[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Part 431

[EERE-2017-BT-STD-0009]

RIN 1904-AD79

Energy Conservation Program: Energy Conservation Standards for Walk-in Coolers and Freezers

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

ACTION: Notification of data availability and request for comment.

SUMMARY: On September 5, 2023, the U.S. Department of Energy ("DOE") published a notice of proposed rulemaking ("NOPR"), in which DOE proposed amended energy conservation standards for walk-in coolers and walk-in freezers ("September 2023 NOPR"). In this notification of data availability ("NODA"), DOE is updating portions of its analysis for walk-in coolers and walk-in freezers based on information DOE received in response to DOE's September 2023 NOPR. DOE requests comments, data, and information regarding the updated analysis.

DATES: DOE will accept comments, data, and information regarding this NODA no later than [INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*].

ADDRESSES: Interested persons are encouraged to submit comments using the Federal eRulemaking Portal at *www.regulations.gov* under docket number EERE-2017-BT-STD-0009. Follow the instructions for submitting comments. Alternatively, interested persons may submit comments, identified by docket number EERE-2017-BT-STD-0009, by any of the following methods:

(1) *Email:* WICF2017STD0009@ee.doe.gov. Include the docket number EERE-2017-BT-STD-0009 in the subject line of the message.

(2) *Postal Mail:* Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, Mailstop EE–5B, 1000 Independence Avenue SW, Washington, DC 20585–0121. If possible, please submit all items on a compact disc (CD), in which case it is not necessary to include printed copies.

No telefacsimiles ("faxes") will be accepted. For detailed instructions on submitting comments and additional information on this process, see section III of this document.

Docket: The docket for this activity, which includes *Federal Register* notices, comments, and other supporting documents/materials, is available for review at *www.regulations.gov*. All documents in the docket are listed in the *www.regulations.gov* index. However, not all documents listed in the index may be publicly available, such as information that is exempt from public disclosure.

The docket webpage can be found at *www.regulations.gov/docket/EERE-2017-BT-STD-0009*. The docket webpage contains instructions on how to access all documents, including public comments, in the docket. See section III of this document for information on how to submit comments through *www.regulations.gov*.

FOR FURTHER INFORMATION CONTACT:

Mr. Troy Watson, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE-5B, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Email: *ApplianceStandardsQuestions@ee.doe.gov*.

Mr. Matthew Schneider, U.S. Department of Energy, Office of the General Counsel, GC-33, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (240) 597-6265. Email: *matthew.schneider@hq.doe.gov*.

For further information on how to submit a comment, review other public comments and the docket, or participate in the public meeting, contact the Appliance and Equipment

Standards Program staff at (202) 287-1445 or by email:

ApplianceStandardsQuestions@ee.doe.gov.

SUPPLEMENTARY INFORMATION:

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I. Background

The Energy Policy and Conservation Act, Pub. L. 94-163, as amended ("EPCA"),[1] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part C of EPCA,[2] established the Energy Conservation Program for Certain Industrial Equipment. (42 U.S.C. 6311-6317) Such equipment includes walk-in coolers and walk-in freezers[3] (hereafter referred to as "walk-ins" or "WICFs"), the subject of this rulemaking.

DOE defines "walk-ins" as an enclosed storage space, including but not limited to panels, doors, and refrigeration systems, refrigerated to temperatures, respectively, above, and at or below 32 degrees Fahrenheit that can be walked into, and has a total chilled storage area of less than 3,000 square feet; however, the terms do not include products designed and marketed exclusively for medical, scientific, or research purposes. 10 CFR 431.302. Rather than establishing standards for complete walk-in systems, DOE has established standards for the principal components that make up a walk-in (*i.e.*, doors, panels, and refrigeration systems).

On September 5, 2023, DOE published a notice of proposed rulemaking ("NOPR") in the *Federal Register* regarding energy conservation standards for walk-in coolers and freezers ("September 2023 NOPR"). 88 FR 60746. Specifically, DOE proposed amended standards for walk-in non-display doors and walk-in refrigeration systems. DOE did not propose to amend the standard for walk-in panels or display doors. For walk-in refrigeration systems, DOE proposed amended standards in terms of the newly adopted annual walk-in

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[1] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Pub. L. 116-260 (Dec. 27, 2020), which reflect the last statutory amendments that impact Parts A and A-1 of EPCA.

[2] For editorial reasons, upon codification in the U.S. Code, Part C was re-designated Part A-1.

[3] Walk-in coolers and walk-in freezers are defined as an enclosed storage space, including but not limited to panels, doors, and refrigeration systems, refrigerated to temperatures, respectively, above, and at or below 32 degrees Fahrenheit that can be walked into, and has a total chilled storage area of less than 3,000 square feet; however, the terms do not include products designed and marketed exclusively for medical, scientific, or research purposes. 10 CFR 431.302.

energy factor 2 ("AWEF2") metric.[4] The technical support document ("TSD") that presented the methodology and results of the September 2023 NOPR analysis ("September 2023 NOPR TSD") is available at *www.regulations.gov/document/EERE-2017-BT-STD-0009-0046*. Additionally, on September 28, 2023, DOE published a notification of data availability ("September 2023 NODA") summarizing additional comments received on the June 2022 Preliminary Analysis (87 FR 39008) that were considered but not discussed in the September 2023 NOPR. 88 FR 66710.

On September 27, 2023, DOE held a public webinar ("September 2023 Public Webinar") in which it presented an overview of the topics addressed in the September 2023 NOPR, allowed time for prepared general statements by participants, and encouraged all interested parties to share their views on issues affecting this rulemaking.

In response to the September 2023 NOPR, DOE received additional data and information regarding walk-in non-display doors and refrigeration systems, which is summarized in sections II.A and II.D.2 of this document.

Upon consideration of the views shared in the September 2023 Public Webinar and public comments DOE received in response to the September 2023 NOPR, this NODA presents updated analysis for walk-in non-display doors and refrigeration systems. DOE is requesting comments, data, and information regarding the updated analysis.

DOE notes that it is continuing to consider all of the stakeholder comments received in response to the September 2023 NOPR and September 2023 Public Webinar in further development of the rulemaking. As discussed in the September 2023 NOPR, based on consideration of all of the public comments received, DOE may adopt energy efficiency levels that are either higher or lower than the proposed standards, or some combination of level(s) that incorporate the proposed standards in part.

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[4] DOE adopted the AWEF2 metric in a test procedure final rule published on May 4, 2023. 88 FR 28780.

II. Discussion

In the following sections, DOE details its updated analysis for walk-in non-display doors and refrigeration systems.

A. Engineering Analysis

1. Non-Display Doors

a. Maximum Daily Energy Consumption Allowances for Non-Display Doors with Certain Electrical Components

In the September 2023 NOPR, DOE assumed for its analysis that baseline non-display doors had 3.5-inch-thick insulation for coolers and 4-inch-thick insulation for freezers, wood framing materials, a viewing window, and anti-sweat heat around the perimeter of the door leaf without controls. 88 FR 60746, 60769. DOE did not consider lighting or other electrical components in its baseline representative units for non-display doors. *Id.* As such, DOE only considered design options relevant to the design of the baseline representative units, including: anti-sweat controls, reduced anti-sweat heat, improvements to the framing systems to make the frame more thermally insulative, and increased insulation thickness. *Id.* at 88 FR 60770.

Kolpak commented that while it agrees with providing limits on door components, it disagrees with the overall formulas representing the proposed energy conservation standards for manual non-display doors. (Kolpak, No. 66, Attachment 1 at pp. 1, 3)[5] Kolpak stated that its basic models are fully compliant with DOE's current regulations, but that it believes the new proposed maximum daily energy consumption ("MDEC") formulas are impossibly

[5] The parenthetical reference provides a reference for information located in the relevant docket for this rulemaking, which is maintained at *www.regulations.gov*. The references are arranged as follows: (commenter name, comment docket ID number, attachment number (if there are multiple attachments in a single comment submission), page of that document).

stringent. (Kolpak, No. 66, Attachment 1 at p. 1) Kolpak stated that when considering all electricity-consuming devices that are installed on its doors, including the anti-sweat heater wire, door light, heated ventilator, heated viewing window, and thermometer/temperature alarms, the proposed standards would not be able to be met. (*Id.*) Kolpak provided calculations of the daily energy consumption of six different doors for both cooler and freezer applications to support their comment. (Kolpak, No. 66, Attachment 2)

The test procedure for non-display doors requires the direct and indirect electrical energy consumption of electrical components be calculated and included in the determination of daily energy consumption ("DEC") using rated power of electrical components sited on the door and an assumed percent time off ("PTO") value. As previously mentioned, in the September 2023 NOPR, DOE only considered one electrical component (*i.e.*, the anti-sweat heat around the perimeter of the door leaf) in its representative units of manual non-display doors for the engineering analysis. DOE also considered motors in its representative units of motorized non-display doors. However, DOE understands that other electricity-consuming devices could be installed on a non-display door, which are included in the calculation of DEC per the test procedure. As indicated by Kolpak in its comment, the current MDEC standards allow for additional electrical components such as heated vents, heated viewing windows, lights, and thermometer/temperature alarms to be included and considered in the DEC calculation. However, the basis of the proposed energy conservation standards only accounts for the energy consumption from anti-sweat heat around the perimeter of the door (and motors for doors classified as motorized non-display doors). As a result, DOE understands that the proposed standards as outlined in the September 2023 NOPR may be difficult to meet for basic models of doors that have additional electrical components beyond what DOE considered in its representative units.

Also in response to the September 2023 NOPR, Senneca and Frank Door commented that DOE's method for complying with the new standards presume that all doors have certain features (*e.g.*, lights) that can be adjusted to consume less energy, but that many doors do not have these features; thus, Senneca and Frank Door commented that DOE cannot conclude that new standards are technologically feasible by pointing to methods for compliance with the standards that are not available for all classes, types, and sizes of doors. (Senneca and Frank Door, No. 78 at p. 3) DOE notes that for the September 2023 NOPR analysis, DOE did not consider lighting in its baseline representative units, and therefore did not consider any design options for reducing lighting energy consumption in the analysis. However, as indicated by Senneca and Frank Door, DOE recognizes that it cannot include all other possible electrical components in its baseline representative units and cannot analyze reduced energy consumption for other electrical components because not all doors contain these components.

In light of these comments, DOE is considering equipment classes with maximum daily energy consumption allowances for non-display doors if manufacturers offer basic models with certain electricity-consuming devices as discussed in the following sections. This is similar to the approach used for the energy conservation standards for consumer refrigerators, refrigerator-freezers, and freezers. In a direct final rule relating to energy conservation standards for refrigerators, refrigerator-freezers, and freezers published on January 17, 2024, DOE established separate standards and separate product classes for products with multiple doors or specialty doors. The standards for those product classes (*i.e.*, any product classes that implement special and multi-door designs) include energy allowances (*i.e.*, specific increases in maximum allowable energy use) corresponding to the specific performance-related features (*i.e.,* door-in-door designs, transparent doors, and multi-door designs). 89 FR 3026, 3028-3029.

To develop the maximum daily energy consumption allowances specific for walk-in non-display doors with certain electrical components, DOE reviewed the data and calculations submitted by Kolpak, as well as product literature from hardware and instrument manufacturers. In its comment, Kolpak provided information regarding the following components that are included on its basic models of non-display doors: anti-sweat heat on viewing windows; lighting and mechanisms to turn the lighting on or off (*e.g.*, manual toggle switches, door open timers, occupancy sensors); heated ventilators (also called heated pressure relief vents); and temperature alarms. (Kolpak, No. 66, Attachment 1 at pp. 1-2) Kolpak provided information on model numbers of electrical components, rated wattage of those components, number of electrical components on its doors, and the calculation of the direct and indirect electrical energy consumption for all electrical components. (Kolpak, No. 66, Attachment 2) Using the detail provided by Kolpak, DOE also looked into the hardware and instrument manufacturers product offerings for electrical components to better understand the range of potential options for these additional electrical components. Based on this, DOE grouped the electrical components into four categories: lighting, anti-sweat heat for viewing windows, digital temperature displays/alarms, and heated pressure relief vents. The underlying assumptions for each category of electrical components are described in the paragraphs that follow.

<u>Lighting</u>

For the lighting category, DOE considered lighting, a night light, and a pilot light located on a switch to develop an appropriate DEC allowance for doors that have lighting. Lighting features provide valuable utility to consumers, namely visibility within the walk-in, particularly near the entrance and exit of the walk-in and is commonly controlled by a switch. Switches used for turning the lights on and off often have a pilot light so that the switch can be located in the dark. Additionally, as included in Kolpak's comment and calculations, a night light could also be attached to the walk-in door. Based on Kolpak's provided data and a review of product literature, DOE assumed lighting would have rated power of 13 W, a switch with a pilot light would have a rated power of 0.3 W, and a night light would have a rated power of 1 W. DOE also assumed that these components would not be controlled by some demand-based controls, and therefore used the PTO values specified for lighting and other electricity-consuming devices without controls, timers, or auto-shut-off systems per table A.2 of appendix A along with the rated power to determine the direct electrical energy consumption. DOE assumed based on a review of product literature and doors it has tested that the light and night light would be located on the interior of the walk-in, and the switch may be located either interior or exterior to the walk-in. Therefore, all of the three components associated with lighting were conservatively assumed to be sited on the internal face of the door for the purposes of determining the indirect electrical energy consumption. See 10 CFR part 431, subpart R, appendix A, sections 6.3.2.2 and 6.3.3. Based on these assumptions, DOE calculated the MDEC allowances (*i.e.*, the sum of the direct and indirect electrical energy consumption) for doors with lighting components which can be found in Table II.1. DOE notes that the lighting MDEC allowance would apply to doors with a light that may also have a night light and/or switch. Therefore, a door does not need to be equipped with all three components to use the allowance (*i.e.,* a door with a light and a switch but no nightlight could use the allowance specified in Table II.1).

<u>Anti-sweat Heater for Viewing Window</u>

As previously mentioned, DOE included windows in its representative units of non-display doors. However, DOE did not consider additional anti-sweat heat specific to the window. Anti-sweat heaters are a performance-related feature used on viewing windows to prevent (1) condensation from collecting on the glass and (2) fogging of the glass. Kolpak commented that it is standard for medium-temperature non-display doors with viewing windows to have an anti-sweat heater wire around the frame of the window and for low-temperature non-display doors with viewing windows to have an anti-sweat heater wire and heated glass coating on the outer pane of glass. Kolpak commented that the widely used supplier used to provide a 10 W/ft anti-sweat heater wire without controls. Kolpak stated that it uses a 5 W/ft heater wire with controls in the frame of the viewport window. Kolpak stated that it cannot find additional means to reduce the energy consumption of the anti-sweat heater wire in the viewing window frame further. (Kolpak, No. 66 at p. 1) Based on Kolpak's provided data and a review of product literature, DOE assumed that if anti-sweat heat is included around and/or on viewing windows, that anti-sweat heat would have rated power of 34 W for medium-temperature (*i.e.*, cooler) applications and 84 W for low-temperature (*i.e.*, freezer) applications. DOE also assumed that these components would be controlled by some demand-based controls based on the information provided by Kolpak, and therefore DOE used the PTO values specified for anti-sweat heat with controls, timers, or auto-shut-off systems per table A.2 of appendix A along with the rated power to determine the direct electrical energy consumption. DOE assumed that for the purposes of determining the indirect electrical energy consumption of the anti-sweat heater, 75-percent of the total power is attributed to the interior and 25-percent of the total power is attributed to the exterior of the walk-in, consistent with the assumptions outlined in the DOE test procedure. See 10 CFR part 431, subpart R, appendix A, sections 6.3.2.2 and 6.3.3. Based on these assumptions, DOE calculated the MDEC allowance (*i.e.*, the sum of the direct and indirect electrical energy consumption) for doors with anti-sweat heat on their viewing windows, which can be found in Table II.1.

Digital Temperature Displays With or Without Alarms

A digital temperature display provides utility in that it allows for users to easily monitor the temperature of the walk-in. The digital temperature display is connected to a thermocouple that measures the temperature of the walk-in and the interface on the exterior of the walk-in displays the temperature within the walk-in compartment. Based on review of product literature and Kolpak's data, DOE has determined that a digital temperature display could be paired with alarms or be standalone (*i.e.,* without alarms). The alarms alert kitchen staff or others if the refrigerated goods within the walk-in compartment are in conditions that are too warm or too cold, which may spoil or ruin these goods. Additionally, alarms can sound if the walk-in door is left open for too long. Kolpak commented that walk-ins with multiple compartments that have only one exterior door but have doors on interior partitions that separate the compartments often have two temperature alarms on the exterior door so that the alarms can be heard by those outside of the walk-in. (Kolpak, No. 6, Attachment 1 at p. 2) Kolpak stated that the temperature alarm is typically rated at 4 W and Kolpak is unable to source a temperature alarm that has a lower rated power. (*Id*.) Additionally, through its review of hardware and instrument manufacturers product offerings, DOE identified that a panic or entrapment alarm could be installed for use in the event that a user is unable to exit the walk-in. Based on Kolpak's provided data and a review of hardware manufacturer product literature, DOE assumed a digital temperature display without alarms would have a rated power of 2.4 W and a digital temperature display with alarms would have rated power of 4 W. In consideration of Kolpak's comment that a walk-in comprised of two compartments may require two temperature displays with alarms to be located on the exterior non-display door, DOE assumed that a digital temperature display with alarm(s) would have a total rated power of 8 W *i.e*., to reflect two digital temperature displays with alarms at 4 W each; an alternative approach could account for the power multiplied by the number of temperature displays with alarms present in the walk-in). DOE assumed based on a review of Kolpak's data and product literature that the digital temperature display with or without alarms would always be on, and as such used the PTO specified for other electricity-consuming devices without controls, timers, or auto-shut-off systems per table A.2 of appendix A along with the rated power to determine the direct electrical energy consumption. The temperature display and alarms would likely be sited on the exterior of the walk-in door to be seen and heard, however, components of the display would be located interior to the walk-in, such as the thermocouple. Therefore, DOE conservatively assumed these components would be sited on both the internal and external face of the door for the purposes of determining the indirect electrical energy consumption. See 10 CFR part 431, subpart R, appendix A, sections 6.3.2.2 and 6.3.3. Based on these assumptions, DOE calculated the MDEC allowances (*i.e.*, the sum of the direct and indirect electrical energy consumption) for doors with a (1) digital temperature display without an alarm or (2) digital temperature display with alarms. These calculated MDEC allowances can be found in Table II.1. DOE assumed that a door would either have one or the other, but would not have both (1) a digital temperature display without an alarm or (2) digital temperature display with alarms. As such, only one of these MDEC allowances would apply based on whether there is or is not an alarm connected to the digital temperature display.

Heated Pressure Relief Vent

Heated ventilators, or heated pressure relief vents, are performance-related features that allow doors to open more easily when there is a pressure differential between the interior and the exterior of the walk-in. Kolpak commented that heated ventilators were not considered in DOE's analysis of non-display doors. Kolpak stated that some manufacturers put heated ventilators on a non-door panel so that they are not considered in the energy consumption calculation of a door, however, Kolpak places these devices on the door, where its energy consumption is captured in the daily energy consumption calculation. Kolpak commented that it uses the lowest wattage heated ventilator available. (Kolpak, No. 66 at p. 2) Kolpak’s data indicates that a 4 W heated ventilator is used on doors for both medium-temperature and low-temperature installations. DOE has tentatively determined, however, that while medium-temperature applications may require a pressure relief vent, it may not be necessary for the pressure relief vent to be heated. Therefore, DOE did not develop a MDEC allowance for medium-temperature non-display doors. Additionally, based on review of hardware manufacturer product literature and the recommendations for pressure relief vents based on the size of a walk-in, DOE has tentatively determined that a heated pressure relief vent for a freezer could require up to 23 W of heat to prevent freezing and therefore provide sufficient airflow between the walk-in compartment and the exterior. DOE assumed based on a review of Kolpak's data and product literature that the heater component of the pressure relief vent would always be on, and as such used the PTO specified for other electricity-consuming devices without controls, timers, or auto-shut-off systems per table A.2 of appendix A along with the rated power to determine the direct electrical energy consumption. Because the heated vent is located between both the exterior and interior of the walk-in, it is considered to be located interior to the walk-in for the purposes of determining the indirect electrical energy consumption. See 10 CFR part 431, subpart R, appendix A, sections 6.3.2.2 and 6.3.3. The MDEC allowance for low-temperature doors with heated pressure relief vents can be found in Table II.1.

Components Summary

Table II.1 presents the MDEC allowances for lighting, anti-sweat heat for viewing windows, digital temperature displays/alarms, and heated pressure relief vents, as described in the previous sections.

Table II.1 Maximum Daily Energy Consumption Allowances and Assumptions for Each Component

Device	Wattage of Component(s) (W)	Controls (Y/N)	Location	MDEC Allowance – Medium-Temperature (kWh/day)	MDEC Allowance – Low-Temperature (kWh/day)

Door light, night light, and/or switch	14.3	No	Interior	0.33	0.40
Heated viewing window: Cooler Freezer	34	Yes	Interior	0.25	-
Heated viewing window – freezer	84	Yes	Interior	-	1.42
Digital temperature without alarm	2.4	No	Interior	0.07	0.09
Digital temperature display with alarm	8	No	Interior	0.24	0.30
Heated vent – freezer only	23	No	Interior	-	0.85

As discussed in the preceding paragraphs, each of these electrical components provide some consumer utility when installed on a non-display door. Additionally, having these electrical components installed on the door limits the number of electrical connections that need to be wired when installing a walk-in. Pursuant to EPCA, DOE may establish separate standards for a group of covered equipment (*i.e.*, establish a separate equipment class) if DOE determines that separate standards are justified based on the type of energy used or if DOE determines that the equipment's capacity or other performance-related feature justifies a different standard. (42 U.S.C. 6316(a); 42 U.S.C. 6295(q)(1)(B)) DOE has tentatively determined that that the devices it has listed previously constitute a performance-related feature that justify a higher standard. DOE notes that the information described previously and in Table II.1 was used to develop the MDEC allowances for basic models of non-display doors that have any number of these components. However, DOE notes that for the purposes of determining DEC in accordance with the Federal test procedure at appendix A, manufacturers must follow the instructions for calculating both direct and indirect electrical energy consumption of components as described in appendix A.

DOE reviewed non-public manufacturer data submitted to DOE's Compliance Certification Management System Database ("CCD") to estimate the percentage of the market that includes these other electricity consuming devices on non-display doors. DOE's estimates of shipments containing electricity consuming devices are shown in Table II.2.

Table II.2 Percentage of Non-Display Door Shipments Containing Each Electricity Consuming Device

Component	Percent of Shipments with Component			
	Medium-Temperature, Manual	**Low-Temperature, Manual**	**Medium-Temperature, Motorized**	**Low-Temperature, Motorized**
Lighting	10%	6%	22%	33%
Viewing Window ASH	4%	1%	4%	3%
All Other Electrical Components	8%	8%	28%	73%

DOE requests comment on the MDEC allowances for the specified electricity consuming devices. Additionally, DOE requests comment on the assumed wattages, presence or absence of controls, and location that were considered in the calculation of MDEC allowances for the specified electricity consuming devices.

The analytical results (*i.e.*, LCC, PBP, and NIA) presented in section II.C of this document account for the updates discussed in this section.

b. Adjustment of U-factors and Resulting Thermal Load

The DOE test procedure requires that the total non-display door energy is calculated by summing (1) the total daily energy consumption due to thermal conduction load through the door (*i.e.*, the additional refrigeration energy consumption to overcome conduction through the door), (2) total daily direct electrical energy consumption (*i.e.*, the energy consumed by electrical components sited on the door), and (3) the total daily indirect electrical energy consumption (*i.e.*, the additional refrigeration energy consumption due to thermal output into the walk-in from electrical components contained on the inside face of the door). See 10 CFR part 431, subpart R, appendix A, section 6.3.4. The energy consumption due to thermal conduction load is based on an assumed temperature difference between the interior and exterior of the walk-in, an assumed refrigeration system energy efficiency ratio (“EER”), and the U-factor and size of the door. Improvements to the design and/or materials of the door and its frame could result in a decreased thermal load.

At the proposed standard level in the September 2023 NOPR, DOE assumed that all manual-opening non-display doors would need to implement anti-sweat heater controls, improved framing systems, and reduced anti-sweat heat. 88 FR 60746, 60845. As discussed in the September 2023 NOPR TSD, DOE determined U-factors for each representative door size by scaling the U-factors determined from tested non-display doors based on theoretical U-factors. DOE also assumed each non-display door had a window sized at 2 ft^2. Wood frames are the least efficient framing material currently found on the market and were selected as the baseline framing material. High-density polyurethane door frames are more thermally insulative and were selected as the improved framing material. See section 5.7.1.3 of the September NOPR TSD. In response to the September 2023 NOPR, Kolpak commented that it uses low-density, high-insulation foam core material in its frame, which has better insulation than wood or high-density foam. (Kolpak, No. 66 at p. 2) Therefore, DOE would expect that the thermal load at the proposed level to be consistent with or greater than the thermal load in the Kolpak data.

In the data provided by Kolpak there are U-factor test results for both medium-temperature and low-temperature non-display doors of various sizes with and without a window. (Kolpak, No. 66 Attachment 2) For medium-temperature doors, DOE found that the thermal conduction load at the proposed energy conservation standard level from the

September 2023 NOPR is consistent with the thermal conduction load calculated from the data provided by Kolpak data. For low-temperature doors, DOE found that the thermal conduction load at the proposed energy conservation standard level from the September 2023 NOPR was lower than the thermal conduction load calculated from the data provided by Kolpak data. To further evaluate thermal conduction load for both medium-temperature and low-temperature non-display doors, DOE further reviewed additional non-public manufacturer data submitted to DOE's Compliance Certification Management System Database ("CCD"). Manufacturers are not currently required to certify the U-factor or thermal conduction load to the CCD; however, they are required to certify the rated power of each light, heater wire, and/or other electricity consuming device associated with each basic model and whether such device(s) has a timer, control system, or other demand-based control reducing the device's power consumption. See 10 CFR 429.53(b)(4)(i). Using the certified data, DOE back-calculated the thermal load and ultimately U-factor for multiple basic models of medium-temperature and low-temperature non-display doors. DOE verified these back-calculated U-factors with its own test data. DOE compared the thermal conduction load by non-display door area (A_{ND}) of (1) Kolpak's data, (2) any back-calculated data from the CCD that has been verified with test data, (3) data received during confidential manufacturer interviews, and (4) test data, with the thermal load by non-display door area for each representative unit and efficiency level with a different door construction design (and thus different thermal conduction load) from the September 2023 NOPR. DOE is posting a supplementary file that contains supplementary information to support the analysis provided in this NODA (referred to as the "NODA support document").[6] The updated thermal conduction load for low-temperature non-display doors is shown in Figure 4.1 of the NODA support document that has been posted to the docket. Additionally, the updated energy

[6] The NODA support document can be found in the docket at *www.regulations.gov/document/EERE-2017-BT-STD-0009*.

consumption values for low-temperature non-display doors that reflect the U-factor and resulting thermal load update can be found in section 2 of the NODA support document. Note that these energy consumption values do not account for any of the MDEC allowances.

For low-temperature applications, DOE has tentatively determined that the thermal conduction load by area for low-temperature applications in the proposed standard level from the September 2023 NOPR is lower than that calculated using the data DOE evaluated for this NODA. Therefore, DOE increased the U-factors for each representative unit of low-temperature non-display doors by 9-percent for this NODA. DOE has tentatively determined that this increase in U-factor would be more representative of the low-temperature non-display doors currently on the market.

DOE requests comment on representativeness of the adjustments made to the U-factors for the low-temperature non-display doors.

The analytical results (*i.e.*, LCC, PBP, and NIA) presented in section II.C of this document account for the updates discussed in this section.

2. Dedicated Condensing Units and Single-Packaged Dedicated Systems

a. More Efficient Single Speed Compressors

In the September 2023 NOPR, DOE analyzed higher-efficiency compressors for dedicated condensing units and single-packaged dedicated systems. The higher-efficiency compressor design options included both higher-efficiency single-speed compressors and variable-speed compressors. For single-packaged dedicated systems, DOE considered both higher-efficiency single-speed compressors and variable-speed compressors in the September 2023 NOPR. However, DOE did not consider higher-efficiency single-speed compressors for dedicated condensing units in the September 2023 NOPR. See section 5.7.2.1 of the September 2023 NOPR TSD for further discussion.

In response to the September 2023 NOPR, the Efficiency Advocates recommended that DOE analyze improved single-speed compressor efficiency as a design option. (Efficiency Advocates, No. 77 at p. 2) The Efficiency Advocates stated that there is a range of single-speed compressor efficiencies available even when selecting for a given compressor type, capacity, input voltage, power supply, and refrigerant. (*Id.* at p. 2)

The CA IOUs recommended that DOE consider two single-speed compressor efficiencies (*i.e.*, CMP1 and CMP2) as design options for dedicated condensing units. (CA IOUs, No. 76 at pp. 8-9) The CA IOUs stated that the compressor manufacturers Copeland and Bitzer offer two or three more compressor options with different efficiencies at each size and temperature application and that therefore CMP1 and CMP2 are justified as design options. (*Id.* at pp. 8-9)

In response to the comments received, DOE reviewed publicly available compressor performance data for both medium-temperature and low-temperature walk-in applications. DOE specifically collected data for compressors applicable to the range of representative capacities analyzed for dedicated condensing units in the September 2023 NOPR.[7] For this NODA analysis, DOE only considered single-speed compressors compatible with R-448A that are rated at the DOE walk-in test conditions and available for the north American walk-in market.[8] DOE excluded from consideration any compressors that may negatively impact

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[7] These capacities are as follows: 9 kBtu/h, 25 kBtu/h, 54 kBtu/h, 75 kBtu/h, and 124 kBtu/h for medium-temperature dedicated condensing units; 3 kBtu/h, 9 kBtu/h, 54 kBtu/h, 75 kBtu/h for low-temperature dedicated condensing units.

[8] For a discussion of DOE's tentative conclusions regarding the appropriateness of setting standards based upon models operating with R-448A, see 88 FR 60746, 60771.

consumer utility—*e.g.*, DOE did not consider three-phase compressors when there were options for both single- and three-phase compressors at a given capacity, as some buildings where walk-ins are installed may not have the necessary three-phase power. Additionally, as discussed in section 5.7.2.1 of the September 2023 NOPR TSD, during interviews manufacturers highlighted utility concerns related to customer preference for specific compressor types (*e.g.*, scroll, semi-hermetic, etc.). Therefore, when evaluating higher-efficiency single-speed compressors for this NODA, DOE selected the highest compressor efficiency that would still allow for consumer choice between scroll and semi-hermetic compressors if both compressor types were available at the given representative capacity. DOE notes that it cannot verify that the compressor data provided by the CA IOUs and Efficiency Advocates in their respective comments are representative of compressors rated at DOE walk-in test conditions. Additionally, the compressors provided may impact utility because there are both scroll and semi-hermetic types. Therefore, DOE did not evaluate the compressors provided in the comments from the CA IOUs and Efficiency Advocates. However, using the criteria described for reviewing publicly available compressor data, DOE identified single-speed compressors with capacities roughly between 50 and 60 kBtu/h that have higher efficiencies than the compressor in that capacity range used in the September 2023 NOPR analysis. Compressors in this capacity range could be used in the DC.M.O.054, DC.M.I.054, and DC.M.O.124 representative units.[9] DOE did not identify any higher efficiency single-speed compressors for low-temperature applications at the representative capacities analyzed based on the criteria previously mentioned.

As such, DOE determined that a higher-efficiency single-speed compressor design option could be applied to the following representative units: DC.M.O.054, DC.M.I.054, and

[9] DOE used two compressors with capacities between 50 and 60 kBtu/h for the 124 kBtu/h medium-temperature outdoor dedicated condensing unit. DOE determined that this would be representative for units of this capacity.

DC.M.O.124. In this NODA, DOE presents an updated analysis when considering the additional compressor design option for these three representative units.

In its updated analysis, DOE added an efficiency level ("EL") which corresponds to the higher-efficiency single-speed compressor design option for the three representative units mentioned previously. The higher-efficiency single-speed compressor has an EER for walk-in refrigeration systems of 7.62 Btu/(W-h), which is 5 percent greater than the baseline compressor's EER of 7.25 Btu/(W-h).[10] Similar to the NOPR analysis, DOE ordered the design options for each representative unit in terms of decreasing cost-effectiveness (manufacturer production cost differential/AWEF2 differential). Table 3.1 of the NODA support document describes the design option codes related to the refrigeration system representative units analyzed in this NODA. The higher-efficiency single-speed compressor was added at EL 1 for the DC.M.I.054 representative unit and at EL 3 for both DC.M.O.054 and DC.M.O.124 representative units. As a result, the design options that are used at ELs after the higher-efficiency single-speed compressor design option are now associated with one EL higher than in the September 2023 NOPR. For example, in the September 2023 NOPR, electronically commutated ("EC") condenser fan motors were implemented at EL 1 for the DC.M.I.054 Because the higher-efficiency single-speed compressor design option was implemented at EL 1 in this NODA analysis, the EC condenser fan motor design option is implemented at EL 2 for this representative unit.

Section 3 of the NODA support document shows the cost-efficiency results from the September 2023 NOPR, which were published in appendix 5A of the September 2023 NOPR

[10] DOE determined compressor performance using conditions representative of the A condition test specified by the DOE test procedure for walk-in refrigeration systems in appendix C1 to subpart R of 10 CFR part 431. The test conditions used to determine compressor performance were as follows: a return gas temperature of 41 °F, an evaporator dewpoint temperature of 23 °F, and a condenser dewpoint temperature of 120 °F.

TSD,[11] and the updated cost-efficiency results with the additional compressor design option EL. The tables show the AWEF2, manufacturer production cost ("MPC"), and manufacturer selling price ("MSP") plus shipping costs associated with each EL. DOE notes that due to the interaction between design options in the engineering analysis, the performance increase and/or incremental MPC associated with design options added after the higher-efficiency single-speed compressor design option differ from those presented in the NOPR analysis.

DOE requests comment on the updated cost-efficiency results for the 54 kBtu/h indoor and outdoor medium-temperature dedicated condensing units and 124 kBtu/h outdoor medium-temperature dedicated condensing unit presented in section 3 of the NODA support document.

The analytical results (*i.e.*, LCC, PBP, and NIA) presented in section II.C of this document account for the updates discussed in this section.

b. Off-Cycle Ancillary Power

Based on test data available at the time, in the September 2023 NOPR analysis DOE tentatively determined that the only source of off-cycle power for dedicated condensing units and single-packaged dedicated systems would be crankcase heater power. See section 5.6.3.3 of the September 2023 NOPR TSD. DOE assumed that the off-cycle crankcase heater power would be the same for both medium-temperature and low-temperature applications, which DOE estimated using crankcase heater wattage specifications from compressor manufacturer product literature.

[11] DOE notes that in appendix 5A of the September 2023 NOPR TSD, the tables label the efficiency values in terms of AWEF, however, they are in terms of AWEF2 and should have been labeled as such.

In response to the September 2023 NOPR, AHRI and Hussmann commented that there are potential sources of off-cycle ancillary power that DOE did not account for and should consider, such as standard operating controls, defrost time clocks, digital controllers, and transformers. (AHRI, No. 72 at p. 19; Hussmann, No. 75 at p. 9)

In response to these comments, DOE analyzed additional test data and compared the tested off-cycle power values to the crankcase heater wattages specified by compressor manufacturers. DOE found that for medium-temperature dedicated condensing units, the assumed crankcase heater wattage used in the NOPR analysis matched both the tested off-cycle power values and the compressor manufacturer-specified wattages. Therefore, DOE has tentatively determined that the assumed crankcase heater wattages used to analyze medium-temperature dedicated condensing units and single-packaged dedicated systems in the NOPR analysis are representative of the entire off-cycle power of such units.

For low-temperature dedicated condensing units, DOE found that the off-cycle power test data was up to 5 Watts greater than the compressor manufacturer-specified crankcase heater wattages, indicating there may be additional sources of off-cycle power other than the crankcase heater. Additionally for low-temperature units, DOE found that the compressor manufacturer-specified crankcase heater wattages at a given capacity range were slightly different than those specified for medium-temperature units. Therefore, for this NODA, DOE adjusted the assumed crankcase heater wattages for low-temperature dedicated condensing units and single-packaged dedicated systems, as shown in table II.2 and table II.3. DOE also added 5 Watts of off-cycle ancillary power not associated with crankcase heater power for all low-temperature dedicated condensing units and single-packaged dedicated systems. Both changes can be seen in the updated refrigeration engineering analysis spreadsheet.[12] As

[12]The updated refrigeration systems engineering sheet can be found in the docket for this rulemaking at *www.regulations.gov/docket/EERE-2017-BT-STD-0009*.

indicated by commenters, DOE suspects that this additional 5 Watts of power is attributed to timers and controls associated with defrost cycles.

Table II.3 Crankcase Heater Power (W) for Low-Temperature Refrigeration Systems from September 2023 NOPR

	Refrigeration System Capacity			
Compressor Type	**< 10,000 Btu/h**	**≥ 10,000 and < 50,000 Btu/h**	**≥ 50,000 – < 100,000 Btu/h**	**≥100,000 – < 200,000 Btu/h**
Hermetic	40	-	-	-
Scroll	40	67	90	100
Semi-Hermetic	40	50	70	100
Rotary	27	-	-	-

Table II.4 Updated Crankcase Heater Power (W) for Low-Temperature Refrigeration Systems for this NODA

	Refrigeration System Capacity			
Compressor Type	**< 5,000 Btu/h**	**≥ 5,000 – < 20,000 Btu/h**	**≥ 20,000 – < 50,000 Btu/h**	**≥ 50,000 – < 200,000 Btu/h**
Hermetic	40	-	-	-
Scroll	40	70	73	100
Semi-Hermetic	40	50	70	100
Rotary	27	-	-	-

DOE requests comment on the updated crankcase heater wattages and additional off-cycle ancillary power for low-temperature dedicated condensing units and single-packaged dedicated systems.

The analytical results (*i.e.*, LCC, PBP, and NIA) presented in section II.C of this document account for the updates discussed in this section.

c. Low GWP Refrigerant Transition

As discussed in the September 2023 NOPR, the Environmental Protection Agency ("EPA") published a NOPR, "Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons Under Subsection (i) the American Innovation and

Manufacturing Act of 2020", on December 15, 2022, as a part of the American Innovation and Manufacturing ("AIM") Act, which outlined new refrigerant regulations regarding acceptable global warming potential ("GWP") limits for various air conditioning and refrigeration systems. 87 FR 76738. On October 24, 2023, EPA finalized these proposals ("October 2023 AIM Act Final Rule"). 88 FR 73098. The October 2023 AIM Act Final Rule established (effective January 1, 2026) a limit of 300 GWP for remote condensing units in retail food refrigeration systems and cold storage warehouses with less than 200 lbs of charge, which includes split-system walk-in refrigeration systems covered under the scope of the September 2023 NOPR. 88 FR 73098, 73209. In the September 2023 NOPR, DOE analyzed R-454A and R-455A refrigerants which have GWPs less than 300 and tentatively determined that R-454A would be the most likely replacement refrigerant for medium- and low-temperature walk-in refrigeration systems once the regulations finalized in the October 2023 AIM Act Final Rule take effect. DOE also tentatively determined that R-454A would have comparable performance to the currently-used refrigerant R-448A. 88 FR 60746, 60772. As there was limited compressor performance data available for R-454A at the time, DOE used R-448A as the basis for its engineering analysis for medium- and low-temperature dedicated condensing units and single-packaged dedicated systems.[13] *Id*. In the September 2023 NOPR, DOE requested performance data for walk-in refrigeration systems using R-454A, R-454C, and/or R-455A. DOE also sought comment on its tentative determinations that R-454A is the most likely replacement for the current refrigerants being used (*i.e.*, R-448A and R-449A) and that walk-in dedicated condensing systems would not suffer a performance penalty when switching from R-448A or R-449A to R-454A. *Id.*

[13] DOE notes that a more efficient single-speed compressor that used propane was analyzed as a design option for some single-packaged dedicated systems. A propane compressor was analyzed if the charge limit for propane was sufficient to provide the analyzed capacity and the propane compressor resulted in increased efficiency.

In response, AHRI, Lennox, and Hussmann commented that R-454A is comparable in performance to R-448A but that it is not the most likely low-GWP replacement for WICFs because R-454A has a GWP above 150. (AHRI, No. 72 at p. 10; Lennox, No. 70 at pp. 6-7; Hussmann, No. 75 at p. 10) AHRI and Lennox recommended that modeling should instead be conducted using R-454C and/or R-455A since California and Washington state regulations prohibit the use of a refrigerant with a GWP greater than 150 for systems with more than 50 lbs. of refrigerant charge. (AHRI, No. 72 at p. 10; Lennox, No. 70 at pp. 6-7) Hussmann and NRAC commented that there may be some states with stricter regulations than the EPA that may not allow refrigerants above 150 GWP. (Hussmann, No. 75 at p. 10; NRAC, No. 73 at p. 2)

DOE acknowledges that certain localities already require, or may require in the future, WICF refrigeration systems to be designed for use with sub-150 GWP refrigerants.[14] Based on analysis of low-GWP refrigerant performance in walk-in refrigeration systems conducted for the September 2023 NOPR, DOE has tentatively concluded that the highest performing sub-150 GWP refrigerant appropriate for use in split-system walk-in refrigeration systems is R-454C. See section 5.6.3.1 of the September 2023 NOPR TSD. To assess the potential impact of state level sub-150 GWP requirements, DOE reviewed the EERs of R-454C compressors with capacities representative of walk-in refrigeration systems and compared these EERs to those of the baseline compressors analyzed in the September 2023 NOPR. DOE determined the R-454C EERs at operating conditions representative for the A test conditions prescribed in the DOE test procedure for walk-in refrigeration systems,

[14] California established (effective January 1, 2022) a limit of 150 GWP for retail food refrigeration equipment and cold storage warehouses with less than 50 lbs of charge. Washington is expected to establish a limit of 150 GWP for retail food refrigeration equipment and cold storage warehouses with less than 50 lbs of charge.

adjusting the condensing dewpoint up 2 ºF to account for the higher refrigerant temperature glide of R-454C as compared to R-448A or R-454A.

DOE found that trends in the R-454C compressor efficiencies generally aligned with the compressor EERs used in the September 2023 NOPR analysis, except for the DC.M.O.025 and DC.M.I.025 representative units. At this 25 kBtu/h capacity DOE found that the available R-454C compressor had an EER that is 4 percent less than that of the compressor analyzed in the September 2023 NOPR. Based on this, DOE determined that using the R-454C compressor analyzed could result in an AWEF2 that is 2 percent lower for 25 kBtu/h medium-temperature dedicated condensing units than a comparable unit using an R-454A-compatible compressor. As such, and in the absence of more efficient compressors of the same type compatible with R-454C, DOE has tentatively determined that to achieve the standard proposed in the September 2023 NOPR (based on the performance of R-448A), a medium-temperature walk-in refrigeration system using a sub-150 GWP refrigerant may need to incorporate additional design options beyond what DOE presumed in the September 2023 NOPR. To determine the cost of these additional design options DOE constructed the cost curves corresponding to use of the R-454C compressor (with roughly 2-percent reduction of AWEF2 for each evaluated design) and calculated additional cost to attain the proposed AWEF2 by interpolating along the cost-efficiency curves. Based on this analysis DOE has tentatively determined that additional MSP required to achieve the proposed AWEF2 for less-than-150 GWP refrigerant would be $381 for 25 kBtu/h medium temperature indoor dedicated condensing units and $96 for 25 kBtu/h medium temperature outdoor dedicated condensing units.

DOE requests comment on the estimated additional MPC associated with 25 kBtu/h medium temperature indoor and outdoor dedicated condensing units achieving the proposed AWEF2 standard levels while operating with a refrigerant with less than 150 GWP.

The analytical results (*i.e.*, LCC, PBP, and NIA) presented in section II.C account for the cost adder presented in this section, as described in section II.C.1.a of this document.

d. Miscellaneous Updates to the Engineering Analysis Spreadsheet

In response to the September 2023 NOPR, stakeholders commented that there were several issues with calculations in the refrigeration systems engineering spreadsheet.[15] AHRI and Hussmann suggested several corrections to the engineering spreadsheet. (AHRI, No. 72 at pp. 17-19; Hussmann, No. 75 at pp. 7-9) DOE also identified several issues not prompted by comments. DOE discusses the corrections that it made in this NODA in the following paragraphs. To the extent that stakeholders made comments on the engineering spreadsheet and DOE has determined that updates to the spreadsheet are not necessary, DOE will address those comments in a subsequent rulemaking.

AHRI and Hussmann commented that row 77 for the condenser and row 86 for the evaporator on the 'Calculation' tab were calculating pressures at the incorrect point of the refrigeration cycle, claiming that all subsequent calculations use the wrong pressures. (AHRI, No. 72 at pp. 17-18; Hussmann, No. 75 at pp. 7-8) DOE notes that the calculations in question are used only for determination of refrigerant glide to adjust from midpoint to dewpoint. The errors in these adjustments result in roughly 0.1 ºF difference in calculated dew point temperature for the condenser. They result in zero difference in evaporator dew

[15] The September 2023 NOPR refrigeration systems engineering sheet can be found at *www.regulations.gov/docket/EERE-2017-BT-STD-0009-0052.*

point temperature for dedicated condensing unit calculations (for which evaporator dew point temperature is prescribed by the test procedure) and roughly 0.03 ºF difference for single-packaged dedicated systems calculations. These differences make no significant impact on overall results. Nevertheless, DOE has revised the calculations for this NODA such that the calculation will be based on a quality of 0.5 for the condenser, which is representative of the condenser midpoint, and a quality for the evaporator somewhat greater than 0.5 to account for the fact that evaporator refrigerant inlet quality is non-zero.

AHRI and Hussmann commented that in rows 165 and 233 of the 'Calculations' tab, which contain the condenser half glide calculation for B and C conditions, the formula is using a temperature input rather than a pressure input to calculate a temperature output. (AHRI, No. 72 at pp. 18 – 19; Hussmann, No. 75 at p. 9). This calculation results in overestimation of the dew point by roughly 0.5 ºF, and a corresponding slight overestimation of compressor energy use. DOE has revised this calculation for this NODA.

In the September 2023 NOPR, the cost of additional spark-proofing electronic components was not properly accounted for due to an incorrect formula. In the updated refrigeration system engineering analysis spreadsheet, DOE updated the compressor cost calculation (which feeds into the MPC) to include the additional costs for spark-proofing electronic components for single-packaged dedicated systems that use propane as the refrigerant. As a result of this change in MPC associated with propane-compatible compressors, DOE reordered the design options of the SP.M.O.002 and SP.M.I.002 representative units such that the design options are ordered from most cost-effective AWEF2 improvements to the least cost-effective AWEF2 improvements, where cost-effectiveness is based on the ratio of AWEF2 increase to MPC increase.

In the September 2023 NOPR, all the high-temperature, 2 kBtu/h and 7 kBtu/h, outdoor single-packaged dedicated system representative units implemented the variable-speed condenser fan design option before the electronically commutated motor design option was implemented. However, an electronically commutated motor is a prerequisite for the variable-speed condenser fan design option. In the updated refrigeration system engineering spreadsheet, DOE reordered the variable-speed condenser fan and electronically commutated motor design options for these representative units. DOE notes that reordering these design options did not impact the results of the proposed efficiency level as both design options were included in the efficiency level corresponding to the proposed standard level.

Additionally, DOE updated the calculation of the enthalpy exiting the unit cooler that is used in the calculation of the gross capacity for dedicated condensing units to be consistent with the DOE test procedure. See section C7.5.2 of American National Standards Institute/Air-Conditioning, Heating, and Refrigeration Institute Standard 1250 (I–P), "2020 Standard for Performance Rating of Walk-in Coolers and Freezers". The calculation for the enthalpy exiting the unit cooler for single-packaged dedicated systems was consistent with the DOE test procedure for the NOPR analysis and therefore, DOE did not update it for single-packaged dedicated systems for this NODA.

Overall, the updates made to the engineering analysis spreadsheet resulted in a minimal change to the cost-efficiency curves for each representative unit. Comparing efficiency levels with the same design option combinations for each representative unit between the September 2023 NOPR and this NODA, the AWEF2s generally increased or decreased between 1- and 3-percent as a result of the changes discussed previously. Similarly, in this NODA, design option order generally remained as it was in the NOPR, and manufacturer production costs did not change from the NOPR for many representative units.

However, in some cases, changes in representative unit performance at the baseline required re-baselining to meet the current energy conservation standards. This re-baselining resulted in slightly different combinations of design options at the baseline efficiency level for the following representative units, which also resulted in either more or fewer design options above baseline depending on whether the baseline efficiency level needed fewer or more design options at the baseline to meet the current AWEF standards: DC.M.O.009, DC.M.I.025, DC.L.O.075, and SP.L.I.006. Additionally, some of the changes to the engineering spreadsheet impacted cost model inputs (*e.g.*, fan motor horsepower impacts the cost of a fan motor); therefore, there are slight changes to the manufacturer production costs associated with some representative units' efficiency levels even if the design option order has not changed from the September 2023 NOPR analysis. This was the case for the following representative units: DC.M.O.009, DC.M.O.025, DC.M.O.054, DC.M.O.075, DC.M.O.124, DC.M.I.009, DC.M.I.025, DC.M.I.054, DC.M.I.075, DC.L.O.003, DC.L.O.009, DC.L.O.025, DC.L.O.054, DC.L.I.003, DC.L.I.009, DC.L.I.025, DC.L.I.054, SP.L.O.002, and SP.L.I.002.

See section 3 of the NODA support document for updated cost-efficiency results. The analytical results (*i.e.*, LCC, PBP, and NIA) presented in section II.C of this document account for the updates discussed in this section.

3. Unit Coolers

a. Cost Assumptions at Max-Tech Efficiency Levels

In the September 2023 NOPR, using the Unit Cooler Performance Database[16] DOE developed linear cost-efficiency correlations for each representative unit, which DOE used to

[16] The Unit Cooler Performance Database can be found at *www.regulations.gov/document/EERE-2017-BT-STD-0009-0064.*

determine the MPC increase from the baseline efficiency level to the higher efficiency levels for unit coolers. See section 5.8.6 of the September 2023 NOPR TSD. When building the Unit Cooler Performance Database, DOE did not consider that adding additional rows to the unit cooler heat exchanger would require an increase in cabinet size when determining the MPCs associated with each efficiency level. DOE based this assumption on manufacturers' unit cooler product catalogs, which included unit cooler case dimensions.

In response, Lennox stated that increasing 4-row unit cooler designs to 5- or 6-row designs is not cost-effective because adding coil rows has diminishing returns on improved efficiency and would result in increased coil face area and increased cabinet size. (Lennox, No. 70 at p. 4) AHRI, Hussmann, and Lennox commented that current unit cooler coil and cabinet designs are optimized around 4-row designs and increasing efficiency would be more costly than what DOE estimated when considering packaging, freight, materials, and scrap. (AHRI, No. 72 at pp. 3-4, 9; Hussmann, No. 75 at pp. 2, 12; Lennox, No. 70 at p. 4) [17]

During the development of the September 2023 NOPR analysis, DOE identified several manufacturers producing unit coolers with heat exchangers 5 or more rows deep. However, DOE acknowledges the concerns of AHRI, Lennox, and Hussmann that some manufacturers may not be currently producing unit coolers with heat exchangers 5 rows deep. As such, these manufacturers may need to expand the cabinet size of their 4-row unit coolers to accommodate larger heat exchangers (*i.e.*, evaporator coils with at least 5 rows). In response to this feedback, DOE updated its analysis for this NODA and assumed that the unit

[17] DOE notes that it also received comments indicating that the conversion costs for refrigeration systems should be incorporated as an amortized consideration in the MSP. DOE will consider and address these stakeholder comments in a subsequent rulemaking.

cooler case would have to be expanded to accommodate an additional row at the maximum technology ("max-tech") efficiency level for every unit cooler representative unit.

DOE estimated the additional MPC using the same cost modeling processes described in section 5.4 of the September 2023 NOPR TSD. The additional MPC includes additional material, scrap, and packaging associated with the cabinet size increase. DOE developed this additional MPC for expanding unit cooler case size for several representative units. The average cost adder associated with the cabinet size increase was $11 for the representative capacities DOE analyzed. Updated unit cooler cost efficiency curves can be found in section 3 of the NODA support document.

DOE has tentatively determined that the increase in shipping cost would not significantly affect the analysis and therefore, did not include this in the revised analysis in this NODA.

The analytical results (*i.e.*, LCC, PBP, and NIA) for unit coolers presented in section II.C of this document account for the updates discussed in this section.

b. Unit Cooler Fan Power

As discussed in section 5.5.4.2 of the September 2023 NOPR TSD, DOE used unit cooler fan powers from manufacturer product catalogs to construct the Unit Cooler Performance Database. In general, DOE found that the fan powers reported in product catalogs were constant across unit cooler models that only appeared to differ in the number of rows in their heat exchangers. Further, fan motor powers per fan were the same across families of unit coolers having the same general geometry and fan diameter, where the unit coolers differed only by overall unit cooler length (and number of fans) and number of tube rows in the evaporator. As such, DOE assumed for the NOPR analysis that unit cooler fan power would not change when additional heat exchanger rows were added.

Lennox stated that adding additional rows would have diminishing performance returns for several reasons including that higher fan power is needed to maintain airflow when additional coil depth is added due to the additional pressure drop imposed by the added tube rows. (Lennox, No. 70 at p. 4)

Increasing heat exchanger size by adding a row could increase the internal static pressure ("ISP") that the unit cooler fan would need to overcome and would therefore require more fan power to maintain the same airflow at a higher ISP. DOE notes that when unit cooler airflow is reported in product catalogs for models that only appear to differ in number of heat exchanger rows, the airflow generally decreases when an additional heat exchanger row is added, but (as previously noted) the fan power listed stays constant. To quantify the potential increase in fan power, DOE estimated the increase in ISP associated with adding additional heat exchanger rows using CoilDesigner.[18] For the CoilDesigner model, DOE assumed heat exchanger and fan characteristics based on physical and catalog teardowns of unit coolers and unit cooler airflow based on manufacturer product catalogs. DOE estimated a percentage fan power increase using representative fan performance curves, the reported air flow, and unit cooler system pressure drop before and after adding the coil row, accounting for the additional ISP estimated using CoilDesigner. Based on this analysis, DOE has tentatively determined that increasing the number of heat exchanger rows from 2 to 3 or 3 to 4 would result in roughly a 6-percent increase in unit cooler fan power, and increasing heat

[18] CoilDesigner is a heat exchanger coil simulation tool. CoilDesigner Version 4.8.20221.110 was used for this analysis.

exchanger rows from 4 to 5 would result in roughly a 4-percent unit cooler fan power increase.

Although the fan power reported in product catalogs does not appear to change, as the number of heat exchanger rows changes, it is likely, as indicated by the analysis described above, that the fan power is different for these models. To evaluate the potential impact of this variation on potential ranges of AWEF2, DOE evaluated multiple scenarios regarding fan power increase with the Unit Cooler Performance Database medium-temperature unit coolers. For medium-temperature unit coolers, AWEF2 depends only on the fan power and capacity, and questions about potential variation in the defrost energy (a factor for low-temperature unit coolers), would not apply. The initial construction of the Unit Cooler Performance Database, posted to the rulemaking docket, was based on using the literature fan power as reported (*i.e.*, DOE did not consider any changes to fan power based on number of rows).[19] DOE further evaluated two alternative approaches: (a) that the reported fan power applies for unit coolers with the least number of tube rows and therefore, the actual fan power increases above the levels reported in the literature with additional tube rows; and (b) that the reported fan power applies for the unit coolers with the greatest number of tube rows and therefore, the actual fan power decreases below the levels reported in the literature with fewer tube rows. For each scenario, DOE adjusted the unit cooler fan powers based on the ISP difference determined by DOE's Coil Designer analysis. In all cases, the calculated AWEF2 values include many that are lower than the current baseline level. However, the number of AWEF2 values that are lower than the current baseline level is significantly lower for approach (b) described previously. The highest AWEF2 values are roughly the same at 10.0 for the NOPR scenario (no fan power differences within a family of unit coolers) and

[19] The Unit Cooler Performance Database can be found at *www.regulations.gov/document/EERE-2017-BT-STD-0009-0064.*

scenario (b), and are lower (close to 9.7) for scenario (a). Given that the unit coolers evaluated are all certified as compliant with DOE standards, and the likelihood that the reported motor power would apply for the highest-power (motor design) operating point, DOE concludes that scenario (b) is the most likely. DOE notes that for all three of the scenarios, the Unit Cooler Performance Database has AWEF2 values that are higher than the max-tech AWEF2 values calculated for the representative capacities. Thus, DOE concludes that the max-tech efficiency levels considered in the NOPR were not overestimated due to the potential increase in fan power as additional tube rows are added within the range considered. Therefore, DOE did not adjust the unit cooler AWEF2 values proposed in the September 2023 NOPR based on the potential for additional unit cooler rows to impose additional ISP that could require increased fan power. The results of the three scenarios are shown in Figure 5.1 through Figure 5.3 of the NODA support document that has been posted to the docket.

c. Miscellaneous Updates to The Unit Cooler Analysis

After the September 2023 NOPR was published, DOE identified an issue in the calculation of baseline net capacities for high-temperature unit coolers in its engineering analysis. DOE corrected this issue for this NODA and as a result baseline AWEF2 values are slightly less than the AWEF2 values shown in the NOPR. Additionally, since the AWEF2 values at efficiency levels above baseline are dependent on the baseline AWEF2 values for the high-temperature unit cooler analysis, the AWEF2 values at higher efficiency levels are less than those AWEF2 values shown in the NOPR. On average, the calculated efficiencies of all high-temperature unit cooler efficiency levels have decreased by 2-percent from the NOPR values.

In addition, DOE found an issue in the calculation of the max-tech MPC of the UC.L.009 representative unit, which resulted in a higher MPC. For this NODA analysis, DOE addressed this calculation issue, which results in an MPC that is 4-percent lower than the MPC presented in the September 2023 NOPR. When accounting for this change and the MPC change associated with the cabinet size increase cost adder discussed in section II.A.3.a, the MPC determined for this NODA is 2-percent less than the MPC presented in the NOPR for this representative unit.

See section 3 of the NODA support document that has been posted to the docket for the updated cost-efficiency curves that includes these corrections. The analytical results (i.e., LCC, PBP, and NIA) presented in section II.C of this document account for these corrections.

B. Trial Standard Levels

DOE analyzed the benefits and burdens of three trial standard levels ("TSLs") for the considered walk-in doors, panels, and refrigeration systems in the September 2023 NOPR. 88 FR 60746, 60785-60786.

DOE notes that the TSLs presented in this NODA are tentative and for evaluating the analytical changes considered in the context of this NODA and DOE may revise the number of, or structure of, these TSLs in response to comments in future analysis. DOE further notes that the TSLs presented in this NODA are within or close to the range of values presented in the September 2023 NOPR.

1. Refrigeration Systems

For this NODA, DOE is presenting three TSLs to demonstrate the changes discussed in sections II.A.2 and II.A.3 of this document that pertain to refrigeration systems. The efficiency levels that correspond to these TSLs for these equipment classes are shown in Table II.5 through Table II.7.

TSL 3 in this NODA includes the efficiency levels that use the combination of design options for each representative unit at the maximum technologically feasible ("max-tech") level. For this NODA, DOE notes a correction here where in the NOPR, the design option representing max-tech for the DC.M.O.054 representative unit was mapped to EL 7 – when in fact it should have been EL 8. With the added efficiency level in this NODA, the max-tech efficiency level for the DC.M.O.054 representative unit is now EL 9 as shown in Table II.5. TSL 1 represents the efficiency levels in this NODA that yield AWEF2 values closest to those AWEF2 values that align with TSL 2 in the September 2023 NOPR, which is the TSL that DOE proposed to adopt. TSL 2 in this NODA is an intermediate TSL that is higher than TSL 1 but below the max-tech level.

Table II.5 Refrigeration Systems Efficiency Level by Representative Unit Mapping for TSL 3

	Capacity (kBtu/hr)								
	2	**3**	**6**	**7**	**9**	**25**	**54**	**75**	**124**
Dedicated Condensing Units									
Low Temperature, Indoor (DC.L.I)		2			1	3	2		
Low Temperature, Outdoor (DC.L.O)		3			5	8	5	4	
Medium Temperature, Indoor (DC.M.I)					1	3	4	3	
Medium Temperature, Outdoor (DC.M.O)					8	8	9	8	9
Single-packaged Dedicated Systems									
High Temperature, Ducted, Indoor (SP.H.ID)	2			2					
High Temperature, Ducted, Outdoor (SP.H.OD)	6			6					
High Temperature, Indoor (SP.H.I)	2			2					
High Temperature, Outdoor (SP.H.O)	6			6					
Low Temperature, Indoor (SP.L.I)	7		2						

Low Temperature, Outdoor (SP.L.O)	4		4						
Medium Temperature, Indoor (SP.M.I)	5				3				
Medium Temperature, Outdoor (SP.M.O)	9				5				
Unit Coolers									
High Temperature (UC.H)					1	1			
High Temperature, Ducted (UC.H.ID)					1	1			
Low Temperature (UC.L)		2			2	2	2	2	
Medium Temperature (UC.M)		2			2	2	2	2	

Table II.6 Refrigeration Systems Efficiency Level by Representative Unit Mapping for TSL 2

	Capacity (kBtu/hr)								
	2	**3**	**6**	**7**	**9**	**25**	**54**	**75**	**124**
Dedicated Condensing Units									
Low Temperature, Indoor (DC.L.I)		1			0	2	1		
Low Temperature, Outdoor (DC.L.O)		2			4	7	4	3	
Medium Temperature, Indoor (DC.M.I)					0	2	3	2	
Medium Temperature, Outdoor (DC.M.O)					3	3	4	3	4
Single-packaged Dedicated Systems									
High Temperature, Ducted, Indoor (SP.H.ID)	2			2					
High Temperature, Ducted, Outdoor (SP.H.OD)	6			6					
High Temperature, Indoor (SP.H.I)	2			2					
High Temperature, Outdoor (SP.H.O)	5			5					
Low Temperature, Indoor (SP.L.I)	4		1						
Low Temperature, Outdoor (SP.L.O)	2		2						
Medium Temperature, Indoor (SP.M.I)	3				1				
Medium Temperature, Outdoor (SP.M.O)	8				3				
Unit Coolers									
High Temperature (UC.H)					0	0			
High Temperature, Ducted (UC.H.ID)					1	1			
Low Temperature (UC.L)		2			2	2	2	2	
Medium Temperature (UC.M)		2			2	2	2	2	

Table II.7 Refrigeration Systems Efficiency Level by Representative Unit Mapping for TSL 1

	Capacity (kBtu/hr)								
	2	**3**	**6**	**7**	**9**	**25**	**54**	**75**	**124**
Dedicated Condensing Units									
Low Temperature, Indoor (DC.L.I)		1			0	2	1		

Low Temperature, Outdoor (DC.L.O)		2			4	7	4	2	
Medium Temperature, Indoor (DC.M.I)					0	2	2	2	
Medium Temperature, Outdoor (DC.M.O)					2	2	2	2	2
Single-packaged Dedicated Systems									
High Temperature, Ducted, Indoor (SP.H.ID)	2			2					
High Temperature, Ducted, Outdoor (SP.H.OD)	5			6					
High Temperature, Indoor (SP.H.I)	1			2					
High Temperature, Outdoor (SP.H.O)	5			5					
Low Temperature, Indoor (SP.L.I)	4		1						
Low Temperature, Outdoor (SP.L.O)	0		1						
Medium Temperature, Indoor (SP.M.I)	3				1				
Medium Temperature, Outdoor (SP.M.O)	8				3				
Unit Coolers									
High Temperature (UC.H)					0	0			
High Temperature, Ducted (UC.H.ID)					1	1			
Low Temperature (UC.L)		2			2	2	2	2	
Medium Temperature (UC.M)		2			2	2	2	2	

2. Non-display Doors

For this NODA, DOE is presenting three TSLs to demonstrate the changes discussed in section II.A.1 of this document that pertain to non-display doors. The efficiency levels that correspond to these TSLs for these equipment classes are shown table II.8.

TSL 3 in this NODA includes the efficiency levels that use the combination of design options for each representative unit at the max-tech level. TSL 1 and TSL 2 are intermediate TSLs between baseline and TSL 3. The efficiency levels for each TSL are based on the updated engineering analysis for non-display doors, as discussed in section II.A.1 of this document and as shown in the NODA support document.

Table II.8 Non-display Doors Efficiency Level to TSL Mapping

Equipment Class	Trial Standard Level		
	1	2	3
Non-display Doors, Manual			
Low Temperature (NM.L)	1	3	5
Medium Temperature (NM.M)	1	3	6
Non-display Doors, Motorized			
Low Temperature (NO.L)	1	3	5
Medium Temperature (NO.M)	1	3	6

C. Analytical Results

To quantify the impacts to consumers and the Nation from the additional analysis of the technologies described in section II.A of this document, DOE ran its life-cycle cost ("LCC") and payback period ("PBP") analysis and national impacts analysis ("NIA") with the same inputs as it used in the September 2023 NOPR, with the exception of the changes described in sections II.A and II.B of this document. DOE also considered the potential impacts of the updated analysis discussed in this NODA on the manufacturer impact analysis ("MIA"). As discussed in chapter 12 of the September 2023 NOPR TSD, DOE relies on several sources, including the engineering analysis and the shipments analysis, to obtain inputs to quantify the potential impacts of amended energy conservation standards on the walk-in cooler and freezer industry. Changes to MSPs and shipments would affect industry revenue, and, therefore, the MIA results. However, considered in isolation, DOE does not expect that the changes to the engineering analysis or shipments distribution detailed in this NODA would substantively alter the industry financial results (represented by change in industry net present value) presented in the September 2023 NOPR. DOE will assess and incorporate the most up-to-date data in any subsequent MIA conducted for this rulemaking.

1. Life-Cycle Cost and Payback Period Analysis

DOE analyzed the economic impacts on walk-in coolers and freezers consumers by looking at the effects that potential amended standards at each TSL would have on the LCC and PBP. The detailed description of how DOE calculates its LCC impacts can be found in chapter 8 and associated appendices of the September 2023 NOPR TSD.

In general, higher-efficiency equipment affect consumers in two ways: (1) purchase price increases and (2) annual operating costs decrease. Inputs used for calculating the LCC and PBP include total installed costs (*i.e.*, product price plus installation costs), and operating costs (*i.e.*, annual energy use, energy prices, energy price trends, repair costs, and maintenance costs). The LCC calculation also uses product lifetime and a discount rate. For this NODA, DOE maintained the same methods and modeling assumptions discussed in chapter 8 of the September 2023 NOPR TSD with the exception of the revised engineering analysis discussed in section II.A of this document and TSL composition discussed in section II.B of this document.

a. Application of the Low-GWP Refrigerant Transition to Specific Regions

As discussed in section II.A.2.c of this document, the states of California and Washington require the use of sub-150-GWP refrigerants. In the September 2023 NOPR, DOE conducted its LCC analysis at the geographic level of Census regions, where the region containing the states of California and Washington is the Western Region (Region 4).[20] To approximate any additional costs associated with moving to low-GWP refrigerants to consumers in California and Washington DOE applied the cost of the additional design options determined in section II.A.2.c of this document to the fraction of consumers in

[20] See: *https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf.*

Western Census Region based on population.[21] Theses weights and design option cost are shown in table II.9.

Table II.9 Low-GWP Refrigerant Cost Adders

EC	Capacity (kBtu/hr)	Census Region	Cost Adder ($)	Weight
DC.M.I	3	4	0	0.59
	3	4	0	0.41
	9	4	0	0.59
	9	4	0	0.41
	25	4	381.20	0.59
	25	4	0	0.41
	54	4	0	0.59
	54	4	0	0.41
	75	4	0	0.59
	75	4	0	0.41
DC.M.O	3	4	0	0.59
	3	4	0	0.41
	9	4	0	0.59
	9	4	0	0.41
	25	4	95.94	0.59
	25	4	0	0.41
	54	4	0	0.59
	54	4	0	0.41
	75	4	0	0.59
	75	4	0	0.41
	124	4	0	0.59
	124	4	0	0.41

DOE seeks comment on its approach to applying the transition to low-GWP refrigerant to specific regions.

b. Results for Refrigeration Systems

Table II.10 through table II.14 show the LCC and PBP results for the TSLs for each category of refrigeration system equipment impacted in this NODA. In the first of each pair of tables by equipment category (dedicated refrigeration systems, single-packaged dedicated

[21] See: *https://www.census.gov/data/tables/time-series/demo/popest/2020s-state-total.html.*

refrigeration systems, *etc.*), the simple payback is measured relative to the baseline equipment. In the second table, impacts are measured relative to the efficiency distribution in the no-new-standards case in the compliance year. The savings refer only to consumers who are affected by a standard at a given TSL. Those who already purchase equipment with efficiency at or above a given TSL are not affected. Consumers for whom the LCC increases at a given TSL experience a net cost.

Table II.10 Average LCC and PBP Results for Dedicated Condensing Units

TSL	Average Costs (2023$)				Simple Payback Period (yrs)	Average Lifetime (yrs)
	Installed Cost	First Year's Operation Cost	Lifetime Operating Cost	LCC		
Dedicated Condensing Units, Low Temperature, Indoor (DC.L.I)						
0	7,643	2,486	22,151	29,793	0.0	10.6
1	7,771	2,435	21,844	29,615	3.2	10.6
2	7,771	2,435	21,844	29,615	3.2	10.6
3	10,891	2,331	22,956	33,847	*inf*	10.6
Dedicated Condensing Units, Low Temperature, Outdoor (DC.L.O)						
0	26,579	3,790	39,853	66,432	0.0	10.5
1	26,799	3,731	39,540	66,339	5.3	10.5
2	26,885	3,724	39,546	66,430	7.5	10.5
3	38,360	3,321	43,510	81,870	*inf*	10.5
Dedicated Condensing Units, Medium Temperature, Indoor (DC.M.I)						
0	3,783	1,164	10,379	14,162	0.0	10.5
1	3,882	1,123	10,126	14,008	3.0	10.5
2	3,921	1,111	10,058	13,979	3.3	10.5
3	5,107	1,037	10,214	15,320	64.4	10.5
Dedicated Condensing Units, Medium Temperature, Outdoor (DC.M.O)						
0	5,757	1,661	15,136	20,892	0.0	10.6
1	5,761	1,648	15,041	20,802	0.4	10.6
2	5,884	1,607	14,799	20,683	2.9	10.6
3	8,470	1,297	14,004	22,474	18.7	10.6

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline equipment.

Table II.11 LCC Savings Relative to the Base Case Efficiency Distribution for Dedicated Condensing Units

TSL	% Consumers with Net Cost	Average Savings - Impacted Consumers (2023$)
Dedicated Condensing Units, Low Temperature, Indoor (DC.L.I)		
1	7	276
2	7	276
3	100	-4,054
Dedicated Condensing Units, Low Temperature, Outdoor (DC.L.O)		
1	28	93
2	47	2
3	100	-15,438
Dedicated Condensing Units, Medium Temperature, Indoor (DC.M.I)		
1	1	594
2	2	709
3	97	-1,159
Dedicated Condensing Units, Medium Temperature, Outdoor (DC.M.O)		
1	0	90
2	3	209
3	95	-1,582

Note: The savings represent the average LCC for affected consumers.

Table II.12 Average LCC and PBP Results for Single-packaged Dedicated Systems

TSL	Average Costs (2023$)				Simple Payback Period (yrs)	Average Lifetime (yrs)
	Installed Cost	First Year's Operation Cost	Lifetime Operating Cost	LCC		
Single-packaged Dedicated Systems, High Temperature, Ducted, Indoor (SP.H.ID)						
0	2,051	436	3,977	6,027	0.0	10.5
1	2,145	370	3,586	5,731	1.7	10.5
2	2,145	370	3,586	5,731	1.7	10.5
3	2,145	370	3,586	5,731	1.7	10.5
Single-packaged Dedicated Systems, High Temperature, Ducted, Outdoor (SP.H.OD)						
0	2,820	590	5,401	8,221	0.0	10.5
1	3,119	476	4,811	7,930	3.5	10.5
2	3,146	474	4,819	7,965	3.8	10.5
3	3,146	474	4,819	7,965	3.8	10.5
Single-packaged Dedicated Systems, High Temperature, Indoor (SP.H.I)						
0	1,978	255	2,709	4,688	0.0	10.5
1	2,006	230	2,557	4,563	1.3	10.5
2	2,035	226	2,550	4,585	2.5	10.5
3	2,035	226	2,550	4,585	2.5	10.5
Single-packaged Dedicated Systems, High Temperature, Outdoor (SP.H.O)						
0	2,857	357	3,829	6,686	0.0	10.5

1	2,948	319	3,629	6,577	3.1	10.5
2	2,948	319	3,629	6,577	3.1	10.5
3	1,764	62	2,033	3,797	*inf*	10.5
Single-packaged Dedicated Systems, Low Temperature, Indoor (SP.L.I)						
0	3,755	732	6,963	10,718	0.0	10.5
1	3,947	665	6,621	10,568	3.9	10.5
2	3,947	665	6,621	10,568	3.9	10.5
3	3,947	665	6,621	10,568	3.9	10.5
Single-packaged Dedicated Systems, Low Temperature, Outdoor (SP.L.O)						
0	4,951	967	9,202	14,153	0.0	10.6
1	4,952	955	9,121	14,074	0.2	10.6
2	4,974	951	9,095	14,068	1.5	10.6
3	6,129	920	9,641	15,771	*inf*	10.6
Single-packaged Dedicated Systems, Medium Temperature, Indoor (SP.M.I)						
0	4,002	713	6,958	10,959	0.0	10.5
1	4,177	674	6,800	10,977	7.8	10.5
2	4,177	674	6,800	10,977	7.8	10.5
3	5,042	666	7,307	12,349	*inf*	10.5
Single-packaged Dedicated Systems, Medium Temperature, Outdoor (SP.M.O)						
0	4,795	667	7,023	11,818	0.0	10.5
1	4,857	636	6,846	11,703	2.5	10.5
2	4,857	636	6,846	11,703	2.5	10.5
3	5,806	632	7,436	13,242	*inf*	10.5

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline equipment.

Table II.13 LCC Savings Relative to the Base Case Efficiency Distribution for Single-packaged Dedicated Systems

TSL	% Consumers with Net Cost	Average Savings - Impacted Consumers (2023$)
Single-packaged Dedicated Systems, High Temperature, Ducted, Indoor (SP.H.ID)		
1	0	296
2	0	296
3	0	296
Single-packaged Dedicated Systems, High Temperature, Ducted, Outdoor (SP.H.OD)		
1	5	291
2	16	256
3	16	256
Single-packaged Dedicated Systems, High Temperature, Indoor (SP.H.I)		
1	2	124
2	3	103
3	3	103
Single-packaged Dedicated Systems, High Temperature, Outdoor (SP.H.O)		

1	3	108
2	3	108
3	21	-55
Single-packaged Dedicated Systems, Low Temperature, Indoor (SP.L.I)		
1	8	150
2	8	150
3	8	150
Single-packaged Dedicated Systems, Low Temperature, Outdoor (SP.L.O)		
1	0	105
2	20	85
3	100	-1,618
Single-packaged Dedicated Systems, Medium Temperature, Indoor (SP.M.I)		
1	27	-17
2	27	-17
3	100	-1,390
Single-packaged Dedicated Systems, Medium Temperature, Outdoor (SP.M.O)		
1	6	114
2	6	114
3	100	-1,425

Note: The savings represent the average LCC for affected consumers.

Table II.14 Average LCC and PBP Results for Unit Coolers

TSL	Average Costs (2023$)				Simple Payback Period (yrs)	Average Lifetime (yrs)
	Installed Cost	First Year's Operation Cost	Lifetime Operating Cost	LCC		
Unit Coolers, High Temperature (UC.H)						
0	3,083	479	4,595	7,678	0.0	10.5
1	3,083	479	4,595	7,678	0.0	10.5
2	3,083	479	4,595	7,678	0.0	10.5
3	3,223	474	4,642	7,865	*inf*	10.5
Unit Coolers, High Temperature, Ducted (UC.H.ID)						
0	3,161	681	6,111	9,271	0.0	10.5
1	3,212	642	5,859	9,071	1.5	10.5
2	3,212	642	5,859	9,071	1.5	10.5
3	3,212	642	5,859	9,071	1.5	10.5
Unit Coolers, Low Temperature (UC.L)						
0	2,658	4,413	34,322	36,980	0.0	10.5
1	2,918	4,186	32,772	35,690	1.3	10.5
2	2,918	4,186	32,772	35,690	1.3	10.5

3	2,918	4,186	32,772	35,690	1.3	10.5
Unit Coolers, Medium Temperature (UC.M)						
0	2,468	1,675	13,649	16,118	0.0	10.6
1	2,569	1,631	13,373	15,942	2.7	10.6
2	2,569	1,631	13,373	15,942	2.7	10.6
3	2,569	1,631	13,373	15,942	2.7	10.6

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline equipment.

Table II.15 LCC Savings Relative to the Base Case Efficiency Distribution for Unit Coolers

TSL	% Consumers with Net Cost	Average Savings - Impacted Consumers (2023$)
Unit Coolers, High Temperature (UC.H)		
1	n/a	n/a
2	n/a	n/a
3	100	-187
Unit Coolers, High Temperature, Ducted (UC.H.ID)		
1	0	201
2	0	201
3	0	201
Unit Coolers, Low Temperature (UC.L)		
1	10	1,290
2	10	1,290
3	10	1,290
Unit Coolers, Medium Temperature (UC.M)		
1	23	176
2	23	176
3	23	176

Note: The savings represent the average LCC for affected consumers.

c. Results for Non-display Doors

Table II.16 through table II.19 show the LCC and PBP results for the TSLs for each non-display doors equipment class impacted in this NODA. In the first of each pair of tables by equipment class (manual non-display doors, motorized non-display doors), the simple payback is measured relative to the baseline equipment. In the second table, impacts are measured relative to the efficiency distribution in the no-new-standards case in the compliance year. The savings refer only to consumers who are affected by a standard at a given TSL. Those who already purchase equipment with efficiency at or above a given TSL are not affected. Consumers for whom the LCC increases at a given TSL experience a net cost.

As discussed in the September 2023 NOPR, to estimate the impacts of improved efficiency on walk-in envelope components (*e.g.*, panels, doors), DOE must first establish the efficiencies and energy use of the connected refrigeration equipment. 88 FR 60746, 60786. For the purposes of this NODA, DOE has presented the results for non-display doors based on both the baseline and max-tech refrigeration system to show the range of potential impacts associated with each analyzed TSL.

Table II.16 Average LCC and PBP Results for Manual Non-display Doors

TSL	Average Costs (2023$)				Simple Payback Period (yrs)	Average Lifetime (yrs)
	Installed Cost	First Year's Operation Cost	Lifetime Operating Cost	LCC		
Non-display Doors, Manual, Low Temperature (NM.L)						
Connected to a Baseline Refrigeration System						
0	2,663	315	2,079	4,742	0.0	8.7
1	2,754	237	1,566	4,319	1.2	8.7
2	2,854	161	1,068	3,922	1.3	8.7
3	3,136	147	975	4,111	2.8	8.7
Connected to a Max Tech Refrigeration System						
0	2,574	347	2,289	4,863	0.0	8.7
1	2,705	240	1,582	4,288	1.2	8.7
2	2,833	159	1,050	3,883	1.4	8.7
3	3,136	145	961	4,097	2.8	8.7
Non-display Doors, Manual, Medium Temperature (NM.M)						
Connected to a Baseline Refrigeration System						
0	2,766	77	505	3,271	0.0	8.8
1	2,827	51	337	3,163	2.4	8.8
2	2,900	35	233	3,132	3.2	8.8
3	3,229	32	211	3,439	10.4	8.8
Connected to a Max Tech Refrigeration System						
0	2,605	108	714	3,319	0.0	8.8

1	2,736	56	368	3,105	2.5	8.8
2	2,850	37	246	3,095	3.4	8.8
3	3,229	34	226	3,454	8.4	8.8

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline equipment.

Table II.17 LCC Savings Relative to the Base Case Efficiency Distribution for Manual Non-display Doors

TSL	% Consumers with Net Cost	Average Savings - Impacted Consumers (2023$)
Non-display Doors, Manual, Low Temperature (NM.L)		
Connected to a Baseline Refrigeration System		
1	1	607
2	1	1,049
3	5	847
Connected to a Max Tech Refrigeration System		
1	1	575
2	1	980
3	5	766
Non-display Doors, Manual, Medium Temperature (NM.M)		
Connected to a Baseline Refrigeration System		
1	3	233
2	8	263
3	69	-91
Connected to a Max Tech Refrigeration System		
1	4	214
2	9	224
3	78	-135

Note: The savings represent the average LCC for affected consumers.

Table II.18 Average LCC and PBP Results for Motorized Non-display Doors

TSL	Average Costs (2023$)				Simple Payback Period (yrs)	Average Lifetime (yrs)
	Installed Cost	First Year's Operation Cost	Lifetime Operating Cost	LCC		
Non-display Doors, Motorized, Low Temperature (NO.L)						
Connected to a Baseline Refrigeration System						
0	7,120	495	3,244	10,364	0.0	8.7
1	7,240	362	2,376	9,615	0.9	8.7

2	7,367	253	1,663	9,029	1.0	8.7
3	7,688	223	1,466	9,154	2.1	8.7
Connected to a Max Tech Refrigeration System						
0	7,102	480	3,146	10,248	0.0	8.7
1	7,233	341	2,237	9,470	0.9	8.7
2	7,363	237	1,558	8,921	1.1	8.7
3	7,688	210	1,381	9,069	2.2	8.7
Non-display Doors, Motorized, Medium Temperature (NO.M)						
Connected to a Baseline Refrigeration System						
0	7,333	91	597	7,930	0.0	8.8
1	7,377	66	436	7,813	1.8	8.8
2	7,435	50	331	7,767	2.5	8.8
3	7,704	45	298	8,002	8.1	8.8
Connected to a Max Tech Refrigeration System						
0	7,059	151	992	8,051	0.0	8.8
1	7,190	81	536	7,727	1.9	8.8
2	7,307	56	373	7,679	2.6	8.8
3	7,704	50	333	8,037	6.4	8.8

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline equipment.

Table II.19 LCC Savings Relative to the Base Case Efficiency Distribution for Motorized Non-display Doors

TSL	% Consumers with Net Cost	Average Savings - Impacted Consumers (2023$)
Non-display Doors, Motorized, Low Temperature (NO.L)		
Connected to a Baseline Refrigeration System		
1	0	819
2	0	1,417
3	2	1,291
Connected to a Max Tech Refrigeration System		
1	0	778
2	0	1,326
3	2	1,179
Non-display Doors, Motorized, Medium Temperature (NO.M)		
Connected to a Baseline Refrigeration System		
1	1	349
2	3	424
3	42	77
Connected to a Max Tech Refrigeration System		
1	1	324

2	4	372
3	51	14

Note: The savings represent the average LCC for affected consumers.

2. National Impacts Analysis

This section presents DOE's estimates of the changes in national energy savings ("NES") and the net present value ("NPV") of consumer benefits that would result from each of the TSLs as potential amended standards for the equipment under consideration in this NODA. For this NODA, DOE maintained the methodologies and modeling assumptions that were used in the 2023 September NOPR. For brevity the NIA results are presented here by equipment category (*i.e.*, refrigeration systems), the results for each equipment class can be found in section 6 of the NODA support document.

The detailed description of how DOE calculates its national impacts can be found in chapter 10 and associated appendices of the September 2023 NOPR TSD.

a. Non-Display Doors

As discussed in the September 2023 NOPR, the energy savings from improved insulation or reduced heat infiltration would be realized as reduced load on the attached refrigeration systems; however, for the purpose of reporting, these energy savings are attributed to the individual door in question. 88 FR 60746, 60788. For this NODA, when determining the NES and NPV of consumer benefits of each TSL DOE bounds the range of potential costs and benefits for non-display doors when they are connected to max-tech refrigeration systems (the low bound), and baseline refrigeration systems (the high bound). These results are shown in table II.21 and table II.23.

b. Significance of Energy Savings

To estimate the energy savings attributable to potential amended standards for walk-in refrigeration systems, DOE compared their energy consumption under the no-new-standards case to their anticipated energy consumption under each TSL. The savings are measured over the entire lifetime of equipment purchased in the 30-year period that begins in the year of anticipated compliance with amended standards (2027–2056). Table II.20 and table II.21 present DOE's projections of the NES for each TSL considered for walk-in refrigeration systems shown in section II.B. The savings were calculated using the approach described in chapter 10 of the September 2023 NOPR TSD. [22]

Table II.20 Cumulative Full-fuel Cycle National Energy Savings for Walk-in Coolers and Freezer Refrigeration Systems (Quads); 30 Years of Shipments 2027–2056

	Trial Standard Level		
	1	2	3
	quads		
Primary energy	0.86	1.11	3.51
FFC energy	0.89	1.14	3.61

Table II.21 Cumulative Full-fuel Cycle National Energy Savings for Walk-in Coolers and Freezers: Non-display Doors (Quads); 30 Years of Shipments 2027–2056

	Trial Standard Level		
	1	2	3
	quads		
Primary energy	0.27 to 0.28	0.58 to 0.61	0.65 to 0.70
FFC energy	0.28 to 0.29	0.59 to 0.63	0.67 to 0.72

c. Net Present Value of Consumer Costs and Benefits

DOE estimated the cumulative NPV of the total costs and savings for consumers that would result from the TSLs considered for walk-in refrigeration systems. In accordance with

[22] See: *www.regulations.gov/document/EERE-2017-BT-STD-0009-0046.*

the Office of Management and Budget's guidelines on regulatory analysis,[23] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table II.22 and table II.23 show the consumer NPV results with impacts counted over the lifetime of walk-in coolers and freezers refrigeration systems and non-display doors purchased in 2027–2056.

Table II.22 Cumulative Net Present Value of Consumer Benefits for Walk-in Coolers and Freezers Refrigeration Systems; 30 Years of Shipments (2027–2056)

Discount Rate	Trial Standard Level		
	1	2	3
	billion 2023$		
3 percent	1.53	1.57	-25.45
7 **percent**	0.64	0.62	-13.15

Table II.23 Cumulative Net Present Value of Consumer Benefits for Walk-in Coolers and Freezers: Non-display Doors; 30 Years of Shipments (2027–2056)

Discount Rate	Trial Standard Level		
	1	2	3
	billion 2022$		
3 percent	0.78 to 0.83	1.57 to 1.72	-0.43 to -0.24
7 **percent**	0.35 to 0.37	0.69 to 0.76	-0.43 to -0.35

D. Updated Equations for Proposed Standards

1. Energy Consumption Equations for Non-Display Doors

In the September 2023 NOPR, DOE proposed amended energy conservation standards for walk-in non-display doors at TSL 2 from the NOPR analysis. 88 FR 60746, 60748. Table II.24 presents updated MDEC curves for the affected equipment classes at the

[23] U.S. Office of Management and Budget. Circular A-4: Regulatory Analysis. September 17, 2003. *www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/circulars/A4/a-4.pdf* (last accessed April 26, 2023).

same trial standard level proposed in the September 2023 NOPR using the updated analysis presented in this NODA.

Table II.24 Changes to Energy Conservation Standards for Walk-in Non-Display Doors Proposed in the September 2023 NOPR

Equipment Class	TSL 2 NOPR Equations for MDEC (kWh/day)*	TSL 2 NODA Equations for MDEC (kWh/day)*
Non-Display Door, Manual, Medium Temperature	$0.01 \times A_{nd} + 0.25$	$0.01 \times A_{nd} + 0.25 + 0.33a + 0.25b + 0.07c + 0.24d$
Non-Display Door, Manual, Low Temperature	$0.06 \times A_{nd} + 1.32$	$0.06 \times A_{nd} + 1.35 + 0.40a + 1.42b + 0.09c + 0.30d + 0.85e$
Non-Display Door, Motorized, Medium Temperature	$0.01 \times A_{nd} + 0.39$	$0.01 \times A_{nd} + 0.39 + 0.33a + 0.25b + 0.07c + 0.24d$
Non-Display Door, Motorized, Low Temperature	$0.05 \times A_{nd} + 1.56$	$0.05 \times A_{nd} + 1.59 + 0.40a + 1.42b + 0.09c + 0.30d + 0.85e$
A_{nd} represents the surface area of the non-display door. a = 1 for a door with lighting and = 0 for a door without lighting. b = 1 for a door with a heated viewport window and = 0 for a door without a heated viewport window. c = 1 for a door with a digital temperature display without alarms and = 0 for a door without a digital display without alarms. d = 1 for a door with a digital temperature display with alarms and = 0 for a door without a digital temperature display with alarms. e = 1 for a door with a heated pressure relief vent and = 0 for a door without a heated pressure relief vent.		

2. AWEF2 Equations

In the September 2023 NOPR, DOE proposed amended energy conservation standards for walk-in refrigeration system equipment at TSL 2 from the NOPR analysis. 88 FR 60746, 60748. The equations for the proposed amended energy conservation standards for dedicated condensing units and single-packaged dedicated systems generally followed the trends of the TSL 2 levels determined for the analyzed representative capacities. For unit coolers, DOE proposed energy conservation standards that do not vary with capacity.

AHRI and Hussmann commented on the proposed energy conservation standards for unit coolers by providing plots for medium- and low-temperature unit coolers showing that DOE proposed AWEF2 standards equations that resulted in AWEF2 values above the AWEF2 values determined for EL 2 (*i.e.*, the max-tech efficiency level) for certain representative capacities. (AHRI, No. 72 at pp. 4-5; Hussmann, No. 75 at pp. 2-3)

DOE notes that it proposed unit cooler standards that do not depend on capacity, averaging the proposed TSL 2 efficiency levels of the representative capacities within each unit cooler class. Thus, the proposed standard levels at higher representative capacities were above the max-tech efficiency levels determined for those capacities. DOE analyzed the unit cooler performance database to determine if the proposed standards for medium- and low-temperature were technologically feasible. DOE was able to identify low-temperature unit cooler models above the standard level proposed in the September 2023 NOPR across the full range of capacities analyzed. Therefore, DOE has tentatively concluded that the AWEF2 standard proposed in the September 2023 NOPR for low-temperature unit coolers is technologically feasible. DOE was unable to identify medium-temperature unit cooler models at efficiency levels at or above the standard level proposed in the September 2023 NOPR at certain capacities. Therefore, DOE has revised the medium-temperature unit cooler standard equation proposed in the September 2023 NOPR such that it never exceeds the maximum technology level identified in the unit cooler performance database for given capacity ranges. Revised medium-temperature unit cooler standard equations are presented in section 7 of the NODA support document.

In the September 2023 NOPR, DOE proposed an AWEF2 standard level for medium-temperature outdoor single-packaged dedicated systems of 7.11 for models with capacities greater than or equal to 9 kBtu/h. 88 FR 60746, 60853. In response to the September 2023

NOPR, the Efficiency Advocates commented that DOE's proposed AWEF2 standard of 7.11 corresponds to EL 1 for 9 kBtu/h medium-temperature outdoor single-packaged dedicated systems even though table IV.26 in the September 2023 NOPR maps TSL 2 to EL 3 (Efficiency Advocates, No. 77 at p. 6). DOE acknowledges that table IV.26 in the September 2023 NOPR maps TSL 2 for 9 kBtu/h medium-temperature single-packaged outdoor dedicated systems to EL 3, which has an AWEF2 of 7.5. 88 FR 60746, 60787. Additionally, table 5A.5.21 in appendix 5A in the September 2023 NOPR TSD specifies that EL 3 of the 9 kBtu/h medium-temperature outdoor single-packaged dedicated systems (SP.M.O.009) corresponds to an AWEF2 of 7.5. However, the proposed standard level for medium-temperature outdoor single-packaged dedicated systems was erroneously set based on an AWEF2 of 7.11 for the representative capacity of 9 kBtu/h. DOE has corrected this in table 7.1 of the NODA Support Document.

Section 7 of the NODA Support Document presents updated AWEF2 calculations for refrigeration system equipment classes at the trial standards levels presented in this NODA.

III. Public Participation

DOE requests comment on the updated efficiency levels, incremental MPCs, LCC, PBP, and NIA results for walk-in refrigeration systems presented in the NODA. As noted in the September 2023 NOPR, DOE may adopt energy efficiency levels that are either higher or lower than the proposed standards, or some combination of level(s) that incorporate the proposed standards in part.

DOE will accept comments, data, and information regarding this NODA no later than the date provided in the **DATES** section at the beginning of this document. Interested parties may submit comments, data, and other information using any of the methods described in the **ADDRESSES** section at the beginning of this document.

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It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

IV. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this notification of data availability and request for comment.

Signing Authority

This document of the Department of Energy was signed on March 11, 2024, by Jeffrey Marootian, Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the *Federal Register*.

Signed in Washington, DC, on March 11, 2024.

Treena V. Garrett,
Federal Register Liaison Officer,
U.S. Department of Energy.

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