Energy Efficiency for Historic Buildings & Houses
Why Retrofit for Energy?

Retrofitting historic Main Street buildings for energy efficiency is critical to sustain the cultural and economic health of any community.
Why Retrofit for Energy?

In order to adaptively reuse historic buildings we must be able to cost effectively retrofit them with energy efficient systems so we can afford to operate them
Why Retrofit for Energy?

The good news is that this can be done while retaining important architectural integrity of the building and its historic elements.
Where to Start

When considering energy retrofits it is critical to first have the structure analyzed for its current energy footprint.
Where to Start

To start with, have an energy audit which includes blower door testing and infrared testing. Be sure to have an analysis of the existing HVAC system as well.
Air Infiltration

Excessive air infiltration is one of the primary energy loss aspects in historic buildings.

Stopping this is cost effective and as such, will deliver one of the biggest paybacks available.
Windows Realities

Typically windows comprise only 10% to 15% of the energy footprint of any historic building.
STOP
YOU NEED TO REPLACE YOUR WINDOWS IF...

- Your windows are 15 years or older.
  - New windows could save you over 20% per year on heating and cooling costs!*

- Your windows are difficult to operate.
  - New windows are easy to open, close and clean!

- Your windows are drafty or have cloudy glass.
  - New windows eliminate drafts, look great and add value to your home!

BEST SELECTION. BEST PRICES. PERIOD.
YOUR WINDOW EXPERIENCE STARTS HERE!
1930’s Movie Theater
Great Windows
2015 = Windows Gone
The two primary questions with any window are, what is the U-value and air infiltration?
Windows Realities

U-values are a calculation of how much energy passes through a one square foot area of a window in one hour.
Let the Numbers Convince You: Do the Math

**TUNE-UP STRATEGIES**

- **Storm window over single-pane original window**
- **Double-pane thermal replacement of single-pane window**
- **Low-e glass double-pane thermal replacement of single-pane window**
- **Low-e glass double-pane thermal replacement of single-pane window with storm window**

**ANNUAL ENERGY SAVINGS**

- **722,218 Btu**
- **625,922 Btu**
- **902,772 Btu**
- **132,407 Btu**

**ANNUAL SAVINGS PER WINDOW**

- **$13.20**
- **$11.07**
- **$16.10**
- **$2.29**

**SIMPLE PAYBACK**

- **4.5 Years**
- **40.5 Years**
- **34 Years**
- **240 Years**

*Cost of 3’ x 5’ window, installed
**Assuming gas heat at $1.09/therm

*U-Value: A measure of air-to-air heat transmission (loss or gain) due to thermal conductance and the difference in indoor and outdoor temperatures.

Source: Keith Haberern P.E., R.A.
Collingswood Historic District Commission
MISSOURI DEPARTMENT OF NATURAL RESOURCES
ENERGY CENTER - ENERGY LOAN PROGRAM
WINDOW REPLACEMENT WORKSHEET

Main Street  USA  6-11

To estimate the savings of replacing existing windows with efficiency upgrades, the following information must be known:

- The U-Factor of the existing window (See U-Value table below).
- The U-Factor of the replacement window (See U-Value table below).
- The total area of the windows being replaced (square feet).
- The heating energy cost ($/million Btu).
- The heating plant efficiency (in percent).

SAVINGS CALCULATIONS

1. Enter the U-Factor of the existing windows.......................... 1.44
2. Enter the U-Factor of the replacement windows.................. 0.55
3. Subtract line 2 from line 1 ........................................... 0.89
4. Add 0.68 to line 3 ...................................................... 1.57
5. Enter the total area of the windows to be replaced .............. 3.75
6. Multiply line 4 by line 5 .............................................. 10.59
7. Multiply 0.1 by line 6 .................................................. 0.53
8. Enter the heating plant efficiency (percent divided by 100) ...... 9.3%
9. Divide line 7 by line 8 .................................................. 1.23
10. Enter the energy cost ($/million Btu) .............................. $7.94

YEARLY SAVINGS

11. Multiply line 9 by line 10 ............................................ $794/year

PROJECT COST

12. Enter the total cost of the window replacement including material, labor and design ................................ $1,600

SIMPLE PAYBACK

13. Divide line 12 by line 11 .............................................. 204.08 years

WINDOW U-VALUE TABLE

<table>
<thead>
<tr>
<th>Window System Type</th>
<th>U-Factor*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Glass</td>
<td>1.10</td>
</tr>
<tr>
<td>Single Glass with storm window</td>
<td>1.50</td>
</tr>
<tr>
<td>Single Glass, low E coating</td>
<td>0.91</td>
</tr>
<tr>
<td>Single Glass, low E coating with storm window</td>
<td>0.44</td>
</tr>
<tr>
<td>Insulating Glass (double glass)</td>
<td>0.55</td>
</tr>
<tr>
<td>Insulating Glass (double glass) with storm window</td>
<td>0.35</td>
</tr>
<tr>
<td>Insulating Glass (double glass), low E coating</td>
<td>0.38</td>
</tr>
<tr>
<td>Insulating Glass (double glass), low E coating with storm window</td>
<td>0.32</td>
</tr>
<tr>
<td>Insulating Glass (triple glass)</td>
<td>0.35</td>
</tr>
<tr>
<td>Insulating Glass (triple glass) with storm window</td>
<td>0.25</td>
</tr>
</tbody>
</table>

* U-Factor values adapted from the 1985 ASHRAE Fundamentals Handbook.

Fig. 2. Many excellent worksheets are available for calculating payback of replacement windows; this one is produced by the Missouri Department of Natural Resources. Results of payback calculations often reveal grossly overstated claims. Courtesy of the Missouri Department of Natural Resources.
$20 and $60 worth of weather stripping and a $400 wooden, exterior storm window, with low-e glass, you can expect the U-value to go from the stated 0.44 down to a 0.34 to 0.40.
Windows Realities

Total restoration to safely remove old lead paint and putty as well as adding new weather stripping, should run between $750 to $1,200 for commercial and $450 to $700 for residential.
Original Windows Should Be Kept
Awnings

US Department of Energy says, "Window awnings can reduce solar gain in the summer up to 65% on south-facing windows and 77% on west-facing window."
Awnings

While every building is different and orientation to the sun varies, awnings can potentially save 10% to 25% on energy costs per year.
Masonry
Insulating Your Building

The idea is to make the building as energy efficient as possible while doing no harm to the structural and architectural elements.
Insulation over a brick thermal mass is a waste of money
HVAC
(heating, ventilation and air conditioning)

Have the existing heating and air conditioning systems inspected by a mechanical engineer before you make any decisions about replacing these systems.
Conventional Hot Water = 82%
Geothermal can work in urban environments
Energy Retrofit Case Study

Lamb-Munger
Circa 1859
521 Bird Street
Hannibal, Missouri 63401
Energy Retrofit Case Study
Energy Retrofit Case Study

- **Square feet:** 7,950.
- **Site:** Corner lot; Party wall on south
- **Construction:** Solid 3-brick thick, stone foundation, framed, hip roof
# Energy Retrofit Case Study

Circa 1859, Brick House, 7,950 square feet

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window restoration, $950 each x 42</td>
<td>$39,900</td>
</tr>
<tr>
<td>Weatherization &amp; plugging air infiltration</td>
<td>$5750</td>
</tr>
<tr>
<td>Cost of Geothermal system after 30% fed tax credit</td>
<td>$29,400</td>
</tr>
<tr>
<td><strong>Total energy retrofit costs</strong></td>
<td><strong>$75,050</strong></td>
</tr>
</tbody>
</table>

Original Gas & Electric annual cost ($1,621.17 p/m x 12) $19,452

Current Gas & Electric annual cost ($580 p/m x 12) $6,960

Gas & electric annual savings $12,492

Total years to payback energy retrofit investment = 6.01
Energy Retrofit Case Study

- **Original Use:**
  Commercial & residential

- **Work Began:**
  June 1, 2009

- **Work End:**
  90% complete-anticipated completion,
  June 1, 2014

- **Financing:**
  Commercial & private
Be an educated Energy consumer
Make The Point!

• *Retrofitting* historic houses & buildings for energy efficiency make them more affordable for building and homeowners to operate.
• *Historic* buildings can be made energy efficient, cost effectively.
• *Energy* retrofits around preservation are cost effective with fast paybacks.
• *Preserving* original windows costs less and is more energy efficient than replacement windows.
• Paybacks for window preservation run between 2 and 10 years
• *Paybacks* for replacement windows run between 34 & 240 years.
• *Air Infiltration* is the number one issue for energy efficiency.
• *Replacement* products are just that, products you have to replace over and over again.
• *Exterior* wall insulation is expensive and usually damaging to historic buildings.
• **Historic** masonry houses & buildings have a thermal mass that retains heat in the winter and cooling in the summer.
• *Exposed Brick*, unless it was a warehouse, is not a good energy choice.
Plaster Removed from Ceiling and Front Wall of a Loft
Plaster removed with new trim showing gaps at brick
Sustainability simply means doing good work that lasts.
• *Preservation* has been at the forefront of the “green movement” for 50 years.
• *Nothing* is more green or environmentally sound than an existing building.