Chapter 9: Energy Efficiency

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Photograph on cover page:
Energy Audits

According to recent energy reports from the U.S. Department of Energy, buildings account for roughly 40% of all U.S. energy use. The majority of the country’s energy is obtained through non-renewable resources (coal and nuclear) and as such, more and more consumers are seeking energy alternatives and ways to increase energy efficiency in homes and businesses. When investigating the energy use of a building, it is beneficial to look at the building’s overall energy performance as a whole. For example, factors such as the amount of natural ventilation and the presence (or absence) of insulation will have an impact on the efficiency of heating and air conditioning equipment, and thus will have a direct correlation to energy consumption.

Consider obtaining a professional energy audit when trying to determine the most appropriate approach to increasing energy efficiency. The goal of an energy audit is to help the property owner assess and prioritize possible energy improvements which provide the most cost effective, energy conscious solutions. Tests that may be performed include: a blower door test or infrared thermography scan, which help to identify air infiltration and building insulation problems. The audit will itemize ways to reduce air infiltration, tighten the building envelope, increase efficiency of mechanical systems, and improve overall site conditions. An energy audit will also help explain how a historic house operates, good or bad. The more educated a property owner is about how their home and all its interwoven components function, the easier it will be to create a long-term weatherization and maintenance plan.

It should be noted that property owners do not need or require an energy audit. It is an option available, but not required, to address energy conservation and efficiency of your property.

NOTE: While there are high-tech gadgets to suit just about every energy need, it is highly recommended that a professional energy audit is conducted when considering more expensive and complex equipment upgrades.


Average residential energy use

Where to Begin?

Once a home or business has been evaluated for its energy loss (typically through an energy audit performed by a professional), the following questions should be answered to develop a weatherization plan prior to beginning an energy retrofit:

• How much money is spent monthly/annually on energy? What is the most common energy source?

• Where are the greatest energy losses in the building?

• How long will it take for an investment in energy efficiency to pay for itself in energy cost savings? (For instance, if the installation of new windows will cost $10,000 but the return on investment is less than $100 per year in energy savings, it would take over 100 years for new windows to pay for themselves.)

• Do the energy-saving measures provide additional benefits that are important to make the home more liveable?

• How long will the home be occupied to ensure return on investment?

• Is it a do-it-yourself job or will a professional contractor be needed?

• Will be a permit be required?

• Will be a COA be required?

• What is the budget and how much time will be required for regular maintenance or repair?

Once energy needs are assessed and prioritized, a whole house weatherization plan can be made. Keep in mind that any improvements should be sensitive to the historic property and should follow the Secretary of the Interior’s Standards for Rehabilitation. The plan will provide a strategy for making smart purchases and home improvements that maximize energy efficiency, save the most money, and have the least visual impact on the historic property.
ENERGY EFFICIENCY

When seeking a professional to carry out an energy audit, ask the following:

1. Does the auditor have any experience with historic buildings and building materials?
2. How will the building’s historic integrity be addressed and protected?
3. Will alteration of historic building materials or demolition be required?
4. Is the auditor certified to conduct an audit?
5. What type of access into the building will be required?
6. What type of tests and diagnostics will be performed?
7. Once a report is generated, will the auditor do a walk-through of the building with you?
8. Are there financial incentives available for energy improvements through the local, state, or federal government?

Once an Audit is Complete

Making building improvements to a historic property involves thoughtful research and planning. Property owners are encouraged to consult a professional architect and/or engineer (consultant) familiar with retrofitting historic properties and sustainable design prior to the start of any considerable “green” improvement. The owner and professional architect/engineer should consult the City of Independence Historic Preservation Design Guidelines throughout the design process, and they should contact the City of Independence Historic Preservation Department, as questions arise.

NOTE: The Sustainability COA Approval Matrix is located at the end of Chapter 10. Please reference this matrix in addition to the Rehabilitation COA Approval Matrix (found in Chapter 4), prior to the initiation of a project that includes energy efficient upgrades.
For additional information regarding home energy audits, please visit:


Energy Efficiency in Historic Buildings - Addressing the Building Envelope

Ten Tips for Sealing Air Leaks

The following information is from the U.S. Department of Energy:

How Does the Air Escape?

Air infiltrates into and out of a building through every hole and tiny crack. About one-third of air infiltrates through openings in ceilings, walls, and floors.

1. First, test your home for air tightness. On a windy day, carefully hold a lit incense stick or a smoke pen next to your windows, doors, electrical boxes, plumbing fixtures, electrical outlets, ceiling fixtures, attic hatches, and other locations where there is a possible air path to the outside. If the smoke stream travels horizontally, you have located an air leak that may need caulking, sealing, or weatherstripping.

2. Caulk and weatherstrip doors and windows that leak air.

3. Caulk and seal air leaks where plumbing, ducting, or electrical wiring penetrates through walls, floors, ceilings, and soffits over door and window frames.

4. Install foam gaskets behind outlet and switch plates on walls.

5. Look for dirty spots in insulation, which often indicate holes where air leaks into and out of the house. Seal holes in inconspicuous areas with low-expansion spray foam.

6. Install storm windows over single-pane windows.

7. Chimneys are a major source of air leakage. When the fireplace is not in use, keep the flue damper tightly closed. Install an inflatable chimney balloon to help seal the flue during seasons when the chimney is not in use. The balloons are made from several layers of durable plastic and can be removed easily and re-used for years. For safety, if the balloon should accidentally be left in place when a fire is started, the balloon will automatically deflate within seconds of coming into contact with heat.
8. Kitchen exhaust fan covers can keep air from leaking in when the exhaust fan is not in use. The covers typically attach using magnets for ease of replacement.

9. Replacing existing door sweeps and thresholds with ones that have pliable sealing gaskets is a great way to eliminate conditioned air from leaking out from underneath the doors. Take caution not to damage historic doors.

10. Fireplace flues are made from metal. Over time, repeated heating and cooling can cause the metal to warp or break, creating a channel for hot or cold air loss. Inflatable chimney balloons are designed to fit beneath your fireplace flue during periods of non-use.

Sources of Air Leaks in Your Home
Areas that leak air into and out of your home cost you lots of money.

1. Dropped ceiling
2. Recessed light
3. Attic entrance
4. Sill plates
5. Water and furnace flues
6. All ducts
7. Door frames
8. Chimney flashing
9. Window frames
10. Electrical outlets and switches
11. Plumbing and utility access

Source: http://www.energysavers.gov/tips/air_leaks.cfm
Energy Efficiency in Historic Buildings - Addressing the Building Envelope

The following are some of the most common improvements that assist in making a historic building more energy efficient and weather tight:

Weatherstripping & Caulking

Weatherstripping helps seal air leaks around movable joints, such as windows or doors. Foam or rubber weatherstripping should be applied to all doors and windows in a historic home. Weatherstripping should withstand the friction, weather, temperature changes, and wear and tear associated with its location. It should seal well when the door or window is closed while allowing it to open freely.

Caulking should be applied to any gap seen between window and door trim and the exterior of a house, the tops of doors and windows, and at other small cracks around the building’s foundation at the sill. A siliconized caulk will allow for some movement while retaining its integrity for many years. Gaps larger than 1/4” should first be filled with foam backer rod in order to provide a base for the caulk to adhere to.

The application of weatherstripping and caulking are considered basic maintenance and requires no administrative or Heritage Commission approval prior to their installation.

Insulation

Inadequate insulation and air infiltration are the top causes of energy inefficiency in homes. Many older homes have inadequate insulation in spaces like attics, crawl spaces, ceilings, garages, and basements. Proper insulation can help lower heating and cooling bills, and provide a sound barrier between interior spaces. There are numerous types, materials, and manufacturers of insulation. These include cotton or...
fiberglass batts, blown-in cellulose, foam board, and spray-on open and closed cell expanding foam, to name just a few. However, it is highly discouraged to pump or blow in insulation into closed wall cavities in historic buildings. Packing the cavities and limiting air flow does not allow building materials such as plaster walls, wood, stone, or brick to breathe. This lack of air flow can actually encourage the retention of moisture in the walls and can create a breeding ground for mold and mildew. Moisture retention in exterior walls can also cause exterior peeling of paint and the de-lamination of stone and brick.

**Insulation can be installed by the property owner or a qualified contractor with no administrative or Heritage Commission approval required.**

**When should insulation be installed?**

Introduce or add insulation when:

- There is little or no insulation in unconditioned, easily-accessible areas such as attics, basement ceilings, and garage walls;
- It is noticeably and consistently cold in the winter or hot in the summer;
- A new addition is added; and,
- Energy bills are consistently high in the summer and winter.

**Did you Know?**

It is estimated by the U.S. Department of Energy that only 20% of homes built before 1980 are well insulated.

Source: [http://www.energysavers.gov/tips/insulation_sealing.cfm](http://www.energysavers.gov/tips/insulation_sealing.cfm)
Mechanical Systems

The introduction of heating and cooling systems to areas not previously conditioned, may cause damage to the building both on the exterior and interior. Prior to the installation of new mechanical equipment, refer to an energy audit performed on the building or consult a professional heating and cooling contractor about your building’s specific heating and cooling needs in order to determine the size/capacity of mechanical units that will be required. Choose ENERGY STAR® equipment and carefully consider the placement of the new equipment on the building site so the equipment is not visible from the public right-of-way.

Windows and Doors

Historic wood and metal windows and doors typically have a good thermal rating (or U-value) to begin with, and are not the main cause of energy loss. Inadequate insulation and not sealing up gaps where air infiltration occurs are the leading causes for energy loss. Existing historic windows and doors are simple to retrofit for greater energy efficiency. Improvements may include the installation an additional layer of glass increasing single pane windows to double pane, and re-glazing. A larger investment may include the installation of storm windows or doors. Retrofitting windows with additional panes of glass and re-glazing both require no review or approval and are encouraged by the Commission.

Installation of new storm windows and doors, while appropriate, may affect the exterior appearance of the building from the public right-of-way. As a result, installation of new storm windows and doors requires administrative review and approval.

To further decrease drafts around doors and windows, framing around windows and doors can be carefully removed to accommodate the application of sprayed expanding foam. This project is best accomplished when the property owner is looking to restore original historic windows as trim pieces are often removed as a part of this restoration process. Please note that every effort should be made to retain the original trim around doors and windows. As with other basic maintenance, this treatment requires no review or approval.

If historic wood or metal windows and doors are no longer repairable, the installation of new windows and doors will be considered by the Heritage Commission on a case-by-case basis.
**Cold-Climate Window Tips**

- Install tight-fitting, insulating interior window shades on windows that feel drafty after weatherizing.

- Hang lined curtains. Close curtains and shades at night; open them during the day.

- Keep windows on the south side of the house clean to let in the winter sun.

- Install exterior storm windows. Storm windows can reduce heat loss through the windows by 25% to 50%. Storm windows should have weatherstripping at all movable joints; be made of strong, durable materials; and have interlocking or overlapping joints. Storm windows incorporating low-e glazing save even more energy.

- Repair and weatherize your current storm windows and doors.


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**Warm-Climate Window Tips**

- Install white window shades, drapes, or blinds to reflect heat away from the house.

- Close curtains on south and west-facing windows during the day.

- Install awnings on south and west-facing windows.

- Apply sun-control or other reflective films on south-facing windows to reduce solar gain.

## ENERGY EFFICIENCY

<table>
<thead>
<tr>
<th>Description</th>
<th>U-Value</th>
<th>Annual Energy Savings</th>
<th>Annual Savings per Window*</th>
<th>Simple Payback</th>
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<tbody>
<tr>
<td>Storm window over single-pane original window</td>
<td>0.50</td>
<td>722,218 Btu</td>
<td>$13.20</td>
<td>4.5 Years</td>
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<td>Double-pane thermal replacement of single-pane window</td>
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<td>625,922 Btu</td>
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<td>902,772 Btu</td>
<td>$16.10</td>
<td>34 Years</td>
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<td>Low-e glass double-pane thermal replacement of single-pane window with storm window</td>
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<td>132,407 Btu</td>
<td>$2.29</td>
<td>240 Years</td>
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*Estimated cost of Average 3’x5’ window, installed by a professional (discount per unit may apply to whole house)

**Assuming gas heat at $1.09/therm

Graphic by Susan Richards Johnson & Associates, Inc., 2011
For additional information regarding historic windows and doors please refer to these sources:


Site Improvements and Landscaping

A well-designed landscape can add curb appeal to a property and can also help to reduce heating and cooling needs. According to the U.S. Department of Energy, appropriately placed landscaping elements can provide real energy savings to property owners. On the average, the initial investment in landscaping materials is recovered in less than eight years.

Landscaping elements include shade trees, native shrubs, grasses, and groundcovering (plants which serve to keep the soil from eroding). For example, planting a large deciduous tree on the south and west sides of a house will shade the house in summer, and allow sunlight into the windows to help heat the house in the fall and winter. Proper selection of landscape elements which grow within the USDA Hardiness Zone for Missouri is critical. Native trees and plants to Missouri are always a good choice, for they are already adapted to the region’s climate.

Only the removal of mature trees is regulated by the Heritage Commission. The Commission encourages the introduction of historic landscape patterns, native plantings and mature trees on historic properties.