# The forgotten market

## maximizing energy efficiency in today's world

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While the window industry has made many advances in energy efficiency over the last decade, the success has largely been limited to new housing and remodeling projects. The vast majority of existing buildings still have inefficient windows, and the current rate of window replacement is far too slow, estimated from 30 to over 100 years! The large amount of energy wasted in existing windows is an enormous problem – and a huge market opportunity – that has been largely ignored. Technology available today, such as low-e storm windows and replacement glass, can be used to address this problem, as well as expand a large new market in "affordable energy performance."

### Window Replacement

Western Europe's new construction market in 2000 was approximately 2 million new dwellings with an estimated window area of 33.8 million $m^2$.(1) The total existing dwellings in Europe is estimated to be 168 million with a glazing area of approximately 2.9 billion $m^2$, of which 9% is low-e.(2) Replacing the 2.6 billion $m^2$ single-glazed and double-glazed windows would achieve €14 billion energy savings which equals 1.1 BGJ or 82 Mtonnes of $CO_2$ reduction.(2) However, only 1.6% of the existing windows are replaced every year, so it will take over 30-60 years to achieve these benefits.

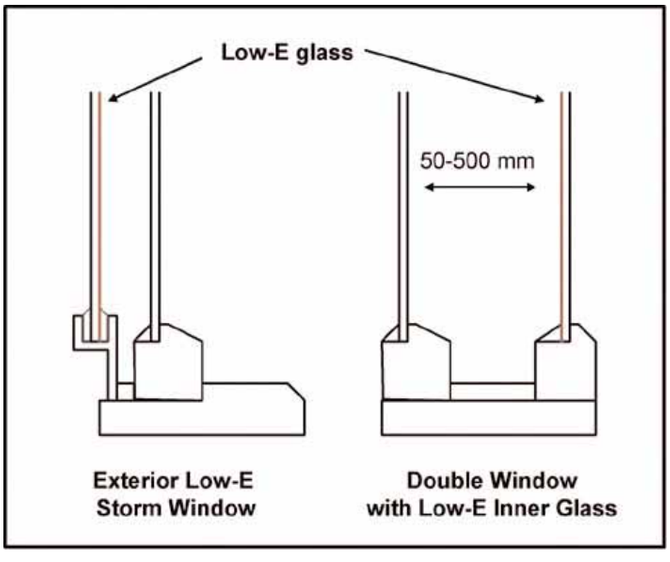
In the U.S., there are approximately 107 million homes and 1.8 billion $m^2$ of existing windows, of which 69% were built prior to 1980 when energy efficient windows were not widely available.(3) There were 1.6 million new homes built in 2002, representing approximately 1.5% of the total homes.(4) Total new window installation accounts for no more than 2-3% of all the existing windows per year. At this pace, it could conceivably take over 50 years to incorporate energy efficient windows into all residential buildings. This pace needs to be accelerated to achieve real energy savings, as existing residential homes consume over 20% of all energy usage and the annual cost attributable to windows exceeds $20 billion. David Engel, Division Director at the U.S. Department of Housing and Urban Development, recently gave a presentation on this issue at the Energy Efficient Windows-3 workshop in Moscow. He commented, "We all work very hard on window technology for new homes, and ignore the 100 million existing units where vast amounts of energy are wasted."

Another example is Germany, which has one of the highest penetration rates of low-e coatings and other energy efficient technologies in new windows. However, refurbishment of old buildings is still a major problem.

The forgotten market: existing windows

75% of the existing buildings were constructed prior to 1977 using old inefficient windows. Despite this need, the German window market has actually decreased 50% between 1995 and 2002, because most of the new housing and high end remodeling applications have been addressed, but cost barriers prevent penetration into the much larger existing window market.

Improving the existing window stock is essential for reducing society's energy consumption – and also provides a huge market opportunity for those willing to address the problem. What are the major barriers that have prevented faster replacement of old windows? One could argue it is simply an issue of manufacturing capacity, but the experience of the German window market shows otherwise. In fact, one of the largest barriers is cost. While windows that cost US$100 to $500 may be acceptable in new homes and home remodeling projects, current owners in existing single family homes or multifamily housing units either can not afford this investment, or choose to spend their income on other items. In the U.S., 40% of households had total income less than $25,000, and generally can not afford to pay for replacement windows.(3) Ironically, it is these lower income households that require energy efficient technologies the most, as some of the lowest income families spend up to 30% of their income on energy costs.




### Low-E Storm Windows and Replacement Inner Leaves – Affordable Energy Performance

Energy efficiency is not just an option for consumers buying new or replacement windows. It is also an option for those who remain satisfied with the appearance of their current windows or cannot afford the cost of new windows, but want greater energy savings. For these consumers, increased energy performance comes in the form of either low-e storm windows or the addition of inner leaves to existing windows. For those with existing double windows, the inner clear glazing can be replaced with low-e glass to improve performance and comfort at little cost.

In a recent study at Lawrence Berkeley National Laboratory (LBNL), it was determined that, "The addition of a low-e storm window to a prime window provided performance very similar to that of the replacement window."(5) The testing compared an efficient replacement window (spectrally selective low-e, argon-filled IG, well-weather-stripped vinyl frame) to an intentionally leaky single-glazed prime window with either an interior or exterior low-e storm window. The heat flows through the windows were accurately measured over several winter days at LBNL's mobile thermal test facility. The results showed the energy performance of both the interior and exterior low-e storm/prime window combinations to be essentially equivalent to that of the replacement window, at a fraction of the cost. The interior low-e storm window reduced the U-factor of the prime window by 46% from 4.7 W/m$^2$K to 2.4 W/m$^2$K. This was essentially the same as the efficient replacement window, with a U-factor of 2.3 W/m$^2$K, despite having an argon-filled IG unit and lower emissivity glass. The exterior low-e storm window was also quite effective, reducing the U-factor to 2.8 W/m$^2$K. (Note that these U-factors were determined for the entire window under actual conditions, and should not be directly compared with product literature values calculated for fixed conditions using NFRC 100 or EN 673.) The driving factor for consumers is that with a low-e storm window, they can maximize energy savings at a fraction of the cost. Whereas replacement windows can range from $100-500 per window, a low-e storm window would be in the range of $40-100, and can be easily installed by the homeowner.

Using a low-e storm window for increased energy performance was also recommended by Mattinson, DePaola, and Arasteh in their recent case study evaluating window retrofit options in Madison, Wisconsin.(6) In this study, the use of a low-e storm window produced energy cost savings 50-61% over the original single pane window. This was nearly equivalent to a new double-pane low-e window (61% savings), while being much more affordable for the homeowner.

Similarly, for European buildings with existing double windows, the inner clear glazing can easily be replaced with pyrolytic low-e glass. Of course, this is not as effective as installing a new IG unit and new frame, but for a fraction of the cost, the U-factor can be reduced by 30% by simple substitution of the glass. The result is a similar reduction in energy consumption, as well as increased comfort near the window. The low cost and simplicity also allows this solution to be implemented much faster than replacement with complete new windows.

Government programs whose purpose is to increase energy efficiency should promote methods for lower-income housing consumers to afford energy efficient products. Likewise, window manufacturers who seek to advance profits while promoting energy efficiency have a large potential in the "affordable energy performance" market. With 43% of all windows in the U.S. still single-glazed, in addition to the large volumes of single-glazed windows in Europe and Asia, low-e storm windows provide an affordable path for consumers to achieve the energy savings now, without having to wait for the future.(2,5) The bigger market picture for manufacturers, however, remains staggering at a potential volume of 750 million m$^2$ of low-e storm windows to increase the energy performance of single-glazed windows in the U.S., and similar numbers in other countries. In the global battle for energy efficiency, the government, the fenestration industry, and the consumers can win by the innovations already available today. ■

1. *Euroconstruct 54th conference Munich, Summary report.*
2. *"Low-E Glass in Buildings", Groupement Europeen des Producteurs de Verre Plat.*
3. *2001 Residential Energy Consumption Survey, U.S. Department of Energy.*
4. *U.S. Census Department.*
5. *J. Klems, "Measured Winter Performance Of Storm Windows", Lawrence Berkeley National Laboratory, to be presented at ASHRAE Annual Meeting, Jun 2003.*
6. *W. Mattinson, R. DePaola, D. Arasteh, "What should I do about my Windows?" Home Energy Magazine, July/August 2002.*