

August 20, 2021

US Environmental Protection Agency  
1200 Pennsylvania Avenue N.W.  
Washington, DC 20004

Re: Comments on ENERGY STAR Residential Window Draft 1 Version 7 Specification

Greetings:

On behalf of Pacific Northwest National Laboratory's (PNNL) Residential Windows Team, I am providing comments on the proposed revisions to the ENERGY STAR Windows Specifications (Version 7) and commend EPA and the supporting technical team for providing a comprehensive and transparent analysis in support of the proposed revisions. As part of a 3-year project sponsored by the U.S. Department of Energy (DOE) and Bonneville Power Administration (BPA), PNNL is conducting performance testing and field validation studies of high-R triple-pane windows in multiple house types and regions spanning the ENERGY STAR Northern climate zone. The findings from this research supports the proposed Version 7 revisions, particularly in the Northern climate zone where the benefits of high-R (i.e., U-factors below .22) windows are particularly pronounced in terms of reducing the heating and cooling loads (including peak loads) of the home, improving comfort, and reducing the condensation potential on the interior surface of the window. In addition, based on a market assessment and builder surveys completed as part of this study, we have found that many builders, remodelers, home performance contractors, and utility efficiency program managers would welcome the advancements of this ENERGY STAR Specification to help guide efficient building and program design as well as encourage competition and scaled up production of high-efficiency windows.

I am highlighting three findings from these field validation studies that support the proposed advancement of the Version 7 ENERGY STAR Windows Specification.

#### High-Performance Building Trends in Cold and Mixed Climate Zones

As part of the [Builder Survey](#)<sup>1</sup>, 30 homebuilders participating in DOE's Zero Energy Ready Home (ZERH) program were interviewed regarding their decisions related to window

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<sup>1</sup> Gilbride TL, S Selkowitz, OG Dingus, and KA Cort. 2019, *Double or Triple? Factors Influencing the Window Purchasing decisions of High Performance Builders*. PNNL-28809, Pacific Northwest National Laboratory, Richland, Washington.

purchases for the homes they build. While the DOE ZERH builders interviewed are required to install windows that meet the current ENERGY STAR window criteria as a mandatory requirement for certifying their homes as ZERH, the survey revealed that many of these builders go beyond the current ENERGY STAR levels, which implies they have already determined that the benefits of doing so, outweigh any costs associated with these higher performing windows. Figure A (below) shows the U-factors of the windows that builders use, where builders who build in more than one climate zone are represented by more than one data point and each data point can represent multiple homes built in a given year. Over 60% of the builders are currently installing a window rated at R-5 or better (U-value  $\leq 0.20$ ), and over two-thirds of the builders in the ENERGY STAR northern climate are meeting or beating an R-5 window.

In addition to the thermal insulating performance, the builders surveyed noted that homebuyers value the noise reduction, increased comfort, and reduction in interior condensation that come with higher performing windows, which is why most of the ZERH builders are able to justify exceeding the current ENERGY STAR specification even though it is not a requirement of the ZERH program. Several builders also noted that building with triple-pane windows offers them additional flexibility with wall and HVAC design, allowing for smaller sized mini-split HP units, when this is desired.

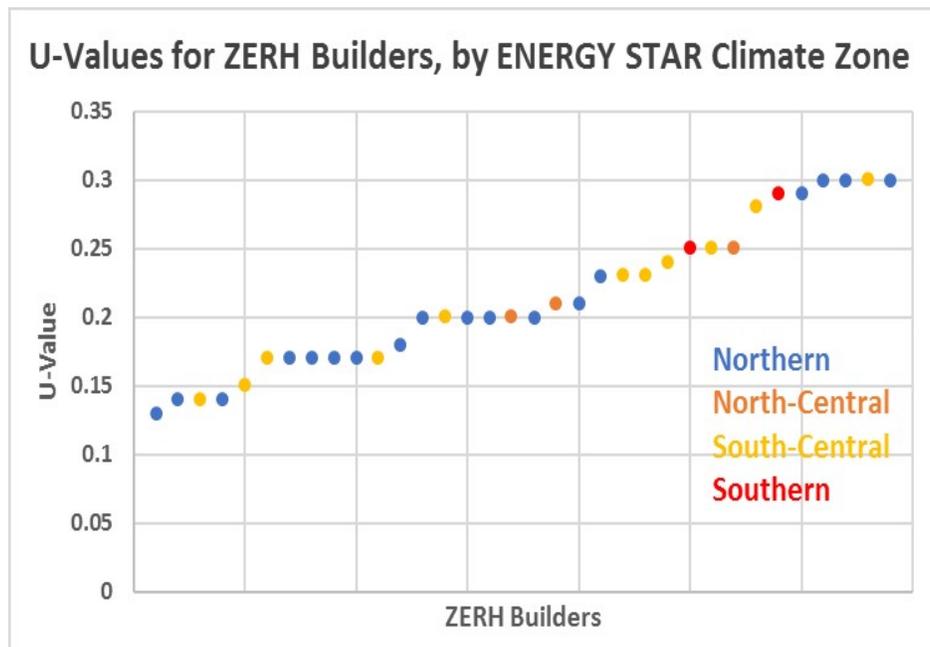


Figure A. U-Value for Zero Energy Ready Home Builders

### Demand-Side Incentives for High-Performance Windows Needed

PNNL's High-R Field Validation project included a [Market Assessment](#)<sup>2</sup> where it was observed that outside BPA and the Energy Trust of Oregon in the Northwest, only one utility in the Northeast (Eversource in CT) and a total of five utilities in California and the Mountain West states have programs in place that specifically incentivize the highest performing windows in the market with U-factors less than .23. In discussions with utility program managers, the increasing reliance of utility programs on ENERGY STAR criteria (currently U-factor  $\leq$  .27 in northern climate zone) was identified as one of the primary reasons for the scarcity of programs that focused on windows with U-factors less than .23, even though this energy-saving measure could help achieve program goals, including reducing peak demand during both heating and cooling seasons. These same program managers indicated that if ENERGY STAR were to advance their specifications, this would provide a straightforward manner for many of the programs that currently reference ENERGY STAR criteria to advance their current windows programs and provide more generous incentives for higher performing windows.

### "Drop-in" Thin Triple-Pane IGU Validated in Field

One of the key outcomes of the [High-R Windows Field Validation](#)<sup>3</sup> studies is the validation of "drop-in" thin triple-pane insulated glass units (IGUs) into multiple vendors' standard affordable double-pane vinyl frames. This was completed using 5 different vinyl frame manufacturers in 5 different states (CA, WA, MN, MI, NY) in single-family, multi-family, and manufactured homes, for both new and retrofit applications. All of these thin triple-pane windows had overall U-factors of .20 or lower. One promising aspect of this "drop-in" IGU concept is that window manufacturers can use their lower-cost double-pane frames and production lines to manufacture high-performance thin triple-pane windows. As demonstrated in the field, it requires no significant investment in redesign on the part of the window manufacturer; is based on cost-effective market-ready new technology; can be supplied via the existing industry supply chain; and is flexible enough to accommodate a variety of window types and sizes. This field-validated technological advancement could potentially make even more high-performance windows available in the market that meet the proposed ENERGY STAR specifications in multiple configurations for affordable prices.

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<sup>2</sup> Cort, KA and TL Gilbride. 2019. *Field Validation of High-R Windows: Market assessment and Program Plan*, PNNL-28823, Pacific Northwest National Laboratory, Richland, WA.

<sup>3</sup> Hunt, WE, SI Rosenberg, and KA Cort. 2021. *Evaluation of Thin Triple- Pane Windows in the PNNL Lab Homes*, PNNL-31165, Pacific Northwest National Laboratory, Richland, WA.

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In summary, our field validation studies indicate that the proposed Version 7 revisions could significantly help increase the savings achieved from windows by increasing the overall uptake of energy-efficient windows in a manner that carefully tailors the specification to the homes and climate zones that could benefit most from lower U-factors and well-tuned solar heat gain coefficients. Thank you for your efforts in this area and thank you for the opportunity to comment.

Sincerely,

A handwritten signature in black ink, appearing to read "K. Cort", with a stylized flourish at the end.

Katherine A. Cort  
High-R Windows Program Lead  
Pacific Northwest National Laboratory