Cardinal®
Glass Industries Inc.

March 28, 2003

Mr. Richard Karney P.E., Manager
Energy Star Program
United States Department of Energy
1000 Independence Ave SW
Mailstop EE-40
Washington, DC 20585

Subject: Energy Star Windows Program Alternatives

Dear Rich,

Cardinal supports DOE's position that the Three-Zone Alternative is the preferred choice for the new Energy Star Windows program requirements.
Some of the key points for recommending the Three Zone Alternative are presented in the department's analysis and reiterated here:

- Simplicity of the program and consistency of three climate zones with the windows program already in place
- Provides energy savings over the IECC and the current Energy Star program
- Summer peak demand savings

To these points, I'd like to add some additional supporting comments:

1. Pollution Savings.
   Based upon the balance of heating and cooling savings shown for the Three vs. Four-Zone proposals, the Three-Zone criteria will reduce SO_x emissions by 500 tons per year. Using a 40 year window life projection, this equates to a 20,000 ton reduction in SO_x emissions for every year the program is implemented. Failing to implement the Three-Zone Alternative puts the next opportunity to replace these windows a generation away. Our children will have to live with the air that we pass on to them from today's decisions.

775 Prairie Center Drive
Eden Prairie MN 55344
952.935.1722
952.935.5538 Fax

2. Air-Conditioner Sizing and Costs.
   The technical analysis work for evaluating the alternatives did not consider the impact of properly sizing the air conditioning equipment to match low solar gain windows. The peak load savings for the North Central region would increase by 40% with a ½ ton reduction in AC unit capacity. The life expectancy of an air-conditioner is half that of a window so the homeowner saves on equipment downsizing twice during the window campaign. Code analysis work performed by PNNL for the new IECC development has used an air-conditioner sizing cost of $579 per ton. With this level of equipment savings added to the North Central region housing population into the consumer analysis, the Three-Zone Alternative becomes the economic winner.

3. COMFORT.
   Thermal discomfort associated to windows is mostly a matter of extremes: cold winter nights and hot summer days. Winter design temperatures correlate well with heating degree days (the duration of winter) and vary significantly from north to south. For this reason energy codes, which have historically focused only on heating, follow lines of heating degree days. It's appropriate from a comfort aspect that Energy Star requires lower U-factor windows in the north. The length of cooling season varies from north to south, but summer design temperatures do not. Take the example of Bismarck North Dakota – this is the coldest climate in the Resfen cities list but the summer design temperature is 90°F - the same as Miami. Notable cities with less extreme summer temperatures include Honolulu, San Diego, Los Angeles, San Francisco. The Bismarck homeowner that buys an Energy Star qualified high solar gain window doesn't get the same level of summer comfort as the lower 2/3 of the country! Of the nine Resfen cities in the north central region, six have summer designs conditions hotter than Bismarck and the remaining three are hotter than the three California cities from above.

   Research from LBNL shows that high solar gain windows fail to provide acceptable summertime comfort at the 78°F air-conditioning setpoint temperature used in the energy analysis. More than 50% of the people will express comfort dissatisfaction in this sunlit room. The ASHRAE thermal comfort standard uses 20% as the maximum. Worked backwards, the LBNL window comfort research suggests that homeowners with high solar gain windows will set the thermostat to 75°F to accomplish the same comfort as the house with low solar gain windows and a 78°F cooling setpoint. This 3°F comfort offset gives the Three-Zone alternative an 11% advantage in total energy for the North Central region.

The AEP900 database that forms the backbone of the energy calculations is built on a very rigid set of operational assumptions with an active occupant.

Examples of the homeowner involvement with the windows include:

- open blinds 2/3 of the time in the winter
- closes the blinds 2/3 of the time in the summer
- operates windows during the spring/fall swing seasons to vent excessive heat gain

This management style represents an optimum strategy to minimize energy consumption all year: maximize passive solar gains in the winter, minimize gains in the summer, and shorten the length of the cooling season. Do homeowners remember to open the blinds when they leave for work on a cold dark winter morning? Conversely, do they actively block the view to a brilliant summer morning? How many people really open the windows to noise and dirt rather than turning on the air-conditioner? Is everyone secure at home with open windows?

The AEP900 building model than replicates one of the major flaws from all the building energy performance procedures – the heating and cooling thermostat setpoints are fixed at the same level regardless of envelope characteristics. In Bismarck North Dakota you could remove the insulation from the wall, put in single pane windows, or use high solar gain glass. Whatever the change, the programs model energy losses and gains under the assumption that occupants are comfortable year-round using 70°F heat and 78°F cool setpoints.

In 2001 NAHB statistics show the median new home size was 2,082 ft^2. U.S. Census statistics show that in that same year 56% of all new homes sold were two-story. The AEP900 model, used to represent all U.S. homes, is a single story house with 1,540 ft^2 of floor area. If the entire population of new homes in the department analysis are modeled as a 2,000 ft^2 two-story, the total heating energy increases by only 3% - this despite a 30% increase in heated floor space. Cooling loads in this comparison increase by 50%. Clearly the proportions of heating and cooling loads are affected by building type.

The 1997 RECS data used to predict existing house savings shows national source energy requirements of 6.08 quads for heating and 1.34 for cooling. Data for the 2001 RECS is not published yet, but information from the 2002 Core Databook (table 1.2.3) puts these numbers at 5.55 quads for heat and 2.04 quads for cooling. This huge change in ratio of heat to cool energy cuts the savings difference between the Three and Four-zone models in half.

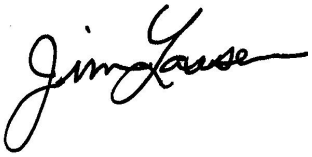
There is no doubt to the benefits of wintertime passive solar gains. The question remains as to how much this overcomes the detriment of cooling in a society where air-conditioning has become the norm. By the department's analysis, allowing solar gains generates a 1% national energy benefit for new homes. Given the lack of an error prediction and the concerns raised in my letter, I recommend that this difference is "too close to call" and may actually be fictitious given real people in real houses.

In light of these uncertainties, we feel the Three-Zone Alternative is the clear winner and best serves the interests of consumers.

We appreciate the time and personal energy that you and DOE has expended to hear the concerns of all stakeholders. Cardinal remains committed in our support of the Energy Star program. We continue to invest in our business and capacity in order to stay ahead of growing demands. Our latest low E coater, located in the Dallas area will be operational this spring. Rest assured that as DOE's efforts to improve building energy performance increase the market for high performance glass products we'll plan our production capabilities to cover all the market regions.

Thank you for reviewing our comments. If you have questions on any the data I've presented here, please call me at 952-229-2609.

Sincerely,



Jim Larsen
Director, Technology Marketing