CARDINAL
Glass Industries

Via Electronic Submission

February 8, 2013

Doug Anderson
ENERGY STAR Home Improvement Program
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460-0001

Subject: ENERGY STAR Program Requirements for Residential Windows, Doors, and Skylights – Version 6.0 Draft 2 Eligibility Criteria

Dear Mr. Anderson:

Comments from Cardinal Glass Industries on the solar heat gain trade-offs proposed in draft 2:

Modify Table 4 as shown:

Table 4. Equivalent Energy Performance for Windows		
Climate Zone	**U-Factor[1]**	**SHGC[2]**
Northern	= 0.28	≥ 0.32 **0.40**
	~~= 0.29~~	~~≥ 0.37~~
	~~= 0.30~~	~~≥ 0.42~~

1. Btu/h ft2·°F
2. Solar Heat Gain Coefficient

Reason Statement

Draft 2 expands the U-Factor "trade-up" to new precedent: it's now possible to qualify a higher U-Factor for the Northern zone than what's needed in the North Central region. This seems inappropriate in a region with inherently colder weather when the logic behind the U:SHGC trade ratio does NOT account for seasonal comfort and is based upon building operational assumptions that do NOT follow the 2012 IECC. See the detailed explanations to follow.

1. The Northern region covers 4 zones from the model energy code (CZ5, 6, 7, and 8) while North Central comprises only climate zone 4. With each zone further north the hours of cold weather get larger and the winter design temperature gets colder.

ENERGY STAR Zone	Climate Zone	Winter Design Temperature*	Hours Below Freezing*
Northern	8	-30°F	4000
	7	-20°F	3500
	6	-10°F	3000
	5	0°F	2300
North Central	4	+10°F	1500

*weather data approximates an average across each climate zone

An average roomside window surface temperature can be calculated using interior film coefficients exported from the Window6 program. In the table below, this average surface temperature at the outdoor design condition is labeled as "Feels Like"; this gives an approximation of what the night time comfort conditions will be for each zone.

ENERGY STAR Zone	Climate Zone	Maximum U-Factor	"Feels Like" Temperature
Northern	8	0.30	43°F
	7		45°F
	6		48°F
	5		51°F
North Central	4	0.29	54°F

As the latitude increases with the more northerly zones the hours of winter sunlight decrease about 15 minutes per climate zone. Within the lower 48 states there's almost 1 hour less of daylight in climate zone 7 than in the North Central (CZ5) region. Regardless of what the energy balances might suggest, when night hours are over 50% of the day the proposed reduction in ENERGY STAR window comfort needs to be acknowledged and addressed in setting the trade-off limits.

2. Modeling the trade-off house with equal distribution on all 4 sides is the opposite of how the performance path in the code works. Yes, the standard reference house for performance trade-offs uses equal windows on all sides, but this is used to establish the budget for the actual building. The budget house sees some "good" winter sun on its south façade and some "bad" summer sun on east and west. Real houses tend to be heavily glazed on one side (typically the backside) or at best on the front and back. In the typical backside distribution only 1 in 4 homes has any exposure that can benefit from a passive solar benefit while the east and west houses (2 of 4 exposures) will backslide on total energy due to the summer solar penalty.

3. Window SHGC is rated without grids, with grids <1" wide, and with grids > 1" wide. In this process the same window is rated three times. Grids < 1" would reduce the base window SHGC on the order of 0.04 - 0.05 and grids > 1" will be an offset around 0.06 - 0.07. Cardinal's IG production data suggest that about 1/3 of the operable windows have grid bars (of any size) so averaging the NFRC database to determine a "market" SHGC will be artificially too low with respect to sales.

4. The LBNL studies from 2008 for version 5 of the ENERGY STAR Windows-Doors-Skylight program used thermostat settings that do NOT match the model code (IECC). LBNL's heating setpoint is 2°F lower than IECC and includes a night setback not used in IECC. The LBNL cooling setpoint is 3°F higher than IECC. The U:SHGC trade-off ratios that have been carried over into this draft 2 proposal are questionable in regards to the ENERGY STAR desire to be better than code.

5. These same LBNL studies used an interior shade scalar that is technically incorrect. When this scalar is applied to lower solar gain windows it over estimates the impact of the shades. For the analysis of winter solar trade-offs this incorrectly penalizes the low gain window and puts further doubt into the validity of the 5:1 ratio.

6. LBNL presumes a shade usage pattern that is nearly ideal: 2/3 open in winter and 2/3 closed in summer. My personal observations from having lived in climate zone 6 all my life is that more homeowners tend to do the opposite. At winter night the interior drapes/blinds are closed for privacy. In the morning it's still dark and most shades remain closed as the occupants leave the house and get on with their day. Come summer these "cave dwellers" see the sun as early as 5am. Opening the shades to daylight and views is a common practice. Few occupants understand the need to, nor take the time, to close the shades and properly balance the seasonal window energy loads. When presented with this conundrum between desired and likely shade usage patterns IECC concluded with the 2012 code to not use seasonal variations and instead set shades at 50% closed year-round to represent the best average of all occupancy patterns.

7. For the northern climate zones IECC, ENERGY STAR homes, and HERS uses a 0.40 SHGC baseline to evaluate trade-offs. This value is the basis of the suggested change to the SHGC trade-up level for ENERGY STAR Windows. The picture below is an excerpt from Table 405.5.2(1) of the 2012 IECC. The two highlights demonstrate the SHGC baseline and the interior shade fraction as a function of the actual window properties.

Glazing[a]	Total area[b] = (a) The proposed glazing area; where proposed glazing area is less than 15% of the conditioned floor area. (b) 15% of the conditioned floor area; where the proposed glazing area is 15% or more of the conditioned floor area. Orientation: equally distributed to four cardinal compass orientations (N. E. S & W). *U*-factor: from Table R402.1.3 SHGC: From Table R402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used. Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design) External shading: none	As proposed As proposed As proposed As proposed 0.92-(0.21 × SHGC as proposed) As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed

(continued)

8. Window SHGC can be binned in ranges of about 0.50 for high solar gain low-E, 0.30 for medium solar gain low-E, and less than 0.25 for low solar gain low-E. Gaming the trade-offs in bins as narrow as 0.05 is playing with variations due to window size, frame widths, grid bars, etc., and likely to miss the intent of moving from lower gain products into full-on high solar gain windows.

Summarizing our concerns with the "equivalent energy" path, we suggest adding these guidelines to the criteria:

- Make sure the paths are **equal** (energy) and that they're nearly the **same** (comfort). Simulation programs are dumb - there's no feedback as to what the occupant might do in regards to a loss of comfort. In the 1980's homeowners in the Northern zone routinely criticized low-E as the only products available at the time were high solar gain variants and they didn't validate manufacturer's claims towards saving energy year-round.
- Make the trade-off a "go big or go home" moment by raising the SHGC trade-off to a meaningful level. Questions about the carry over modeling routines cast doubt on the validity of applying the 5:1 trade-off ratio universally. This small ratio will be gamed in much the same manner that tax credit values from ARRA were tweaked.

Regards,

Jim Larsen
Director, Technology Marketing