

September 3, 2021

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Mr. Douglas W. Anderson
Product Manager for Windows, Doors, and Skylights
ENERGY STAR Labeled Products
US Environmental Protection Agency
Via email to: anderson.doug@epa.gov

Re: Comments on the Proposed Changes to the Energy Star Windows Program (Version 7)

Dear Mr. Anderson:

We hope you know that Mathis Consulting Company (MC2) supports the founding principles of the Energy Star program and is committed to continued market transformation. As building science practitioners specializing in building envelopes, we are especially supportive of the Energy Star Windows (ESW) program.

As previously noted, we are concerned that the current proposal fails Energy Star's founding goal (atmospheric pollution reduction) and ESW's market transformation goal (consumer signals leading to increasing levels of efficiency). The current proposal, version 7, fails due to:

- Unintended masking of meaningful consumer signals
- Use of outdated and incomplete data
- Flawed data analysis decisions leading to extremely faulty conclusions for proposed Program changes.

While we have detailed many of our technical concerns below, we also believe that meaningful updates from the energy modeling already performed by LBNL is possible. These comments are not intended to solve issues with the current proposal, only to identify them and enumerate the (unintended) consequences.

Using updated data sources (population, fuel mix, energy costs, etc.), proper data analysis (proper summation of heating and cooling energies, criteria for determining "equal energy" versus "equal costs," etc.), addressing known window performance issues with EnergyPlus version 8.9, and other analytical improvements – significantly more accurate recommendations for the Energy Star Windows program can be developed. We would be happy to assist EPA and its project team in updating these analyses. We would be happy to offer known (needed) data sources and proven analytical techniques to help shape the proposed criteria to make more accurate and appropriate steps toward the overall Program objectives.

Background

Born of the Atmospheric Pollution Prevention Division of EPA, the Energy Star Program was a brilliant approach to accomplishing EPA's clean air objectives – a "carrot" for products that reduced fossil fuel-based electricity demand. From lights and office equipment to domestic

appliances, the Energy Star label allowed consumers to choose products that delivered significantly improved levels of energy efficiency. Entire market norms of energy performance were transformed to ever-greater levels of efficiency, and EPA's clean air objectives have been well served for decades.

Along with USDOE, EPA understood that buildings (and their energy demands) were the nation's largest energy consuming sector and, by extension, the largest contributor to atmospheric pollution because of that demand. Reducing building energy demand (from HVAC energy to lights and plug loads) was a priority, and improved windows became a high priority.

Energy Star Windows came relatively late to the portfolio of targeted products. With them came a unique challenge: For the first time the program had to address an item that crossed fuel types and fuel needs. That is, windows were the first "dual fuel" appliance EPA had to regulate. This is significant because EPA is again proposing window performance trades that swap heating energy for cooling energy. Such trades have significant local cost and atmospheric carbon implications, as well as unintended consequences when delivering misleading consumer signals about energy performance.

Our comments that follow address some of the unintended consequences resulting from masked consumer signals, incomplete and outdated data, and flawed data analysis undermining the current proposed Version 7 of the Energy Star Windows program.

Unintentionally Masking Meaningful Consumer Signals

We applaud the intention to improve the Program, recognizing and rewarding windows that deliver superior efficiency. LBNL's use of state-of-the-art (at the time) building energy simulation programs provided the Program with better, more granular energy performance data with which to shape new Program criteria. While we might have taken a slightly different approach to this portion of the data generation, we believe that the LBNL output is valuable and useful to the task as planned.

We have some concern about known window simulation issues with EnergyPlus versions prior to v9.4 (<https://github.com/NREL/EnergyPlus/pull/8001>). However, we believe that a few simple checks in the current version can address these simulation issues.

A significant concern is the prioritization of "Consumer Signals." A consumer in Tampa values different window performance priorities than one in Topeka or Tacoma. Said another way – all product purchase decisions are local.

LBNL's simulations provided excellent local building performance data – even down to the use of seasonally-adjusted fuel prices and energy demand. Sadly, those granular data with which EPA could make informed local decisions and recommendations for the Program were directed to be abandoned for averages. The decision to use average annual fuel prices – to aggregate broad climate regions – effectively masks meaningful local consumer signals.

Additionally, the climate regions identified in the building code are grossly defined by Heating Degree Days and Cooling Degree Days – generally for the purpose of peak load determination and equipment sizing. These gross climate regions essentially prevent delivery of window

performance-based consumer signals for a given locale. Not every locale in Climate Zone 5 values window energy performance the same way! This is especially true when considering the cost of energy locally – driven by fuel mix, state pricing regulation, and seasonal price fluctuations locally. Considering that LBNL had provided excellent local energy use data with which EPA could deliver meaningful local signals, we view this as “snatching defeat from the jaws of victory”.

We realize that EPA is somewhat invested in the Energy Star Windows “map.” We believe, however, that greater market transformation potential exists in delivering more local market messages. This is especially true since EPA has the local energy use profiles, local fuel mix, and local seasonal fuel prices with which to shape such local messaging. We believe the map has outlived its usefulness and that any attempt to connect Program recommendations to gross and widely varied climate zone designations suppresses EPA’s stated intent for the Program. If California can use zip codes, why not Alabama?

The aggregation of locations into broad climate zone recommendations amplifies the “dual fuel” problem cited above. The program essentially is choosing whether a customer values heating or cooling energy saving more. Again, a consumer signal for each variable is possible. But in the current experimental design, EPA chose to aggregate huge regions that have widely varied heating and cooling energy loads as well as widely varied fuel mix and seasonal fuel prices. In the aggregated Northern Climate Region, EPA’s experimental design suggests that a consumer in Chicago values heating and cooling energy savings/costs the same as a consumer in Duluth! LBNL’s monthly energy and fuel cost data clearly show this is not the case.

This issue becomes even more problematic when considering the founding principles of the Energy Star Program – atmospheric pollution prevention. We believe that all program decisions should focus on delivering consumer signals that address and deliver on this goal. The atmospheric pollution implications for a locale where all electricity is generated by coal is very different from a similar locale using natural gas or hydro. Again, the “dual fuel” appliance nature of windows requires careful consideration of local energy source fuels. While we understand that EPA might like to simplify the Program messaging, the current simplification serves to completely hide – and in many cases wrongly prioritize – these important pollution-prevention objectives.

Outdated and Incomplete Data

Attempting to reverse-engineer the applied population weighting, we could not resolve sums against recent, public data. During later discussion with the analysis contractor, we determined that an existing, in-house population tool was used, but that the designer had moved on. Though unconfirmed, we suspect 2000 Census data was used in that tool, else roughly 50 million people were lost in the averaging/redistributing. This reflects a repeated incongruity: Why is ESW updating, reweighting, and adjusting their desired trade-off model with outdated population, weather, fuel mix, and building model data? The population weighting presents a more immediate problem, however, in going from the specific to the general and back again: Once precision is lost, it cannot be recovered.

While we have been unable to check the math used in these population distributions, we can guess some decisions due to their outcomes. The most impactful yet found is the assignment of

more people to International Falls, MN, when Duluth is the population center in Minnesota's IECC climate zone 7. With much of the domestic window industry headquartered in Minnesota, stakeholders know that improperly assigning people to International Falls grossly skews the heating fraction of total building energy; it's the coldest Class 1 design weather station in the contiguous states! We are told individual errors like this do not change the results, but it clearly does in this example, and if such logic is applied elsewhere, it could have a cumulative effect.

Regardless, the tragedy in population weighting is that LBNL provided local energy signatures, from local weather, which could have been directly joined with local fuel mix and local costs. Local fuel mix and cost would allow more meaningful comparisons: Energy cost signals for consumers and carbon impacts for policymakers. The opaque and unnecessary blending and redistributing techniques employed introduce systemic error.

As mentioned, the EPA is in a rare position of data wealth. Combining eGRID, EIA historical data, and local energy modeling is the beginning of the best approach. It is unfortunate that the granular energy cost data provided to LBNL was abandoned for broad, undefined averages, especially when seasonal pricing can have more influence than the range of window performance differences examined. Presumed outdated Census data, questionable weather station selection, and irreproducible population shuffling undermined a good start. For example, even though great pains were made to model multiple foundations and fuel types in each location, there was no attempt to examine equipment efficiency. A "market window" was used, but not market equipment? Can a minimum efficiency (80 AFUE) furnace even be purchased in International Falls? Was any attempt made to quantify the window energy and heating/cooling trade implications due to equipment efficiency norms (AFUE, SEER, etc.) in a given market?

Faulty Data Analysis and Conclusions

Selecting the right metric is essential to the entire Energy Star product portfolio. But what metric is used in this proposal? It appears that site energies were added, regardless of fuel type. Total site energy – especially as an amalgamation of multiple fuel mixes, foundation types, and window properties – is at best an intermediate metric. Meaningless site energy additions for false equivalence trade-offs are not supported by the window industry. Just because energies are reported in the same units (gigajoules), does not mean they are fungible. They are useful as feedstock for energy cost and atmospheric carbon comparisons, which are EPA-stated end goals. The poor choice in site energy manifests starkly in ESW's own conclusions: The "equivalent" window performance trade-offs have dramatically different energy cost savings. From a building science perspective making both performance categories worse for trades is nonsensical.

Further, Grouping IECC climate zones 5, 6, 7, and 8 into a "northern" zone ignores the considerable differences among the regions and leads to energy-, cost-, and carbon penalties for the proposed performance "equivalents." Though we have not been able to analyze every weather data source, the inclusion of Class 2 stations is troubling, based on experience – especially regarding insolation. Reassigning counties to broad geographic regions seems misguided, especially if outdated population and weather data remain in use. The original, localized plan given to LBNL was the better strategy, allowing the granularity to highlight anomalies and more appropriately deliver meaningful, local consumer signals.

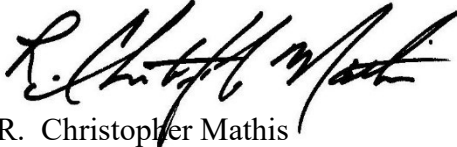
We would encourage EPA ESW to look to the methodology employed by PNNL in their energy codes determinations. Their transparency and data reproducibility are industry-standard, and ESW is not constrained by code limitations (e.g., NAECA minima). This puts ESW in a position to provide better localized market signals than base codes and standards, which has been the stated goal from the Program's beginning.

There are additional topics of concern – even severing the fundamental relationship of window heat transfer resistance to spectral selectivity technologies – that are troubling but can be left for discussions during future improvement of the Proposal. However, to reiterate: Incorrect metric selection led to a faulty energy addition that wrongly promotes overall worse-performing windows as “equivalent.”

In conclusion, we appreciate the value that the Energy Star Program has brought to market transformation across all product sectors. Regarding the Energy Star Windows Program, we recognize the many challenges associated with defining simple messaging that accurately addresses and conveys the complexity of window energy performance. The “dual fuel” nature of windows complicates development and delivery of simple consumer messaging enjoyed by other ES product classes. But it can be done.

We hope these comments serve to convey the depth of our review and our commitment to the Program's success. We pledge to continue to work with EPA in helping to improve the experimental design, data sources, and data analysis necessary to deliver new, more accurate, and more appropriate definitions for what constitutes an Energy Star Window.

Respectfully,



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cc:

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