

## **Energy Costs in an Old House: Balancing Preservation and Energy Efficiency**

*-Sally Zimmerman, Preservation Specialist, Historic Homeowner Membership Program*

This winter rising energy costs will challenge owners of old and/or historic homes to improve home energy usage, and this challenge poses some particularly difficult questions about balancing historic preservation and energy efficiency. Articles in the popular media focus either on energy enhancements in new construction or on generic retrofits for improved efficiency. Recommended approaches can be incompatible or even inappropriate for the traditional older, historic house. Certain energy upgrades, such as blown-in or spray foam insulations that are now standard for new construction, can seriously damage or compromise the fabric and significance of a historic house. Following are some observations and tips on improving energy efficiency in old houses without damaging their historic character.

### **What's Green? Sustainability, Embodied Energy, and Historic Preservation**

Underlying the balance between preservation and energy usage is the concept of sustainability, using environmental and energy resources in a way that ensures the long term health and viability of our environment, economy, and society. Preservationists argue that the “greenest” building is the building that already exists. In terms of the energy required to extract, process, transport, and install a product from its raw state to its intended use, what is called “embodied energy,” this is certainly true. All existing buildings contain a store of embodied, or embedded, energy in the materials and labor that went into their creation.<sup>1</sup> Broadening the definition of embodied energy to include the energy expended in removing, recycling, or disposing of a product when it is no longer useful, as happens when a building is demolished, strengthens the argument that historic buildings are inherently “green.”

For those of us who love old houses, part of what has always been of value is the “embodied” human and material energy that characterizes a hand-planed molding or an eighteenth-century mahogany baluster, but increasingly owners of older houses need to address another element in the home energy equation, the operating energy costs of heating, cooling, and running their homes. While the question of how to operate our houses in a “green” way can be complex, for owners of historic and older homes, there are a few preferable options.

### **Beware of Insulating Walls**

---

<sup>1</sup> One preservation group now offers a website, [www.thegreenestbuilding.org](http://www.thegreenestbuilding.org), with a simple “Embodied Energy Calculator” to determine how much embodied energy resides in an existing building, or might be lost when one is demolished.

Often the first recommendation made to old house owners looking to conserve energy usage is to add insulation to the exterior walls of the house. Rarely is it feasible, let alone advisable, to insulate the walls of an old house: this is because installing wall insulation requires permanently altering the historic fabric of the building or introducing potentially destructive forces the house was never engineered to manage. While the newest insulation materials and techniques achieve significant energy efficiencies with few or none of the health and moisture-related problems associated with forms of insulation promoted after the oil crises of the 1970s, these products are primarily designed for new or recently constructed houses. They are generally not suited for use in historic houses, and the older the house, the greater is the potential that significant features will be adversely affected by their installation.

The two most common wall insulating materials home owners encounter for use in existing homes are loose-fill and spray foam (or foamed in place) insulation. Loose-fill insulation, most often composed of cellulose, fiberglass, or mineral wool, is generally blown into cavities in existing walls using hoses to pack the material in tightly and infrared monitors to ensure that insulation reaches irregular or obstructed areas in the walls. Sprayed or foamed in place insulation uses a variety of plastics that expand to completely fill wall cavities with a highly thermally-resistant foam (usually polyurethane or polyisocyanurate). Additionally, spray foam insulation creates superior air sealing and has good moisture controlling properties when installed in conjunction with other ventilation and vapor retarding systems, and achieves a high standard of energy efficiency in new construction.

But foam insulation, which is easily sprayed over the open framing of a house under construction, can only be added to existing finished spaces if the interior wall surface is removed. In a historic home, this could require the removal of original plaster or other potentially significant original or historic finishes. Furthermore, the sprayed foam forms a continuous layer over the entire structural frame which obscures historic construction details. Most troublesome from a preservation standpoint is the irreversibility of this procedure: a core tenet when adding any new material or feature to a historic structure is that it be capable of being removed without damaging the historic fabric. Once installed, foam insulation cannot be removed, short of scraping it off of the frame.

The other major wall insulation, blown-in loose-fill insulation, only requires drilling small holes in the exterior walls, a relatively easily repaired intervention, but with blown-in materials, a series

of other variables must be addressed to prevent problems. The U.S. Department of Energy's Energy Efficiency and Renewable Energy website<sup>2</sup> advises that a home's energy efficiency depends on maintaining a balance between four elements: air sealing, insulation, moisture control, and ventilation. Installing any wall insulation without at the same time sealing for air leakage, providing properly installed vapor barriers to control moisture, and adequately ventilating for interior air quality can cause serious structural and health problems.

Old houses by their nature reflect a host of alterations made by various owners over the life of the structure, alterations that create unforeseeable conditions within that structure. The extent to which the Energy Department's recommended balance can be maintained in an old or historic house is questionable and probably shouldn't be tested by adding blown-in insulation.

### **Insulating Walls from Outside . . .**

Another approach to wall insulation recommends adding insulation to the outside of the house. This involves removing all of the exterior siding and trim down to the sheathing boards, applying an exterior housewrap (such as Tyvek or Typar, two typical housewraps on the market) to provide a drainage plane, and then installing one or two layers of two-inch polyisocyanurate insulating rigid foam panels on the exterior wall surfaces. For the owner of a historic or traditional older house, this approach presents some critical drawbacks, among them the necessity of removing original siding and trim. Wholesale removal and replacement of these materials destroys historic fabric and even when the intent is to reproduce the detailing, the dimensions, workmanship, and appearance of the original is rarely matched, even by conscientious carpenters.

Once the original walls have been encased in two to four inches of foam panel insulation, other problems arise from the standpoint of retaining historic character: windows, which cannot be moved forward to the new outer plane of the wall, will sit farther back than intended, new trim elements will meet the roof in a different plane, and proportions of other architectural features, such as bays or porches, will meet the thickened walls in unintended ways. The Department of Energy warns that achieving "maximum performance from foam board insulation depends heavily on proper installation"<sup>3</sup> to avoid trapping moisture in the wall cavity. Finally, foam insulation, though hard to ignite, emits toxic gases when burnt. Adding wall insulation, either in the wall cavity or over the building exterior, adversely impacts the historic, architectural, and

---

<sup>2</sup> See [http://www.eere.energy.gov/consumer/your\\_home/insulation\\_airsealing/index.cfm/mytopic=11220](http://www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11220)

<sup>3</sup> See [http://apps1.eere.energy.gov/consumer/your\\_home/insulation\\_airsealing/index.cfm/mytopic=11620](http://apps1.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11620)

structural integrity of an old or historic house. For all of these reasons, the most prudent option is to avoid insulating walls.

### **Focus on the Main Living Space**

Even without insulating walls, old house owners can still achieve important gains in energy efficiency (and comfort) by concentrating on those systems and aspects of the old house structure that can be easily accessed and modified without detriment: first focus on enhancing the energy use within the main living space.

In new construction, the entire interior envelope (attic, main floors, basement) is treated as a single “conditioned” (i.e., heated and cooled) space, within which air sealing, insulation, moisture control, and ventilation have been engineered into one comprehensive, integrated, energy-efficient volume. In historic houses, where attics and basements often function solely as service spaces, conditioned space is almost always confined to the main floors. Focusing on these primary living spaces is the key to achieving a higher standard of energy efficiency in an older or historic house.

“Conditioning” the main living spaces requires minimizing air leakage and reducing heat flow (from the interior to the outdoors in heating season and to the interior from outdoors in cooling season). Minimizing air leakage means caulking and sealing both inside and outside the house; reducing heat flow involves containing heat within the living area by adding insulation to attic floors and sometimes to basements and crawlspaces. Both are relatively easy and inexpensive to complete.

Two different types of caulk or sealant are needed to air seal the house. On the interior, use a water-based latex caulk to seal the perimeters around window and door casings, baseboards, and other moldings. Latex caulk is inexpensive, adheres well, and is paintable. Outside, new hybrid modified-silicone polymers, which combine water-base, silicone and polyurethane products, are more costly but provide the best sealant for exterior joints around windows, doors, and moldings. While the lower edge of clapboards should never be sealed, all other construction joints need to be caulked against air leakage. Seal large gaps and cracks at foundations with expanding polyurethane foam, cutting back any excess once it cures (in exterior applications, polyurethane foam needs to be painted to remain weather resistant).

Adding insulation to basements and attics reduces heat flow between main living spaces and these areas and the outdoors. Again, advice on how and where to add insulation varies when dealing with an older or pre-modern house. The Department of Energy advises insulating basement walls rather than ceilings for a better payback in energy savings, but in most historic houses, “basements” are cellars, unfinished spaces with brick or unmortared fieldstone foundations. It is generally not feasible to insulate this type of wall. Instead, consider sealing gaps (to the outside and first floor), sealing and insulating ductwork, and wrapping hot water pipes to minimize heat loss and air infiltration.

Far more effective is insulating the attic. Heat loss through the roof accounts for a major component of overall heat loss and insulating an attic floor quickly repays the effort. In the attic, floorboards are often loosely laid on top of the joists and can be taken up along with any existing loose-fill or batt insulation laid in the joist spacing.<sup>4</sup> Check for evidence of air infiltration (dirt marks on old batt insulation) and seal gaps with caulk or expanding foam before relaying insulation. Install insulation in joist spacing to the top of the joist and relay flooring; loose-fill insulation is cheaper and easier to install than batts.

### **Keep Your Old Windows but Replace Your Old Furnace**

The best treatments for drafty, leaky wood windows are repair, weather-stripping, and a good storm window. Replacement windows offer NO operational or energy improvements that cannot be realized in a repaired or restored, weather-stripped, single-glazed wood window with a good quality storm window. At \$700-1000 or more per double-glazed replacement window, it would take decades of energy “savings” to recoup your investment in a product that will at best be a plausible facsimile of your existing wood windows and at worst fail at or near the twenty year warranty period.

Keep your existing windows and get them repaired or restored and weather-stripped by one of the many preservation carpenters now specializing in this area. Then, invest in new, heavy-duty storm windows.<sup>5</sup> Spring-bronze weather-stripping, a v-shaped metal strip attached to the sash (or door) using copper-plated steel nails, provides a further seal against air leakage. You’ll be saving a valuable architectural resource, one that contributes immeasurably to the authenticity and

---

<sup>4</sup> Check [http://www.eere.energy.gov/consumer/your\\_home/insulation\\_airsealing/index.cfm/mytopic=11390](http://www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11390) for warnings on vermiculite insulation or heat sources such as recessed lights, chimneys, fans or flues.

<sup>5</sup> See [www.windowrestorationne.org](http://www.windowrestorationne.org), the Northeast Window Restoration Alliance for repair information.

appearance of your historic house, “reinvesting” the embodied energy of the existing windows, reducing your carbon footprint, *and* saving money on heating and cooling.

Another cost-effective way to “green” your historic house is to update the heating system with a highly-efficient new furnace or boiler. All furnaces and boilers are now measured by their annual fuel utilization efficiency (AFUE) and must operate at or above 75% AFUE. Condensing furnaces and boilers, which use the heat generated in combustion condensation to further enhance efficiency, can operate at 90-97% efficiency, saving fuel costs and reducing carbon emissions. Discontinuing use of the heating system flue in a historic chimney and direct-venting a high-efficiency system through the foundation, an existing cellar window, or an unobtrusive wall location will also help to preserve the chimney by eliminating the build-up of destructive creosote and combustion by-products.

### **You Can Preserve Your Old House AND Reap Energy Savings and Benefits**

Through these and other common sense approaches (turn down the thermostat, switch to compact fluorescent light bulbs, replace an inefficient refrigerator, close curtains and blinds against heat and cold), your old or historic house can be a greener and more energy efficient place to live *without* losing its distinctive character and significance.

### **For Further Information**

- The most reliable general information source on energy efficiency comes from the Department of Energy’s Energy Efficiency and Renewable Energy Building Technologies Program, on line at <http://www1.eere.energy.gov/buildings/>. Remember that the information and advice it contains does not account for historic buildings or significant architectural resources.
- The best technical discussion of the pros and cons of energy upgrades for historic buildings is contained in the Association for Preservation Technology’s *Special Issue on Sustainability and Preservation*, available at <http://www.apti.org/publications/Past-Bulletin-Articles/bulletin-PR-36-4.pdf>.
- The most comprehensive and detailed practical source on energy-related installations in the old or historic house is *Renovating Old Houses: Bringing New Life to Vintage Homes* (Taunton Press, 2003) by George Nash.
- Still useful though it is not recent is *The Old-House Journal Guide to Restoration* (Dutton Adult, 1992), edited by Patricia Poore.
- The National Park Service’s Technical Preservation Brief Number 3 “Conserving Energy in Historic Buildings” (1978) by Baird M. Smith (available on line at

<http://www.nps.gov/history/hps/tps/briefs/brief03.htm>) continues to provide relevant and reliable information for the old house owner.

- For historic preservation efforts underway to address sustainability in old buildings, see the National Conference of State Historic Preservation Officers website, <http://www.ncshpo.org/current/leed.htm> or the Sustainability page of the National Trust for Historic Preservation's website, <http://www.preservationnation.org/issues/sustainability/>.

©Historic New England, September 2008