DOCKET
10-BSTD-01
DATE
RECD. AUG 05 2011

Before the California Energy Commission
Docket No. 10-BSTD-01
2013 Building Energy Efficiency Standards

Comments of Cardinal Glass Industries on Proposed Changes in Residential Fenestration Requirements Discussed At the July 15, 2011 Staff Workshop

Cardinal Glass Industries submits the following comments on proposed changes in residential fenestration requirements for the 2013 standards. We participated through WebEx in the July 15, 2011 Staff Workshop. These written comments are specifically intended to follow-up on the remarks we made during the workshop on two residential topics that were discussed: (a) proposed Prescriptive Component Package A; and (b) proposed Mandatory Requirements for windows.

INTRODUCTION

Cardinal Glass is the national leader in manufacturing high performance low-E coatings and insulating glass units used in residential and commercial fenestration. Cardinal is a management-owned corporation headquartered in Minnesota with 5,500 employees and 27 manufacturing facilities nationwide. Cardinal has two low-E coating facilities in California that produce the type of coated glass products currently required by California Standards, as well as products that would meet the new standards proposed during the Staff Workshop. Cardinal also has facilities that produce float glass, tempered glass and insulating glass units on the West Coast. Over the past two decades, we have actively participated as necessary during California's prior standards updates and have participated nationally in the model code development process. We have been following with interest the 2013 Rulemaking, both residential and nonresidential topics.

We are submitting these comments to support the residential window proposals posted for review and offer some suggestions to consider in enhancing those proposals. Please note that we are focusing our commentary on vertical residential fenestration only and do not address skylights. In particular, we support the window requirements included in proposed Prescriptive Component Package A that was presented at the July 15th workshop; we support setting reasonable mandatory window performance requirements; and we support the overall effort for simplification in requirements to the degree possible.

California's Title 24 has long been a national pioneer in setting baseline window U-factor and SHGC criteria that encourage the use of high performing, cost-effective and widely available fenestration. There is significant low-E market penetration in the state in part

due to these past efforts, and California has for many years reaped the benefit of energy and peak demand savings resulting from high performance windows. The 2013 Rulemaking is an opportunity for California to take the next step forward in moving the window efficiency bar up the next rung of the performance ladder. The analysis that has been presented during the workshops, as well as our own considerable experience, demonstrates that the proposed new targets – a 0.32 maximum U-factor and 0.25 maximum SHGC for most of the state – are cost-effective and will generate substantial additional energy and peak demand savings for the future.

Aside from our solid support for the proposals, we think there are opportunities to make further improvements, and we ask that Staff consider incorporating the following recommendations in the next draft of the Standards, which recommendations are explained in greater detail below:

- Set the maximum SHGC prescriptive requirement for Climate Zone 5 at 0.25, or at least leave it at 0.40.
- Set the maximum U-factor proposed in the Mandatory Requirements for windows at a lower level than initially proposed; we suggest a mandatory maximum 0.40 U-factor, or at least a 0.48 U-factor.
- Include in the Mandatory Requirements for windows a maximum SHGC; we suggest a mandatory maximum 0.40 SHGC, or at least a 0.50 SHGC.
- If flexibility for passive solar designs is desired, the Mandatory Requirements are able to be met on an area-weighted average basis. Additionally, south-facing orientations with suitable overhangs could be specifically excluded from the Mandatory Requirements for windows, or a process could be implemented to exempt certified passive solar designs.

Cardinal Supports the Proposed Fenestration Prescriptive Path Values

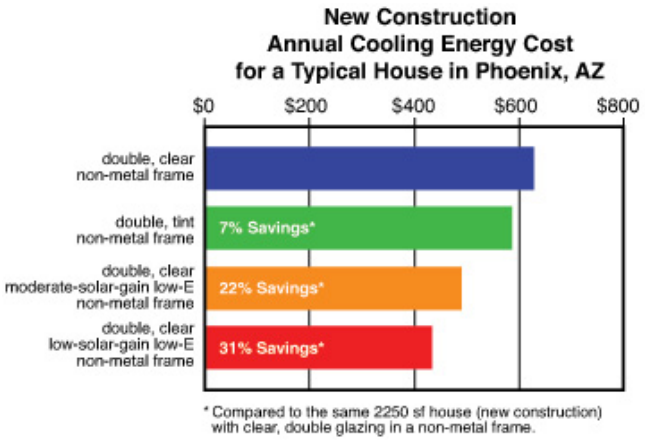
Before going into the specifics of our above recommendations, we want to make it clear that we fully support Staff's efforts and the analysis behind the proposed new "Package A" prescriptive values.

A. The Proposed Prescriptive Path Values Are Cost-Effective and the Best Available

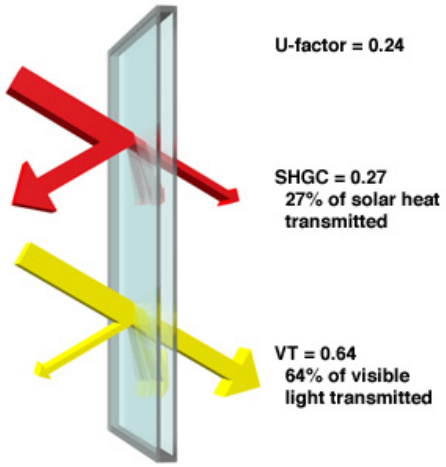
The analysis that has been provided shows that the most beneficial, readily available cost-effective glazing technology is extra low solar gain low-e ("ELSLE") in 13 out of 16

California climate zones. We agree. (In addition, one of our recommendations explained in detail below is that Staff should re-look at Climate Zone 5 as an opportunity for re-establishing maximum prescriptive SHGC criteria in that zone.) We also fully support the stated goal of simplification for the 2013 Rulemaking to the greatest practical degree in order to enhance compliance and enforcement and to achieve market transformation and resulting economic efficiencies and consumer savings. The proposed maximum 0.32 U-factor and 0.25 SHGC are the correct "technology points" for setting a reasonable and easy to comply with set of criteria.

Focusing first on the proposed 0.25 SHGC, this improvement represents a significant opportunity for increased energy efficiency by saving energy (kWh), particularly high-priced on-peak energy, reducing electric utility system peak demand and the sizing of cooling systems, as well as improving the overall occupant comfort levels. The graphs below from the Efficient Windows Collaborative (EWC) website (www.efficientwindows.org) illustrate the peak demand, HVAC sizing and energy savings benefits of low solar gain glass (as opposed to the moderate solar gain glass currently specified in the prescriptive requirements in California), as well as showing how such glass can provide substantial benefits in solar heat reduction while retaining substantial visible light (the solar heat gain is blocked primarily in the non-visible part of the spectrum). The first graph displays potential cooling cost savings by moving from a moderate solar gain low-E product to a low solar gain low-E product – 22% savings to 31% savings (while this is a Phoenix home, the same concept would certainly apply in California climates with cooling requirements although the overall percentage savings would vary).



The following graph, also from the EWC, shows the effects of ELSLE glazing (windows with an SHGC at or below 0.25) exclusive of frame (since windows are rated by NFRC with the frame, a 0.27 SHGC glass translates to a whole product SHGC below 0.25), including its ability to transmit high visible light.



Performance of Double-Glazed Low-Solar-Gain Low-E Glass (Spectrally Selective) and Argon Gas Fill

A 0.32 max U-factor and 0.25 max SHGC are also in line with the direction energy efficient windows are heading in the national model standards and across the country:

- In the 2012 International Energy Conservation Code ("IECC") – the recently published version of the nation's model energy code – the prescriptive compliance path requires a 0.35 max U-factor and a 0.25 max SHGC for most of California, and a 0.32 max U-factor for the coldest zones.
- The Federal Energy Star program currently requires a 0.35 U-factor and 0.30 SHGC for its South-Central zone, which is over half of California, and a 0.32 U-factor and 0.40 SHGC for the rest of the state (the revision process for the standard has begun and is expected to establish SHGCs and U-factors equal to or below the 2012 IECC specification). Similarly, to have qualified for the very successful Federal tax credit under the stimulus plan during 2009-2010, windows across the entire U.S. had to meet a 0.30 U-factor and 0.30 SHGC.

The proposed prescriptive values are equal to, or better, than these national standards and are the proper next step to carry the state until its subsequent Standards update in 2017. The values proposed were supported by the Energy Efficient Codes Coalition ("EECC"), a national coalition of leaders in the policy, business, building and environmental worlds, during the IECC development process (*i.e.*, 0.32 U-factor for heating climates and 0.25 SHGC for cooling climates). Lastly, we think it is worth mentioning that California already adopted a maximum 0.25 SHGC in six climate zones under its 2008 Package E.

As just noted, the proposed 0.32 max U-factor and 0.25 max SHGC are equal to, or better than, what the 2012 IECC requires for California. The recent publication of the 2012 IECC includes considerable energy efficiency gains for fenestration that leapfrog the requirements of California's 2008 Standards. (*For example*, IECC CZ3 covers much of California and in that zone, the 2012 IECC requires a 0.35 max U-factor and a 0.25 max SHGC. The comparable values in the 2008 Standards are a 0.40 max U-factor and a 0.40 max SHGC.) If the proposed 0.32 maximum U-factor and 0.25 maximum SHGC prescriptive values are adopted by the Commission, California will continue its position as the leader in building energy efficiency standards as to residential fenestration and provide support for adoption of the 2012 IECC in other states. If California misses this opportunity to go beyond 2012 IECC, Title 24 will lag behind the IECC until the state's next opportunity, which will not produce a new version until 2017 or beyond.

B. A Maximum 0.25 SHGC Is Widely Available and the Proper Baseline for California

We have reviewed a few comments filed in the BSTD Docket Log and witnessed limited discussion during the July 15th workshop questioning whether ELSLE (0.25 SHGC or better) glazing is available in California. Some of these same commenters have incorrectly suggested that the glazing technology necessary to meet the 0.25 SHGC is "proprietary" or not readily available to window manufacturers. These claims are simply untrue. As was correctly pointed out in an earlier workshop, ELSLE is available to all window manufacturers from most of the major U.S. glass manufacturers (including Cardinal) and is currently available in a wide array of window products, even in some of the most challenging frame types that have very small frame profiles and must rely on the glass performance, as opposed to large frames, to block solar again.

Here are some examples. If a manufacturer elects to meet the required U-factor and SHGC simply by upgrading its choice of Low-E glass, the center-of-glass SGHC for Cardinal's triple silver ELSLE (Low-E^3-366) is 0.27. (Cardinal and other manufacturers also offer other lower SHGC products with less visible light if desired.) These values imply that a frame (and dividers if any) comprising just 7% of the total product area (a very thin profile) will bring the whole product SHGC to 0.25. To put this in further perspective, picture windows are typically the most difficult product profile to meet a 0.25 SHGC because of their high glass-to-frame ratio. Several different manufacturers offer multiple picture window products that meet the 0.25 SHGC. Moreover, with area weighted averaging, even if a few products used in a home are above 0.25 SHGC, it should not matter. Moreover, there is always the performance compliance path for those who do not want to meet these prescriptive requirements.

In 2009, 51% of window products in the NFRC Certified Products Directory had SHGCs of 0.25 or better. It is expected that the same survey performed today would result in an even higher percentage. Product research also shows that conforming windows are already sold in California from numerous window manufacturers. Finally, our experience tells us that these types of products are currently readily available in California and that adoption of the proposed new Standards will only increase the availability of these products.

- **Cardinal Recommended Improvement #1: Do not eliminate a max SHGC from Climate Zone 5.**

  We noticed an aberration with regard to Climate Zone 5 when comparing the 2008 Standards to the current proposal. Except for CZ5, the proposal has strengthened the SHGC baseline values that existed in the 2008 Standards in every California climate zone and even added a max 0.25 SHGC in CZ16 where no maximum previously existed. We support recognizing the savings potential in CZ16 and the other zones in setting a 0.25 max SHGC for them. In CZ5, however, the 2008 Standards required a maximum 0.40 SHGC, like most of the other zones, but the current proposal does not include a max 0.25 SHGC for CZ5. In fact, the current CZ5 proposal would change 2008's max 0.40 SHGC to no requirement ("NR"). We ask Staff to reconsider eliminating a maximum SHGC requirement from CZ5. Analysis for the 2008 Standards obviously supported setting a max SHGC in CZ5, and there are clear peak demand saving benefits and cost savings from smaller HVAC sizing that would occur in this zone. If the SHGC requirement is eliminated from CZ5, we hope the analysis has properly accounted for the increased cost (larger HVAC) and higher peak demand that will result. As an alternative to setting a max 0.25 SHGC in CZ5, we ask that Staff at least consider reinstating the 0.40 max SHGC from the 2008 Standards. At least in that event, the cooling-related savings and benefits would be comparable to the 2008 Standards.

Cardinal Supports Reasonable Mandatory Fenestration Requirements

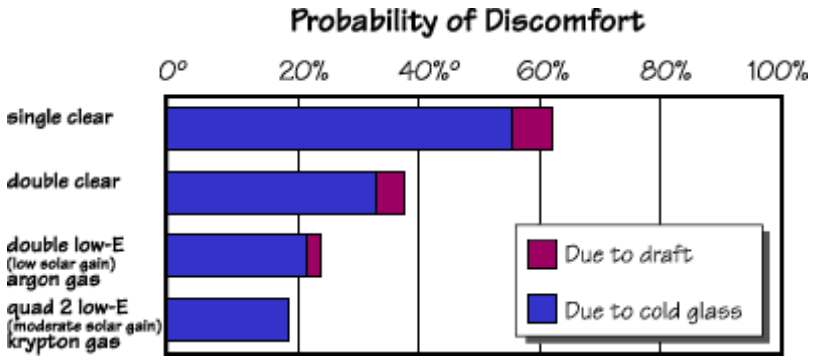
As stated above, Cardinal fully supports the proposal to implement a mandatory fenestration U-factor requirement, and we recommend instituting a mandatory SHGC requirement, as well. For California, which has significant cooling and heating energy demands, mandatory fenestration requirements (maximum U-factors and SHGCs) that cannot be traded off in the performance compliance path are simple measures that ensure all new homes contain high quality, cost-effective windows that save energy,

provide reasonable comfort, resist condensation during the heating season, and block unwanted solar gain during the cooling season.

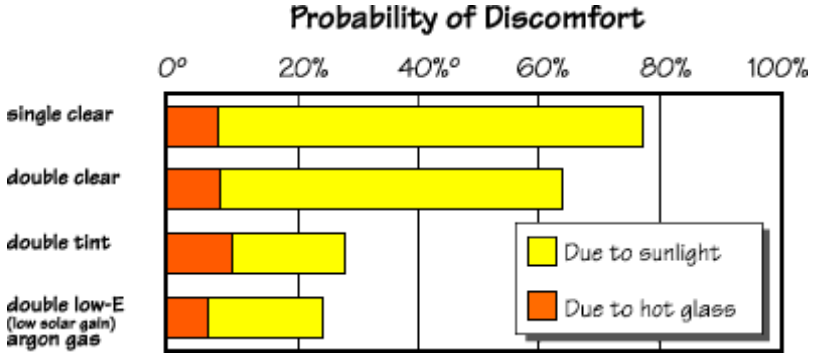
The IECC has included mandatory maximums (U-factor and SHGC) since its 2004 version. Requiring a minimum level of performance from fenestration is justified for a number of reasons. A primary rationale for these mandatory provisions is that a reasonable thermal envelope avoids discomfort and increased energy use in response to discomfort. For example, if an occupant is uncomfortable (due to poor windows), the natural response is to adjust the thermostat to offset the occupant's discomfort, which would result in far more heating or cooling energy use than what was projected in an energy budget. In addition, thermal envelope measures, like fenestration, last longer than many other measures. Allowing trade-offs against other measures with shorter lives does not result in equivalent energy savings over longer time periods. A third reason to limit trade-offs is the effect of windows on electrical peak demand and HVAC sizing. Alternative measures to good fenestration might be equivalent under performance analysis but have a far different effect on peak demand and HVAC sizing. Mandatory window performance is a key safety net and provides important homeowner and societal protection against bad or impractical trade-offs.

Reasonable Mandatory Window Performance Measures Result in More Comfortable Homes and Less Energy Use. Without adequate occupant comfort, any perceived energy savings will be instantly lost when an occupant adjusts the thermostat to correct their discomfort. Relatively small changes in window U-factors and SHGCs can have a disproportionate impact on occupant comfort. Everyone has experienced discomfort at some point due to poor windows. Hot spots created by high solar gain in the summer and cold or drafty glass in the winter months can force an occupant to adjust the thermostat to compensate. The charts below, again displayed on the EWC website, show that the likelihood of significant occupant discomfort can double or triple, depending on the type of glass installed.

For example, the following graph shows the probability of discomfort during winter from poorer windows ranging from over 60% with single pane clear windows and almost 40% with double pane clear windows. This risk declines to almost 20% with a low-E window. This problem is due to the cold window – at zero degrees outdoors, the double clear glass is slightly over 40 degrees, while the low-e glass is approaching 60 degrees. Obviously, the warmer the interior glass surface (generally the lower the U-factor), the less likelihood of discomfort.



Similarly, the following graph from the EWC shows the probability of discomfort during summer from sunlight and hot glass. The potential comfort problem from bad windows is even worse in the summer. The summertime probability of discomfort ranges from almost 80% with single clear and over 60% with double clear declining to almost 20% with low solar gain low-E windows.

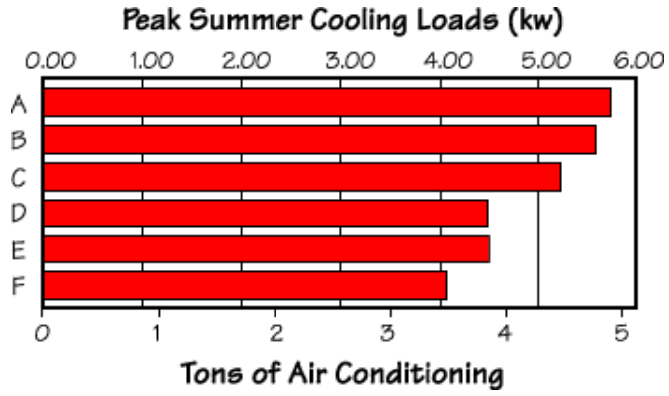


It should be noted that in order to achieve the benefits of improved comfort (and likely reduced energy usage) lower solar gain, low-E glass is essential.

Reasonable Mandatory Window Performance Measures Reduce Peak Demand and HVAC Sizing. By requiring efficient windows, reasonable mandatory measures based on low solar gain, low-E glass create immediate cost savings for the builder by permitting the downsizing of heating and cooling equipment. On a state policy level, high-quality windows can help reduce the strain on both the electric grid and gas transmission system and delay the need to build peak generation.

The following chart, also from the EWC website, shows the potential for saving peak demand and reducing HVAC sizing for different window types. Window F is a low SHGC, low U-factor window that would satisfy the window performance caps we are proposing

(by contrast, window C is a double-pane clear glass window). As is readily apparent, improved windows are crucial to lower peak cooling loads and smaller HVAC sizes (with lower costs – a one ton reduction). Trade-offs against other building components, even if one believed that they saved the same amount of energy, would clearly lose these benefits.



Low solar gain, low-E windows are readily available throughout the state, are proven to be cost-effective, and offer obvious comfort and condensation benefits over clear glazing for all California climate zones. Following the IECC's lead, we urge the implementation of mandatory maximums that prevent backsliding from low-E. If the Commission agrees that window performance caps should be included in the final version of the Standards, then we see no reason why such caps should continue to allow the use of clear glass in homes. There was discussion during the July 15th workshop regarding a clear glass exception being necessary for passive solar designs. We disagree for two reasons. First, we do not agree that clear glass should be used in passive solar designs, because there is no reason to not require at least low U-factors for insulating value. Second, we think passive solar designs can be handled through area-weighted averaging or targeted exceptions (explained in greater detail below).

By way of comparison, the IECC mandatory window requirements set a maximum 0.48 U-factor in IECC CZs 4-5 (roughly equivalent to California CZs 1 & 16) and a 0.50 maximum SHGC in IECC CZs 1-3 (roughly the rest of California). Both caps in essence require some form of low-E, but we think California can and should do better than the IECC benchmark.

- **<u>Cardinal Recommended Improvement #2</u>: The proposed Mandatory Requirement maximum U-factor should be lowered to 0.40.**

- **Cardinal Recommended Improvement #3: There should be a Mandatory Requirement for SHGC, and it should be a maximum 0.40 SHGC.**

  For California, we suggest changing the 0.57 proposed U-factor Mandatory Requirement to a maximum 0.40 U-factor across the state, and we suggest implementing a maximum 0.40 SHGC Mandatory Requirement for all but California CZs 1 & 3. These caps would ensure the use of moderate solar gain, low-E windows and their associated benefits in California for all compliance approaches. These values are also a natural progression from the 2008 Standards, in which the 2008 "Package D" prescriptive path baselines for most of California were a 0.40 U-factor and 0.40 SHGC. Setting window caps of a 0.40 U-factor and 0.40 SHGC are reasonable upper limit spreads from the proposed 2013 Rulemaking "Package A" prescriptive values that are well below the 0.40 U-factor/0.40 SHGC maximums. Given the improvements to window efficiency brought about by previous versions of the Standards and the state's high priority for energy efficiency, our proposal is a common-sense upgrade to an effective code requirement. These values would prevent any backsliding from the low-E market penetration already achieved in California and ensure the comfort and condensation benefits described above are not traded away.

- **Passive Solar Exception:**

  We are mindful that Staff is concerned about creating an impediment to passive solar design by implementing a maximum U-factor lower than 0.57 or any maximum SHGC. We believe those concerns can be adequately addressed. During the July 15th workshop, we suggested creating a passive solar exception to the Mandatory Requirements and pledged to follow-up with written comments including an example of how to exempt true passive solar designs. First, the Mandatory Requirements already may be implemented on an area-weighted average basis, which means clear glazing (U-factor/SHGC > 0.40) could be used on the optimal passive solar orientations (*i.e.*, the south face) if offset by installing appropriate low-E glazing (U-factor/SHGC < 0.40) on the other orientations, which do not contribute to the passive solar design.

  As an example, using energy performance values from the ASHRAE Handbook of Fundamentals, a standard double-pane clear glass, operable window in a non-metal frame has a U-factor of 0.51 and an SHGC of 0.52.

Windows with these properties could be used on the south-facing orientation and still meet the 0.40 U-Factor/SHGC caps, so long as windows meeting the baseline prescriptive values were installed on the other orientations. This is illustrated in the following chart. In fact, as the chart illustrates, over 40% of the windows in the home could be double-pane clear glass installed on the south face and still meet our proposed caps.

	North	South	East	West	Total Area / Wtd. Avg.
Window Area	4%	8%	4%	4%	**20%**
U-Factor	0.32	0.52	0.32	0.32	**0.40**
SHGC	0.25	0.63	0.25	0.25	**0.40**

We believe area-weighted averaging is a sufficient exemption to allow passive solar design. However, if Staff and the Commission wish to go further by adding a specific exemption for passive solar, another simple approach would be to merely exempt south-facing glazing from the window Mandatory Requirements, ideally in conjunction with a suitable overhang. This would allow passive solar benefits, while retaining moderate solar gain low-E benefits where they are needed on the other orientations. A third option, but more complicated, would be to institute a process for certifying passive solar designs that would be exempt from the Mandatory Requirements for windows.

Response to Docket Comments

In addition to our participation in the July 15th workshop, we have reviewed the presentations made available online from earlier workshops, and we have read several comments submitted in the rulemaking docket. We are taking this opportunity to reply to one set of comments in particular submitted by Mr. Zaremba that questions certain aspects of the proposed window measures.

Specifically, Mr. Zaremba argues that a 0.25 maximum SHGC should not be required in California climate zones 5, 12 or 16. We disagree. With regard to CZ5, it appears Mr. Zaremba has misread the proposal, because while he believes a 0.25 SHGC is recommended for CZ5, the proposed SHGC presented is in fact “NR” for CZ5, meaning no requirement. Aside from that, as we commented above, we take the opposite

position of Mr. Zaremba for CZ5 and believe there should be a maximum SHGC requirement in CZ5. Our reasons are more fully explained above, but in summary, a maximum SHGC should be required in CZ5 primarily because a maximum SHGC was required in the 2008 Standards. Continuing the max SHGC requirement in CZ5 would provide some degree of electrical peak demand and HVAC sizing benefits, and the 2013 Rulemaking should not take a step backwards in this respect. With regard to CZ12, Mr. Zaremba argues against a maximum 0.25 SHGC because he stated that CZ12 is the same climate zone as IECC CZ4, which does not require a 0.25 SHGC. Again, we think Mr. Zaremba might be misinterpreting the proposal because the comparison of California CZ12 to IECC CZ4 is flatly incorrect. California CZ12 is entirely within IECC CZ3, and IECC CZ3 requires a maximum 0.35 U-factor and 0.25 SHGC. The California proposal for CZ12 would be roughly equivalent to, and slightly better than, the 2012 IECC prescriptive path and is the proper course. Lastly, with regard to Mr. Zaremba's request to remove the 0.25 SHGC from CZ16, we believe the analysis that has been presented soundly refutes his position. The analysis shows significant energy and demand savings in CZ16 from a maximum 0.25 SHGC prescriptive requirement. We have seen no evidence to suggest that the analysis is incorrect or flawed, and we support what has been presented.

In other comments, Mr. Zaremba suggests that north orientations should be exempt from the maximum SHGC requirement and that special requirements should be created for windows within 45 degrees of west. We disagree and think this type of approach would make the Standards far less energy efficient and effective. California has always required meeting SHGC on all four orientations, because there is a benefit even in north orientations from reducing reflected solar gain. The analysis provided presumably modeled energy and demand savings by including ELSLE glazing on all four orientations. We believe that to remove ELSLE from the north orientation would reduce expected energy and demand savings, and would affect HVAC sizing, as well. Aside from the reduction in energy performance, we also believe Mr. Zaremba's approach would negatively affect compliance and enforcement and create unintended bad consequences. This type of "different windows for different orientations" approach has been rejected by the IECC and goes against the clear simplification goals that have been set for the 2013 Rulemaking. Such an exemption is just too complicated for housing that utilizes the prescriptive path. For production housing, it would be difficult to ensure the correct windows are installed in the proper orientations. If a user wishes to go to this level of detail, it can and should be done through the performance path with tighter design and implementation controls. We think adding this type of detailed exemption to the prescriptive path baseline would be a step in the wrong direction.

Mr. Zaremba also argues that the new "Package A" proposed prescriptive U-factor and SHGC criteria are too aggressive for replacement windows. We do not agree. There is

no reason to broadly exempt replacement windows or establish different requirements. The same windows are generally used for new and replacement purposes.

Lastly, Mr. Zaremba argues that provisions for dynamic glazing should be added to the Title 24 residential standards. We do not believe the residential standards should be complicated with these provisions at this time, and we are not aware of any residential standard that includes dynamic glazing provisions. The language Mr. Zaremba has proposed is taken largely from the 2012 IECC's commercial section on dynamic glazing. Moreover, we have a concern with the proposed approach for this product because dynamic glazing is given full credit for its optimal performance functionality in summer and winter when its actual operation (*i.e.*, human intervention) will likely be less than perfect operation and undercut the assigned performance values. Human intervention is more likely in a residential setting than in commercial buildings, which often benefit from automatic controls and/or building operators and managers.

CONCLUSION

In summary, we fully support the proposed upgrades to the Title 24 Building Energy Efficiency Standards. These changes will improve the Standards to be equal to or better than the 2012 IECC, a key benchmark. Additionally, we recommend careful consideration of the limited enhancements we have recommended above. We thank you for the opportunity to provide these comments.

Respectfully submitted,

Garrett A. Stone
Eric M. DeVito
BRICKFIELD, BURCHETTE, RITTS & STONE, PC
1025 Thomas Jefferson Street, NW
Eighth Floor West Tower
Washington, DC 20007
(202) 342-0800
Eric.DeVito@bbrslaw.com

On Behalf of Cardinal Glass Industries

August 5, 2011