Response to Comments on the Specification Discussion Guide

Part 2 Version 7 ENERGY STAR® for Windows, Doors, and Skylights

Contents

I. Background

In September 2019, the U.S. Environmental Protection Agency (EPA) released an ENERGY STAR Version 7.0 Windows, Doors, and Skylights Specification Discussion Guide and invited stakeholder input on key topics prior to considering a Draft 1 Version 7.0 specification proposal.

EPA requested public comments on the topics laid out in the Version 7.0 Specification Discussion Guide and comments are available for review on the specification development web page: www.energystar.gov/products/building_products/residential_windows_doors_and_skylights/partners (Click on the "In Development" tab).

In September 2020, EPA released a Response to Comments, Part 1, that addressed comments on energy savings analysis, market share, and component cost research.

EPA's responses to the remaining Version 7.0 Specification Discussion Guide comments can be found below.

II. General Comments on the Version 7.0 Specification Discussion Guide

Several commenters expressed appreciation for the thoroughness of the Specification Discussion Guide and EPA's efforts in working with stakeholders to carefully assess next steps for a potential specification revision. Several commenters also expressed general support for consideration of a specification revision for windows, doors, and skylights, with the following reasoning:

- Revising the specification, including reducing the U-factor in the Northern Climate Zone, will save energy.
- Utilities continue to use ENERGY STAR as a tool to advance innovative energy efficiency solutions.
- Current ENERGY STAR criteria for windows, doors, and skylights must be made more stringent if they are to offer significant savings above evolving baselines, including local building codes and climate targets.
- Cost-effective technology is available, and it is appropriate for ENERGY STAR to be an indicator of best-in-class energy-efficient products.

In addition, several commenters expressed opposition to EPA considering a potential specification revision at this time, stating that:

- The current Version 6.0 Northern Climate Zone criteria are at the limit of cost-effectiveness and consumer preference; therefore, any increase in stringency would result in considerable additional cost and regulatory burden on the industry and consumers.
- Stakeholders must have an opportunity to review and provide input on cost data collection and energy savings analyses before EPA can consider proceeding with a specification revision.
- EPA should wait until the 2021 International Energy Conservation Code (IECC) model codes have been finalized and published before considering criteria revisions.

EPA Response:

EPA thanks the commenters for their support for the Version 7.0 Specification Discussion Guide and potential specification revision, and also appreciates the general feedback against proceeding at this time.

EPA has based its decision to propose a Version 7.0 specification on the ENERGY STAR Guiding Principles and after careful consideration of stakeholder comments and the research and analysis outlined in the Specification Discussion Guide. EPA has addressed all general concerns raised by commenters in detail in the Version 7.0 Criteria Analysis Report and in specific sections of this comment-

response narrative. EPA will continue to provide opportunities for stakeholders to comment on each step of the specification revision.

EPA acknowledges that the final 2021 IECC model codes are an issue to consider in its final criteria decisions. These new model codes were finalized in 2020, providing EPA with more clarity on the direction of the codes. However, code levels are just one indication for EPA to consider, and the decision to propose a Version 7.0 specification at this time is based on EPA's independent analysis and is informed by the Guiding Principles.

Alternative Proposals for the ENERGY STAR Windows, Doors, and Skylights Program

Two commenters proposed that EPA adopt the prescriptive performance requirements in the latest IECC codes. The commenters suggest that EPA could reduce specification development efforts by using analyses already completed and vetted through the code proceedings. As a result, EPA could focus on marketing the program toward replacing the existing residential stock of single- and double-pane clear-glazed windows and doors.

One commenter suggested that many local jurisdictions are slow to adopt the new model year codes, while the ENERGY STAR program would be able to quickly implement the criteria. The commenter cites figures for IECC adoption by state, showing that as of February 2019, only a few states have adopted the 2018 IECC and about half of the states have yet to adopt the 2015 IECC.

One commenter proposed that Version 6 be retired and rebranded as ENERGY STAR Replacement Windows. The replacement windows market accounts for about half of the national window sales volume.

One commenter provided the following alternative proposal, including merging existing climate zones:

ENERGY STAR Zone	IECC Zones	U-Factor	SHGC*
Southern	1, 2, and 3	≤ 0.30	≤ 0.25
Central	4 and 5	≤ 0.30	≤ 0.40 or ≤ 0.30
Northern	6, 7, and 8	≤ 0.30	Any

* Solar heat gain coefficient

EPA Response:

EPA thanks the commenters for their suggestion. As stated in the Specification Discussion Guide, it is important for the ENERGY STAR specification to keep pace with code improvements to align with the ENERGY STAR program's Guiding Principles for effectively differentiating energy-efficient products and contributing significant energy savings nationwide. Consumers and energy efficiency programs around the country look to the ENERGY STAR label to differentiate products that perform better and save more energy compared to standard, baseline products on the market.

While individual jurisdictions may be slower to adopt the latest model year codes, data from the U.S. Department of Energy's (DOE) Energy Code Field Study[1] demonstrates that the minimum performance used by builders already exceeds the latest code in a number of regions.

The commenters' proposal would require that EPA make the criteria less stringent compared to Version 6. EPA believes that such a rollback would not sufficiently differentiate ENERGY STAR certified products and would make the label less useful for consumers and stakeholders.

III. Current Market Assessment

(Note: EPA provided a response to Market Share comments in Part 1.)

[1] U.S. Department of Energy, Building Energy Codes Program. Energy Efficiency Field Studies. Accessed at https://www.energycodes.gov/compliance/energy-code-field-studies.

Developments in Energy Codes

Several commenters provided input on EPA's review of recent building code improvements, and how they should be incorporated into EPA's analysis.

International Energy Conservation Code Building Energy Codes

One commenter stated that, at the time, the only proposal that had been tentatively approved for the 2021 IECC had prescriptive U-factor criteria that was more stringent than ENERGY STAR in IECC Climate Zone 2 and equal to ENERGY STAR in IECC Climate Zones 3 and 4. The commenter noted that, even if approved, the 2021 IECC would not be widely adopted for a number of years.

Two commenters argued that the prescriptive criteria in the IECC codes are not mandatory, as there are alternative pathways for compliance that provide considerable flexibility for manufacturers and builders. The commenters believe that ENERGY STAR should not immediately and automatically upgrade its requirements in lockstep to reflect or exceed changes in energy code prescriptive values.

EPA Response:

EPA appreciates the feedback. Building codes are only one variable to consider when evaluating the market, including market share and product availability. When code revisions are adopted, it is a strong signal that the level of the new code represents a reasonable baseline product (widely available and cost-effective).

EPA acknowledges that building codes are variable and allow for flexibility. However, in order to maintain the value of the ENERGY STAR brand, it must be clearly distinct and perform better than the standard products on the market. EPA looks to building codes as one indicator of the market baseline, but also takes other data into consideration and ultimately proposes criteria based on a number of variables.

EPA also must consider the importance of providing a clear differentiating signal to consumers in the replacement market.

ENERGY STAR Canada

Several commenters agree with EPA's decision to not align the U.S. and Canadian ENERGY STAR specification for Windows, Doors, and Skylights and provided specific reasoning for their support of the EPA's assessment. The comments included the following:

- Two commenters argued that it is not realistic for the United States to take the Canadian "one ENERGY STAR zone" approach because the United States has significantly different climate conditions that necessitate the need for separate ENERGY STAR Climate Zones across the United States.
- One commenter argued that the Canadian program, which is focused on heating energy, is not a good model for the larger and more diverse U.S. market. The commenter argued that the 0.21 U-factor requirement in Canada's Version 5.0 specification (effective January 1, 2020) is too stringent for the northern United States, and Canada's alternative Energy Rating approach would create electrical peak demand and discomfort issues in the cooling season, even in the Northern Climate Zone.
- One commenter believed that cost considerations carried far less weight in the Canadian ENERGY STAR revision process compared with the U.S. ENERGY STAR program.
- Another commenter appreciated EPA's continued efforts to align the U.S. program with Canada's program, and encourages EPA to continue considering long-term opportunities for collaboration. However, the commenter agreed that, at this time, the two programs are quite divergent with

regard to time frames, criteria, and Guiding Principles. The commenter recommended that alignment should not be a barrier to progress for Version 7.

EPA Response:

EPA thanks the commenters for their support and appreciates the comments received from multiple stakeholders. For this specification revision cycle, EPA decided to revise the specification based on U.S. market data and analysis. EPA will continue to monitor policy and market developments in Canada for future potential specification revisions.

IV. Proposed Methodology

Product Availability

Pathways Methodology

Several commenters agreed with EPA's proposal to use the National Fenestration Rating Council's (NFRC) Certified Product Directory (CPD) filter to see only FenStar certified product lines as a reasonable proxy for products available for sale.

On the other hand, several commenters suggested reasons why the filtered NFRC CPD may not be a complete and accurate reflection of products on the market:

- It does not reflect production and sales volume, cost-effectiveness, or consumer preferences.
- Manufacturers can develop a line and test prototypes before they actually put them on the market.
- Many product lines need to be recognized as outliers, including specialty or custom configurations, that are not viable for mainstream market availability demands.

One commenter recommended other data sources, such as DuckerFrontier or Hanley Wood, for better information on product availability. Several commenters believed that the best data come from products that are currently available for sale by manufacturers.

EPA Response:

EPA thanks commenters for providing feedback. EPA understands that using the filtered CPD is not a perfect proxy and that it does not represent sales volume; however, EPA believes that the filtered CPD is a reasonable proxy for availability and can be used to find common product component configurations without requiring each manufacturer to provide their detailed sales data for each product line to EPA. The filtered data represents only product lines identified by manufacturers that have ENERGY STAR (FenStar) certified options and are currently available to be manufactured. EPA does not have sales volume or manufacturing data on every individual ENERGY STAR product line or product option manufactured. That information can only come from individual manufacturers, and manufacturers are resistant to provide that data to EPA. EPA has other analysis and data that represent market share and cost-effectiveness.

EPA has reviewed market studies produced by DuckerFrontier and Hanley Wood. These studies do not have sufficient granularity to compare in detail the availability of different ENERGY STAR component combinations or performance levels.

Common Pathways

Several commenters provided information about the most common pathways (component combinations) that manufacturers use to make ENERGY STAR certified products. The comments included the following:

- Low-e coated glass products are the main contributing component to the solar heat gain coefficient (SHGC) of a window, and common pathways today include a moderate or high SHGC package in northern windows and a lower SHGC package in southern windows.
- Use of different low-e glass types and gas fills, within existing overall thickness parameters, typically represents the quickest and most cost-effective method of achieving performance improvements. After that, the use of foam fills in sash and frame members are employed to make incremental performance gains.
- Common pathways can vary among manufacturers and product lines and the climate zone for which they are intended to qualify. In general, common pathways include the following.

  Windows

  Northern Climate Zone:

  - Clad wood, composite, or fiberglass frames: Dual pane with multi-silver layer low-e coatings and a low-e coating on surface 4.
  - Metal-clad frames: Triple pane with double-silver layer low-e coatings and warm edge spacers for either option. May need to use the alternative performance path with a high-solar low-e or possibly triple pane.

  North-Central Climate Zone:

  - Clad wood, composite, or fiberglass frames: Dual pane with double-silver low-e coatings and warm edge spacers.

  South-Central and Southern Climate Zones:

  - Most framing materials with a triple-silver layer low-e coating to meet respective SHGC requirements and warm edge or other metal spacers.

  Doors

  - All climate zones: Fiberglass or steel skin with a foam insulation core and glass packages for door lites consistent with those for windows, depending on the size of the lite and the ENERGY STAR Climate Zone for which it is intended to qualify.

  Skylights

  - Northern Climate Zone: Wood-frame dual pane with a higher solar triple-silver low-e coating and stainless steel spacer.
  - Southern Climate Zone: Wood-frame dual pane with a lower solar triple-silver low-e coating and stainless steel spacer.
- Most ENERGY STAR skylight products will consist of a wood frame, double-pane glass with triple-silver low-e coating, and the spacer would be a stainless steel material. Various other configurations exist (e.g., triple pane) but are more costly.
- Another commenter lists the most common pathways as surface 4 low-e coatings, triple glazing, incorporation of thermal breaks on aluminum and aluminum-clad products, and high-solar low-e coatings for Northern Climate Zone trade-offs.
- U-factors could be lowered by about 0.03 Btu/hr·ft²·°F, but that requires the addition of a fourth surface low-e coating, and/or massive changes in frame heat transfer.

One commenter suggested two component categories for EPA to consider more carefully:

- Grids create additional complexity for meeting SHGC requirements. This can have consequences for regional design considerations, specifically when considering pathways for lower SHGC in the south (where grids are less popular yet improve SHGC) and higher SHGC in the north (where grids are more common but detrimental to SHGC).
- Frame material type is a significant factor in understanding realistic performance improvements, particularly for hybrid frame categories and added elements such as foam fill or additional air cavities.

EPA Response:

EPA thanks commenters for providing this information. EPA has considered commonly used materials and common components by analyzing a filtered version of the NFRC CPD containing only product lines with ENERGY STAR certified products. EPA's research and analysis confirmed that the common pathways reported by commenters also are reflected in the distribution of products in the filtered CPD, as well as the configurations available for sale. This provides EPA with additional confidence that the filtered CPD represents a reasonable proxy for product availability. See the Version 7.0 Criteria Analysis Report for more details on the performance distribution of different component combinations, including grids and frame materials.

Visual Transmittance

Several commenters stated that darker glass is necessary to achieve SHGCs lower than 0.25 that would result in lower visible transmittance (VT). One commenter offered that every 0.01 point of SHGC reduction will reduce light transmission by about 2 percentage points, adding that lower light transmission will generally impart more reflected color and move the low-e coating away from the residential preference for "clear" glass. The commenters explain that this type of glass may be suitable for typical commercial applications but is often not well received in residential applications.

EPA Response:

EPA agrees that as window SHGC goes lower, VT also goes lower. Although there may be product-specific considerations, EPA's analysis showed that a large plurality of products using the triple-silver glazing option have an SHGC between 0.20 and 0.22 and a VT of 0.40 or higher (see Table 1). In the South-Central and Southern Climate Zones, the small SHGC improvement significantly improves the energy savings for the consumer.

Table 1. SHGC vs. VT for Two-Pane Vinyl Windows With Triple-Silver Glazing

	Visual Transmittance					
SHGC	**0–0.194**	**0.195–0.294**	**0.295–0.394**	**0.395–0.499**	**0.50+**	**Total Options**
< 0.175	80	3,980	4,265			8,325
0.175–0.194	4		119	693		816
0.195–0.224	28	36	1,676	22,393	3,309	27,442
0.225–0.254	14	18	2	2,752	2,410	5,196
0.255–0.284		67	26	1,401	578	2,072
0.285–0.314		851	207	4,858	1,899	7,815
0.315–0.344		413	1,643	1,556	798	4,410
0.345–0.374			222	224	757	1,203
0.375–0.404					105	105
Total Options	**126**	**5,365**	**8,160**	**33,877**	**9,856**	**57,384**

Note: Colored shading indicates higher and lower counts of products. Red shading indicates low counts, light shading indicates medium counts, blue shading indicates higher counts.

Non-Viable Pathways and Outliers

Several commenters provided information on pathways represented in the filtered NFRC CPD that should be considered non-viable or outliers.

One commenter stated that EPA should not consider pathways that rely on technologies that are not commercially available, cost-prohibitive materials, or technologies where the payback exceeds the life of the product.

One commenter believes that exotic gas fills, such as krypton, and triple-pane glazing are not widely used except for those products aimed at the ENERGY STAR Most Efficient program.

One commenter suggest that EPA should consider as outliers any products with performance ratings that exceed those of Version 6.0, especially for the North-Central and Northern Climate Zones. Other outliers may be products with limited glazing uses, such as dynamic glazing or glazing with exotic gas fills.

One commenter believes that outliers are the products that are in the CPD but not currently available in the marketplace.

EPA Response:

EPA thanks commenters for providing these suggestions. EPA reviewed the availability and costs of many of these product options in its analysis, including through mystery shopping research, and found that triple-pane products and high-performing double-pane products were available for sale at affordable prices. EPA found that consumers would realize cost-effective energy savings at the proposed Northern Climate Zone criteria. The proposed criteria can be met through multiple viable technical pathways and do not require the use of krypton gas fills or dynamic glazing options.

Cost-Effectiveness

Cost Research Methodology

Several commenters argued that EPA should base its cost-effectiveness determination on the prices paid by consumers. The commenters stated that prices obtained through retail and mystery shopping would reflect the value of the product and capture any consumer-level promotional discounts better than manufacturers' list prices or component costs.

Several commenters recommended that EPA source data from multiple distribution channels and geographical locations, including, but not limited to, big-box retailers, installing retailers, lumberyards, and smaller retail centers. One commenter noted that obtaining data from big-box stores and mystery shopping may yield limited results because most, if not all, manufactures have a significant number of products that are not sold in traditional retail markets.

Several commenters stated that manufacturers may not be willing to share list pricing, even under non-disclosure agreements with third parties. The commenters state that list pricing may not reflect the actual price paid by the consumer, and EPA would need to substantiate claims that manufacturers' list pricing was representative.

One commenter suggested that EPA work with industry associations, such as the Window and Door Manufacturers Association, National Association of Home Builders (NAHB), and the National Association of the Remodeling Industry, to estimate product costs.

EPA Response:

EPA thanks the commenters for providing feedback. The ENERGY STAR program focuses on the incremental cost between non-ENERGY STAR products and better performing low-cost products and best sellers. To do this, EPA gathered data volunteered from manufacturers and conducted mystery shopping at retailers, dealers, and wholesalers in various parts of the United States to focus on specific, common technology increments. EPA gathered data that did not include installation costs since installation would be the same between an ENERGY STAR and a non-ENERGY STAR product. EPA also gathered ranges of component costs to understand the basis for technology improvements. The component cost range information was published in Part 1 of the Response to Comments. Industry associations did not provide EPA with detailed product cost data by performance level.

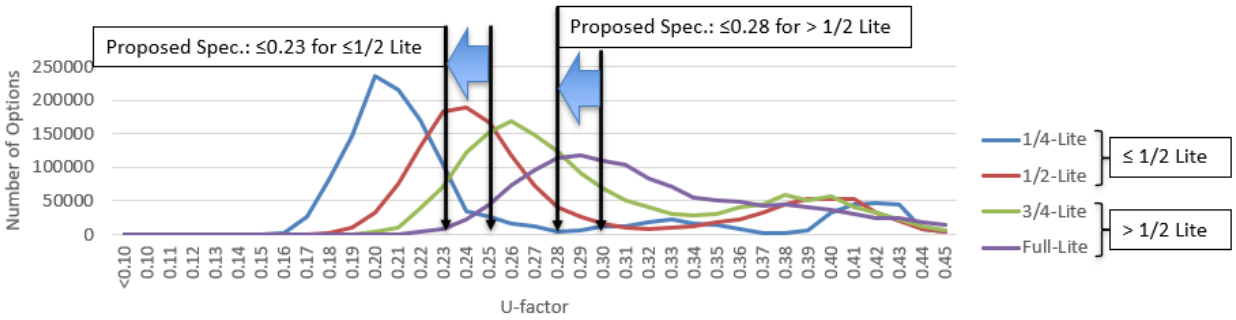
Door Cost Research

One commenter explains that door glass assembly components constructed with the same materials perform differently depending on the number of square inches of glazing area in relation to the door slab. It is easier for ¼-lites to qualify for ENERGY STAR than ½-lites, and it is easier for ¾-lites to qualify than it is for full-lites for many glazing packages. The commenter recommends comparing the total cost of an insulating glass unit (IGU) used in an ENERGY STAR qualified door at the various glazing sizes defined by NFRC.

EPA Response:

EPA appreciates the suggestions for door cost analysis. However, EPA was only able to gather insulating glass components and completed product cost information. The wide variety and types of doors slabs, glass inserts, and frames made it difficult to gather door data. Instead, EPA evaluated door performance and technical feasibility by looking at the U-factor distribution of doors by the amount of glass. This analysis confirmed the commenter's point that it is easier for door configurations with less glass to meet their respective criteria levels. EPA believes that the proposed criteria provide consumers with more energy savings while still providing an opportunity for doors with more glazing to meet the criteria.

Figure 1. Distribution of Door Performance by Glazing (Lite) Level



Payback Period

Commenters suggested a range of payback period options from 6 to 20 years, and provided the following explanations:

Several commenters suggested that the payback period should reflect the preference of homeowners to recoup their investment within the period of time they live in a home. One commenter explains that homeowners would prefer a relatively short payback period that allows them to see those additional savings while still in the home. Another commenter argues that "the resale values of homes with newly replaced windows are 75% to 80%, and with a typical replacement package cost of $8,000 to $15,000, the homeowner is risking up to $3,000 in the decision to spend extra dollars on more energy efficiency."

The commenter further explains that according to 2019 NAHB data, nearly 40% of homeowners move in the first 8 years of homeownership and recommends that 6 to 8 years is the best payback time.

One commenter recommends that the payback period be no more than 8 years, the length of time most Americans owned their homes before the housing recession.

Several commenters argue that the payback period should not exceed the average length of homeownership, typically 7 to 10 years. One commenter explains that this figure may be further supported by typical window warranty language in which a warranty is non-transferrable between owners.

Two commenters suggested that EPA evaluate the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1 methodology for determining whether proposed baseline code changes are cost-effective. This methodology considers whether a baseline code change will or will not add to the cost of construction as a part of the debate that determines whether to accept, reject, or modify the proposed code change.

Several commenters state that NAHB advocates for a maximum 10-year payback for the cost-effectiveness of baseline code changes. An analysis published in NAHB's What Home Buyers Really Want (2019 edition) found that nearly two-thirds of consumers require a payback period of 10 years or less. The commenters recommend that EPA consult with NAHB, the NAHB Remodelers Council, National Association of the Remodeling Industry, and the Home Innovation Research Labs.

Several commenters argue that cost-effectiveness should be based on the reasonable lifespan of the product, or approximately 20 years. One commenter characterized this as the number of years such products are typically warranted and/or expected to provide such energy efficiency. One commenter argued that energy savings are not tied to the homeowner, they are tied to the period of time that the window is functionally installed, no matter how many occupants come and go. The commenter believes that the homeowner will recover the extra cost paid, if selling the building sooner, through the appreciated value of the building.

Another consideration for payback calculation for replacement windows is that older homes may be very inefficient in other areas (e.g., roofs, walls) and the only way to get a true measure of payback would be through an onsite energy audit. In some cases, this may reveal that even ENERGY STAR certified windows will not achieve a payback when considering the other energy deficiencies of the home.

EPA Response:

EPA appreciates the wide variety of suggestions for a reasonable payback period. EPA did not consider the ASHRAE 90.1 methodology as that standard applies to commercial buildings and not low-rise residential homes. After considering several different approaches to this question, EPA settled on "about" 10 to 13 years as a reasonable payback period. The basis for this decision was a reasonable compromise between the range of the suggested 6 to 8 years and 20+ year lifetime of the product. In addition, NAHB data and National Association of Realtors data suggest that 13 years is the median duration of homeownership.[2]

Energy Savings

Trade-Off Analysis

One commenter suggests that EPA address thermal comfort, fan energy, and worst case window orientation when evaluating trade-offs. The commenter argued that high solar gain windows require a

[2] National Association of Realtors. How long do homeowners stay in their homes? January 8, 2020. Accessed at https://www.nar.realtor/blogs/economists-outlook/how-long-do-homeowners-stay-in-their-homes.

high-capacity fan to handle the extra cooling load. This adds a penalty to wintertime performance as well, as the “big” fan will draw more even though winter run times may be shorter with high solar gain windows.

The commenter provided a scenario where the typical house has most of the windows on the back and front sides (few windows on the ends adjacent to neighboring houses). For most locations in the Northern Climate Zone, the current trade-off fails for houses with west/east-facing facades (and is marginal for those with a northern exposure). The commenter recommended that EPA base trade-offs on a worst case orientation to ensure that all exposures realize energy savings.

The commenter contends that trade-offs provide a poorer insulating value with a risk of winter daytime overheating and the near guarantee of hot discomfort in the summer.

EPA Response:

EPA thanks the commenter for bringing up this issue. EPA does not include thermal comfort as a criteria parameter for its program because thermal comfort is not a product energy performance parameter. As a matter of personal preference, thermal comfort is an issue that consumers can consider when making a window purchase, along with ways to address possible comfort issues stemming from house orientation, exterior window shading, and planned window attachments. There are already several existing thermal comfort scales online that consumers can consider to get an idea of possible heating or cooling considerations by the location of their home.

EPA relied on the Lawrence Berkeley National Laboratory’s EnergyPlus modeling software, which includes fan energy, to analyze energy use for various locations and for a variety of product performance parameters. EPA found equivalent energy performance for the prescriptive and trade-off criteria in the Northern Climate Zone. EPA understands that high solar gain windows may not be ideal for some customers but may be preferred by others.

To evaluate the impact of house orientation, EPA conducted a sensitivity analysis for a variety of Northern Climate Zone locations where the higher solar gain trade-offs might be used. EPA found that high-gain products, even in all east-west or north-south glass orientations, gave higher energy savings than medium- or low-gain products at the same U-factor. To address thermal comfort issues from higher solar gain window products, consumers can choose to internally or externally shade windows in the summer and enjoy additional warm solar gain in the winter. Many residential windows already have some kind of internal window attachment for privacy, glare control, and/or comfort control so that additional expense is limited. EPA also plans to provide additional guidance on high solar gain vs. lower solar gain windows, advising consumers to consider their own comfort preferences, internal/external shading, and other home characteristics when deciding what windows they should purchase.

V. Climate Zone Changes

Moving IECC Climate Zone 5

EPA received comments both in support of and opposed to moving IECC Climate Zone 5 from the Northern to the North-Central Climate Zone.

Several commenters indicated that they would support the move. Several other commenters would only support the move if the current North-Central Climate Zone ENERGY STAR criteria does not change. Specific comments included the following:

- This would create a lower barrier to entry for ENERGY STAR in Climate Zone 5 and offer more selection to consumers.
- This would allow EPA to set the same U-factor requirements for most of the country, leading to more efficiency at a lower cost.

- Climate Zone 5 has more cooling degree days than Climate Zones 6 through 8 and therefore has more in common with Climate Zone 4.
- Such a shift would allow EPA to set a maximum SHGC that would reduce solar gain and lower air conditioning demand.
- This move would benefit the large share of the U.S. population that lives in Climate Zone 5.

On the other hand, several commenters do not support moving Climate Zone 5 to the North-Central Climate Zone. Two commenters explained that this would move the North-Central Climate Zone northward through all of Ohio and halfway into Michigan. One commenter noted that a minimum SHGC would lead to higher energy consumption in many parts of Climate Zone 5, providing an example of cold winters in Wisconsin.

Several commenters suggested that EPA make its determination based on the results of energy savings calculations.

Several commenters suggested that EPA evaluate and potentially adopt the latest changes to the ASHRAE 90.1 climate zones, which shifted some of the southernmost counties in Climate Zone 5 to Climate Zone 4.

One commenter suggested that EPA wait for the proposed 2021 IECC updates before making any final decision to move Climate Zone 5.

One commenter believes that moving Climate Zone 5 would create short-term concern over handling the effective date, labeling, and inventory loss and the transition should be carefully considered.

Several commenters provided information on common product characteristics among ENERGY STAR certified windows in Climate Zone 5.

EPA Response:

EPA thanks commenters for providing multiple opinions on this issue. The 2021 IECC is now complete and EPA can proceed with more confidence on the direction of the codes. EPA analyzed energy savings and paybacks for each IECC Climate Zone for a wide variety of U-factor and SHGC combinations. The results of that work indicated that the current climate zones are still reasonable. EPA understands that the IECC has addressed the issue of a warming climate through the code mapping process and has decided to follow IECC and move select counties from Climate Zone 5 to Climate Zone 4. EPA will redraw the ENERGY STAR Climate Zone map to continue to reflect the IECC Climate Zone lines.

Combining Southern and South-Central Climate Zones

EPA received comments both in support of and opposed to changing the current climate zone configuration.

Several commenters support merging the Southern and South-Central Climate Zones into a single zone, arguing that a combined zone will result in less consumer confusion and easier participation for manufacturers. One commenter states that a lower U-factor in the Southern Climate Zone would save additional energy.

Two commenters indicated support for merging climate zones if EPA sets the U-factor at 0.35 for the combined zone. Another commenter indicated that they could potentially support the change, but they needed to know the prosed criteria first.

Several commenters do not support a change. Two commenters argued that SHGCs as low as 0.23 are appropriate for the Southern Climate Zone but not the South-Central Climate Zone, and higher U-factors are actually better in the Southern Climate Zone to allow the thermal mass of the building to cool at night. Another commenter added that consumers want spectrally selective products tailored for their climate.

Another commenter urged EPA to wait for the final determinations on the 2021 IECC before changing climate zones.

Several commenters offered insights on the potential market impact of such a change. Several commenters claimed that simplifying the specification would be good for both consumers and manufacturers. Two commenters noted that aluminum framing is necessary for hurricane protection, which would pose a challenge if the Southern Climate Zone U-factor became more stringent. One commenter noted that because the two zones currently have the same SHGC requirement, there would be limited impact on product availability. Another commenter stated that there may be a slight cost increase for some windows, but that most of the market already meets U-factor 0.30. One commenter notes that the U.S. DOE/Pacific Northwest National Laboratory (PNNL) field studies show widespread use of similar products across both climate zones.

EPA Response:

EPA thanks commenters for providing multiple opinions on this issue. The 2021 IECC is now complete and EPA can proceed with more confidence on the direction of the codes. As with Climate Zone 5, EPA did analysis on energy savings and paybacks for each IECC Climate Zone for a wide variety of U-factor and SHGC combinations. The results of that work indicated that the current climate zones are still reasonable. EPA understands that the IECC has addressed the issue of a warming climate through the code mapping process and has decided to follow IECC and move select counties to follow the IECC approach. EPA will redraw the ENERGY STAR Climate Zone map to continue to reflect the IECC Climate Zone lines.

EPA found that there currently are no ENERGY STAR certified aluminum-framed product lines that can meet a U-factor below 0.34. EPA understands that tightening the criteria in the Southern Climate Zone would make it harder to meet ENERGY STAR criteria for aluminum-framed products.

Minimum Solar Heat Gain Coefficient for the Northern Climate Zone

EPA received comments on both sides of this issue.

Several commenters would support a minimum SHGC for the Northern Climate Zone. Specific comments include the following:

- A minimum SHGC would potentially eliminate the use of inappropriate low-SHGC products for the Northern Climate Zone.
- Without a minimum SHGC, some products sold in the Northern Climate Zone have triple-silver low-e coatings that block as much as 75% to 78% of the sun's free solar energy and result in higher energy consumption. IGUs with fourth surface and second surface low-e coatings can deliver more energy savings to the Northern Climate Zone compared with triple-silver low-e coated IGUs.
- Labeling ENERGY STAR windows with a minimum SHGC would encourage Northern Climate Zone homeowners to use higher SHGC windows that permit the sun's free, renewable energy to heat their homes in the winter.
- Glare and heat gain, when it does occur, can be addressed with intermittent shading. Consumers may still select tinted windows for privacy reasons, but there should not be criteria for ENERGY STAR.
- Minimum SHGC should not be set too high in order to allow options for solar control when needed.

On the other hand, several commenters would oppose a minimum SHGC for the Northern Climate Zone. Specific comments include the following:

- EPA has rejected this idea in the past, and it has been consistently rejected in the code development process.
- EPA must provide adequate data to propose a sound minimum SHGC requirement for the Northern Climate Zone.
- High-SHGC products are not optimum for high elevations and can result in overheating.
- High solar gain assumes that existing homes are designed for passive solar, which is not the case in most instances. There are many variables of architecture and exposure that may make high solar heat gain undesirable in some instances. Establishing a minimum SHGC in the Northern Climate Zone could mislead consumers by suggesting that simply installing high solar gain fenestration represents effective passive solar design, while it is only one of many factors to consider.
- Changing weather and climate data suggest that a greater emphasis should be placed on reducing solar gain instead of setting a minimum SHGC.
- West-facing orientations (and to lesser degree east- and south-facing without an overhang) will likely have significant consumer discomfort due to increased solar gain. Since the orientation of the window is not known in advance, it would be far better to leave it to the consumer to choose the correct SHGC for their home in the Northern Climate Zone.
- Minimum SHGC would add a regulatory burden for manufacturers. Depending on the level of minimum SHGC, it could significantly affect product availability and require manufacturers to offer a significantly different window than for other climate zones. A minimum SHGC could potentially limit grille options as any grilles have a large impact on the SHGC of a window. Manufacturers also may adjust the tint on the products they offer.
- Requiring a higher windows SHGC will result in more electrical peak demand, leading to the construction of more power plants. While the Northern Climate Zone is heating-dominated, there are still significant periods that require cooling. The commenter added that many homes in the region do not have efficient central air conditioning and rely on less efficient room air conditioners during cooling months. The commenter recommended that EPA factor in the consumer cost for larger HVAC units as a likely consumer response to discomfort into its analysis of a minimum SHGC.
- One commenter cautioned that consumers expect ENERGY STAR windows to perform and be comfortable in all seasons and for all orientations; however, a high SHGC product would not meet this standard; such a departure from past practice would lead to consumer confusion and dissatisfaction and negatively impact the ENERGY STAR brand.
- One commenter argued that the current optional Northern Climate Zone trade-offs already encourage higher SHGC products, so a minimum SHGC is not necessary.

EPA Response:

EPA reviewed all the comments provided and thanks stakeholders for providing many different viewpoints on this issue. The 2021 IECC is now complete and EPA can proceed with more confidence on the direction of the codes. EPA is proposing to set a minimum SHGC only in the ENERGY STAR Northern Climate Zone that would exclude products at the very low end of the SHGC range (≤ 0.17). EPA found that products at that range would save less energy and would also lower VT below 0.40 for many products (see Table 1 above). EPA does not want these products with lower annual energy impacts and low VT to carry the ENERGY STAR label as they would not deliver on the energy performance that consumers would expect, and they may be disappointed with a low VT in a region of the country where

daylighting is typically appreciated during winter months. Setting a minimum SHGC in this range would not impact comfort or peak load.

VI. Product Categories

Applying the ENERGY STAR Windows Specification to Full-Lite Sliding Patio Doors

EPA received comments on both sides of this issue.

Several commenters would generally support the idea of including sliding patio doors in the windows specifications. One commenter stated that it would potentially create more product consistency across a house package.

On the other hand, several other commenters opposed the idea and provided specific reasons why:

- This potential change would create unnecessary confusion about the distinction between windows and doors and would require substantial changes in labeling and marketing.
- Patio doors commonly have low-profile sills with durable materials to account for frequent foot traffic or wheelchairs; the higher glass-to-frame ratio can result in higher U-factors than comparable windows.
- Sliding patio doors have poorer air leakage performance than double-hung windows.

EPA Response:

EPA appreciates the range of comments on this issue. After reviewing the U-factor performance distribution of certified full-lite sliding glass patio doors and confirming with dealers that the same higher performance glass packages for windows were available in sliding patio doors, EPA is proposing to align sliding glass patio door criteria with the ENERGY STAR window criteria. Patio doors consist of a large area lite with a frame and are more similar to windows than swinging doors in performance and components. This change also allows consumers to match patio door and window glass to provide a consistent look across the wall façade. EPA proposes to use the air leakage requirement for doors for these criteria.

Sunsetting the ENERGY STAR Door Specification

EPA received comments in support of and opposed to sunsetting the ENERGY STAR door specification.

Several commenters were supportive of the possibility. One commenter was in favor of sunsetting the specification for swinging doors provided that EPA maintains the current criteria for sliding doors.

Several commenters opposed sunsetting the door specification and supported maintaining the current criteria. Commenters argued that sunsetting the specification for swinging doors would add complexity to the program and make it more difficult for manufacturers to sell a complete package of energy-efficient windows and doors. Commenters noted that EPA used the rationale of encouraging consistent glazing packages to expand the Most Efficient criteria to include full-lite patio doors and stated that the same rationale should be applied in this case.

Commenters also noted that, according to NAHB, windows, doors, and skylights are among the most desired ENERGY STAR product for homeowners. Therefore, sunsetting could frustrate consumers by removing a clear means for identifying superior swinging doors and making certain products ineligible for tax credits or utility rebates. Several commenters stated that the door products may regress in energy efficiency if the specification is sunset.

One commenter encourages EPA to evaluate cost-effectiveness based on the energy savings for complete door systems, including transoms and sidelites, as this would increase the glazing area and make the savings more favorable. In addition, the commenter notes that code exemptions for sidelights and transoms mean that EPA can use single-glazed products as a baseline, instead of code.

One commenter encourages EPA to consider a more nuanced breakdown of door lite configurations based on NFRC 100. The commenter recommends that EPA not sunset the specification but instead freeze performance criteria for lite configurations that cannot demonstrate cost-effective improvements.

EPA Response:

EPA appreciates the comments received on possibly sunsetting the ENERGY STAR door criteria. After some consideration, EPA has decided not to sunset the ENERGY STAR door criteria. Please refer to other comments and the Criteria Analysis Report regarding changes and adjustments to the current door criteria.

Simplifying the ENERGY STAR Skylight Criteria

Several commenters urged EPA to maintain a specification for skylights that is clearly distinct from windows. Commenters were concerned about EPA combining the specifications for windows and skylights, and they cautioned that would be confusing for both manufacturers and consumers. Commenters noted that windows and skylights have different criteria tables in the IECC and consumers understand them to be separate products. One commenter stated that expressing the skylights criteria as a multiplier to the windows criteria would add complexity to the program and introduce the possibility of manufacturer error. Another commenter stated that consumers will need a separate criteria table for skylights to understand the specifications.

One commenter explained that skylights are subject to different technical requirements for energy performance simulation and NFRC certification. Namely, skylights are assumed to be mounted on a curb 4 inches above the roof, which leads to more energy loss compared to a vertical window installed into a recessed wall. Several commenters explained the additional technical differences between tubular daylighting devices and windows.

Sunsetting the ENERGY STAR Skylight Criteria

Several commenters cited data in arguing to maintain the specification. One commenter cited an analysis by Group 14 Engineering showing that builders can reduce the total fenestration need for a building by using skylights to achieve the same amount of daylighting, and therefore reduce the annual heating and cooling costs for the building. Another commenter cited NAHB's finding from What Home Buyers Really Want (2019 edition) that windows, doors, and skylights are the number one must have or desired ENERGY STAR product by homeowners.

One commenter explained that NFRC is researching new ratings for non-planar (domed) skylights. Completion of these ratings will create new analysis tools and allow more types of skylights to be rated; therefore, it is premature to sunset the skylights specification

One commenter argued that maintaining the current criteria will still encourage superior energy-efficient skylight products, even if further advancing the criteria is not justified.

EPA Response:

EPA appreciates the comments received on the ENERGY STAR skylight and tubular daylighting device (TDD) criteria. EPA will not sunset the ENERGY STAR skylight and TDD criteria at this time because better performing products are available for sale. EPA reviewed the U-factor performance distribution of certified skylight products and found that many options were available at lower U-factors. Therefore, EPA proposes to reduce the U-factor criteria for skylights and TDDs in all climate zones to improve insulating

power and to reduce SHGC in the Southern Climate Zones to reduce heat gain and cooling costs. EPA also will simplify the criteria to one level for the Northern and North-Central Climate Zones and another for the Southern and South-Central Climate Zones.

Dynamic Glazing and Shading

Several commenters believe that the market penetration of dynamic glazing is still extremely low, and it is difficult to produce on any type of scale. Therefore, it may be better to consider dynamic windows as part of a future update, not the Version 7.0 specification revision. Commenters acknowledge that these products provide a cost-effective alternative that delivers greater energy savings to the consumer; however, they believe that the current provisions for qualifying dynamic glazing products should be maintained.

Several commenters believe that new product ratings from the Attachments Energy Rating Council will help grow the market for integrated shading systems over the next few years. One commenter believes that dynamic glazing will grow significantly in the commercial market but not in the residential market in the near future. One commenter expects the residential market for dynamic glazing and shading to grow as consumer awareness increases.

One commenter supports exploring and including dynamic glazing and shading in the Version 7.0 specification revision process because such products will be useful for utility-integrated demand-side management opportunities. The commenter advocates for performance-based objectives in order to allow for innovation and maximize the savings potential of future commercial products. One commenter suggested that ENERGY STAR Version 7.0 include a section to define connected criteria for windows, similar to the latest ENERGY STAR lighting specifications.

One commenter believes that the current process for certifying dynamic products using open and shut metrics creates understandable performance metrics. However, the commenter supports considering a weighted average usage calculation to better understand the potential energy savings. One commenter believes that these types of products should only get credit for performance that is automatic, saves equivalent energy, and cannot be overridden by the operator of the product. Another commenter cites a 2018 PNNL home study showing that even simple operating schedules—such as opening blinds during the day and closing them at night—were able to achieve consistent and significant savings.

One commenter noted that NFRC is developing a new method for simulating and labeling manually controlled blinds between panes of glass that could be applied to other types of dynamic glazing and shading.

One commenter does not support dynamic products for ENERGY STAR Version 7.0 and believes that these products should be considered for the ENERGY STAR Most Efficient program since that program is reviewed yearly and advances can be taken into consideration as more information becomes available on those products.

EPA Response:

EPA thanks stakeholders for their interest and feedback on this issue. EPA is interested in finding a way to account for energy savings that dynamic products may provide when used manually or when automated. However, the current approach to certifying product performance in the “all open” or “all closed” state does not make it possible to determine the overall energy performance under certain conditions, patterns, or algorithms. Due to this situation, EPA does not believe that there is sufficient data to do analysis and determine the energy performance benefits of certain dynamic product scenarios. EPA encourages stakeholders to continue developing certification processes so that the energy savings benefits of these products may be considered. EPA will follow the development of performance data availability and reevaluate the status of this product category again in the future.

High Altitude and Impact Resistance

Several commenters stated that high-altitude and impact-resistant products represent a small share of the market. One commenter explained that impact resistance is usually only used when specified by the building code. Another commenter stated that high-altitude and impact-resistant products constitute approximately 20% of all wood-clad windows sold by their company.

Several commenters stated that allowances for high-altitude and impact-resistant products add significantly more complexity for product labeling and marketing. One commenter argued that distribution systems would make it difficult, at best, to control which products are sold in areas subject to these conditions, leading to the possibility that consumers may purchase products that perform worse than expected. Another commenter stated that allowance for such products should be considered if the labeling questions can be resolved.

One commenter argued that even if these areas represent a fairly small portion of the windows sold, it is important that these areas have a reasonable, cost-effective ENERGY STAR windows designation. The commenter likened setting criteria for these areas to differentiating products based on climate zone. The commenter explained the 2021 IECC will have an allowance of an extra 0.02 U-factor for products installed above 4,000 feet in elevation or where impact resistance is required.

EPA Response:

EPA thanks stakeholders for providing feedback on this topic. EPA has considered this issue in the past and reviewed the issue again. For this criteria revision, EPA has not proposed to create special criteria for high-altitude products or impact-resistant products. First, products are available that can meet the proposed criteria in these areas. Consumers who buy ENERGY STAR window, door, or skylight products in high-altitude or hurricane zones should be able to have the same comfort and performance as other consumers in the same climate zone. Furthermore, special criteria would add unnecessary complexity to the current climate zone map and create more difficulty in product labeling and distribution for manufacturers. Finally, in the case of fenestration products in a hurricane zone, other solutions are available for consumers, including exterior hurricane shutters and panels that may meet local code requirements.

VII. Product Certification and Verification

Verification Testing

One commenter suggested that the ENERGY STAR verification testing requirements should be revised to allow additional testing in response to an initial failure before disqualifying the product. The commenter referred to verification testing under the U.S. DOE's Appliance and Equipment Standards Program.

EPA Response:

EPA thanks the commenter for their suggestion. The ENERGY STAR program has its own certification and verification procedures to ensure that each model delivered offers the savings promised by ENERGY STAR. There are exceptions for appliances procedures to align with DOE regulatory procedures, but for all other product types, verification is structured to ensure that consumers get the performance from each and every ENERGY STAR product they purchase. The National Appliance Energy Conservation Act (NAECA) run by U.S. DOE has its own testing and certification requirements. Fenestration products are not included in NAECA. Requirements and background information on EPA's certification and verification program for ENERGY STAR can be found at:
https://www.energystar.gov/partner_resources/products_partner_resources/third_party_cert

NAFS Certification

Two commenters recommended that ENERGY STAR require North American Fenestration Standard/Specification (NAFS) certification to align with building codes and the Most Efficient program, arguing that NAFS certification will add to the program's credibility and the safety of consumers.

EPA Response:

EPA thanks commenters for their recommendation. EPA has considered this issue before and the Agency's position has not changed. EPA already requires air leakage as part of the current window, door, and skylight criteria, which is the part of the NAFS certification that impacts the energy performance of the product. Furthermore, NAFS is already required by code, so to have ENERGY STAR require NAFS would be duplicative.

VIII. Extended Implementation Schedule

Several commenters recommended that the effective date should be between 12 and 18 months after release of the final specification, starting on January 1 of the following year. These commenters stated that 9 to 12 months does not allow enough time for all that is required to update products, sales and marketing materials, and training and distribution plans for products that meet new ENERGY STAR specifications. Commenters noted that testing lab capacity could be a bottleneck as manufacturers seek to update their certification on time.

Two commenters stated that 12 months for implementing ENERGY STAR criteria is enough time for partners to carry out the necessary changes.

One commenter noted that manufacturers do not need to rush to meet a certification deadline because products can be labeled as ENERGY STAR certified on a continuous basis as manufacturers complete the necessary steps to update products and bring them to market.

EPA Response:

EPA thanks commenters for providing feedback on this topic. EPA cannot currently predict how long finalizing the Version 7 criteria will take. It is EPA's intent to allow at least 12 months after finalizing and before implementation of the criteria.