Windows: Energy Efficiency Facts and Myths

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Purpose and Methodology

My decision to do this project was prompted by my belief in the important of retaining historic windows and my second-hand knowledge that replacing them in the name of energy efficiency was not sound, especially in warmer climates. The problem was that while I could say make that statement I didn't really understand how to back it up. As I started, I realized just how little I knew about energy efficiency, heat flow, etc. Over the course of the semester, I've conducted a great deal of research about energy efficiency, window rehabilitation, window replacement, etc. I've spoken with various energy-related professionals and worked with various computer programs designed to measure the efficiency of various windows. In general, the only time I ran across the advice to replace windows was in literature from the industry. Most articles and books on energy efficiency in general did not recommend wholesale replacement of windows as a cost effective option. It's intriguing that the replacement window has seemingly had such huge success in shifting public opinion. I spoke recently to a recently hired Energy Advisor at my local electricity provider. I asked him about energy audits. He informed me that he didn't do audits per se, but he would visit with people at their homes about how to conserve energy. "If I went to a house with single-pane historic windows, the first thing I'd say is to think about replacing them." I questioned if that would really be the first bit of advice and he answered affirmatively. I challenged him with the fact that replacing the windows would be costly and, in this climate, might only save a homeowner $30/yr. "Yes, but triple pane windows are most efficient." How else do you explain this gut reaction by an energy professional than to attribute it to the successful marketing by the window industry?

As I see it, the purpose of this project is to inform both historic homeowners and small contractors about wood windows: not only their architectural significance but also their ability to be retained and rehabilitated. It is to educate them about how and why it is more cost effective to repair windows than to replace them. With this purpose in mind, the document is not written in a technical way, but rather in layman's terms for use by the general public. All the technical information about windows and energy efficiency one could ever want is out there somewhere. What is lacking, both for preservationists as a way to "make their case" and for homeowners concerned with the bottom line, is information in plain English. That's what I hope to provide.

Windows: Energy Efficiency
Facts and Myths

The replacement window industry says that single-pane wood windows cannot be energy efficient and must be replaced. The local historic district design guidelines say that historic windows must be retained, seemingly without regard to energy efficiency. The homeowner is caught in the middle without the facts. The truth is that windows (old or new) are never highly energy efficient when compared with other materials. Will triple-glazed, Low-e, argon gas-filled replacement windows decrease heat loss to a level below that which is allowed by a historic window? Chances are that it will. The big question, though, is whether the decrease will result in a cost savings that makes replacing the windows cost effective. In general, the answer is no. This paper will elaborate on this point.

We'll start with a general discussion of heat flow and of home energy as well as energy audits and identifying areas of energy loss. This will be followed by a discussion of windows: value, design, materials, costs, life expectancy, etc. To conclude, we'll look at energy cost calculations of various window types and compare those costs or savings over its lifetime with the initial cost of the window.

Heat Flow and Energy Loss

The basic issue behind understanding energy efficiency is heat flow: the transfer of heat energy from one place to another. It's important to understand and remember that heat always flows from warm area to cool ones. In your home in winter, heat does not just disappear it leaves. The opposite occurs in the summer; the heat flows inside and forces your air conditioner to cool it as well. The level of winter heat loss and summer heat gain, along with efficiency of appliances, etc., plays a dominant role in determining energy costs. Weatherization efforts decrease heat flow. In a typical one-story house, 25-28% of heat loss occurs through the ceiling or roof, 22-25% is lost through the walls, 15-22% is attributable to the windows, 14-15% of heat loss occurs by air infiltration and 5-10% is lost through the floors.[1] This is important to understand. While windows are often blamed for heat loss, they account for approximately 1/5 of the heat loss.

It's also important to learn how heat flows: conduction, convection and radiation. Conduction is the transfer from one molecule to the next. Convection is the transfer of heat by the movement of liquids or gases. Commonly, this is referred to as air infiltration or "drafts." Finally, radiation is the transfer of heat through open space by electromagnetic waves. The heat radiates in a straight line from a source to a cooler area. Radiation is the least significant method of energy loss in a home. Convection is a larger consideration. It is the leakage of outdoor air into the home such as the cold draft the sometimes blows under the door in winter, for example. According to Doug Rye, 35% of the average heating and cooling load is due to air infiltration alone. Windows of any kind account for some level of air infiltration, but there are many other culprits. Air infiltration comes from cracks throughout the house, around electrical outlets,

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[1] Lewis Vaughn, *Chilton's Guide to Home Energy Saving* (Radnor, Pennsylvania: Chilton Book Company, 1982), 3.