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B. General Comments on the Version 7 Draft 2 Proposal

I. Overall Response to the Version 7 Draft 2 Proposal

EPA received comments from 25 organizations and individuals for the Version 7 Draft 2 specification proposal. Many commenters continued to provide strong support for the proposed specification. These commenters approved of the updated analysis in the second draft proposal, appreciated the potential for expanding the use of technological advancements, and emphasized a willingness to support the industry in adopting the proposed criteria. Several commenters specifically supported the removal of climate zone "islands" and the realignment of sliding and swinging door criteria. Conversely, some commenters expressed continued concern that the proposed criteria and its implementation timeline are too aggressive. These commenters cited increased product costs caused by performance requirements and the burden placed on manufacturers from a supply chain perspective. Several commenters questioned the baseline used in EPA's analysis and opposed the tradeoff pathways in the Northern zone. These comments are addressed in further detail in the following sections.

C. Energy Analysis

I. Baseline

EPA received comments opposing the market baseline used for the energy savings and payback analysis. Commenters suggested that the Version 6.0 criteria should have been used for this analysis. Specific comments included the following:

- One commenter claims that the baseline should not exceed code minimums for any climate zone and contends that Version 6.0 should be used as the baseline, citing DOE's cost-effectiveness assessment for energy code upgrades that uses the existing code as a baseline.
- Some commenters disagreed with the market baseline, as using Version 6.0 for the baseline would indicate whether the specification revision is warranted or cost-effective for manufacturers.

EPA Response:

EPA thanks stakeholders for their comments regarding the window baseline performance levels used for the for the Version 7.0 Analysis. EPA addressed this issue in the Draft 1 response to comments and explained how it chose the market and code baseline. EPA's response to these comments has not changed. EPA has documented that the proposed criteria revision is warranted, and products exist in the marketplace that are cost effective for consumers. EPA does recognize that the 2021 International Energy Conservation Code (IECC) minimum code for windows was made more stringent in Zone 4 (ENERGY STAR North Central) and Zone 3 (ENERGY STAR South Central). The more stringent criteria could impact payback, especially for new construction requirements for homes in States that adopt the more progressive 2021 code criteria. To help address that concern, EPA ran a code baseline analysis for ENERGY STAR North Central and South-Central zones. The results were found to have reasonable paybacks and the

tables can be found in Appendix IV. EPA also found several cities which were incorrectly assigned to historical ENERGY STAR zones. Those assignments are corrected in this version of the results. The list of incorrectly assigned cities (now correctly assigned) can be found in Appendix VII.

II. IECC Zone 5

EPA also received several comments asserting that IECC zone 5 be included in the ENERGY STAR North-Central zone. Specific comments included the following:

- Several commenters asserted that the IECC climate zone 5 should be moved into the North-Central ENERGY STAR climate zone as opposed to the Northern climate zone. This aligns with the max SHGC of 0.40 in the 2021 IECC.
- One commenter asserted that keeping zone 5 in the Northern zone distorts the data because 75% of the population in the Northern zone is in zone 5.
- One commenter asked for an in-depth explanation as to why the EPA has decided to keep zone 5 in the Northern zone.
- One commenter asserted that IECC Zone 5 is more like the North-Central climate zone because it has a much more moderate climate for heating and has more need for cooling compared to zones 6-8. They suggested to compare the heating degree days across these zones.

EPA Response:

EPA thanks the stakeholders for their additional comments on IECC zone 5. The energy savings trend for zone 5 is more like that of IECC zones 6-8 than IECC zone 4 at the proposed U-factor levels for the Northern and North-Central zone criteria, respectively. The graphs in Appendix VIII show this relationship. The site energy savings all increase in a similar linear fashion as SHGC is increased. However, comparing Zone 4 to Zone 5 shows that the Zone 4 energy savings trend starts to diverge from Zone 5 more drastically as SHGC is increased. This divergence shows the energy penalty is higher in Zone 4 during the summer for higher SHGC products that increase the cooling load that is met by electricity. This relationship is even more pronounced when looking at source energy savings for Zones 4 and 5. The comparison further emphasizes the higher electricity energy penalty in Zone 4 compared to Zone 5 of increased cooling load during the summer months for high SHGC products. Given these energy savings trends, IECC Zone 5 will remain in the Northern zone for the Version 7 criteria. Zone assignments will be re-assessed in future revisions with the hope of using more recent weather data which could impact these trends. It should also be noted that the IECC has withdrawn the SHGC maximum for Zone 5 from the 2021 IECC. To be clear, EPA primarily considers SITE energy savings for ENERGY STAR products as this is what the consumer experiences in their home wherever it is located

III. Climate Zones and Northern Zone "Islands"

EPA received comments regarding the climate zones used in the Version 7 analysis. Several commenters supported EPA's decision to revise the climate zone map to eliminate Northern zone "islands".

EPA Response:

EPA appreciates the feedback from stakeholders on this issue and has adjusted the zone map to include identified 'zone islands' from the Draft 1 Response to Comments in with the surrounding zone. EPA also plans to update its zone finder tool with the all the county zone changes and provide an updated list of U.S. counties by zone on its web site before Version 7 is implemented.

IV. Site vs. Source Energy

EPA received several comments discussing site versus source energy of the energy savings analysis. The commenters asserted that source energy would be a more appropriate metric for comparison for energy savings, as using site energy contradicts ENERGY STAR Portfolio Manager's claim that source energy is the most equitable unit for evaluation of building performance.

EPA Response:

EPA appreciates the issues surrounding the use of site versus source energy for its analysis. EPA considers SITE energy savings for ENERGY STAR products as this represents the savings the consumer experiences in their home wherever it is located. The ENERGY STAR Commercial Buildings program uses source energy for their program since the location of the building is known. For the Version 7.0 analysis, EPA has also considered source energy in Draft 1 to confirm the proposed criteria were appropriate and did not have unintended consequences.

D. Cost-Effectiveness/Payback

I. Representative Frame Material and Operator Type for Windows

EPA received two comments concerning the cost analysis relying primarily on vinyl double-hung windows, as other frame types could be disproportionately affected by the proposed criteria.

EPA Response:

EPA thanks the stakeholders for providing their concerns on the use of vinyl-frame, double-hung windows for the cost analysis. EPA addressed this issue in the Draft 1 Response to Comments and EPA's position has not changed. EPA is aware of other frame types (wood, clad wood, composite, and fiberglass) in the market and that these frames can have poor thermal performance. Nevertheless, high performance products with those frame types are currently available in the marketplace. It should be noted that those other frame types also represent a relatively small percent of sales (20% or less). Based on the response of the market to the Version 6 criteria revision, EPA believes that the cost analysis approach used for Version 7 was reasonable to identify better performing products for a criteria advancement.

II. Cost Model

EPA received multiple comments concerning the cost model used in the payback analysis. The specific comments included the following:

- One commenter claimed that the payback analysis was rigorous and shows that higher-performing windows are achievable at a reasonable cost.
- One commenter questioned the cost model and suggested that a median price be used to capture a more accurate impact of triple pane upgrade costs.
- One commenter asserted that average costs should be used for incremental cost analysis, as this is more reflective of the market than the current analysis which is a "best case scenario".

EPA Response:

EPA thanks stakeholders for their comments regarding the cost model used for the analysis. As discussed in the Draft 1 Response to Comments, EPA understands the costs of upgrading products because it collected component and product cost data as a part of its analysis. As previously explained, EPA does not use the median or average product costs for its analysis as that would include markups that are not related to performance improvements. Since EPA found multiple products in the marketplace which met the cost model that was used, EPA believes its cost model was reasonable for this analysis.

III. Appropriate Payback Period

EPA received several comments discussing the time period that constitutes a reasonable payback period for consumers asserting that a shorter payback is required. The specific comments include the following:

- One commenter claimed that the payback period in the Northern zone is justified because it aligns with the length of time the average homeowner stays in a home.
- Several commenters have asserted that a payback period of over ten years is not reasonable.
- Some commenters believe the proposed criteria will extend the payback period due to cost increases caused by new technologies.
- One commenter recommended that the payback analysis should incorporate the useful life of the product, consumer willingness to invest, and potential discount rates, as the current analysis is too simplistic.

EPA Response:

EPA appreciates the feedback on the time period for payback. EPA addressed this issue in the Criteria Analysis Report (CAR) released with Draft 1 and in the Draft 1 Response to Comments, citing 3 studies to support its proposal. Further, it is important to understand that the amount of time it takes to pay back the incremental cost of buying a higher performing product depends both on the cost of the products and on the cost of energy. As discussed in the webinar EPA gave on the Draft 2 proposal, the cost of natural gas is significantly higher than the gas cost EPA used for its initial analysis. Tables provided in the webinar showed that higher gas prices mean faster

payback for consumers. Therefore, although some product costs may have gone up since EPA first did its analysis, the cost of energy has also gone up likely reducing the payback period. Since it impossible to predict the exact product cost or energy cost in the future, EPA believes its payback approach is reasonable for this analysis. EPA has provided updated tables on payback at different energy prices in Appendix VI as an example.

IV. Product Costs

EPA received several comments concerned about the product costs, stating that increased costs for manufacturers and consumers would be required to improve the performance levels of windows to meet the proposed Version 7.0 criteria. The specific comments included the following:

- Several commenters stated that the increased cost to consumers caused by added technology will outweigh tax credits and energy savings.
- One commenter suggested that the proposed criteria would drive up consumer costs particularly in the Northern zone and reduce consumer choice by excluding many product lines.

EPA Response:

EPA appreciates the feedback on product costs. EPA addressed this issue in the Draft 1 Response to Comments saying that EPA acknowledges that products meeting the proposed criteria, especially some premium product lines, are more expensive; however, EPA's analysis found multiple high-performance products available for sale at cost-effective prices. EPA also found that the market responded well to the Version 6 criteria revision and consumers continued to have good product choices in the market. Additionally, EPA's analysis for Draft 1 found that 50% or more partner manufacturers had certified products that could meet the Version 7 criteria.

E. Product Availability

I. Market Share

EPA received comments about the market share of ENERGY STAR windows, doors, and skylights between Version 6 and Version 7. Several commenters expressed that the high market share under Version 6 shows that ENERGY STAR is failing to differentiate higher-performing products in the market, affirming that the improved criteria under Version 7 will allow for meaningful differentiation in the market.

EPA Response:

EPA agrees that the current high market share means that ENERGY STAR is not currently differentiating many of the higher-performing products in the marketplace and appreciates the support for advancing the Version 7 proposal.

II. Market Share Projection

EPA received several comments regarding market share projection and market transformation. Some commenters believed that the proposed criteria would allow for market innovation and increase the domestic availability of high-performing windows without prescribing component requirements. Others voiced concerns about the potential supply chain issues that any new technology may cause. The specific comments included the following:

- Some commenters reported no obstacles in meeting the proposed criteria given the available materials and confirmed the changes are fair and equitable.
- Several commenters supported the technological advancements required by the proposed specification, as this enables market transformation and will aid in the development of energy efficiency programs, thus driving demand and lowering costs.
- One commenter claimed that the addition of new technologies and materials required to meet the proposed criteria have not been accounted for from a supply chain perspective, placing an unfair burden on suppliers in the Northern zone.
- One commenter asked if higher savings on a smaller number of products will be more beneficial than modest savings on a greater number of products.

EPA Response:

EPA appreciates the comments supporting advancing the ENERGY STAR criteria. EPA has not heard from any component suppliers who indicate major issues with supply chain constrains for Version 7 Northern zone products. Regarding predicting the impact of savings from less stringent Version 7 criteria or more stringent Version 7 criteria, EPA points to the market response from the last criteria revision (Version 6) where there was no significant drop in market share. While it is impossible to predict the future, EPA believes that the market will respond strongly to the Version 7 criteria.

III. Market Share Methodology

Several commenters requested EPA perform more market share analysis to better understand the impact the proposed criteria will have. The specific comments included the following:

- Two commenters were critical of the use of the Ducker Report for market share due to the small sample size.
- One commenter was concerned about the NFRC subject window sizes used in simulations particularly regarding casement windows, as they have found these lead to inconsistencies in product offerings. A more realistic method in determining product availability was recommended.

EPA Response:

EPA appreciates the comments on market share methodology it received. With this Final Draft, EPA shares its intention to bring the sales data collection and market share analysis in-house to align with the data collection that EPA uses for its other product categories. Regarding window

sizes used for simulations, EPA suggests bringing the issue to the National Fenestration Rating Council (NFRC) for discussion as they set the window sizes for simulations.

IV. Triple Pane Windows

EPA received comments about the higher cost and limited availability of triple pane products and the burden to manufacturers that the proposed criteria would place on manufacturers in providing these product offerings. The specific comments included the following:

- One commenter contended that triple pane products would be required at the proposed levels for the North and North-Central zones, which is not cost-effective. Looking solely at vinyl-framed products is insufficient, as EPA should include other material types with significant market share in its analysis.
- One commenter felt that the requirement of triple pane glass has not been accounted for from a supply chain perspective.

EPA Response:

EPA appreciates stakeholders expressing their concern on the availability of triple pane products. However, as EPA stated in the Draft 1 Response to Comments, the analysis performed for this criteria revision found reasonable paybacks at the performance levels proposed for both high-performance triple and double pane products. Further, EPA does not require a specific technology such as triple panes for the criteria. EPA found that some manufacturers can meet the proposed levels with a double pane product. EPA has also offered equivalent energy trade-offs for the Northern zone criteria which require less stringent U-factors. EPA has not heard directly from any glass manufacturer or Insulating Glass Unit (IGU) fabricator that the triple pane glass option for manufacturers will cause significant supply chain issues.

V. NFRC Certified Products Directory (CPD)

EPA received several comments concerning the use of the NFRC CPD as representative of the windows market. The commenters assert that the CPD does not directly correspond to the number of products in production, therefore inflating the number of available products in the market.

EPA Response:

EPA appreciates the additional feedback on the analysis using the NFRC CPD. EPA has addressed this concern on multiple occasions and provided a detailed response in the Draft 1 Response to Comments. EPA's response has not changed.

VI. New Window Technologies

EPA received comments regarding the limited availability of new window technologies and the cost increase associated with providing products that meet the proposed criteria.

- One commenter pointed out that the National Labs are providing technical support to help address the difficulty manufacturers are experiencing in complying with technological requirements under the proposed specification.
- One commenter stated that glass technologies such as thin triples, vacuum glazing, and aerogels are still emerging technologies that are not yet readily available and are therefore more expensive.
- One commenter noted that the increased cost of Krypton-filled insulated glass unit has not been accounted for from a supply chain perspective.

EPA Response:

EPA thanks the stakeholders for expressing their concern about the availability of various window technologies that could help meet the Version 7 criteria. EPA agrees that the National Labs have been providing research and guidance to industry to help reduce the concern and uncertainty about technologies that can improve the performance of products. As stated in the Draft 1 Response to Comments, EPA presented its pathway analysis methodology in the CAR and used it to identify the common technologies used in the marketplace today to meet various performance thresholds. The proposed criteria do not specifically require triple-pane windows. The analysis showed that the proposed criteria can be met without thin triples, vacuum glazing, aerogels, or krypton gas fills. If the cost and availability of those technologies improves it will only expand the number of technology options manufacturers have to meet the proposed criteria.

F. Window Criteria

Several stakeholders provided alternative criteria for EPA to consider. EPA has responded to suggestions for these alternative proposals in the appropriate sections of this document according to the subject matter. See Appendix I for all alternative proposals for each ENERGY STAR zone.

I. Northern Zone Criteria

EPA received a wide range of suggestions for the Northern zone criteria. Some supported the proposal and some expressed concern over the proposed levels. The specific comments include the following:

- Several commenters expressed support for the proposed criteria. The criteria will differentiate better-performing products for consumers and deliver additional energy savings while pushing manufacturers to adopt new technologies.
- Two commenters affirmed that they would align their energy-efficiency program requirements with the Version 7 specification in support of its adoption.

- Several commenters proposed higher U-factor criterion as the proposed U-factor of 0.22 in the Northern zone is too stringent. It is a larger increase than previous iterations of the criteria revisions and will often require a more expensive, triple-pane product that would burden suppliers.
- The proposed criteria require room-side low-e coatings, which can decrease comfort levels.

EPA Response:

EPA thanks the stakeholders for suggestions on the proposed Northern zone criteria. EPA appreciates the support for the proposed criteria and that it makes sense for some programs to help make homes more energy efficient. EPA did address the issue of the proposed Northern zone U-factor criteria in the Draft 1 Response to Comments. The updated energy analysis performed for this criteria revision using EnergyPlus version 9.5 shows significant, cost-effective energy savings at the proposed level of 0.22 U-factor. EPA does not require triple-pane products to meet the criteria, has provided energy equivalent trade-offs, and has not received information from component suppliers that supplying materials for Version 7 products will be an issue. EPA has discussed the performance of room-side low-e coatings with glass manufacturers and researchers and there is no evidence that room comfort levels will significantly decrease compared to the same typical residential product without the coating.

II. Northern Zone Tradeoffs

EPA received comments about the equivalent energy savings tradeoffs in the Northern zone. Some commenters supported the tradeoffs because they provide flexibility to the manufacturers in meeting the criteria in the North, while one commenter recommended further limitations or elimination of equivalency options. There were concerns over the use of high solar gain products, specifically in zone 5, that could create an energy penalty during the summer cooling months and increase energy costs for consumers above an SHGC level of 0.37 and approaching 0.5.

EPA Response:

EPA thanks stakeholders for the feedback on the energy equivalent tradeoffs in the Northern zone. EPA appreciates the support for the proposed approach using equivalent energy trade and notes that such trade-offs have been used successfully in previous criteria revisions. EPA evaluated the full annual energy profile of the trade-offs all the IECC zones in the Northern zone and found more annual savings or similar annual savings at higher SHGC levels. EPA has presented this information broken out by IECC zone in the Results and Assumptions file included with this draft release.

III. Minimum SHGC in Northern Zone

EPA received a comment proposing the elimination of a minimum SHGC in the Northern zone, citing thermal comfort issues and the lack of SHGC criteria for skylights. Consumers are concerned with dollar savings on energy costs rather than incremental energy savings that may not be cost effective.

EPA Response:

EPA thanks comments for their feedback. EPA has shown conclusively in the Draft 1 Response to Comments and Draft 2 webinar that extremely low SHGC levels (under 0.18) in the Northern zone save less energy (and less money) than mid-range or high SHGC. EPA is not aware of any comfort issues with the extremely low SHGC level proposed as a minimum for the Northern zone. EPA will consider minimum SHGC levels for skylights in the Northern zone in the future.

IV. North-Central Zone Criteria

EPA received comments proposing less stringent criteria in the North-Central zone. Two commenters questioned why the North-Central zone criteria is more stringent than the Northern zone criteria.

EPA Response:

EPA thanks the stakeholders for feedback on the criteria in the North-Central zone. Although the current proposed North-Central criteria (U ≤ 0.24) has a lower U-factor than the highest trade-off criteria (U = 0.26), the higher trade off criteria still saves more energy and money for Northern zone locations. While several stakeholders strongly agree with the current proposed criteria, EPA recognizes that a small criteria change could help accommodate more products in the North-Central zone even though there is a small loss of energy savings. **Therefore, EPA is proposing to increase the proposed U-factor criteria in the North-Central zone to U ≤ 0.25 while keep the SHGC criteria at ≤ 0.40. EPA will not change the Northern zone criteria as trade-off options at higher U-factors already exist for that zone.** EPA also recalculated the payback and energy

G. Door Criteria

See Appendix II for all alternative proposals for each ENERGY STAR zone.

I. Realigning Sliding Door and Swinging Door Criteria

EPA received many comments opposed to aligning the sliding door criteria with the window criteria in response to the first draft of the Version 7 specification. EPA has since moved sliding glass doors back to the swinging door criteria. Commenters who responded to this change were mainly supportive of the decision to realign swinging and sliding door criteria. However, several commenters maintained concerns about EPA's decision to revise both the sliding glass door criteria and greater-than half-lite door criteria. Many of these commenters proposed less stringent criteria for greater-than half-lite doors. The specific comments included the following:

- Most commenters were supportive of the realignment of swinging and sliding door criteria, as consumers consider these to be structurally similar.

- One commenter supported the proposed U-factor of less than or equal to 0.25.
- Two commenters opposed this realignment and recommended sliding door criteria be aligned with window criteria to maintain a U-factor criterion of 0.28.
- One commenter proposed placing sliding glass doors in their own category with separate criteria rather than aligning them with window or swinging door criteria.
- Several commenters have concerns about the proposed U-factor criterion of 0.25 being too stringent in southern climate zones and suggested that this be revised back to the proposed value of 0.28 in Draft 1, as this matches the South-Central U-factor proposed criteria for windows. Some of these commenters suggested that greater-than half-lite U-factor criteria be split up between northern and southern zones similar to SHGC criteria.
- Other commenters recommended a U-factor of 0.28 because of the low availability of products that meet the requirement of less than or equal to 0.25. These commenters also cited the lack of cost analysis performed to assess the implications of the change to 0.25.

EPA Response:

EPA appreciates the wide ranges of comments from stakeholders on this issue. **To accommodate the stakeholder suggestion that a U-factor of 0.25 may be overly stringent for >1/2-Lite doors in Southern and South-Central zones and to align with the South-Central window criteria, EPA is proposing to increase the U-factor for >1/2-Lite doors from 0.25 to 0.28 for the Southern and South-Central zones.** See Appendix V for updated energy savings analysis for doors.

H. Skylight Criteria

See Appendix III for all alternative proposals for each ENERGY STAR zone.

I. U-Factor and Energy Savings

EPA received one comment proposing a U-factor of 0.53 and an SHGC criterion of no less than 0.28.

EPA Response:

EPA thanks the stakeholder for their suggestion. However, as discussed in Draft 1 Response to Comments, EPA found a significant number of products that can currently meet the proposed criteria and based its proposed criteria on those selections. EPA does not plan to change the proposed skylight criteria.

I. Implementation Timeline

I. Effective Date

EPA received comments requesting a significant grace period before implementation of the Version 7.0 criteria to allow for the re-design of product lines where necessary and recent supply chain issues. Some commenters also expressed support of the implementation timeline. The specific comments included the following:

- Several commenters expressed support for implementation in mid-2023 in order to facilitate market transformation.
- Several commenters have suggested that the effective date for the Version 7.0 criteria be delayed until 2024 or 2025. If the current criteria proposals are implemented, manufacturers would need a longer time horizon to make design changes to product offerings and deal with supply chain issues resulting from the COVID-19 pandemic.
- Some commenters claimed that mid-year implementation of a new specification will place an additional burden on manufacturers. Summer is busier for suppliers, so implementation should occur at the beginning of the calendar year.
- One commenter proposed that a 24-month implementation period be given for Northern and North-Central zone suppliers.

EPA Response:

EPA thanks stakeholders for their feedback on the implementation timeline for Version 7.0. The Version 7 specification will take effect in one year after finalization. EPA acknowledges that the specification may not take effect at the start of the calendar year, but many manufacturers can produce products that meet the criteria today and others can certify when they are able. EPA has only received one minor indication from a single component supplier that there may be a delay in implementing a new technology. In addition, there is no clear indication of when all supply chain constraints will completely subside; and therefore, the EPA will not delay implementation of the criteria based on uncertainty within the market that is impacting all stakeholders.

II. Version 8

EPA received comments asking about future criteria revisions and the timeline on which they could occur. The commenters suggested that the Version 8 specification should be developed within a shorter timeframe than that between Version 6.0 and Version 7. One commenter also proposed that all new specifications should be developed and implemented on a more frequent and regular basis.

EPA Response:

EPA thanks the stakeholders for their comments on future criteria revisions. EPA's response has not changed from Draft 1. After Version 7.0 implementation, EPA will monitor the market and use its standard revision process when it considers another criteria revision.

J. Miscellaneous

I. Alternative Program

EPA received a comment suggesting EPA initiate its own program with NFRC to replace the FenStar program. If FenStar is still used, EPA should modify the program to adopt a retest protocol similar to other ENERGY STAR programs offering tolerances.

EPA Response:

EPA thanks the commenter for their suggestion. NFRC is the Certification Body for the ENERGY STAR window, door, and skylight (WDS) program and FenStar is NFRC's protocol for certification and verification testing of ENERGY STAR WDS products. EPA is satisfied with the current approach NFRC uses for verification testing which already includes significant testing result tolerances for all products.

II. Energy Codes

EPA received several comments regarding ENERGY STAR's relation to energy codes and ENERGY STAR's guiding principle to be a voluntary, above-code program. The specific comments are below.

- Several commenters requested that EPA proactively communicate that it is a voluntary, above-code program and discourage local jurisdictions from adopting ENERGY STAR as local code.
- One commenter emphasized that energy codes use cost as a basis for tradeoffs and performance comparisons rather than energy savings.
- One commenter claimed that the lack of consideration of window orientation in EPA's analysis goes against energy codes and suggested that ENERGY STAR adopt a construct in which a "worst-case" orientation is used to certify all others.

EPA Response:

EPA thanks the stakeholders for their comments. As stated in the Draft 1 Response to Comments, EPA does not have any direct influence over local code decisions, nor does it encourage the adoption of current ENERGY STAR criteria for building codes. Regarding the International Energy Conservation Code's (IECC) use of cost for trade-offs, EPA found those trade-offs were between different parts of a new construction building, not within a specific product category. EPA found using energy as a basis for trade-offs very relevant and is an approach that has been used successfully in previous criteria revisions and in Canada for their program. Finally, EPA did a window orientation sensitivity analysis for Draft 1. The analysis is discussed on page 20 of the CAR and results are presented on page 38 of the CAR.

III. Most Efficient

EPA received comments concerning the ENERGY STAR Most Efficient program and its relevance under the Version 7.0 proposal because the criteria are similar.

EPA Response:

EPA thanks the stakeholder for pointing out the similarities in the proposed Version 7.0 criteria and the current Most Efficient criteria. The Most Efficient criteria will be reviewed in 2023 and updates will be considered at that time.

IV. Embodied Carbon

EPA received a comment suggesting embodied carbon reduction and circular life should be incorporated into the ENERGY STAR program, as windows have additional components that should be considered such as transportation, fabrication, glazing, and installation. One commenter asked if EPA has analyzed the increase in embodied carbon for triple pane products and its impact on emissions.

EPA Response:

EPA thanks the stakeholder for raising the issue of additional embodied carbon in triple pane products. However, as stated in the Draft 1 Response to Comments, it is EPA policy that the ENERGY STAR program focuses on carbon impact from the "use phase" of products. EPA did point to analysis from an industry trade publication which indicated the embodied energy/carbon for adding a third lite to a window is paid back within a year or less through the energy savings resulting from the increased thermal performance of the window.

V. Non-Energy Related Benefits

EPA received several comments discussing the implications of the proposed specification unrelated to energy. The specific comments are below.

- Some commenters stated that the improved performance in the proposed specification will enhance home resiliency against extreme weather events, improve occupant thermal comfort, and benefit builders in marketing, home valuation, and resale value. Higher performing windows will lower HVAC system costs by lowering heating and cooling loads.
- One commenter asked EPA to consider occupancy comfort in determining criteria, as not incorporating this could cause occupant comfort issues and greater energy use for cooling due to passive solar heat design.
- One commenter argued that high solar gain products will increase cooling loads in the summer, therefore increasing overall emissions.

EPA Response:

EPA appreciates the comments stakeholders raise on non-energy related benefits and agrees that there are several additional benefits for homeowners from the installation of high-performance windows including better resilience, more comfort, and increased home resale value. EPA does not intend to include 'comfort' as part of the ENERGY STAR criteria but did review the Efficient

Window Collaborative (EWC) guidance on high performance window products. The new EWC Windows Selection Tool indicated either no comfort issues summer and winter for moderate gain windows (SHGC 0.26-0.40) and only "slightly warm" comfort issues during the summer for high gain windows (SHGC 0.41-0.60). As previously stated, EPA plans to include consumer guidance on their website before the implementation of Version 7 to help consumers consider these issues. Finally, in the Draft 1 Response to Comments (Table 1), EPA presented analysis using both site and source energy showing that Northern zone higher gain 'trade-off' products would have a small decrease in source energy savings - so a small increase in source emissions depending on the electricity fuel source mix. However, the savings of energy and emissions are still much better than baseline (non-ENERGY STAR) products. EPA finds this a reasonable trade-off so consumers can choose to purchase less expensive, higher U-factor products if they prefer.

VI. North American Fenestration Standards (NAFS)

EPA received comments regarding the use of NAFS certification. The specific comments are below.

- One commenter suggested that NAFS AAMA/WDMA/CSA 101/I.S.2/A440 be required under the Version 7.0 criteria as it is for the Most Efficient program.
- One commenter recommended that NAFS certification be required for all ENERGY STAR fenestration products, as other ENERGY STAR programs have adopted similar safety and quality requirements.

EPA Response:

EPA thanks the stakeholders for their recommendations. This issue was addressed in the Discussion Guide Response to Comments and the Draft 1 Response to Comments. EPA's response remains the same.

VII. ENERGY STAR Climate Map

EPA received one comment suggesting a climate map with only three zones. Zones 1-3 would be incorporated into the Southern zone, 4-5 into a Central zone, and 6-8 into the Northern zone.

EPA Response:

EPA thanks the Stakeholder for their detailed feedback and supporting analysis. EPA is not making further adjustments to the climate zone map for the Version 7 criteria but will consider adjustments for future revisions.

VIII. EnergyPlus

EPA received one comment asking about the potential conversion of metric U-factor to inch-pound U-factor to do EnergyPlus runs.

EPA Response:

EPA thanks the stakeholder for expressing concern about the conversion factors used for EnergyPlus run. EPA consulted with the staff at Lawrence Berkeley National Laboratory (LBNL)

about the U-factor conversions used when running EnergyPlus. LBNL confirmed that the precision levels for the Energy Plus input was in increments of 0.05678 $W/m^2 \cdot °C$, and incorrect rounding protocols were not used.

IX. Grouping of Population Weighting by Zone

One commenter claimed that population weighting used for the Northern and North-Central zones was not consistent with the weighting used for energy code assignments leading to an inconsistency and a potential location error.

EPA Response:

EPA appreciates the commenter's concern regarding population weighting and energy code location assignments. However, EPA was not required to use strict energy code location assignments for its analysis. Instead, EPA selected 132 cities that represented a reasonable geographic distribution across the U.S., assigned the locations to the appropriate IECC climate zones, and mapped nearby counties to the appropriate nearby city within that zone. Populations of the locations were used to provide weighted savings results for the analysis. Additionally, EPA did find that 6 cities had been inadvertently assigned to historical ENERGY STAR zones. EPA corrected this and recalculated the analysis for consumer payback. The payback for windows did increase in some zones by less than a year – which is still a very reasonable result. EPA recalculated the results tables, including the proposed Final Draft changes, and they can be found in Appendix IV. The re-assigned cities can be found in Appendix VII.

K. Appendix

I. Alternative Proposals Window

EPA received several comments fully supporting the proposed window criteria. In addition, EPA received several alternative proposals for the criteria for each ENERGY STAR climate zone and the Northern zone tradeoffs, which are summarized in the tables below. EPA considered all these proposals and adjusted the North-Central zone U-factor in this draft.

ENERGY STAR Zone Proposals	Alternative Proposals U-Factor	Alternative Proposals SHGC	Current Proposal U-Factor	Current Proposal SHGC
Northern 1	≤ 0.25	N/A	≤ 0.22	≥0.17
Northern 2	≤ 0.26	N/A	≤ 0.22	≥0.17
Northern 3	≤ 0.27	N/A	≤ 0.22	≥0.17
Northern 4	N/A	Any (remove minimum)	≤ 0.22	≥0.17
North-Central 1	≤ 0.26	N/A	≤ 0.25	≤ 0.40
North-Central 2	≤ 0.27	N/A	≤ 0.25	≤ 0.40

Tradeoff Proposals	Alternative Proposals U-Factor	Alternative Proposals SHGC	Current Proposal U-Factor	Current Proposal SHGC
Northern Tradeoffs 1	= 0.23	≥ 0.27	= 0.23	≥ 0.35
	= 0.24	≥ 0.27	= 0.24	≥ 0.35
	= 0.25	≥ 0.30	= 0.25	≥ 0.40
	= 0.26	≥ 0.30	= 0.26	≥ 0.40
Northern Tradeoffs 2	= 0.23	≥ 0.30	= 0.23	≥ 0.35
	= 0.24	≥ 0.30	= 0.24	≥ 0.35
	= 0.25	≥ 0.35	= 0.25	≥ 0.40
	= 0.26	≥ 0.35	= 0.26	≥ 0.40

II. Alternative Proposals > ½-Lite Doors

EPA received several comments fully supporting the proposed door criteria. In addition, EPA received several alternative proposals for the criteria, which are summarized in the tables below. EPA considered all these proposals and adjusted the South-Central and Southern zone U-factor criteria for in this draft.

ENERGY STAR Zone Proposals	Alternative Proposals U-Factor	Alternative Proposals SHGC	Existing Proposal U-factor	Existing Proposal SHGC	
All	≤ 0.28	N/A	≤ 0.25	Northern and North-Central	≤ 0.40
				South-Central and Southern	≤ 0.23
Northern and North-Central	≤ 0.26	N/A	≤ 0.25	≤ 0.40	
South-Central and Southern	≤ 0.28	N/A	≤ 0.25	≤ 0.23	

III. Alternative Proposals Skylights

EPA received alternative proposals for the skylight criteria to set a less stringent U-factor in the Northern zone and general concerns over VT with the proposed SHGC level in the other zones. This is summarized in the table below.

ENERGY STAR Zone Proposals	Alternative Proposals U-Factor	Alternative Proposals SHGC	Existing Proposal U-factor	Existing Proposal SHGC
All	≤ 0.53	≤ 0.28	≤ 0.45	Any

IV. Energy Savings Analysis for Windows Updated with Proposed North-Central Zone Change

Proposed Window Criteria

	V7.0 Prescriptive		Baseline					
Energy Star Zone	**U-factor**	**SHGC**	**U-factor**	**SHGC**	**Savings ($/yr)**	**Simple Payback (Yrs)**	**$200 Incentive Payback (Yrs)**	**65% Recouped from Sale Payback (Yrs)**
Northern (Market)	0.22	0.30	0.35	0.30	$107.39	12.0	10.1	4.2
Northern (Code)	0.22	0.30	0.30	0.30	$67.15	17.0	14.0	6.0
North/Central (Market)	0.25	0.30	0.35	0.30	$76.47	9.0	6.4	3.2
North/Central (Code)	0.25	0.30	0.30	0.30	$38.98	14.0	8.9	4.9
South/Central (Market)	0.28	0.23	0.35	0.30	$67.17	4.8	1.8	1.7
South/Central (Code)	0.28	0.23	0.30	0.25	$19.78	9.0	0.0	3.2
Southern	0.32	0.23	0.35	0.30	$51.26	3.5	0.0	1.2

Proposed Tradeoff Window Criteria Updated Cost Savings and Payback (Market Baseline)

Energy Star Zone	U-factor	SHGC	Savings ($/yr)	Simple Payback (Yrs)	$200 Incentive Payback (Yrs)	65% Recoupment Payback (Yrs)
Northern Tradeoffs	0.23	0.35	$101.44	12.7	10.7	4.4
	0.24	0.35	$93.04	7.4	5.3	2.6
	0.25	0.40	$84.67	8.2	5.8	2.9
	0.26	0.40	$76.34	9.0	6.4	3.2

Proposed Tradeoff Window Criteria Updated Cost Savings and Payback (Code Baseline)

Energy Star Zone	U-factor	SHGC	Savings ($/yr)	Simple Payback (Yrs)	$200 Incentive Payback (Yrs)	65% Recoupment Payback (Yrs)
Northern Tradeoffs	0.23	0.35	$61.20	18.7	15.4	6.5
	0.24	0.35	$52.80	10.4	6.6	3.6
	0.25	0.40	$44.42	12.3	7.8	4.3
	0.26	0.40	$36.10	15.2	9.6	5.3

Estimated National Energy Savings for Windows Including Proposed Criteria

	Unit Energy Savings (MMBtu)	2020 ES Shipments	Total Energy Savings (TBtu)
Northern Replacement/Remodel	0.35	10,946,811	3.78
Northern New Construction	0.21	6,639,088	1.42
North/Central Replacement/Remodel	0.21	5,455,895	1.13
North/Central New Construction	0.10	4,123,631	0.43
South/Central Replacement/Remodel	0.08	6,472,275	0.55
South/Central New Construction	0.02	6,016,711	0.14
Southern	0.06	4,877,119	0.28
National Total (100% 2020 ES Shipments)			7.73
National Total (50% 2020 ES Shipments)			3.87

V. Energy Savings Analysis for Doors Updated with Proposed >1/2-Lite Southern and South-Central Zone Changes

Door Baseline Assumptions

Door Category	U-Factor	SHGC
≤1/2-Lite	0.30	0.17
>1/2-Lite Northern and North-Central	0.35	0.30
>1/2-Lite Southern and South-Central	0.35	0.25

Energy and Cost Savings for ≤1/2-Lite Door Criteria Proposal

Climate Zone	Door Type	U-Factor	SHGC	Energy Savings (GJ)	Savings ($/yr)
Northern	≤1/2-Lite	0.23	0.17	0.56	$7.03
North-Central	≤1/2-Lite	0.23	0.17	0.45	$6.58
South-Central	≤1/2-Lite	0.23	0.17	0.29	$3.51
Southern	≤1/2-Lite	0.23	0.17	0.17	$2.93

Energy and Cost Savings for Updated >1/2-Lite Door Criteria Proposal

Climate Zone	Door Type	U-Factor	SHGC	Energy Savings (GJ)	Savings ($/yr)
Northern	>1/2-Lite	0.25	0.30	0.77	$9.63
North-Central	>1/2-Lite	0.25	0.30	0.61	$9.00
South-Central	>1/2-Lite	0.28	0.23	0.26	$4.53
Southern	>1/2-Lite	0.28	0.23	0.18	$4.13

Estimated National Energy Savings for Doors Including Proposed Criteria

Door Type	Unit Energy Savings (MMBtu)	2020 Shipments	Total Energy Savings (TBtu)
> ½ Lite	0.23	6,450,995*	1.49
≤ ½ Lite	0.18	3,045,083	0.56
National Total (100% 2020 ES Shipments)			2.05
National Total (50% 2020 ES Shipments)			1.02

*Includes Sliding Glass Patio Doors

VI. EnergyPlus Version 9.5 Summary Tables with Higher Gas Prices

50% Higher Gas Prices

Energy Star Zone	U-factor	SHGC	Savings ($/yr)	Simple Payback (Yrs)	$200 Incentive Payback (Yrs)	65% Recoupment Payback (Yrs)
Northern (Market)	0.22	0.30	$153.75	8.4	7.1	2.9
Northern (Code)	0.22	0.30	$95.86	11.9	9.8	4.2
North/Central (Market)	0.25	0.30	$107.30	6.4	4.6	2.3
North/Central (Code)	0.25	0.30	$54.22	10.1	6.4	3.5
South/Central (Market)	0.28	0.23	$71.61	4.5	1.7	1.6
South/Central (Code)	0.28	0.23	$20.86	8.6	0.0	3.0
Southern	0.32	0.23	$49.02	3.6	0.0	1.3

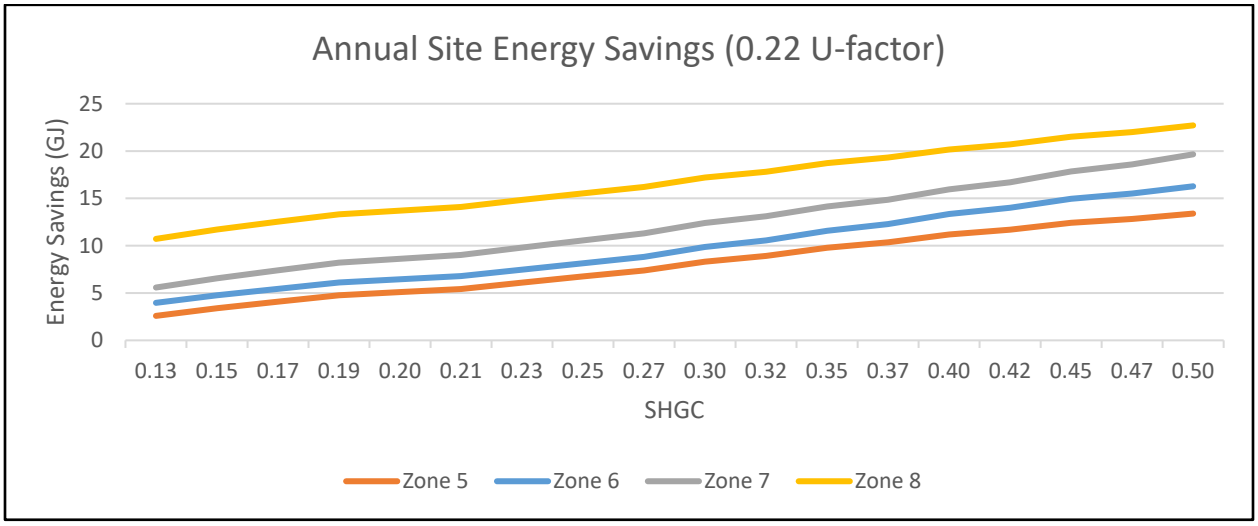
100% Higher Gas Prices

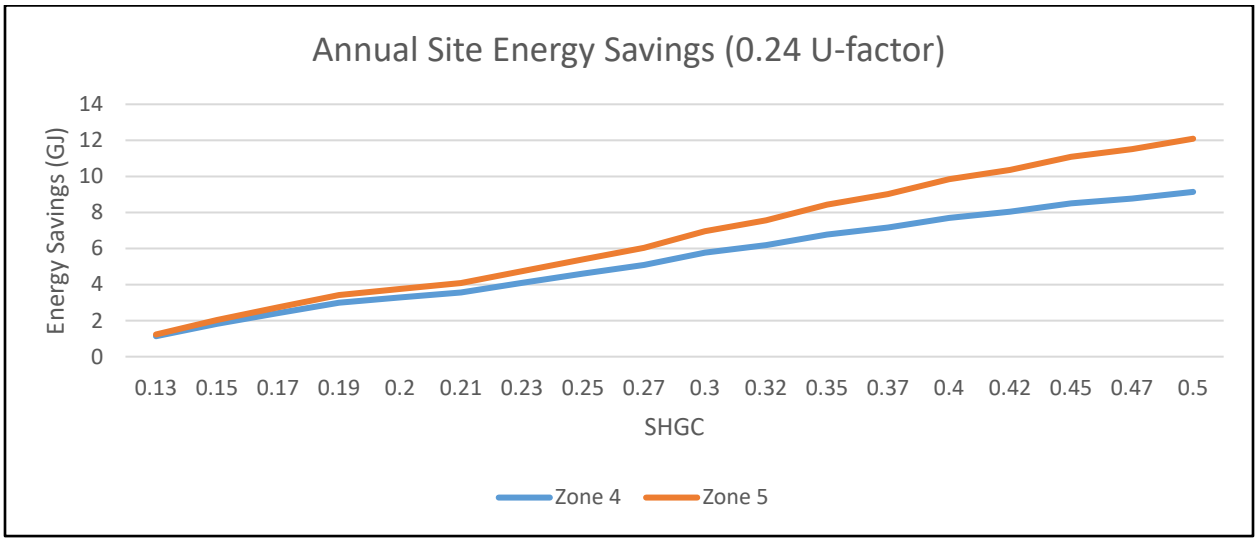
Energy Star Zone	U-factor	SHGC	Savings ($/yr)	Simple Payback (Yrs)	$200 Incentive Payback (Yrs)	65% Recoupment Payback (Yrs)
Northern (Market)	0.22	0.30	$200.11	8.4	5.4	2.2
Northern (Code)	0.22	0.30	$124.58	9.2	7.6	3.2
North/Central	0.25	0.30	$138.13	5.0	3.5	1.7
North/Central (Code)	0.25	0.30	$69.45	7.9	5.0	2.8
South/Central (Market)	0.28	0.23	$76.04	4.2	1.6	1.5
South/Central (Code)	0.28	0.23	$21.95	8.1	0.0	2.8
Southern	0.32	0.23	$46.78	3.8	0.0	1.3

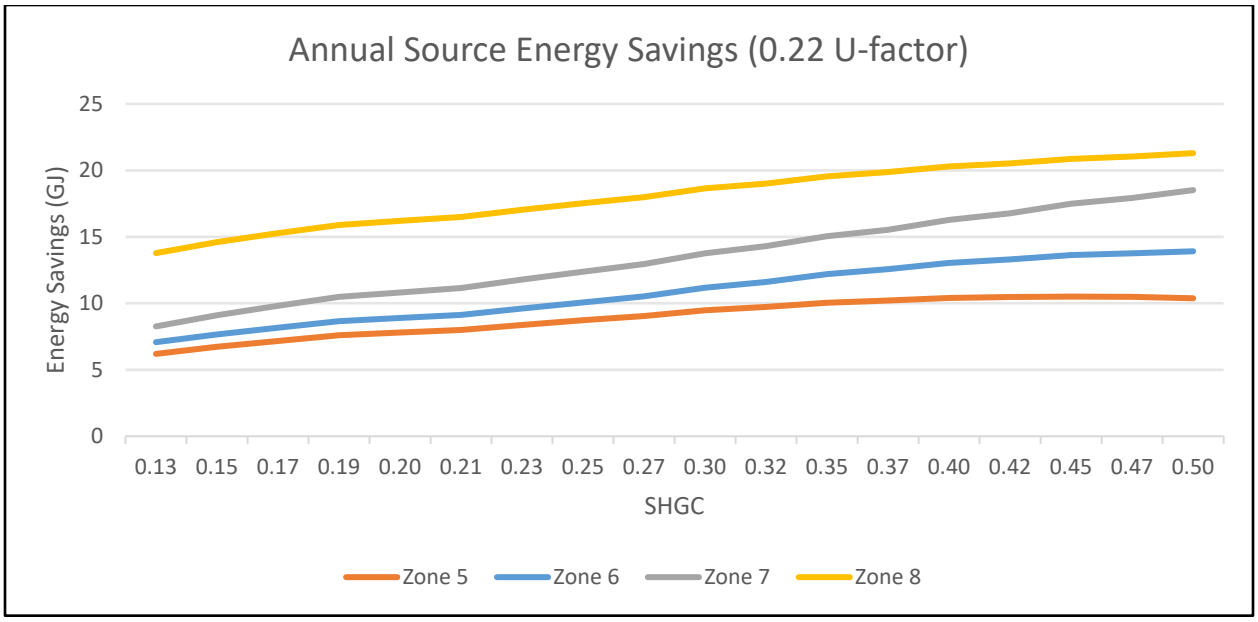
VII. Reassignments of Cities to Updated ENERGY STAR Zones

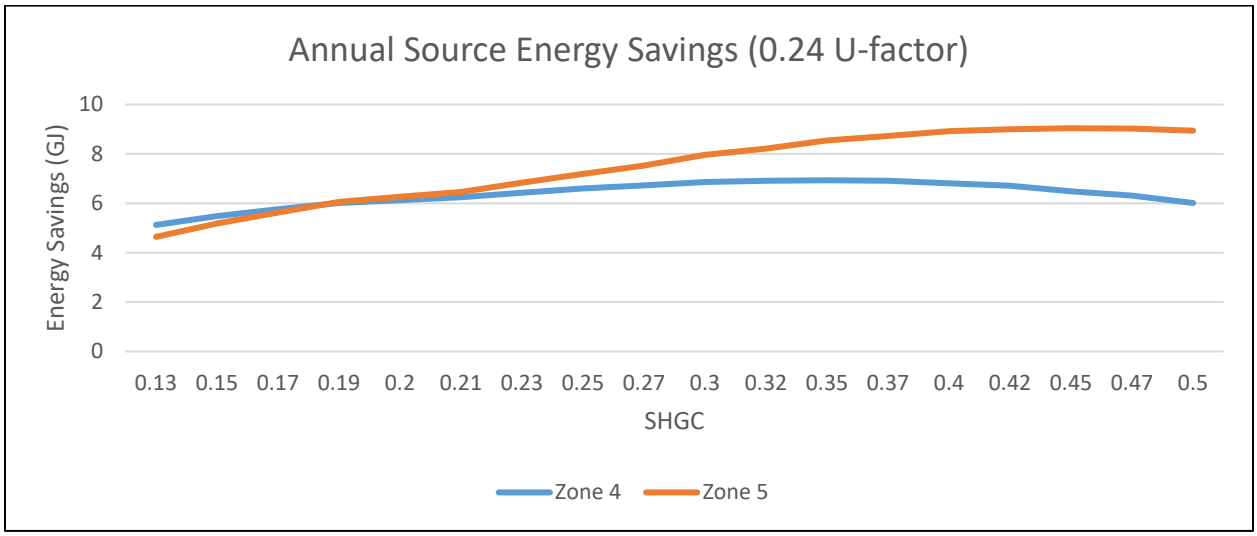
City ID	Historical ENERGY STAR Zone	Updated ENERGY STAR Zone
Fort.Worth-Alliance.AP.722594	South/Central	Southern
Harrisburg.Intl.AP.725115	Northern	North/Central
Indianapolis.Intl.AP.724380	Northern	North/Central
Nashville.Intl.AP.723270	North/Central	South/Central
Norfolk.Intl.AP.723080	North/Central	South/Central
Raleigh-Durham.Intl.AP.723060	North/Central	South/Central

VIII. Site & Source Energy Savings Trends for IECC Zone 5 Versus the Other IECC Zones in the Northern & North-Central ENERGY STAR Zones






Annual Source Energy Savings (0.22 U-factor)
Energy Savings (GJ)
25
20
15
10
5
0
0.13 0.15 0.17 0.19 0.20 0.21 0.23 0.25 0.27 0.30 0.32 0.35 0.37 0.40 0.42 0.45 0.47 0.50
SHGC
Zone 5
Zone 6
Zone 7
Zone 8


Annual Source Energy Savings (0.24 U-factor)
Energy Savings (GJ)
10
8
6
4
2
0
0.13 0.15 0.17 0.19 0.2 0.21 0.23 0.25 0.27 0.3 0.32 0.35 0.37 0.4 0.42 0.45 0.47 0.5
SHGC
Zone 4
Zone 5