximum fenestration *U*-factors were updated from 0.35 to 0.30 for IECC climate zones 3 and 4 (except marine); and from 0.32 to 0.30 for IECC climate zones marine 4, 5 through 8.
- The maximum glazed fenestration SHGC was updated from NR to 0.40 for IECC climate zones 5 and marine 4.
- The minimum ceiling *R*-value was updated from *R*-38 to *R*-49 for IECC climate zones 2 and 3; and from *R*-49 to *R*-60 for IECC climate zones 4 through 8.
- The minimum wall *R*-value was updated from *R*-13 to *R*-13 or *R*-0+10 for IECC climates zones 0 through 2; from *R*-20 or *R*-13+5 to *R*-20 or *R*-13+5ci or *R*-0+15 for IECC climate zones 3; from *R*-20 or *R*-13+5 to *R*-20+5 or *R*-13+10ci or *R*-0+15 for IECC climate zones 4 and 5; and from *R*-20+5 or *R*-13+10ci to *R*-20+5ci or *R*-13+10ci or *R*-0+20 for IECC climate zones 6 through 8.

With regards to the 2021 IECC updates, DOE did not incorporate the minimum ceiling *R*-value updates given the physical space constraints of manufactured homes and because EISA allows DOE to consider the design and factory construction techniques of manufactured homes as compared to site-built and modular homes. (42 U.S.C. 17071(b)(2)). Specifically, manufactured homes typically have a lower overall height compared to site-built homes, which leads to constrained space, and therefore there is less exterior ceiling insulation. DOE did consider all other updates consistent with EISA and the analysis done for the June 2016 NOPR and the August 2021 SNOPR. Accordingly, DOE similarly mapped the 2021 IECC updates to the corresponding climate zone.

Therefore, for the standard, the Tier 1 prescriptive building thermal envelope requirements are presented in Table III.5 and the Tier 2 prescriptive building thermal envelope requirements are presented in Table III.6. Further discussion on the requirements is provided in the forthcoming sections.

Table III.5: Tier 1 Building Thermal Envelope Prescriptive Requirements

Climate Zone	Exterior Wall Insulation *R*-value	Exterior Ceiling Insulation *R*-value	Exterior Floor Insulation *R*-value	Window *U*-factor	Skylight *U*-factor	Door *U*-factor	Glazed Fenestration SHGC
1	13	22	22	1.08	0.75	0.40	0.7
2	13	22	19	0.5	0.55	0.40	0.6
3	19	22	22	0.35	0.55	0.40	Not applicable

Table III.6: Tier 2 Building Thermal Envelope Prescriptive Requirements

Climate Zone	Exterior Wall Insulation *R*-value	Exterior Ceiling Insulation *R*-value	Exterior Floor Insulation *R*-value	Window *U*-factor	Skylight *U*-factor	Door *U*-factor	Glazed Fenestration SHGC
1	13	30	13	0.32	0.75	0.40	0.33
2	21	30	19	0.30	0.55	0.40	0.25
3	21	38	30	0.30	0.55	0.40	Not applicable

As discussed, use of the HUD zones instead of the IECC climate zones does not allow for use of the IECC requirements absent modification. In line with the building thermal envelope requirements and use of the HUD zones, DOE is finalizing the following proposals from the August 2021 SNOPR:

- The requirement regarding the use of a combination of *R*-21 batt insulation and *R*-14 blanket insulation in lieu of *R*-30 for the purpose of compliance with the Climate Zone 3 exterior floor insulation *R*-value requirement. (This would be applicable for Tier 2 only.)
- The maximum *U*-factor values as alternatives to the minimum *R*-value requirements. DOE calculated the maximum *U*-factor values by using the Battelle Method that was recommended by the MH working group.[41] DOE performed these calculations based on typical wall, ceiling, and floor assemblies used by the manufactured home industry. Table III.7 provides the updated maximum *U*-factor values for Tier 1 manufactured homes (which would be for single-section homes only).
- Table III.8 provides the updated maximum U-factor values for Tier 2 manufactured homes (which would be for multi-section homes only).

[41] "Overall *U*-Values and Heating/Cooling Loads—Manufactured Homes'' by Conner and Taylor.

Table III.7 *U*-factor Alternatives to the Tier 1 *R*-value Requirements

Climate Zone	Exterior Ceiling *U*-factor	Exterior Wall *U*-factor	Exterior Floor *U*-factor
1	0.061	0.094	0.049
2	0.061	0.094	0.056
3	0.061	0.068	0.049

Table III.8 U-factor Alternatives to the Tier 2 R-value Requirements

Climate Zone	Exterior Ceiling *U*-factor	Exterior Wall *U*-factor	Exterior Floor *U*-factor
1	0.043	0.094	0.078
2	0.043	0.063	0.056
3	0.037	0.063	0.032

- *Uo* values using the Battelle Method for single- and multi-section manufactured homes. Table III.9 provides the updated *Uo* values for Tier 1 manufactured homes. The Tier 1 standards provide energy efficiency standards more stringent than the HUD thermal protection standards required in 24 CFR 3280.506(a). Table III.10 provides the updated *Uo* values for Tier 2 manufactured homes.

Table III.9 Tier 1 Building Thermal Envelope Performance Requirements

Climate Zone	Single-Section U_o
1	0.110
2	0.091
3	0.074

Table III.10 Tier 2 Building Thermal Envelope Performance Requirements

Climate Zone	Multi-Section U_o
1	0.082
2	0.066
3	0.055

- Area-weighted average vertical fenestration *U*-factor requirements to not exceed 0.48 in Climate Zone 2 or 0.40 in Climate Zone 3.
- Area-weighted average skylight *U*-factor requirements to not exceed 0.75 in Climate Zone 2 and Climate Zone 3.

The following sections discuss comments DOE received regarding the building thermal envelope requirements proposed in the August 2021 SNOPR and presented in the October 2021 NODA. Further, the following sections also provides the reasoning for the amended final rule prescriptive and performance requirements.

Tier 1 standard requirements

DOE received a number of comments regarding the proposed Tier 1 standard requirements. Schulte stated that Tier 1 standards are only a minor improvement from the existing HUD standards issued nearly 30 years ago, and that it is hard to see how approving these standards would accomplish the EISA goals. (Schulte, No. 1028 at p. 12) RECA stated that the *Uo* baseline should be improved by at least a similar percentage as the improvements in the IECC made since the 2007 EISA. RECA stated that, even if the efficiency requirements for specific components may not match the IECC perfectly, they would expect the percentage improvement in the *Uo* targets for both single- and multi-section units to improve by as much as the IECC over the period since Congress included this requirement in the 2007 EISA, and likely even more, considering how far behind these standards were in 2007. RECA also mentioned that the proposed *Uo* targets for Tier 1 (for both single-section and multi-section units) are only moderately improved (5.17-

9.38 percent) from the current targets in 24 CFR 3280.506(a), and capture only a fraction of the IECC improvements adopted since 2007. Because of this, RECA recommended that DOE eliminate Tier 1 *Uo* targets and instead use Tier 2 *Uo* targets for all buildings, consistent with the improvements in the IECC since the 2007 EISA. If different Tier 1 targets are deemed absolutely necessary, they suggested that the standards should be set at least 20-25 percent more stringent than the current requirement. (RECA, No. 1570 at pp. 4-6)

In response to August 2021 SNOPR and October 2021 NODA, Clayton Homes stated that proposed Tier 1 energy conservation standards are a reasonable first step in raising the energy standards for MH. (Clayton Homes, No. 1589 at p. 16) MHI stated that based on the calculations performed on prototypical homes, the proposed Zone 1 requirements should be able to be met with upgraded insulation and upgraded windows. MHI recommended the following changes for Table 460.102-5 of the regulatory text: Change Zone 1 total *Uo* to 0.098 for single and 0.096 for multi-sectional, Zone 2 total *Uo* to 0.081 for single and 0.079 for multi-sectional, and the Zone 3 total *Uo* to 0.076 for single and 0.073 for multi-sectional. (MHI, No. 1592 at p. 9, 18); (Clayton Homes, No. 1589 at p. 9)

However, in response to the January 2022 DEIS, both MHI and Clayton provided alternate recommendations. MHI recommended untiered standards with less stringent requirements than Tier 2. (MHI, No. 1990 at p. 14-17) Clayton Homes separately recommended the following changes to Table 460.102-1 of the regulatory text: Change

Zone 1 exterior wall insulation requirements to R-11, exterior ceiling insulation to R-22, and exterior floor insulation requirements to R-13; Change zone 2 exterior wall insulation requirements to R-11 and exterior ceiling insulation requirements to R-25; and change Zone 3 exterior wall insulation requirements to R-15, and exterior ceiling insulation requirements to R-25. In addition, Clayton Homes recommended the following changes to Table 460.102-3 of the regulatory text: Change Zone 1 exterior wall U-factor to 0.111 and exterior floor U-factor to 0.078, and change Zone 2 exterior wall U-factor to 0.111. (Clayton Homes, No. 1986 at p. 11, 13)

Regarding specific Tier 1 component requirements, RECA recommended that climate zone 2 be set at the same insulation R-value level as climate zones 1 and 3 for floor insulation, because they see no reason why climate zone 2 should be lower than climate zone 1 or 3. (RECA, No. 1570 at pp. 4-6) RECA also commented that the fenestration requirements for Tier 1 are unreasonably weak given the ubiquity of reasonably efficient and cost-effective fenestration with U-factors at or below 0.30 and SHGCs less than 0.25. Further, RECA stated that the proposed requirements for Tier 1 ceiling insulation, particularly in Climate Zone 3, are lower than the prescriptive requirements for any climate zone set by any version of the IECC published in the past 15 years. (RECA, No. 1570 at p. 3, 6) VEIC stated that they find it unacceptable that DOE would allow for single pane windows or single pane with storm windows in any climate zone. VEIC stated that if tiered standards are adopted, DOE should increase the prescriptive window efficiency standards for all zones. (VEIC, No. 1633 at p. 6, 7)

As discussed previously, in developing the set of Tier 1 energy efficiency measures, DOE started with the 2021 IECC building components and then adjusted the requirements to meet a first cost target. As such, DOE compared the potential energy savings for each of the different combinations analyzed (those building components subject to the 2021 IECC, *i.e.*, exterior floor, exterior walls, exterior ceiling, and fenestration) using the range of efficiency measures originally identified by the MH working group as appropriate for manufactured home design and determined the optimal set of energy efficiency measures that would yield an incremental cost increase less than $750.

DOE's objective in defining the Tier 1 incremental purchase price threshold was based on which threshold a low-income buyer purchasing a single-section home (using typical loan terms available to these homebuyers, primarily chattel loans with higher interest rates) would, on average, realize a positive cash flow within Year 1 of the standard based on the down payment, incremental loan payment, and energy cost savings. DOE considered positive cash flow within Year 1 to ensure manufactured homes would remain affordable for a low-income consumer. DOE believes this addresses the concerns raised by HUD and other stakeholders. As such, DOE determined that an incremental purchase price of less than $750 provided a beneficial financial outcome for these consumers given lifecycle cost savings and energy cost savings, while minimizing first cost impacts.

Accordingly, because of the objective of the tier to develop an optimal set of

measures, the analysis resulted in different insulation requirements depending on climate zone, and for certain insulation requirements to be higher than others. Therefore, any changes in requirements would have negative effects on positive cash flow for low-income consumers, which is contrary to DOE's intentions regarding housing affordability. Any decrease in efficiency measures would not provide the original benefit of expected energy cost savings within Year 1 of the standard. Finally, DOE notes that the performance method, i.e., *Uo* method, provides manufacturers more flexibility with determining the component specific requirements, as long as the minimum *Uo* requirements are met. As such, DOE maintains the Tier 1 energy efficiency options proposed in the August 2021 SNOPR.

Additional efficiency packages

Section R401.2.5 of the 2021 IECC requires that in addition to the prescriptive compliance option, additional energy efficiency requirements must be utilized to achieve further energy savings. Section 408.2 provides five additional efficiency package options to achieve these additional energy savings, which include: (1) enhanced envelope performance; (2) more efficient HVAC equipment performance; (3) reduced energy use in service water heating; (4) more efficient duct thermal distribution; and (5) improved air sealing and efficient ventilation systems. In developing recommendations, the MH working group evaluated the 2015 IECC, which did not include comparable provisions to sections R401.2.5 and R408.2 of the 2021 IECC. In the August 2021 SNOPR, DOE did not propose any of the additional efficiency packages either because of consideration of

the design and factory construction of manufactured homes, or potential cost-effectiveness constraints. 86 FR 47744, 47773-47774.

In response to the August 2021 SNOPR, DOE received a number of comments regarding these additional efficiency packages.

NPCC stated that the standards should ensure additional savings through prescriptive requirements and an additional efficiency requirement with package options based on the model code. (NPCC, No. 1567 at p. 2) The CEC recommended that DOE should incorporate the State Attorneys General's request to require manufacturers to include the additional efficiency packages consistent with IECC R401.2.5.1. (CEC, No. 1629 at p. 4) NBI stated that the 2021 IECC requires homes following the prescriptive pathway to choose among several efficiency packages, which they believe should apply to manufactured homes. (NBI, No. 1404 at p. 1-2) The Joint Commenters stated that neither DOE's tiered nor untiered standards require manufacturers to provide additional energy savings through efficiency package options such as those required by IECC R401.2.5.1. Therefore, to ensure compliance with EISA, they stated that DOE's final standards should include such a requirement. (Joint Commenters, No. 1630 at p. 1, 2) The Attorneys General urged DOE to consider additional energy savings through efficiency package options such as those required by IECC R401.2.5.1 to ensure compliance with EISA. (Attorneys General, No. 1625 at p. 2, 4, 6)

RECA stated that the final rule should incorporate the additional efficiency options of equivalent energy savings. RECA commented that the fact that specific requirements in the IECC are not already adapted for use in manufactured housing does not release DOE from its obligation to set energy conservation standards that are consistent with the model code, and RECA urged DOE to reconsider this decision and to require a 5 percent improvement and/or to find other alternatives to achieve similar energy savings. (RECA, No. 1570 at p. 1, 2, 7) Earthjustice and Prosperity Now suggested that DOE is required to evaluate provisions of sections R401.2.5 and R408 of the 2021 IECC. They stated that DOE has not yet determined whether this requirement would be cost-effective. Further, they suggested that HRV/ERVs (i.e., heat recovery and energy recovery ventilators) must be addressed. They commented that DOE is required to consider the statutorily-mandated analysis and must address this defect in the final rule. (Earthjustice and Prosperity Now, No. 1637 at p. 7) Major mentioned that furnaces in MH are always oversized and that there are no furnace standards mentioned in the document. (Major, No. 1023 at p. 1)

NRECA stated that they have researched upgrading the "shell" or envelope of the manufactured home through rebates but doing so did not make sense once applying a cost-benefit analysis. Instead, they suggested focusing on upgrading the heating/cooling of the manufactured home made the most economic sense. NRECA stated that the most effective way to both improve efficiency in manufactured homes and lead to lower electricity bills for their consumer-members is by upgrading to high-efficiency heat pumps in the heating systems of these homes up front, before the home is delivered. They

suggested that providing rebates to install high-efficiency heat pumps in new or existing MH would be helpful. (NRECA, No. 1406 at p. 1, 3)

NEEA recommended inclusion of the five IECC options plus a "limited house size" option. For enhanced envelope performance, not only did NEEA encourage DOE to increase the attic insulation to align with the IECC 2021 prescriptive path, but also to insert an additional efficiency package focused on envelope improvements that could reward manufacturers who are already building efficient envelopes. (NEEA, No. 1601 at p. 4) For more efficient HVAC, NEEA encouraged an additional efficiency package that requires air-source heat pumps instead of electric furnaces or electric baseboard heat will have significant energy and cost savings (NEEA found that 40 percent of MH use low efficiency electric furnaces). NEEA encouraged DOE to require 10 HSPF/16 SEER air source heat pumps, which aligns with IECC 2021. For gas furnaces in manufactured homes, NEEA encouraged requiring a 95 percent AFUE condensing gas furnace plus 16 SEER air conditioning unit, which would be installed instead of a non-condensing gas furnace. NEEA referenced a study that suggested that there is an incremental cost of $217 for a 95 AFUE gas furnace compared to current practice baseline assumed at 92 AFUE. (NEEA, No. 1601 at pp. 4-5)

For reduced energy use in service water heating, NEEA encouraged DOE to consider more efficient heat pump water heaters and tankless gas water heaters. Due to challenges in retrofitting heat pump water heaters into manufactured homes after initial construction, NEEA recommends encouraging their installation during initial

construction. For distribution or ductwork, NEEA encouraged ductless heat pump ("DHP") solutions that eliminate all energy losses due to ductwork. They suggested that allowing a 10 HSPF/16 SEER DHP option to satisfy the distribution criteria could lead to significant energy savings. Alternatively, NEEA suggested that bringing ducts inside the building shell to reduce the amount of heat loss external to the building. (NEEA, No. 1601 at p. 5) Regarding enhanced air sealing, NEEA stated that technology such as pressurized whole-building air sealing could be used in a warehouse and result in a very low-infiltration rate of the building shell. Further, they suggested an Energy Recovery Ventilator ("ERV") or Heat Recovery Ventilator ("HRV") for continuous mechanical ventilation could address poor air quality. Finally, NEEA encouraged a sixth additional efficiency option package based on limited house size. They suggested that manufacturers could build a single wide home to the untiered standards and select the limited house size option (i.e., they would not need to choose one of the five additional energy package options). For multi-section homes, however, NEEA suggested these homes would still need to select from the five other options. (NEEA, No. 1601 at p. 6)

ACEEE stated that a heat pump for cooling and heating, a heat pump water heater, a better thermal distribution system, better air sealing and ventilation, and possibly a better envelope all may be cost-effective options for additional savings. They stated that heat pumps can provide highly efficient heating (especially compared to electric resistance heat, the most common source in MH) and that heat pump water heaters also can provide large energy and carbon savings at a reasonable cost. ACEEE further provided a detailed study, with costs and energy savings, for including a heat

pump option for manufactured homes.[42] (ACEEE, No. 1631 at p. 6) VEIC strongly recommended DOE adopt the additional efficiency package options requirement and modify the package options as appropriate to manufactured housing. They stated that only one option needs to be selected to demonstrate cost-effectiveness of the code overall, and provided an example of one potential package option, where ductwork was brought inside the thermal envelope by a factory located in New England. They stated that these duct designs could easily be integrated into a manufactured home assembly line. (VEIC, No. 1633 at p. 7, 8)

On the other hand, MHI stated that HRV and ERV provisions would add significantly to the cost (because of redesign and construction) of manufactured homes. (MHI, No. 1592 at p. 25) MHCC also stated that HRV and ERV systems are not cost effective for manufactured housing and have proven to be problematic in certain climate zones (without providing further details as to why). (MHCC, No. 1600 at p. 11)

Regarding costs, Schulte stated that the costs and energy savings for the five additional efficiency packages in the IECC have been evaluated by several organizations. The first is the National Association of Home Builders Home Innovation Research Lab Report No. CR1391: 2021 IECC Residential Cost Effectiveness Analysis.[43] The report

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[42] Bell-Pasht, A., and L. Ungar. 2021. Strong Universal Energy Efficiency Standards Will Make Manufactured Homes More Affordable. Washington, DC: American Council for an Energy-Efficient Economy. *aceee.org/white-paper/2022/01/strong-universal-energy-efficiencystandards-manufactured-homes*.

[43] Home Innovation Research Labs. 2021. 2021 IECC Residential Cost Effectiveness Analysis; Report No. CR1391_06112021. *https://www.nahb.org/-/media/NAHB/advocacy/docs/top-priorities/codes/code-adoption/2021-iecc-cost-effectiveness-analysis-hirl.pdf*

covered the five additional efficiency options based on a 2,500 square foot standard reference single family home and the changes from the 2018 to the 2021 IECC standards. The report concluded that the five optional efficiency packages would have very long simple paybacks ranging from 20 years for the water heater to as much as 90 years for the improved ventilation, electric house with improved air tightness. The enhanced water heater had substantially shorter payback periods than the HVAC or duct sealing options. Schulte stated that the water heater option might be cost efficient, but even that option has a payback period of 20 years. Further, they referenced the PNNL-31440 Report[44] which they stated confirms the other findings that optional efficiency measure R408.2.3 for water heaters is the most cost-effective way to achieve the 5 percent additional reduction in energy usage. (Schulte, No. 1028 at p. 24-25)

As discussed in the August 2021 SNOPR and further in this section, consistent with the recommendations of the MH working group, the performance requirements in the proposed energy conservation standards are specific to the building thermal envelope only, and do not incorporate any specifications on HVAC energy efficiency. Accordingly, DOE did not consider the more efficient HVAC equipment performance and reduced energy use in service water heating options. Further, DOE also did not examine the more efficient duct thermal distribution option based on EISA's allowance to consider the design and factory construction techniques of manufactured housing. This option in the 2021 IECC focuses primarily on the location of the duct or ductless systems

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[44] PNNL-31440 prepared for U.S. DOE; July 2021; Energy Savings Analysis: 2021 IECC for Residential Buildings; *https://www.energycodes.gov/sites/default/files/2021-07/2021_IECC_Final_Determination_AnalysisTSD.pdf*

in a home (in terms of duct thermal distribution design) as opposed to improving efficiency of the ducts as already installed and designed, and therefore is not appropriate for this rule. (42 U.S.C. 17071(b)(2)) Finally, for the enhanced envelope performance option, DOE was unable to incorporate this requirement given the building thermal envelope energy efficiency measure limitations based on the space constraints of manufactured homes. 86 FR 47744, 47773-47774

For the remaining efficiency package option, i.e., improved air sealing and efficient ventilation system option, DOE acknowledges the possibility of achieving additional energy savings for manufactured homes, as suggested by commenters. In the August 2021 SNOPR, DOE presented the Building Energy Codes Program ("BECP") analysis on HRVs and stated that that it had not yet determined whether including HRV or ERV would be cost-effective for manufactured homes. 86 FR 47744, 47774. Accordingly, DOE requested costs and savings data associated with this requirement (in addition to the other additional efficiency package options). *Id.* DOE did not receive any data regarding the cost-effectiveness of the ERV/HRV requirement. At this time, DOE does not have sufficient data to provide a reasonable assessment of these measures when applied to manufactured homes as required by the EISA statute. In other words, DOE is unable to determine whether these measures are appropriate for manufactured homes when considering the unique design and construction techniques of these homes and whether such measures would be cost-effective when applied to them. Accordingly, DOE is not considering these additional efficiency package options in this final rule.

However, DOE will continue to accept any data regarding these measures and may consider these options in any future rulemakings.

Tier 2 exterior wall insulation requirement

In the August 2021 SNOPR, DOE proposed R-20+5 insulation for climate zone 2 and 3 for the Tier 2/Untiered standard to be consistent with the 2021 IECC. 86 FR 47744, 47772. DOE received a number of comments on the proposed Tier 2 Climate Zones 2 and 3 proposed R-20+5 continuous exterior wall insulation requirement.

VEIC applauded DOE's inclusion of a continuous insulation requirement for zones 2 and 3. VEIC recommended that DOE maintain the 2021 IECC alternative prescriptive approaches to obtaining the intended exterior wall efficiency, by specifically including the additional prescriptive wall insulation options within the prescriptive requirements table, *i.e.*, the 2021 IECC Table R402.1.3 minimum insulation R-value requirement for wood frame walls is written as follows: R-20+5 or 13+10 or 0+20. (VEIC, No. 1633 at p. 5) NEEA encouraged DOE not to revert to R-21 as explored in the NODA. They stated that continuous wall insulation reduces thermal bridging and increases occupant comfort, and they stated that there is evidence of potential cost savings from stick-built practices. NEEA recommended keeping the continuous insulation provision to align with IECC in Climate Zones 2 and 3, and that Climate Zone 1 better aligns with 2021 IECC currently. (NEEA, No. 1601 at pp. 4, 16)

ACC FSC suggested that DOE consider alternatives to 2x6 R-20 construction for Climate Zones 2 and 3 in the Tier 2 provisions.[45] They stated that 2x4 construction is much more common and suitable for manufactured housing, and recommended that if a compromise to the IECC levels of wall performance is needed, the most practical and reasonable cost-effective solutions should turn to 2x4 wall assembly options which may include R-15+5, R-13+7.5, R-15+7.5, or similar prescriptive R-value solutions for HUD Zones 2 and 3. They stated that the alternatives (R-15+5, R-13+7.5, or R-15+7.5) will make use of and employ the mentioned economic and performance benefits of a continuously insulated wall assembly, will more closely maintain the basis of the 2021 IECC, and will make modifications to better accommodate the practical constraints of manufactured housing as the authority given to DOE in EISA allows. (ACC FSC, No. 1364 at p. 2)

Further, ACC FSC commented that the R-20+5 analysis misses the benefits of foam plastic continuous insulation by protecting the wall assembly from moisture and condensation by providing an insulation ratio effect that is effective in HUD Zones 2 and 3. They commented that the benefits tend to result in better performing and more resilient manufactured homes, which will also tend to improve the economics of home-ownership by having extended life-expectancy (typically more than 40-years, not 30-years as assumed by DOE). ACC FSC also commented that vapor and moisture control strategies are inextricably linked to energy efficiency measures such as insulation properties,

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[45] In the energy simulation analysis, DOE considered a 2x6 stud for any R-values at or greater than R-19 and a 2x4 stud for any R-values less than R-19. Chapter 7, Section 7.4.2 of the August 2021 SNOPR TSD.

amount, and location on the assembly. (ACC FSC, No. 1364 at p. 2-3) Finally, ACC FSC stated that the R-20+5 vs. R-21 wall insulation analysis missed the economic benefit of having reduced heating/cooling load and equipment sizing with the R-20+5 option, and that this benefit would also apply to consideration of the above-mentioned R-15+5, R-13+7.5, and R-15+7.5 alternatives. (ACC FSC, No. 1364 at p. 3)

On the other hand, Schulte stated it is not clear that the energy savings for R-20+5 will offset the added investment cost, and therefore DOE should defer imposition of the R-20+5 requirement until it can demonstrate its cost effectiveness. (Schulte, No. 1028 at p. 23) Cavco stated that homes built for thermal zones 2 and 3 will no longer allow for 2x4 wall construction but will require 2x6 walls with rigid foam insulation. They stated that this simple change increases the cost of materials, adds steps to the production process, decreases the available habitable space and requires floor plans to be redrawn and resubmitted. Cavco stated that this large jump is not cost justified, especially when considering the impact to the production process. (Cavco, No. 1497 at p. 2)

In response to the August 2021 SNOPR and October 2021 NODA, Clayton Homes commented that insulated foam sheathing is not a good option for manufactured homes because it adds a layer of flexible foam product between rigid framing and sheathing materials, which adversely impacts homes transportation performance. (Clayton Homes, No. 1589 at p. 4, 6) Clayton Homes stated that R-21 wall insulation without a continuous insulation should be the benchmark requirement in Climate Zones 2 and 3. (Clayton Homes, No. 1589 at p. 16) MHI stated that the requirement of R-20 in the

exterior wall will force the sidewall to 2x6 construction resulting in the following: (1) The installation of the exterior insulation will be more costly for manufacturers to install, stemming from the overall cost of the home being higher from the increased material and labor costs; (2) The exterior insulation will also require most plants to re-work their production stations to allow time for this installation; (3) The exterior insulation will also create an additional problem for fastening the exterior finish siding since the siding would now have to be fastened thru the exterior insulation -- currently, there are no approved fasteners to penetrate through the 1-inch exterior insulation and the fasteners themselves would also have to support the siding during transportation; (4) Windows and doors will need to be installed on framed extensions to pack out nailing surfaces to the thickness of the continuous R-5 insulation; (5) Continuous flashing may be required at the bottom edge of the rigid insulation layer to protect from exposure to weather and infestation; and (6) The extra thickness of insulation on the exterior wall would either increase the shipping width or decrease the habitable space on the interior. Accordingly, MHI stated that for houses currently designed to maximize the legal shipping width, there is no additional width available on the exterior, and therefore, the space for the exterior insulation on these homes would have to be taken from the interior of the home. (MHI, No. 1592 at p. 8) Further, MHI stated that the use of continuous insulation is problematic due to the required changes in design, associated costs, and need for products that do not exist. Additionally, they stated that the R-20 wall insulation listed in Tier 2 for zones 2 and 3 may not be readily available in roll form, as typically used in production. In addition, they commented that having a continuous insulation on the outside of the studs may become problematic for siding installation due to transportation. Accordingly, MHI

recommended revising 20+5 wall R-values to R-21 or R-13+5. Further, they stated it will be difficult to source a material to use as the R-5 continuous exterior insulation that will meet the requirements of the proposed changes as well as the current HUD Code.[46] MHI stated that the perm ratings of the rigid foam may also lead to redundant vapor barriers and stud cavities that may not breathe properly, and therefore this may be a potential area where the proposed changes and the current HUD Code may have a conflict. (MHI, No. 1592 at p. 6, 17, 29); (Clayton Homes, No. 1589 at p. 9, 21)

In response to the January 2022 DEIS, however, Clayton Homes and MHI provided alternative recommendations. They recommended that DOE change the exterior wall insulation R-value for Climate zone 2 to R-13, and for Climate Zone 3 to R-15. In addition, they recommended that DOE change the U-factor alternative for the exterior wall insulation to 0.094 for Climate Zone 2, and 0.076 for Climate Zone 3. (Clayton Homes, No. 1986 at p. 13); (MHI, No. 1990 at p. 16)

MHCC also stated that an R-20+5 exterior wall insulation is neither cost effective or feasible for MH, asserting that implementing continuous exterior wall insulation would negatively impact throughput rates of manufacturers and significantly increase overall costs. (MHCC, No. 1600 at p. 7, 12) Skyline Champion commented that the requirement of continuous R-5 insulation in thermal zones 2 and 3 not only adds significant direct material and labor expense but also adds indirect material and labor costs. Indirect costs

[46] Section 3280.504 has requirements for the perm rating of the exterior wall assemblies.

like flashing, window/door installations, jamb extensions, sliding installation changes, soffit and floor width impacts are some of the costs that Skyline Champion argued DOE's analysis may have not properly captured. Skyline Champion recommended holding prescriptive R-values in wall assemblies to R-19 for zones 2 and 3 for tier 2 and adjust overall U-values accordingly. (Skyline Champion, No. 1627 at p. 2); (Champion Home Builders, No. 1639 at p. 2)

In this final rule, DOE is requiring R-21 insulation instead of the August 2021 SNOPR proposed R-20+5 for the prescriptive requirements for Tier 2 climate zone 2 and 3. As presented in the August 2021 SNOPR (and with updated inputs in the October 2021 NODA), both the R-20+5 and R-21 Tier 2 30-year life-cycle cost savings results for the nation are positive. 86 FR 59042, 59048. However, San Francisco resulted in negative Tier 2 30-year LCC savings for R-20+5, which is not the case for R-21. 86 FR 47744, 47802; 86 FR 59042, 59055.

EISA requires consideration of cost-effectiveness of the standards (42 U.S.C. 17071(a) and (b)(1)) and the design and factory construction techniques of manufactured homes (42 U.S.C. 17071(b)(2)). As discussed in section III.A of this document, DOE determined the cost-effectiveness of the standards by considering the LCC savings over the life of the manufactured home not only for the nation, but also for each city analyzed. Therefore considering at least one city during the 30-year analysis in Tier 2 resulted in negative LCC savings with R-20+5 exterior wall insulation, in this final rule, DOE is adopting the next stringent insulation, R-21 for Tier 2. Further, DOE was unable to assess

the other implications presented by the stakeholders at this time, including but not limited to the limitations on including R-20+5 with the design of the home. DOE needs to conduct further study on the full implementation of the continuous insulation requirement on manufactured homes, and therefore is not including this requirement at this time. Finally, adopting R-21 instead of R-20+5 also resolves issues regarding shipping width that the stakeholders commented on, which is discussed in a following section. However, DOE is open to receiving further data to consider this requirement in future standards.

DOE notes, however, that requiring R-21 for Tier 2 prescriptive standards does not preclude manufacturers in using R-20+5 to comply with Tier 2 prescriptive standards. Further, the performance method (i.e., *Uo*) allows manufacturers flexibility in using any combination of energy efficiency measures as long as the minimum *Uo* is met, including, but not limited to, R-20+5.

DOE also received other comments regarding exterior wall insulation. NAIMA commented that the standards should include minimum mandatory wall insulation requirements under 460.102(c) of the regulatory text, consistent with the 2021 IECC, which includes minimum insulation requirements for performance path compliance. They recommended a mandatory minimum wall insulation requirement of R-13 in Tier 1 and Climate Zone 1 Tier 2 homes and R-21 in Climate Zones 2-3 Tier 2 homes when a builder selects the performance path for standards compliance. (NAIMA, No. 1017 at p. 2) The 2021 IECC does not have a *Uo*-based performance path. However, the 2021 IECC does include a "Total UA alternative" requirement in R402.1.5, which is similar in

concept to *Uo* in that the calculation is done using the component U-factor and the component area. As such, R402.1.5 of the 2021 IECC only provides additional requirements for fenestration SHGC and maximum U-factors, and does not include additional requirements for exterior wall insulation. Accordingly, DOE is only including additional requirements for fenestration SHGC and maximum U-factors in 460.102(c)(2)-(4).

ACC FSC requested that the wall U-factors (associated with the prescribed R-values) in Tables 460.102-3 and 460.102-4 be revised (decreased) to be consistent with a typical or "default" framing factor of 15 percent and that the *Uo* values in Tables 460.102-5 and 460.102-6 be adjusted accordingly, as opposed to the 25 percent that was used for the baseline framing for walls. They stated that the *Uo* approach (and the referenced Battelle Method) provide a default value of 15 percent for typical manufactured housing walls (see also HUD Code Section 3280.509). (ACC FSC, No. 1364 at p. 4) DOE notes that the Battelle Method report cites the 1989 ASHRAE Handbook of Fundamentals ("HoF") as the source of the 15 percent framing factor for exterior walls with 16" on center (o.c.). The 1993 edition of the ASHRAE handbook, however, updated the framing factor for exterior walls 16" o.c. to 25 percent and all successive editions through the 2021 edition of the HoF have included a 25 percent factor. In addition, a 25 percent framing factor was used during the MH working group negotiations. At this time, DOE has not found any data on whether framing factors should be lower for manufactured housing. Therefore, DOE continued to use 25 percent framing factor as part of the analysis.

Tier 2 exterior ceiling insulation requirement

In the August 2021 SNOPR, for the untiered/Tier 2 standard, DOE proposed R-30 for climate zone 1 and 2, and R-38 for climate zone 3. DOE proposed not to incorporate the minimum ceiling R-value updates from the 2021 IECC given the physical space constraints of manufactured homes. Accordingly, DOE proposed ceiling insulation requirements that were consistent with the June 2016 NOPR requirements (as recommended by the MH working group), updated from four climate zones to three climate zones. 86 FR 47744, 47772. DOE received multiple comments regarding the exterior ceiling insulation requirement.

MHI stated that due to the thicker insulation of R-30 in the ceiling, the proposed standards state that a 5.5-inch truss heel height would be required. This change in the truss profile will affect the overall shipping height of the home unless other conciliatory changes are made. (MHI, No. 1592 at p. 6, 8) Further, MHI stated that for the exterior ceiling insulation as R-38, the depth of insulation will be difficult to achieve on lower sloped roofs and cathedral style truss profiles. (MHI, No. 1592 at p. 8) Skyline Champion stated that requirements for ceiling insulation and heel height will force significant truss re-designs to accommodate energy heels and shipping limitations in many circumstances. Popular design options may be severely limited or eliminated due to increased cavity volume requirements of the truss profiles. Regarding climate zone 3 floor insulation, they suggested that all homes will require increased floor joist sizes to create enough space in joist cavities for additional insulation requirements, leading to additional labor and

materials that are likely not properly reflected in cost calculations. (Skyline Champion, No. 1627 at p. 2); (Champion Home Builders, No. 1639 at p. 3)

On the other hand, VEIC stated that they have worked with factory partners that have demonstrated the ability to cost-effectively install insulation levels above R-38 in the ceiling/roof assembly and still maintain overall height requirements of MH. They presented an example of an MH design that allows for a ceiling insulation system that accommodated R-38 uncompressed and continuous insulation over the entire attic with 7.5-8.5' ceiling height and a 3/12 pitch roof system. They stated that blocking is utilized at the eaves to ensure that full-height insulation can be a simple low-cost application such as a cardboard product. Accordingly, VEIC suggested that if DOE intends to maintain the R-38 ceiling insulation requirement for zone 3, they recommend the standards also require that R-38 is installed uncompressed at full height over 100 percent of the ceiling or attic area extended over the wall top plate at the eaves, as per 2021 IECC Section R402.2.1. Alternatively, DOE could set higher R-value standards with the allowance for a lower R-value when installed uncompressed over the entire ceiling area. (VEIC, No. 1633 at pp. 3-5)

As discussed previously, DOE took into consideration the range of efficiency measures originally considered by the MH working group that was appropriate for manufactured home design, which included the following: exterior ceiling R-22 to R-38. DOE notes that ceiling height constraints in manufactured homes limit the amount of ceiling insulation that can be installed without compression. While NEEM and NEEM+ homes require ceiling insulation of R-40 and R-44 respectively, DOE conducted the

analysis up to ceiling insulation levels of R-38 based on the recommendations of the MH working group. DOE notes that typical R-30 and R-38 insulation has thicknesses of approximately 9.7" and 12.3" respectively. A common MH home truss design is 17" deep at the marriage line and can accommodate these levels of insulation, except the compression at the eaves. Accordingly, DOE understands that there is enough room in the truss to accommodate higher insulation without having to redesign. Further, DOE confirmed with an industry expert in the Pacific Northwest that almost all manufactured home trusses can accommodate ceiling insulation up to R-40. While DOE did not consider ceiling insulation levels beyond R-38, DOE notes that almost all roof truss designs can accommodate insulation up to R-40, but there is a very small incremental improvement in thermal performance between R-38 and R-40. The MH working group also did not consider the requirements regarding uncompressed insulation in R402.2.1 of the 2015 IECC (which is also included in the 2021 IECC), and therefore did not assess the cost-effective impact as part of this rulemaking. DOE will plan to consider these updates in future rulemakings.

Further, as stated by VEIC, homes are currently being built with insulations at the higher end of the range, with no issues with transportation. In addition, even current ENERGY STAR requirements, under the envelope-only package, require ceiling insulation at R-38.[47] DOE also confirmed that the Northwest Energy-Efficient

[47] Further details on specification can be found here: www.energystar.gov/newhomes/energy_star_manufactured_homes.

Manufactured Housing Program (NEEM)+ homes,[48] which go beyond ENERGY STAR and provide ceiling insulation up to R-44, do not deal with transportation issues because of the added insulation.

Finally, DOE notes that manufacturers can also comply with the standards using the performance, Uo, method, which gives manufacturers the flexibility in using any combination of energy efficiency measures as long as the minimum *Uo* is met. Accordingly, DOE is unpersuaded that the Tier 2 ceiling insulation requirements will significantly limit design options, necessitate changes in truss profiles, or impact transportation of MH models, and therefore DOE maintains the August 2021 SNOPR Tier 2 exterior ceiling insulation requirements in this final rule.

Tier 2 exterior floor insulation requirement

In the August 2021 SNOPR, for the untiered/Tier 2 standard, DOE proposed R-13 for climate zone 1, R-19 for climate zone 2, and R-30 for climate zone 3. DOE did not identify any updated floor insulation requirements in the 2021 IECC applicable to manufactured homes. Accordingly, DOE proposed floor insulation requirements that were consistent with the June 2016 NOPR requirements (as recommended by the MH working group), updated from four climate zones to three climate zones. 86 FR 47744,

[48] Further details on specification can be found here: *https://www.neemhomes.com/efficiency-certified/#what-is-neem-plus*

47772. DOE received multiple comments regarding the exterior floor insulation requirements.

Several commenters suggested that for Climate Zone 3, most floors are constructed with 2x6 framing but with an R-30 insulation requirement, DOE analysis assumes 2x8 floor joist and insulation thicknesses that exceed 5.5-inches, which cannot reasonably be assumed in HUD home construction. Further, they stated that placing more than R-11 blankets under the floor joists cannot be done without offsetting outriggers and providing blocking between joists because compressing more than R-11 insulation between an outrigger and a joist results in noticeable humps in the floor at each outrigger location. (MMHA, No. 995 at p. 2); (Michigan MHA, No. 1012 at p. 1-2); (WHA, No. 1025 at p. 1-2); (PMHA, No. 1165 at p. 1-2); (Westland, No. 1263 at p. 1-2); (Pleasant Valley, No. 1307 at p. 1-2); (American Homestar, No. 1337 at p. 1-2); (Oliver Technologies, No. 1350 at p. 1-2); (KMHA, No. 1368 at p. 1-2); (Adventure Homes, No. 1383 at p. 1-2); (Clayton Homes, No. 1589 at p. 22)

MHI stated that DOE's analysis assumes that the floor joists are 2x6 with insulation up to and including R-22, and 2x8 floor joists insulated to R-30 and above. They stated that currently, 90 percent of floors produced use 2x6 floor joists. They also stated that the 2" floor joist change will also increase the shipping height. (MHI, No. 1592 at p. 25-26); (Clayton Homes, No. 1589 at p. 16-18, 22); (MHCC, No. 1600 at p. 6) In response to the January 2022 DEIS, MHI recommended that DOE change the exterior floor insulation R-value for Climate zone 3 to R-25. In addition, they recommended that

DOE change the *U*-factor alternative for the exterior floor insulation to 0.036 for Climate Zone 3. (Clayton Homes, No. 1986 at p. 11, 13); (MHI, No. 1990 at p. 15, 16)

As previously stated, DOE did not update the Tier 2 exterior floor insulation requirements from those recommended by the MH working group in the term sheet, besides updating the June 2016 NOPR-proposed four climate zones to the August 2021 SNOPR-proposed three HUD zones. NEEM+ homes provide floor insulation at R-33, and do not deal with transportation issues because of the added insulation. Even though the analysis assumes 2x8 floor joists for floor insulation above R-30, DOE notes NEEM homes meet R-33 floor insulation by incorporating a combination of R-11 blankets and R-22 in 2x6 joists and R-33 belly insulation below joists.[49] Finally, even current ENERGY STAR requirements, under the envelope-only package, require floor insulation in Climate Zone 3 at R-33. Accordingly, considering current techniques can still be implemented, DOE is unpersuaded that the Tier 2 floor insulation requirements will significantly impact shipping height and result in transportation issues.

Finally, DOE notes that manufacturers can also comply with the standards using the performance, *Uo*, method, which gives manufacturers the flexibility to use any combination of energy efficiency measures as long as the minimum *Uo* is met.

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[49] See Figure 2 on page 10 - *https://static1.squarespace.com/static/5b10a91989c172d4391ab016/t/5b45160b2b6a286e299e4ba5/1531254288322/3157.pdf.*

Accordingly, DOE maintains the August 2021 SNOPR Tier 2 exterior floor insulation requirements in this final rule.

Tier 2 fenestration requirements

In the August 2021 SNOPR, for the untiered/Tier 2 standard, DOE proposed the following window U-factors: 0.32 for climate zone 1, 0.30 for climate zone 2, and 0.30 for climate zone 3. In addition, DOE also proposed the following glazed fenestration SHGCs: 0.33 for climate zone 1, 0.25 for climate zone 2, and "not applicable" for climate zone 3. DOE proposed window U-factors consistent with the 2021 IECC. For the SHGC, DOE proposed requirements based on the updated window U-factors, and the recommendations by the MH working group. 86 FR 47744, 47772. DOE received multiple comments regarding fenestration requirements.

VEIC stated that the SHGC requirements of the Tier 2/untiered proposal run contrary to best practice, and to IECC requirements. They stated that lower SHGC should be required in warmer climate zones. At minimum, VEIC recommends reversing the SHGC requirements for zone 1 and zone 2. (VEIC, No. 1633 at p. 6, 7) ACEEE stated that the proposed standards have higher (less stringent) SHGC values in Climate Zone 1 than in Climate Zone 2 and none in Climate Zone 3. They stated that this difference is counter to the IECC and to the logic of increased savings where there is increased sunlight and it should be corrected. (ACEEE, No. 1631 at p. 8) RECA also recommended that DOE set the maximum SHGC for both Climate Zones 1 and 2 at 0.25, which is consistent with the 2021 IECC requirement for IECC climate zones 1-3 and has been in

the IECC since the 2012 edition. RECA stated there is no reason why HUD Zone 1 should have a higher SHGC than Climate Zone 2. (RECA, No. 1570 at p. 6)

During the MH working group negotiations, to determine the number of climate zones (which at the time was four climate zones), one of the building thermal requirements that DOE analyzed for cost-effectiveness was the window SHGC. For the June 2016 NOPR-proposed Climate Zone 1, DOE analyzed a range of window SHGC from 0.25 to 0.40. DOE proposed the most cost-effective SHGC requirement, which was 0.25. The MH working group agreed on the SHGC for Climate Zone 1 in the term sheet. See Term Sheet at 3. For the June 2016 NOPR-proposed Climate Zone 2, the MH working group recommended that DOE perform a sensitivity analysis of the total cost of ownership to determine the most cost-effective SHGC, rather than recommending a specific SHGC value in the term sheet. See Term Sheet at 3. DOE performed its SHGC sensitivity analysis using SHGC values of 0.25, 0.30, and 0.33. This analysis indicated an SHGC of 0.33 had the greatest total cost of ownership savings; therefore, in the June 2016 NOPR, DOE proposed requiring a SHGC value of 0.33. Except for the SHGC, all other proposed building thermal requirements for the June 2016 NOPR-proposed Climate Zones 1 and 2 were the same. 81 FR 39756, 39772.

In the August 2021 SNOPR, for the Tier 2 standards, DOE mapped the June 2016 NOPR climate zones (based on four climate zones) to the HUD zones (based on three climate zones). DOE used the manufactured home national shipment percentages for each

of the cities analyzed,[50] and the corresponding HUD zone and the June 2016 NOPR climate zone identifiers for each of the cities. For HUD Zone 1, the cities identified were in either the June 2016 NOPR-proposed Climate Zones 1 or 2; however, the summed shipment weights per the June 2016 NOPR-proposed climate zone did not provide an obvious indicator as to which of the energy efficiency measures to incorporate for HUD Zone 1. The only difference between the June 2016 NOPR-proposed Climate Zone 1 and Climate Zone 2 energy efficiency measures was the glazed fenestration requirement. Therefore, in the August 2021 SNOPR, DOE proposed to use the less stringent glazed fenestration requirement (0.33 vs. 0.25) to accommodate cost-effective measures that were proposed in the June 2016 NOPR for HUD Zone 2. 86 FR 47744, 47772. This evaluation is consistent with the recommendations from the MH working group.

For this final rule, DOE reassessed the cost-effectiveness of 0.33 vs. 0.25 SHGC for Tier 2 Climate Zone 1. The new analysis continued to conclude that an SHGC of 0.33 is more cost-effective than 0.25. Therefore, consistent with the recommendation to require the more cost-effective measure as part of the standards, DOE maintains the proposed 0.33 SHGC for Tier 2 Climate Zone 1 in this final rule.

DOE also received comments from MHI and Clayton Homes recommending that the prescriptive requirements for window U-factor be changed to 0.5 for Climate Zone 1, 0.35 for Climate Zone 2, and 0.32 for Climate Zone 3, but did not provide any

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[50] DOE used shipments for 2019 from the annual production and shipment data provided by MHI. See Manufactured Home Shipments by Product Mix, Manufactured Housing Institute (2019).

justification for these changes. (MHI, No. 1990 at p. 14, 15); (Clayton Homes, No. 1986 at p. 11) As previously noted, DOE proposed window U-factor requirements consistent with the 2021 IECC. Further, as discussed in section III.A of this document, DOE has determined the adopted Tier 2 requirements are cost-effective based on the resulting positive 30-year LCC savings. Accordingly, DOE is adopting the August 2021 SNOPR proposal Tier 2 window U-factors.

MHI recommended adding the following language to section R402.3.4 of the proposal: "[R402.3.4] Opaque door exemption. One side-hinged opaque door assembly not greater than 24 square feet (2.22 m^2) in area shall be exempt from the U-factor requirement in Section R402.1.2. This exemption shall not apply to the Total UA alternative in Section R402.1.5." (MHI, No. 1592 at p. 18) In the June 2016 NOPR, DOE did not propose adopting this requirement because excluding these types of doors from this proposed rulemaking also would represent the loss of a significant source of home energy conservation. 81 FR 39756, 39773. DOE carried this proposal forward with the August 2021 SNOPR. As such, in this final rule DOE continues to exclude this exemption for the same reason, consistent with what was proposed in the August 2021 SNOPR.

Further, MHI recommended adding the following language to section R402.3.3 of the proposal: "[R402.3.3] Glazed fenestration exemption. Not greater than 15 square feet (1.4 m^2) of glazed fenestration per dwelling unit shall be exempt from the U-factor and SHGC requirements in Section R402.1.2. This exemption shall not apply to the Total UA alternative in Section R402.1.5." (MHI, No. 1592 at p. 26) MHCC also stated that the

fenestration exemptions that exist in the 2021 IECC must also be included. (MHCC, No. 1600 at p. 7, 12) DOE notes that this specific requirement was deleted by the MH working group, and instead the recommendation was to supersede this requirement with the term sheet. *See* Term Sheet at 17. DOE discussed in the June 2016 NOPR that DOE did not propose to adopt this requirement because the prescriptive fenestration SHGC and U-factor requirements would apply to all fenestration. Given that 15 square feet represents a large portion of the overall fenestration area that comprises a manufactured home, DOE noted that the adoption of this requirement would potentially exclude from these requirements a significant source of energy conservation. 81 FR 39756, 39773. DOE carried this proposal forward with the August 2021 SNOPR. Therefore, in this final rule, DOE continues to exclude this exemption for the same reason consistent with what was proposed in the August 2021 SNOPR.

As noted in the August 2021 SNOPR, based on comments and consistent with the 2015 and 2021 IECC, DOE proposed to remove the maximum ratio of 12 percent for glazed fenestration area to floor area for energy modeling purposes, consistent with the recommendation from the MH working group. MHI and MHCC agreed that DOE should not limit the amount of glazed fenestration. (MHI, No. 1592 at p. 26); (MHCC, No. 1600 at p. 7, 12) As such, DOE is finalizing this proposal in this final rule.

Tier 2 Uo performance requirements

MHI stated that the Untiered/Tier 2 standards requirements represent significant changes over the current HUD Code and will be more of a challenge to implement in a cost-effective manner. (MHI, No. 1592 at pp. 7, 9) Clayton Homes and MHI commented

that the proposed requirements should be significantly reduced (specifically, they encouraged DOE to lower proposed requirements within Climate Zone 3 to more closely align to IECC Climate Zone 3 requirements). (Clayton Homes, No. 1589 at p. 4, 6); (MHI, No. 1592 at p. 25)

Schulte mentioned that there are already HUD-Code homes which have been designed and constructed to meet the 2009 IECC standards, and ENERGY STAR homes. However, the increase in home prices, especially in Zone 2 is significant and, in this zone, the life-cycle cost savings are relatively slight. Accordingly, they recommended adopting less stringent *Uo* values as a first action which would reduce the price increases and the impact on affordability, and suggested that the next version of the standards assess the level of state adoption of the 2021 IECC code and address some of the other issues that have been deferred. (Schulte, No. 1028 at p. 19, 23, 26) Specifically, they recommended the following *Uo*: 0.081 for Climate Zone 1; 0.075 for Climate Zone 2, and 0.060 for Climate Zone 3. (Schulte, No. 1028 at p. 13)

MHI and Clayton Homes stated that in Climate Zone 2, based on the calculations MHI performed on the prototypical homes, the proposed Zone 2 requirements would require many changes such as upgraded insulation, 2x6 wall construction, upgraded windows, and taller truss heel. For Climate Zone 3, MHI was not able to satisfy the overall U factor requirements using common options that are available to most manufacturers. Upgrading insulation, 2x6 exterior walls, deeper trusses, deeper floor joists, and upgraded windows did not lower the overall U-factor enough to meet the

proposed requirements. However, for the calculations that MHI performed, they did not evaluate the addition of continuous exterior insulation due to the installation and transportation issues involved with this product. Accordingly, MHI recommended the following changes for the *Uo* requirements: Change Climate Zone 1 total *Uo* to 0.093 for single-section and 0.090 for multi-section; change Climate Zone 2 total *Uo* to 0.081 for single-section and 0.076 for multi-section and the Climate Zone 3 total Uo to 0.065 for single-section and 0.061 for multi-section. (MHI, No. 1990 at p. 17); (Clayton Homes, No. 1986 at p. 13) Clayton Homes had the same recommendations, however instead elected to change the Climate Zone 3 total Uo to 0.064 for multi-section.

On the other hand, NEEA stated that more than half of the manufactured homes in the Northwest are built with a *Uo* equal to Tier 2 of the August 2021 SNOPR. They stated that they have been applying 2x6 frame walls to homes for the past 14 years. (NEEA, No. 1601 at p. 14) Further, NEEA commented that industry and others have made false claims that the incremental cost of a home should be based on internal floor area of the homes, suggesting that increasing framing in Climate Zone 3 from 2x4 to 2x6 stud walls would increase the cost per square foot of the home. They stated that DOE should avoid this logic as it presumes homes are sold based on interior floor area when in fact the advertised area of a manufactured home is on the exterior frame dimensions of the house. (NEEA, No. 1601 at p. 10)

As discussed previously, in developing the set of Tier 2 energy efficiency measures, DOE's objective was for it to be based on the most recent version of the IECC,

with consideration of cost-effectiveness and design and factory construction techniques of manufactured homes. (42 U.S.C. 17071(b)(1); 42 U.S.C. 17071(b)(2)(A)) As such, in the analysis, DOE took into consideration the range of efficiency measures originally considered by the MH working group that was considered appropriate for manufactured home design, which included the following: exterior ceiling R-22 to R-38; exterior wall R-11 to R-21+5; exterior floor R-11 to R-30; window U-factor U-1.08 to U-0.30; and window SHGC 0.7 to 0.25. (See chapter 5 of the final rule TSD) DOE did not consider any energy efficiency measures beyond the ranges considered by the MH working group.

DOE notes that adopted Tier 2 requirements in this final rule will only update the window U-factor requirements for all climate zones compared to the term sheet agreed upon by the MH working group (window U-factor: 0.35 and 0.32; to 0.32 and 0.30 respectively). The window U-factors were updated consistent with the 2021 IECC. Otherwise, the remaining Tier 2 EEMs are consistent with the recommendations from the MH working group, except based on three climate zones (as opposed to the four climate zones recommended in the Term sheet). As discussed in section III.A of this document, DOE has determined that the adopted Tier 2 requirements are cost-effective because of the positive LCC savings over the life of the manufactured home for both the nation, and every city analyzed. As such, Table III.6 presents the amended building thermal envelope prescriptive requirements. DOE used the Battelle Method to determine the associated *Uo* performance values, which are provided in Table III.9.

Construction and transportation

DOE received multiple comments that the Tier 2/untiered building thermal envelope requirements will make transportation of manufactured homes incredibly challenging, as many states have height restrictions that will be impossible to meet due to the new design requirements. (MMHA, No. 995 at p. 2); (Michigan MHA, No. 1012 at p. 1-2); (WHA, No. 1025 at p. 1-2); (PMHA, No. 1165 at p. 1-2); (Westland, No. 1263 at p. 1-2); (Pleasant Valley, No. 1307 at p. 1-2); (American Homestar, No. 1337 at p. 1-2); (Oliver Technologies, No. 1350 at p. 1-2); (KMHA, No. 1368 at p. 1-2); (Adventure Homes, No. 1383 at p. 1-2); (Clayton Homes, No. 1589 at p. 22); (IMHA, No. 1453 at p.1)

PMHA commented that their factories are concerned that several of the proposed changes will change the building thermal systems, which in turn will affect the overall shipping height and width of a home. By increasing the truss heel height, increasing floor joist depth and adding insulation outside of the studs, the overall shipping envelope would change and in most cases be significant. They stated that homes built in Pennsylvania are sold throughout the Northeast and Mid-Atlantic (70 percent of production is shipped outside of Pennsylvania) and that the Northeast relies heavily on the Pennsylvania factories for supply. They stated that the Northeast has the most restrictive laws for transporting manufactured homes. (PMHA, No. 1165 at p. 2) PMHA commented that most of Pennsylvania's market region limits height to 14'6" when transporting homes, whereas several states such as Connecticut and Massachusetts limit height to 13'6". They stated that the highways in Connecticut and Massachusetts are vital

when shipping homes to homebuyers in Vermont, New Hampshire and Maine. PMHA commented that Pennsylvania would not entertain future efforts to increase the loads beyond 16 feet width. They stated that width restrictions take the body of the home in consideration, in addition to eave overhangs, doorknobs, windowsills, siding, exterior trims etc. (PMHA, No. 1165 at p. 3)

Mississippi MHA stated that the Mississippi Department of Transportation allows width up to 16 feet and 15 feet and 6 inches for height for manufactured homes. Any home that exceeds these dimensions will require a special permit which will cost the customer more in transportation costs. Therefore, they stated that the proposed standards may even prohibit a customer in rural Mississippi from buying a home due to the transporting requirements on rural roads. (Mississippi MHA, No. 1588 at p. 3)

NJMHA commented, having no manufacturers located in New Jersey, that the proposal will directly impact the transportation of manufactured homes and add additional cost for homes delivered to New Jersey. They stated that the added challenge of transporting a manufactured home into New Jersey, coupled with their supply issues, will decrease their ability to supply homes at an affordable price point. (NJMHA, No. 1451 at p. 2)

Clayton Homes and MHI and multiple others stated that the proposed rule fails to take into consideration construction methods, transportation demands, and short on-site completion duration that are unique to manufactured housing. (Campaign Form Letter, Multiple Submissions at p. 1) Clayton Homes and MHI stated that several of the changes

in the proposed rule would apply to the building thermal systems which may affect the overall shipping height and width of a home, and by changing various factors, the overall shipping envelope will change. For example, the additional height could prevent shipping a home into an area of the country with low bridges, resulting in consumers having to settle for a different style of home, or, more than likely, being forced out of the housing market due to a lack of affordable housing. Also, additional escorts could add thousands of dollars to the purchase price of the home. Essentially, they stated that by increasing the truss heel height, increasing floor joist depth, and adding insulation outside of the studs, the overall shipping envelope will change. (Clayton Homes, No. 1589 at p. 3, 6); (MHI, No. 1592 at p. 2) MHI also stated that for houses currently designed to maximize the legal shipping width, there is no additional width available on the exterior, and therefore, the space for the exterior insulation (i.e., proposed R-20+5 continuous insulation) on these homes would have to be taken from the interior of the home. (MHI, No. 1592 at p. 8)

On the other hand, NEEA stated that more than half of the manufactured homes in the Northwest are built with a Uo equal to Tier 2 of the August 2021 SNOPR. They stated that they have been applying 2x6 frame walls to homes for the past 14 years.[51] (NEEA, No. 1601 at pp. 13-14)

DOE understands the construction and transportation issues that the stakeholders are commenting on relate specifically to the increased insulation for exterior wall, floor

[51] All frame and related dimensional descriptions (e.g. "2x6") are denoted in inches.

and ceiling insulation required by Tier 2 in this final rule. As discussed in the previous sections (which provides further detail, but is summarized here), for Tier 2 exterior wall insulation, DOE is finalizing an R-21 exterior wall insulation for climate zones 2 and 3, which should resolve a number of the width concerns. For Tier 2 exterior ceiling insulation, DOE notes that there is enough room in the truss to accommodate higher insulation without having to redesign. For Tier 2 exterior floor insulation, DOE confirmed that there are homes being built that meet R-33 floor insulation by incorporating a combination of R-11 blankets and R-22 in 2x6 joists, and R-33 belly insulation below joists (instead of only using 2x8 joists). Accordingly, DOE is unpersuaded with the concerns that amended Tier 2 standards would require changes in exterior home dimensions and cause transportation issues beyond any transportation issues that currently exist.

Additionally, as suggested by NEEA, DOE notes that there are homes that are currently being built with insulation levels at the Tier 2 requirements, with no issues with transportation. Even current ENERGY STAR requirements, under the envelope-only package, require insulation similar to the Tier 2 standards. Finally, DOE confirmed that the Northwest Energy-Efficient Manufactured Housing Program (NEEM)+ homes, which go beyond ENERGY STAR, do not deal with transportation issues because of the added insulation. DOE is acknowledging that changes will be needed to accommodate higher insulation. However, DOE understands that around 53,400 NEEM homes have been transported over the last 20 years without any issues. In addition, the northwest went

through the transition in 1990s and Clayton Homes also has models meeting the higher insulation requirements.[52]

Finally, DOE also notes that manufacturers can also comply with the standards using the performance, *Uo*, method, which gives manufacturers the flexibility to use any combination of energy efficiency measures as long as the minimum *Uo* is met.

Other efficiency improvements

Greer suggested that DOE consider light pollution and recommended using downward positioning lighting for the outside of the buildings. (Greer, No. 1443 at p. 1) DOE's authority for this rule is only with regards to establishing energy conservation standards (42 U.S.C. 17071(a) and (b)(1)), which does not encompass light pollution or the position of lighting, and therefore those topics are not addressed in this rule.

VEIC recommends that DOE adopt the IECC R404 requirement for 100 percent high efficacy lighting in permanently installed fixtures and controls. (VEIC, No. 1633 at p. 6) The NPCC stated that the standards should include additional cost-effective energy-saving measures, including equipment, because measures beyond the building shell, including efficient lighting, heating and cooling equipment, water heating equipment, appliances, and ducts could yield large cost-effective energy savings. (NPCC, No. 1567 at p. 2) Next Step also stated the standards should include cost-effective energy-saving

[52] The NEEM website lists Clayton Homes in CA, ID, NV, OR, UT, and WA as retailers for NEEM-certified homes; *https://www.neemhomes.com/where-to-buy*. NEEM and NEEM+ require insulation levels greater than Tier 2 for ceilings and floors.

measures, including equipment. Next Step also stated the standards should include ventilation and moisture control measures, if needed, to ensure that air sealing improves the health of residents. (Next Step, No. 1617 at p. 10, 11) The Attorneys General urge DOE to include a requirement that manufacturers provide additional energy saving features such as high-efficiency appliances or heating and cooling systems using an ENERGY STAR®-certified heat pump. (Attorneys General, No. 1625 at p. 2, 4, 6)

Earthjustice and Prosperity Now suggested that several important provisions of the 2021 IECC are absent from DOE's analysis of potential manufactured housing standards, including lighting efficacy requirements found in section R404 of the 2021 IECC. (Earthjustice and Prosperity Now, No. 1637 at p. 7) They stated that in DOE's previous response suggesting that "the energy efficiency of those products is specifically governed by the comprehensive Appliance Standards program established under [the Energy Policy and Conservation Act ("EPCA")] (42 U.S.C. 6291–6317)" DOE cites no authority for the proposition that it can ignore IECC provisions applicable to covered appliances, nor does the Department make any attempt to explain why Congress would have intended to allow DOE to ignore IECC provisions that address the efficiency of regulated appliances. *Id.* In addition, Earthjustice, Prosperity Now, and Sierra Club commented saying that DOE's characterization of its appliance efficiency program as "comprehensive" ignores that the Department has long refused to update the standards for some furnaces used in manufactured homes because such standards allegedly could not meet other requirements applicable under EPCA. (Earthjustice, Prosperity Now, and Sierra Club, No. 1992 at p. 8, 9)

While the 2021 IECC does include certain efficiency requirements for HVAC, water heaters, lighting, furnaces, and appliances, DOE is not adopting energy conservation standards for these products in the manufactured home energy conservation standards. As discussed in section III.A of this document, section 413 of EISA requires DOE to *base* the manufactured housing energy conservation standards on the latest version of the IECC, except where not cost-effective or where a more stringent code would be more cost-effective (42 U.S.C. 17071(b)(1)). The use of the phrase "based on" readily indicates that Congress anticipated that DOE would need to use its discretion in adapting elements of the IECC's provisions for manufactured housing use. This language does not require the imposition of requirements for manufactured homes that are identical to those of the IECC.

DOE also did not simply ignore the updated provisions of the 2021 IECC related to appliance and product energy efficient requirements that were not included in the 2015 IECC, and therefore not considered by the working group. In the August 2021 SNOPR, DOE addressed the fact that the MH working group evaluated the 2015 IECC, which does not include updated sections of the 2021 IECC, such as comparable provisions to sections R401.2.5 and R408.2 of the 2021 IECC. 86 FR 47773-47774. With respect to those provisions of the 2021 IECC, DOE noted that the MH working group generally did not recommend provisions addressing minimum appliance or equipment efficiencies for manufactured housing, and therefore, DOE declined to adopt such measures consistent with the approach of the working group. *Id.* Accordingly, the performance requirements in the energy conservation standards proposed in the August 2021 SNOPR and adopted

in this document are specific to the building thermal envelope only, and do not incorporate any specifications on HVAC or appliance energy efficiency.[53]

The energy efficiency of those products is specifically governed by the comprehensive Appliance Standards program established under EPCA. (42 U.S.C. 6291-6317) Covered products going into newly built manufactured homes will still have to meet the minimum energy conservation standards set by the Appliance Standards program. DOE notes that under this final rule, manufacturers would not be prohibited from installing more efficient appliances than the minimum standards set by the Appliance Standards program into newly manufactured homes.[54]

Insulation supply and demand

MHI stated that manufacturers are currently using R-11 for most of the insulation which is predominantly used in the walls and floors for Zones 1 and 2. Further, manufacturers typically prefer to use two layers of R-11 if they need more insulation in the floors. However, they are concerned that the proposed changes do not use R-11, but rather the lowest insulation value used is R-13. Therefore, MHI stated that this may cause a supply issue for the manufacturers that have ramped up to supply large quantities of R-

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[53] Earthjustice and Prosperity Now also stated that DOE's refusal to consider lighting efficacy measures is inconsistent with its rationale for refusing to evaluate the HVAC and water heating equipment requirements in the 2021 IECC because the 2014 working group specifically recommended that DOE include the lighting efficacy provisions from the 2015 IECC in the negotiated manufactured housing standards. Earthjustice, Prosperity Now, and Sierra Club, No. 1992 at p. 7). However, in the June 2016 NOPR, DOE stated that it was not proposing the lighting efficacy requirements from the 2015 IECC recommended by the working group because of DOE's ongoing rulemaking efforts to establish nationwide minimum lamp efficacy standards under EPCA, and requested comment on the sufficiency of DOE's rulemaking efforts for lamp efficacy to achieve lighting efficiency in manufactured homes. *See* 81 FR 39780.
[54] See *http://energy.gov/eere/buildings/standards-and-test-procedures*.

11, and the same supply issue will be present for R-20 and R-19, which is currently not used in large quantities. Further, the availability of R-30 insulation in a blanket style may be an issue in meeting this requirement or force further production changes to accommodate other styles of insulation. (MHI, No. 1592 at pp. 6, 8) Clayton Homes stated that the proposed standards would require manufactured homes to have significantly more insulation, which would cause the demand for fiberglass insulation to overwhelm a market that is already under substantial stress from the current insulation shortage, which is projected to continue for a few more years. (Clayton Homes, No. 1589 at p. 4, 6)

DOE notes that the performance path, i.e., *Uo* method, gives manufacturers the flexibility in using any combination of energy efficiency measures as long as the minimum *Uo* is met. Manufacturers do not need to meet both the prescriptive and the performance method; rather they have the option to only meet one. As such, manufacturers can continue to use current insulation types and techniques to meet the energy conservation standards. DOE is not restricting the type of insulation being used, as long as the standards (either prescriptive or performance) are met.

Other Remaining Comments

Redwood Energy suggested that DOE adopt an all-electric version of ENERGY STAR as the standards. They suggested that all-electric design is already roughly 50 percent of manufactured housing and produces less net GHGs than natural gas or propane on clean grids. They stated that ENERGY STAR yellow tags show the lowest utility bills only to ENERGY STAR heat pump for HVAC and DHW. They also commented that

there was some support from the Director of Business Development of Champion Homes for a California Energy Commission grant, illustrating their willingness to build with a 2x6 framed walls, 14" deep attic insulation and all-electric. (Redwood Energy, No. 1363 at p. 1) The statutory authority for this rulemaking requires DOE to base its standards on the most recent version of the IECC and any supplements to that document, subject to certain exceptions and considerations. (42 U.S.C. 17071(b)(1)) Accordingly, DOE developed the standards based on the requirements in the 2021 IECC.

In addition, regarding NFRC labels, NEEA recommended that the final rule be explicit that the NFRC labels should remain on the windows until the house arrives at the site. (NEEA, No. 1601 at pp. 14-15) DOE's authority for this rulemaking is to establish energy conservation standards for manufactured housing as manufactured. (42 U.S.C. 17071(c)) The energy conservation standards are specific only to the building thermal requirements for a manufactured home. However, DOE notes that DOE's energy conservation standards would not prevent industry from pursuing this labeling practice suggested by NEEA.

Schulte stated that setting the *Uo* values for the home and letting manufacturers decide how to meet these performance standards encourages innovation by allowing manufacturers to choose higher efficiency windows or other changes to achieve the required *Uo* values. (Schulte, No. 1028 at p. 23) VEIC recommended considering a compliance option using an Energy Rating Index ("ERI") compliance alternative, which not only allows for prescriptive and total UA compliance approaches, but also provides

performance-based compliance based on annual modeled energy costs of the whole-home. (VEIC, No. 1633 at p. 3) Consistent with the recommendations of the MH working group, the performance requirements in the energy conservation standards are specific to the building thermal envelope only, and do not provide for tradeoffs with mechanical equipment such as appliances. DOE does allow tradeoffs between the building thermal envelope components as long as the Uo is met through the performance path. This is similar to the Total UA path in the IECC. Similar to those sections, a *Uo* calculation gives the manufactured home manufacturer the flexibility to design the manufactured home, as long as the overall *Uo* is met.

NEEA recommended that the final rule be explicit about what needs to be included in an installation manual, specifically that the multi-section marriage line air seal shall be installed at the factory with proper QA/QC. (NEEA, No. at p. 14, 15) All requirements in this final rule would apply to the manufactured home as manufactured, *i.e.*, the manufacturer of the manufactured home is responsible for ensuring compliance with the requirements. (42 U.S.C. 17071(c)) A manufactured home would have to comply with the requirements, once finalized, prior to being installed in the field. Therefore, DOE has included a clarification in §460.1 of the regulatory text that the requirements apply to the manufactured home as manufactured at the factory, prior to distribution in commerce for sale or installation in the field.

ACC FSC stated that the proposed standards do not appear to address, amend, or prohibit use of §3280.508 of the HUD Code which provides for a so-called "high

efficiency heating and cooling equipment credit", and requested that this loophole be removed to avoid erosion of durable envelope energy efficiency in trade-off for shorter-lived equipment that happens to exceed NAECA minimum efficiency requirements which, in some key cases, have not kept up with the market. They stated that while DOE indicated that equipment trade-offs are "only allowed within the building thermal envelope, and not HVAC equipment or other appliances", this issue still remains unclear in the proposed standards and in DOE's documentation. (ACC FSC, No. 1364 at p. 4-5). EISA directs DOE to establish energy conservation standards for manufactured housing. 42 U.S.C. 17071. As such, §3280.508 is under HUD's authority and not DOE. However, DOE's energy conservation standards are more stringent than the HUD code in a number of key respects, and manufacturers must comply with both HUD and DOE's requirements. Nevertheless, DOE acknowledges this comment and will plan to coordinate with HUD, as needed, on the application of the DOE requirements in relation to the HUD heat loss/heat gain requirements.

MHI and Clayton Homes recommended clarifying the language in §460.102 paragraphs (b)(1) and (b)(5) of the proposed regulatory text as follows: adding that the applicable R-value for the prescriptive requirements is the "nominal value of insulation", specifying the maximum U-factor as "glazing maximum U-factor", and adding that compliance with the applicable requirements in paragraph (b)(1) may be determined using the "maximum component U-factor" values set forth in §460.102 of the proposed regulatory text. (Clayton Homes, No. 1986 at p. 11-13); (MHI, No. 1990 at p. 14, 15)

DOE views these additions as adding further specificity to the prescriptive requirements, and therefore has adopted the recommendations.

Finally, MHI recommended that DOE delete the entirety of §460.3 of the regulatory text, as well as paragraph (c)(2) of §460.3. In addition, MHI also recommended deleting Tables 460.102-1 and 460.102-3 of the regulatory text as proposed in the August 2021 SNOPR. (MHI, No. 1990 at p. 11, 12, 14, 16) DOE understands MHI's recommended deletion in the regulatory text to suggest that MHI does not recommend a tiered standard, but rather an untiered standard albeit with requirements less stringent than those proposed by DOE. As previously discussed in section III.A of this document, in light of affordability and cost-effectiveness concerns, DOE is adopting the tiered standards in this final rule. Therefore, DOE is maintaining the Tier 1 regulatory text requirements. Otherwise, responses to MHI's recommendations for the prescriptive and performance requirements for the tiered standards are already addressed in previous sections.

c. §460.103 Installation of Insulation

Consistent with the August 2021 SNOPR, in this final rule, DOE is adopting in §460.103 of the regulatory text, the requirement for manufacturers to install insulation according to both the insulation manufacturer's installation instructions and the instructions set forth in proposed Table 460.103. §460.103 specifies requirements for the installation of insulation, which is based on the R402 of the 2021 IECC. DOE is also adopting the requirement for manufacturers to comply with the insulation manufacturer's

installation instructions to ensure that the intended performance of the insulation is achieved. Further, consistent with the August 2021 SNOPR, DOE is adopting as part of a new Table 460.103 several component installation requirements, including general requirements, and requirements for access hatches, panels and doors, baffles, ceiling or attic, narrow cavities, rim joists, shower or tub adjacent to exterior wall, and walls, and is removing installation requirements for eave vents.

In addition, in response to comments received on the August 2021 SNOPR proposal, DOE is adding clarifying language for the "baffles" component as it relates to air-permeable insulation in vented attics and eave venting, and to the "Access hatches, panels, and doors" component as it relates to doors. The installation of insulation requirements would apply to both Tier 1 and Tier 2 homes.

The following paragraphs discuss comments DOE received regarding the installation of insulation requirements proposed in the August 2021 SNOPR.

DOE received comments on the August 2021 SNOPR regarding the language used in Table 460.103, particularly the "baffles" component. MHCC commented that DOE should clarify that the requirements for baffles in Table 460.103 should apply when the baffles are used in conjunction with eave venting. (MHCC, No. 1600 at p. 8) The 2021 IECC does not include specification that the installation requirements for baffles are only applicable when the baffles are used in conjunction with eave venting. However, DOE notes that baffles are typically used in conjunction with eave venting. As such,

DOE understands MHCC's recommended change to be more of a clarification specific to manufactured housing. Therefore, in this final rule, DOE is adding clarifying language for "baffles" to specify that the requirements apply when they are used in conjunction with eave venting, consistent with the recommendation by the MHCC.

MHI commented that DOE should add a statement clarifying that baffles must extend over the top of the attic insulation "where insulation is restrained from full depth in order to maintain 1-inch minimum air space between insulation and roof decking." (MHI, No. 1592 at p. 26, 27); (Clayton Homes, No. 1589 at p. 10, 13, 16); (MHCC, No. 1600 at p. 2, 3) DOE notes that the proposed August 2021 SNOPR requirement is stronger in terms of maintaining the clear path of airflow between the insulation and the eaves in all cases. Specifically, the baffles component in proposed Table 460.103 states that "baffles must be constructed using a solid material, maintain an opening equal or greater than the size of the vents, and extend over the top of the attic insulation" ensuring that baffles are always properly installed, and that insulation does not fall into the vents and block the air path. Adding in MHI's recommended language would lead to ambiguity when determining where baffles must be installed over the top of the attic insulation. Therefore, DOE has chosen to maintain the August 2021 SNOPR requirements.

VEIC commented that it is essential that the factories install solid baffles and venting at the eaves to ensure that compliant insulation levels extend to the outside of the exterior wall, and that there is ventilation along the roof sheathing to prevent moisture issues. (VEIC, No. 1633 at p. 4) DOE appreciates the comment and agrees that this is

good building practice. This practice is covered in Table 460.103 under the installation requirements for "baffles" and therefore DOE maintains the proposed language in the final rule.

DOE received comments regarding the installation requirements for "eave vents" in Table 460.103. MHI and MHCC suggested that the language regarding "eave vents" be removed, since it is not within the 2021 IECC and is not relevant to manufactured housing. MHI also said that it should be acceptable to use nonpermeable insulation adjacent to ventilated soffits as long as the required free air path is maintained. (MHI, No. 1592 at p. 18, 27); (MHCC, No. 1600 at p. 8) DOE notes that R402.2.3 of 2021 IECC discusses eave vents as it relates to baffles. Specifically, R402.2.3 includes language that "for air-permeable insulation in vented attics, a baffle shall be installed adjacent to soffit and eave vents." As such, consistent with the 2021 IECC, DOE has removed the separate "eave vents" row in Table 460.103, and included the same requirements in the "baffles" row instead. Further, DOE notes that this requirement only clarifies insulation installation criteria as it relates to air permeable insulation; the requirement is not restricting use of other insulation products.

DOE also requested comment in the August 2021 SNOPR on whether the 2021 IECC updates on the installation criteria for baffles are applicable to manufactured housing and should be considered in this rulemaking. 86 FR 47744, 47781. DOE did not receive any comments regarding the applicability of these requirements to manufactured homes and is therefore not including them in the final rule.

DOE received a comment regarding a language change for the "Access hatches, panels, and doors" component of Table 460.103. MHCC suggested that "doors" be deleted from Table 460.103 under "Access hatches, panels, and doors." MHCC stated that doors are commonly used for exterior access of utility and water heater room in certain regions of the country, and they are specified by the U-factor requirements already established in § 460.102. (MHCC, No. 1600 at p. 8, 9) In addition, MHI stated that the requirement that access hatches, panels, and doors between conditioned space and unconditioned space must be insulated to a level equivalent to the insulation of the surrounding surface does not seem to be consistent with the discussion around exterior doors in the earlier section of the proposed standards. (MHI, No. 1592 at p. 7)

DOE understands that there is confusion regarding the door U-factor requirements specified in Table 460.102 compared to the door installation of insulation requirements in Table 460.103. In this final rule, DOE is clarifying the requirements in Table 460.102 specifically relate to attic or crawlspace access doors. External doors, which are used to block or allow access to an entrance of a manufactured home, would be required to meet the requirements in Table 460.102. As such, DOE is retaining the door insulation installation requirements and adding the clarification that it applies to attic and crawlspaces in Table 460.102.

DOE received a comment on the August 2021 SNOPR regarding the language used in Table 460.103, particularly the "walls" component. ACC FSC commented that

Table 460.103 appears to be restrictive of and only addresses "air permeable" insulation products, to the exclusion of many others. Specifically, they identified that the proposed installation requirements state that air-permeable insulation must completely fill cavities, and this potentially excludes or disfavors the use of other cavity insulation materials and methods, such as a combination of closed-cell spray foam and fibrous insulation. (ACC FSC, No. 1364 at p. 5) DOE notes that the wall component specifications only clarify the wall insulation installation criteria as it relates to air permeable insulation. The wall component specifications are not restricting use of other insulation products. The MH working group recommended that DOE modify the language of the 2015 IECC requirement with this clarification to account for the unique design of manufactured housing. See 9/23 Working Group Transcript, EERE–2009–BT–BC–0021–0122 at p. 315. The 2021 IECC did not update the wall insulation installation criteria from the 2015 IECC. Accordingly, DOE continues to include this requirement, as recommended by the MH working group, to ensure that wall assemblies in manufactured homes achieve the thermal performance requirements set forth under §460.102.

Regarding duct insulation, NEEA recommended that all crossover ducts should have *R*-8 insulation. (NEEA, No. 1601 at p. 14, 15) DOE's research indicates that HVAC ducts are generally located between the floor and the insulation and are therefore within the conditioned space. Therefore, because ducts are already located within the conditioned space, and would already be insulated because of the insulation required within the conditioned space, DOE is not adopting any additional insulation for ducts in this final rule.

NEEA also commented that a clearer definition of how a proper air barrier should be designed was needed to make construction requirements more specific, and to establish a single meaning without ambiguity. (NEEA, No. 190 at p. 2). NEEA did not provide further explanation of how the proposed requirements for an air barrier were lacking or present an opportunity for misapplication. As stated earlier in this section, DOE has listed many specific requirements for proper air barrier installation in Table 460.104. These requirements were based on Table R402.4.1.1 of the 2021 IECC and related recommendations from the MH working group. Further, DOE reviewed the 2021 IECC to make any additional updates to the air barrier criteria (see Table III.14 in the August 2021 SNOPR).

NEEA also recommended adding a clearer statement that, as installed, insulation should contain no voids or compression. (NEEA, No. 1601 at p. 15) DOE requires that insulation must be installed according to the insulation manufacturer's installation instructions. Certain insulation manufacturer's installation instructions specifically state that compression must be avoided when installing insulation, because compression will reduce the *R*-value. Therefore, DOE continues to find that the requirements proposed in § 460.103 of the August 2021 SNOPR are sufficient to prohibit compression and voids, and will adopt these requirements without change, consistent with R303.2 of the 2021 IECC.

In the August 2021 SNOPR, DOE also requested comment on removing the proposed requirement that exterior floor insulation installed must maintain permanent

contact with the underside of the rough floor decking over which the finished floor, flooring material, or carpet is laid. 86 FR 47744, 47780. Commenters supported exempting manufactured housing from the requirement that exterior floor insulation installed must maintain permanent contact with the underside of the rough floor decking. They stated that doing this will result in many design changes which will increase shipping height. (MHI, No. 1592 at p. 25-26); (Clayton Homes, No. 1589 at p. 16-18, 22); (MHCC, No. 1600 at p. 6) As such, DOE is finalizing the August 2021 SNOPR proposal in this final rule.

In the August 2021 SNOPR, DOE also requested comment on the proposal to not require that exterior ceiling insulation must have uniform thickness or a uniform density. 86 FR 47744, 47778. NAHB supported DOE's proposal to not require exterior ceiling insulation to have uniform thickness or density. They also agreed that space constraints make several of the insulation requirements in the 2021 IECC not applicable to manufactured housing. (NAHB, No. 1398 at p. 3) MHI, Clayton Homes and MHCC agreed that manufactured homes should not have a uniform thickness of installation requirement. Installing insulation with a non-uniform thickness is required to construct most manufactured homes due to shipping height restrictions and the need to minimize truss heel height. They provided further supporting information to remove this requirement. (MHI, No. 1592 at p. 25-26); (Clayton Homes, No. 1589 at p. 16-18, 22); (MHCC, No. 1600 at p. 6) As such, in this final rule, DOE is not requiring that exterior ceiling insulation must have uniform thickness or a uniform density.

d. §460.104 Building Thermal Envelope Air Leakage

Consistent with the August 2021 SNOPR, DOE is adopting §460.104 to require manufacturers to seal manufactured homes against air leakage. Air leakage sealing limits air infiltration through the building thermal envelope, which in turn reduces heating and cooling loads. Section 460.104 would specify both general and specific requirements for sealing a manufactured home to prevent air leakage, all of which are based on Table R402.4.1.1 of the 2021 IECC with modifications based on recommendations from the MH working group. Term Sheet No. 107 at p. 5. The MH working group also recommended prescriptive air leakage sealing requirements that are designed to achieve an overall air exchange rate of five air changes per hour ("ACH") within a manufactured home. Term Sheet No. 107 at p. 5.

The general requirements in §460.104 would require that manufacturers seal all joints, seams, and penetrations in the building thermal envelope to establish a continuous air barrier and use appropriate sealing materials to allow for differential expansion and contraction of dissimilar materials. The specific requirements in Table 460.104 include air barrier criteria for ceiling or attic, duct system register boots, electrical box or phone on exterior walls, floors, mating line surfaces, recessed lighting, rim joists, shower or tub adjacent to exterior wall, walls and windows, skylights and doors. In response to comments, however, DOE is adjusting language for the air barrier installation criteria for "rim joists" in Table 460.104 based on a recommendation received from MHI, which is discussed below. The adopted building thermal envelope air leakage requirements would apply to both Tier 1 and Tier 2 homes.

In developing its recommendations, the MH working group also identified concerns regarding the potential impacts of the air sealing requirements on the indoor air quality in manufactured homes, but understood indoor air quality to be outside the scope of the working group. (MH Working Group Meeting Transcript No. 115, pp. 95-96) As such, DOE published the January 2022 DEIS to, in part, address the impacts of DOE's proposed standards on indoor air quality. As discussed more in section V.D, DOE received numerous comments on indoor air quality issues in the January 2022 DEIS, and DOE considered all of the information presented in the analyses and comments from the January 2022 DEIS, and the analyses in the final EIS in constructing this final rule.

The following paragraphs discuss comments DOE received regarding the building thermal envelope air leakage requirements proposed in the August 2021 SNOPR.

DOE received a comment regarding a language change in Table 460.104. MHI recommended removing "to the sill plate and the rim board" from Table 460.104 in the "Rim Joists" section. MHI stated that mud sill plates are not typically used in manufactured housing and, if used, would be installed on-site by others outside the scope of this rule. (MHI, No. 1592 at p. 19) As DOE understands this situation, a sill plate is the board laid directly on top of the foundation wall attached to the foundation wall with anchor bolts. DOE proposed the aforementioned requirements in the August 2021 SNOPR because the 2021 IECC included the update. However, DOE also requested comment on whether the proposed update applies to manufactured home construction. 86

FR 47744, 47784 Therefore, although the 2021 IECC included updates that the junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed, based on MHI's comment, DOE has concluded that sill plates and their air leakage installation criteria are not directly applicable to manufactured housing construction in the factories. To be consistent with EISA in considering the design and factory construction techniques for manufactured homes (42 U.S.C. 17071(b)(2)), DOE has removed "to the sill plate and the rim board" from the air barrier installation criteria of the "Rim Joists" component of Table 460.104 in the final rule.

DOE received a comment regarding duct sealing methodologies. Schulte commented that the requirement that the duct sealing should be done in accordance with the duct manufacturer's instructions is consistent with the approach used for many manufactured housing systems. (Schulte, No. 1028 at p. 25) DOE notes that this is consistent with what was proposed in the August 2021 SNOPR; therefore, DOE maintains the requirement in the final rule.

DOE received a comment regarding sealing exemptions. MHI recommended that holes in the floor, such as under bathtubs and showers, must be exempted from sealing to permit the installation of p-traps in 2x6 floor systems, because these holes do not allow air intrusion from the exterior because the exterior floor air barrier is the bottom board and is not the floor itself. (MHI, No. 1592 at p. 27-28) DOE understands this comment to mean that holes in the floor must not be sealed to allow future installation of plumbing pipe components. However, DOE's research confirms that the holes in the floor around

bathtubs and showers are difficult to go back and fix, and need to be sealed correctly the first time. In addition, DOE's requirement is consistent with the air barrier criteria in Table R402.4.1.1 of the 2021 IECC which states that all holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed. Therefore, DOE maintains the requirement in the final rule to ensure that efficiency standards are being met.

DOE received several comments regarding the requirements for sealing of duct system register boots. MHI and Clayton Homes stated that in manufactured homes with heat ducts installed in the belly of the home, there is no need to seal the duct register and boots to the sub-floor because they are installed within the thermal envelope. (MHI, No. 1592 at p. 6, 7); (Clayton Homes, No. 1589 at p. 8, 10,11, 15, 20) DOE notes that the duct system register boots requirement is consistent with Table R402.4.1.1 of the 2021 IECC, and additionally states that only the HVAC supply and return register booths that penetrate building thermal envelope shall be sealed to the subfloor, wall covering, or ceiling penetrated by the boot. Therefore, this requirement only applies when the duct system penetrates the building thermal envelope. If the duct system does not penetrate the building thermal envelope, this requirement would not apply. Therefore, to ensure proper sealing for when HVAC supply and return register booths penetrate the building thermal envelope, DOE maintains the requirement in the final rule.

DOE received several comments regarding a language clarification in Table 460.104. MHI, Clayton Homes and MHCC stated that the "shower or tub adjacent to

exterior wall" component of Table 460.104 should be deleted or clarified to apply only when interior wall surface is used as an air barrier. (MHI, No. 1592 at p. 19); (Clayton Homes, No. 1589 at p. 18); (MHCC, No. 1600 at p. 9, 10) Table R402.4.1.1 of the 2021 IECC states, with regards to the shower/tub on exterior wall component, that the air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub, and that exterior walls adjacent to showers and tubs shall be insulated. This IECC requirement has been both accepted by the MH working group and has been implemented for years, as it was in the 2015 version of the IECC as well. In addition, having an air barrier between the showers/tubs and the exterior wall is necessary to prevent energy loss through these gaps and to prevent the shower or tub enclosures from getting too cold. Therefore, DOE maintains the requirement in the final rule.

DOE received a comment regarding the air barrier criteria for electrical boxes or phone boxes on exterior walls. MHCC stated that the option to provide an air barrier behind junction boxes or seal around the junction boxes should remain as written in Table 460.104. (MHCC, No. 1600 at p. 9) As such, DOE is finalizing the proposed requirement as it relates to the air barrier installation criteria for electrical boxes or phone boxes on exterior walls.

DOE received comments regarding the air leakage rate target. ACC FSC commented that for HUD zones 2 and 3, the air leakage rate target should be set at 3 air changes per hour at 50 Pascals pressure difference between the inside and outside of the home (ACH50). Further, they stated that the IECC requires whole building air leakage

testing with the air barrier installation requirements providing minimum practices to achieve the required air leakage control and recommended that whole building air leakage testing be implemented in a manner that provides assurance of the intended performance on a model-by-model basis, not necessarily for every installation of a model. (ACC FSC, No. 1364 at p. 6) VEIC recommended that the air leakage testing requirement as part of the third-party certification process be included in the HUD Code as follows: maximum air leakage rate of 5 ACH50 for HUD zones 1 and 2, and maximum air leakage rate of 3 ACH50 for HUD zone 3. (VEIC, No. 1633 at p. 6) MHCC stated that in the absence of building leakage testing criteria, it is unrealistic for the MHCC to provide proper feedback, and that there are current requirements and terminology in the proposed rule that do not apply to manufactured homes. (MHCC, No. 1600 at p. 9)

Conversely, DOE received a comment from MHI saying that there is substantial evidence that the prescriptive building thermal envelope air leakage standards incorporated within the rule are adequate to ensure homes achieve an air leakage rate of 5 ACH50. Further, MHI believes that whole house air leakage testing is unnecessary. (MHI, No. 1592 at p. 27)

The requirement of 5 ACH50 was evaluated by the MH working group. Specifically, the requirements set forth in the working group term sheet were intended to provide a prescriptive path for reaching envelope tightness of 5 ACH when pressurized to 50 Pascals. (Term Sheet, No. 107 at p. 5). Therefore, the rule would not establish

maximum building thermal envelope air leakage rate requirements. Instead, the MH working group recommended sealing requirements that would ensure that a home can be tightly sealed with techniques that can be visually inspected, thus minimizing the compliance burden on manufacturers. Because the working group agreed upon the requirements to reach an air leakage rate target of 5 ACH50 to minimize burden, DOE is finalizing requirements that meet that leakage rate in this final rule. Further, as discussed previously, this rulemaking only specifies energy conservation standards for manufactured housing and is not addressing a test procedure in this rulemaking.

In the August 2021 SNOPR, DOE requested comments on whether any other air barrier criteria language for recessed lighting, narrow cavities and plumbing from the 2021 IECC are applicable to manufactured housing. 86 FR 47744, 47784. MHI and MHCC stated that no additional language needs to be added for narrow cavities as any such activities are rare in manufactured housing and when they do occur, they generally do not disrupt the air barrier and are insulated or gasketed. Similarly, they stated that additional information does not need to be added for wiring and plumbing as most often these utilities are routed in the floor systems within the thermal envelope and larger vent piping is already caulked and sealed. (MHCC, No. 1600 at p. 10); (MHI, No. 1592 at p. 27) In addition, MHCC stated that they did not find any additional 2021 IECC updates that would be relevant to manufactured housing. (MHCC, No. 1600 at p. 9) MHI and MHCC stated that recessed lighting housings do not need specification on air leakage rates, as these fixtures are usually insulated contact rated and significantly airtight especially when considering that they are buried in the attic and will be sealed at the

ceiling penetration. (MHI, No. 1592 at p. 27-28); (MHCC, No. 1600 at p. 9, 10) Therefore, DOE did not add any additional air barrier criteria language for recessed lighting, narrow cavities and plumbing and maintains the proposed language in the final rule.

Finally, DOE received a comment from MHI recommending that DOE delete the recessed lighting requirements in Table 460.104 of the regulatory text without providing any further justification. (MHI, No. 1990 at p. 19) The proposed recessed lighting air barrier criteria requirement is consistent with Section R402.4.5 of the 2021 IECC, therefore DOE has chosen to maintain this requirement in the final rule.

3. Subpart C: HVAC, Service Water Heating, and Equipment Sizing

Subpart C adopts requirements that are applicable to manufactured homes related to ducts; HVAC; service hot water systems; mechanical ventilation fan efficacy; and heating and cooling equipment sizing. Subpart C requirements would be applicable to all manufactured homes. The following sections provide further details regarding Subpart C.

a. §460.201 Duct system

In this final rule, DOE is adopting the August 2021 SNOPR proposed duct systems requirements, and is including in §460.201(a) a requirement that manufactured homes equipped with a duct system be designed to limit total air leakage to less than or equal to 4 cubic feet per minute ("cfm") per 100 square feet of conditioned floor area when ducts are pressurized to 25 Pascals. DOE determined this requirement to be

consistent with section R403 of the 2021 IECC. In addition, DOE also will require that building framing cavities not be used as ducts or plenums under §460.201(a), consistent with the 2021 IECC and the recommendation of the MH working group (Term Sheet, No. 107 at p. 1). Building framing cavities are typically not tightly sealed and do not provide an adequate barrier against foreign bodies for air quality reasons. The use of building framing cavities as ducts and plenums is generally considered to be poor construction practice and is not a typical practice in the manufactured housing industry. The adopted duct system requirements would apply to both Tier 1 and Tier 2 homes.

The following paragraphs discuss comments DOE received regarding the duct system requirements proposed in the August 2021 SNOPR.

DOE received multiple comments regarding duct leakage testing. NEEA recommended that ductless heat pumps or other HVAC systems with all ductwork placed inside the conditioned space not be required to have duct leakage tested. In addition, NEEA recommended that DOE include language requiring pressure testing of supply ducts during construction. (NEEA, No. 1601 at p. 11, 16) MHCC commented that total duct leakage is not an appropriate test for a manufactured home because the majority of duct work in manufactured homes is within the thermal barrier. (MHCC, No. 1600 at p. 10) MHI also stated that with homes where the duct system is installed in the belly, any duct leakage that may occur is still within the thermal envelope of the home, and that the required testing for the duct leakage limitation is not included in the DOE cost analysis. In addition, MHI recommended DOE clarify the testing requirements to ensure supply

duct systems maintain a leakage of less than 4 cfm per 100 square feet of conditioned floor area as installed and tested within the building facility. (MHI, No. 1592 at p. 28) MHI also recommended that DOE add language to specify that "multi-section homes may have each home section isolated and tested separately" (MHI, No. 1592 at p. 7, 19-20) Finally, Clayton Homes and MHI advocated for the use of a specific rough-in test method to determine the air leakage of the duct systems, where Clayton Homes elects to include the exception for the case where all ducts and air handlers are located entirely within the building (MHI, No. 1592 at p. 19) (Clayton, No. 1986 at p. 15). DOE appreciates the information received regarding testing and compliance. As discussed previously, this rulemaking only specifies energy conservation standards for manufactured housing and is not addressing a test procedure at this time. However, DOE will consider these comments for any potential future rulemaking.

DOE also received comments regarding language adjustments in §460.201. MHI recommended specifying in the rule that only the supply ducts be sealed to limit total air leakage to less than or equal to 4 cfm per 100 square feet of conditioned floor area. (MHI, No. 1592 at p. 7, 19-20) MHI also recommended adding sealing provisions to this section regarding metal ducts and fittings, glass fiberboard ducts, connections of installed ductwork, and flexible ducts. (MHI, No. 1990 at p. 20) The August 2021 SNOPR proposal did not specify that duct systems must have supply ducts be sealed to the limit total air leakage or any specific sealing provisions; rather, the proposal generally specified that a manufactured home equipped with a duct system be sealed to limit total air leakage. 86 FR 47744, 47784-47785 As such, DOE notes that the proposed

requirements already apply to homes with supply ducts and cover all elements of an air distribution system. In addition, although DOE recognizes the extra provisions recommended by MHI as best practices for installation, in this final rule, DOE is being consistent with the 2021 IECC and allowing the manufacturers to use any appropriate sealing provisions as long as the duct leakage limits are met. Therefore, DOE is finalizing the August 2021 SNOPR proposed requirements.

DOE received comments in support of the requirement to limit duct air leakage to 4 cfm per 100 square feet of conditioned floor area when ducts are pressurized to 25 Pascals. Schulte stated that duct leakage can be a source of energy loss and puts more strain on the HVAC equipment, and that this is a reasonable requirement. (Schulte, No. 1028 at p. 25) NEEA strongly supported DOE's inclusion of limiting duct leakage to the exterior to not more than 4 cfm per 100 square feet and preventing the use of building cavities as ductwork. (NEEA, No. 1601 at p. 10) However, NEEA also recommended that ductless heat pumps or other HVAC systems with all ductwork placed inside the conditioned space not be required to comply with the 4 cfm per 100 square foot requirement. *Id.* DOE notes that the duct leakage requirement only applies to manufactured homes equipped with a duct system (not ductless systems). Further, for manufactured homes, DOE understands that it is not always the case that ducts and air handlers are located entirely within the building thermal envelope. As such, the proposed duct leakage specification applies to all manufactured homes and is consistent with the recommendations provided by the MH working group. *See* Term Sheet at p. 5. Therefore, DOE is adopting the proposed requirement in the final rule.

b. §460.202 Thermostats and controls

In this final rule, DOE is adopting the August 2021 SNOPR proposed specifications for thermostats in §460.202(a) of the regulatory text based on the IECC. Section R403.1 of the 2021 IECC specifies that at least one thermostat shall be provided for each separate heating and cooling system. DOE is also adopting specifications for programmable thermostats in §460.202(b), based on section R403.1.1 of the 2021 IECC. Section R403.1.1 of the 2021 IECC specifies that the thermostat controlling the primary heating or cooling system must be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. In addition, consistent with the August 2021 SNOPR, DOE is including in § 460.202(c) specifications for heat pumps having supplementary heat, based on section R403.1.2 of the 2021 IECC, which identifies specific controls that prevent supplemental heat operation when the heat pump compressor can meet the heating load. The adopted thermostat and control requirements would apply to both Tier 1 and Tier 2 homes.

The following paragraphs discuss comments DOE received regarding the thermostat and controls requirements proposed in the August 2021 SNOPR.

DOE requested comment on DOE's interpretation of section R403.1 of the 2021 IECC, and on whether there were any of the 2021 IECC updates relevant to manufactured housing that should be considered as part of this rulemaking. 86 FR 47744, 47786. Regarding thermostat control, MHI recommended that programmable thermostats should

remain an option for the homebuyer, and any pre-program requirements should be part of regulation requirements on thermostat manufacturers if deemed appropriate rather than on home manufacturers. (MHI, No. 1592 at p. 28) MHI also stated they have observed that many of the current homeowners do not use these thermostats correctly or have replaced them with a simpler version, and that the programmable thermostat is not perceived as "providing value" to the current consumer and should not be mandated. (MHI, No. 1592 at p. 7) The proposed requirements for programmable thermostats are consistent with the requirements in Section R403.1.1 of the 2021 IECC. Further, these requirements were recommended to be included by the MH working group. See Term Sheet at 1. Finally, DOE notes that programmable thermostats help consumers save energy by providing the capability to reduce energy use automatically during predetermined times (generally times the home is not occupied). Accordingly, DOE is adopting the August 2021 SNOPR language in this final rule without modifications.

DOE also received recommendations regarding language adjustments in §460.202. MHI recommended revising §460.202(b)(3) to the following: "Homeowner manuals should include recommendation that homeowners program thermostat with a heating temperature set point no higher than 70 °F (21 °C) and a cooling temperature set point no lower than 78 °F (26 °C)." (MHI, No. 1592 at p. 20). The August 2021 SNOPR originally proposed that any thermostat installed by the manufacturer that controls the heating or cooling system must initially be programmed with the previously mentioned heating and cooling temperature set points, without any specification about the homeowner manuals. The initial heating and cooling temperature set points that DOE

proposed are consistent with section R403.1.1 of the 2021 IECC and recommendations from the working group. The 2021 IECC does not specify that it is the homeowner's responsibility for this setting; rather that temperatures are programmed initially by the manufacturer. Accordingly, DOE is adopting the August 2021 SNOPR language in this final rule without modifications.

Regarding thermostat control, NEEA recommended that the final rule be explicit that the electric resistance lockout in central heat pump systems when the outdoor air temperature is greater than 40 °F. (NEEA, No. 1601 at p. 14, 15). While section R403.1.2 of the 2021 IECC provides requirements for the shutoff of heat pumps having supplementary electric-resistance heat under certain conditions, the 2021 IECC does not provide any temperature specifications for this shutoff. Therefore, DOE did not consider this requirement in the energy conservation standards.

c. §460.203 Service hot water

In this final rule, DOE is adopting the August 2021 SNOPR proposed specifications for service hot water in §460.203(a) that requires manufacturers to install service water heating systems according to the service water heating system manufacturer's installation instructions. Section 460.203 would apply to any service water heating system installed by a manufacturer. In addition, §460.203 would require manufacturers to provide maintenance instructions for the service water heating system with the manufactured home. These requirements would promote the correct installation

and maintenance of service water heating equipment and help to ensure that such equipment performs at its intended level of efficiency.

Further, DOE is adopting the requirement in §460.203(b) that would require any automatic and manual controls, temperature sensors, and pumps associated with service water heating systems to be similarly accessible. This requirement would ensure that homeowners would have adequate control over service water heating equipment in order to achieve the intended level of efficiency contemplated in 10 CFR part 460. This requirement is consistent with the recommendation of the MH working group. Term Sheet, No. 107 at p. 1.

DOE also is adopting specifications for heated water circulation systems in §460.203(c) based on section R403.5.1.1 of the 2021 IECC, which provides information on heated water circulation and temperature maintenance systems. The specifications include: (1) requiring heated water circulation systems be provided with a circulation pump, and that the system return pipe be a dedicated return pipe or cold water supply pipe; (2) prohibiting gravity and thermosyphon circulation systems; (3) requiring that controls for heated water circulation system pumps identify a demand for hot water within the home when starting the pump; and (4) requiring the controls to automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water.

Finally, DOE is adopting the requirement that all hot water pipes outside conditioned space be required to be insulated to at least *R*-3, and that all hot water pipes from a water heater to a distribution manifold be required to be insulated to at least *R*-3. These requirements are consistent with the recommendations of the MH working group. Term Sheet, No. 107 at p. 6. The adopted service hot water requirements would apply to both Tier 1 and Tier 2 homes.

The following paragraphs discuss comments DOE received regarding the service hot water requirements proposed in the August 2021 SNOPR.

DOE requested comment in the August 2021 SNOPR on whether the circulating hot water system temperature limit should be included as a requirement due to the update in section R403.5.1.1 of the 2021 IECC which states that the controls of the heated water circulation systems shall limit the temperature of the water entering the cold-water piping to not greater than 104ºF (40ºC). 86 FR 47744, 47786. In response, MHI stated that circulating hot water systems are not typically used in manufactured homes, and that 24 CFR 3280 already has provisions for scald prevention that limit the temperature of hot water, so additional requirements would be redundant and unnecessary. (MHI, No. 1592 at p. 28) Therefore, DOE did not incorporate a circulating hot water system temperature limit into the final rule.

DOE received a comment regarding water heater insulation. An individual commenter stated that water heater jackets have proven effective at reducing heat loss

and improving energy efficiency and believes that the final rule should incorporate water heater insulation provisions. (Individual commenter, No. 1563 at p. 1) DOE acknowledges that water heater jackets and insulating entire water heater systems would result in higher energy efficiency and more savings for homebuyers. However, water heater jackets were not discussed in the 2021 IECC and are not within the scope of this rulemaking. Specifically, DOE is not proposing energy conservation standards for HVAC, water heaters, lighting, and appliances because the energy efficiency of those products is specifically governed by the comprehensive Appliance Standards program established under EPCA. (42 U.S.C. 6291-6317). However, manufacturers would not be prohibited from installing more efficient products and appliances, as long as the energy conservation standards for manufactured housing established in this final rule are met.

DOE received a comment regarding further pipe insulation. NEEA recommended that pipe insulation be required on the hot water main branch and locations where the insulation is not in direct contact with the pipe or underfloor. (NEEA, No. 1601 at p. 5, 16) DOE's requirement of a minimum R-value for all hot water pipes outside conditioned space, and from a service hot water system to a distribution manifold is consistent with the 2021 IECC and the MH working group recommendation. Term Sheet, No. 107 at p. 6. Therefore, DOE is adopting the hot water pipe insulation requirement from the August 2021 SNOPR. DOE notes that its energy conservation standards do not prohibit manufacturers from employing additional insulation beyond DOE's requirements.

DOE also received a comment regarding language adjustments in §460.203. MHI recommended deleting the proposed provision requiring that, when service hot water systems are installed by the manufacturer, the manufacturer must ensure that any maintenance instructions received from the service hot water system manufacturer are provided with the manufactured home. (MHI, No. 1592 at p. 20); (MHI, No. 1990 at p. 21) DOE understands MHI's rationale for deleting this proposed requirement to be that typical water heater instructions do not include maintenance instructions because they are readily available online, and that this information is already accommodated in 24 CFR Part 3280. As discussed in the August 2021 SNOPR, DOE included this requirement as it would promote the correct installation and maintenance of service water heating equipment and help to ensure that such equipment performs at its intended level of efficiency. 86 FR 47744, 47786. Considering the added instruction would ensure correct installation, DOE continues to include in the requirements that maintenance instructions provided by the service hot water manufacturer must be provided with the manufactured home.

d. §460.204 Mechanical ventilation fan efficacy

In this final rule, DOE is adopting the August 2021 SNOPR proposed mechanical ventilation fan efficacy requirements, based on Table R403.6.2 of the 2021 IECC. This includes minimum fan efficacy requirements for HRV and ERV, and air handlers that are integrated to tested and listed HVAC equipment, in addition to more stringent minimum efficacy requirements for in-line supply or exhaust fans, other exhaust fans (with separate requirements for fans having a minimum airflow rate of < 90 cubic feet per minute

("CFM") and ≥ 90 CFM). The adopted mechanical ventilation fan efficacy requirements would apply to both Tier 1 and Tier 2 homes.

The following paragraphs discuss comments DOE received regarding the mechanical ventilation fan efficacy requirements proposed in the August 2021 SNOPR.

DOE received comments regarding current ventilation strategies. ACC FSC commented that DOE's intent to rely on a continuously operated whole-house exhaust fan could create issues with maintaining a healthy indoor environment and humidity control depending on the climate and season of the year. (ACC FSC, No. 1364 at p. 6) ACEEE suggested that it appears to be more typical for homes to use a furnace fan for ventilation and to meet the HUD code, the furnace supply system to be in continuous operation in fan-only mode. (ACEEE, No. 1631 at p. 12) On the other hand, MHCC commented that they agree with not including alternative ventilation strategies since the mitigation measures are already addressed in the HUD Manufactured Home Construction and Safety Standards in §3280.103(b)(1). (MHCC, No. 1600 at p. 11) In the August 2021 SNOPR, DOE estimated the energy use associated with ventilations by modeling a dedicated central exhaust fan for both the base case representing today's manufactured homes and the standards case representing manufactured homes that would comply with the proposed standards. DOE modeled the ventilation system in this manner because it represents the current requirements under the HUD Code as explained previously. The selection of the central exhaust fan for the energy use modeling was based on analysis from the MH Working Group. DOE acknowledges other ventilation strategies exist, and

the requirements in this final rule do not preclude the use of other types of ventilation systems as long as the energy conservation standards requirements are met.

DOE requested comment in the August 2021 SNOPR on the proposal to include the 2021 IECC fan efficacy standard requirements, and if any of the fan efficacy requirements were not applicable to manufactured homes. 86 FR 47744, 47787. MHI stated that DOE must clarify that the requirements of the whole-house mechanical ventilation system do not apply to bath fans and range hoods, which are systems MHI does not believe should be included. (MHI, No. 1592 at p. 21) Separately, MHCC stated that the applicability of the increased efficacy standards would be dependent upon the additional costs associated and return of investment of the increased mechanical ventilation requirements. (MHCC, No. 1600 at p. 11)

As discussed in section III.F.1.b of this document, DOE is amending the definition to "whole house ventilation system" in response to MHI's comment and to be consistent with the 2021 IECC. As such, the updated definition now specifically includes the term "to satisfy the whole house ventilation rates". Otherwise, to maintain consistency with the 2021 IECC, DOE will not be incorporating extra language to exclude bath fans and range hoods from the definition of whole-house mechanical ventilation system.

Schulte separately stated that consumers will prefer quieter rather than louder mechanical devices as they do with many household appliances, and therefore, it does not

appear to be necessary to establish a maximum sound level for ventilation fans. (Schulte, No. 1028 at p. 26) DOE did not propose sound level requirements in the August 2021 SNOPR and continues not to in this final rule.

e. §460.205 Equipment sizing

In this final rule, DOE is adopting the August 2021 SNOPR proposed specifications for equipment sizing, based on section R403.7 of the 2021 IECC, which sets forth specifications on the appropriate sizing of heating and cooling equipment within a manufactured home. This section of the 2021 IECC requires the use of ACCA Manual S to select appropriately sized heating and cooling equipment based on building loads calculated using ACCA Manual J. The MH working group recommended the inclusion of this specification in the final rule. Term Sheet, No. 107 at p. 1. The adopted equipment sizing requirements would apply to both Tier 1 and Tier 2 homes.

The following paragraphs discuss comments DOE received regarding the heating and cooling equipment sizing specifications proposed in the August 2021 SNOPR.

DOE received several comments on the August 2021 SNOPR regarding the removal of ACCA Manual J and ACCA Manual S references. MHI commented that the incorporation of these manuals is an example of trying to use a site-built code for manufactured homes and would restrict current sales practices in the industry especially for retailers located near the Zone boundaries, and that the use of Manual J or Manual S software, as proposed, will add additional time and cost for each model plan submission.

(MHI, No. 1592 at p. 7, 21, 24); (Clayton Homes, No. 1589 at p. 8, 9, 12, 15-17, 19-20); (MHCC, No. 1600 at p. 10, 11) MHCC commented that incorporating Manual J and Manual S references will complicate the manufacturing process and will also increase the overall cost of the units, approval time, and frequency of approval. (MHCC, No. 1600 at p. 5)

Further, MHI also commented that ACCA Manual J analysis requires knowledge of the orientation of the home with respect to the sun for cooling load analysis, and that the proposed rule must establish a default orientation. MHI also said that the proposed rule must provide the required design parameters to perform an ACCA Manual J analysis within the context of the three thermal zones in the proposed rule, and that the rule must establish a threshold for requiring a revised Manual J or Manual S analysis. (MHI, No. 1592 at p. 7, 21, 24) In addition, MHCC commented that both Manual J and Manual S consider the orientation and site-specific weather for the home, which is unknown at the time of construction of manufactured homes. (MHCC, No. 1600 at p. 5) MHI and Clayton Homes also suggested that the proposed rule must establish alternate criteria for using ACCA Manual S where the design parameters vary within a thermal zone, because the variation in design parameters within a single thermal zone exceeds the sizing limits of ACCA Manual S. (MHI, No. 1592 at p. 7, 21, 24); (Clayton Homes, No. 1589 at p. 12) Alternatively, MHI and Clayton Homes suggested in their comments submitted in response to the January 2022 DEIS that the requirements to use ACCA Manual S and J in regulatory section 460.205 be deleted entirely. (MHI, No. 1990 at p. 22); (Clayton Homes, No. 1986 at p. 16) Clayton Homes also recommended deleting section 460.3

(b)(1) and (b)(2), which lists ACCA Manual J and Manual S as materials incorporated by reference. (Clayton Homes, No. 1986 at p. 9)

On the other hand, Schulte commented that heating and cooling equipment sizing in accordance with ACCA Manuals J and S have been a part of the IECC for many years, and therefore, including these manuals would be consistent with the EISA. In addition, HUD has included the ACCA Manual J calculation for cooling loads for site installed air conditioners, so ACCA Manual J is already a part of the regulatory system in circumstances where the site of placement is known. (Schulte, No. 1028 at p. 11)

Section R403.7 of the 2021 IECC requires the use of ACCA Manual S and J. Further, the same section states that "Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies." DOE notes that Manual J and Manual S calculations require details such as orientation of the building which are unknown for manufactured housing until placed on site, but that these calculations are an important part of the design process. DOE expects that manufacturers already conduct system sizing calculations using best practices based on the load calculation and system sizing methodology specified in the HUD code.[55] Further, DOE understands that Manual J/S calculations are used in the field based on feedback received and also evidenced by plants which already use software to conduct these calculations.

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[55] *See* 24 CFR 3280.508

This is confirmed by the lookup tables developed by EnergyStar based on Manual J calculations conducted by the Manufactured Housing Research Alliance for typical home configurations and design conditions across the country.[56] Accordingly, DOE is referencing ACCA Manual J and S as they would apply to manufactured housing design, and is allowing further requirements for ACCA Manual J and S to be consistent with current manufacturer specifications and best practices.

G. Crosswalk of Standards with the HUD Code

DOE compared the energy conservation standards in this final rule to the construction and safety standards for manufactured homes established by HUD to confirm that compliance with the requirements would not prohibit a manufacturer from complying with the HUD Code.

Table III.11 lists the energy conservation standards and discusses their relationship to similar requirements contained in the HUD Code.

Table III.11: Crosswalk of Final Rule with the HUD Code

DOE Final Rule (10 CFR part 460)	**HUD Code** (24 CFR part 3280)	**Notes**
Section 460.101 would establish three climate zones, in line with HUD, delineated by state boundaries. Further, there would be different U_o performance requirements for single- and multi-section homes.	Section 3280.506 establishes three zones delineated by state boundaries. The HUD Code establishes one standard for homes of all sizes within a zone.	
Section 460.102(a) would establish building thermal envelope prescriptive and	Section 3280.506 establishes a performance approach.	Both DOE and HUD performance requirements are based on maximum *Uo*

[56] EnergyStar lookup tables *https://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/SizingGuidelines.pdf?59f6-4ecc*

DOE Final Rule (10 CFR part 460)	**HUD Code** (24 CFR part 3280)	**Notes**
performance compliance requirements.		requirement per zone for the building thermal envelope. DOE, however, established separate Uo requirements per climate zone for single- and multi-section homes, whereas HUD only establishes one *Uo* requirement, regardless of home size, per zone.
Section 460.102(b) would set forth the prescriptive option for compliance with the building thermal envelope requirements.	Section 3280.506 establishes a performance approach only.	The Battelle Method is used to determine performance standards (in terms of *Uo*) from prescriptive standards. The DOE performance standards would be prescribed in §460.102(c)(1)
Section 460.102(b)(2) would establish a minimum truss heel height.	No corresponding requirement	
Section 460.102(b)(3) would establish an acceptable batt and blanket insulation combination for compliance with the floor insulation requirement in Tier 2 Climate Zone 3.	No corresponding requirement	
Section 460.102(b)(4) would identify certain skylights not subject to SHGC requirements.	No corresponding requirements.	
Section 460.102(b)(5) would establish *U*-factor alternatives for the *R*-value requirements under 460.102(b)(1).	No corresponding requirements.	
Section 460.102(c)(1) would establish maximum building thermal envelope U_o requirements.	Section 3280.506(a) establishes maximum building thermal envelope U_o requirements by zone.	DOE's maximum building thermal envelope U_o requirements are lower than the corresponding maximum U_o requirements under §3280.506(a). Compliance with the DOE U_o requirements achieve compliance with the U_o requirements under the HUD Code.
Section 460.102(c)(2) would establish maximum area-weighted vertical fenestration *U*-factor requirements in climate zones 2 and 3.	No corresponding requirements.	
Section 460.102(c)(3) would establish maximum area-weighted average skylight *U*-factor requirements in climate zones 2 and 3.	No corresponding requirements.	
Section 460.102(c)(4) would authorize windows, skylights and	No corresponding requirements.	

DOE Final Rule (10 CFR part 460)	HUD Code (24 CFR part 3280)	Notes
doors containing more than 50 percent glazing by area to satisfy the SHGC requirements of §460.102(a) on the basis of an area-weighted average.		
Section 460.102(e)(1) would establish a method of determining U_o using the Overall *U*-values and Heating/Cooling Loads—Manufactured Homes, or the Battelle Method.	Section 3280.508(a) and (b) reference the Overall *U*-values and Heating/Cooling Loads—Manufactured Homes, or the Battelle Method.	
Section 460.103 would require insulating materials to be installed according to the manufacturer installation instructions and the prescriptive requirements of Table 460.103.	No corresponding requirements.	
Section 460.103 would establish requirements for the installation of batt, blanket, loose fill, and sprayed insulation materials.	No corresponding requirements.	
Section 460.104 would require manufactured homes to be sealed against air leakage at all joints, seams, and penetrations associated with the building thermal envelope in accordance with the manufacturer's installation instructions and the requirements set forth in Table 460.104	Section 3280.505 establishes air sealing requirements of building thermal envelope penetrations and joints	
Section 460.201(a) would require each manufactured home to be equipped with a duct system that must be sealed to limit total air leakage to less than or equal to 4 cfm per 100 square feet of floor area and specify that building framing cavities are not to be used as ducts or plenums when directly connected to mechanical systems.	Section 3280.715(a)(4) establishes requirements for airtightness of supply air duct systems.	
Section 460.202(a) would require at least one thermostat to be provided for each separate heating and cooling system installed by the manufacturer.	Section 3280.707(e) requires that each space heating, cooling, or combination heating and cooling system be provided with at least one adjustable automatic control for regulation of living space temperature.	Both DOE's rule and the HUD Code require the installation of at least one thermostat that is capable of maintaining zone temperatures.
Section 460.202(b) would require that installed thermostats controlling the primary heating or cooling system be capable of	No corresponding requirements.	

DOE Final Rule (10 CFR part 460)	**HUD Code** (24 CFR part 3280)	**Notes**
maintaining different set temperatures at different times of day and different days of the week.		
Section 460.202(c) would require heat pumps with supplementary electric resistance heat to be provided with controls that, except during defrost, prevent supplemental heat operation when the pump compressor can meet the heating load.	Section 3280.714(a)(1)(ii) requires heat pumps to be certified to comply with ARI Standard 210/240-89, heat pumps with supplemental electrical resistance heat to be sized to provide by compression at least 60 percent of the calculated annual heating requirements of the manufactured home, and that a control be provided and set to prevent operation of supplemental electrical resistance heat at outdoor temperatures above 40ºF.	Both DOE's rule and the HUD Code require heat pumps with supplemental electric resistance heat to prevent supplemental heat operation when the heat pump compressor can meet the heating load of the manufactured home.
Section 460.203(a) would establish requirements for the installation of service hot water systems.	No corresponding requirements.	
Section 460.203(b) would require any automatic and manual controls, temperature sensors, pumps associated with service hot water systems to be accessible.	No corresponding requirement.	
Section 460.203(c) would establish requirements for heated water circulation systems.	No corresponding requirements.	
Section 460.203(d) would establish requirement for the insulation of hot water pipes.	No corresponding requirements.	
Section 460.204 would establish requirements for mechanical ventilation system fan efficacy.	Section 3280.103(b) establishes whole-house ventilation requirements.	HUD requirements at §3280.103(b) do not overlap with DOE's rule. DOE's requirement is for fan electrical efficiency, while HUD requirements specify minimum and maximum air flow rates.
Section 460.205 would establish requirements for heating and cooling equipment sizing.	No corresponding requirements.	

IV. Discussion and Results of the Economic Impact and Energy Savings

A. Economic Impacts on Individual Purchasers of Manufactured Homes

DOE conducted LCC and PBP analyses to evaluate the economic impacts on individual consumers of energy conservation standards for manufactured housing. The effect of new or amended energy conservation standards on individual consumers usually involves a reduction in operating cost and an increase in purchase cost. DOE used the following two metrics to measure consumer impacts:

- The LCC is the total consumer expense of a manufactured home over the life of that home, consisting of total installed cost plus total operating costs. To compute the total operating costs, DOE discounts future operating costs to the time of purchase and sums them over the lifetime of the product (or another specified period).

- The PBP is the estimated amount of time (in years) it takes consumers to recover the increased purchase cost (including installation) of a more-efficient manufactured home through lower operating costs.

The LCC of a manufactured home refers to the total homeowner expense over the life of the manufactured home (30 years), consisting of purchase expenses (*e.g.*, loan or cash purchase) and operating costs (*e.g.*, energy costs). To compute the operating costs, DOE discounted future operating costs to the time of purchase and summed them over the 30-year lifetime of the home used for the purpose of analyzing this rulemaking. A 10-

year LCC was also calculated to reflect the cost of ownership over the tenure of the first homebuyer based on recommendations from the MH working group. First homebuyer tenancy is estimated to be 13 years; however, DOE did not do a 13-year analysis, and instead approximates first tenancy with the 10-year analysis at the recommendation of the MH working group. DOE calculated the PBP by dividing the incremental increase in purchase cost by the reduction in average annual operating costs that would result from this rule.

In the August 2021 SNOPR and the October 2021 NODA, the LCC analysis demonstrated that increased purchase prices due to the proposed EEMs would be offset by the benefits manufactured home homeowners would experience via operating cost savings. DOE evaluated these projected impacts on individual manufactured home homeowners by analyzing the potential impacts to LCC, energy savings, and purchase price of manufactured homes under the proposed rule. DOE compared the purchase price and LCC for manufactured homes built in accordance with the proposed rule relative to a baseline manufactured home built-in compliance with the minimum requirements of the HUD Code. Specifically, DOE performed energy simulations on manufactured homes located in 19 geographically diverse locations across the United States, accounting for five common heating fuel/system types and two typical industry sizes of manufactured

homes (single-section and double-section manufactured homes).[57] 86 FR 47744, 47790-47805; 86 FR 59042, 59043.

DOE received a number of comments regarding several aspects of the economic impacts on individual consumers described in the August 2021 SNOPR and October 2021 NODA. DOE also received comments pertaining to the methodology and assumptions used in the economic analysis conducted. For this final rule, DOE conducted similar LCC and PBP analyses for the requirements adopted in this final rule. The changes made from the analyses performed for the August 2021 SNOPR and October 2021 NODA are discussed in the following sections, including any changes that DOE has made in the methodology and assumptions, along with a discussion of the submitted comments.

1. Discussion of Comments and Analysis Updates

a. General

UC Law School stated that DOE failed to analyze the findings and relevant information from the 2021 CFPB report and the 2020 U.S. Census Manufactured Housing Survey, thereby risking a finding that its action was arbitrary and capricious. They stated that these documents have relevant information that should be taken into account for the rulemaking process, especially for the financial implications of the proposed rule. (UC Law School, No. 1634 at p. 6, 7, 10) DOE reviewed the updates to

[57] Double-section manufactured homes were used to represent all multi-section homes. Double-section manufactured homes have the largest market share by shipments (about 98 percent) of all multi-section homes.

the 2021 CFPB and the 2020 MHS in the October 2021 NODA and provided updated analysis results. 86 FR 59042. DOE is incorporating the same updates in this final rule.

Schulte stated that loans made for used homes are likely to be much smaller than for new home loans. Table 4 of the 2021 CPFB report shows a median chattel loan amount is $58,672. Schulte also mentioned that there is currently no government-sponsored enterprise ("GSE") secondary market for the purchase of chattel manufactured home loans, and that, until private financing sources decide to purchase chattel loan pools or the GSE's move into the chattel loan market, limited lender choice and higher loan rates are likely to persist with regards to purchasing new manufactured homes. (Schulte, No. 1028 at pp. 6, 20) DOE appreciates the comment. As previously mentioned, DOE has updated the analysis to consider the 2021 CFPB. As such, the loan interest rates DOE is using (5 percent for consumers using real estate loans, 9 percent for consumers using chattel or personal property loans) is consistent with the rates used in the 2021 CFPB report (4.6 percent for mortgage/real estate loans and 8.6 percent for chattel loans).

b. Analysis Period for LCC

In the August 2021 SNOPR and the October 2021 NODA, DOE analyzed a 10-year LCC to represent the first ownership period and cost to the first homebuyer, and a 30-year LCC to represent the lifetime of the manufactured home and associated costs, which would represent the total costs and benefits for all occupants over the life of the manufactured home. The 30-year lifetime was selected as a typical length that EEMs last in the aggregate. DOE assumed that the energy efficiency measures (e.g., thicker insulation) had a lifetime of 30 years before requiring replacement. In addition, DOE

assumed that the monetary value of those energy efficiency measures depreciated linearly over time to having no value at the end of its lifetime; however, DOE assumed that the effectiveness of these measures does not decrease over time. As noted in the TSD, EEMs may have a shorter lifespan than the home if the measures reduce in efficacy over the 30-year lifetime; to the extent that this is the case, the energy savings presented in IV.D may be reduced. At the end of this 30-year lifetime, the EEMs would have no monetary value. DOE received comments on the analysis period used.

Based on MHI's industry data, they stated that buyers usually sell their homes within seven to ten years of purchase, and therefore it is unlikely that a manufactured homebuyer financing the purchase of a new manufactured home being proposed would even recover these upfront costs at a future sale. (MHI, No. 1592 at p. 4) They stated that at the efficiency levels proposed by DOE, MHI's survey of manufacturers found that it is unlikely that a buyer purchasing a new home and financing 90 percent of the purchase price would even recover these upfront costs at a future sale. *Id*

On the other hand, Schulte stated that the average tenancy for a manufactured home is 14 years, which supports a longer period for the LCC analysis. (Schulte, No. 1028 at pp. 6, 20) NASEO stated that DOE should not consider the benefits of only 10 years for determining cost effectiveness, because it is inconsistent with DOE's previous positions on the average 30 to 40-year lifetime of manufactured homes and an average ownership period of 13 years. They stated that the lifetime of a manufactured home averages 30 years as found by DOE in the June 2016 NOPR, and corroborated by DOE's own findings which indicate that many manufactured homeowners live in their homes for

40 or more years. Furthermore, they commented that DOE's proposed benefit analysis indicates an "average ownership period of 13 years" for new homes and states "62 percent of all homeowners anticipate living in their homes for more than 10 years and that 38 percent of homeowners do not anticipate ever selling their home." Accordingly, they stated that DOE should account for the "total life-cycle construction and operating costs", as required by EISA. (NASEO, No. 1565 at p. 2)

Next Step commented that HUD's affordability compliance requirements for new housing production are up to 30 years. (Next Step, No. 1617 at p. 7-9) They also stated that two of the most prominent affordable housing, new construction programs (the HOME Program and the Low-Income Housing Tax Credit Program), require affordability compliance periods for 30 years for rental new construction. Accordingly, they recommended that the federal government considers the long-term affordability of this housing stock, and the same principles should be applied to manufactured housing. (Next Step, No. 1617 at p. 5) Further, they stated that the consideration for LCC costs for manufactured homes should be based on 30 years. (Next Step, No. 1617 at p. 6) Schulte also stated that the current HUD thermal standards were based on the useful life of the home (33 years). Manufactured homes once sited are not often moved unless required to do because of a loan default or for other reasons. (Schulte, No. 1028 at p. 17)

DOE appreciates the information provided by these organizations regarding the potential tenure period for the occupants of manufactured homes. Based on a review of the 2019 AHS, the mean year that the householder (owner and renter) moved to a

manufactured home is 2008, which equates to 11 years living in the home in 2019. When separating owner and renter, the mean year was 2006 for the owner (equating to 13 years living in the home in 2019) and 2014 for the renter (equating to 5 years living in the home in 2019). Further, based on the nationally representative housing sample data in the 2019 AHS, the maximum duration for a householder living in the home is 49 years. Separately, a 2012 study conducted by Foremost Insurance Group found that 40 percent of manufactured home homeowners do not anticipate ever selling their manufactured home.[58] Furthermore, a 2021 manufactured housing industry overview fact sheet developed by MHI suggests that 62 percent of all homeowners anticipate living in their homes for more than 10 years and that 38 percent of homeowners do not anticipate ever selling their home.[59] Therefore, there are many factors that may affect the duration of time that a manufactured home remains under a given homeowner and similarly many factors that DOE must consider in developing its analysis. Considering the MH working group agreed on the 30-year and 10-year analysis periods, and analysis conducted by other organizations, including HUD, and the Low-Income Housing Tax Credit Program also conduct their analyses based on a 30-year analysis period, DOE is maintaining both the 30-year and the 10-year analyses.

EISA directs DOE to base the standards on the most recent version of the IECC considering, among other things, the total life-cycle construction and operating costs. (42 U.S.C. 17071(b)(1)) Therefore, based on DOE's reasoning and the comments discussed

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[58] Foremost Insurance Group. 2012 Mobile Home Market Facts.
[59] Manufactured Housing Institute. 2021 Manufactured Housing Facts: Industry Overview.

previously, DOE continued to perform the 30-year analysis to determine the economic impacts, as well as the cumulative benefits over the lifetime of the manufactured home. As such, DOE is considering the total life-cycle costs and operating costs of the standards over a 30-year period in this final rule. Separately, for the purposes of this analysis and based on the range of time periods provided in the comments discussed previously, DOE continues to rely on the 10-year time period as a reasonable representation of the ownership period of the first homebuyer for the overall manufactured housing market as it falls within the middle ground of the ranges described in the 2019 AHS and the comments provided.

c. LCC Methodology

DOE received a number of comments regarding the LCC methodology to capture potential savings related to the rulemaking.

Several commenters stated that using DOE's cost analysis assumptions and the average tenure of a manufactured homeowner, the changes recommended by DOE will actually cost homebuyers money that they will never recoup with energy savings. (MMHA, No. 995 at p. 1-2); (Michigan MHA, No. 1012 at p. 1-2); (WHA, No. 1025 at p. 1-2); (PMHA, No. 1165 at p. 1-2); (Westland, No. 1263 at p. 1-2); (Pleasant Valley, No. 1307 at p. 1); (American Homestar, No. 1337 at p. 1); (Oliver Technologies, No. 1350 at p. 1); (KMHA, No. 1368 at p. 1); (Adventure Homes, No. 1383 at p. 1-2); (NJMHA, No. 1451 at p. 2); (WMA, No. 1452 at p. 1-2); (IMHA/RVIC, No. 1466 at p. 2); (Cavco, No. 1497 at p. 2); (Skyline Champion, No. 1499 at p.1); (Mississippi MHA, No. 1588 at p. 2)

; (Skyline Champion, No. 1612 at p.2); (Cavco, No. 1622 at p. 2); (VAMMHA, No. 1624 at p. 2)

MHI stated that DOE's analysis uses improper calculations and methodologies. They stated that the proper way to do the cost-benefit analysis is by examining each incremental improvement in efficiency, individually, which DOE did not do, even though DOE developed and promotes a Building Energy Optimization Tool that uses this incremental approach to find the optimum investment. MHI stated that, by combining all the energy measures together into a single figure, the slim benefits of adding the last, least cost-efficient measures, is subsumed in and masked by the benefits of adding the first, most cost-effective measures. (MHI, No. 1592 at p. 4) Further, MHI also commented that many of the locations selected by the DOE for its analysis are not locations where manufactured housing is prevalent. (MHI, No. 1592 at p. 5) Accordingly, MHI performed their own analysis using a down-payment of 10 percent, an interest rate of 9 percent – which MHI stated is at the high end of mortgage rates today – a loan term of 20 years, and a tenancy period of 10 years, MHI's cost-benefit analysis found that the DOE's proposal would result in a net loss for single- and multi-section homes depending on location. (MHI, No. 1592 at p. 4) Cavco commented that the cost benefit analysis should begin at the HUD Code minimum requirements and increase incrementally, taking into account the actual cost and potential savings until the elements are found to produce negative paybacks over a reasonable time period. (Cavco, No. 1622 at p. 3)

Generally, NRDC stated that while the costs of energy efficiency improvements are borne by the first-time owner, the value is reaped by all residents of the product,

including renters and the purchasers of existing homes. They stated that neither of these actors has any say in determining energy efficiency unless they choose to perform retrofits, which are much less cost effective than building in the efficiency from the factory. (NRDC, No. 1599 at p. 2)

ACEEE recommended that DOE update the LCC analyses to also include renters. Based on their analysis, they stated that 25 percent of residents in manufactured homes are renters and 29 percent of residents are in homes less than ten years old. For low-income residents, 29 percent are renters (33 percent of those in homes less than ten years old). ACEEE also commented that the analyses should fully include owners with no debt - the percentage of owners (not including renters) with no home loan increases from 30 percent of owners of homes less than 4 years old to 38 percent of homes up to 10 years, 57 percent of homes 11-20 years, 76 percent of homes 21-30 years, and 87 percent of those 31-70 years old. They stated that 82 percent of low-income owners have no debt so, assuming low-income owners disproportionately purchase homes for under $63,000, the percentage of owners with no debt is likely higher for the cheapest homes. (ACEEE, No. 1631 at p. 8-10)

Accordingly, ACEEE referenced a separate white paper they conducted,[60] which suggested the following updates to the DOE LCC analysis. First, ACEEE noted that

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[60] Bell-Pasht, A., and L. Ungar. 2021. Strong Universal Energy Efficiency Standards Will Make Manufactured Homes More Affordable. Washington, DC: American Council for an Energy-Efficient Economy. *https://www.aceee.org/white-paper/2022/01/strong-universal-energy-efficiency-standards-manufactured-homes*.

affordability concerns are greatest for low-income households, only 3 percent of whom own homes that are less than ten years old; these residents tend to rent or to own older homes. If DOE chooses also to do 10-year LCC analyses, ACEEE recommended looking at all types of residents in years 1–10, 11–20, and 21–30 of a home to gain a better understanding of the impact on all residents. They stated that while these residents are roughly included in the 30-year LCC analyses, DOE should either blend these residents into the 10-year LCC analyses or do additional 10-year analyses to consider the impacts on these residents. Second, although income data are limited, ACEEE stated that there is no evidence that taking out chattel loans varies significantly by income level. They stated that median income of borrowers is almost the same for mortgages and chattel loans, per the 2021 CFPB Report. Therefore, ACEEE recommended that residents of single-section (or Tier 1) homes and lower-income residents have the same mix of financing as other residents and that they did not all pay higher interest rates. Third, ACEEE stressed that the EEM costs were too high and so it recommended updating cost estimates for what they claim are "more recent" estimates. Finally, ACEEE noted that incorporation of a heat pump water heater as an "additional efficiency package" option should be included. In addition, ACEEE performed some modifications to the LCC spreadsheet, including the following: (1) correcting the property cash flow payments to be in nominal dollars, such that the discounting used for the LCC calculation is consistent; (2) adjusting the incremental property tax payments to decline annually consistent with the residual value assumptions; and (3) adjusting the assumed chattel loan term from 15 to 23 years.

With the updates suggested, ACEEE's study found that a standard at the untiered/Tier 2 level would generate about $900 more in net life-cycle cost savings in the average single-section home than would the weaker standard. Their projected savings are significant in each climate zone, but they are especially striking in the South (Climate Zone 1), which has been the center of affordability concerns. Further, they estimated significantly higher LCC savings than DOE predicted because of the updated financing assumptions and updated cost assumptions. They also performed a 10-year LCC analysis, which suggested that while the first 10 years provides modest savings for the untiered/Tier 2 standards (consistent with DOE's analysis), the net savings from the untiered/Tier 2 standards surpass Tier 1 in the second and especially the third decade, as the energy cost savings continue and the cost (residual value) of the measures decreases. (See A. Bell-Pasht and L. Ungar study).

NEEA also stated that DOE's assumption that Tier 1 MH are only purchased by low-income households and financed by chattel loans is not accurate. (NEEA, No. 1601 at p. 6-9) Joint commenters also stated that the standards and analysis should take into account both the construction costs and the full energy costs for those who can buy new homes, for renters, and for owners of older homes. They commented that only 3 percent of low-income residents of manufactured homes own homes that are less than ten years old, and only 13 percent of low-income residents owe loan debt for their homes (including mortgages and chattel loans). (Joint Comments, No. 1630 at p. 1) Next Step recommended DOE consider that the energy savings should not be calculated based on a

simple payback for the first home buyer, but also subsequent purchasers who will benefit over the 40-year life expectancy of the home. (Next Step, No. 1617 at p. 7)

EISA requires that DOE establish energy conservation standards for manufactured housing with consideration of the cost-effectiveness as related to the purchase price and total life-cycle construction and operating costs generally. (42 U.S.C. 17071(b)(1)) As such, the LCC analysis addresses this requirement by incorporating the total homeowner expense over the life of the manufactured home, consisting of purchase expenses (e.g., loan or cash purchase) and operating costs (e.g., energy costs). Further, the LCC analysis focuses primarily on the effects of the rule on the individual consumers of manufactured homes. Finally, the LCC analysis applies to all consumers, regardless of whether they purchase the home from a commercial retailer or an onsite community operator.

DOE used the LCC and PBP analyses developed during the MH working group negotiations to inform the development of the rule based on the economic impacts on individual purchasers of manufactured homes. This includes the locations identified in the analysis – the MH working group selected nineteen cities located throughout each of the IECC climate zones. DOE updated the inputs to the LCC and PBP analyses based on updated references, including Annual Energy Outlook 2021 ("AEO 2021"), 2021 CFPB and the latest U.S. Energy Information Administration ("EIA") prices. In performing this analysis, DOE analyzed the costs and benefits to consumers over a 10-year analysis period and a 30-year analysis period. The 10-year analysis period represented the cost of

ownership over the tenure of the first homebuyer, and the 30-year analysis period reflected the total cost of ownership over the lifetime of the manufactured home. Further discussion on analysis period is provided in IV.A.1.b.

In reviewing the general comments regarding the LCC methodology, DOE agrees with ACEEE and has made the following updates: (1) correcting all property cash flow payments to be in nominal dollars, such that the discounting used for the LCC calculation is consistent; and (2) adjusting the assumed chattel loan term from 15 to 23 years (per the 2021 CFPB Report). DOE notes that the chattel loan term was adjusted in the October 2021 NODA. 86 FR 59042, 59044. DOE is maintaining the conservative assumption that incremental property tax payments should be held constant, as this was an assumption used by the MH working group, and because property tax is not just based on the value of the home, but also on the home location. Further, DOE is not including any requirements for the additional energy efficiency packages in this final rule, including heat pumps, as discussed in section III.F.2.b of this document. Finally, section IV.A.1.e addresses all comments regarding updating the incremental costs.

As acknowledged by ACEEE, the 30-year LCC analysis roughly includes all residents of manufactured homes, regardless of whether they are a homeowner or a renter. DOE believes the likely effect to renters is that the landlord would pass on their added purchase costs, financing costs and property taxes to the renters, but the renters would reap the same energy savings benefits as already presented in the 10- and 30-year analyses. In addition, as discussed in section IV.A.1.b of this document, DOE is

maintaining the 30-year analysis period as a reasonable representation of the total cost of ownership over the lifetime of the manufactured home.

Regarding the 10-year analysis, DOE acknowledges comments that there are all types of residents of manufactured homes, not just the homeowners. Further, DOE acknowledges that including other residents could show additional savings than what was presented in the August 2021 SNOPR and October 2021 NODA. However, the 10-year analysis was included in addition to the 30-year analysis specifically to represent the cost of ownership period over the tenure of the first homebuyer, per the MH Working Group (See page 343 at EERE-2009-BT-BC-0021-0120). To address affordability and the potential adverse impacts on price-sensitive, low-income purchasers of manufactured homes from the imposition of energy conservation standards, DOE maintains the 10-year analysis to continue to represent the first homebuyer only, consistent with the analysis conducted by the MH Working Group.

Further, DOE analyzed Tier 1 considering only personal property (i.e., chattel) loans. 86 FR 47744, 47798. Although the 2021 CFPB presents that the median income of borrowers of chattel loans is not significantly different than that of mortgage loans ($52,000 vs. $53,000; See Table 7 of the 2021 CFPB), it also notes that borrowers who own their land can either finance their home purchase with a chattel loan or a mortgage, whereas those who do not own their land are typically only able to finance with a chattel loan (see page 33). Therefore, DOE understands that the chattel loan median income in Table 7 of the 2021 CFPB could include both borrowers who own their land and

borrowers who do not. However, DOE notes that the Tier 1 analysis represents price-sensitive low-income purchasers, most if not all of whom would be unable to own land. DOE also notes that data presented in 2021 CFPB show that the median chattel loan amount for MH is $58,672 (versus a median amount of $127,056 for MH mortgages). These median loan amounts reflect the price differential between the median single-section and multi-section MH as reported in the MHS PUF 2020 ($57,233 and $108,583, respectively), which supports DOE's choice to use chattel loan rates for all Tier 1 homes (i.e., single-section homes). See Table III.1. Further, as acknowledged by ACEEE, income data as it relates to chattel vs. mortgage loans is limited. As such, DOE maintains the conservative consideration that the Tier 1 analysis would apply only to personal property or chattel loans.

Separately, MHARR stated that the October 2021 NODA assumes a lower inflation rate going forward than the August 2021 SNOPR. However, they suggested that current inflation easily exceeds both numbers cited by DOE and is increasing at a rapid pace. They stated that actual inflation is more than two times the rate estimated by DOE and has increased drastically since the beginning of 2021. They suggested that the latest cost data show that the purchase price impact of the DOE proposed rule would be even greater going forward than projected by the August 2021 SNOPR, and would undermine the inherent affordability of manufactured housing contrary to law. (MHARR, No. 1640 at p. 6, 7)

DOE understands that there may be uncertainties regarding inflation rates and future prices of energy. In the August 2021 SNOPR, the inputs used in the LCC analysis, including inflation rates, energy prices and their escalation rates, were based on the *AEO 2020* and Short-Term Energy Outlook studies, prepared by the U.S. EIA. In the October 2021 NODA, DOE updated the AEO source to the latest version, which is *AEO 2021*.[61] Further, DOE updated the electricity prices from the EIA *Short-Term Energy Outlook*.[62]

The *AEO* presents long-term annual projections of energy supply, demand, and prices. The projections, focused on U.S. energy markets, are based on results from EIA's National Energy Modeling System ("NEMS"). NEMS enables EIA to make projections under internally consistent sets of assumptions. DOE has determined these studies are the best current and future estimates of inflation, energy prices and escalation rates and uses these studies in support of all of its energy conservation standard rulemakings. In the final rule, DOE proposes to maintain the same source for establishing inflation rates, energy prices and escalation rates as the October 2021 NODA, which was *AEO 2021*.

d. Payback Periods

DOE also received several comments regarding PBP results relating to the LCC and homeownership periods.

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[61] Energy Information Administration. Annual Energy Outlook 2021 with Projections to 2050. (2021).
[62] Energy Information Administration. Short-Term Energy Outlook: Real Prices Viewer. Available at: *www.eia.gov/forecasts/steo/realprices/.*

NAHB supported a 10-year simple payback as a primary standard for evaluating the cost effectiveness of energy saving measures. They stated that their policy of a 10-year simple payback for mandatory energy measures is based on consumer preferences as determined and confirmed over many years through consumer surveys conducted by its Economics Department and suggested that regulations that exceed a 10-year simple payback should be supported by incentives and voluntary programs. NAHB also identified that 12 out of 19 cities would see paybacks over 10 years for single-section and multi-section homes. Accordingly, they strongly encouraged that DOE re-consider the impact that the Tier 2 and an untiered approach would have on the ability for hundreds of thousands of Americans to be able to afford these homes. (NAHB, No. 1398 at p. 2)

TMHA believed that payback periods across the climate zones should be no longer than four years for all homes. (TMHA, No. 1628 at p. 3) NRECA commented that the payback period in the SNOPR for adhering to the 2021 IECC standard is over 10 years, which is too long for price-sensitive consumers. (NRECA, No. 1406 at p. 5) Further, NRECA commented that any new costs added to the manufactured home will impact the monthly financing payment for the home and thus will impact what the consumer chooses. Therefore, they suggested increasing that cost per month because of efficiency upgrades must have a quick payback to appropriately balance affordability issues. (NRECA, No. 1406 at p. 4)

On the other hand, Schulte stated because the current HUD thermal standards were based on the useful life of the home (33 years), a payback period of 6-8 years would substantially understate the benefits of the proposed energy standards and is inconsistent

with life-cycle methodologies adopted by DOE and HUD. (Schulte, No. 1028 at p. 17, 18) Next Step stated that according to the National Association of Realtors, as of 2018, the median duration of homeownership in the U.S. is 13 years. In addition, they stated that according to MHI, 62 percent of all residents anticipate living in their homes for more than 10 years, and 38 percent do not expect to sell their homes. (Next Step, No. 1617 at p. 7)

Table IV.7 provides the results for DOE's simple payback period analysis for the rule, broken out by climate zone for Tier 1 (single-section) and Tier 2 (multi-section) homes. These resulting simple payback periods indicate that the first homeowner would gain a net benefit and would realize positive net savings from the proposed energy standards prior to the 10-year mark. As previously discussed, based on the 2019 AHS, the mean homeowner duration is 13 years. The national average simple payback period of a Tier 1 standard is 3.7 years for single-section homes, and for a Tier 2 standard is 8.9 years for multi-section homes, although these results vary by location. The Tier 2 standard simple PBP exceeds 13 years for one city, San Francisco.

e. Incremental Cost

In the August 2021 SNOPR, DOE determined the incremental cost to the consumer (i.e., incremental purchase price) by calculating the difference in the EEM costs of DOE-compliant and minimally-compliant HUD homes. These incremental costs correspond to the purchase prices seen by the homeowner, and thus account for manufacturer and retail markups. DOE based the incremental costs on those costs

provided and agreed to by the MH working group. ASRAC Cost Analysis Data, EERE-2009-BT-BC-0021-0091.

DOE received a comment indicating that the cost of labor, overhead, and profit has been underestimated in DOE's cost analysis. MMHA suggested that DOE should be accounting for the costs of additional labor or the additional overhead and profit that would be associated with the higher home cost. In addition, MMHA stated that they conducted an independent cost-benefit analysis using DOE's assumptions of cost and location and concluded that the proposal would add at a minimum of almost $1,000 to the cost of a new single-section home and up to $5,500 to the cost of a multi-section home depending on location. (MMHA, No. 995 at p. 3) MHI stated that DOE's proposal is based on improper calculations and methodologies, including underestimating the current cost of homes and the costs of the new materials to construct them. (MHI, No. 1592 at p. 4-6, 25) Earthjustice and Prosperity Now commented that the costs used in the analysis are no longer relevant but did not provide any updated costs. (Earthjustice and Prosperity Now, No. 1637 at p. 8) MHARR stated that DOE failed to consider the most recent cost data. (MHARR, No. 1640 at p. 2-4) TMHA commented that the pricing data that DOE uses has a tremendous amount of lag. (TMHA, No. 1628 at p. 2) RECA also comments that Tier 1 appears to be based on cost information submitted by one or more manufacturers with no real connection to the model energy codes. (RECA, No. 1570 at p. 2, 7)

DOE also received several comments about additional construction costs. Multiple organizations commented that the DOE analysis assumes that the floor joists are 2x6 with insulation up to and including R-22, and 2x8 floor joists insulated to R-30 and above. However, according to these commenters, currently, 90 percent of floors produced use 2x6 floor joists. Therefore, the commenters stated that the increased joists depth (i.e., going to 2x8 floor joists) will add approximately a 33 percent material cost increase which will be around $200 per 14x76 floor. The commenters also stated that this 2-inch floor joist change will also increase the shipping height. (MHI, No. 1592 at p. 25-26); (Clayton Homes, No. 1589 at p. 16-18, 22); (MHCC, No. 1600 at p. 6) MMHA and many other organizations raised similar concerns, questioning if DOE considered the cost of changing from 2x6 to 2x8 floor joists. They also stated that placing more than R-11 blankets under the floor joists cannot be done without offsetting outriggers and providing blocking between joists because compressing more than R-11 insulation between an outrigger and a joist results in noticeable humps in the floor at each outrigger location, and questioned whether DOE accounted for these additional costs in the analysis. (MMHA, No. 995 at p. 2); (Michigan MHA, No. 1012 at p. 1-2); (WHA, No. 1025 at p. 1-2); (PMHA, No. 1165 at p. 1-2); (Westland, No. 1263 at p. 1-2); (Pleasant Valley, No. 1307 at p. 1-2); (American Homestar, No. 1337 at p. 1-2); (Oliver Technologies, No. 1350 at p. 1-2); (KMHA, No. 1368 at p. 1-2); (Adventure Homes, No. 1383 at p. 1-2); (Clayton Homes, No. 1589 at p. 22). Additionally, NAHB encouraged DOE to work directly with the producers of manufactured homes to validate the construction cost numbers used in the cost effectiveness analysis because costs have increased substantially over the last two years. (NAHB, No. 1398 at p. 2)

DOE also received multiple comments on the cost of testing and compliance. Multiple commenters stated that DOE underestimated the costs of new materials to construct homes and did not consider the cost of testing and compliance in the analysis. (MMHA, No. 995 at p. 1-2); (Michigan MHA, No. 1012 at p. 1-2); (WHA, No. 1025 at p. 1-2); (PMHA, No. 1165 at p. 1-2); (Westland, No. 1263 at p. 1-2); (Pleasant Valley, No. 1307 at p. 1); (American Homestar, No. 1337 at p. 1); (Oliver Technologies, No. 1350 at p. 1); (KMHA, No. 1368 at p. 1); (Adventure Homes, No. 1383 at p. 1-2); (NJMHA, No. 1451 at p. 2); (WMA, No. 1452 at p. 1-2); (IMHA/RVIC, No. 1466 at p. 2); (Cavco, No. 1497 at p. 2); (Skyline Champion, No. 1499 at p.1); (Mississippi MHA, No. 1588 at p. 2); (Skyline Champion, No. 1612 at p.2); (Cavco, No. 1622 at p. 2); (VAMMHA, No. 1624 at p. 2) MHARR claimed that, in DOE's cost-benefit analysis, DOE does not include estimated costs for testing, enforcement, regulatory compliance, or costs related to regular changes to the IECC, therefore making DOE's cost analysis invalid. (MHARR, No. 1640 at pp. 7, 8) In addition, NAHB stated that the insulation requirements in the 2021 IECC greatly increase the cost compared to the 2018 IECC, specifically mentioning the ceiling insulation. (NAHB, No. 1398 at p. 3) In addition, Skyline Champion suggested that expenses associated with design package updates, truss re-designs, structural and thermal calculation revisions, quality process updates, manufacturing process changes, and procurement modifications will contribute significantly to costs associated with implementation and compliance requirements. (Skyline Champion, No. 1612 at p. 2)

Conversely, ACEEE conducted its own research and concluded that DOE overestimated the material and incremental costs in its cost analysis. ACEEE recommended that DOE reconsider the cost of continuous insulation since there is evidence the price at scale will be lower than what DOE estimated, and suggested that DOE should estimate the costs for widespread implementation under a standard. DOE used an installed cost of $0.98/sf from RS Means 2020 construction cost estimating software. With an opaque wall area of 1,053 square feet ("sf") for single-section homes and 1,036 sf for double-section homes, as in DOE's SNOPR analysis, ACEEE suggested that this would correspond to a price of about $1,000. They stated that this is confirmed in the previously mentioned study by E. Levy et al.,[63] which for adding foam sheathing (wall insulation from House B to House C in Table 39) found a cost of $936. (ACEEE, No. 1631 at p. 10-11) In addition, ACEEE recommended reconsidering the cost of windows. ACEEE stated the Environmental Protection Agency conducted field research on current prices for windows (for a 12-window replacement project in site-built homes) and estimated that the price difference per 15 sf window from low-e (U-factor 0.32-0.35) to add argon (0.28-0.31) is $6, to lower SHGC is $7.5, and for two coatings with argon (0.24-0.26) is $29 per window (with much lower component costs), which corresponded to a total price difference of roughly $44 for a single-section home or $75 for a double-section home to add argon, and $214 or $363 for windows (based on 111 and 188 sf of windows respectively). They stated that Faithful + Gould's 2012 report to PNNL[64]

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[63] *See, e.g.*, costs and savings in E. Levy, et al., Field Evaluation of Advances in Energy Efficiency Practices for Manufactured Homes (DOE, 2016), *https://www.nrel.gov/docs/fy16osti/65436.pdf*.
[64] Faithful+Gould, Residential Energy Efficiency Measures: Prototype Estimate and Cost Data, Revision 6.0 (2012), Tables 5.2.1 and 2.5.

estimated a $4.18/sf difference for 0.50 vs 1.2, $0.89/sf difference for 0.35 vs 0.5, $0.18/sf for 0.32 vs 0.35, and $1.15/sf for 0.3 vs 0.32, and this corresponded to a single-section cost for Tier 2 of $583 in Climate Zone 1 and $99 in Climate Zone 2 in 2011 dollars (not including the cost of adding argon and improving SHGC in Climate Zone 2, which per ENERGY STAR data might add $100). They stated that the E. Levy et al. study found a cost for a single-section home of $1,382 for single-pane +storm (U-value 0.47/SHGC 0.73), $218 more for double-pane low-e (0.31/0.33), and $600 for advanced argon-filled (0.30/0.23). ACEEE stated that, while not consistent, these costs are all much lower than in DOE's current analysis, and after adjusting to 2023 dollars, ACEEE found that with the EPA report, estimates would reduce the estimated initial cost of Tier 2 by $900 to $1,500 for single-section homes and $1,500 to $2,100 for multi-section homes, depending on climate zone. (ACEEE, No. 1631 at p. 11-12)

Separately, NEEA also commented that the cost considerations used in the SNOPR analysis should be revaluated because they are too high, resulting in an underestimation of cost effectiveness of a more stringent energy code. NEEA provided information based on factory experience in the Northwest reflecting fully operationalized cost, claiming that if DOE uses these values, payback periods would be reduced by up to 42 percent. NEEA elaborated, stating that manufacturers will have lower cost at scale, especially if DOE employs an options table that enables trade-offs with house size and mechanical equipment. (NEEA, No. 1601 at p. 6-9) NEEA also states that the incremental costs experienced in the Northwest are substantially lower than the values DOE used because manufactured homes are value engineered to cut costs. They stated

factories find ways to achieve *Uo* values using building science to reduce heat transfer paths. (NEEA, No. 1601 at p. 7-8) Further, NEEA stated that in the Northwest housing market, manufactured homes built to HUD Code use 2x6 frame construction rather than 2x4 construction, and if cost per square foot was based on interior floor area, then homes built to the HUD Code in the Northwest would logically use 2x4 frame construction. *Id.* NRDC recommended that DOE take note that the ASHRAE standard allows manufacturers to take credit for compliance for several other measures, such as higher HVAC and water efficiency, ductless heat pumps, high-efficiency appliances and plumbing fixtures, etc. NRDC stated that these new options will decrease costs of various energy efficiency measures. (NRDC, No. 1599 at p. 5-6)

In the August 2021 SNOPR, DOE discussed that the incremental costs used were based on those provided by the MH working group, which represented small, medium and large manufacturers. Further, to corroborate that the costs were still relevant, DOE reviewed the RS Means 2020 and concluded that the estimates by the MH working group continued to remain mostly relevant. 86 FR 47744, 47794. For this final rule, DOE conducted another review of the cost analysis of the different energy efficiency measures to be employed as a result of this rule (ceiling, wall, floor, and window insulation). For this evaluation, DOE used the costs provided by the stakeholders in response to the August 2021 SNOPR and the October 2021 NODA, as summarized previously, in

addition to costs available through RS Means 2020, the 2021 IECC,[65] ASHRAE,[66] and costs provided in response to the June 2016 NOPR that DOE evaluated in the August 2021 SNOPR. From this analysis, DOE again concluded that the cost data DOE used in the analysis relating to wall, floor, and window insulation are all within the range of values from the different sources reviewed. For the cost of ceiling insulation, however, DOE notes that the cost data DOE used is slightly higher than the information provided by the stakeholders, although not unreasonable. Accordingly, DOE concludes that the incremental costs evaluated for the rule are reasonable when compared to the range of cost values provided by stakeholders and determined through other references, as previously discussed. With regards to labor costs, DOE notes that the incremental costs provided by the MH working group were costs relative to the purchase prices made available to the home buyer, which includes labor costs as well as markups to account for manufacturer overhead and profits. As such, the incremental costs should already accommodate costs beyond just the manufacturer production cost. Further, DOE discusses in section III.F.2.b of this document that the amended standards would not require changes in exterior home dimensions and can be accommodated using current home construction techniques. Therefore, the amended standards would primarily require choosing the appropriate EEMs to meet the adopted prescriptive or performance requirements. Finally, DOE performed an MIA to estimate the potential financial impact

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[65] National Cost Effectiveness of the Residential Provisions of the 2021 IECC: Available at *https://www.energycodes.gov/sites/default/files/2021-07/2021IECC_CostEffectiveness_Final_Residential.pdf*

[66] Available at *https://www.ashrae.org/file%20library/technical%20resources/research/ashrae-d-rp1481-20090630.pdf*

of energy conservation standards on manufacturers of manufactured homes, which is discussed further in section IV.B. of this document.

As discussed in sections III.D and III.E of this document, DOE is not addressing test procedure or compliance issues in this rulemaking, and therefore has not incorporated any of those attendant costs in the analysis at this time. As noted previously, many of the requirements in the standards would require minimal compliance efforts (e.g., documenting the use of materials subject to separate Federal or industry standards, such as the R-value of insulation or U-factor values for fenestration), and therefore such efforts would result in minimal additional costs to manufacturers. Moreover, DOE continues to work with HUD on potential approaches for testing, compliance, enforcement and labeling that may leverage the existing HUD inspection and enforcement process to ensure manufacturer compliance with the standards in a manner that is not overly burdensome or costly to manufacturers.

DOE also received a comment mentioning the costs of truss redesign, testing, and approval. MHCC stated that getting a truss tested and approved for use in accordance with the HUD standard could cost upwards of $2,500 per design. In addition, any modifications to the heel height would create additional cost and transportation issues that were not considered by DOE, and any increase in the shipping height of a home would lead to additional costs such as rerouting units, pilot vehicles, and/or redesign of units. (MHCC, No. 1600 at pp. 7, 12-13) As discussed in section III.F.2.b of this document, DOE remains unconvinced that truss redesigns are needed to comply with the

amended energy conservation standards. Further, DOE is no longer including the exterior wall continuous insulation requirement, which should resolve a number of issues related to shipping width of the home. In addition, DOE notes that the standards developed take into consideration the dimensional limitations of the home and consider the design and factory construction techniques of manufactured homes, as well as the associated incremental costs. As noted previously in section III.F.2.b, DOE has concluded that the amended standards would not require changes in exterior home dimensions and cause transportation issues. Finally, to the extent redesigns are necessary, DOE addresses the costs associated with model plan updates for the standards as part of the MIA.

DOE also received a comment regarding the cost of insulation installation practices. Schulte said that there appears to be a lack of current research about the individual costs and benefits of the items noted in Table 460.103 and their application to manufactured homes. (Schulte, No. 1038 at pp. 6, 12, 23) DOE does not anticipate any incremental costs associated with the proper building practices of correctly installing insulation as listed in Table 460.103, as these installation practices have been widely accepted by industry for many years.

2. Results

This section provides the results for the projected economic impacts on individuals, including the LCC and PBP.

DOE also used different loan parameters for the tiered standard. This is because the Tier 1 and Tier 2 standards each would apply to a portion of all manufactured homes. Specifically, the Tier 1 standard would apply to single-section manufactured homes and would be applicable to price-sensitive, low-income purchasers. This is consistent with data presented in 2021 CFPB, which show that the median chattel loan amount for MH is $58,672 (versus a median amount of $127,056 for MH mortgages).[67] These median loan amounts reflect the price differential between the median single-section and multi-section MH as reported in the MHS PUF 2020 ($57,233 and $108,583, respectively). See Table III.1. Further, the 2021 CFPB notes that those who do not own their land are typically only able to finance with a chattel loan. Therefore, DOE considered only personal property loans for the Tier 1 standard analysis. For the Tier 2 standard, DOE recalculated the loan percentages such that the sales-weighted Tier 1 and Tier 2 standard loan percentages would equate to the overall loan percentages agreed upon by the MH working group. See Table IV.1 for details on the loan parameter percentages used for the analyses.

Table IV.1 Loan Parameter Percentages

	Personal Property	Real Estate	Cash
Tier 1 Standard	100.0%	0.0%	0.0%
Tier 2 Standard	39.5%	20.5%	40.0%
Overall	54.6%	15.4%	30.0%

[67] CFPB report, 2021. *https://files.consumerfinance.gov/f/documents/cfpb_manufactured-housing-finance-new-insights-hmda_report_2021-05.pdf*

The LCC analysis allowed DOE to analyze the effects of the energy conservation standards on both the individual consumer, as well as the aggregate benefits at the national level. Table IV.2 and Table IV.3 provide the average purchase price increases to manufactured homes associated with the HUD zones.

Table IV.2 National Average Manufactured Housing Purchase Price (and Percentage) Increases under Tier 1 Standard (2020$)

	Tier 1 Standard	
	$	***%***
Climate Zone 1	$627	1.1%
Climate Zone 2	$627	1.1%
Climate Zone 3	$719	1.3%
National Average	**$660**	**1.2%**

Table IV.3 National Average Manufactured Housing Purchase Price (and Percentage) Increases under Tier 2 Standard (2020$)

	Tier 2 Standard	
	$	***%***
Climate Zone 1	$4,131	3.8%
Climate Zone 2	$4,438	4.1%
Climate Zone 3	$4,111	3.8%
National Average	**$4,222**	**3.9%**

Figure IV.1 illustrates the average annual energy cost savings for space heating and air conditioning for the first year of occupation by geographic location under the standards based on the estimated fuel costs provided in chapter 8 of the Final rule TSD.

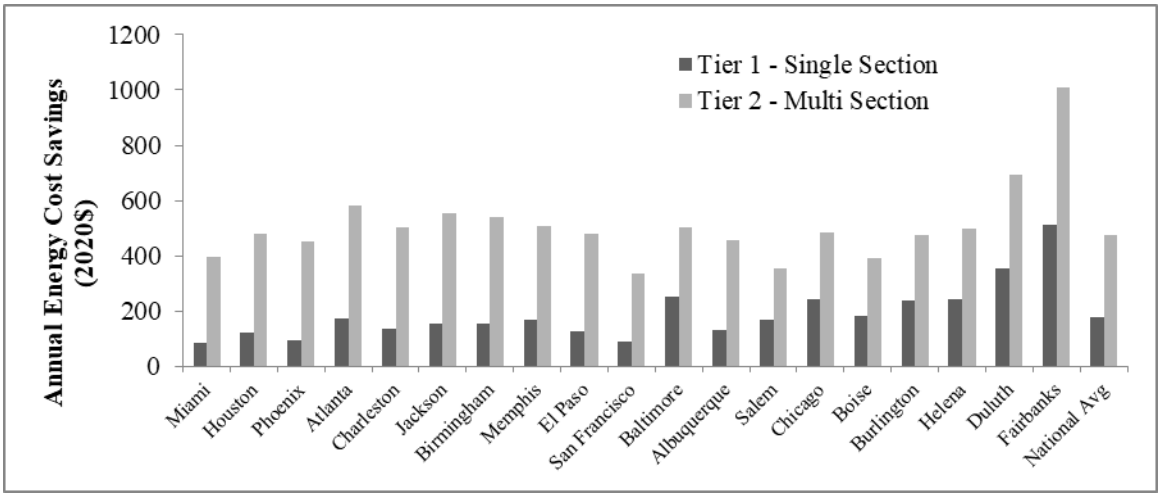

Figure IV.1 Annual Energy Cost Savings under the Standard

Table IV.4, and Figure IV.2 illustrate the average 30-year LCC savings by geographic location (averaged across the five different heating fuel/system types) associated with both single-section and multi-section manufactured homes. As discussed in detail in chapter 8 of the final rule TSD, the results presented account for LCC savings and impacts over a 30-year period of analysis, including energy cost savings and chattel loans or conventional mortgage payment increases discounted to a present value using the discount rates discussed in chapter 4 of the final rule TSD.

Table IV.4 Average Manufactured Home LCC Savings (30 years) under the Tier 1 and Tier 2 Standards by Climate Zone (2020$)

	Single-Section (Tier 1)	Multi-Section (Tier 2)
Climate Zone 1	$1,020	$3,698
Climate Zone 2	$1,123	$3,060
Climate Zone 3	$2,565	$3,960
National Average	**$1,594**	**$3,573**

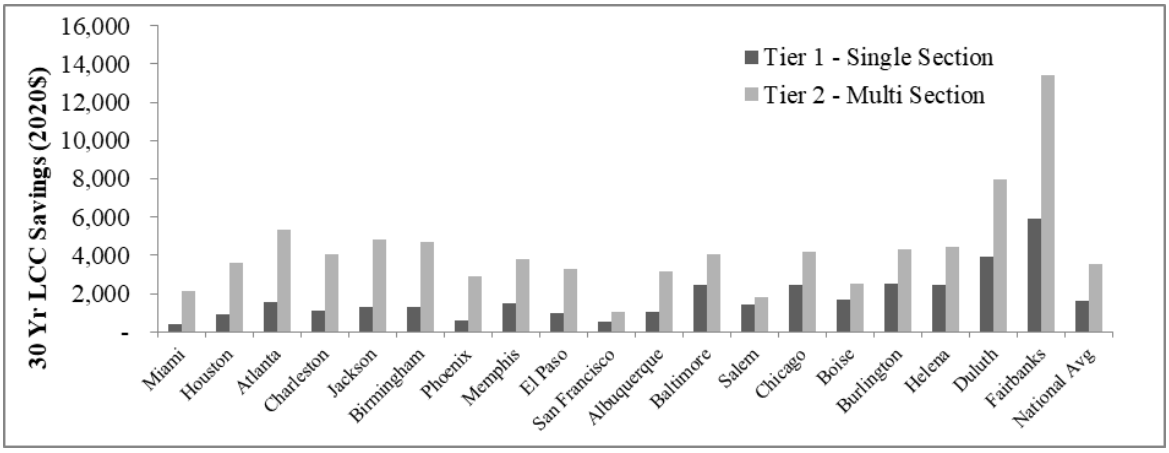

Figure IV.2 Thirty-Year Life-cycle Cost Savings under the Standard

Table IV.5, and Figure IV.3 illustrate the average 10-year LCC savings by geographic location (averaged across the five different heating fuel/system types) associated with both single-section and multi-section manufactured homes.[68]

Table IV.5 Average Manufactured Home LCC Savings (10 years) under the Tier 1 and Tier 2 Standards by Climate Zone (2020$)

	Single-Section (Tier 1)	Multi-Section (Tier 2)
Climate Zone 1	$427	$863
Climate Zone 2	$480	$477
Climate Zone 3	$1,217	$873
National Average	**$720**	**$743**

[68] Although Tier 2 homes (multi-section) in climate zone 2 and 3 on average show positive LCC savings, San Francisco (in climate zone 2) and Salem (in climate zone 3) result in negative LCC savings.

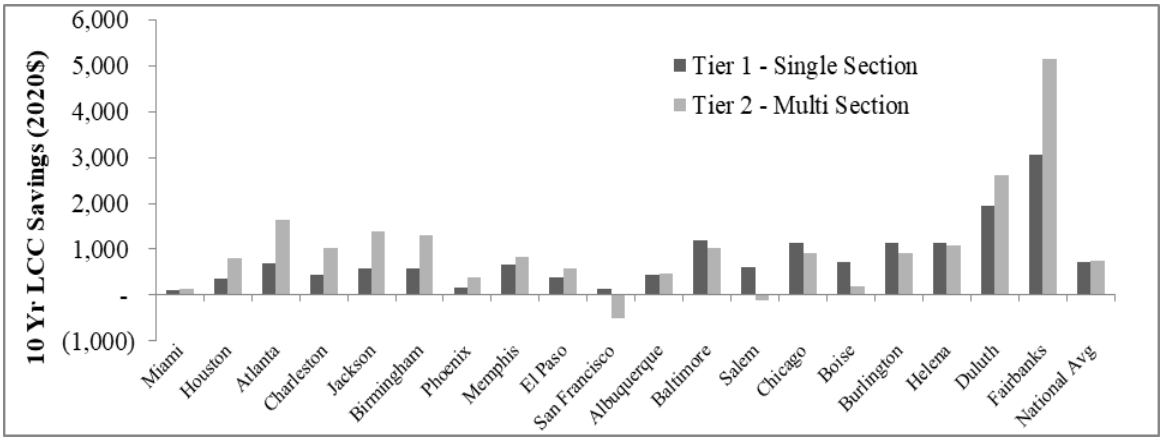

Figure IV.3 Ten-Year Life-cycle Cost Savings under the Standard

The estimated LCC impacts under Figure IV vary by location for three primary reasons. First, each geographic location analyzed is situated in one of three climate zones and therefore would be subject to different energy conservation requirements. Second, geographic locations within the same climate zone would experience different levels of energy savings. Finally, the level of energy cost savings depends on the type of heating system installed and fuel type used in a manufactured home. As discussed in chapter 8 of the final rule TSD, DOE has accounted for regional differences in heating systems and fuel types commonly installed in manufactured housing.

Table IV.6 provides the national average LCC savings and annual energy cost savings associated with the standards for space heating and air conditioning (and percentage reduction in space heating and cooling costs), both of which are measured against a baseline manufactured home constructed in accordance with the HUD Code. As discussed in further detail in chapter 8 of the final rule TSD, each geographic location has been determined to result in positive 30-year LCC savings and energy savings.

Table IV.6 National Average Per-Home Cost Savings under the Final Rule

	Tier 1 Standard (Single-Section)	Tier 2 Standard (Multi-Section)
Life-Cycle Cost Savings (30 Years)	$1,594	$3,573
Annual Energy Cost Savings (2020$)	$177	$475

Table IV.7, and Figure IV.3 illustrate the nationwide average simple payback period (purchase price increase divided by first year energy cost savings) under the energy conservation standards. The estimated simple payback periods vary by geographic location based on the different climate zone requirements for manufactured housing, geographic climatic differences within climate zones, type of heating system installed, and fuel type used in a manufactured home.

Table IV.7 Average Manufactured Home Simple Payback Period under the Tier 1 and Tier 2 Standards by Climate Zone

	Single-Section (Tier 1)	Multi-Section (Tier 2)
Climate Zone 1	4.7	8.5
Climate Zone 2	4.5	9.6
Climate Zone 3	2.9	8.6
National Average	**3.7**	**8.9**

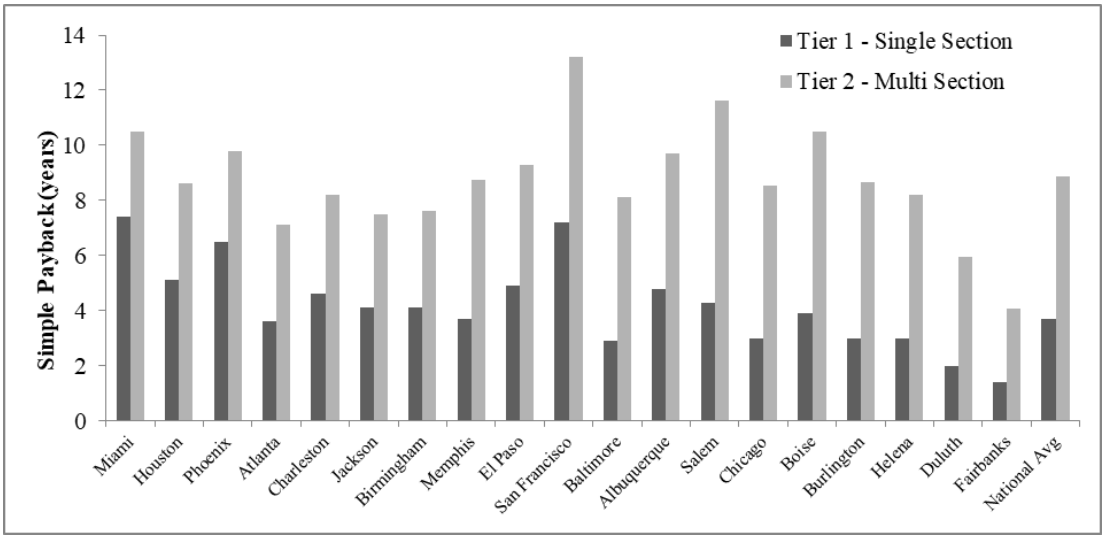

Figure IV.3 Simple Payback Period under the Standard

B. Manufacturer Impacts

DOE performed an MIA to estimate the potential financial impact of energy conservation standards on manufacturers of manufactured homes. The MIA relied on the Government Regulatory Impact Model ("GRIM"), an industry cash-flow model used to estimate changes in industry value as a result of energy conservation standards. The key GRIM inputs are: industry financial metrics, manufacturer production cost estimates, shipments forecasts, conversion costs, and manufacturer markups. The primary output of the GRIM is industry net present value ("INPV"), which is the sum of industry annual cash flows over the analysis period (2022–2052), discounted using the industry average discount rate. The GRIM has a slightly different analysis period than the NIA and LCC since it accounts for the conversion period, the time between the announcement of the standards and the compliance date of the standards, because manufacturers may need to make upfront investments to bring their manufactured homes into compliance ahead of the standards going into effect. DOE used an industry average discount rate of 9.2 percent for the final rule analysis, which is consistent with the discount rate in the August 2021 SNOPR. This rate was based on SEC filings for public manufacturers of manufactured homes.

The GRIM estimates the impacts of more-stringent energy conservation standards on a given industry by comparing changes in INPV between the no-standards case and the standards cases. The GRIM estimates a range of possible impacts under different manufacturer markup scenarios to capture the uncertainty relating to manufacturer

pricing strategy following new standards. Additional detail on the GRIM can be found in chapter 12 of the final rule TSD.

1. Discussion of Comments and Analysis Updates

a. Conversion Costs

DOE received a number of comments regarding the potential conversion costs necessitated by the adopted standard. Conversion costs are the one-time, upfront investments manufacturers would need to make to comply with energy conservation standards. These upfront investments include product conversion costs and capital conversion costs. Product conversion costs are one-time expenses in research, development, engineering time, and other costs necessary to make product designs comply with energy conservation standards. Capital conversion costs are one-time investments in property, plant, and equipment to adapt or change existing production lines to fabricate and assemble new product designs that comply with the energy conservation standards.

MHCC raised concerns about the cost on industry to update model plans. MHCC estimated engineering and third-party review time required for each model plan would be 10-12 hours. MHCC suggest that the number of model plans could range from 300 to 3,000, depending on the size of manufacturer and number of production plants. Skyline Champion noted that the company has thousands of model plans. Skyline Champion went on to note that design choices could lead to assembly changes and capital expenditures, such as jig and station adjustments. (MHCC, No. 1600 at pp. 12, 14); (Skyline Champion, No. 1612 at pp. 2-3)

For the final rule, DOE attempted to take into account stakeholder comments on conversion costs by integrating numeric values, where provided. Specifically, DOE updated its conversion costs to include an average of 10 hours to review each model plan; updated its wage calculation to reflect 2020 fully burdened rates for mechanical engineering time; increased its estimate of the number of model plans in the industry to approximately 40,800 based on 136 production plants in the industry[69] and 300 plans per plant; and incorporated expenditures manufacturing lines adjustments at all production plants. Industry conversion costs total $29.5 million for the final rule. As discussed in detail in section III.E.2.b of this document, DOE remains unconvinced that truss profile updates are necessitated by the standards and truss redesign costs have not been incorporated into the estimate of manufacturer impacts. Additional detail can be found in Chapter 12 of the final rule TSD.

b. Higher Standards

Schulte suggested that adopting higher *Uo* standards based on currently approved designs for ENERGY STAR homes already in production may prevent manufacturing disruptions due to the unavailability of higher energy efficiency components. (Schulte, No. 1028 at p. 14).

The structure of the DOE energy conservation standards for manufactured homes enables manufacturers to choose either prescriptive or performance options for

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[69] MHI reports there are 136 manufacturing plants in the Unites States for manufactured housing in 2021. *www.manufacturedhousing.org/wp-content/uploads/2021/05/2021-MHI-Quick-Facts-updated-05-2021.pdf*

compliance, thereby providing the industry with flexibility for compliance. If manufacturers have established supply chains for ENERGY STAR-certified designs or find it more cost effective to streamline designs around a higher *Uo* value, this final rule does not prevent manufacturers from pursuing those options. Accordingly, DOE did not adopt higher *Uo* values as suggested by the commenter for this final rule or the accompanying analyses.

2. Results

a. Manufacturer Production Costs and Markups

DOE analyzed the effect the standards would have on manufacturer production costs. DOE derived these costs from purchase price information and the markup factor, which is the product of the manufacturer markup, the retail markup, and sales tax. DOE used data from the U.S. Census Bureau to obtain HUD minimum purchase price data by state for single-section and multi-section manufactured homes in 2020.[70] DOE used a shipment-weighted average to convert the average purchase price by state to an average purchase price for each of 19 representative cities.

DOE added incremental purchase prices to the HUD minimum purchase prices to calculate the purchase price for manufactured homes built in compliance with the

[70] U.S. Census Bureau. Manufactured Housing Survey. (2020). Available at: *www.census.gov/data/datasets/2020/econ/mhs/puf.html* (Last accessed March 1, 2022).

proposed standard levels. The incremental purchase prices were negotiated during MH working group meetings and discussed further in section IV.A.1.e. of this document.

To calculate MPCs from purchase prices for homes at the baseline level and at the proposed standard levels, DOE divided the purchase prices by the markup factor. The markup factor is the product of the manufacturer markup, retail markup, and the sales tax factor. Consistent with the August 2021 SNOPR, DOE used a baseline manufacturer markup of 1.72, a retail markup of 1.30, and a sales tax factor of 1.03 in its modeling of impacts of manufacturers.

b. Manufacturer Markup Scenarios

DOE modeled two standard case manufacturer markup scenarios that reflect changes in the manufacturer's ability to pass on their upfront investments and increases in production costs to the consumer. The manufacturer markup scenarios represent the uncertainty regarding prices and profitability for manufactured home manufacturers following the implementation of the rule. DOE modeled a high and a low scenario for manufacturers' ability to pass on their increased costs to the consumer: (1) a preservation of gross margin percentage markup scenario; and (2) a preservation of operating profit markup scenario. These scenarios lead to different manufacturer markup values that result in varying revenue and cash flow impacts to the manufacturer when applied to the inputted manufacturer production costs.

Under the preservation of gross margin percentage scenario, manufacturers maintain their current average markup of 1.72 even as production costs increase.

Manufacturers are able to maintain the same amount of profit as a percentage of revenues, suggesting that they are able to recover conversion costs and pass the costs of compliance to their consumers. DOE considers this scenario the upper bound to industry profitability.

In the preservation of operating profit scenario, manufacturer markups are set so that the per-unit operating profit in the standards case equals the per-unit operating profit in the no-standards case one year after the compliance date of the new energy conservation standard. Under this scenario, as the costs of production increase under a standards case, manufacturers are required to reduce their markups. The implicit assumption behind this manufacturer markup scenario is that the industry can only maintain its existing per-unit operating profit in absolute dollars after compliance with the new standards is required. Therefore, the operating margin is reduced between the no-standards case and standards case. Under this scenario, manufacturers are not able to recover the conversion period investments made to comply with the standard. This manufacturer markup scenario represents a lower bound to industry profitability under a new energy conservation standard.

c. Cash-Flow and INPV Results

DOE compares the INPV of the no-standards case to that of the standards level. The difference between INPV in the no-standards case and INPV in the standards case is an estimate of the economic impacts on the industry.

Table IV.8 INPV Results: Preservation of Gross Margin Percentage Scenario*

	Single-Section	Multi-Section
No-standards case INPV million 2020$	4,489.2	10,492.0
Standards Case INPV million 2020$	4,506.9	10,671.7
Change in INPV million 2020$	17.7	179.8
Change in INPV %	0.4	1.7
Total Conversion Costs million 2020$	9.1	20.4

* Values in parentheses are negative values.

Table IV.9 INPV Results: Preservation of Operating Profit Markup Scenario*

	Single-Section	Multi-Section
No-standards case INPV million 2020$	4,489.2	10,492.0
Standards Case INPV million 2020$	4,459	10,313.4
Change in INPV million 2020$	(29.3)	(178.5)
Change in INPV %	(0.7)	(1.7)
Total Conversion Costs million 2020$	9.1	20.4

* Values in parentheses are negative values.

For single-section homes, the no-standards case INPV is $4.5 billion. The standards level could result in a change of industry value ranging from -0.7 percent to 0.4 percent, or a change of -$29.3 million to $17.7 million, for single-section units. For multi-section units, the no-standards case INPV is $10.5 billion. The standards level could result in a change of industry value ranging from -1.7 percent to 1.7 percent, or a change of -$178.5 million to $179.8 million. For the entire industry, the no-standards case INPV is $15.0 billion. The standards level could result in a change in INPV of -1.4 percent to 1.3 percent, or a change of -$207.8 million to $197.5 million. Industry conversion costs total $29.5 million. In the lower-bound INPV scenario, the potential

decrease in INPV is less than 2%, which suggests adopted standards will not significantly alter the valuation and structure of the manufactured housing industry.

C. Nationwide Impacts

The national impact analysis (NIA) assesses the national energy savings (NES) and the national net present value (NPV) from a national perspective of total consumer costs and savings that would be expected to result from new standards. "Consumer" in this context refers to consumers of the product being regulated. DOE calculates the NES and NPV based on projections of annual product shipments, along with the annual energy consumption and total incremental cost data from the LCC analyses.

In the August 2021 SNOPR and October 2021 NODA, DOE's NIA projected a net benefit to the nation as a whole as a result of the proposed rule in terms of NES and the NPV of total consumer costs and savings that would be expected as a result of the proposed standards in comparison with the minimum requirements of the HUD Code. DOE presented national savings to only accrue to projected no-standards case shipments that are not ENERGY STAR-certified. DOE calculated the NES and NPV based on annual energy consumption and total construction and life-cycle cost data from the LCC analysis (developed during the MH working group negotiation process), and shipment projections. DOE projected the energy savings, operating cost savings, equipment costs, and NPV of consumer benefits sold in a 30-year period from 2023 through 2052. The analysis also accounted for costs and savings for a manufactured home lifetime of 30 years. 86 FR 47744, 47808-47814; 86 FR 59042, 59043.

In the October 2021 NODA, DOE updated the inputs to the August 2021 SNOPR and developed a shipments model to forecast the shipments of manufactured homes during the analysis period. DOE first gathered historical shipments spanning 1990-2020 from a report developed and written by the Institute for Building Technology and Safety and published by the Manufactured Housing Institute.[71] Then, using the growth rate (0.42 percent) in new residential housing starts from the *AEO 2021*, DOE projected the number of manufactured housing shipments from 2023 through 2052 in the no-standards case (no new standards adopted by DOE). For the standards case shipments, DOE used this same growth rate estimate (0.42 percent), but also applied an estimate for price elasticity of demand. Price elasticity of demand (price elasticity) is an economic concept that describes the change of the quantity demanded in response to a change in price. DOE used the price elasticity value of -0.48 (a 10-percent price increase would translate to a 4.8-percent reduction in manufactured home shipments) based on a study published in the Journal of Housing Economics by Marshall and Marsh for estimating standards case shipments.[72] 86 FR 59042, 59045-59047.

DOE developed shipments for each of the tiers using the MHS 2020 PUF data.[73] First, DOE estimated that manufactured homes in Census regions (the U.S. Census Bureau divides the country into four census regions) 1, 2 and 4 combined were representative of HUD zone 3 and manufactured homes in Census region 3 were

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[71] See Manufactured Home Shipments by Product Mix (1990-2020), MANUFACTURED HOUSING INSTITUTE.
[72] See Marshall, M. I. & Marsh, T. L. Consumer and investment demand for manufactured housing units. J. Hous. Econ. 16, 59–71 (2007).
[73] Manufactured Housing Survey, Public Use File (PUF) 2020. *https://www.census.gov/data/datasets/2019/econ/mhs/puf.html*

representative of HUD zones 1 and 2. Second, DOE considered that a percentage of manufactured homes placed/sold would shift to less stringent standards, i.e., a percentage of homes from Tier 2 would shift to Tier 1. The inclusion of this shift in the market is to more accurately estimate energy savings (and other downstream results) if the proposed tiered standards are finalized. For the analysis, DOE applied a "substitution effect" of 20 percent to homes within $1000 of the price threshold ($63,001 - $64,000 in the October 2021 NODA). DOE chose a higher-end estimate of 20 percent based on reports that were reviewed for the energy conservation standards rulemaking for residential furnaces. The reports reviewed included estimates for direct rebound effects of household heating as it relates to more efficient products used more intensively. While the concept of "rebound effect" for the residential furnaces rulemaking is different than the "substitution effect" that is being considered in this rulemaking, with the lack of any data specific to the rebound effect for manufactured homes, DOE determined that 20 percent is a reasonable proxy. 86 FR 59042, 59045.

DOE received a number of comments regarding several aspects of the nationwide impacts described in the August 2021 SNOPR and October 2021 NODA. The following sections provide a discussion of each of the submitted comments as well as updates to the NIA conducted for this final rule.

1. Discussion of Comments and Analysis Updates

a. Shipments Analysis

ACEEE stated that the Tier 2 standards are well above ENERGY STAR levels. In addition, ENERGY STAR will revise its criteria to exceed the new standard. Thus, they stated that one can expect similar savings for those homes, and they should be included in the analysis. (ACEEE, No. 1631 at p. 13)

As discussed previously, DOE's national impact analysis calculates savings in comparison with the minimum requirements of the HUD Code. In response to the June 2016 NOPR, NEEA had commented about how a portion of the Pacific Northwest homes are already built to meet ENERGY STAR levels. 86 FR 47744, 47808. Because ENERGY STAR-certified manufactured homes are more efficient than minimally HUD Code-compliant homes, DOE did not account for ENERGY STAR-certified homes in the no-standard shipments and national impact analyses, so as to avoid overestimating energy savings and NPV benefits to the consumer. As a result, the national savings in the August 2021 SNOPR and October 2021 NODA only accrue to projected no-standards case shipments that are not ENERGY STAR-certified.

In reviewing the ENERGY STAR envelope-only package *Uo* requirements (see Table IV.10), DOE notes that depending on the climate zone, ENERGY STAR-certified homes either meet the Tier 2 DOE *Uo* requirements or are slightly below that level. While DOE does acknowledge there are some possible energy savings associated with ENERGY STAR-certified homes having to now meet the DOE standard, which includes

other requirements beyond *Uo*, DOE considers these estimated savings to be minimal compared to the energy savings associated with HUD Code-compliant homes having to meet the Tier 2 DOE requirements. As such, in this final rule, DOE continues to not account for ENERGY STAR-certified homes in the national impact analyses, so as to avoid overestimating energy savings and benefits to the consumer.

Table IV.10 *Uo* Comparison

Climate Zone	ENERGY STAR (*Uo*)	Tier 2 (*Uo*)
	Multi-section	Multi-section
1	0.071	0.082
2	0.064	0.066
3	0.056	0.055

ACEEE also suggested that the assumption that only 20 percent of homes within $1,000 of the price threshold will shift to Tier 1 seems highly optimistic. They stated that the list price could be cut without changing actual prices by adding on fees or by pricing a stripped-down home to which customers add options. Therefore, they suggested that such pricing adjustments could shift the list price by thousands of dollars with no physical changes to most homes, and manufacturers could redesign others with cheaper components to avoid the first cost of the standard. Accordingly, ACEEE emphasized this is another reason why DOE should not set tiers. (ACEEE, No. 1631 at p. 5) ACEEE stated that manufacturers may shift an even larger fraction of homes within perhaps $10,000 of the threshold to Tier 1 with little change in the actual homes. (ACEEE, No. 1631 at p. 13) As discussed in section III.B of this document, DOE is finalizing a size-based tier threshold in this final rule. Specifically, the Tier 1 standard would apply to all single-section homes, and the Tier 2 standard would apply to all multi-section homes. As such, DOE is no longer considering the retail list price threshold shift. Table IV.11

presents the updated shipments breakdown using the MHS 2020 PUF data set, which DOE had also presented in the October 2021 NODA. 86 FR 59042, 59052-59053.

Table IV.11 Shipment Breakdown based on Tier

	All Climate Zones		
	Single-section (%)	**Multi-section (%)**	**Total (%)**
Tier 1 Standard	100	0	45
Tier 2 Standard	0	100	55
Total	100	100	100

MHARR noted that for potential purchasers excluded from the HUD-code manufactured home market, there would be no "savings" because they wouldn't be able to buy a home in the first place. As a result, they commented that the January 2022 DEIS is materially skewed toward showing alleged benefits attributable to the proposed standards. (MHARR, No. 1974 at p. 10, 11) DOE notes that the NES does not account for the energy savings for the people who do not buy a manufactured home under the standards case because they are price-sensitive (using price elasticity of demand discussion in the next section). As such, NES only accounts for savings for those that are able to purchase a manufactured home. The NES is calculated based on the same number of homes purchased under both the standards and no standards case (using price elasticity of demand) such that there are no energy savings attributed to less homes purchased.

b. Price Elasticity of Demand

Price elasticity of demand (price elasticity) is an economic concept that describes the change of the quantity demanded in response to a change in price. Price elasticity is typically represented as a ratio of the percentage change in quantity relative to a

percentage change in price. It allows DOE to assess the extent to which consumers and retailers are unable or unwilling to purchase new homes as a result of the increased costs. In the August 2021 SNOPR and the October 2021 NODA, DOE used a price elasticity value of -0.48 to estimate the effect of the proposed rule on manufactured home shipments. This value was sourced from a study by Marshall and Marsh.[74] DOE received several comments regarding the price elasticity that was used.

TMHA stated that it is inappropriate for the finalized rule to have any projected decrease in the number of MH's that will ultimately be produced. Many TMHA manufacturers had previously built modular homes in Texas, but after the Texas Department of Licensing and Regulation adopted the 2015 IECC in August of 2017 the number of homes built in the state dropped by 35 percent in the subsequent 2018 fiscal year due to the cost of compliance and the inability to source the materials necessary to meet the new standards from upstream suppliers. TMHA asked that DOE do everything they can to ensure that any new rule does not decrease production. (TMHA, No. 1628 at pp. 3, 4) Clayton Homes commented that very few homes are produced at the Tier 1 level and it is unlikely that additional homes will be manufactured at that level. Instead, Clayton Homes expects an overall reduction in the manufacturing and purchase of manufactured homes across the board. (Clayton Homes, No. 1589 at p. 21)

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[74] See Marshall, M.I. & Marsh, T.L. Consumer and investment demand for manufactured housing units. J. Hous. Econ. 16, 59-71 (2007).

On the other hand, ACEEE stated that the shipment estimates likely overstate the sales impact of the standard. ACEEE stated that the price elasticity used for the analysis (-0.48 and -2.4) are based on data before a significant decline in shipments of manufactured homes after 2007, and thus reflect volatility of a different market. In addition, ACEEE stated that the price elasticity only predicts changes in demand in response to changes in initial purchase price, and not to changes in the underlying value and quality of the home, including reduced energy bills, increased comfort and health, and improved longevity. They stated that under these assumptions any improvement to the homes reduces sales. (ACEEE, No. 1631 at p. 13) NEEA stated that manufactured homes purchased by park owners for rent-to-own or rental will not be impacted by the increase in cost because rental prices are based on market rates, not the purchase price of the home. NEEA stated that rental rates are higher than mortgage rates that a landlord would pay and therefore price elasticity will be near zero for the fraction of the manufactured homes sold to park owners. NEEA stated that manufactured homes remain the low-cost affordable housing option in the Northwest and there is no evidence that higher efficiency has negatively impacted homeownership. (NEEA, No. 1601 at pp. 8, 13)

The Marshall and Marsh study,[75] which DOE used to analyze the -0.48 price elasticity, uses the number of new manufactured homes placed for residential use as a proxy for consumer demand and also separated short-term consumer behavior from long-

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[75] See Marshall, M.I. & Marsh, T.L. Consumer and investment demand for manufactured housing units. J. Hous. Econ. 16, 59-71 (2007).

term influences. As part of their paper, Marshall and Marsh reviewed all previous studies to determine the inputs into their model. They used national level data for their consumer demand model. Marshall and Marsh estimated the price elasticity of demand for manufactured homes at -0.48 using a two-stage regression model and concluded that consumers in general are not so price sensitive and are likely willing to accept incremental higher prices for improvements in cost efficiency. The paper claimed that this is especially true because the cost of a manufactured home is still significantly lower than the cost of a site-built home and low- and moderate-income families have few low-cost choices for home ownership. Accordingly, for the NIA, DOE determined the Marshall and Marsh study is still the most recent and accurate estimate of consumer demand based on price changes for manufactured housing and therefore, DOE maintains use of the -0.48 elasticity value. DOE notes that for the tiered standard, DOE estimates that Tier 1 would have 0.55 percent reduction in demand and availability, which is essentially no reduction.

c. Deadweight Loss

In the August 2021 SNOPR, DOE also estimated the deadweight loss associated with the proposed rule stemming from the reduced shipments in the standards case scenario. Deadweight loss is a cost to society as a whole generated by shifting the market away from the no-standards case equilibrium. If the supply curve is perfectly elastic, then the deadweight loss of energy conservation standards is entirely borne by consumers and not producers. The deadweight loss is equivalent to one-half the incremental price multiplied by the reduction in total shipments, discounted over the 30-year analysis. If,

however, the supply curve's slope near equilibrium is similar in magnitude to the demand curve, then the deadweight loss is equivalent to the incremental price multiplied by the reduction in total shipments, discounted over the 30-year analysis.

DOE did not have data on the supply curve elasticity but estimated the deadweight loss for the proposed standards using a price elasticity of -0.48. DOE tentatively estimated that the discounted total deadweight loss for the standards based on Tier 1 would range from $0.8 to $1.5 million (2020$, discounted at 3 percent) and $0.4 to $0.9 million (2020$, discounted at 7 percent). DOE tentatively estimated that the discounted total deadweight loss for the standards based on Tier 2 would range from $75.4 to $150.9 million (2020$, discounted at 3 percent) and $43.9 to $87.8 million (2020$, discounted at 7 percent). DOE tentatively estimated that the discounted total deadweight loss for the untiered standards would range from $103.1 to $206.2 million (2020$, discounted at 3 percent) and $60 to $120 million (2020$, discounted at 7 percent). 86 FR 47744, 47813.

MHCC stated that deadweight loss would be significantly higher than DOE's estimate as many potential consumers will be priced out of the market. For example, they referenced an NAHB published study in 2021 (NAHB Priced-Out Estimates for 2021), which estimated that a $1,000 increase in the median new home price ($346,757) would price 153,967 households out of the market. The MHCC stated that an increase of $1,000 would have a more significant impact on manufactured housing. (MHCC, No. 1600 at p. 13); (NAHB, No. 1398 at p. 3) MHI stated that deadweight loss will increase as a result

of the proposal, as many potential consumers will be priced out of purchasing a manufactured home. (MHI, No. 1592 at p. 30)

On the other hand, ACEEE stated that the use of deadweight loss is misapplied and not appropriate in this context. They commented that textbook treatments of deadweight loss are limited to analyzing the effects of taxes, trade tariffs, monopoly market power, or other price distortions on demand, all else equal. However, implementing up-to-date efficiency standards for manufactured homes is not tantamount to a price distortion, but instead materially alters the quality and value of the home. They stated that revised standards will reduce energy bills, improve resident comfort, and likely increase the longevity and residual value of the home, none of which are incorporated into DOE's analysis of the deadweight loss (nor captured in its price scenario analysis). ACEEE argued that there could be a possible substitution toward newer homes that become more attractive compared to homes subject to codes nearly 30 years out of date. Further, they commented that even if updated standards were to be considered as a price distortion, estimating deadweight loss requires a complex general equilibrium model, including both a supply and demand curve, which DOE did not have appropriate data to develop. ACEEE commented that estimating deadweight loss is unprecedented and inappropriate for the evaluation of the societal impacts of efficiency standards. (ACEEE, No. 1631 at pp. 13-14)

DOE agrees with ACEEE that the application of deadweight loss for this rulemaking is complex and DOE does not have sufficient data to provide a thorough analysis. Further, the 2021 NAHB report estimates reduction in buyers assuming all

American households intend to buy a home, whereas the DOE analysis considers the number of households no longer able to purchase a manufactured home from the pool of households planning to purchase a manufactured home (which is much smaller than the total number of American households). Finally, as discussed in section IV.C.1.b of this document, the Marshall and Marsh study concludes that manufactured home consumers are not as price sensitive because the cost of a manufactured home is still significantly lower than the cost of a site-built home. Therefore, at this time, DOE is not estimating deadweight loss for this rule. However, DOE continues to accept any data regarding this analysis and may consider deadweight loss in future iterations of this rule.

d. Net Present Value

DOE received a comment concerning the discount rates used to calculate the NPV. MHI stated that DOE's analysis is incorrect in using a discount rate ranging from three to seven percent for computation of future projected energy savings. Using that discount rate, they commented that DOE significantly overstates the net savings. They recommended that DOE should use much higher discount rates, around 10 percent, for personal property/chattel loans. (MHI, No. 1592 at p. 11) On the other hand, UCB stated that the discount rates used in the DOE's analysis are much too high compared to historical and projected values. They commented that the Institute for Policy Integrity found the median value of proposed constant discount rates, excluding outliers, was 2%. They also found that many experts do not agree that a constant discount rate should even be used, and that either a declining rate or a rate calibrated with "ethical parameters" should be used instead. (UCB, No. 1618 at pp. 15-16) They also mentioned that high

discount rates mean that future costs and benefits are undervalued. (UCB, No. 1405 at p. 2)

DOE generally uses real discount rates of 3 percent and 7 percent to discount future costs and savings to present values.[76] The 3- and 7-percent discount rates are based on Circular A-4 issued by the Office of Management and Budget (OMB) as guidance on the development of regulatory analysis as required by Executive Order ("E.O.") 12866.[77] The 7-percent rate is the established estimate of the average rate of return, before taxes, to private capital in the U.S. economy. The 3-percent rate is called the "social rate of time preference," which is the rate at which society discounts future consumption flows to their present value.[78] These real discount rates are used to calculate annualized benefits and costs in DOE rulemakings in order to perform cross-industry comparisons in a standardized manner. For these reasons, in the final rule, DOE maintains discount rates of 3 percent and 7 percent for the NPV and the annualized benefits and costs. Additionally, DOE uses a discount rate based on the chattel loan interest rate in the LCC analysis.

2. Results

This section provides the results for the projected nationwide impact analyses, including the NES and NPV. In this final rule, DOE based all inputs to the NES and NPV using *AEO 2021*. This includes the housing starts growth rate, inflation rates, energy

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[76] DOE relies on a range of discount rates in monetizing emission reductions as discussed in section IV.D.2 of this document.
[77] *https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A4/a-4.pdf*.
[78] Office of Management and Budget, Circular A-4, September 2003

prices, energy prices growth rates, and full-fuel cycle energy factors, consistent with what was presented in the October 2021 NODA. In addition, DOE's shipment analysis includes the latest 2020 MHI shipments and excludes any ENERGY STAR shipments to avoid overestimating energy savings. Further details on the inputs are discussed in chapters 8, 10, and 11 of the final rule TSD.

DOE notes that the NES does not account for the energy savings for those individuals who do not buy a manufactured home under the standards case because they are price-sensitive. As such, NES only accounts for savings for those individuals who are able and who purchase a manufactured home. The NES is calculated based on the same number of homes purchased under both the standards and no standards case such that there are no energy savings attributed to less homes purchased.

Table IV.12 reflects the NES results over a 30-year analysis period on a primary energy savings basis. Primary energy savings apply a factor to account for losses associated with generation, transmission, and distribution of electricity. Primary energy savings differ among the different climate zones because of differing energy conservation requirements in each climate zone and different shipment projections in each climate zone.

Table IV.12 Cumulative National Energy Savings of Manufactured Homes Purchased 2023-2052 with a 30-Year Lifetime

	Single-Section *quads*	Multi-Section *quads*	Total *quads*
Climate Zone 1	0.118	0.522	0.640
Climate Zone 2	0.096	0.443	0.538
Climate Zone 3	0.222	0.381	0.603
Total	**0.436**	**1.346**	**1.782**

Table IV.13 illustrates the cumulative NES over the 30-year analysis period on an FFC energy savings basis. FFC energy savings apply a factor to account for losses associated with generation, transmission, and distribution of electricity, and the energy consumed in extracting, processing, and transporting or distributing primary fuels. NES values differ among the different climate zones because of differing energy efficiency requirements in each climate zone and different shipment projections in each climate zone.

Table IV.13. Cumulative National Energy Savings, Including Full-Fuel-Cycle of Manufactured Homes Purchased 2023-2052 with a 30-Year Lifetime

	Single-Section *quads*	Multi-Section *quads*	Total *quads*
Climate Zone 1	0.123	0.542	0.665
Climate Zone 2	0.100	0.463	0.563
Climate Zone 3	0.239	0.408	0.648
Total	**0.462**	**1.414**	**1.876**

Table IV.14 and Table IV.15 illustrate the NPV of consumer benefits over the 30-year analysis period for a discount rate of 7 percent and 3 percent, respectively. The consumer NPV of manufactured homeowner benefits differ among the different climate zones because there are different upfront costs and operating cost savings associated with

each climate zone and different shipment projections in each climate zone. For the standard being adopted in this final rule, all climate zones have a positive consumer NPV for both discount rates.

Table IV.14 Consumer Net Present Value of Manufactured Homes Purchased 2023-2052 with a 30-Year Lifetime at a 7% Discount Rate

	Single-Section *billion 2020$*	**Multi-Section** *billion 2020$*	**Total** *billion 2020$*
Climate Zone 1	$0.15	$0.31	$0.46
Climate Zone 2	$0.13	$0.20	$0.33
Climate Zone 3	$0.40	$0.32	$0.73
Total	**$0.68**	**$0.84**	**$1.52**

Table IV.15 Consumer Net Present Value of Manufactured Homes Purchased 2023-2052 with a 30-Year Lifetime at a 3% Discount Rate

	Single-Section *billion 2020$*	**Multi-Section** *billion 2020$*	**Total** *billion 2020$*
Climate Zone 1	$0.40	$1.17	$1.58
Climate Zone 2	$0.35	$0.89	$1.24
Climate Zone 3	$1.10	$1.15	$2.25
Total	**$1.85**	**$3.21**	**$5.06**

Table IV.16 shows the projected benefits and costs to the manufactured homeowner associated with the final rule, expressed in terms of annualized values.

Table IV.16. Annualized Benefits and Costs to Manufactured Home Homeowners

	Discount Rate %	Primary Estimate**	Low Estimate**	High Estimate**
		Monetized *million 2020$/year*		
Benefits*				
Operating (Energy) Cost Savings	7	361	322	402
	3	551	478	627
Costs*				
Incremental Purchase Price Increase	7	221	213	231
	3	277	255	294
Net Benefits/Costs*				
	7	140	109	171
	3	274	223	333

*The benefits and costs are calculated for homes shipped in 2023-2052.
**The Primary, Low, and High Estimates utilize forecasts of energy prices from the *AEO 2021* Reference case, Low Economic Growth case, and High Economic Growth case, respectively.

Further, DOE considered two sensitivity analyses relating to shipments, consistent with the August 2021 SNOPR. First, DOE considered a shipment scenario in which the growth rate is 6.5 percent (instead of 0.42 percent) based on the trend in actual manufactured home shipments from 2011 to 2014. This growth rate applies to both the no-standards case and standards case shipments. DOE's primary scenario is based on the residential housing start data from *AEO 2021*. The sensitivity analysis calculates the increase in NES and NPV associated with a much larger future market for manufactured homes. Table IV.17 summarizes the results of the sensitivity analysis. A detailed description of the scenario analysis is provided in appendix 11A of the final rule TSD.

Table IV.17 Shipments Growth Rate Sensitivity Analysis NES and NPV Results

	National Energy Savings *Full Fuel Cycle Quads*	Net Present Value 3% Discount Rate *Billion 2020$*	Net Present Value 7% Discount Rate *Billion 2020$*
0.42% Shipment Growth (primary scenario)	1.88	$5.06	$1.52
6.5% Shipment Growth	6.05	$14.59	$3.73

In a second scenario analysis, DOE considered a standards case shipment scenario in which the price elasticity is -2.4 (instead of -0.48). HUD has used an estimate of -2.4 in analyses of revisions to its regulations[79] promulgated at 24 CFR part 3282 based on a 1992 paper written by Carol Meeks.[80] (See further discussion of this estimate in Appendix 11A.) DOE's primary scenario is based on a study published in 2007 in the *Journal of Housing Economics*. The scenario analysis calculates the decrease in NES and NPV associated with a larger decrease in shipments resulting from a more elastic value. See Table IV.18 for results of the sensitivity analysis. A description of the scenario analysis is provided in appendix 11A of the final rule TSD. Further, a detailed discussion on the corresponding change in shipments is provided in section 10.4 of chapter 10 of the final rule TSD.

[79] For example, see *http://www.regulations.gov/#!documentDetail;D=HUD-2014-0033-0001*.
[80] Meeks, C., 1992, Price Elasticity of Demand for Manufactured Homes: 1961 to 1989.

Table IV.18 Price Elasticity of Demand Scenario Analysis NES and NPV Results

	National Energy Savings ***Full-Fuel Cycle Quads***	**Net Present Value 3% Discount Rate** ***Billion 2020$***	**Net Present Value 7% Discount Rate** ***Billion 2020$***
-0.48 Price Elasticity (primary scenario)	1.88	$5.06	$1.52
-2.4 Price Elasticity	1.76	$4.77	$1.44

D. Nationwide Energy Savings and Emissions Benefits

1. Emissions Analysis

DOE estimates environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with electricity production. DOE bases these estimates on a 30-year analysis period of manufactured home shipments, accounting for a 30-year home lifetime. DOE's analysis estimates reductions in emissions of six pollutants associated with energy savings: carbon dioxide (CO_2), mercury (Hg), nitric oxide and nitrogen dioxide (NO_X), sulfur dioxide (SO_2), methane (CH_4), and nitrous oxide (N_2O). These reductions are referred to as "site" emissions reductions. Furthermore, DOE estimates reductions due to "upstream" activities in the fuel production chain. These upstream activities comprise extraction, processing, and transporting fuels to the site of combustion. Together, site emissions reductions and upstream emissions reductions account for the FFC.

As in the August 2021 SNOPR and October 2021 NODA, DOE estimated emissions reductions based on emission factors for each pollutant, which depend on the type of fuel associated with energy savings (electricity, natural gas, liquefied petroleum gas, fuel oil). The analysis of power sector emissions of CO_2, NO_X, SO_2, and Hg uses

marginal emissions factors that were derived from data in *AEO 2020* for the August 2021 SNOPR, updated to *AEO 2021* for the October 2021 NODA. Full details of this methodology are described in chapter 13 of the final rule TSD.

Because the on-site operation of manufactured homes may require combustion of fossil fuels and results in emissions of CO_2, NO_X, and SO_2 at the manufactured home sites where this combustion occurs, DOE also accounted for the reduction in these site emissions and the associated upstream emissions due to the standards. Site emissions of the above gases were estimated using emissions intensity factors from an EPA publication.[81] The emissions intensity factors are expressed in terms of physical units per MWh or MMBtu of site energy savings. Total emissions reductions are estimated using the energy savings calculated in the national impact analysis. As discussed previously in section IV.C.2 of this document, the energy savings calculated does not account for the energy savings for the people who do not buy a manufactured home under the standards case because they are price-sensitive, but only accounts for savings for those that are able to purchase a manufactured home. The energy savings is calculated based on the same number of homes purchased under both the standards and no standards case such that there are no energy savings attributed to less homes purchased. After calculating the total reduction of emissions, DOE estimated the monetized value associated with the reduction of these emissions, as discussed in section IV.D.2 of this document.

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[81] U.S. Environmental Protection Agency. External Combustion Sources. In *Compilation of Air Pollutant Emission Factors*. AP-42. Fifth Edition. Volume I: Stationary Point and Area Sources. Chapter 1. Available at *https://www.epa.gov/aiR-emissions-factors-and-quantification/ap-42-compilation-aiR-emissions-factors*.

2. Monetizing Emissions Impacts

As part of the analysis of the impacts of this final rule, DOE considered the estimated monetary climate and health benefits from the reduced emissions of CO_2, CH_4, N_2O, NO_X and SO_2 that are expected to result from the standards. In order to make this calculation analogous to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of products shipped in the projection period for the standards. This section summarizes the basis for the values used for monetizing the emissions benefits in this final rule.

C2ES et. al. stated that DOE operates from the premise that the manufactured homes purchased after the proposed standards go into effect have 30-year lifetimes, which means that any manufactured housing purchased later than 2023 would exist—and provide value—past 2052. However, DOE's cost-benefit analysis only presents costs and benefits for the initial 30-year period, thus failing to clearly identify future costs and benefits beyond that timeframe. Instead, C2ES et. al. recommended that DOE should project and disclose all costs and benefits, including benefits from avoided climate damages, out beyond the year 2052. DOE should identify how far into the future it believes the proposed manufactured housing energy conversation standards will continue to generate significant costs or benefits. If the standards will have significant effects after 2052, DOE should either extend its timeframe or else state its reasons for not doing so. If DOE lacks sufficient data to fully project costs and benefits beyond 2052, it should explain the data limitations. (C2ES et. al., No. 1399 at p. 35) As previously described, DOE projected the energy savings, operating cost savings, equipment costs, and NPV of

consumer benefits sold in a 30-year period from 2023 through 2052, in addition to accounting for costs and savings for a manufactured home lifetime of 30 years. Further, in order to make the emissions reduction calculation analogous to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of products shipped in the projection period for the standards (through 2082).

DOE notes that the analysis of the monetized climate and health benefits was performed in support of the cost-benefit analyses required by Executive Order 12866, and is provided to inform the public of the impacts of emissions reductions resulting from this final rule. The monetized climate and health benefits were not factored into DOE's determination of whether the final rule is cost-effective under section 413 of EISA 2007.

a. Monetization of Greenhouse Gas Emissions

In the August 2021 SNOPR and October 2021 NODA DOE presented estimates of the monetized benefits of the reductions in emissions of CO_2, CH_4, and N_2O by using a measure of the social cost (SC) of each pollutant (*e.g.*, SC-CO2). 86 FR 47744, 47814 – 47122; 86 FR 59042. DOE relied on SC-GHG estimates developed by an interagency working group (IWG) that included DOE, the EPA and other executive branch agencies and offices using three integrated assessment models to develop the SC-CO_2 estimates. 86 FR 47744, 47815. For purposes of reflecting a range of modeling assumptions and capturing the uncertainties involved in estimating climate risks, including the risk of greater-than-expected damages, DOE determined it was appropriate to include the four sets of SC-CO_2 values as recommended by the IWG. *Id.* DOE emphasized that the SC-GHG analysis presented in the August 2021 SNOPR was performed in support of the

cost-benefit analyses required by Executive Order 12866, and was provided to inform the public of the impacts of emissions reductions resulting from this proposed rule. 86 FR 47744, 47817. DOE further emphasized that the SC-GHG estimates were not factored into DOE's determination of whether the proposed rule could be cost-effective under section 413 of EISA 2007. *Id.*

The APGA commented that the interim SC-GHG values developed by the IWG still require additional modifications before they are appropriate for use in federal agency rulemakings or policy decisions and provided a copy of comments previously submitted in response to a NODA published by the Office of Management and Budget on May 7, 2021, requesting comment on the "Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990" (86 FR 24669). (APGA, No. 1636 at p. 2) C2ES et al. recommended that DOE expand upon its rationale for adopting a global damages valuation and for the range of discount rates it applied to climate effects, and presented potential legal, economic, and policy justifications for the methodological approach presented in the August 2021 SNOPR. (*See* generally, C2ES et al., No. 1399) MHARR called on DOE to withdraw the proposed standards entirely as a result of the preliminary injunction issued on February 11, 2022, in *Louisiana v. Biden*, No. 21-cv-1074-JDC-KK (W.D. La.), saying that DOE is prohibited from adopting, employing, treating as binding, or relying upon any Social Cost of Greenhouse Gas estimates based on global effects or that otherwise fails to comply with applicable law. (MHARR, No. 1848 at p. 2); (MHARR, No. 1974 at p. 2-5)

On March 16, 2022, the Fifth Circuit Court of Appeals (No. 22-30087) granted the federal government's emergency motion for stay pending appeal of the February 11, 2022, preliminary injunction issued in *Louisiana v. Biden*, No. 21-cv-1074-JDC-KK (W.D. La.). As a result of the Fifth Circuit's order, the preliminary injunction is no longer in effect, pending resolution of the federal government's appeal of that injunction or a further court order. Among other things, the preliminary injunction enjoined the defendants in that case from "adopting, employing, treating as binding, or relying upon" the interim estimates of the social cost of greenhouse gases—which were issued by the Interagency Working Group on the Social Cost of Greenhouse Gases on February 26, 2021—to monetize the benefits of reducing greenhouse gas emissions. In the absence of further intervening court orders, DOE will revert to its approach prior to the injunction and presents monetized benefits where appropriate and permissible under law.

DOE estimates the monetized benefits of the reductions in emissions of CO_2, CH_4, and N_2O by using a measure of the SC of each pollutant (e.g., SC-CO_2). These estimates represent the monetary value of the net harm to society associated with a marginal increase in emissions of these pollutants in a given year, or the benefit of avoiding that increase. These estimates are intended to include (but are not limited to) climate-change-related changes in net agricultural productivity, human health, property damages from increased flood risk, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services.

DOE exercises its own judgment in presenting monetized climate benefits as recommended by applicable Executive orders, and DOE would reach the same conclusion presented in this document in the absence of the social cost of greenhouse gases, including the February 2021 Interim Estimates presented by the Interagency Working Group on the Social Cost of Greenhouse Gases. DOE estimated the global social benefits of CO_2, CH_4, and N_2O reductions (*i.e.,* SC–GHGs) using the estimates presented in the Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990 published in February 2021 by the Interagency Working Group on the Social Cost of Greenhouse Gases (IWG) (IWG, 2021). The SC–GHGs is the monetary value of the net harm to society associated with a marginal increase in emissions in a given year, or the benefit of avoiding that increase. In principle, SC–GHGs includes the value of all climate change impacts, including (but not limited to) changes in net agricultural productivity, human health effects, property damage from increased flood risk and natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services. The SC–GHGs therefore, reflects the societal value of reducing emissions of the gas in question by one metric ton. The SC–GHGs is the theoretically appropriate value to use in conducting benefit-cost analyses of policies that affect CO_2, N_2O and CH_4 emissions. As a member of the IWG involved in the development of the February 2021 SC–GHG TSD), DOE agrees that the interim SC–GHG estimates represent the most appropriate estimate of the SC–GHG until revised estimates have been developed reflecting the latest, peer-reviewed science.

The SC–GHGs estimates presented here were developed over many years, using transparent process, peer reviewed methodologies, the best science available at the time of that process, and with input from the public. Specifically, in 2009, an IWG that included the DOE and other executive branch agencies and offices was established to ensure that agencies were using the best available science and to promote consistency in the social cost of carbon (SC–CO2) values used across agencies. The IWG published SC–CO_2 estimates in 2010 that were developed from an ensemble of three widely cited integrated assessment models (IAMs) that estimate global climate damages using highly aggregated representations of climate processes and the global economy combined into a single modeling framework. The three IAMs were run using a common set of input assumptions in each model for future population, economic, and CO_2 emissions growth, as well as equilibrium climate sensitivity (ECS)—a measure of the globally averaged temperature response to increased atmospheric CO_2 concentrations. These estimates were updated in 2013 based on new versions of each IAM. In August 2016 the IWG published estimates of the social cost of methane (SC–CH_4) and nitrous oxide (SC–N_2O) using methodologies that are consistent with the methodology underlying the SC– CO_2 estimates. The modeling approach that extends the IWG SC–CO_2 methodology to non-CO_2 GHGs has undergone multiple stages of peer review. The SC–CH_4 and SC–N_2O estimates were developed by Marten *et al*. (2015) and underwent a standard double-blind peer review process prior to journal publication. In 2015, as part of the response to public comments received to a 2013 solicitation for comments on the SC–CO_2 estimates, the IWG announced a National Academies of Sciences, Engineering, and Medicine review of the SC–CO_2 estimates to offer advice on how to approach future updates to

ensure that the estimates continue to reflect the best available science and methodologies. In January 2017, the National Academies released their final report, Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide, and recommended specific criteria for future updates to the SC–CO_2 estimates, a modeling framework to satisfy the specified criteria, and both near-term updates and longer-term research needs pertaining to various components of the estimation process (National Academies, 2017). Shortly thereafter, in March 2017, President Trump issued Executive Order 13783, which disbanded the IWG, withdrew the previous TSDs, and directed agencies to ensure SC–CO_2 estimates used in regulatory analyses are consistent with the guidance contained in OMB's Circular A–4, "including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates" (E.O. 13783, Section 5(c)). Benefit-cost analyses following E.O. 13783 used SC-GHG estimates that attempted to focus on the U.S.-specific share of climate change damages as estimated by the models and were calculated using two discount rates recommended by Circular A-4, 3 percent and 7 percent. All other methodological decisions and model versions used in SC-GHG calculations remained the same as those used by the IWG in 2010 and 2013, respectively.

On January 20, 2021, President Biden issued Executive Order 13990, which reestablished the IWG and directed it to ensure that the U.S. Government's estimates of the social cost of carbon and other greenhouse gases reflect the best available science and the recommendations of the National Academies (2017). The IWG was tasked with first reviewing the SC–GHG estimates currently used in Federal analyses and publishing

interim estimates within 30 days of the E.O. that reflect the full impact of GHG emissions, including by taking global damages into account. The interim SC– GHG estimates published in February 2021 are used here to estimate the climate benefits for this final rule. The E.O. instructs the IWG to undertake a fuller update of the SC– GHG estimates by January 2022 that takes into consideration the advice of the National Academies (2017) and other recent scientific literature. The February 2021 SC–GHG TSD provides a complete discussion of the IWG's initial review conducted under E.O. 13990. In particular, the IWG found that the SC–GHG estimates used under E.O. 13783 fail to reflect the full impact of GHG emissions in multiple ways.

First, the IWG found that the SC-GHG estimates used under E.O. 13783 fail to fully capture many climate impacts that affect the welfare of U.S. citizens and residents,, and those impacts are better reflected by global measures of the SC-GHG. Examples of effects omitted from the E.O. 13783 estimates include direct effects on U.S. citizens, assets, and investments located abroad, supply chains, U.S. military assets and interests abroad, and tourism, and spillover pathways such as economic and political destabilization and global migration that can lead to adverse impacts on U.S. national security, public health, and humanitarian concerns. In addition, assessing the benefits of U.S. GHG mitigation activities requires consideration of how those actions may affect mitigation activities by other countries, as those international mitigation actions will provide a benefit to U.S. citizens and residents by mitigating climate impacts that affect U.S. citizens and residents. A wide range of scientific and economic experts have emphasized the issue of reciprocity as support for considering global damages of GHG

emissions. If the United States does not consider impacts on other countries, it is difficult to convince other countries to consider the impacts of their emissions on the United States. The only way to achieve an efficient allocation of resources for emissions reduction on a global basis—and so benefit the U.S. and its citizens—is for all countries to base their policies on global estimates of damages. As a member of the IWG involved in the development of the February 2021 SC–GHG TSD, DOE agrees with this assessment and, therefore, in this final rule, DOE centers attention on a global measure of SC–GHG. This approach is the same as that taken in DOE regulatory analyses from 2012 through 2016. A robust estimate of climate damages to U.S. citizens and residents does not currently exist in the literature. As explained in the February 2021 TSD, existing estimates are both incomplete and an underestimate of total damages that accrue to the citizens and residents of the U.S. because they do not fully capture the regional interactions and spillovers discussed above, nor do they include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature. As noted in the February 2021 SC–GHG TSD, the IWG will continue to review developments in the literature, including more robust methodologies for estimating a U.S.-specific SC–GHG value, and explore ways to better inform the public of the full range of carbon impacts. As a member of the IWG, DOE will continue to follow developments in the literature pertaining to this issue.

Second, the IWG found that the use of the social rate of return on capital (7 percent under current OMB Circular A– 4 guidance) to discount the future benefits of reducing GHG emissions inappropriately underestimates the impacts of climate change

for the purposes of estimating the SC–GHG. Consistent with the findings of the National Academies (2017) and the economic literature, the IWG continued to conclude that the consumption rate of interest is the theoretically appropriate discount rate in an intergenerational context (IWG 2010, 2013, 2016a, 2016b), and recommended that discount rate uncertainty and relevant aspects of intergenerational ethical considerations be accounted for in selecting future discount rates.

Furthermore, the damage estimates developed for use in the SC-GHG are estimated in consumption-equivalent terms, and so an application of OMB Circular A-4's guidance for regulatory analysis would then use the consumption discount rate to calculate the SC-GHG. DOE agrees with this assessment and will continue to follow developments in the literature pertaining to this issue. DOE also notes that while OMB Circular A-4, as published in 2003, recommends using 3% and 7% discount rates as "default" values, Circular A-4 also reminds agencies that "different regulations may call for different emphases in the analysis, depending on the nature and complexity of the regulatory issues and the sensitivity of the benefit and cost estimates to the key assumptions." On discounting, Circular A-4 recognizes that "special ethical considerations arise when comparing benefits and costs across generations," and Circular A-4 acknowledges that analyses may appropriately "discount future costs and consumption benefits…at a lower rate than for intragenerational analysis." In the 2015 Response to Comments on the Social Cost of Carbon for Regulatory Impact Analysis, OMB, DOE, and the other IWG members recognized that "Circular A-4 is a living document" and "the use of 7 percent is not considered appropriate for intergenerational

discounting. There is wide support for this view in the academic literature, and it is recognized in Circular A-4 itself." Thus, DOE concludes that a 7% discount rate is not appropriate to apply to value the social cost of greenhouse gases in the analysis presented in this analysis. In this analysis, to calculate the present and annualized values of climate benefits, DOE uses the same discount rate as the rate used to discount the value of damages from future GHG emissions, for internal consistency. That approach to discounting follows the same approach that the February 2021 TSD recommends "to ensure internal consistency—i.e., future damages from climate change using the SC-GHG at 2.5 percent should be discounted to the base year of the analysis using the same 2.5 percent rate." DOE has also consulted the National Academies' 2017 recommendations on how SC-GHG estimates can "be combined in RIAs with other cost and benefits estimates that may use different discount rates." The National Academies reviewed "several options," including "presenting all discount rate combinations of other costs and benefits with [SC-GHG] estimates."

As a member of the IWG involved in the development of the February 2021 SC–GHG TSD, DOE agrees with this assessment and will continue to follow developments in the literature pertaining to this issue. While the IWG works to assess how best to incorporate the latest, peer reviewed science to develop an updated set of SC–GHG estimates, it set the interim estimates to be the most recent estimates developed by the IWG prior to the group being disbanded in 2017. The estimates rely on the same models and harmonized inputs and are calculated using a range of discount rates. As explained in the February 2021 SC– GHG TSD, the IWG has recommended that agencies to revert

to the same set of four values drawn from the SC–GHG distributions based on three discount rates as were used in regulatory analyses between 2010 and 2016 and subject to public comment. For each discount rate, the IWG combined the distributions across models and socioeconomic emissions scenarios (applying equal weight to each) and then selected a set of four values recommended for use in benefit-cost analyses: An average value resulting from the model runs for each of three discount rates (2.5 percent, 3 percent, and 5 percent), plus a fourth value, selected as the 95th percentile of estimates based on a 3 percent discount rate. The fourth value was included to provide information on potentially higher-than-expected economic impacts from climate change. As explained in the February 2021 SC–GHG TSD, and DOE agrees, this update reflects the immediate need to have an operational SC–GHG for use in regulatory benefit-cost analyses and other applications that was developed using a transparent process, peer-reviewed methodologies, and the science available at the time of that process. Those estimates were subject to public comment in the context of dozens of proposed rulemakings as well as in a dedicated public comment period in 2013.

There are a number of limitations and uncertainties associated with the SC-GHG estimates. First, the current scientific and economic understanding of discounting approaches suggests discount rates appropriate for intergenerational analysis in the context of climate change are likely to be less than 3 percent, near 2 percent or lower.[82]

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[82] Interagency Working Group on Social Cost of Greenhouse Gases (IWG). 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990. February. United States Government. Available at: <*https://www.whitehouse.gov/briefing-room/blog/2021/02/26/a-return-to-science-evidence-based-estimates-of-the-benefits-of-reducing-climate-pollution/*.

Second, the IAMs used to produce these interim estimates do not include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature and the science underlying their "damage functions" – i.e., the core parts of the IAMs that map global mean temperature changes and other physical impacts of climate change into economic (both market and nonmarket) damages – lags behind the most recent research. For example, limitations include the incomplete treatment of catastrophic and non-catastrophic impacts in the integrated assessment models, their incomplete treatment of adaptation and technological change, the incomplete way in which inter-regional and intersectoral linkages are modeled, uncertainty in the extrapolation of damages to high temperatures, and inadequate representation of the relationship between the discount rate and uncertainty in economic growth over long time horizons. Likewise, the socioeconomic and emissions scenarios used as inputs to the models do not reflect new information from the last decade of scenario generation or the full range of projections. The modeling limitations do not all work in the same direction in terms of their influence on the SC-CO_2 estimates. However, as discussed in the February 2021 TSD, the IWG has recommended that, taken together, the limitations suggest that the interim SC-GHG estimates used in this final rule likely underestimate the damages from GHG emissions. DOE concurs with this assessment.

DOE's derivations of the SC-CO_2, SC-N_2O, and SC-CH_4 values used for this final rule are discussed in the following paragraphs, and the results of DOE's analyses estimating the benefits of the reductions in emissions of these pollutants are presented in section IV.D.3.b of this document.

Social Cost of Carbon

The SC-CO_2 values used for this final rule were generated using the values presented in the 2021 update from the IWG. Table IV.19 shows the updated sets of SC-CO_2 estimates from the latest interagency update in 5-year increments from 2020 to 2050. The full set of annual values used is presented in Appendix 14-A of the final rule TSD. For purposes of capturing the uncertainties involved in regulatory impact analysis, DOE has determined it is appropriate to include all four sets of SC-CO_2 values, as recommended by the IWG.[83]

Table IV.19 Annual SC-CO_2 Values from 2021 Interagency Update, 2020–2050 (2020$ per Metric Ton CO_2)

Year	Discount Rate			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
2020	14	51	76	152
2025	17	56	83	169
2030	19	62	89	187
2035	22	67	96	206
2040	25	73	103	225
2045	28	79	110	242
2050	32	85	116	260

In calculating the potential global benefits resulting from reduced CO_2 emissions, DOE used the values from the February 2021 TSD, adjusted to 2020$ using the implicit price deflator for gross domestic product (GDP) from the Bureau of Economic Analysis.

[83] For example, the TSD discusses how the understanding of discounting approaches suggests that discount rates appropriate for intergenerational analysis in the context of climate change may be lower than 3 percent.

DOE derived values from 2051 to 2070 based on estimates published by EPA.[84] These estimates are based on methods, assumptions, and parameters identical to the 2020-2050 estimates published by the IWG. DOE derived values after 2070 based on the trend in 2060-2070 in each of the four cases (see appendix 14A).

DOE multiplied the CO_2 emissions reduction estimated for each year by the SC-CO_2 value for that year in each of the four cases. To calculate a present value of the stream of monetary values, DOE discounted the values in each of the four cases using the specific discount rate that had been used to obtain the SC-CO_2 values in each case.

Social Cost of Methane and Nitrous Oxide

The SC-CH_4 and SC- N_2O values used for this final rule were generated using the values presented in the February 2021 TSD. Table IV.20 shows the updated sets of SC-CH_4 and SC- N_2O estimates from the latest interagency update in 5-year increments from 2020 to 2050. The full set of annual values used is presented in Appendix 14-A of the final rule TSD. To capture the uncertainties involved in regulatory impact analysis, DOE has determined it is appropriate to include all four sets of SC-CH_4 and SC- N_2O values, as recommended by the IWG. DOE derived values after 2050 using the approach described above for the SC-CO_2.

[84] See EPA, Revised 2023 and Later Model Year Light-Duty Vehicle GHG Emissions Standards: Regulatory Impact Analysis, Washington, D.C., December 2021. Available at: *www.epa.gov/system/files/documents/2021-12/420r21028.pdf* (last accessed January 13, 2022).

Table IV.20 Annual SC-CH_4 and SC-N_2O Values from 2021 Interagency Update, 2020–2050 (2020$ per Metric Ton)

	SC-CH_4				SC-N_2O			
	Discount Rate and Statistic				Discount Rate and Statistic			
	5%	3%	2.5%	3%	5%	3%	2.5 %	3%
Year	Average	Average	Average	95th percentile	Average	Average	Average	95th percentile
2020	670	1500	2000	3900	5800	18000	27000	48000
2025	800	1700	2200	4500	6800	21000	30000	54000
2030	940	2000	2500	5200	7800	23000	33000	60000
2035	1100	2200	2800	6000	9000	25000	36000	67000
2040	1300	2500	3100	6700	10000	28000	39000	74000
2045	1500	2800	3500	7500	12000	30000	42000	81000
2050	1700	3100	3800	8200	13000	33000	45000	88000

DOE multiplied the CH_4 and N_2O emissions reduction estimated for each year by the SC-CH_4 and SC-N_2O estimates for that year in each of the cases. To calculate a present value of the stream of monetary values, DOE discounted the values in each of the cases using the specific discount rate that had been used to obtain the SC-CH_4 and SC-N_2O estimates in each case.

b. Monetization of Other Air Pollutants

For this final rule, DOE also estimated the monetized value of NO_X and SO_2 emissions reductions from electricity generation using benefit per ton estimates based on air quality modeling and concentration-response functions conducted for the Clean Power Plan final rule. EPA values for $PM_{2.5}$-related benefits associated with NO_X and SO_2 and for ozone-related benefits for 2025, 2030, 2035 and 2040, calculated with discount rates of 3 percent and 7 percent. For this analysis DOE used linear interpolation to define values for the years not given in the 2025 to 2040 range; for years beyond 2040 the value is held constant.

DOE estimated the monetized value of NO_X and SO_2 emissions reductions from site use of gas in manufactured homes using benefit per ton estimates from the EPA's "Technical Support Document Estimating the Benefit per Ton of Reducing $PM_{2.5}$ Precursors from 17 Sectors" ("EPA TSD"). Although none of the sectors refers specifically to residential and commercial buildings, the sector called "area sources" would be a reasonable proxy for residential and commercial buildings. "Area sources" represents all emission sources for which states do not have exact (point) locations in their emissions inventories. Because exact locations would tend to be associated with larger sources, "area sources" would be fairly representative of small dispersed sources like homes and businesses. The EPA TSD provides high and low estimates for 2016, 2020, 2025, and 2030 at 3- and 7-percent discount rates. DOE primarily relied on the low estimates to be conservative. DOE multiplied the emissions reduction (in tons) in each year by the associated $/ton values, and then discounted each series using discount rates of 3 percent and 7 percent as appropriate.

3. Results

a. Emissions Analysis

In this final rule, DOE utilized emission factors derived from data in the *AEO 2021*.[85] The *AEO* incorporates the projected impacts of existing air quality regulations on emissions. *AEO 2021* generally represents current legislation and environmental

[85] *See* Energy Information Administration, Annual Energy Outlook 2020 with Projections to 2050 (2021).

regulations, including recent government actions, for which implementing regulations were available at the time of preparation of *AEO 2021,* including the emissions control programs discussed in the following paragraphs.[86]

SO_2 emissions from affected electric generating units ("EGUs") are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (D.C.). (42 U.S.C. 7651 *et seq*.) SO_2 emissions from numerous eastern States and D.C. are also limited under the Cross-State Air Pollution Rule ("CSAPR"), which created an allowance-based trading program that operates along with the Title IV program in those States and DC. 76 FR 48208 (Aug. 8, 2011). CSAPR requires these States to reduce certain emissions, including annual SO_2 emissions, and went into effect as of January 1, 2015.[87] *AEO 2021* incorporates implementation of CSAPR, including the update to the CSAPR ozone season program emission budgets and target dates issued in 2016, 81 FR 74504 (Oct. 26, 2016).[88] Compliance with CSAPR is

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[86] For further information, see the Assumptions to *AEO2021* report that sets forth the major assumptions used to generate the projections in the Annual Energy Outlook. Available at *www.eia.gov/outlooks/aeo/assumptions/ (last accessed July 6, 2020)*.

[87] CSAPR requires states to address annual emissions of SO_2 and NO_X, precursors to the formation of fine particulate matter ("$PM_{2.5}$") pollution, in order to address the interstate transport of pollution with respect to the 1997 and 2006 $PM_{2.5}$ National Ambient Air Quality Standards ("NAAQS"). CSAPR also requires certain states to address the ozone season (May-September) emissions of NO_X, a precursor to the formation of ozone pollution, in order to address the interstate transport of ozone pollution with respect to the 1997 ozone NAAQS. 76 FR 48208 (Aug. 8, 2011). EPA subsequently issued a supplemental rule that included an additional five states in the CSAPR ozone season program; 76 FR 80760 (Dec. 27, 2011) (Supplemental Rule), and EPA issued the CSAPR Update for the 2008 ozone NAAQS. 81 FR 74504 (Oct. 26, 2016).

[88] In Sept. 2019, the D.C. Court of Appeals remanded the 2016 CSAPR Update to EPA. In April 2021, EPA finalized the 2021 CSAPR Update which resolved the interstate transport obligations of 21 states for the 2008 ozone NAAQS. 86 FR 23054 (April 30, 2021); *see also*, 86 FR 29948 (June 4, 2021) (correction to preamble). The 2021 CSAPR Update became effective on June 29, 2021. The release of AEO2021 in February 2021 predated the 2021 CSAPR Update.

flexible among EGUs and is enforced through the use of tradable emissions allowances. Under existing EPA regulations, for states subject to SO_2 emissions limits under CSAPR, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the adoption of efficiency standards could be used to permit offsetting increases in SO_2 emissions by another regulated EGU.

However, beginning in 2016, SO_2 emissions began to fall as a result of implementation of the Mercury and Air Toxics Standards ("MATS") for power plants. 77 FR 9304 (Feb. 16, 2012). In the MATS final rule, EPA established a standard for hydrogen chloride as a surrogate for acid gas hazardous air pollutants ("HAP"), and also established a standard for SO_2 (a non-HAP acid gas) as an alternative equivalent surrogate standard for acid gas HAP. The same controls are used to reduce HAP and non-HAP acid gas; thus, SO_2 emissions are being reduced as a result of the control technologies installed on coal-fired power plants to comply with the MATS requirements for acid gas. To continue operating, coal plants must have either flue gas desulfurization or dry sorbent injection systems installed. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions. Because of the emissions reductions under the MATS, it is unlikely that excess SO_2 emissions allowances resulting from the lower electricity demand would be needed or used to permit offsetting increases in SO_2 emissions by another regulated EGU. Therefore, energy conservation standards that decrease electricity generation will generally reduce SO_2 emissions.

CSAPR also established limits on NO_X emissions for numerous States in the eastern half of the United States. Energy conservation standards would have little effect

on NO_X emissions in those States covered by CSAPR emissions limits if excess NO_X emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in NO_X emissions from other EGUs. In such a case, NOx emissions would remain near the limit even if electricity generation goes down. A different case could possibly result, depending on the configuration of the power sector in the different regions and the need for allowances, such that NO_X emissions might not remain at the limit in the case of lower electricity demand. In this case, energy conservation standards might reduce NOx emissions in covered States. Despite this possibility, DOE has chosen to be conservative in its analysis and has maintained the assumption that energy conservation standards will not reduce NO_X emissions in States covered by CSAPR. Energy conservation standards would be expected to reduce NO_X emissions in the States not covered by CSAPR. DOE used *AEO 2021* data to derive NO_X emissions factors for the group of States not covered by CSAPR.

The MATS limit mercury emissions from power plants, but they do not include emissions caps and as such, DOE's energy conservation standards would be expected to slightly reduce Hg emissions. DOE estimated mercury emissions reduction using emissions factors based on *AEO 2021*, which incorporates the MATS.[89]

[89] DOE has not included the monetary impacts of the reduction of Hg for this rule. DOE is evaluating the appropriate monetization of these emissions for energy conservation standards rulemakings.

Combustion emissions of CH_4 and N_2O are estimated using emissions intensity factors published by the EPA.[90] The FFC upstream emissions are estimated based on the methodology described in chapter 13 of the final rule TSD. The upstream emissions include both emissions from fuel combustion during extraction, processing, and transportation of fuel, and "fugitive" emissions (direct leakage to the atmosphere) of CH_4 and CO_2.

Table IV.21 reflects the emissions reductions for both single-section and multi-section manufactured homes.

Table IV.21 Emissions Reductions as a Result of the Final Rule

Pollutant	Single-Section	Multi-Section	Total
Site Emissions Reductions			
CO_2 (million metric tons)	19.5	53.8	73.3
Hg (metric tons)	2.92E-02	9.60E-02	1.25E-01
NO_X (thousand metric tons)	10.9	26.6	37.5
SO_2 (thousand metric tons)	7.2	20.4	27.6
CH_4 (thousand metric tons)	1.03	3.11	4.14
N_2O (thousand metric tons)	0.21	0.57	0.78
Upstream Emissions Reductions			
CO_2 (million metric tons)	2.01	5.05	7.06
Hg (metric tons)	1.48E-04	4.45E-04	5.93E-04
NO_X (thousand metric tons)	25.4	64.8	90.2
SO_2 (thousand metric tons)	0.21	0.47	0.67
CH_4 (thousand metric tons)	127	354	481
N_2O (thousand metric tons)	0.011	0.026	0.037
Total Emissions Reductions			
CO_2 (million metric tons)	21.5	58.9	80.4
Hg (metric tons)	2.93E-02	9.64E-02	0.13
NO_X (thousand metric tons)	36.3	91.4	127.7
SO_2 (thousand metric tons)	7.44	20.9	28.3
CH_4 (thousand metric tons)	128	357	485
N_2O (thousand metric tons)	0.23	0.59	0.82

[90] Available at *www2.epa.gov/climateleadership/centeR-corporate-climate-leadership-ghg-emission-factors-hub*.

b. Monetization of Emissions

DOE estimated the global social benefits of GHG emission reductions expected from this final rule using the SC-GHG estimates presented in the Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990 (IWG 2021) that would be expected to result from the final rule as discussed in IV.D.2. DOE has determined that the estimates from the February 2021 TSD are based upon sound analysis and provide well-founded estimates for DOE's analysis of the impacts of GHG related to the reductions of emissions resulting from this final rule. Table IV.22 presents the global values of the CO_2 emissions reduction.

Table IV.22 Present Monetized Value of CO_2 Emissions Reduction for Manufactured Homes Purchased 2023–2052 with a 30-Year Lifetime

	SC-CO_2 Case			
	5% Discount Rate, Average	**3% Discount Rate, Average**	**2.5% Discount Rate, Average**	**3% Discount Rate, 95th Percentile**
	million 2020$			
Single Section	160.1	723.4	1,211.5	2,228.5
Multi Section	439.8	1,985.3	3,323.0	6,115.3
Total	**599.9**	**2,708.7**	**4,534.4**	**8,343.7**

Similarly, DOE has updated the quantified total climate benefits to estimate monetary benefits likely to result from the reduced emissions of CH_4 and N_2O, consistent with the interim estimates in the February 2021 TSD. DOE multiplied the CH_4 and N_2O emissions reduction estimated for each year by the SC-CH_4 and SC-N_2O estimates for that year in each of the two cases.

Table IV.23 presents the value of the CH_4 emissions reduction, and Table IV.24 presents the value of the N_2O emissions reduction.

Table IV.23 Present Monetized Value of Methane Emissions Reduction for Manufactured Homes Purchased 2023–2052 with a 30-Year Lifetime

	SC-CH_4 Case			
	5% Discount Rate, Average	**3% Discount Rate, Average**	**2.5% Discount Rate, Average**	**3% Discount Rate, 95th Percentile**
	million 2020$			
Single Section	47.7	154.9	230.1	412.5
Multi Section	133.3	432.8	643.0	1,152.6
Total	**181.0**	**587.6**	**873.2**	**1,565.1**

Table IV.24 Present Monetized Value of Nitrous Oxide Emissions Reduction for Manufactured Homes Purchased 2023– 2052 with a 30-Year Lifetime

	SC-N_2O Case			
	5% Discount Rate, Average	**3% Discount Rate, Average**	**2.5% Discount Rate, Average**	**3% Discount Rate, 95th Percentile**
	million 2020$			
Single Section	0.68	3.00	4.95	7.99
Multi Section	1.80	7.89	13.01	21.03
Total	**2.48**	**10.89**	**17.97**	**29.02**

DOE updated the monetization of NO_X and SO_2 emissions reductions from both electricity generation and direct use from manufactured homes. For this analysis, DOE used linear interpolation to define values for the years not given in the 2025 to 2040 range; for years beyond 2040 the value is held constant. Full details of this methodology are described in chapter 14 of the final rule TSD. DOE multiplied the NO_X and SO_2 emissions reduction (in tons) in each year by the associated $/ton values, and then discounted each series using discount rates of 3 percent and 7 percent as appropriate. Table IV.25 and Table IV.26 presents the results.

Table IV.25 Present Monetized Value of NO_X Emissions Reduction for Manufactured Homes Purchased 2023–2052 with a 30-Year Lifetime

	3% Discount Rate (High)	7% Discount Rate (High)	3% Discount Rate (Low)	7% Discount Rate (Low)
	million 2020$			
Single Section	1,220.1	410.2	1,170.8	393.5
Multi Section	3,208.7	1,082.0	3,110.6	1,048.9
Total	**4,428.8**	**1,492.2**	**4,281.4**	**1,442.4**

Table IV.26 Present Monetized Value of SO_2 Emissions Reduction for Manufactured Homes Purchased 2023–2052 with a 30-Year Lifetime

	3% Discount Rate (High)	7% Discount Rate (High)	3% Discount Rate (Low)	7% Discount Rate (Low)
	million 2020$			
Single Section	452.9	152.4	332.7	114.6
Multi Section	1,227.2	416.0	977.6	337.4
Total	**1,680.1**	**568.3**	**1,310.3**	**452.0**

DOE has not considered the monetary benefits of the reduction of Hg for this final rule. Not all the public health and environmental benefits from the reduction of greenhouse gases, NOx, and SO_2 are captured in the values above, and additional unquantified benefits from the reductions of those pollutants as well as from the reduction of Hg, direct PM, and other co-pollutants may be significant.

DOE emphasizes that the emissions analysis, including the SC-GHG analysis, presented in this final rule and TSD was performed in support of the cost-benefit analyses required by Executive Order 12866, and is provided to inform the public of the impacts of emissions reductions resulting from this final rule. The emissions estimates were not factored into DOE's determination of whether the final rule is cost-effective under section 413 of EISA 2007.

E. Total Benefits and Costs

DOE has determined that under the standards the benefits to the Nation of the standards (energy savings, consumer LCC savings, positive NPV of consumer benefit, energy security benefits, and emission reductions) outweigh the burdens (loss of INPV, and LCC increases for some homeowners of manufactured housing). The projected total benefits and costs (from the manufactured homeowner's perspective) associated with the standard, expressed in terms of annualized values, is presented in Table I.10 (See section I.E of this document).[91]

V. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

Executive Order ("E.O.") 12866, "Regulatory Planning and Review," as supplemented and reaffirmed by E.O. 13563, "Improving Regulation and Regulatory Review, 76 FR 3821 (Jan. 21, 2011), requires agencies, to the extent permitted by law, to (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent

[91] DOE used a two-step calculation process to convert the time-series of costs and benefits into annualized values. First, DOE calculated a present value in 2016, the year used for discounting the net present value of total consumer costs and savings, for the time-series of costs and benefits using discount rates of three and seven percent for all costs and benefits except for the value of CO_2 reductions. From the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in 2020 that yields the same present value. The fixed annual payment is the annualized value. Although DOE calculated annualized values, this does not imply that the time-series of cost and benefits from which the annualized values were determined would be a steady stream of payments.

practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. DOE emphasizes as well that E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs ("OIRA") in the Office of Management and Budget ("OMB") has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, this proposed/final regulatory action is consistent with these principles.

Section 6(a) of E.O. 12866 also requires agencies to submit "significant regulatory actions" to OIRA for review. OIRA has determined that this final regulatory action constitutes an economically significant regulatory action under section 3(f) of E.O. 12866. Accordingly, pursuant to section 6(a)(3)(C) of E.O. 12866, DOE has provided to OIRA an assessment, including the underlying analysis, of benefits and costs anticipated from the proposed/final regulatory action, together with, to the extent feasible, a quantification of those costs; and an assessment, including the underlying analysis, of

costs and benefits of potentially effective and reasonably feasible alternatives to the planned regulation, and an explanation why the planned regulatory action is preferable to the identified potential alternatives. These assessments are summarized in the tables below, as well as elsewhere in this preamble. Further detail on alternatives can be found in chapter 15 of the final rule TSD for this rulemaking.

Table V.1 Summary of Total Monetized Benefits and Costs to Manufactured Home Homeowners under the Adopted Standards

	Net Present Value ***billion $2020***
3% discount rate	
Consumer Operating Cost Savings	10.2
Climate Benefits*	3.3
Health Benefits**	5.6
Total Benefits	19.1
Consumer Incremental Product Costs†	5.1
Net Benefits	**14.0**
7% discount rate	
Consumer Operating Cost Savings	3.9
Climate Benefits*	3.3
Health Benefits**	1.9
Total Benefits†	9.1
Consumer Incremental Product Costs††	2.4
Net Benefits	**6.7**

Note: This table presents the costs and benefits associated with manufactured housing shipped in 2023−2052. These results include benefits to consumers which accrue after 2052 from the products shipped in 2023−2052.

* Climate benefits are calculated using four different estimates of the social cost of carbon (SC-CO2), methane (SC-CH4), and nitrous oxide (SC-N2O) (model average at 2.5 percent, 3 percent, and 5 percent discount rates; 95th percentile at 3 percent discount rate), as shown in Table IV.22 through Table IV.24. Together these represent the global SC-GHG. For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown, but the Department does not have a single central SC-GHG point estimate. See section. IV.D of this document for more details. On March 16, 2022, the Fifth Circuit Court of Appeals (No. 22-30087) granted the federal government's emergency motion for stay pending appeal of the February 11, 2022, preliminary injunction issued in *Louisiana v. Biden*, No. 21-cv-1074-JDC-KK (W.D. La.). As a result of the Fifth Circuit's order, the preliminary injunction is no longer in effect, pending resolution of the federal government's appeal of that injunction or a further court order. Among other things, the preliminary injunction enjoined the defendants in that case from "adopting, employing, treating as binding, or relying upon" the interim estimates of the social cost of greenhouse gases—which were issued by the Interagency Working Group on the Social Cost of Greenhouse Gases on February 26, 2021—to monetize the benefits of reducing greenhouse gas emissions. In the absence of further intervening court orders, DOE will revert to its approach prior to the injunction and presents monetized benefits where appropriate and permissible under law.

** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for NO_x and SO_2) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. See section IV.D.2 of this document for more details.
† Total and net benefits include those consumer, climate, and health benefits that can be quantified and monetized. For presentation purposes, total and net benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 3-percent discount rate, but the Department does not have a single central SC-GHG point estimate. DOE emphasizes the importance and value of considering the benefits calculated using all four SC-GHG estimates.
†† The incremental costs include incremental costs associated with principal and interest, mortgage and property tax for the analyzed loan types. Further discussion can be found in chapter 8 of the TSD.

Table V.2 Annualized Monetized Benefits and Costs to Manufactured Home Homeowners under the Standards

	Million $2020
	3% discount rate
Consumer Operating Cost Savings	551
Climate Benefits*	169
Health Benefits**	285
Total Benefits	1005
Consumer Incremental Product Costs†	277
Net Benefits	**728**
	7% discount rate
Consumer Operating Cost Savings	361
Climate Benefits*	169
Health Benefits**	153
Total Benefits	682
Consumer Incremental Product Costs†	221
Net Benefits	**461**

*Climate benefits are calculated using four different estimates of the social cost of carbon (SC-CO_2), methane (SC-CH_4), and nitrous oxide (SC-N_2O) (model average at 2.5 percent, 3 percent, and 5 percent discount rates; 95th percentile at 3 percent discount rate). Together these represent the global social cost of greenhouse gases (SC-GHG). For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown, but the Department does not have a single central SC-GHG point estimate, and it emphasizes the importance and value of considering the benefits calculated using all four SC-GHG estimates. On March 16, 2022, the Fifth Circuit Court of Appeals (No. 22-30087) granted the federal government's emergency motion for stay pending appeal of the February 11, 2022, preliminary injunction issued in *Louisiana v. Biden*, No. 21-cv-1074-JDC-KK (W.D. La.). As a result of the Fifth Circuit's order, the preliminary injunction is no longer in effect, pending resolution of the federal government's appeal of that injunction or a further court order. Among other things, the preliminary injunction enjoined the defendants in that case from "adopting, employing, treating as binding, or relying upon" the interim estimates of the social cost of greenhouse gases—which were issued by the Interagency Working Group on the Social Cost of Greenhouse Gases on February 26, 2021—to monetize the benefits of reducing greenhouse gas emissions. In the absence of further intervening court orders, DOE will revert to its approach prior to the injunction and presents monetized benefits where appropriate and permissible under law.
** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for NO_x and SO_2) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. The health benefits are presented at real discount rates of 3 and 7 percent.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 et seq.) requires preparation of an initial regulatory flexibility analysis ("IRFA") and a final regulatory flexibility analysis ("FRFA") for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by E.O. 13272, "Proper Consideration of Small Entities in Agency Rulemaking," 67 FR 53461 (Aug. 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990 (Feb. 9, 2003) DOE has made its procedures and policies available on the Office of the General Counsel's website (*www.energy.gov/gc/office-general-counsel*).

DOE prepared an IRFA as part of the August 2021 supplemental notice of proposed rulemaking ("SNOPR"). 86 FR 47825. In the IRFA, DOE identified 29 domestic small businesses impacted by the energy conservation standards for manufactured housing. DOE determined that the costs imposed on domestic small businesses as a result of this rulemaking would be small relative to the size of the average small manufacturer. DOE sought comment from stakeholders on the cost and number of model plans manufacturers must update as a result of the rule, the types of capital expenditures necessitated by the proposal, and the total cost of updating product offerings and manufacturing facilities. DOE also sought comment on how these values would differ for small manufacturers, and DOE's estimate of average annual revenues for small

manufacturers of manufactured housing. In light of DOE's analysis in the IRFA and input from stakeholders, DOE has prepared the following FRFA as part of this final rule.

1. Need for, and objectives of, the rule

EISA requires DOE to regulate energy conservation in manufactured housing, an area of the building construction industry traditionally regulated by HUD. HUD has regulated the manufactured housing industry since 1976, when it first promulgated the HUD Code. Among other provisions, EISA directs DOE to consult with the Secretary of HUD, who may seek further counsel from the Manufactured Housing Consensus Committee ("MHCC"); and to base the energy conservation standards on the most recent version of the International Energy Conservation Code ("IECC"), except where DOE finds that the IECC is not cost effective or where a more stringent standard would be more cost effective, based on the impact of the IECC on the purchase price of manufactured housing and on total life-cycle construction and operating costs. (42 U.S.C. 17071)

2. Significant Issues Raised

DOE received comments from the Manufactured Housing Association for Regulatory Reform ("MHARR"), the Manufactured Housing Institute ("MHI"), and the MHCC related to small businesses and the regulatory flexibility analysis presented in the manufactured housing August 2021 SNOPR. These comments are addressed in this section.

In written comments, MHARR cited a U.S. Small Business Administration ("SBA") study to conclude that the cost burdens of Federal regulation fall disproportionately on smaller businesses. MHARR made a general request that DOE evaluate potential impacts on smaller manufactured housing producers, retailers and communities and on the future viability and market share of those smaller, independent manufactured housing manufacturers.

DOE notes that its Regulatory Flexibility Analysis is scoped to the parties that have a direct compliance burden resulting from the rule, specifically the manufacturers that are subject to the energy conservation standard. DOE's rule requires only manufacturers of manufactured housing to comply with the rule's requirements. Analysis of retailers and communities is therefore outside the scope of DOE's FRFAs. For this final rule, DOE has further revised its analysis of small manufacturer impacts based on additional data submitted in written comments from industry stakeholders.

In response to the August 2021 SNOPR's IRFA, MHI raised concerns about the retail list price threshold used in the tiered proposal. MHI noted that the cost to update model plans would be a recurring annual cost rather than a one-time cost due to recurring retail price changes. (MHI, No. 1592 at p. 30) For the final rule, DOE is adopting a tiered approach wherein the standard levels are dependent on a size-based threshold instead of retail list prices. As such, the cost of updating the industry's current model plans to comply with the standards is expected to be a one-time conversion cost and not a recurring cost.

MHCC provided comments on DOE's August 2021 SNOPR and stated that smaller manufacturers may not always have the ability to make model plan changes in-house and must rely on external experts, which results in higher costs. The MHCC noted that the estimated engineering and third-party review time of 3 hours estimated in DOE's August 2021 SNOPR analysis is too conservative. MHCC estimated the actual time required would be 10-12 hours. As an example of changes needed, MHCC noted model plans must be revised for physical space impacts, evaluated through calculation for compliance to new thermal envelope requirements, analyzed for structural load path impacts, evaluated for procurement and material changes, and a third-party plan review and approval. MHCC gave the example that one large manufacturer on the MHCC has upwards of 3,000 model plans while data received from a single facility manufacturer estimates 300 model plans.

For the final rule analysis, DOE revised its estimates of conversion costs based on feedback from stakeholders. Specifically, DOE revised upward its estimates of the number of model plans and the cost to update model plans, in line with MHCC's comments. Additional detail is in section 4 "Description and Estimate of Compliance Requirements" of the Review Under the Regulatory Flexibility Act.

3. Description and Estimate of the Number of Small Entities Affected

The SBA has set a size threshold for manufacturers of manufactured homes, which defines those entities classified as "small businesses" for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. (13 CFR part 121) The

size standards are listed by North American Industry Classification System ("NAICS") code and industry description and are available at *www.sba.gov/document/support--table-size-standards*. Manufacturing of manufactured housing is classified under NAICS code 321991: "Manufactured Home (Mobile Home) Manufacturing." The SBA sets a threshold of 1,250 employees or fewer for an entity to be considered as a small business for this category. DOE notes that the IRFA in the June 2016 NOPR was based on an employee threshold of 500 employees. 81 FR 42576. The updated threshold of 1,250 employees in the IRFA in the August 2021 SNOPR and today's FRFA reflects the SBA's most recent guidance on the employee threshold for small businesses.

To estimate the number of companies that manufacture manufactured housing covered by this rulemaking, DOE conducted a market survey using publicly available information. DOE first attempted to identify all manufactured housing manufacturers by researching industry trade associations (*e.g.*, MHI[92]) and individual company websites. DOE used market research tools such as Dun & Bradstreet reports,[93] Glassdoor,[94] and LinkedIn[95] to gather information about the number of employees and manufacturing locations. DOE also asked stakeholders and industry representatives if they were aware of any other small manufacturers. After a comprehensive list of businesses was created, DOE screened out companies that do not offer manufactured homes affected by this final

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[92] Manufactured Housing Institute. MHI Company Members. (2019). *www.manufacturedhousing.org/wp-content/uploads/2019/07/Current-Member-List-USE-7-18-19-3.pdf* (Last accessed March 10, 2022).
[93] Dun & Bradstreet Hoovers. Subscription login accessible at: *app.dnbhoovers.com/* (Last accessed March 10, 2022).
[94] Glassdoor, Inc. Available at: *www.glassdoor.com/index.htm* (Last accessed March 10, 2022).
[95] LinkedIn. Available at: *www.linkedin.com/* (Last accessed March 10, 2022).

rule, do not meet the definition of a "small business," are foreign-owned and operated, or do not manufacture manufactured homes in the United States.

DOE identified 31 manufacturers of manufactured housing affected by this rulemaking. Of these, DOE identified 27 manufacturers that qualify as domestic small businesses.

4. Description and Estimate of Compliance Requirements

To evaluate impacts facing manufacturers of manufactured housing, DOE estimated both the product conversion costs (*e.g.*, expenditures on R&D, testing, marketing, and other non-depreciable expenses) and capital conversion costs (*e.g.*, investments in property, plant, and equipment) manufacturers would incur to bring their product designs and manufacturing facilities into compliance with the standards.

To calculate product conversion costs, DOE estimated the number of model-plans manufacturers would need to redesign. MHI reports there are 136 production plants for manufactured housing in the United States.[96] Three large manufacturers in the industry account for 100 of those production plants, based on production plant counts in the companies' annual reports. The remaining 36 plants are associated with small manufacturers. MHCC's comments indicate that individual production plants have approximately 300 model plans. (MHCC, No. 1600 at pp. 14) DOE estimated there are

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[96] Manufactured Housing Institute. *2021 Manufactured Housing Facts.* Available at: *www.manufacturedhousing.org/wp-content/uploads/2021/05/2021-MHI-Quick-Facts-updated-05-2021.pdf* (Last accessed March 10, 2022).

10,800 model plans associated with the small manufacturers. Based on stakeholder input from written comments, DOE estimated that each plan would require 10 hours of engineering time to update. DOE chose to use the lower end of MHCC's 10-12 hour estimate because of revisions to the adopted standards, specifically removal of R-5 continuous insulation from the prescriptive requirements, addresses some of the more complex design concerns of manufacturers raised in response to the August 2021 SNOPR. Using data from the U.S. Bureau of Labor Statistics, DOE calculated a fully burdened mean hourly wage for a mechanical engineer at $65.53/hour in 2020.[97] Based on these inputs, DOE estimated total small business product conversion costs of approximately $7.1 million. For this FRFA, DOE assumed the $7.1 million in product conversion costs were evenly spread across the 27 small businesses identified. DOE believes that particularly small, low-volume manufacturers would offer fewer model plans, however there was insufficient information to determine the exact number of plans each small business offered. Furthermore, DOE believes this even allocation avoids underestimating the investment needed for particularly small, low-volume manufacturers. Using these assumptions, DOE estimates product conversion costs of approximately $262,000 per small manufacturer.

While DOE understands most manufacturers have the necessary equipment to produce manufactured homes that are compliant with the standards as proposed in this document, DOE incorporated capital conversion costs of $20,000 per production plant to

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[97] U.S. Bureau of Labor Statistics. *Occupational Employment and Wage Statistics.* Available at: *www.bls.gov/oes/current/oes172141.htm* (Last accessed March 10, 2022).

cover tooling and work station adjustments that may be needed to support compliance with the standard. Accounting for 36 production plants, DOE estimates capital conversion costs of approximately $27,000 per small manufacturer.

DOE estimated the average small manufacturer would incur $289,000 in conversion costs. Based on data from business databases (*i.e.*, Dun & Bradstreet and Manta), DOE estimated that small manufacturers of manufactured housing have an average annual revenue of $52.3 million. Per manufacturer conversion costs are less than one percent of average small business annual revenue.

While DOE's analysis indicated that conversion costs are small relative to the annual revenue of most small manufacturers, DOE recognized that there is a range of company sizes within the set of 27 small manufacturers. DOE evaluated the impacts of the standard of different groupings of small manufacturers based on revenue. See Table V.3 for the grouping of small manufacturers by revenue.

Table V.3 Annual Revenue Distribution of Manufactured Housing Small Businesses

Annual Company Revenue *(Millions)*	**Number of Small Manufacturers**	**Conversion Cost / Annual Revenue**
Less than $10	4	5%
$10 to $20	6	2%
$20 to $30	5	1%
$30 to $40	2	1%
$40 to $50	4	1%
$50 or more	6	0%
Total	**27**	

For the small manufacturer groupings with revenue over $10 million, DOE finds the conversion costs to be small relative to company revenue. However, the impacts could be more severe for the grouping with annual revenue less than $10 million. For this grouping of manufacturers, which accounts for less than 0.5 percent of industry shipments, the estimated conversion costs could reach 5 percent of annual revenue over the conversion period.

DOE expects the four manufacturers with less than $10 million in annual revenue to have one production location each. If these small manufacturers maintain fewer than 300 model plans or if these manufacturers have existing high efficiency models that meet the standard today, then the conversion costs would be lower. However, there is insufficient publicly available information to allow DOE to determine the exact number of model plans requiring redesign for just these four specific companies.

5. Significant Alternatives Considered and Steps Taken to Minimize Significant Economic Impacts on Small Entities

In reviewing alternatives to the proposed standards, DOE examined energy conservation standards proposals in the June 2016 NOPR, proposals the August 2021 SNOPR, and sensitivities in the October 2021 NODA. The June 2016 NOPR was adopted by the MH working group, which consisted of 22 representatives of

stakeholders,[98] including representatives of manufacturer trade groups that included small manufacturers. However, in response to concerns related to potential adverse impacts on price-sensitive, low-income purchasers of manufactured homes from the imposition of energy conservation standards on manufactured housing, DOE considered multiple alternatives.

DOE evaluated the alternative of adopting tiered standards with tiers based on retail pricing. In the August 2021 SNOPR, Tier 1 applied to manufactured home with a manufacturer's retail list price of $55,000 or less, and would incorporate building thermal envelope measures based on certain thermal envelope components subject to the 2021 IECC but would limit the incremental purchase price increase to $750 or less. The August 2021 SNOPR also set up a Tier 2 that would apply to manufactured homes with a manufacturer's retail list price greater than $55,000. The Tier 2 standards would be set to stringencies based on the 2021 IECC and would increase purchase prices by more than $750.

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[98] Selected member of the MH working group were: Bert Kessler, Palm Harbor Homes, Inc.; David Tompos, NTA, Inc.; Emanuel Levy, Systems Building Research Alliance; Eric Lacey, Responsible Energy Codes Alliance; Ishbel Dickens, National Manufactured Home Owners Association (NMHOA); Keith Dennis, National Rural Electric Cooperative Association; Lois Starkey, Manufactured Housing Institute; Lowell Ungar, American Council for an Energy-Efficient Economy; Manuel Santana, Cavco Industries; Mark Ezzo, Clayton Homes, Inc.; Mark Weiss, Manufactured Housing Association for Regulatory Reform; Michael Lubliner, Washington State University Extension Energy Program; Michael Wade, Cavalier Home Builders; Peter Schneider, Efficiency Vermont; Richard Hanger, Housing Technology and Standards; Richard Potts, Virginia Department of Housing and Community Development; Rob Luter, Lippert Components, Inc.; Robin Roy, Natural Resources Defense Council; Scott Drake, East Kentucky Power Cooperative; Stacey Epperson, Next Step Network. DOE and ASRAC members were: Joseph Hagerman (DOE); and John Caskey (ASRAC, National Electrical Manufacturers Association).

DOE is adopting energy conservation standards based on the tiered approach presented in the August 2021 SNOPR and October 2021 NODA with some revisions. Tier 1 will apply to single-section manufactured homes and Tier 2 will apply to multi-section manufactured homes. The removal of tiers based on retail price eliminates the possibility that manufacturers would need to revise models plans frequently due to fluctuations in production costs or changes in retail pricing strategy. Additionally, DOE is adopting alternate exterior wall insulation prescriptive requirements to reduce burden on manufacturers, including small manufacturers. Specifically, for manufacturers choosing to follow the prescriptive requirements, eliminating the continuous insulation requirement in exterior wall insulation reduces product conversion costs by reducing the complexity and the extent of plan redesign. Without this change, DOE would expect product conversion costs for manufacturers, including small manufacturers, to be at least 20 percent higher.

The adopted energy conservation standards incorporate building thermal envelope measures based on specifications of the 2021 IECC, with consideration of the design and factory construction techniques of manufactured homes. Further, the energy conservation standards also include duct and air sealing, insulation installation, HVAC specifications, service hot water systems, mechanical ventilation fan efficacy, and heating and cooling equipment sizing provisions, based on the 2021 IECC. Additionally, the energy conservation standard incorporates feedback from manufacturers and takes steps to mitigate the burdens on small manufacturers, such as removing prescriptive requirements requiring continuous insulation. The tiered energy conservation standards provide

positive national average lifecycle cost savings over the life of the manufactured home (i.e., 30-years). Additionally, this adopted standard is expected to save 1.88 quads of FFC savings over the 30-year analysis period.

C. Review Under the Paperwork Reduction Act

This rulemaking does not include any information collection requirements subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*).

D. Review Under the National Environmental Policy Act of 1969

On January 14, 2022, DOE published the draft environmental impact statement for proposed energy conservation standards for manufactured housing (DOE/EIS-0550D). ("January 2022 DEIS"). The January 2022 DEIS was published pursuant to the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality's Regulations for implementing the procedural provisions of the National Environmental Policy Act (40 CFR parts 1500-1508), and DOE's NEPA Implementing Procedures (10 CFR part 1021). In response to the August 2021 SNOPR and October 2021 NODA, DOE received a number of comments regarding the January 2022 DEIS, as follows.

Schulte commented that there may be difficulty in establishing national standards because evaluating the impact of tightening the air envelope of the home on indoor air quality would be influenced by regional differences in ambient climate. (Schulte, No. 1028 at p. 23) UCB commented that they were concerned that there is not an EIS available, and that they cannot make an informed comment without the EIS, especially

when looking at alternatives to this rule. (UCB, No. 1405 at p. 1) UC Law School stated that by failing to publish a Draft Environmental Impact Statement, the DOE has compromised the ability of the public to offer meaningful comments. Under NEPA, "NEPA procedures must ensure that environmental information is available to public officials and citizens before decisions are made and before actions are taken." 40 CFR 1500.1(b). They stated that this provision indicates that a DEIS should have been prepared before the DOE decided on this proposed rule and certainly should be available for public comment before the proposed rule is promulgated. (UC Law School, No. 1634 at p. 2, 3, 5, 6) They also stated that DOE must incorporate the cost-benefit analysis into the EIS. The CEQ rules do not require a formal CBA, but if the agency prepares one, it must be presented in the EIS, according to 40 CFR 1502.22. (UC Law School, No. 1634 at p. 10) Further, UC Law School commented that the CBA does not comply with the directives of Executive Order 12866. Executive Order 12866 directs agencies, in the rulemaking process, to "assess all costs and benefits of available regulatory alternatives….". The Executive order mandates that agencies shall: identify the problem to be addressed and its significance; consider the need to fix existing regulations; assess alternatives to direct regulation; design regulations to maximize cost-efficiency; confirm that the benefits of new rules justify the costs, use the best reasonably obtainable information; tailor regulations to minimize burdens; and write rules clearly to minimize uncertainty and litigation. UC Law School stated that the alternatives were not entirely assessed, a third approach was not examined, the regulation was not designed to maximize cost-efficiency, and the proposed rule was not written to minimize uncertainty and litigation since the EIS has not been published. (UC Law School, No. 1634 at p. 11)

ACEEE stated that the analysis presented in the EIS supports a strong untiered standard to provide the greatest environmental, socioeconomic, and health benefits. ACEEE says that air sealing requirements have mixed but acceptable impacts on IAQ. ACEEE stated that its analysis shows that the air sealing requirements of the proposed standards may increase concentrations of certain indoor air pollutants but that does not change the overall hazard status of these pollutants. ACEEE also stated that analysis also shows that the proposed air sealing requirements reduce indoor exposure to pollutants from outdoor sources (by reducing uncontrolled air flow). Thus, the proposed efficiency standards should not be rejected based on the potential impacts to IAQ. ACEEE stated that it is worth noting that all options considered in the SNOPR and in the EIS have the same air sealing requirements and thus the same IAQ impacts. ACEEE stated that requiring effective mechanical ventilation and reducing use of off-gassing materials in manufactured homes, regardless of the efficiency standard, is the best way to ensure healthy indoor air quality by reducing exposure to air pollutants from indoor sources, and referred to ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Residential Buildings, as an option for meeting the HUD Code. ACEEE concluded that the EIS confirms that the untiered standard delivers the highest 30-year LCC savings to residents, and delivers strong climate and environmental justice benefits. ACEEE said the untiered standard delivers the largest reduction in ongoing energy costs, which is an essential part of preserving the affordability of MH and lowering high energy burdens for its residents. (ACEEE, No. 1988 at p. 1-2)

Earthjustice and Prosperity Now stated that there is no need to view energy-saving requirements that reduce air infiltration in MH as establishing a zero sum game between different groups or air pollutants, and that DOE should follow through on the draft EIS recommendations that to promote installation of energy efficient fans for ventilation. Earthjustice and Prosperity Now stated that, at the absolute minimum, DOE needs to fulfill its statutory obligation to evaluate the requirements for improved ventilation contained in the IECC, and concluded that the substantial economic, environmental, and health benefits of improving air sealing practices in MH construction should not come at the cost of creating environments where air pollutants generated indoors linger until concentrations reach potentially harmful levels, and that it is essential that these risks be mitigated, and DOE must not pass up any opportunities to use its legal authority to ensure the safety of the MH residents.

As previously mentioned, DOE has published the January 2022 DEIS and the Final EIS in April of 2022 which informs this final rule. Although DOE was unable to issue the DEIS simultaneously with the August 2021 SNOPR, the agency reopened the energy conservation standards rule docket for public comment in January 2022, when it issued the January 2022 DEIS, to ensure an opportunity to comment on how the January 2022 DEIS should inform the standards final rule. Comments received in the rulemaking docket during the January 2022 comment period have been considered in the previous sections, though some are discussed more below; comments received on the DEIS specifically are considered in the FEIS.

The January 2022 DEIS analyzed a range of alternatives and impacts for the standards considered in the August 2021 SNOPR and October 2021 NODA (i.e., tiered – using manufacturer's list price or home size; untiered; alternate exterior wall insulation for certain climate zones), as well as the no action alternative. The final EIS further analyzed these alternatives, and incorporated and addressed feedback from stakeholder comments on the DEIS. DOE utilized the analyses in the DEIS, the comments received on the DEIS, and the analyses in the final EIS to inform this final rule, particularly in regards to the issues of indoor air quality and socioeconomics.

With respect to indoor air quality, the final EIS provides a discussion of potential environmental impacts to indoor air quality related to the alternatives analyzed, as well as potential mitigation measures, which informed this rulemaking. See sections 4.2.3 and 4.3 of the Final EIS. As noted in the EIS, all the action alternatives analyzed would result in more airtight homes, which would have higher indoor air concentrations of pollutants emitted indoors, increasing the existing potential for health effects, particularly when ventilation is not routinely used. Conversely, all the action alternatives would result in better indoor protection from outdoor air pollutants, including wildfire smoke. Additionally, DOE expects a lower risk of moisture problems (e.g., mold) in the belly and attic of manufactured homes. As noted in section 4.11 of the final EIS, DOE identified potential mitigation measures to address increased indoor air pollutants resulting from better sealing of homes, such as promotion of installation of energy-efficient ventilation systems, advanced research and stakeholder engagement to increase implementation of efficient ventilation in manufactured housing, and promoting indoor air quality and

environmental justice through informational resources and labeling. DOE considered all of this information in constructing this final rule.

With respect to socioeconomics, the final EIS provides a discussion of impacts to indoor socioeconomics, which informed this rulemaking of the reasonable alternatives that could avoid or minimize adverse impacts. See section 4.4 of the Final EIS. DOE received numerous comments from a variety of stakeholders about the impacts of the alternatives analyzed in the DEIS on socioeconomics, particularly on low-income consumers. Accordingly, DOE has finalized the tiered standard based on home size in this final rule.

With respect to the comments at the beginning of this section, as discussed in section III.B of this document, DOE is adopting a tiered standard in this final rule to mitigate the affordability and cost-effectiveness concerns raised by HUD during and consultation, and in other stakeholder comments. DOE acknowledges that the untiered standard provided greater long-term energy savings benefits. However, for the reasons stated in section III.B of this document, DOE has determined to adopt the tiered standard in today's final rule. As ACEEE noted, DOE considered similar sealing requirements across the analyzed action alternatives, and they had similar indoor air quality impacts. Therefore, these impacts would be similar regardless of the alternative chosen. With respect to Earthjustice and Prosperity Now's comments, as discussed in section III.A.3 of this document, DOE disagrees with the commenter that a provision-by-provision analysis of the IECC is necessary for this final rule. Moreover, HUD is the Federal authority that

regulates safety standards, including ventilation, in manufactured homes. Additional ventilation requirements to improve indoor air quality are better addressed by HUD. DOE notes that the standards adopted in this final rule are similar to those already required by the HUD Code. Additionally, as discussed in section 4.11 of the final EIS, DOE identified potential mitigation measures to address increased indoor air pollutants resulting from better sealing of homes, such as promotion of installation of energy-efficient ventilation systems, advanced research and stakeholder engagement to increase implementation of efficient ventilation in manufactured housing, and through informational resources and labeling. DOE intends to pursue these potential mitigation measures to promote indoor air quality and environmental justice in manufactured homes.

Elsewhere in this issue of the *Federal Register*, DOE is publishing its record of decision ("ROD") pursuant to its obligations under NEPA. The ROD finalizes DOE's considerations of the environmental impacts under the NEPA process and memorializes DOE's determinations and approach chosen consistent with this final rule. In addition, to remain compliant with Executive Order 12866, DOE is submitting this final rule for review to the Office of Information and Regulatory Affairs to ensure that the final rule, including the assessments of cost-effectiveness and benefits, meet the requirements of Executive Order 12866. DOE is statutorily required by EISA to base these energy conservation standards on the most recent version of the IECC except where it is not cost-effective, and as such, DOE followed that statutory direction for this final rule. DOE strived to incorporate feedback from stakeholders to maximize clarity and minimize the burden placed on manufacturers, while also following its statutory obligations and

ensuring energy and cost savings for consumers of manufactured housing. With regards to difficulties establishing national standards based on regional differences in ambient climate, DOE has based the adopted standards on the established HUD zones to account for differences in regional climates consistent with section 413 of EISA (42 U.S.C. 17071(b)(2)(B)).

E. Review Under Executive Order 13132

Executive Order 13132, "Federalism," 64 FR 43255 (Aug. 10, 1999) imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt State law or that have federalism implications. The Executive order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this final rulemaking and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.

DOE has examined this action and has determined that it will not pre-empt State law. This action impacts energy efficiency requirements for manufacturers of manufactured homes. Therefore, no further action is required by E.O. 13132.

F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of E.O. 12988, "Civil Justice Reform," imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; (3) provide a clear legal standard for affected conduct rather than a general standard; and (4) promote simplification and burden reduction. 61 FR 4729 (Feb. 7, 1996). Regarding the review required by section 3(a), section 3(b) of E.O. 12988 specifically requires that executive agencies make every reasonable effort to ensure that the regulation: (1) clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of E.O. 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met, or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this proposed rule meets the relevant standards of E.O. 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 ("UMRA") requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Pub. L. 104-4, section 201 (codified at 2 U.S.C. 1531). For a regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a "significant intergovernmental mandate," and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect them. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. DOE's policy statement is also available at *https://energy.gov/sites/prod/files/gcprod/documents/umra_97.pdf*.

DOE has concluded that this rule may require expenditures of $100 million or more in one year by the private sector. Such expenditures may include: (1) Updates to product plans and investment in capital expenditures by manufactured home manufacturers in the years between the final rule and the compliance date of the new

standards, and (2) incremental additional expenditures by consumers to purchase higher-efficiency manufactured homes, starting at the compliance date for the standards.

Section 202 of UMRA authorizes a Federal agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the rule. (2 U.S.C. 1532(c)) The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under E.O. 12866. This **SUPPLEMENTARY INFORMATION** section and chapter 15 of the TSD for this final rule respond to those requirements.

Under section 205 of UMRA, the Department is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. (2 U.S.C. 1535(a)) DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the rule unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law.

In accordance with the statutory provisions discussed in this document, this rule would establish energy conservation standards for manufactured homes based on the most recent IECC, except in cases in which DOE finds that the IECC is not cost-effective, or a more stringent standard would be more cost-effective, based on the impact of the code on the purchase price of manufactured housing and on total life-cycle construction and operating costs, and taking into consideration the design and factory construction techniques of manufactured homes. (42 U.S.C. 17071(b)(1) and 42 U.S.C.

17071(b)(2)(A)) As discussed previously, DOE found the 2021 IECC-based adopted final rule cost-effective consistent with section 413 of EISA. A discussion of the alternatives considered by DOE is presented in chapter 15 of the TSD for this final rule.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105-277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. These standards would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

Pursuant to E.O. 12630, "Governmental Actions and Interference with Constitutionally Protected Property Rights," 53 FR 8859 (Mar. 18, 1988), DOE has determined that these standards would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under the Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516, note) provides for Federal agencies to review most disseminations of information to the public under information quality guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). Pursuant to OMB Memorandum M-19-15, Improving Implementation of the

Information Quality Act (April 24, 2019), DOE published updated guidelines which are available at *https://www.energy.gov/sites/prod/files/2019/12/f70/DOE%20Final%20Updated%20IQA%20Guidelines%20Dec%202019.pdf*. DOE has reviewed this rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use," 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA at OMB, a Statement of Energy Effects for any significant energy action. A "significant energy action" is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that: (1) is a significant regulatory action under E.O. 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

DOE has concluded that this regulatory action, which establishes new energy conservation standards for manufactured housing, is not a significant energy action because the standards are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at

OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on this final rule.

L. Information Quality

On December 16, 2004, OMB, in consultation with the Office of Science and Technology Policy (OSTP), issued its Final Information Quality Bulletin for Peer Review (the Bulletin). 70 FR 2664 (Jan. 14, 2005). The Bulletin establishes that certain scientific information shall be peer-reviewed by qualified specialists before it is disseminated by the Federal Government, including influential scientific information related to agency regulatory actions. The purpose of the Bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are "influential scientific information," which the Bulletin defines as "scientific information the agency reasonably can determine will have, or does have, a clear and substantial impact on important public policies or private sector decisions." 70 FR 2664, 2667.

In response to OMB's Bulletin, DOE conducted formal peer reviews of the energy conservation standards development process for consumer products and industrial equipment under EPCA and the analyses that are typically used and prepared a report describing that peer review.[99] Generation of this report involved a rigorous, formal, and

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[99] The 2007 "Energy Conservation Standards Rulemaking Peer Review Report" is available at the following website*: http://energy.gov/eere/buildings/downloads/energy-conservation-standards-rulemaking-peeR-review-report-0*.

documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical, scientific, and business merit; the actual or anticipated results; and the productivity and management effectiveness of programs and/or projects. Because available data, models, and technological understanding have changed since 2007, DOE has engaged with the National Academy of Sciences to review DOE's analytical methodologies to ascertain whether modifications are needed to improve the Department's analyses. DOE is in the process of evaluating the resulting report.[100]

M. Materials Incorporated by Reference

Under section 301 of the Department of Energy Organization Act (Pub. L. 95-91; 42 U.S.C. 7101), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C. 788; FEAA) Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the FTC Chairman concerning the impact of the commercial or industry standards on competition.

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[100] The report is available at *www.nationalacademies.org/our-work/review-of-methods-for-setting-building-and-equipment-performance-standards*.

DOE is incorporating by reference the industry standard published by ACCA, titled Manual J–2016 (ver 2.50), Manual J - Residential Load Calculations, Eight Edition, Version 2.50.. ACCA Manual J is an industry accepted standard for calculating the heating and cooling load associated with a building. DOE is requiring building heating and cooling loads to be calculated (for purposes of equipment sizing) in accordance with ACCA Manual J. ACCA Manual J is readily available on ACCA's website at *www.acca.org/*.

DOE is incorporating by reference the industry standard published by ACCA, titled Manual S–2014, Manual S - Residential Equipment Selection, Second Edition, Version 1.00. ACCA Manual S is an industry accepted standard for calculating the appropriate heating and cooling equipment size for a building. DOE is requiring building heating and cooling equipment to be sized in accordance with ACCA Manual S. ACCA Manual S is readily available on ACCA's website at *www.acca.org/*.

DOE is incorporating by reference the industry standard written by C.C Conner and Z.T. Taylor of Pacific Northwest Laboratory, titled *Overall U-Values and Heating/Cooling Loads–Manufactured Homes*. This industry standard (referred to as the "Battelle Method") is an industry accepted method for calculating the overall thermal transmittance of a manufactured home. In instances in which manufacturers demonstrate compliance with the overall thermal transmittance requirement, DOE is requiring manufactured housing manufacturers to calculate the overall thermal transmittance of a manufactured home in accordance with this industry standard. This standard is readily

available on the U.S. Department of Housing and Urban Development's website at *www.huduser.org/portal/publications/manufhsg/uvalue.html*.

DOE has evaluated these standards and was unable to conclude whether they fully comply with the requirements of section 32(b) of the FEAA (*i.e.*, whether they were developed in a manner that fully provides for public participation, comment, and review.) DOE has consulted with both the Attorney General and the Chairman of the FTC about the impact on competition of using the methods contained in these standards and has received no comments objecting to their use.

N. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of this rule prior to its effective date. The report will state that it has been determined that the rule is a "major rule" as defined by 5 U.S.C. 804(2).

VI. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this final rule.

List of Subjects in 10 CFR Part 460

Administrative practice and procedure, Buildings and Facilities, Energy conservation, Housing standards, Incorporation by reference, Reporting and recordkeeping requirements.

Signing Authority

This document of the Department of Energy was signed on May 16, 2022, by Kelly J. Speakes-Backman, Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and

submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the *Federal Register*.

Signed in Washington, DC, on May 17, 2022.

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Treena V. Garrett
Federal Register Liaison Officer,
U.S. Department of Energy

For the reasons stated in the preamble, DOE adds part 460 of chapter II of title 10, Code of Federal Regulations as set forth below:

PART 460—ENERGY CONSERVATION STANDARDS FOR MANUFACTURED HOMES

Subpart A – General

Sec.
460.1 Scope.
460.2 Definitions.
460.3 Materials incorporated by reference.
460.4 Energy conservation standards.

Subpart B – Building Thermal Envelope

460.101 Climate zones.
460.102 Building thermal envelope requirements.
460.103 Installation of insulation.
460.104 Building thermal envelope air leakage.

Subpart C – HVAC, Service Hot Water, and Equipment Sizing

460.201 Duct systems.
460.202 Thermostats and controls.
460.203 Service hot water.
460.204 Mechanical ventilation fan efficacy.
460.205 Equipment sizing.

Authority: 42 U.S.C. 17071; 42 U.S.C. 7101 *et seq*.

Subpart A – General

§460.1 Scope.

This subpart establishes energy conservation standards for manufactured homes as manufactured at the factory, prior to distribution in commerce for sale or installation in the field. A manufactured home that is manufactured on or after the [**INSERT DATE 1 YEAR AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***] must comply with all applicable requirements of this part.

§460.2 Definitions.

Adapted from section R202 of the 2021 IECC and as used in this part–

2021 IECC means the 2021 version of the International Energy Conservation Code, issued by the International Code Council.

Access (to) means that which enables a device, appliance or equipment to be reached by ready access or by a means that first requires the removal or movement of a panel or similar obstruction.

Air barrier means one or more materials joined together in a continuous manner to restrict or prevent the passage of air through the building thermal envelope and its assemblies.

Automatic means self-acting or operating by its own mechanism when actuated by some impersonal influence.

Building thermal envelope means exterior walls, exterior floors, exterior ceiling, or roofs, and any other building element assemblies that enclose conditioned space or provide a boundary between conditioned space and unconditioned space.

Ceiling means an assembly that supports and forms the overhead interior surface of a building or room that covers its upper limit and is horizontal or tilted at an angle less than 60 degrees (1.05 rad) from horizontal.

Climate zone means a geographical region identified in §460.101.

Conditioned space means an area, room, or space that is enclosed within the building thermal envelope and that is directly or indirectly heated or cooled. Spaces are indirectly heated or cooled where they communicate through openings with conditioned space, where they are separated from conditioned spaces by uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping, or other sources of heating or cooling.

Continuous air barrier means a combination of materials and assemblies that restrict or prevent the passage of air from conditioned space to unconditioned space.

Door means an operable barrier used to block or allow access to an entrance of a manufactured home.

Dropped ceiling means a secondary nonstructural ceiling, hung below the exterior ceiling.

Dropped soffit means a secondary nonstructural ceiling that is hung below the exterior ceiling and that covers only a portion of the ceiling.

Duct means a tube or conduit, except an air passage within a self-contained system, utilized for conveying air to or from heating, cooling, or ventilating equipment.

Duct system means a continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans, and accessory air-handling equipment and appliances.

Eave means the edge of the roof that overhangs the face of an exterior wall and normally projects beyond the side of the manufactured home.

Equipment includes material, devices, fixtures, fittings, or accessories both in the construction of, and in the plumbing, heating, cooling, and electrical systems of a manufactured home.

Exterior ceiling means a ceiling that separates conditioned space from unconditioned space.

Exterior floor means a floor that separates conditioned space from unconditioned space.

Exterior wall means a wall, including a skylight well, that separates conditioned space from unconditioned space.

Fenestration means vertical fenestration and skylights.

Floor means a horizontal assembly that supports and forms the lower interior surface of a building or room upon which occupants can walk.

Glazed or glazing means an infill material, including glass, plastic, or other transparent or translucent material used in fenestration.

Heated water circulation system means a water distribution system in which one or more pumps are operated in the service hot water piping to circulate heated water from the water heating equipment to fixtures and back to the water heating equipment.

Insulation means material deemed to be insulation under 16 CFR 460.2.

Manual means capable of being operated by personal intervention.

Manufactured home means a structure, transportable in one or more sections, which in the traveling mode is 8 body feet or more in width or 40 body feet or more in length or which when erected onsite is 320 or more square feet, and which is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air conditioning, and electrical systems contained in the structure. This term includes all structures that meet the above requirements except the size requirements and with respect to which the manufacturer voluntarily files a certification pursuant to 24 CFR 3282.13 and complies with the construction and safety standards set forth in 24 CFR part 3280. The term does not include any self-propelled recreational vehicle. Calculations used to determine the number of square feet in a structure will be based on the structure's exterior dimensions, measured at the largest horizontal projections when erected on site. These dimensions will include all expandable rooms, cabinets, and other projections containing interior space, but do not include bay windows. Nothing in this definition should be interpreted to mean that a manufactured home necessarily meets the requirements of the U.S. Department of Housing and Urban Development Minimum Property Standards (HUD Handbook 4900.1) or that it is automatically eligible for financing under 12 U.S.C. 1709(b).

Manufacturer means any person engaged in the factory construction or assembly of a manufactured home, including any person engaged in importing manufactured homes for resale.

Opaque door means a door that is not less than 50 percent opaque in surface area.

R-value (thermal resistance) means the inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area ($h \times ft^2 \times °F/Btu$).

Rough opening means an opening in the exterior wall or roof, sized for installation of fenestration.

Service hot water means supply of hot water for purposes other than comfort heating.

Skylight means glass or other transparent or translucent glazing material, including framing materials, installed at an angle less than 60 degrees (1.05 rad) from horizontal, including unit skylights, tubular daylighting devices, and glazing materials in solariums, sunrooms, roofs and sloped walls.

Skylight well means the exterior walls underneath a skylight that extend from the interior finished surface of the exterior ceiling to the exterior surface of the location to which the skylight is attached.

Solar heat gain coefficient (SHGC) means the ratio of the solar heat gain entering a space through a fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation that is then reradiated, conducted, or convected into the space.

State means each of the 50 states, the District of Columbia, the Commonwealth of Puerto Rico, Guam, the U.S. Virgin Islands, and American Samoa.

Thermostat means an automatic control device used to maintain temperature at a fixed or adjustable set point.

U-factor (thermal transmittance) means the coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (Btu/h × ft^2 × °F).

U_o (overall thermal transmittance) means the coefficient of heat transmission (air to air) through the building thermal envelope, equal to the time rate of heat flow per unit

area and unit temperature difference between the warm side and cold side air films (Btu/h × ft^2 × °F).

Ventilation means the natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

Vertical fenestration means windows (fixed or moveable), opaque doors, glazed doors, glazed block and combination opaque and glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of greater than or equal to 60 degrees (1.05 rad) from horizontal.

Wall means an assembly that is vertical or tilted at an angle equal to greater than 60 degrees (1.05 rad) from horizontal that encloses or divides an area of a building or room.

Whole-house mechanical ventilation system means an exhaust system, supply system, or combination thereof that is designed to mechanically exchange indoor air with outdoor air when operating continuously or through a programmed intermittent schedule to satisfy the whole house ventilation rates.

Window means glass or other transparent or translucent glazing material, including framing materials, installed at an angle greater than 60 degrees (1.05 rad) from horizontal.

Zone means a space or group of spaces within a manufactured home with heating or cooling requirements that are sufficiently similar so that desired conditions can be maintained using a single controlling device.

§460.3 Materials incorporated by reference.

Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, the U.S. Department of Energy (DOE) must publish a document in the *Federal Register* and the material must be available to the public. All approved material is available for inspection at DOE and at the National Archives and Records Administration (NARA). Contact DOE at: the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, Sixth Floor, 950 L'Enfant Plaza SW., Washington, DC 20024, (202) 586–9127, *Buildings@ee.doe.gov*, *https://www.energy.gov/eere/buildings/building-technologies-office*. For information on the availability of this material at NARA, email: *fr.inspection@nara.gov*, or go to: *www.archives.gov/federal-register/cfr/ibr-locations.html.* The material may be obtained from the following sources:

(a) *ACCA*. Air Conditioning Contractors of America, Inc., 2800 S. Shirlington Road, Suite 300, Arlington, VA 22206, 703-575-4477; *www.acca.org*/.

(1) ANSI/ACCA 2 Manual J–2016 (ver 2.50) ("ACCA Manual J"), Manual J–Residential Load Calculations, Eight Edition, Version 2.50, Copyright 2016; IBR approved for §460.205.

(2) ANSI/ACCA 3 Manual S–2014 ("ACCA Manual S"), Manual S–Residential Equipment Selection, Second Edition, Version 1.00, Copyright 2014; IBR approved for §460.205.

(b) *HUD User*, 11491 Sunset Hills Road, Reston, VA 20190-5254; *www.huduser.gov/portal/publications/pdrpubli.html.*

(1) HUD User No. 0005945, Overall U-Values and Heating/Cooling Loads–Manufactured Homes, February 1, 1992 (available from *www.huduser.org/portal/publications/manufhsg/uvalue.html*); IBR approved for §460.102(e).

(2) [Reserved].

§460.4 Energy conservation standards.

(a) *General*. A manufactured home must comply with the energy conservation standards specified for the applicable tier as presented in paragraphs (b) and (c) of this section.

(b) *Tier 1.* A single-section manufactured home (*i.e.*, a Tier 1 manufactured home) must comply with all applicable requirements in subparts B and C of this part.

(c) *Tier 2.* A multi-section manufactured home (*i.e.*, a Tier 2 manufactured home) must comply with all applicable requirements in subparts B and C of this part.

Subpart B – Building Thermal Envelope

§460.101 Climate zones.

Manufactured homes subject to the requirements of this subpart must comply with the requirements applicable to one or more of the climate zones set forth in figure 1 to § 460.101 and table 1 to § 460.101.

Figure 1 to § 460.101 Climate Zones

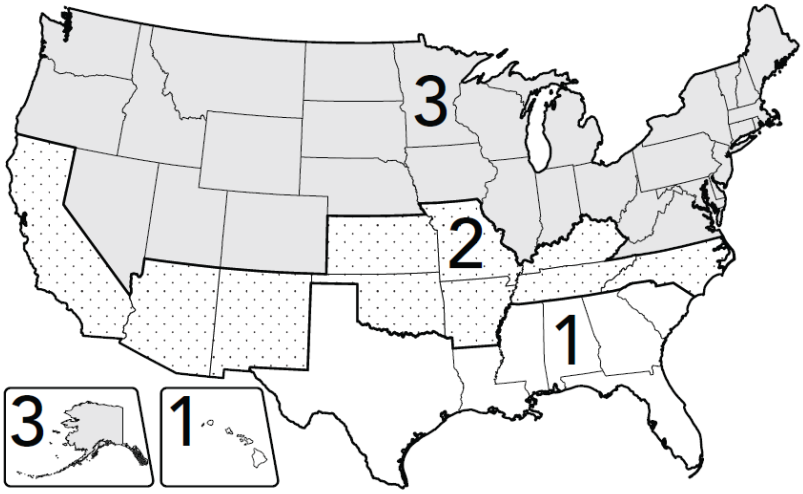

Table 1 to § 460.101 U.S. States and Territories per Climate Zone

ZONE 1	ZONE 2	ZONE 3
Alabama	Arkansas	Alaska
American Samoa	Arizona	Colorado
Florida	California	Connecticut
Georgia	Kansas	Delaware
Guam	Kentucky	District of Columbia
Hawaii	Missouri	Idaho
Louisiana	New Mexico	Illinois
Mississippi	North Carolina	Indiana
South Carolina	Oklahoma	Iowa
Texas	Tennessee	Maine
The Commonwealth of Puerto Rico		Maryland
U.S. Virgin Islands		Massachusetts
		Michigan
		Minnesota
		Montana

		Nebraska
		Nevada
		New Hampshire
		New Jersey
		New York
		North Dakota
		Ohio
		Oregon
		Pennsylvania
		Rhode Island
		South Dakota
		Utah
		Vermont
		Virginia
		Washington
		West Virginia
		Wisconsin
		Wyoming

§460.102 Building thermal envelope requirements.

(a) *Compliance options*. The building thermal envelope must meet either the prescriptive requirements of paragraph (b) of this section or the performance requirements of paragraph (c) of this section.

(b) *Prescriptive requirements*. (1) The building thermal envelope must meet the applicable minimum *R*-value (nominal value of insulation), and the glazing maximum *U*-factor and SHGC, requirements set forth in table 1 to § 460.102(b)(1) and table 2 to § 460.102(b)(2) or component U-values set forth in table 3 to § 460.102(b)(5) and table 4 to § 460.102(b)(5).

Table 1 to § 460.102(b)(1) Tier 1 Building Thermal Envelope Prescriptive Requirements

Climate Zone	Exterior Wall Insulation *R*-value	Exterior Ceiling Insulation *R*-value	Exterior Floor Insulation *R*-value	Window *U*-factor	Skylight *U*-factor	Door *U*-factor	Glazed Fenestration SHGC
1	13	22	22	1.08	0.75	0.40	0.7
2	13	22	19	0.5	0.55	0.40	0.6

3	19	22	22	0.35	0.55	0.40	Not applicable

Table 2 to § 460.102(b)(1) Tier 2 Building Thermal Envelope Prescriptive Requirements

Climate Zone	Exterior Wall Insulation *R*-value	Exterior Ceiling Insulation *R*-value	Exterior Floor Insulation *R*-value	Window *U*-factor	Skylight *U*-factor	Door *U*-factor	Glazed Fenestration SHGC
1	13	30	13	0.32	0.75	0.40	0.33
2	21	30	19	0.30	0.55	0.40	0.25
3	21	38	30	0.30	0.55	0.40	Not applicable

(2) For the purpose of compliance with the exterior ceiling insulation *R*-value requirement of paragraph (b)(1) of this section, the truss heel height must be a minimum of 5.5 inches at the outside face of each exterior wall.

(3) A combination of *R*-21 batt insulation and *R*-14 blanket insulation may be used for the purpose of compliance with the floor insulation *R*-value requirement of table 2 to § 460.102(b)(1)**,** Climate Zone 3.

(4) An individual skylight that has an SHGC that is less than or equal to 0.30 is not subject to the glazed fenestration SHGC requirements established in paragraph (b)(1) of this section. Adapted from section R402 of the 2021 IECC.

(5) *U*-factor alternatives to *R*-value requirements. Compliance with the applicable requirements in paragraph (b)(1) of this section may be determined using the applicable maximum *U*-factor values set forth in table 3 to § 460.102(b)(5) and table 4 to § 460.102(b)(5), which reflect the thermal transmittance of the component, excluding fenestration, and not just the insulation of that component, as an alternative to the minimum nominal *R*-value requirements set forth in table 1 to § 460.102(b)(1) and table 2 to § 460.102(b)(1), respectively.

Table 3 to § 460.102(b)(5) *U*-factor Alternatives to Tier 1 *R*-value Requirements

Climate Zone	Exterior Ceiling *U*-factor	Exterior Wall *U*-factor	Exterior Floor *U*-factor
1	0.061	0.094	0.049
2	0.061	0.094	0.056
3	0.061	0.068	0.049

Table 4 to § 460.102(b)(5) *U*-factor Alternatives to Tier 2 R-value Requirements

Climate Zone	Exterior Ceiling *U*-factor	Exterior Wall *U*-factor	Exterior Floor *U*-factor
1	0.043	0.094	0.078
2	0.043	0.063	0.056
3	0.037	0.063	0.032

(c) *Performance requirements*. (1) The building thermal envelope must have a U_o that is less than or equal to the applicable value specified in table 5 to § 460.102(c)(1) and table 6 to § 460.102(c)(1).

Table 5 to § 460.102(c)(1) Tier 1 Building Thermal Envelope Performance Requirements

Climate Zone	Single-Section U_o
1	0.110
2	0.091
3	0.074

Table 6 to § 460.102(c)(1) Tier 2 Building Thermal Envelope Performance Requirements

Climate Zone	Multi-Section U_o
1	0.082
2	0.066
3	0.055

(2) Area-weighted average vertical fenestration *U*-factor must not exceed 0.48 in Climate Zone 2 or 0.40 in Climate Zone 3. Adapted from section R402 of the 2021 IECC.

(3) Area-weighted average skylight *U*-factor must not exceed 0.75 in Climate Zone 2 and Climate Zone 3. Adapted from section R402 of the 2021 IECC.

(4) Windows, skylights and doors containing more than 50 percent glazing by area must satisfy the SHGC requirements established in paragraph (b)(1) of this section on the basis of an area-weighted average. Adapted from section R402 of the 2021 IECC.

(d) [Reserved].

(e) *Determination of compliance with paragraph (c) of this section*. (1) U_o must be determined in accordance with Overall *U*-Values and Heating/Cooling Loads – Manufactured Homes (incorporated by reference; see §460.3)

(2) [Reserved]

§460.103 Installation of insulation.

Insulating materials must be installed according to the insulation manufacturer's installation instructions and the requirements set forth in table 1 to 460.103, which is adapted from section R402 of the 2021 IECC.

Table 1 to § 460.103 Installation of Insulation

COMPONENT	INSTALLATION REQUIREMENTS
General	Air-permeable insulation must not be used as a material to establish the air barrier.
Access hatches, panels, and doors	Access hatches, panels, and doors between conditioned space and unconditioned space, such as attics and crawlspaces, must be insulated to a level equivalent to the insulation of the surrounding surface, must provide access to all equipment that prevents damaging or compressing the insulation, and must provide a wood-framed or equivalent baffle or retainer when loose fill insulation is installed within an exterior ceiling assembly to retain the insulation both on the access hatch, panel, or door and within the building thermal envelope.
Baffles	For air-permeable insulations in vented attics, a baffle must be installed adjacent to soffit and eave vents. Baffles, when used in conjunction with eave venting, must be constructed using a solid material, maintain an opening equal or greater than the size of the vents, and extend over the top of the attic insulation.
Ceiling or attic	The insulation in any dropped ceiling or dropped soffit must be aligned with the air barrier.

Narrow cavities	Batts to be installed in narrow cavities must be cut to fit or narrow cavities must be filled with insulation that upon installation readily conforms to the available cavity space.
Rim joists	Rim joists must be insulated such that the insulation maintain permanent contact with the exterior rim board.
Shower or tub adjacent to exterior wall	Exterior walls adjacent to showers and tubs must be insulated.
Walls	Air permeable exterior building thermal envelope insulation for framed exterior walls must completely fill the cavity, including within stud bays caused by blocking lay flats or headers.

§460.104 Building thermal envelope air leakage.

Manufactured homes must be sealed against air leakage at all joints, seams, and penetrations associated with the building thermal envelope in accordance with the component manufacturer's installation instructions and the requirements set forth in table 1 to 460.104. Sealing methods between dissimilar materials must allow for differential expansion, contraction and mechanical vibration, and must establish a continuous air barrier upon installation of all opaque components of the building thermal envelope. All gaps and penetrations in the exterior ceiling, exterior floor, and exterior walls, including ducts, flue shafts, plumbing, piping, electrical wiring, utility penetrations, bathroom and kitchen exhaust fans, recessed lighting fixtures adjacent to unconditioned space, and light tubes adjacent to unconditioned space, must be sealed with caulk, foam, gasket or other suitable material. The air barrier installation criteria are adapted from section R402 of the 2021 IECC.

Table 1 to § 460.104 Air Barrier Installation Criteria

COMPONENT	AIR BARRIER CRITERIA
Ceiling or attic	The air barrier in any dropped ceiling or dropped soffit must be aligned with the insulation and any gaps in the air barrier must be sealed with caulk, foam, gasket, or other suitable material. Access hatches, panels, and doors, drop-down stairs, or knee wall doors to unconditioned attic spaces must be weather-stripped or equipped with a gasket to produce a continuous air barrier.
Duct system register boots	Duct system register boots that penetrate the building thermal envelope or the air barrier must be sealed to the subfloor, wall

	covering or ceiling penetrated by the boot, air barrier, or the interior finish materials with caulk, foam, gasket, or other suitable material.
Electrical box or phone box on exterior walls	The air barrier must be installed behind electrical and communication boxes or the air barrier must be sealed around the box penetration with caulk, foam, gasket, or other suitable material.
Floors	The air barrier must be installed at any exposed edge of insulation. The bottom board may serve as the air barrier.
Mating line surfaces	Mating line surfaces must be equipped with a continuous and durable gasket.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope must be sealed to the drywall with caulk, foam, gasket, or other suitable material.
Rim joists	The air barrier must enclose the rim joists. The junctions of the rim board and the subfloor must be air sealed.
Shower or tub adjacent to exterior wall	The air barrier must separate showers and tubs from exterior walls.
Walls	The junction of the top plate and the exterior ceiling, and the junction of the bottom plate and the exterior floor, along exterior walls must be sealed with caulk, foam, gasket, or other suitable material.
Windows, skylights, and exterior doors	The rough openings around windows, exterior doors, and skylights must be sealed with caulk or foam.

Subpart C – HVAC, Service Hot Water, and Equipment Sizing

§460.201 Duct system.

Each manufactured home equipped with a duct system, which may include air handlers and filter boxes, must be sealed to limit total air leakage to less than or equal to four (4) cubic feet per minute per 100 square feet of conditioned floor area at a pressure differential of 0.1 inch w.g. (25 Pascals) across the system. Building framing cavities must not be used as ducts or plenums when directly connected to mechanical systems. The duct total air leakage requirements are adapted from section R403 of the 2021 IECC.

§460.202 Thermostats and controls.

(a) At least one thermostat must be provided for each separate heating and cooling system installed by the manufacturer. The thermostat and controls requirements are adapted from section R403 of the 2021 IECC.

(b) Any programmable thermostat installed by the manufacturer that controls the heating or cooling system must–

(1) Be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day and different days of the week;

(2) Include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55 °F (13 °C) or up to 85 °F (29 °C); and

(3) Initially be programmed with a heating temperature set point no higher than 70 °F (21 °C) and a cooling temperature set point no lower than 78 °F (26 °C).

(c) Heat pumps with supplementary electric-resistance heat must be provided with controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

§460.203 Service hot water.

(a) Service hot water systems installed by the manufacturer must be installed according to the service hot water manufacturer's installation instructions. Where service hot water systems are installed by the manufacturer, the manufacturer must ensure that any maintenance instructions received from the service hot water system manufacturer are provided with the manufactured home. The service hot water requirements are adapted from section R403 of the 2021 IECC.

(b) Any automatic and manual controls, temperature sensors, pumps associated with service hot water systems must provide access.

(c) Heated water circulation systems must–

(1) Be provided with a circulation pump;

(2) Ensure that the system return pipe is a dedicated return pipe or a cold water supply pipe;

(3) Not include any gravity or thermosyphon circulation systems;

(4) Ensure that controls for circulating heated water circulation pumps start the pump based on the identification of a demand for hot water within the occupancy; and

(5) Ensure that the controls automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water.

(d) All hot water pipes–

(1) Outside conditioned space must be insulated to a minimum *R*-value of *R*-3; and

(2) From a service hot water system to a distribution manifold must be insulated to a minimum *R*-value of *R*-3.

§460.204 Mechanical ventilation fan efficacy.

(a) Whole-house mechanical ventilation system fans must meet the minimum efficacy requirements set forth in table 1 to 460.204(a) , except as provided in paragraph (b) of this section. The mechanical ventilation fan efficacy requirements are adapted from section R403 of the 2021 IECC.

Table 1 to § 460.204(a). Mechanical Ventilation System Fan Efficacy

Fan Type Description	Airflow rate minimum (cfm)	Minimum Efficacy (cfm/watt)
Heat recovery ventilator or energy recovery ventilator	Any	1.2
In-line supply or exhaust fans	Any	3.8
Other exhaust fan	<90	2.8
Other exhaust fan	≥90	3.5

(b) Mechanical ventilation fans that are integral to heating, ventilating, and air conditioning equipment, including furnace fans as defined in § 430.2 of this subchapter, are not subject to the efficiency requirements in paragraph (a) of this section.

§460.205 Equipment sizing.

Sizing of heating and cooling equipment installed by the manufacturer must be determined in accordance with ACCA Manual S (incorporated by reference; see §460.3) based on building loads calculated in accordance with ACCA Manual J (incorporated by reference; see § 460.3). The equipment sizing criteria are adapted from section R403 of the 2021 IECC.

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