DRAFT ENVIRONMENTAL ASSESSMENT

FOR

Notice of Proposed Rulemaking, 10 CFR Part 460, "Energy Conservation Standards for Manufactured Housing"

WITH

REQUEST FOR INFORMATION ON IMPACTS TO INDOOR AIR QUALITY

(RIN 1904-AC11)

(DOE/EA-2021)

Prepared by the

U.S. Department of Energy

Office of Energy Efficiency and Renewable Energy

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ABBREVIATIONS AND ACRONYMS

ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.
CAIR	Clean Air Interstate Rule
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CO_2	carbon dioxide
CO	carbon monoxide
CSAPR	Cross-State Air Pollution Rule
D.C.	District of Columbia
DOE	Department of Energy
EA	environmental assessment
EGU	electric generating unit
EPA	Environmental Protection Agency
EUI	energy use intensity
FR	Federal Register
GHG	greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
kBtu	one thousand British thermal units
Hg	mercury
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act of 1969
NESHAP	national emissions standards for hazardous air pollutants
N_2O	nitrous oxide
NO_2	nitrogen dioxide
NO_X	nitrogen oxide
NRC	National Research Council
O_3	ozone
PM	particulate matter
SO_2	sulfur dioxide
SO_x	sulfur oxide gases
UNEP	United Nations Environment Programme
U.S.C.	United States Code
VOC	volatile organic compounds

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1 INTRODUCTION

1.1 National Environmental Policy Act

The U.S. Department of Energy (DOE) prepared this draft Environmental Assessment (EA) to evaluate the potential direct, indirect, and cumulative environmental impacts of establishing energy conservation standards for manufactured housing (the Proposed Action). In this Draft EA, DOE also evaluates the impacts that could occur if DOE were not to establish energy conservation standards for manufactured housing (the No Action Alternative) and an action alternative wherein DOE would adopt some, but not all, of the proposed energy conservation standards (the No Sealing Alternative). DOE prepared this Draft EA pursuant to the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 et seq.), the implementing regulations of the Council on Environmental Quality (CEQ) (40 CFR Parts 1500-1508), and DOE's regulations for implementing NEPA (10 CFR Part 1021).

In conjunction with issuance of this Draft EA for public review and comment, DOE is issuing a request for information that will help it analyze potential impacts on indoor air quality. See section 3.3.1.2 and chapter 4.

1.2 Background

Section 413 of the Energy Independence and Security Act of 2007 (EISA) directs DOE to establish energy conservation standards for manufactured housing. Section 413 further directs DOE to base its energy conservation standards on the most recent version of the International Energy Conservation Code (IECC) and any supplements to that document, 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 lifecycle construction and operating costs. See 42 U.S.C. 17071. In accordance with this statutory directive, DOE is proposing to establish energy conservation standards for manufactured housing.

During the development of the Proposed Rule, DOE consulted with the U.S. Department of Housing and Urban Development (HUD) and sought input from the manufactured housing community and the public. On February 22, 2010, 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. See 75 FR 7556. After considering the input received, DOE ultimately determined that development of proposed manufactured housing energy conservation standards would benefit from a negotiated rulemaking process. DOE initiated a negotiated rulemaking process by establishing the manufactured housing working group (MH working group), which consisted of representatives of interested stakeholders

The MH working group reached consensus on energy conservation standards in manufactured housing and provided its recommendations to DOE to develop the Proposed Rule. After considering the information provided by the MH working group, DOE developed the Proposed Rule that would establish energy conservation standards for manufactured housing.

DOE based the Proposed Rule on the negotiated consensus recommendations of the MH working group. The MH working group made recommendations to DOE based on the 2015 version of the

IECC (the 2015 IECC), the most recent version of the model industry energy conservation code that applies to residential site-built buildings. The MH working group made recommendations to DOE to adopt some of the 2015 IECC provisions directly into its Proposed Rule and to establish other standards, which are modifications of the 2015 IECC. The MH working group developed its recommendations based on the 2015 edition of the IECC, the impact of the 2015 IECC on the purchase price of manufactured housing, total lifecycle construction and operating costs, factory design and construction techniques unique to manufactured housing, and the current construction and safety standards set forth by HUD.

After developing the Proposed Rule, DOE published the Proposed Rule for public comment, along with a Public Meeting Notice. Please see the Proposed Rule for further information on the rulemaking process. http://energy.gov/eere/buildings/appliance-and-equipment-standards-program.

1.3 Purpose and Need

EISA directs DOE to establish energy conservation standards for manufactured homes. The establishment of energy conservation standards for manufactured homes can help to reduce national energy consumption, reduce outdoor pollutants, reduce the emissions of greenhouse gases that may lead to climate change, and reduce energy costs for manufactured housing homeowners.

Based on 2005 statistics, manufactured homes constitute about 6% of U.S. households and about 5% of U.S. residential energy consumption (DOE 2005). These same data show that on average manufactured homes consume more energy per unit floor area on an annual basis, 850 JM/m2 (75,0000 Btu/ft2), than detached homes, which consume 450 MJ/m2 (39,800 Btu/ft2). Given the smaller size of manufactured homes, the average energy consumption per household is about 74 GJ/y (70 MBtu/y) compared with 114 GJ/y (108 MBtu/y) for detached homes. Low energy manufactured homes have been constructed, with annual energy consumption as low as 52 MJ/y (49 MBtu/y) (Lubiner, Hadley et al. 2004). Therefore, while manufactured homes constitute a small fraction of the national housing stock, they also provide an opportunity for significant energy savings through improved design, construction and operation.

Establishing energy conservation standards for manufactured homes would also help reduce energy expenses for manufactured home owners. Manufactured home owners, on average, have a median annual income of $35,000, which is roughly $17,000 below the national average. Among households with very-low incomes (that is, less than 50 percent of area median), 23 percent of home-ownership growth between 1993 and 1999 came through manufactured housing. Nationwide, manufactured homes are a major source of unsubsidized, low-cost housing for many owners and renters with few housing alternatives (Apgar et al., 2002). Of the 540,000 affordably priced new units added to the housing stock from 1997 to 1999, two-thirds were manufactured units (Collins, Crowe and Carliner, 2000).

The Proposed Action would establish energy conservation standards for manufactured housing. These standards would meet the requirements mandated by EISA for DOE to establish standards, as well as meet the national goals of saving energy, reducing outdoor pollutants and greenhouse gases, and reducing energy costs for manufactured home owners.

1.4 Public Participation and Agency Consultation

DOE encourages public participation in the NEPA process. This Draft EA is being released for public review and comment on June 30, 2016. The public is invited to provide written comments by the close of the comment period on August 15, 2016. DOE is providing written notification of this Draft EA to the EERE Building Technology Office Group Stakeholder lists, though DOE welcomes input from any interested party. In preparing a final EA, DOE will consider all written comments received by the stated comment period deadline. The Draft EA is also available on the DOE website:

www.energy.gov/node/1840021

In additional to soliciting comments on the Draft EA, DOE is seeking information on the specific items set forth in Chapter 4.

Send comments to:

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2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This section describes the Proposed Action and alternatives.

2.1 Proposed Action

DOE's Proposed Action is to establish, for the first time, energy conservation standards for all new manufactured homes by adopting the energy efficiency recommendations of the MH working group, which are based on the 2015 IECC. The Proposed Action would include the specific recommendations found in Subpart B and C of the Proposed Rule. Currently the HUD building code (found at 245 CFR 280) sets forth certain building requirements that may be supplanted by the Proposed Action. Thus, the baseline for this analysis is the HUD code found at 24 CFR 280.

Subpart B of the Proposed Rule would require manufacturers to produce manufactured homes that, at a minimum, meet energy efficiency requirements related to climate zones and the building thermal envelope[1].

Section 460.101 would establish four climate zones within the U.S.

Section 460.102 would establish requirements related to the building thermal envelope. Under this section manufacturers would have two options for compliance; the prescriptive option or the performance option. The prescriptive approach would establish specific component R-value, U-factor, and solar heat gain coefficient (SHGC) requirements, providing a straightforward option for construction planning. The performance approach would allow a manufacturer to use a variety of materials with various thermal properties so long as the building thermal envelope achieved a required level of overall thermal performance. The proposed performance-based requirements would be functionally equivalent to the prescriptive-based requirements in that both options would result in manufactured homes with approximately the same amount of energy use. Table 1 identifies the proposed thermal envelope prescriptive requirements.

Table 1: Proposed Building Thermal Envelope Prescriptive Requirements

Climate Zone	Ceiling R-value	Wall R-value	Floor R-value	Window U-factor	Skylight U-factor	Door U-factor	Glazed Fenestration SHGC
1	30	13	13	0.35	0.75	0.40	0.25
2	30	13	13	0.35	0.75	0.40	0.33
3	30	21	19	0.35	0.55	0.40	0.33
4	38	21	30	0.32	0.55	0.40	No Rating

Section 460.103 would establish requirements regarding the installation of insulation. Manufacturers would be required to install insulation in accordance with insulation manufacturer's installation instructions. In addition, Section 460.103 would include specific

[1] Subpart B includes Sections 460.101-460.104 of the Proposed Rule.

requirements for insulation installation in the following locations: near access hatches, panels, doors between conditioned space and unconditioned space, adjacent top baffles, ceilings, attics, floors, wall cavities, narrow cavities, rim joists, and exterior walls adjacent to showers and tubs.

Section 460.104 would establish both general and specific requirements for sealing a manufactured home to prevent air leakage. The general requirements in section 460.104 require that manufacturers properly 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. Section 460.104 would establish specific sealing requirements for: ceilings or attics, duct system register boots, recessed lighting, windows, skylights, exterior doors walls, floors, electrical boxes or phone boxes on exterior walls, mating line surfaces[2], rim joists, and showers or tubs adjacent to exterior walls.

In addition, the Proposed Action, in Subpart C of the Proposed Rule, would establish requirements related to duct leakage, heating, ventilation and air conditioning (HVAC), service hot water systems, mechanical ventilation fan efficacy, and heating and cooling equipment size[3].

Section 460.201 would require manufacturers to equip each manufactured home with a duct system designed to limit total air leakage to less than or equal to four cubic feet per minute per 100 square feet of conditioned floor area.

Section 460.202 would mandate specific requirements for number and types of thermostats.

Section 460.203 would require manufacturers to install service water heating systems according to the service water heating system manufacturer's installation instructions. In addition, this section would require that automatic controls, temperature sensors, and pumps related to service water heating must be accessible and that manual controls be readily accessible; that homeowners have adequate control over service water heating equipment; and, that all pipes outside conditioned space, and all hot water pipes from a water heater to a distribution manifold be insulated to at least R-3.

Section 460.204 includes requirements for mechanical ventilation system fan efficacy.

Section 460.205 sets forth specifications on the appropriate sizing of heating and cooling equipment within a manufactured home.

Table 2 present a crosswalk between the Proposed Action and the existing baseline.

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[2] A mating line surface is the area of connection between two sections of a multi-section manufactured home. This requirement is designed to ensure that multi-section manufactured homes have a continuous air barrier.

[3] Subpart C includes Sections 460.201-205 of the Proposed Rule.

Table 2: Crosswalk of Proposed Action and Existing Baseline

Proposed Action (Reference to DOE Proposed Rule 10 CFR Part 460)	No Action Alternative (Existing Baseline) (Reference to Existing HUD Requirements Applicable to Manufactured Housing--24 CFR Part 3280)
§ 460.101 would establish four climate zones, which would be delineated by home size and both state and county boundaries.	§ 3280.506 establishes three climate zones delineated by state boundaries, and one standard for homes of all sizes within a climate zone.
§ 460.102(a) would establish building thermal envelope prescriptive and performance compliance options.	§ 3280.506 establishes a performance approach.
§ 460.102(b) would set forth the prescriptive option for compliance with the building thermal envelope requirements.	§ 3280.506 establishes a performance approach only.
§ 460.103(b)(2) would establish a minimum truss heel height.	No corresponding requirement
§ 460.103(b)(3) would require ceiling insulation to have uniform thickness and density.	No corresponding requirement.
§ 460.103(b)(4) would establish an acceptable batt and blanket insulation combination for compliance with the floor insulation requirement in climate zone 4.	No corresponding requirement.
§ 460.103(b)(5) would identify certain skylights not subject to SHGC requirements.	No corresponding requirements.
§ 460.102(b)(6) would establish U-factor alternatives for the R-value requirements under § 460.102(b)(1).	No corresponding requirements.
§ 460.102(b)(7) would establish a maximum ratio of 12 percent for glazed fenestration area to floor area under the prescriptive option.	No corresponding requirements.
§ 460.102(c)(1) would establish maximum building thermal envelope U_o requirements by home size and climate zone.	§ 3280.506(a) establishes maximum building thermal envelope U_o requirements by climate zone.
§ 460.102(c)(2) would establish maximum area-weighted vertical fenestration U-factor requirements in climate zones 3 and 4	No corresponding requirements.
§ 460.102(c)(3) would establish maximum area-weighted average skylight U-factor requirements in climate zones 3 and 4.	No corresponding requirements.
§ 460.102(c)(4) would authorize windows, skylights and 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.	No corresponding requirements.
§ 460.102(d)(3) would establish a method of determining total R-value where multiple layers comprise a component.	§ 3280.508(a) and (b) reference the Overall U-values and Heating/Cooling Loads—Manufactured Homes method and the 1997 ASHRAE Handbook of Fundamentals.
§ 460.102(d)(6) would establish prescriptive default U-factor values.	§ 3280.508(a) and (b) reference the Overall U-values and Heating/Cooling Loads—Manufactured Homes method and the 1997 ASHRAE Handbook of Fundamentals.
§ 460.102(d)(8) would establish prescriptive default U-factor values	No corresponding requirements.
§ 460.102(e)(1) would establish a method of determining U_o.	§ 3280.508(a) and (b) reference the Overall U-values and Heating/Cooling Loads—Manufactured Homes

	method and the 1997 ASHRAE Handbook of Fundamentals.
§ 460.102(e)(3) would establish default fenestration and door U-factor and fenestration SHGC values.	§ 3280.508(a) and (b) reference the Overall U-values and Heating/Cooling Loads—Manufactured Homes method and the 1997 ASHRAE Handbook of Fundamentals. These references contain default values.
§ 460.103(a) would require insulating materials to be installed according to the manufacturer installation instructions and the prescriptive requirements of Table 460.103.	No corresponding requirements.
§ 460.103(b) would establish requirements for the installation of batt, blanket, loose fill, and sprayed insulation materials.	No corresponding requirements.
§ 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.	§ 3280.505 establishes air sealing requirements of building thermal envelope penetrations and joints.
§ 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 when tested according to § 460.201(b) and specifies that building framing cavities are not to be used as ducts or plenums.	§ 3280.715(a)(4) establishes requirements for airtightness of supply duct systems.
§ 460.202(a) would require at least one thermostat to be provided for each separate heating and cooling system installed by the manufacturer.	§ 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.
§ 460.202(b) would require that installed thermostats controlling the primary heating or cooling system be capable of maintaining different set temperatures at different times of day.	No corresponding requirements.
§ 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.	§ 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.
§ 460.203(a) would establish requirements for the installation of service water heating systems.	No corresponding requirements.
§ 460.203(b) would require any automatic and manual controls, temperature sensors, pumps associated with service water heating systems to be accessible.	No corresponding requirement.
§ 460.203(c) would establish requirements for heated water circulation systems.	No corresponding requirements.

§ 460.203(d) would establish requirement for the insulation of hot water pipes.	No corresponding requirements.
§ 460.204 would establish requirements for mechanical ventilation system fan efficacy.	No corresponding requirements.
§ 460.205 would establish requirements for heating and cooling equipment sizing.	No corresponding requirements.

2.2 No Action Alternative

Under the No Action Alternative, DOE would not adopt a rule establishing energy conservation standards for manufactured housing. The standards for manufactured housing would remain at current, or baseline, levels established in the HUD Code. See Table 2 above. The environmental effects identified in the EA may still occur if more manufacturers voluntarily seek to build manufactured homes that are more energy efficient than required under current standards, but those impacts would not be the result of a DOE action. However, for purposes of providing a comparative analysis of the current baseline and the anticipated environmental consequences of the action alternatives, the EA presumes there would be no changes to environmental impacts on indoor air quality, energy usage, or emissions if DOE adopted the No Action Alternative.

2.3 No Sealing Alternative

Under the No Sealing Alternative, all aspects of the Proposed Action are preserved, except for the prescriptive requirements for sealing of the building, found in Section 460.104. Under the No Sealing Alternative DOE would not adopt any requirements relating to sealing a manufactured home to prevent air leakage.

3 AFFECTED ENVIRONMENT AND IMPACTS

This section describes the existing environmental setting for environmental resources with potential to be affected by the Proposed Action and the No Sealing Alternative, as well as provides the potential environmental impacts to resource areas that may result from implementing the Proposed Action, the No Sealing Alternative, and the No Action Alternative. Resource areas evaluated and not carried forward for detailed analysis are also identified. The Proposed Action and the No Sealing Alternative would apply to all 50 states and U.S. territories.

3.1 Environmental Consequence of the No Action Alternative

Under the No Action Alternative, DOE would not establish energy conservation standards for manufactured homes. Therefore, there would be no direct, indirect, or cumulative impacts to the environment and resources discussed in this Draft EA from activities related to the Proposed Action. The expected reductions in fossil fuel generated energy pollutant emissions realized by the action alternatives would not be realized under the No Action Alternative.

3.2 Environmental Resources Evaluated and Dismissed from Detailed Analysis

Consistent with NEPA implementing regulations and guidance, DOE focused the analysis in this Draft EA on topics with the greatest potential for environmental impacts (40 CFR 1502.2(b)). Table 3 presents DOE's evaluations of the environmental resource areas on which the Proposed Action and No Sealing Alternative would not be expected to have any measurable effects. These resource areas were not carried forward for detailed analysis.

Table 3: Resource Areas Not Carried Forward for Detailed Analysis

Resource Area	Considerations
Sensitive Ecosystems	• Action alternatives are not site specific
Geology and Soils	• Action alternatives are not site specific
Wetlands and Floodplains	• Action alternatives are not site specific
Prime Agricultural Lands	• Action alternatives are not site specific
Historic, Cultural or Archeological Resources	• Action alternatives are not site specific
Species, including Threatened and Endangered Species	• Action alternatives are not site specific • Action alternatives reduce pollutant emissions
Solid Waste Management	• Action alternatives do not impact waste generation
Hazardous Materials and Hazardous Waste[4]	• No hazardous materials used or produced as result of action alternatives
Intentionally Destructive Acts	• Action alternatives are not site specific

[4] Manufactured Homes may contain certain materials which would be considered pollutants or contaminants, as discussed in section 3.3.1.1. However, no additional hazardous materials would be generated as a result of this Proposed Action or the Action Alternative, and thus the generation of hazardous materials or wastes is not carried forward for additional analysis.

3.3 Environmental Resources Carried Forward for Analysis

This section of the draft EA describes the affected environment and analyzes the environmental impacts of the Proposed Action and No Sealing Alternative on the following resource areas.

- Indoor Air
- Outdoor Air
- Socioeconomic and Environmental Justice
- Climate Change

3.3.1 Indoor Air

Indoor air quality, and specifically building habitability, is a resource area with possible impacts from the Proposed Action and No Sealing Alternative. In developing its recommendations, the MH working group identified concerns regarding the potential impacts of some of the recommendations on the indoor air quality in manufactured homes. However, the MH working group determined it could not consider potential impacts to indoor air quality when making their recommendations because the means for addressing the issue (change in mechanical ventilation standards) was outside of their scope. (See, October 1, 2014 and October 31, 2014 transcripts of MH working group).

3.3.1.1 Affected Environment

According to the 2007 American Housing Survey (AHS), 8.7 million manufactured homes account for 6.3% of the 128.3 million housing units in the United States and house 17.2 million people (U.S. Census Bureau 2007, 2008). The main sources of indoor air pollutants in manufactured homes, and in site-built homes as well, are furnishings within a building (e.g., carpet, furniture), building materials (e.g., insulation material, pressed wood materials, paints, adhesives), the ground (e.g., radon), the building occupants' indoor activities (e.g., tobacco smoking, painting), fossil fuel appliances (e.g. gas stoves, gas water heaters), and wood stoves and fireplaces. The primary indoor air pollutants that can adversely affect human health in typical manufactured homes are particulate matter (PM), carbon monoxide (CO), carbon dioxide ($CO_{2)}$, nitrogen dioxide (NO_2), radon, formaldehyde, volatile organic compounds (VOCs), and biological contaminants. Fossil-fuel-burning appliances (including gas stoves/ovens) and, if allowed, tobacco smoke, are the main sources of combustion products. Potential combustion emissions include CO, CO_2, NO_X, and SO_2. While pollutant levels from individual sources may not pose a significant health risk by themselves, most manufactured homes have more than one source that contributes to indoor air pollution (EPA, 2015g). There can be a serious risk from the cumulative effects of these sources (EPA, 2015g). In addition to internal sources of pollutants, pollutants entrained in outdoor air, particularly vehicle exhaust, can enter into the manufactured home through leaks in the building envelope or outdoor air inlets.

Poor indoor air quality is connected with a range of undesirable health effects, such as respiratory diseases, neurodevelopmental problems for children, increased cancer risks, and asthma symptoms (CDC, Safety and Health in Manufactured Structures, 2011). Groups that are more likely to be adversely affected by air pollution, such as infants, the elderly, and the infirm are indoors a greater proportion of the time than the general public (Sexton, 1993). Even low

concentrations of air pollutants can be injurious to long-term health because exposure to indoor pollutants is more frequent and more prolonged than is ambient air exposure (Smith, 1993). "The confined spaces of manufactured structures, and in some cases lower ventilation and air exchange rates, can make indoor air quality a concern in manufactured homes," (CDC, Safety and Health in Manufactured Structures, 2011, at page 5).

Table 4 summarizes the principal indoor air pollutants that can potentially be of concern within manufactured homes.

Table 4: Indoor-Air Pollutants in Manufactured Homes

Pollutant	Potential Health Impacts	Sources
Particulate Matter	Bronchitis and respiratory infections. Eye, nose, and throat irritations.[|]	Combustion, dust.[|]
Carbon Monoxide	CO is an odorless and colorless gas that is an asphyxiate and disrupts oxygen transport. At high concentration levels, CO causes loss of consciousness and death.[°]	Unvented kerosene and gas space heaters; leaking chimneys and furnaces; back drafting from furnaces, gas water heaters, wood stoves, and fireplaces; gas stoves; and automobile exhaust.
Carbon Dioxide	An excessive concentration of CO_2 triggers increased breathing to maintain the proper exchange of oxygen and CO_2. Exposure to concentrations of CO_2 in air of 5% for 30 minutes can cause symptoms of intoxication, and exposure to concentrations of 7% to 10% for few minutes can cause loss of consciousness.[*]	Human respiration, tobacco smoking, gas stoves, and gas ovens.
Nitrogen Dioxide	Short term exposure to NO_2 is linked with negative respiratory effects including inflammation of airways and increased symptoms of those with asthma.[**]	Kerosene heaters, gas stoves, ovens, and tobacco smoke.
Radon	Radon in breathed air can deposit and stay in the lungs, contributing to lung cancer. Radon is the leading cause of lung cancer in non-smokers.[†]	Radon is a radioactive gas that occurs in nature and comes from the decay of uranium that is found in soil.[††]
Formaldehyde	The EPA has classified formaldehyde as a probable human carcinogen. In low concentration levels, formaldehyde irritates the eyes and mucous membranes of the nose and throat. Formaldehyde can cause watery eyes; burning sensations in the eyes, nose, and throat; nausea; coughing; chest tightness; wheezing; skin rashes; and allergic reactions.[°]	Various pressed-wood products can emit formaldehyde, including particle board, plywood, pressed wood, paneling, some carpeting and backing, some furniture and dyed materials, urea-formaldehyde insulating foam, and pressed textiles.[°°]
Volatile organic compounds (VOCs)	VOCs can cause a wide variety of health problems. Some examples of potential health effects include increased cancer risks, depression of the central nervous system, irritation to the	VOCs are emitted from a variety of products including paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids

Pollutant	Potential Health Impacts	Sources
	eyes and respiratory tract, and liver and kidney damage.‡	and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions.‡
Biological Contaminants	Many biological pollutants are small enough to be inhaled and can cause allergic reactions as well as infectious illnesses. Molds and mildews in particular release disease-causing toxins. Symptoms of health problems include sneezing, watery eyes, coughing, shortness of breath, dizziness, lethargy, fever, and digestive problems.‡‡	Common biological pollutants include mold; dust mites; pet dander; droppings and body parts from cockroaches, rodents and other pests; viruses; and bacteria. These contaminants are typically found in damp or wet areas such as humidifiers, condensate pans, or unvented bathrooms as well as in areas where dust accumulates.‡‡

| U.S. Environmental Protection Agency. Particulate Matter | Air & Radiation | US EPA. at <https://www3.epa.gov/pm/>
° U.S. Environmental Protection Agency. Carbon Monoxide | Air & Radiation | US EPA. at <https://www3.epa.gov/airquality/carbonmonoxide/>
* CDC - Immediately Dangerous to Life or Health Concentrations (IDLH): Carbon dioxide. at <http://www.cdc.gov/niosh/idlh/124389.html>
** U.S. Environmental Protection Agency. Health | Nitrogen Dioxide | US EPA. at <http://www.epa.gov/air/nitrogenoxides/health.html>
† U.S. Environmental Protection Agency. Radon Health Risks. at <http://www.epa.gov/radon/healthrisks.html>
†† U.S. Environmental Protection Agency. EPA's Radon Program Home Page. at <http://www.epa.gov/radon/?_ga=1.96254044.1118407248.1426515419>
▫ U.S. Environmental Protection Agency. Formaldehyde. at <http://www2.epa.gov/formaldehyde>
▫▫ U.S. Consumer Product Safety Commission. *An Update on Formaldehyde*. (Washington, DC, 2015).
‡ U.S. Environmental Protection Agency. An Introduction to Indoor Air Quality: Volatile Organic Compounds (VOCs). at <http://www.epa.gov/iaq/voc.html>
‡‡ U.S. Environmental Protection Agency. An Introduction to Indoor Air Quality: Biological Pollutants. at <http://www.epa.gov/iaq/biologic.html>

While no comprehensive data are available on the quality of air in manufactured homes, several studies have addressed indoor air quality in manufactured homes to a limited extent. Studies have addressed specific contaminants, overall indoor air quality and pollutant concentrations, and building tightness[5]. It is generally accepted that air leakage[6] alone is not enough to ensure

[5] For example, multiple studies have examined formaldehyde concentrations, generally from building materials, in manufactured and site-built homes (Liu et al., 1991; CDC et al., 2008; Offerman 2009)

[6] Air leakage, or natural infiltration, refers to passive ventilation of air into and out of the building. "Passive ventilation takes place naturally through windows, doors, and other air leakage sites," (GAO, 2012).

adequate indoor air quality and that appropriate mechanical ventilation[7] is necessary to remove pollutants and ensure adequate indoor air quality in all homes, including manufactured homes[8] (ASHRAE 2014, DOE 2015). It is also accepted that manufactured homes with relatively less air circulation may develop higher levels of indoor contaminants (CDC, 2011). Many studies and reports have addressed the importance of appropriate mechanical ventilation in all homes, including manufactured homes, confirming the importance of "build tight, ventilate right"[9].

3.3.1.2 Impacts of Proposed Action

In analyzing the impacts of the Proposed Action, DOE examined how the Proposed Action would impact indoor air quality as compared to the baseline indoor air quality conditions in manufactured homes. The analysis below considers both the role of air leakage and mechanical ventilation. It is generally accepted that indoor air quality and building energy performance are substantially linked because indoor air quality often improves with increased mechanical ventilation (ASHRAE, 2014). Generally speaking, the tighter the thermal envelope of a home, the less air leakage that occurs, so mechanical ventilation is the technique used to make air exchange occur. However, while indoor air quality and building energy performance are linked, it is difficult to analyze the anticipated impacts of the Proposed Action due to lack of specific data regarding how the Proposed Action would impact indoor air quality. In addition, since no Federal agency or program regulates contaminants as they apply to air quality in residential buildings, the lack of agreed upon standards for levels of exposure in residential buildings, both in concentration levels of pollutants and time of exposure of occupants, makes it difficult to draw conclusions about the extent of the impacts.

While the Proposed Action would seal manufactured homes more tightly than the No Action Alternative, it is not anticipated that the Proposed Action would change the sources of pollutants within a manufactured home, including sources or types of building materials. The Proposed Action establishes thermal envelope requirements under section 460.102, but does not mandate how manufacturers would achieve those requirements. Thus, while the type of building materials used to construct manufactured homes may not change under the Proposed Action, the quantity of some materials may change as manufacturers increase materials in order to achieve the thermal envelope requirements of 460.102. For example, more insulation material may be used to meet the building thermal envelope requirements under the Proposed Action than would be used under the No Action Alternative. Therefore, a manufactured home compliant with the Proposed Action may contain an increased amount of construction materials. If those materials outgas[10] or otherwise contribute pollutants to the indoor air, an increase in materials could lead to

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[7] Mechanical ventilation refers to active ventilation of air into and out of the building. "Mechanical ventilation uses fans and ducts to bring fresh air into the home or draw contaminated air to the outdoors," (GAO, 2012).

[8] Mechanical ventilation rates for manufactured homes are regulated by HUD at 24 CFR 3280.

[9] See, for example, Burch, 1993; Hales, 2007; Offerman, 2009; GAO 2012; ASHRAE, 2014; DOE, 2015.

[10] Some construction materials may outgas contaminants. Such materials could include, for example, certain paints, wood products, and certain spray foam insulation. See, for example, https://www.epa.gov/saferchoice/spray-polyurethane-foam-spf-insulation-and-how-use-it-more-safely.

an increase in indoor air pollutants. Any increase will depend on the materials chosen for construction, as well as their method of installation.

In addition, because the Proposed Action would seal manufactured homes more tightly than the No Action Alternative, outdoor pollutants, such as car exhaust, may be less likely to enter the manufactured home.

The Proposed Action would mandate prescriptive sealing requirements under Section 460.104, the effect of which would be to create a tighter building envelope and reduce air leakage relative to the existing baseline condition. MH working group members estimated that the measures in the Proposed Action would achieve a maximum building thermal envelope air leakage rate of five air changes per hour (ACH) when measured using a blower door test at a pressure differential of 50 pascals (ACH50). Based on discussions with the MH working group, DOE has assumed in this analysis that a typical manufactured home compliant with existing requirements has an air leakage rate of eight ACH50[11]. Therefore, the Proposed Action would seal manufactured homes more tightly by decreasing the amount of air exchange via air leakage relative to the No Action Alternative.

The Proposed Action is expected to reduce air leakage. However, any resulting impacts to indoor air quality are difficult to quantify, as air leakage is heavily dependent on weather, location, climate, elevation, time of day, etc. The National Institute of Standards and Technology (NIST) conducted modeling research to evaluate ventilation requirements for future revisions to HUD's Manufactured Housing Construction and Safety Standards (Persily, 2000). The modeling found that the air leakage rates vary by as much as five times, based on variations in weather conditions.

Air leakage alone, without any mechanical ventilation, could not provide adequate ventilation in tightly sealed homes (Persily, 1998). Thus, the amount of mechanical ventilation in a home will influence indoor air quality. Mechanical ventilation involves a system of fans and/or ducts to intake and distribute fresh air and expel stale air and pollutants, and is a required system on all manufactured homes. Some mechanical ventilation systems may be integrated into the heating and cooling system, while others may consist of a central ceiling exhaust fan. Mechanical ventilation is more stable than air leakage rates because mechanical ventilation is not significantly influenced by weather; however, some systems are dependent upon the homeowner to turn on the ventilation system[12]. If the homeowner does not turn on the system, or runs the system only intermittently, mechanical ventilation may not adequately ventilate a home.

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[11] Existing requirements for sealing can be found in the HUD regulations at 24 CFR 3280.505(a).

[12] A study of 105 manufactured homes built and sited in the Pacific Northwest in 2000 and 2001, found that 30% of occupants do not turn on their whole house fans (often a major component in mechanical ventilation systems), which may have health implications (Davis, et al., 2001).

The 2015 IECC requires, for site-built homes, the use of the International Residential Code (IRC) or International Mechanical Code (IMC) or other approved means of ventilation[13]. While the Proposed Action mandates air sealing requirements based on the 2015 IECC which may reduce air leakage, the Proposed Action does not address mechanical ventilation[14]; existing mechanical ventilation requirements would remain in place[15]. Because the Proposed Action mandates sealing a manufactured home tighter than existing conditions, without any change to existing mechanical ventilation requirements, the Proposed Action may decrease the total amount of ventilation in a manufactured home. A potential decrease in total ventilation may be of concern, as ventilation may remove some air pollutants from the indoor environment of a manufactured home. To the extent that there are sources of pollutants within a given manufactured home, the proposed air leakage requirements may also lead to increased time-averaged pollutant concentrations and exposure levels for occupants.

Differences exist among existing manufactured housing mechanical ventilation requirements, which will remain in place under the Proposed Action, and those referenced in the 2015 IECC upon which the Proposed Action is based. Those differences may be important in determining the extent the Proposed Action would impact indoor air quality[16].

These factors and potentially others currently limit DOE's ability to analyze the potential impacts of the Proposed Action on indoor air quality, including potential epidemiological (population-level) impacts to occupant health, in this Draft EA. DOE has previously sought the missing information or information from which it could extrapolate relevant data. On June 25, 2013 DOE issued a request for information (RFI) regarding "data, studies, and other such materials that address the relationship between potential reductions in levels of natural air infiltration and both indoor air quality and occupant health for a manufactured home.[17]" 78 FR 37995. DOE has conducted a literature review and determined specific data regarding the missing information is not available.

In conjunction with issuance of this Draft EA for public review and comment, DOE is issuing a second RFI that seeks information to help it analyze potential impacts on indoor air quality. See

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[13] The 2015 IECC was developed by the International Code Council (ICC), an independent organization whose mission is to provide the highest quality codes, standards, products and services for all concerned with the safety and performance of the built environment. The ICC develops codes through a government consensus process and by convening a committee composed of building science professionals, state officials, licensed engineers and architects, health safety representatives, and members of the general public with a diverse range of expertise and varying degrees of professional credentials.

[14] Section 460.04 addresses system (fan) efficacy but does not address actual mechanical ventilation requirements.

[15] Existing requirements for mechanical ventilation can be found in the HUD Code at 24 CFR 3280.103(b).

[16] For example, differences include accounting for occupancy rates, home size, number of bedrooms, and accounting for intermittent use versus continuous use of a system. See, Davis, et al., 2001; DOE, 2011a; CDC, 2011 Lawrence Berkeley National Laboratory, 2015.

[17] DOE received five responses to the RFI, though none sited specific data or studies.

chapter 4. DOE will consider responses to this RFI along with comments on this Draft EA in determining how to proceed with its analysis of potential environmental impacts. As part of its analysis, DOE will consider the applicability of a provision in the CEQ regulations regarding incomplete or unavailable information (40 CFR 1502.22). Though this provision refers to preparation of an environmental impact statement, the approach also is relevant to the preparation of EAs. Under the CEQ regulations, an agency shall clearly state if there is incomplete or unavailable information, and the agency shall include such information if it is essential to a reasoned choice among alternatives and if the overall costs of obtaining it are not exorbitant. If it is not possible to obtain the information because the overall costs of obtaining it are exorbitant or the means to obtain the information are not known, the agency must, for example, describe the relevance of the information, summarize existing relevant credible scientific evidence and evaluate reasonably foreseeable significant adverse impacts based upon theoretical approaches or research methods generally accepted in the scientific community. 40 CFR 1502.22(b).

3.3.1.3 Impacts of No Sealing Alternative

The No Sealing Alternative would not mandate the sealing requirements of Section 460.104 of the Proposed Rule. Because this alternative does not require building the manufactured home tighter than the No Action Alternative, DOE has determined that impacts to indoor air quality caused by sealing the building may be minimally different from the baseline condition.

While the No Sealing Alternative would not include the prescriptive sealing requirements of the Proposed Action, the No Sealing Alternative would include all other requirements of the Proposed Action. Therefore, a manufactured home compliant with the No Sealing Alternative may contain an increased amount of construction materials, such as insulation, as discussed in connection with the Proposed Action. Consequently, the amount of potential pollutants within a manufactured home may increase, potentially impacting indoor air quality. (See discussion of section 460.102 of the Proposed Action in 3.3.1.2 above). Any such change in indoor air quality would depend on the materials chosen for construction, as well as their method of installation.

3.3.2 Outdoor Air

Outdoor air quality is a resource area with possible impacts from the Proposed Action and the No Sealing Alternative. Specifically, impacts would include changes in pollutant emissions due to changes in fossil fuel generated energy use associated with operation of the manufactured home.

3.3.2.1 Affected Environment

An air pollutant is any substance in the air that can cause discomfort or harm to humans or the environment. Pollutants may be natural or man-made (*i.e.,* anthropogenic), and may take the form of solid particles (*i.e.,* particulates or particulate matter), liquid droplets, or gases.[18]

The generation of electricity from fossil fuels results in emission of air pollutants and is the largest source of U.S. greenhouse gas (GHG) emissions. According to DOE's Buildings Energy Data Book, U.S. buildings account for 39 percent of primary energy consumption and 72 percent

[18] More information on air pollution characteristics and regulations is available on EPA's website at www.epa.gov.

of all electricity consumed domestically. Moreover, in 2010, residential buildings account for 22.07 quads of primary energy consumption, or 22.5% of total primary energy consumption in the U.S. The DOE Buildings Energy Data Book indicates that in 2010, total site CO_2 emissions associated with residential buildings are expected to total 1231 million metric tons. Buildings accounted for more energy use than the entire U.S. transportation sector in 2006 and produced more greenhouse gases than any other country in the world except China. The two most common sources of energy for buildings are electricity and direct consumption of natural gas and petroleum for heating and cooking. Electricity accounts for approximately 78 percent of total building energy consumption and contributes to GHG emissions. According to EPA, GHG emissions from electricity have increased by about 18 percent since 1990, as the demand for electricity has grown and fossil fuel has remained the dominant source for generation. In addition, U.S. buildings account for nearly 40 percent of the nation's man-made CO_2 emissions, 18 percent of the NOx emissions, and 55 percent of the SO_2 emissions. These emissions in turn contribute to smog, acid rain, haze, and global climate change. Improving the efficiency of the nation's buildings can play a role in reducing air pollution (Park, 2013).

Because the action alternatives would impact energy usage, they would also impact levels of emissions of air pollutants that are emitted as a result of energy production. This Draft EA considered the following outdoor air pollutants: CO_2, NO_X, Hg, SO_2, CH_4, and N_2O. This section describes these pollutants as well as relevant regulations that control the emission of these pollutants.

Carbon Dioxide. CO_2 is of interest because of its classification as a greenhouse gas (GHG). GHGs trap the sun’s radiation inside the Earth’s atmosphere and either occur naturally in the atmosphere or result from human activities. Naturally occurring GHGs include water vapor, CO_2, CH_4, N_2O, and ozone (O_3). Human activities, however, add to the levels of most of these naturally occurring gases. For example, CO_2 is emitted to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), wood, and wood products are burned. In 2013, 93.7 percent of anthropogenic CO_2 emissions resulted from burning fossil fuels (EPA 2015d).

Concentrations of CO_2 in the atmosphere are naturally regulated by numerous processes, collectively known as the “carbon cycle.” The movement of carbon between the atmosphere and the land and oceans is dominated by natural processes, such as plant photosynthesis. While these natural processes can absorb some of the anthropogenic CO_2 emissions produced each year, billions of metric tons are added to the atmosphere annually. In the United States, in 2013, CO_2 emissions from electricity generation accounted for nearly 40 percent of total U.S. GHG emissions (EPA 2015d).

Nitrogen Oxides. Nitrogen oxides is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen. In the context of air pollution, nitrogen oxide generally refers to the gases NO and NO_2, abbreviated as NO_X. Many of the nitrogen oxides are colorless and odorless. However, one common pollutant, NO_2, along with particles in the air, can often be seen as a reddish-brown layer over many urban areas. In the atmosphere, NO_X gases react to form smog and acid rain, impairing visibility in areas such as national parks, as well as contribute significantly to the formation of tropospheric, or ground-level, ozone, which can trigger serious respiratory problems. NO_X also contributes to the formation of fine particles that can harm human health (EPA 2015b).

NO_X gases generally form in combustion systems via the reaction of nitrogen and oxygen at high temperatures. The primary manmade sources of NO_X are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fossil fuels. NO_X can also be formed naturally. Electric utilities account for about 22 percent of NO_X emissions in the United States.

Mercury. Coal-fired power plants emit Hg found in coal during the burning process. Coal-fired power plants are the largest remaining source of human-generated Hg emissions in the United States (EPA 2015c). U.S. coal-fired power plants emit Hg in three different forms: oxidized Hg (likely to deposit within the United States); elemental Hg, which can travel thousands of miles before depositing to land and water; and Hg that is in particulate form. Atmospheric Hg is deposited on land, lakes, rivers, and estuaries through rain, snow, and dry deposition. Once there, it can transform into methylmercury and accumulate in fish tissue through bioaccumulation.

Americans are exposed to methylmercury primarily by eating contaminated fish. Women of childbearing age are regarded as the population of greatest concern because the developing fetus is the most sensitive to the toxic effects of methylmercury. Children exposed to methylmercury before birth may be at increased risk of poor performance on neurobehavioral tasks, such as those measuring attention, fine motor function, language skills, visual-spatial abilities, and verbal memory (Trasande et al. 2006).

Sulfur Dioxide. SO_2 belongs to the family of sulfur oxide gases (SO_X). These gases dissolve easily in water. Sulfur is prevalent in all raw materials, including crude oil, coal, and ore that contains common metals like aluminum, copper, zinc, lead, and iron. SO_X gases are formed when fuel containing sulfur, such as coal and oil, is burned, and when gasoline is extracted from oil or metals are extracted from ore. SO_2 dissolves in water vapor to form acid, and interacts with other gases and particles in the air to form sulfates and other products that can be harmful to people and their environment (EPA 2015a).

Methane. CH_4 emissions are primarily from human-related sources, not natural sources. U.S. CH_4 emissions come from three categories of sources, each accounting for about one-third of total emissions: (1) energy sources, (2) emissions from domestic livestock, and (3) decomposition of solid waste in landfills. The CH_4 emitted from energy sources occurs primarily during the production and processing of natural gas, coal, and oil; not in the actual use (combustion) of these fuels. CH_4 is the primary ingredient in natural gas, and production, processing, storage, and transmission of natural gas account for 60 percent of the energy source emissions (or 25 percent of all CH_4 emissions) (DOE 2011).

Nitrous Oxide. N_2O emission rates are more uncertain than those for CO_2 and CH_4, with nitrogen fertilization of agricultural soils being the primary human-related source. Fuel combustion is also a source of nitrous oxide; however, in the commercial and residential sector total emissions are a negligible amount of all U.S. emissions (DOE 2011).

Outdoor Air Quality Regulation

The Clean Air Act Amendments of 1990 list 188 toxic air pollutants that EPA is required to control (EPA 1990). EPA has set national air quality standards for six common pollutants (also

referred to as "criteria" pollutants), two of which are SO_2 and NO_X. Also, the Clean Air Act Amendments of 1990 gave EPA the authority to control acidification and to require operators of electric power plants to reduce emissions of SO_2 and NO_X. Title IV of the 1990 amendments established a cap-and-trade program for SO_2, in all 50 states and the District of Columbia (D.C.), intended to help control acid rain. This cap-and-trade program serves as a model for more recent programs with similar features.

In 2005, EPA issued the Clean Air Interstate Rule (CAIR) under sections 110 and 111 of the Clean Air Act (40 CFR Parts 51, 96, and 97),[19] (70 FR 25162–25405 (May 12, 2005)). CAIR limited emissions from 28 eastern States and D.C. by capping emissions and creating an allowance-based trading program. Although CAIR was remanded to EPA by the U.S. Court of Appeals for the District of Columbia Circuit (D.C. Circuit), (see *North Carolina v. EPA*, 550 F.3d 1176 (D.C. Cir. 2008)), it remained in effect temporarily, consistent with the D.C. Circuit's earlier opinion in *North Carolina v. EPA*, 531 F.3d 896 (D.C. Cir. 2008).

On July 6, 2011, EPA promulgated a replacement for CAIR, entitled "Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals," but commonly referred to as the Cross-State Air Pollution Rule (CSAPR), or the Transport Rule (76 FR 48208 (Aug. 8, 2011)).[20] On August 21, 2012, the D.C. Circuit issued a decision to vacate CSAPR. See *EME Homer City Generation, LP v. EPA*, 696 F.3d 7, 38 (D.C. Cir. 2012). The court ordered EPA to continue administering CAIR. More recently, however, EPA requested that the court lift the CSAPR stay and toll the CSAPR compliance deadlines by three years. On October 23, 2014, the D.C. Circuit granted EPA's request. CSAPR took effect January 1, 2015 for SO_2 and annual NO_X, and May 1, 2015 for ozone season NO_X.

On February 16, 2012, EPA issued national emissions standards for hazardous air pollutants (NESHAPs) for Hg and certain other pollutants emitted from coal and oil-fired electric generating units (EGUs), which are also known as the Mercury and Air Toxics Standards (MATS) for power plants (77 FR 9304). More recently, the Supreme Court remanded EPA's 2012 MATS rule regarding national emission standards for hazardous air pollutants from certain electric utility steam generating units. See *Michigan v. EPA* (Case No. 14-46, 2015).

On October 23, 2015, EPA published the final Clean Power Plan (CPP) for existing electricity generating units in the Federal Register (80 FR 64966). In the CPP the Environmental Protection Agency (EPA) proposes a federal plan to implement the greenhouse gas (GHG) emission guidelines (EGs) for existing fossil fuel-fired electric generating units (EGUs) under the Clean Air Act (CAA). The October 23, 2015, EPA notice also included the EPA's proposed model plans for states and its draft federal implementation plan (FIP) (80 FR 64662). The former is intended to guide states as they craft their own plans or to act as a ready-made option, and the latter describes how EPA would enforce CO_2 emission reductions on power plants in states that opt not to comply. The CPP went into effect on December 22, 2015. In response, multiple states and industry groups challenged the CPP. The U.S. Supreme Court has stayed the rule

[19] See http://www.epa.gov/cleanairinterstaterule/.
[20] See also http://www.epa.gov/crossstaterule/.

implementing the Clean Power Plan until the current litigation against it concludes. *Chamber of Commerce, et al. v. EPA, et al.*, Order in Pending Case, 577 U.S. ___ (2016).

3.3.2.2 Outdoor Air Impacts: General Analysis

To assess estimated impacts to outdoor emissions, it is first necessary to determine changes to energy consumption. This section provides the potential energy savings that may result from implementing the action alternatives. Because the No Action Alternative represents the base-case scenario, all energy savings presented are relative to the No Action Alternative. DOE analyzed the national energy savings for each action alternative assuming 30 years of manufactured housing shipments and a 30-year lifetime for manufactured homes.

DOE modeled the annual energy use per square foot of floor space (energy use intensity) associated with the No Action Alternative, the Proposed Action, and the No Sealing Alternative. DOE completed simulations using the EnergyPlus modeling software for manufactured homes in 19 representative cities with differing climate characteristics. In addition, DOE analyzed two sizes of manufactured homes: single-section and multi-section. Using these energy use intensities and the typical floor space of single-section and multi-section manufactured homes respectively, DOE calculated the annual unit site energy consumption[21].

DOE converted the unit site energy consumption of the No Action Alternative, the Proposed Action, and the No Sealing Alternative into primary energy consumption[22] and Full-fuel-cycle (FFC) energy consumption[23]. DOE calculated primary energy savings (power plant consumption) from site electricity savings by applying a factor to account for losses associated with the generation, transmission, and distribution of electricity. DOE calculated FFC energy savings from primary energy savings by applying a factor to account for the energy losses associated with the energy consumed in extracting, processing, and transporting or distributing primary fuels. DOE derived these factors based on the version of the National Energy Modeling System (NEMS) that corresponds to the 2014 Annual Energy Outlook (*AEO 2014*).

The factors change over time in response to projections of future oil, natural gas and coal supply, energy use for oil and gas field and refinery operations, and fuel consumption and emissions related to electric power production.

Table 5 shows the primary energy factors and FFC factors for the different fuel types used in the analysis from 2020 to 2040 in 5-year increments. Because the analysis period goes beyond 2040, DOE assumed the primary energy and FFC factors for all years beyond 2040 were equal to the 2040 factors.

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[21] Unit site energy consumption refers to energy consumed on site of the building, but does not incorporate transmission, delivery, and production losses.

[22] Primary energy refers to the raw fuel that is burned to create heat and electricity.

[23] Full-fuel-cycle measures source energy, that is total energy required including transmission, delivery, and production losses.

Table 5: Primary Energy and FFC Factors, 2020-2040

Factor Type	Fuel Type	Dimensionless Factor				
		2020	2025	2030	2035	2040
Primary	Electricity	3.042	2.813	2.623	2.533	2.558
FFC	Electricity	1.044	1.045	1.046	1.047	1.047
	Natural Gas	1.109	1.111	1.113	1.114	1.114
	LPG/Oil	1.176	1.176	1.174	1.172	1.170

DOE analyzed the national energy savings for 30 years of single-section and multi-section manufactured home shipments, and considered the entire lifetime of each shipment. DOE developed a shipment model to project shipments of manufactured homes from 2017 until 2046. The shipment model uses historical shipments published by the Manufactured Housing Institute (MHI), and uses the *AEO 2015* reference case growth rate in new residential housing starts to project shipments to 2045. DOE assumes the lifetime of a manufactured home to be 30 years. In a given year, the housing stock is the cumulative number of shipments from 2016 through that year less the number of homes that have exceeded their 30-year lifetime. For example, in 2046, the total housing stock is the sum of all shipments from 2016 to 2045 less the shipments from 2016. In each year, the total housing stock is multiplied by the unit energy consumption to calculate annual energy consumption for all housing stock. With annual energy consumption values over the entire analysis period for the No Action Alternative, the Proposed Action, and the No Sealing Alternative, DOE calculated the energy savings associated with the Proposed Action and the No Sealing Alternative.

Table 6 presents the national energy savings resulting from implementation of the Proposed Action and the No Sealing Alternative relative to the No Action Alternative.

Table 6: Cumulative National Energy Savings, Including FFC of Manufactured Homes Purchased 2017-2047 with a 30-Year Lifetime

	Single-Section Homes quads[24]	Multi-Section Homes quads	Total quads
Proposed Action	0.884	1.428	2.312
No Sealing Alternative	0.650	1.011	1.661

The outdoor air analysis for each action alternative estimates the impact of the action on pollutant emissions, which are largely driven by reductions in electricity demand and fuel usage. The emissions analysis consists of two components. The first component estimates the effect of potential energy conservation standards on site emissions, which include both power sector emissions and site combustion emissions of CO_2, NO_X, SO_2 and Hg. These emissions are those

[24] A quad is 1 quadrillion btus.

directly related to the consumption of electricity or combustion fuel. The second component estimates the impacts of a potential standard on emissions of two additional greenhouse gases, CH_4 and N_2O, as well as the reductions to emissions of all pollutants due to "upstream" activities in the fuel production chain. These upstream activities comprise extraction, processing, and transporting fuels to the site of combustion. The associated emissions are referred to as upstream emissions. Together, the site and upstream emissions account for the FFC, in accordance with DOE's FFC Statement of Policy. (76 FR 51282; Aug. 18, 2011).

Methodology

The analysis of power sector emissions uses marginal emissions intensity factors calculated by DOE. As of 2014, DOE is using a new methodology based on results published for the *AEO 2014* reference case and a set of side cases that implement a variety of efficiency-related policies. The new methodology is described in the report "Utility Sector Impacts of Reduced Electricity Demand" authored by Coughlin (2014). The *AEO* does not publish estimates of the CH_4 and N_2O emissions associated with combustion of fossil fuels. For these pollutants, the power sector emissions are estimated using emissions intensity factors published by the U.S. Environmental Protection Agency (EPA). Site combustion emissions are also estimated using emissions intensity factors published by the EPA. The FFC upstream emissions are estimated based on the methodology developed by Coughlin. 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.

Air Quality Regulations and Impact on Assumptions

Sulfur dioxide emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap and trading programs, as discussed in section 3.3.2.1. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 50 states and the District of Columbia (D.C.). SO_2 emissions from 28 eastern states and D.C. were also limited under EPA's CAIR and CSAPR regulation. In this analysis, the *AEO 2014* emissions factors used for the present analysis were computed prior to January 1, 2015, and therefore assume that CAIR remains a binding regulation through 2040.

The attainment of emissions caps is typically flexible among affected EGUs and is enforced through the use of emissions allowances and tradable permits. Under existing EPA regulations, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the imposition of an energy conservation standard could be used to permit offsetting increases in SO_2 emissions by any regulated EGU. In past rulemakings, DOE recognized that there was uncertainty about the effects of energy conservation standards on SO_2 emissions covered by the existing cap-and-trade system, but it concluded that no reductions in power sector emissions would occur for SO_2 as a result of the proposed standards.

Beginning in 2016, however, SO_2 emissions will fall as a result of the Mercury and Air Toxics Standards (MATS) for power plants. 77 FR 9304 (Feb. 16, 2012). In the final MATS 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 will be reduced as a result of the control technologies installed on coal-fired power plants to comply with the MATS requirements for acid gas. *AEO 2014* assumes that, in order to continue operating, coal plants must have either flue gas desulfurization or dry sorbent injection systems installed by 2016. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions. Under the MATS, emissions will be far below the cap established by CAIR, so 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 any regulated EGU. Therefore, energy conservation standards would reduce SO_2 emissions in 2016 and beyond.

CAIR established a cap on NO_X emissions in 28 eastern states and the District of Columbia. Energy conservation standards are expected to have little effect on NO_X emissions in those States covered by CSAPR because excess NO_X emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in NO_X emissions. However, standards would be expected to reduce NO_X emissions in the states not affected by CAIR. As a result, DOE estimated NO_X emissions reductions from potential standards for those states.

The MATS limit Hg emissions from power plants, but they do not include emissions caps and, as such, DOE's energy conservation standards would likely reduce Hg emissions. DOE estimated Hg emissions reductions using emissions factors based on *AEO 2014*, which incorporates the MATS.

DOE notes that the Supreme Court recently remanded EPA's 2012 rule regarding national emission standards for hazardous air pollutants from certain electric utility steam generating units. See *Michigan v. EPA* (Case No. 14-46, 2015). DOE has tentatively determined that the remand of the MATS rule does not change the assumptions regarding the impact of energy efficiency standards on SO_2 emissions. Further, while the remand of the MATS rule may have an impact on the overall amount of mercury emitted by power plants, it does not change the impact of the energy efficiency standards on mercury emissions.

Site Emissions Factors

The analysis of power sector emissions uses marginal emissions intensity factors derived from analysis of the *AEO 2014* reference case and a number of side cases incorporating enhanced equipment efficiencies. To model the impact of a standard, DOE calculates factors that relate a unit reduction to annual site electricity demand for a given end use to corresponding reductions to installed capacity by fuel type, fuel use for generation, and power sector emissions. Total emissions reductions are estimated by multiplying the emissions factors, computed for specific end uses and years, by the corresponding calculated energy savings associated with a particular efficiency scenario. Details on the approach have been described by Coughlin (2014). The electricity end uses relevant to manufactured housing are residential space heating, residential space cooling, and residential water heating. Tables 7, 8, and 9 list the power sector emissions factors for these three end uses for selected years. Years beyond 2040 were assumed to have the same emissions factors as the year 2040. The *AEO* does not publish estimates of the CH_4 and N_2O emissions associated with combustion of fossil fuels. For these pollutants, the power sector emissions are estimated using emissions intensity factors published by the EPA (2014). This publication provides emissions intensity factors for different grades of coal, petroleum fuels and

natural gas. DOE uses these fuel-specific emissions factors to develop time-dependent emissions factors as a function of the changing fuel mix in the power sector.

Table 7: Power Sector Emissions Factors for Residential Space Heating

	Unit	2020	2025	2030	2035	2040
CO_2	kg/MWh	831	743	674	618	563
SO_2	g/MWh	0.00230	0.00179	0.00151	0.00127	0.00113
NO_X	g/MWh	731	696	650	615	564
Hg	g/MWh	617	482	405	340	304
N_2O	g/MWh	83.5	66.9	57.1	48.9	43.9
CH_4	g/MWh	12.0	9.6	8.1	6.9	6.2

Table 8: Power Sector Emissions Factors for Residential Space Cooling

	Unit	2020	2025	2030	2035	2040
CO_2	kg/MWh	786	709	643	594	546
SO_2	g/MWh	0.00199	0.00155	0.00131	0.00109	0.00098
NO_X	g/MWh	722	688	641	610	566
Hg	g/MWh	535	418	351	294	263
N_2O	g/MWh	72.6	58.3	49.8	42.7	38.4
CH_4	g/MWh	10.4	8.3	7.1	6.0	5.4

Table 9: Power Sector Emissions Factors for Residential Water Heating

	Unit	2020	2025	2030	2035	2040
CO_2	kg/MWh	813	730	662	609	556
SO_2	g/MWh	0.00220	0.00172	0.00144	0.00121	0.00108
NO_X	g/MWh	723	690	644	611	561
Hg	g/MWh	591	462	388	326	291
N_2O	g/MWh	80.2	64.3	54.9	47.0	42.2
CH_4	g/MWh	11.6	9.2	7.8	6.6	6.0

Site combustion of fossil fuels in buildings (for example in water-heating, space-heating, or cooking applications) also produces emissions of CO_2 and other pollutants. DOE used emissions factors published by the EPA, which are constant in time. These factors are presented in Table 10.

Table 10: Site Combustion Emissions Factors

Species	Natural Gas *g/mcf**	Fuel Oil/Liquefied Petroleum Gas *g/bbl***
CO_2	54116	446241
SO_2	69.9048	11531
NO_X	0.27083	219.66
N_2O	1.022	13.260
CH_4	0.1022	8.6481
*g/mcf = grams per one-thousand cubic feet **g/bbl = grams per barrel of oil		

Upstream Emission Factors

The upstream emissions accounting uses the same approach as the upstream energy accounting described by Coughlin (2013, 2014). When demand for a particular fuel is reduced, there is a corresponding reduction in the emissions from combustion of that fuel at either the building site or the power plant. The associated reduction in energy use for upstream activities leads to further reductions in emissions. These upstream emissions are defined to include the combustion emissions from the fuel used upstream, the fugitive emissions associated with the fuel used upstream, and the fugitive emissions associated with the fuel used on site.

Fugitive emissions of CO_2 occur during oil and gas production, but are small relative to combustion emissions. They comprise about 2.5 percent of total CO_2 emissions for natural gas and 1.7 percent for petroleum fuels. Fugitive emissions of methane occur during oil, gas, and coal production. Combustion emissions of CH_4 are very small, while fugitive emissions (particularly for gas production) may be relatively large. Hence, fugitive emissions make up more than 99 percent of total methane emissions for natural gas, about 95 percent for coal, and 93 percent for petroleum fuels.

Upstream emissions factors account for both fugitive emissions and combustion emissions in extraction, processing, and transport of primary fuels. DOE estimated fugitive emissions factors for methane from coal mining and natural gas production based on a review of recent studies compiled by Burnham. This review includes estimates of the difference between fugitive emissions factors for conventional production of natural vs. unconventional (shale or tight gas). These estimates rely in turn on data gathered by EPA under new greenhouse gas reporting requirements for the petroleum and natural gas industries (EPA 2009, 2012). As more data are made available, DOE will continue to update these estimated emissions factors.

For ease of application in its analysis, DOE developed all of the emissions factors using site (point of use) energy savings in the denominator. Table 11 presents the electricity upstream emissions factors for selected years. These were used to estimate the emissions associated with the decreased electricity use. The caps that apply to power sector NO_X emissions do not apply to upstream combustion sources. Tables 12 and 13 present upstream emissions factors for natural gas and fuel oil/LPG, respectively.

Table 11: Electricity Upstream Emissions Factors

	Unit	2020	2025	2030	2035	2040
CO_2	kg/MWh	30.3	30.7	30.8	30.4	30.0
SO_2	g/MWh	0.0000134	0.0000126	0.0000117	0.0000111	0.0000108
NO_X	g/MWh	388	395	399	396	391
Hg	g/MWh	5.62	5.45	5.20	5.06	5.00
N_2O	g/MWh	2127	2163	2200	2196	2160
CH_4	g/MWh	0.275	0.270	0.261	0.253	0.246

Table 12: Natural Gas Upstream Emissions Factors

	Unit	2020	2025	2030	2035	2040
CO_2	kg/mcf	7.89	7.96	7.90	7.85	7.88
SO_2	g/mcf	115	116	115	114	114
NO_X	g/mcf	0.0344	0.0348	0.0344	0.0341	0.0343
N_2O	g/mcf	686	689	686	686	687
CH_4	g/mcf	0.0126	0.0128	0.0127	0.0126	0.0126

Table 13: Fuel Oil/Liquefied Petroleum Gas Upstream Emissions Factors

	Unit	2020	2025	2030	2035	2040
CO_2	kg/bbl	70.0	69.1	67.8	67.7	67.5
SO_2	g/bbl	0.00000693	0.00000647	0.00000622	0.00000621	0.00000609
NO_X	g/bbl	814	810	791	787	781
Hg	g/bbl	15.4	15.3	15.0	14.9	14.8
N_2O	g/bbl	882	872	857	855	854
CH_4	g/bbl	0.630	0.625	0.611	0.608	0.603

Emission Reduction Results

Table 14 lists the estimated cumulative emissions reductions relative to the No Action Alternative, for single-section and multi-section manufactured homes, under the Proposed Action and the No Sealing Alternative, for homes sold from 2017 through 2046.

Table 14: Emissions Reductions Under the Proposed Action and No Sealing Alternative

Pollutant	Proposed Action			No Sealing Alternative		
	Single-Section	Multi-Section	Total	Single-Section	Multi-Section	Total
Site Emissions Reduction						
CO_2 (million metric tons)	56.5	91.1	148	41.2	64.0	105
Hg (metric tons)	0.0904	0.146	0.236	0.0681	0.107	0.175
NO_X (thousand metric tons)	223	356	579	142	207	349
SO_2 (thousand metric tons)	27.6	44.4	72.0	20.3	31.5	51.8
CH_4 (thousand metric tons)	3.78	6.09	9.87	2.81	4.37	7.18
N_2O (thousand metric tons)	0.632	1.02	1.65	0.455	0.701	1.156
Upstream Emissions Reduction						
CO_2 (million metric tons)	4.01	6.45	10.5	2.8	4.25	7.05
Hg (metric tons)	0.000944	0.00153	0.00247	0.000707	0.00111	0.00182
NO_X (thousand metric tons)	51.8	83.2	135	36.2	55	91.2
SO_2 (thousand metric tons)	0.615	0.991	1.61	0.435	0.665	1.1
CH_4 (thousand metric tons)	239	385	624	171	264	435
N_2O (thousand metric tons)	0.0294	0.0474	0.0768	0.0209	0.032	0.0529
Full-Fuel-Cycle Emissions Reduction*						
CO_2 (million metric tons)	60.5	97.6	158	44.0	68.3	112
Hg (metric tons)	0.0913	0.148	0.239	0.0688	0.108	0.177
NO_X (thousand metric tons)	275	439	714	178	262	440
SO_2 (thousand metric tons)	28.2	45.4	73.6	20.7	32.2	52.9
CH_4 (thousand metric tons)	243	391	634	174	268	442
N_2O (thousand metric tons)	0.661	1.07	1.73	0.476	0.733	1.21

* Full-fuel-cycle emissions reductions are calculated by summing site and upstream emissions reductions. The FFC totals in this table have been rounded to 3 significant digits.

3.3.2.3 Impacts of Proposed Action

As identified in Table 6, under the Proposed Action total energy savings would be 2.184 quads. As identified in Table 14, above, under the Proposed Action cumulative FFC emissions reductions would be 146 million metric tons of CO_2, 0.247 metric tons of Hg 661,000 metric tons of NO_X, 89,400 metric tons of SO_2, 627,000 metric tons of CH_4, and 1,650 metric tons of N_2O, for 30 years of construction (2016 through 2045) and 30 years of energy reduction for all manufactured homes shipped during that period.

3.3.2.4 Impacts of No Sealing Alternative

As identified in Table 6, under the No Sealing Alternative total energy savings would be 1.56 quads, which would be 71 percent of the energy savings achieved under the Proposed Action. Under the No Sealing Alternative cumulative FFC emissions reductions would be 107 million metric tons of CO_2, 0.19 metric tons of Hg, 446,000 metric tons of NO_X, 67,000 metric tons of

SO_2, 452,000 metric tons of CH_4, and 1,230 metric tons of N_2O, for 30 years of construction (2016 through 2045) and 30 years of energy reduction for all manufactured homes shipped during that period. These emission reductions are less than those obtained from the Proposed Action; specifically, the reductions are between 67 percent (for NO_X) and 76 percent (for Hg) of the emission reductions for the Proposed Action.

3.3.3 Global Climate Change

Climate change has evolved into a matter of global concern because it is expected to have widespread, adverse effects on natural resources and systems. A growing body of evidence points to anthropogenic sources of greenhouse gases, such as CO_2, as major contributors to climate change. Climate change is a resource area with possible impacts from the Proposed Action and No Sealing Alternative.

3.3.3.1 Affected Environment

Climate is defined as the average weather, over a period ranging from months to many years. Climate change refers to a change in the state of the climate, which is identifiable through changes in the mean and/or the variability of its properties (e.g., temperature or precipitation) over an extended period, typically decades or longer. The World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) to provide an objective source of information about climate change. According to the IPCC Fourth Assessment Report (IPCC Report), published in 2007, climate change is consistent with observed changes to the world's natural systems; the IPCC expects these changes to continue (IPCC WGI 2007A).[25]

The IPCC Report states that the world has warmed by about 0.74°C in the last 100 years. Additionally, the IPCC Report finds that most of the temperature increase since the mid-20th century is very likely caused by the increase in anthropogenic concentrations of CO_2 and other long-lived greenhouse gases such as CH_4 and N_2O in the atmosphere, rather than from natural causes.

Increasing the concentration of CO_2 and greenhouse gases in the atmosphere partially blocks the Earth's re-radiation of captured solar energy in the infrared band, inhibits the radiant cooling of the Earth, and thereby alters the energy balance of the planet, which gradually increases its average temperature. The IPCC Report estimates that currently, CO_2 makes up about 77 percent of the total CO_2-equivalent global warming potential in GHGs emitted from human activities, with the vast majority (74 percent) of the CO_2 attributable to fossil fuel use.[26] Globally, 49

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[25] Note that a fifth IPCC Assessment Report is now available at http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-ts.pdf. DOE will update this section of this EA in subsequent versions of this EA.

[26] GHGs differ in their warming influence (radiative forcing) on a global climate system due to their different radiative properties and lifetimes in the atmosphere. These warming influences may be expressed through a common metric based on the radiative forcing of CO_2, i.e., CO_2-

billion metric tons of CO_2 equivalent of anthropogenic (man-made) greenhouse gases are emitted every year.[27] For the future, the IPCC Report describes a wide range of GHG emissions scenarios, but under each scenario, CO_2 would continue to comprise more than 70 percent of the total global warming potential (IPCC 2000).

Researchers have focused on considering atmospheric CO_2 concentrations that likely will result in some level of global climate stabilization, and the emissions rates associated with achieving the "stabilizing" concentrations by particular dates. They associate these stabilized CO_2 concentrations with temperature increases that plateau in a defined range. For example, at the low end, the IPCC Report scenarios target CO_2 stabilized concentrations range between 350 ppm and 400 ppm (essentially today's value)—because of climate inertia, concentrations in this low-end range would still result in temperatures projected to increase 2.0°C to 2.4°C above pre-industrial levels[28] (about 1.3 °C to 1.7 °C above today's levels). To achieve concentrations between 350 ppm to 400 ppm, the IPCC scenarios present that there would have to be a rapid downward trend in total annual global emissions of greenhouse gases to levels that are 50 to 85 percent below today's annual emissions rates by no later than 2050. Because it is assumed that there would continue to be growth in global population and substantial increases in economic production, the scenarios identify required reductions in greenhouse gas emissions intensity (emissions per unit of output) of more than 90 percent. However, even at these rates, the scenarios describe some warming and some climate change is projected because of already accumulated CO_2 and GHGs in the atmosphere (IPCC WGI 2007b).

3.3.3.2 Impacts of Action Alternatives

It is difficult to correlate specific emissions rates with atmospheric concentrations of CO_2 and specific atmospheric concentrations with future temperatures because the IPCC Report describes a clear lag in the climate system between any given concentration of CO_2 (even if maintained for long periods) and the subsequent average worldwide and regional temperature, precipitation, and extreme weather regimes. For example, a major determinant of climate response is "equilibrium climate sensitivity", a measure of the climate system response to sustained radiative forcing. It is defined as the global average surface warming following a doubling of carbon dioxide concentrations. The IPCC Report describes its estimated, numeric value as about 3°C, but the likely range of that value is 2°C to 4.5°C. Further, as illustrated above, the IPCC Report scenarios for stabilization rates are presented in terms of a range of concentrations, which then correlates to a range of temperature changes. Thus, climate sensitivity is a key uncertainty for CO_2 mitigation scenarios that aim to meet specific temperature levels.

The Council on Environmental Quality's 2014 Revised Draft Guidance for Greenhouse Gas Emissions and Climate Change Impacts recommends using the "projected GHG emissions…as

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equivalent. CO_2 equivalent emission is the amount of CO_2 emission that would cause the same- time integrated radiative forcing, over a given time horizon, as an emitted amount of other long- lived GHG or mixture of GHGs.

[27] Other non-fossil fuel contributors include CO_2 emissions from deforestation and decay from agriculture biomass, agricultural and industrial emissions of CH_4, and emissions of nitrous oxide and fluorocarbons.

[28] IPCC Working Group 3, Table TS 2.

the proxy for assessing a proposed actions potential climate change impacts." The IPCC lists NO_X, CH_4, and N_2O as having global warming potential factors of -11, 28, and 265 times the impact of CO2 over a 100 year horizon (Myhre, 2013). The IPCC does not list SO_2 or Hg as having CO_2 equivalent global warming potential factors. The full fuel cycle emissions reductions of NO_X, CH_4, and N_2O were converted to CO2 equivalents using these global warming potential factors. The CO_2 equivalent emissions were summed to determine the total CO2 equivalent emissions avoided under the proposed action and the no air sealing alternative. The total CO_2 equivalent greenhouse gas emissions avoided under the proposed action is 168 million metric tons. The total CO_2 equivalent greenhouse gas emissions avoided under the no sealing alternative is 120 million metric tons.

3.3.4 Socioeconomic and Environmental Justice

This consideration of Environmental Justice is made pursuant to Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (59 FR 7629, EO signed Feb. 11, 1994). The Executive Order requires Federal agencies to address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on low-income or minority populations.

Manufactured home owners, on average, have a median annual income of $35,000, which is roughly $17,000 below the national average. Among households with very-low incomes (that is, less than 50 percent of area median), 23 percent of home-ownership growth between 1993 and 1999 came through manufactured housing. For southern households the figure was 30 percent, and for rural households 35 percent. In the rural South manufactured home purchases accounted for 63 percent of the increase in very-low-income home ownership. Nationwide, manufactured homes are a major source of unsubsidized, low-cost housing for many owners and renters who have few housing alternatives (Apgar et al., 2002). Of the 540,000 affordably priced new units added to the housing stock from 1997 to 1999, two-thirds were manufactured units (Collins, Crowe and Carliner, 2000).

DOE has determined that any action alternative would affect manufactured home residents in an equal manner. However, DOE acknowledges that manufactured home purchasers and residents are disproportionately from lower income populations. As discussed above, DOE has not been able to determine the extent of impacts to indoor air quality that would result from the Proposed Action, and thus has not determined that any impacts would occur. DOE can determine that if any adverse impacts to indoor air quality from the Proposed Action would occur, those impacts may have disproportionately affect low income populations. There would be no adverse health effects on minorities and, or, low-income populations under the No Sealing and the No Action Alternatives since there will be minimal or no impacts to indoor air quality.

DOE expects there to be positive and negative economic benefits under the action alternatives for low-income populations. The negative economic impacts result from the increase in the purchase price of manufactured homes from builders incorporating the action alternatives energy conservation measures. However, the increase in purchase price would be offset by the benefits manufactured homeowners would experience in operating cost savings under the action alternatives. Establishing robust energy conservation requirements for manufactured homes would result in the dual benefit of substantially reducing manufactured home energy use and

easing the financial burden on owners of manufactured homes in meeting their monthly utility expenses.

3.4 Cumulative Impacts

Cumulative impacts are those potential environmental impacts that result "from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such action. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

The Proposed Action would establish energy conservation standards for manufactured homes. The Proposed Action is not a site specific action or project which would impact any specific geographic area or region. Cumulative impacts are discussed for those resource areas where cumulative impacts could occur, specifically for indoor air and outdoor air.

3.4.1 Cumulative Indoor Air Impacts

Indoor air quality may be impacted by existing regulations regarding construction, health and safety of manufactured homes. Those regulations are set forth by HUD at 24 CFR 3280.

Indoor air quality may also be impacted by future regulations. EPA is proposing new requirements under the Formaldehyde Standards for Composite Wood Products Act of 2010, or Title VI of the Toxic Substances Control Act (TSCA). These proposed requirements are designed to implement the statutory formaldehyde emission standards for hardwood plywood, medium-density fiberboard, and particleboard. No final rules have been issued. The formaldehyde levels in composite wood products that are used in the construction of manufactured homes currently regulated by HUD are higher than those established by the 2010 Act. Section 4 of the 2010 Act directs HUD to update its regulations to ensure that their regulations reflect the standards established by section 601 of TSCA. DOE expects that the changes, if placed into law, would have a beneficial impact on indoor air quality of manufactured homes. Given that formaldehyde is but one of many potential pollutants, DOE expects that the total cumulative impact from updates to formaldehyde regulations would be minimal. However, because the impacts of the Proposed Action on indoor air remain uncertain, the cumulative impacts also remain uncertain.

3.4.2 Cumulative Outdoor Air impacts

While the EPA is continuously working on updating and creating regulations to improve outdoor air quality, the cumulative impact of the action alternatives with any potential regulations would be small relative to the impact of those potential regulations.

The known impact of the action alternatives on outdoor air would be beneficial in that those impacts would be to reduce air pollutant emissions. While the combination of the action alternatives with reasonably foreseeable regulations on outdoor air may be minor, the action alternatives could have a small positive cumulative effect on the amount of outdoor pollutant emissions.

4 REQUEST FOR INFORMATION

DOE seeks comment on the potential impacts of the Proposed Action on indoor air quality and occupant health for manufactured homes. Commenters should address the question: "How would the prescriptive sealing requirements as defined in Section 460.104 of the Proposed Action impact indoor air quality and occupant health for manufactured homes?" DOE is interested in data, calculations, expert opinions, and studies, including epidemiological studies that would support the positions set forth in response to this RFI. DOE will consider the information received in analyzing potential air quality impacts, as discussed in section 3.3.1.2. Areas of interest include, but are not limited to:

1. The relationship among indoor air quality, natural air infiltration and mechanical ventilation in manufactured homes, residential buildings or other building types.
2. Whether the Proposed Action would be protective of human health given the existing requirements for mechanical ventilation at 24 CFR 3280.103(b).
3. Data on safe or unsafe levels of indoor pollutants within manufactured homes, residential buildings or other building types.
4. Data on existing levels of indoor pollutants within manufactured homes, residential buildings or other building types.

DISCLAIMER AND IMPORTANT NOTES: This is a Request for Information (RFI) only. It is issued solely for information purposes; this RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. In accordance with FAR 15.201(e), responses to this notice are not offers and cannot be accepted by the Government to form a binding contract. DOE will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that DOE is under no obligation to acknowledge receipt of the information received or provide feedback to respondents with respect to any information submitted under this RFI. Responses to this RFI do not bind DOE to any further actions related to this topic.

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