

Energy-
Efficient
Residential
Windows
and Doors
Can Make a
Difference.

Climate Change



The topic of climate change is uppermost in many people's minds and is in the news on a regular basis. A growing number of people and many scientists worldwide believe that the earth is warming due to human generation of "greenhouse" gasses. This belief may not be scientifically conclusive, but the potential consequences of climate change are projected to be so severe that the argument in favor of limiting "greenhouse" gas emissions is compelling.



Yet few are aware of how much energy-efficient windows and doors can do to help. They can significantly reduce energy consumption in both hot and cold climates. • What about emissions from Cardinal plants in manufacturing these products? In fact, the energy saved by Cardinal glass products neutralizes our entire carbon footprint within twelve months. What's more, the windows continue conserving energy for many years to come.

How residential windows and doors can fight climate change.

The facts are persuasive. And the opportunity is enormous.

- Eleven U.S. states still do not have a building energy code.
- Only twelve states enforce a current version of the residential model energy code (2006) as it relates to windows and doors.
- Twenty-three years after commercialization, only 58% of residential windows and doors sold in the United States contain energy-efficient LoE glass.
- Second generation LoE² (low-e squared) products are now commonly available in every state with adequate production capacity already installed to handle 100% of the nation's window demand.
- LoE² glass contains two layers of silver which selectively transmit visible light and reflect solar heat and far infrared, making it efficient in both hot and cold climates.
- The U. S. Census Bureau reports that more than 91% of all new homes built in America have mechanical air conditioning, pushing up peak electrical demand.

The cost is minimal.

- Efficient LoE windows cost about \$15 more per window than clear double-pane windows, on average.
- Builders experience an additional cost of about \$350 per average house (2,500 ft² of floor space, 22 windows) for these energy-efficient window products. But with proper engineering, builders would save up to \$1,000 in first-time HVAC costs.



All states should adopt an energy-conserving building code requiring at least second generation LoE² glass in all residential windows and patio doors. This equates to a solar heat gain coefficient (SHGC) < 0.40 in the South and a U-value of < 0.35 in the North. No exceptions. No substitutions.

The energy savings are huge.

Currently, the residential windows and doors sold with energy-efficient glass (58%) are reducing peak energy demand enough to eliminate the need for eight new 200 MW coal-fired power plants each year.

If the remaining inefficient windows and doors (42%) sold each year were required to have LoE² glass:

- Peak U.S. energy demands would be reduced sufficiently to eliminate the need to construct six additional new 200 MW coal-fired power plants each year.
- Greenhouse gas emissions (CO₂) from heating and cooling U.S. homes would be reduced by 2.5 million tons each year.
- The annual CO₂ emissions prevented by converting an average house to energy-efficient LoE² windows and doors equate to the difference between the volume of CO₂ emitted by driving an SUV versus a small hybrid vehicle.
- More than 50% of all windows manufactured in the United States are installed as remodeling or replacement windows in older homes. If these were energy-efficient windows, the improved energy performance would become actual reductions in the total U.S. consumption.

The future appears even brighter.

- The third generation of LoE window and door products (LoE³ pronounced low-e cubed) is now entering the market. These products incorporate a triple layer of silver with still more efficient solar selectivity.
- If all windows and patio doors in the U.S. were required to use this third generation of LoE products, greenhouse gas emissions (CO₂) from heating and cooling U.S. homes would be reduced by 7.0 million tons each year.
- This would amount to eliminating two new coal-fired power plants per year, or a total elimination of eight new coal-fired power plants per year.

Cardinal energy-conserving products neutralize our own carbon footprint.

Cardinal's business of manufacturing insulating glass products is fully integrated. Therefore we experience significant gas emissions through the combustion of natural gas in glass melting and the consumption of electrical power in glass coating, tempering and insulating glass fabrication. We believe it is important to judge ourselves on the entire enterprise including the energy-conserving nature and performance of our products.

Nitrous oxide, sulfur dioxide and particulates are all emissions from our float

glass operations which are controlled and monitored by Federal EPA requirements. Carbon dioxide, a byproduct of combustion, is measured but is not controlled; it is carbon dioxide which is commonly believed to be the most important of all of the "greenhouse" gasses. There are no known methods of controlling the carbon dioxide generated by the combustion of natural gas in glass melting furnaces.

Cardinal's generation of carbon dioxide from all of its manufacturing and transportation activities is

1.1 million tons per year.

However, our product performance offsets our production emissions – and a lot more.

Our advanced energy-conserving LoE³ (low-e cubed) insulating glass products help homes to significantly reduce peak and annual energy consumption. The prevention of CO₂ emissions through conservation must also be considered when judging industrial activity such as Cardinal's. Without the production of efficient glass products, significant emission savings would not be

accomplished in the housing sector which is the largest single consumer of energy in the United States (40% of all U.S. energy is consumed by buildings).

Cardinal's entire carbon footprint is neutralized within the first twelve months after its products have been installed in North American homes. After this point of neutralization, significant conservation of energy – and consequently the prevention of the generation of "greenhouse" gasses – begins to take place.

Our environmental story: *going beyond energy conservation.*

All of Cardinal's float glass manufacturing activities meet or exceed Federal EPA emission standards. When operating at full capacity, Cardinal's latest plant in Winlock, Washington will have the lowest total emissions per ton of glass shipped of any conventional float glass plant in the world.

We are also a glass industry leader in controlling and reducing waste.

- Captured emission particulates and chemicals from our float glass facilities reenter the raw material stream eliminating the need to dispose of these wastes while at the same time improving the quality of the new glass produced.
- Cardinal conducts an aggressive cullet (broken glass) recycling program with its customers. This glass is returned, remelted and formed into pristine product. Each year this program prevents more than 150,000 tons of broken glass from being discarded.

- Corrugated packaging material is reused numerous times and recycled at the end of its useful life. Additionally, all plastic stretch wrap materials are bundled and recycled from all Cardinal plants.
- Throughout the entire Cardinal system, steel reusable racks and glass packs are used for the most efficient and effective packaging and transportation systems. The use of reusable steel racks alone saves the construction and disposal of more than 500,000 wooden boxes per year.

Cardinal's roots are in energy-conserving glass products for windows and doors. Today, Cardinal's annual output of high performance, energy-conserving products prevents the need for construction of three and one-half new coal fired power plants each year.

With widespread usage of our next generation LoE³ (low-e cubed) products, Cardinal's total integrated "greenhouse" gas emissions will be neutralized within less than twelve months through annual savings by window consumers. Best of all, the reduced gas emissions and annual energy savings will continue for years to come.

Resources and Notes:

1. Average house size and housing start information from U.S. Census Bureau
<http://www.census.gov/const/C25Ann/sfttotalmedavgsgqftfinance.pdf>
<http://www.census.gov/const/www/permitsindex.html#estimates>
2. Window unit sales from Ducker 2005, Exhibit D.1 Patio door sales from Exhibit E.1
3. Average window size is 15ft², which approximates a vertical slider of 3-0 x 5-0 or double casement of 4-0 x 4-0
4. Distribution of national window sales to housing starts yields "typical" single family house with 22 windows
5. Energy analysis details are consistent with the National Fenestration Rating Council (www.nfrc.org) draft procedure 901: "Guidelines to Estimate the Effects of Fenestration on Heating and Cooling Energy Consumption in Single Family Residences". Total window area is set to 18% of the conditioned floor area and are distributed equally on all four facades. The analysis uses a thermostat offset to accomplish equal comfort. For windows with clear double pane glass the heating setpoint is 2°F higher than for low-E windows. For windows with high solar gain glass (clear and LoE-178) the cooling setpoint needs to be lowered by 4°F to maintain the same comfort as windows using LoE² or LoE³.
6. Gas heat at \$1.20 per therm; 90% AFUE new north, 78% AFUE for southern and existing.
7. Electric cool at \$0.12 per kW; 13SEER new construction, 10SEER existing homes.
8. Average coal power plant size and CO₂ emissions
<http://buildingsdatabook.eere.energy.gov/docs/6.2.1.pdf>
<http://buildingsdatabook.eere.energy.gov/docs/6.1.3.pdf>
9. CO₂ emissions for cars and SUV:
<http://buildingsdatabook.eere.energy.gov/docs/6.1.4.pdf>



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Superior glass products for residential windows and doors

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