# Still No Substitute

Historic windows are routinely replaced in the name of energy savings and reduced maintenance costs, but the best way to save money and energy is often to save the windows. A continuation of the article "No Substitute" in the November 2005 issue of *Period Homes*. *By John H. Cluver, AIA*

Historic windows are an endangered species. On a seemingly daily basis, hundred-year-old windows are prematurely thrown into landfills in favor of new windows, windows that may not be capable of lasting a quarter of that lifespan. This is wasteful, shortsighted and unnecessary. They are being removed not because they are no longer functional, but because they are old, and in our culture that loves the new, most people assume that these windows cannot be repaired and that they need to be replaced. Additionally, in a society that values the bottom line above all else, replacement windows also seem to make more economic sense. A better understanding, however, of the true costs of replacing historic windows would make any homeowner realize that the better value lies in the less glamorous option of repair and maintenance.

If keeping old windows is indeed superior to replacement, then why is replacement so common? The answer lies in the age-old discrepancy between perception and reality. The home-repair market is full of misconceptions and myths that appear plausible, but do not stand up under closer scrutiny. The earlier article, "No Substitute," presented the five fables of modern replacement materials. In summary, they are:

Fable #1: Replacement is cheaper than repair.
Fable #2: The best price is the best deal.
Fable #3: New looks better than old.
Fable #4: Replacement is more energy efficient than repair.
Fable #5: No maintenance is the ultimate goal.

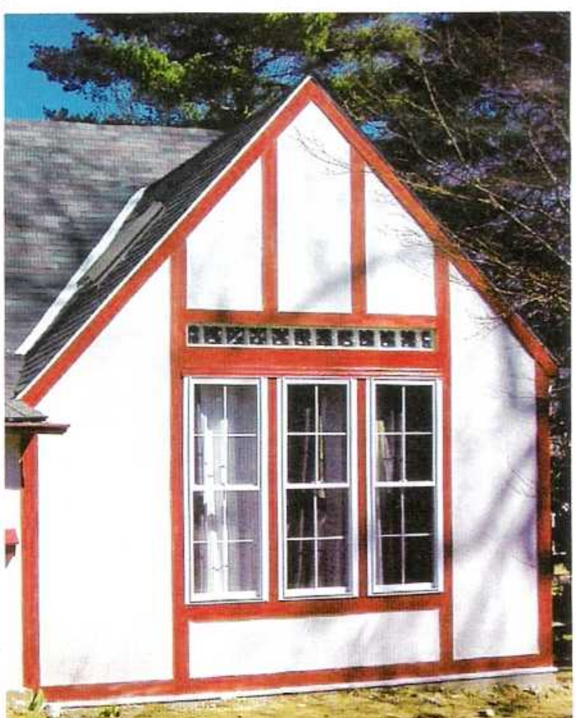
As with any fable, there is some element to them that people can relate to, and which appeals to their "common sense." Windows are particularly susceptible to all five fables, and as such are under regular attack from the replacement-window marketing machine. It will tout the lack of maintenance, ease of cleaning, energy efficiency and durability (lifetime warranty!) of the replacement vinyl window, all for a very affordable price. These benefits, however, conceal other costs that go unconsidered and unmentioned. A review of the true aesthetic, environmental and financial costs of replacing windows will reveal that the common way is not the best way.

### Keeping Up Appearances

From both the inside and outside, windows are a crucial visual element in a building, and original windows can provide instant clues to the age and history of a house. The tiny panes and heavy frames of the pre-Revolutionary era, the larger panes and gracefully narrow muntins of the Federal period and the distinctive 2-over-2 pattern and pocketed frames of the late-19th century are all examples of the distinct character offered by historic windows. Unfortunately, old windows have only a single pane of wavy glass separating the interior from the exterior, which, when coupled with the drafts from unsealed openings and the peeling paint and rotting sills that result from poor maintenance, create an almost irresistible urge to pull the aged windows out and replace them with sparkling new vinyl windows.

Most people who understand old houses can effortlessly recite the aesthetic costs of replacing a home's original windows. It is very difficult to accurately replace the original profiles and configurations of the window sash and frame, and all but impossible unless using custom-manufactured wood elements. Muntin profiles and sizes are limited and are frequently installed only on the interior face of the glass. Muntins installed only on the interior or, even worse, in between panes of insulated glass, can create a "blank stare" look to the windows due to the lack of shadow lines beneath the muntins. And when interior and exterior muntins are used with insulated glass, there will be a visible gap between them unless an inter-pane spacer bar is used. Aside from the muntins, the mitered or welded corners of vinyl windows are more visible than the stile-and-rail joints in the wood sash. It is very easy to change the color of wood windows, while vinyl windows have a very limited color palette (frequently only white is offered) that is inappropriate for the historic appearance of the house, and there is no ability to refresh or change the color of the windows without replacing them.

Even replacement wood windows are not immune to their own problems. They can suffer from the vinyl jamb liner, used instead of a pocket and counter balance, which creates an unsightly white streak on the sides of the window frame. Another weakness is that when a wood grid is applied over the exterior of the glass to simulate the look of divided lites, the profile of the exterior muntin is frequently an inappropriate ovolo or cyma curve. All replacement windows also run the risk of altering the proportions of the old window openings if purchasing from stock sizes or,

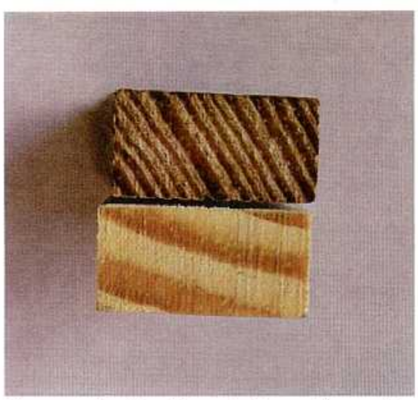


**The limited choices in size, configuration and color of most new windows (above) force compromises that can frustrate attempts to maintain an historic character (left).** *All photos courtesy of John H. Cluver, AIA, Voith & Mactavish Architects, LLP*

**While the owner of this house spent extra money on this replacement window (left) for a custom muntin pattern to match the original, the stark white color, shallow muntin depth and lack of divided lites fail to convey the feel of the original (center). The trim around the replacement window was also capped with aluminum, another "no maintenance" effort that ruins the appearance of the window (notice the loss of the backband surrounding the trim). It will create a long-term problem when water trapped behind the aluminum rots the wood beneath. A level of thermal resistance comparable to that of a new window can be obtained by adding a storm window to the original (right).**

even worse, saving money on the installation by fitting the new sash and frame inside of the old frame. Finally, the true lover of old windows will rabidly defend the little things, such as the ease of opening a nicely counterbalanced window, the timeless feel of looking through aged glass and the substantial feel of the old bronze hardware.

Other aesthetic problems occur as replacement windows age. The most obvious is a failure in the insulated glass unit (IGU), which can cause a non-removable condensation on the inner face of the glass. All IGUs will fail; the question is will they fail before or after their 20-year warranty is up. As vinyl ages, the constant expansion and contraction from exposure to the sun will make the joints in the windows open up, potentially allowing water into the house's framing, and the sun can also make its colors fade. While using white vinyl can reduce these problems, vinyl becomes increasingly difficult to clean with age; it seems like the dirt gets baked on. In addition, vinyl will become brittle and prone to cracking, particularly at the jamb liner, which can lose its weather-tightness. With enough aging, the meeting rail of the upper sash of a vinyl window can develop a slight bow, but this is uncommon since the windows are usually replaced for other reasons before this becomes noticeable. The end result is a window that in only one or two decades will look so bad that it will need to be replaced again.



**The cross grain of the old-growth pine used for most historic windows (above) is very dense, helping to create a very durable wood. This old pine has a much longer lifespan than either the new-growth pine (below) or vinyl used in most replacement windows.**

### An Energetic Argument

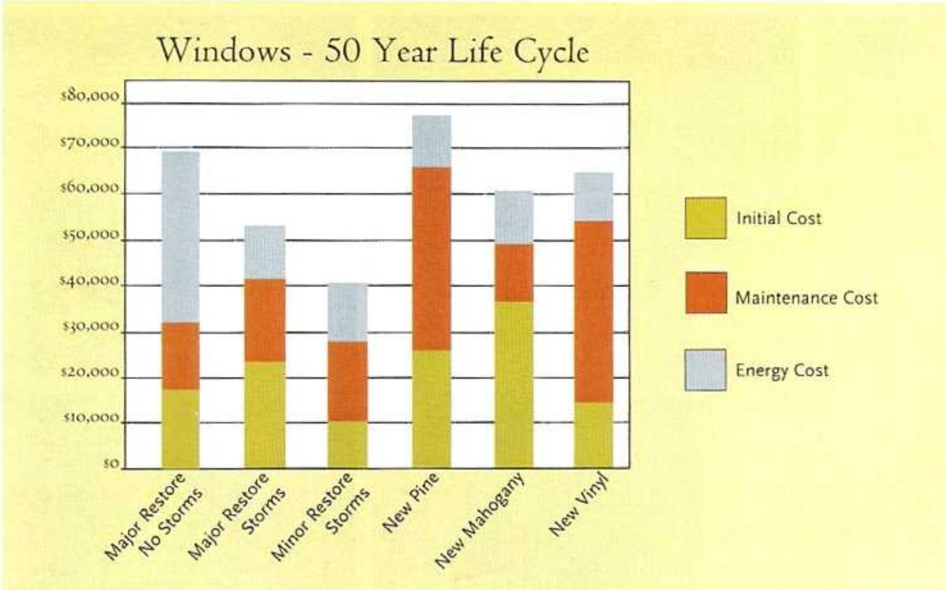
When people talk about the energy savings from new windows, the discussion always focuses on energy in the form of heat loss. While important, this is only part of the whole energy and cost issue. The other major consideration is sustainability, in the form of embodied energy. Embodied energy is that which is required to obtain raw materials for, manufacture, transport, install and finish a particular item. Vinyl windows have a high level of embodied energy, due in part to the process needed to produce vinyl, and therefore have a high environmental cost. Vinyl is also made from petroleum, a non-renewable resource. New wood windows are better than vinyl in these regards, but still require energy for their production and installation. Historic windows, however, represent an environmental bill that has already been paid. Keeping what already exists does not require expending any energy, and the energy required to maintain the windows, primarily in the form of painting, is a small percentage of that of manufacturing and installing new. In addition, disposing of the old windows will add to the environmental cost of replacement. And while wood windows will gradually decay in a landfill and return to an organic state, the same cannot be said of the vinyl that eventually will be following them a few decades later.

While issues of sustainability are of increasing interest, it is heat loss that is the primary energy concern today. Windows have the potential to let great quantities of energy escape from the house. Heat passing through a window requires generating extra energy to make up for the lost heat, so achieving energy efficiency provides a clear environmental and economic advantage. The energy-loss difference between a well-maintained historic window and new replacement window, however, is not as significant as one would suppose. There are two main ways a window loses energy: through the window (in the form of conduction and radiation) and around the window (in the form of infiltration). The energy efficiency of a window relative to the former can be identified by its U-value (or Btu lost per hour per sq.ft. of surface area per the difference in temperature between the interior and exterior – let's stick with the special symbol).

A wood or vinyl window, old or new, with a single pane of glass has a U-value of roughly 1.0. Modern insulated glass windows with low-E glazing and insulated sash can achieve a U-value of 0.33, which means a window that is three times more efficient. (A lower U-value is more desirable). While this sounds substantial, simply adding a plain storm window in front of the single-glazed window will drop the U-value to 0.5, making the window with low-E insulated glass only 50-percent more efficient than the historic window with a standard storm window. While a 50-percent improvement still sounds significant, consider that the windows account for 10 to 15 percent of the exterior envelope in a typical house. Therefore, a 50-percent energy savings at the windows equates to an overall savings of only 5 to 7.5 percent. Furthermore, if a low-E coating is added to the storm window, the U-value for the old window with the new storm window is roughly 0.36, which is almost identical to the value of the new insulated glass window! The second component in heat loss, infiltration, is often higher with old wood windows due to gaps that have emerged over time. Some basic repairs and the installation of weather-stripping, however, especially when combined with a storm window, will greatly reduce the amount of air leaking from the house and can produce an effect comparable to that of a newer window.

### Throwing Money Out the Window

The low cost of replacing old windows coupled with the inflated claims of energy savings that can be realized with replacement units are frequently cited as arguments for installing new vinyl windows. A comparative cost analysis, however, reveals a different reality. The economic costs have three variables: initial cost, life-cycle cost and usage cost, which in this case is the energy cost. The chart (page 14) shows the comparative values of these




**A comparison of the cost of repairing old wood windows and replacing them with new windows shows that on a life-cycle basis, repairing and maintaining the existing windows makes the most economic sense.** *Graph courtesy of John H. Cluver, AIA, Voith & Mactavish Architects, LLP*

three costs for a range of window options based on a case-study house consisting of 14 double-hung windows measuring 44x64 in. Starting with initial costs, the most cost effective approach is to make minor repairs, which in this case include removal of damaged paint and window glazing, priming bare wood, painting all wood and basic weatherstripping (all combined, roughly a day's worth of work per window) and installing a new storm window. Should the historic windows have been neglected for a long period of time and require more extensive repairs, including complete stripping, sill replacement and hardware replacement, then the cost may approach or exceed the cost of replacement vinyl. The difference, however, becomes justifiable when the life-cycle costs are considered. The old-growth pine typically used to make historic windows is proverbially as hard as steel and can last seemingly forever, even without perfect maintenance. In addition, the repair of traditional sash and frame can be done by any knowledgeable and handy homeowner. Looking at the various options listed on the chart, all of those options involving repair of existing windows (including major repairs and installation of storm windows) end up being cheaper at the end of 50 years than any form of replacement. The next best option is buying a window made with a material of similar durability as the old windows, such as mahogany. While the initial cost can be high, their increased durability results in reduced life-cycle costs (even with periodic repainting), since later window replacement is not required.

Vinyl windows, in contrast, will require periodic replacement when failures occur. Failure can take the form of color fading or dirtying, cracking of the vinyl, failure of the jamb liner and leaks through joints that open up due to the constant expansion and contraction of the vinyl. Vinyl windows also are difficult, if not impossible, to repair, meaning that relatively simple damage may require replacement of the whole sash or perhaps the entire unit. A particular example is the glass. The insulated-glass unit is a sealed assembly that is integral with the window sash. If the glass is cracked or the perimeter seal is broken, the entire sash must be replaced, as opposed to simply re-glazing the broken pane. The replacement sash (if one is available) will most likely not match the aged vinyl of the rest of the window. While vinyl windows offer a "lifetime warranty," this warranty is typically limited to the original owner, does not cover typical aging (such as loss of the inert gas in the glass unit or color variations) and depends on the manufacturer not going out of business – thereby leaving the homeowner unable to collect on the warranty. Even if covered by a warranty, the labor to execute the replacement is typically not included, what is covered may be prorated and there is no calculation for the mess and inconvenience created by the work. The insidious part of this replacement cycle is that, since homeowners move frequently, they do not see the full life cycle of vinyl windows, leaving the next homeowner with the task of replacing windows that may only be 20 years old.

The energy cost of windows is very prominent these days in discussions of replacement windows. As discussed previously, however, the U-value of new windows and single-paned windows coupled with storm panels are roughly equal, and definitely not worth the cost of replacement windows. In fact, comparing the heat lost through an uninsulated window and a high-efficiency window at the case-study house, it would take more than 10 years of energy savings to recover the cost of installing the replacement window; that payback period increases to 50 years if the historic windows have simple storm windows added to them. While this does not seem possible, remember that windows comprise only 10 to 15 percent of the exterior wall surface, a disproportionate percentage of heat loss typically occurs at the roof, and even the most efficient windows are still less efficient than the typical wall. As a result, even a 50-percent increase in window energy efficiency generates a much smaller percentage energy savings. While new windows will definitely generate energy savings, so will installing storm windows, simple weatherstripping and perimeter sealant around the window frame. Reviewing the cost chart, repaired, uninsulated windows have the potential to cost less than replacement vinyl windows in the long term. And this chart pertains to the higher quality vinyl windows; the cheap vinyl windows that are frequently advertised have higher U-values, thereby reducing energy savings even further.

### Real Energy Savings

Window replacement is often the first or only step people take in the effort to save energy, even though the benefits are minor at best. Any savings generated from reducing energy loss are greatly exceeded by the costs of replacing the windows, and if embodied energy is considered, it is possible that there is not any real energy savings. If conserving energy is a true goal, however, there are several cost-effective measures that an owner of an old house can take.

The first step is to check the levels of insulation in the attic. Everyone has heard this before, but how many have actually done it? If the attic is uninsulated (unlikely, but it still occurs), the heat loss in the winter and heat gain in the summer can be responsible for 50 percent of the energy bill. More frequently, many old houses have a few inches of mineral-wool insulation that have packed down over time and provide minimal insulation value. Simply adding 6 in. of attic insulation (R-19) could save several thousand dollars per year. The cost of adding this insulation, particularly in an unfinished attic, is low, and may even be low enough to pay for itself within a single year.

The efficiency of the mechanical system can also play a major factor in energy costs. While it does not reduce any heat losses at the envelope, a more efficient boiler reduces the cost of the heat that is lost at all areas of the house, regardless of whether it occurs at the windows, attic or elsewhere. Old boilers can have efficiency percentages between 50 and 60 percent, which is almost half of the energy bill literally going up in smoke. A new conventional boiler will be 70 to 80 percent efficient, while a condensing boiler will be close to 90 percent. Improving the efficiency from 60 to 80 percent would generate a savings of 25 percent of the heating bill for the year. While a new boiler represents a substantial financial investment, its payback will generally occur within five or six years.

Finally, addressing those drafty windows can provide some noticeable energy savings. But the most cost-effective method is not replacing them. Instead, a combination of weatherstripping and basic storm windows can provide an annual energy savings of roughly 15 percent; this could grow to 20 percent if low-E glass is used in the storm windows. This matches the potential savings that could be achieved with replacement windows, and at a fraction of the cost. Some will argue that the convenience of the new windows compared to storm windows justifies the extra cost, and it is true that taking a Saturday morning to remove storm windows every spring is not fun. But because these storm windows are designed to be taken in and out, it is easy to replace a unit that gets broken. The storm windows also protect the historic windows, helping to reduce the amount of maintenance they require and extending their lifespan indefinitely.

What do these three alternative energy-saving methods have in common? They are all cheaper than installing new windows, while providing equal or greater energy savings. The commercials and "common sense" may lead you to believe that installing new windows is the right thing to do, but when you consider the aesthetic, environment and life-cycle costs of replacing your historic windows, you will see that there is still no substitute. ■


*John H. Cluver, AIA, is a senior associate and director of preservation at Voith & Mactavish Architects, LLP, located in Philadelphia, PA. He received his professional degree in architecture from the University of Notre Dame and a Certificate in Historic Preservation from the University of Pennsylvania. He has worked on a wide range of rehabilitation projects for a variety of educational and commercial institutions in the extended region, both as architect and preservation consultant. Cluver is also an adjunct professor at Moore College of Art and Design, where he teaches a studio focusing on the design of historic interiors.*