



HERITAGE
WORKS



ENERGY EFFICIENCY IN HISTORIC HOMES

Guidelines for increasing comfort, saving money,
and preserving historic character



Your home is not just a roof over your head.

It should be a pleasant, inviting environment, and a place of privacy, comfort and enjoyment. For many, their home is also their most valuable asset; the result of years of savings and hard work. Protecting that investment is extremely important.

Protecting one's investment in a historic home brings along unique challenges. People choose to live in historic homes for a variety of reasons. In popular culture, historic homes are viewed as icons of the "American Dream," with the white picket fence, the front porch swing and the cozy hearth in the living room. Historic homes were built to last, incorporating expert craftsmanship and durable materials. No two historic homes are alike. Each has its own character and identity.

But historic homes also have the reputation of being energy inefficient and difficult to maintain. They are thought to have drafty windows, high maintenance building materials and small, compartmentalized rooms. In today's world, people have expectations for comfort and livability that are different from those of the original builder.

As a result, it is expected that an owner of a historic home will want to modernize his or her home and enhance its energy efficiency. However, it is important that the homeowner be aware that upgrades and alterations can be accomplished in a way that increases comfort, saves money and preserves the historic character of the home.

This publication is a resource for owners of historic homes when they are considering options for upgrading and enhancing the energy efficiency of their homes. It outlines an easy-to-follow process that can assist the homeowner in both assessing their home and determining which strategies make sense in enhancing energy efficiency.



A Historic Home's Character is Valuable

A historic home's character adds value to the overall worth of the property. It is likely a one-of-a-kind design and incorporates materials that are unique, durable and nearly impossible to replace. Enhancing your historic home's energy efficiency will add to its overall value. However, if the energy efficiency enhancements destroy or impair historic character in the process, it is possible that property value may decrease. With proper planning, energy efficiency upgrades to historic homes can be accomplished without negatively impacting historic character, maximizing property value.

HISTORIC HOMES ARE INHERENTLY ENERGY EFFICIENT

It is often said that “the greenest building is one already standing.” But what does that mean when it comes to a historic home? Most homes built in the 1800s and early 1900s were designed and built without central heating and cooling systems. They were constructed to retain as much heat as possible in the winter months and remain as cool as possible in the summer months. If done correctly, energy efficiency upgrades that incorporate a historic home’s inherently efficient design will result in a home that can be just as energy efficient as a new home.

Historic homes represent an accumulation of energy that went into extracting the raw materials, manufacturing the building products and constructing the home (also known as “embodied energy”). Maintaining a historic home and its materials saves the embodied energy inherent in the home. Choosing not to demolish the historic home to build a new home also saves energy expended in demolition and the embodied energy expended in building a new home. Additionally, maintaining a historic home keeps its building materials out of the landfill.

ASSESSMENT, THEN INVESTMENT

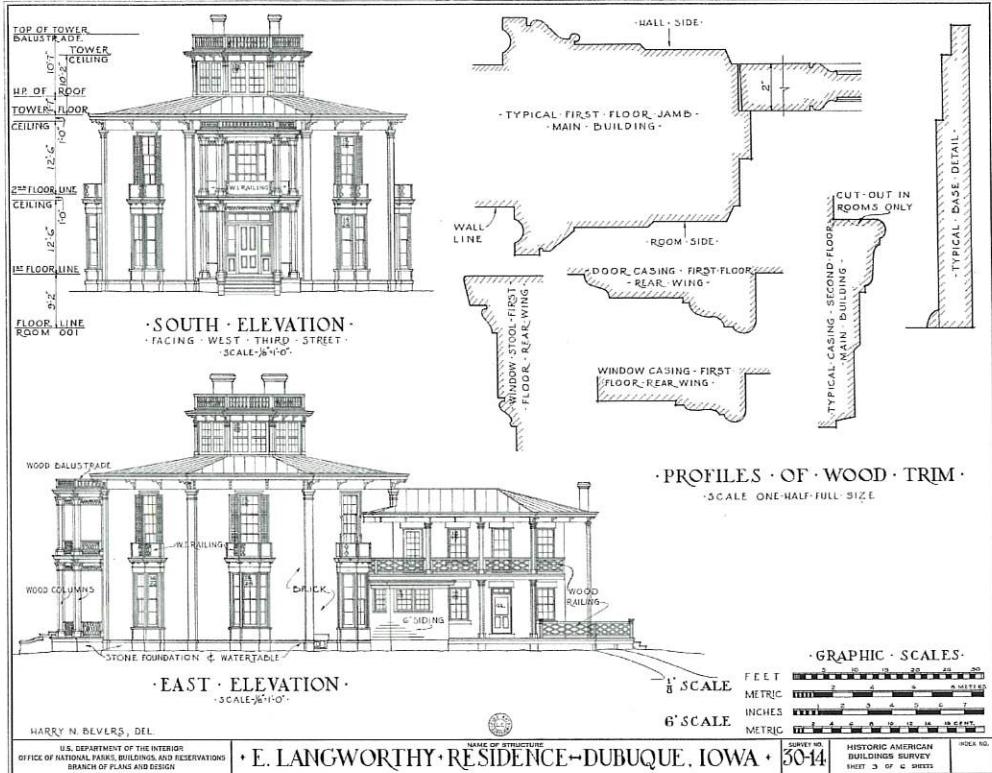
The goal of any historic home energy enhancement project should be to incorporate cost effective solutions while retaining the home’s historic character and value.

Before a homeowner begins any energy efficiency improvement project it is vitally important that:

- 1 The home’s historic character defining features are assessed and documented;
- 2 The historic home’s energy efficient design features are noted; and
- 3 A baseline of the home’s current energy usage is established by an energy audit.

Only after these assessments are complete should the homeowner begin energy enhancement investments.

Knowledge saves time and money!



A historic home has unique character. Assessing your home’s historic character before doing any work will minimize potential adverse impact on the home’s historic features.

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Assess your Home



What gives your home its character?

- Architectural style
- Windows and doors
- Chimneys
- Trim and detail
- Brick and stone
- Woodwork and plaster



Does your home have inherent energy efficient features?

- Existing storm windows and doors
- Porches and awnings
- Solid masonry
- Shade trees



What is your home's current energy use?

- A professional energy audit guides energy improvements
- An energy audit will establish a baseline that will help measure the effectiveness of energy enhancements

Knowledge saves time and money.

Making your home energy efficient while retaining its historic character enhances comfort, saves money and increases value



Enhance your Home



Reduce the Use

- Passive heating and cooling
- Appliances and lighting
- Programmable thermostat
- Close off unused rooms
- HVAC tune-up
- Use powerstrips



Seal the Envelope

- Seal gaps with caulk and weather stripping
- Fireplace and flue
- Add insulation
- Window and door repair



Upgrade!

- Add or replace appropriate storm windows and doors (exterior or interior)
- Replace boiler/furnace with an Energy Star model
- Add solar or geothermal power

ASSESSING A HOME'S HISTORIC CHARACTER

People are drawn to historic homes because of their unique features, distinctive character and charm. Character refers to the mixture of visual aspects and physical features that comprise the appearance of a historic home. Before doing any work on a historic home, it is important to identify the home's character defining features.

There is a simple 3-step process to assist in identifying a home's character-defining elements.

STEP 1

Identify the Overall Visual Aspects of the Home

- Architectural style;
- Shape, setting, environment;
- Roof and features (cupola, chimney, dormer);
- Projections from the house, such as porches and bay windows;
- Window and door openings (pattern, size, type); and
- Materials (brick, stone, wood, etc.).

STEP 2

Identify the Exterior Details

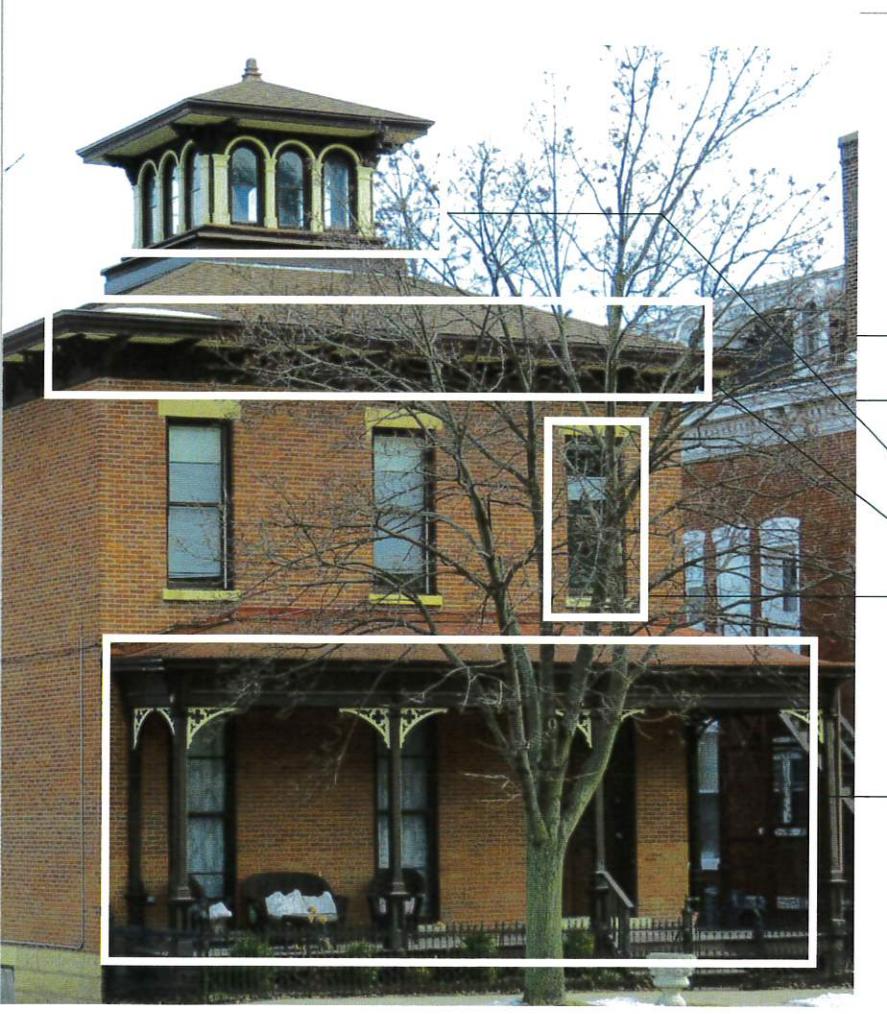
This step involves examining the home at close range:

- Surface quality of materials (texture and color); and
- Surface evidence of craftsmanship or age (evidence of hand-tooling of stone, hand-carved wood or stone, unique mortar joints).

STEP 3

Identify the Visual Character of Interior Spaces, Features and Finishes

- Spatial arrangements: How does the interior flow?
- What are the unique features of the interior? (mantels, light fixtures, moldings and casings, staircases, etc.)
- Are there any unique surface finishes? (parquet floors, pressed metal ceilings, grained doors, stencil painting, hand painted murals, etc.)



CHARACTER DEFINING HISTORIC FEATURES
1192 LOCUST STREET, DUBUQUE

ITALIANATE ARCHITECTURAL STYLE

BRICK MASONRY CONSTRUCTION

BELVEDERE CUPOLA

WIDE EAVES WITH WOOD BRACKETS

WOOD ONE-OVER-ONE DOUBLE HUNG WINDOWS WITH LIMESTONE SILLS AND LINTELS

WOOD PORCH WITH DECORATIVE BRACKETS AND COLUMNS



INHERENT ENERGY EFFICIENT DESIGN

Most homes built before World War II have numerous features designed to retain heat in the winter and expel heat in the summer. With the widespread adoption of central heating and cooling in the mid-20th Century, many of these features were either forgotten or altered. With knowledge of a home's inherent energy efficient design, a homeowner can incorporate existing efficiencies into planned energy efficiency enhancements. Design features to look for include:

Site Orientation

- More intensely used spaces are oriented to the south and west, to maximize natural light and heat gain in the winter.
- Deciduous trees provide shade in summer but admit winter sun when leaves have fallen.
- Evergreen trees provide year-round windbreak

Roof Overhangs

Large overhangs keep high summer sun off the walls while admitting the lower winter sun.

Porches

Provide summer shade and sheltered outdoor living space.

Massive Masonry Walls

- In winter, masonry absorbs heat from the sun during the day, releasing it at night.
- In summer, masonry absorbs heat from the sun slowly, so the interior stays cooler than midday exterior temperature. Stored heat is released at night when it's cooler.

Transoms

Provide natural light to hallways and vestibules.

Skylights, Clerestories and Dormers

Provide natural light and ventilation to top floor interior spaces.

Storm Windows

Provide additional protection from elements during winter months and prevent air infiltration.

ENERGY EFFICIENT DESIGN FEATURES

975 KIRKWOOD STREET, DUBUQUE





ASSESSING A HOME'S ENERGY PERFORMANCE

Many utility companies offer homeowners a free energy audit. It's always a good idea to schedule a utility company's energy audit before you start any work to make sure you pre-qualify for available rebates.

In Dubuque, both Black Hills Energy and Alliant Energy offer a free basic energy audit. Depending on what you learn from the free energy audit, it could be important to also hire a professional energy consultant to help guide your planning process for energy upgrades.

A professional energy consultant should be able to provide an analysis of your current energy use and make projections about energy savings from improvements to your home. You should look for someone certified by BPI (Building Performance Institute) or RESNET (Residential Energy Services Network).

Comprehensive energy audits (often called "Home Performance Assessments") should include diagnostics performed with a blower door, infrared camera, and gas analyzer. The blower door test will determine how leaky the home is and potential savings that could come from air sealing work. The infrared camera can see into the walls and identify areas that are missing insulation. The gas analyzer will check for any gas leaks and detect for potential carbon monoxide issues that could be a health and safety problem.



WHAT IS A "HOME PERFORMANCE" ASSESSMENT?

This type of assessment goes beyond just looking at energy issues in a house. Your house is a "system" with many interactions. Some energy improvements (like insulation) have the potential to increase hazards like moisture, carbon monoxide, and radon. A Home Performance Assessment will cover health and safety issues in addition to energy efficiency. Look for someone with professional certifications like BPI or RESNET.



The following chart shows an example of annual utility costs broken down for a typical 1,800 square foot house:

ELECTRICITY USE	
Air conditioning	\$200
Lighting	\$200
Clothes washer	\$200
Refrigeration/freezer	\$150
Television/cable/DVR	\$150
Computers	\$100
Dishwasher	\$100
Other electronics, etc.	\$100
Annual Electricity Cost:	\$1,200
NATURAL GAS USE	
Furnace	\$650
Water heater	\$250
Stove, dryer, etc.	\$100
Annual Natural Gas Cost:	\$1,000
TOTAL ANNUAL UTILITY COST: \$2,200	

The energy consultant may make upgrade recommendations that not only save a significant amount of energy and money, but also qualify for generous rebates from your local utility. Be sure to check your utility's website for the exact rebate amounts on upgrades like:

- Increased levels of insulation and air sealing work
- A new high efficiency furnace and/or air conditioning system
- A new water heater
- A new washing machine
- New LED lighting

In addition to advising you on energy improvements, a good consultant will also make sure you are aware of potential problems that could arise from making improvements. For example, some common recommendations might include:

- Addressing moisture issues in your basement
- Replacing knob and tube wiring before adding insulation
- Adding a powered vent to your water heater
- Adding a radon mitigation system

Use the information from your Home Performance Assessment to make the simplest efficiency improvements first.

Home Energy Score

Score

Home Facts

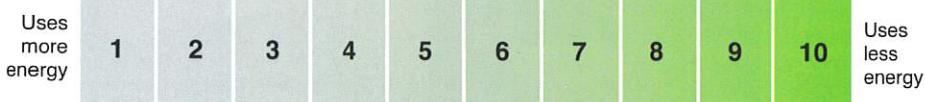
Recommendations

Address: 12345 Honeysuckle Lane
Smithville, AR 72466

Home size: 1,800 square feet
Year built: 1970
Air conditioned: Yes

Your home's current score **3**

Score with improvements **7**
Estimated annual savings **\$411**



There are a variety of energy audit reports used by utilities and energy consultants. The U.S. Department of Energy has developed a report called the "Home Energy Score" that can help guide homeowners in their upgrade decisions.



REDUCE THE USE

COMMIT TO ENERGY SAVING BEHAVIORS

There are a number of energy efficiency strategies that can be implemented for little cost and without impacting a historic home's character. You may already be doing some of these!

Utilize your programmable thermostat

According to the U.S. Department of Energy, you can save as much as 1% for each degree setback for a period of 8 hours. If you adjust your thermostat in the winter from 70 degrees to 66 while you're sleeping or at work, you can save about 4%.

Shut things off completely

Everybody knows they should shut their lights off when they leave a room, but many electronics don't completely shut off unless you actually unplug them. However, using a powerstrip is just like unplugging. Connect your television, cable box, and video game machine to a powerstrip and turn it off every night.

Take advantage of passive heating and cooling

Many historic homes were designed with operable transoms for natural ventilation when it gets warm. Ceiling fans help circulate air really well, too. When it gets cold, heavy drapes or blinds can cut down convective currents near windows. Make sure the windows are clear again to let through the warmth of the sun.

Care for your heating and cooling systems

Regular maintenance of your furnace and air conditioner can save you money while prolonging the life of the equipment. Be sure to change out your furnace filter on a regular basis. Clean your air conditioner's outside unit at least once a year by removing debris and spraying it down with a hose. Have a professional tune up your furnace and air conditioner before each season.

Close off unused rooms

Sometimes there are rooms that don't need to be heated and cooled as much as the rest of the house and can be closed off to save you money. However, it's important to keep your heating and cooling system properly balanced so consult a professional before just closing off all the vents in a room.

With a Wi-Fi thermostat you can control your heating and cooling from the palm of your hand and save money on your utility bills.

COMMIT TO MAKING LONG-TERM INVESTMENTS IN YOUR HOME

If your home is a hundred years old, chances are it is going to be around for another hundred years.

Pay special attention to the envelope

The "envelope" of your house is anything that is part of the barrier between inside and outside. Investments you make in envelope improvements like insulation and air sealing can reap rewards for many decades of energy savings and comfort. But beware of poorly designed solutions that can lead to mold and rot and contribute to unhealthy indoor air quality.

Use durable, traditional materials

Old growth wood, hardwoods, granite, slate, and terrazzo are all materials that add value to your home and last a long time, saving you money on replacement costs. Avoid removing old growth wood trim and replacing it with short-lived, wide-grained contemporary wood or vinyl. Especially consider restoring historic wood windows rather than replacing them with new windows.

Invest in high-efficiency equipment

High-efficiency equipment may be more expensive to purchase but will save you more money in the long run. Look for ENERGY STAR rated equipment and appliances. Rebates are typically better for higher efficiency equipment as well. Once you improve the envelope you may be able to replace the heating and cooling systems with smaller units that are less expensive to purchase and operate.





SEAL THE ENVELOPE

The biggest source of energy loss in most homes comes from “conditioned air” (air that has been warmed by a furnace or cooled by an air conditioner) escaping to the outside.

While many people immediately think of a drafty window or door, the majority of air is actually escaping through the attic. Most attics are intentionally vented so the air that’s moving from the house to the attic just flows right outside. A big part of what’s happening is called the “stack effect.” Air is coming into a house through a “leaky” basement and pressure caused by the stack effect moves that air upwards and out of the house through the attic.

Air Sealing

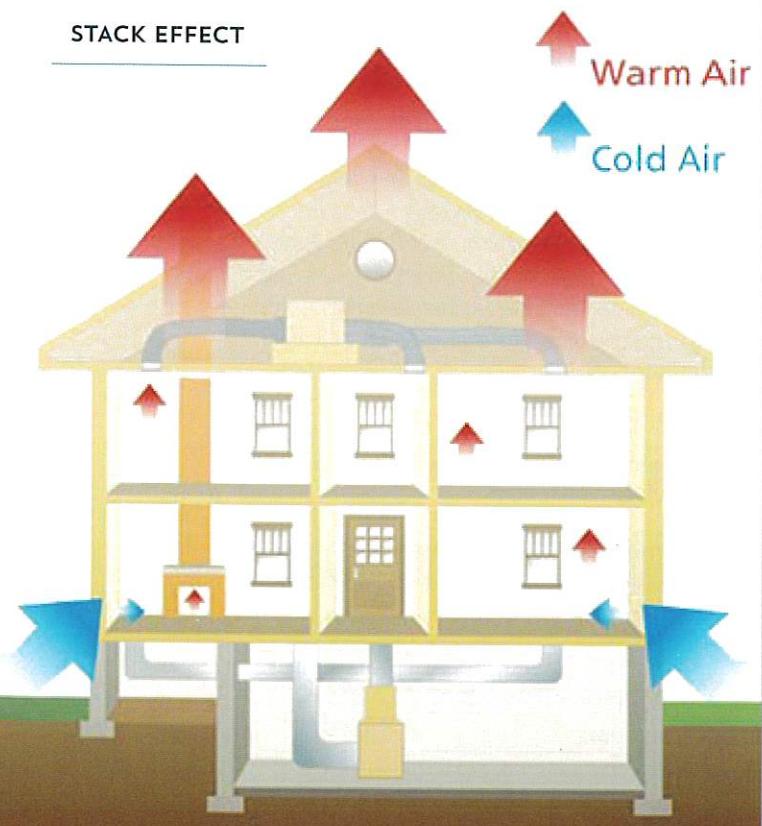
The best way to solve the problem of a “leaky house” is to seal all the cracks and openings in both the basement and the attic. This slows

down the stack effect and keeps conditioned air from escaping. The most common tool for doing this work (called “air sealing”) is a can of spray foam like Great Stuff. Larger openings can be blocked off with pieces of rigid foam. While you can tackle some of this work yourself, a professional contractor typically uses a blower door to accelerate the air flowing through the house to find all the holes to be sealed.

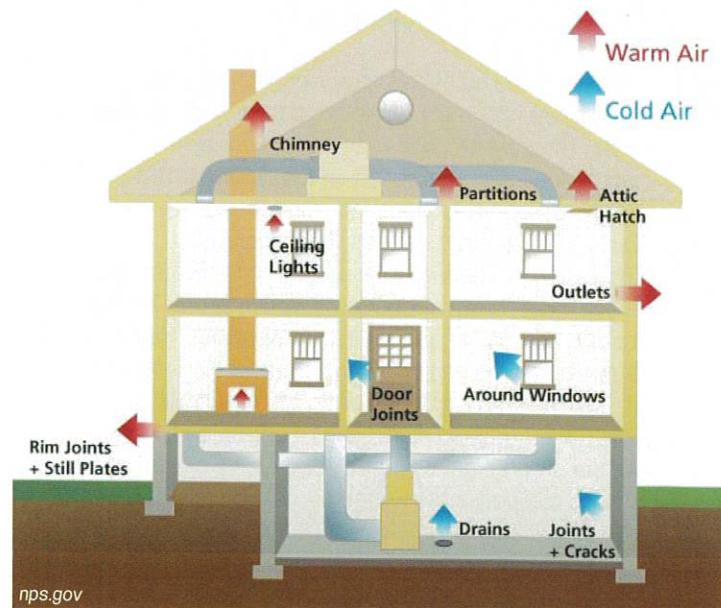
Common areas that need air sealing:

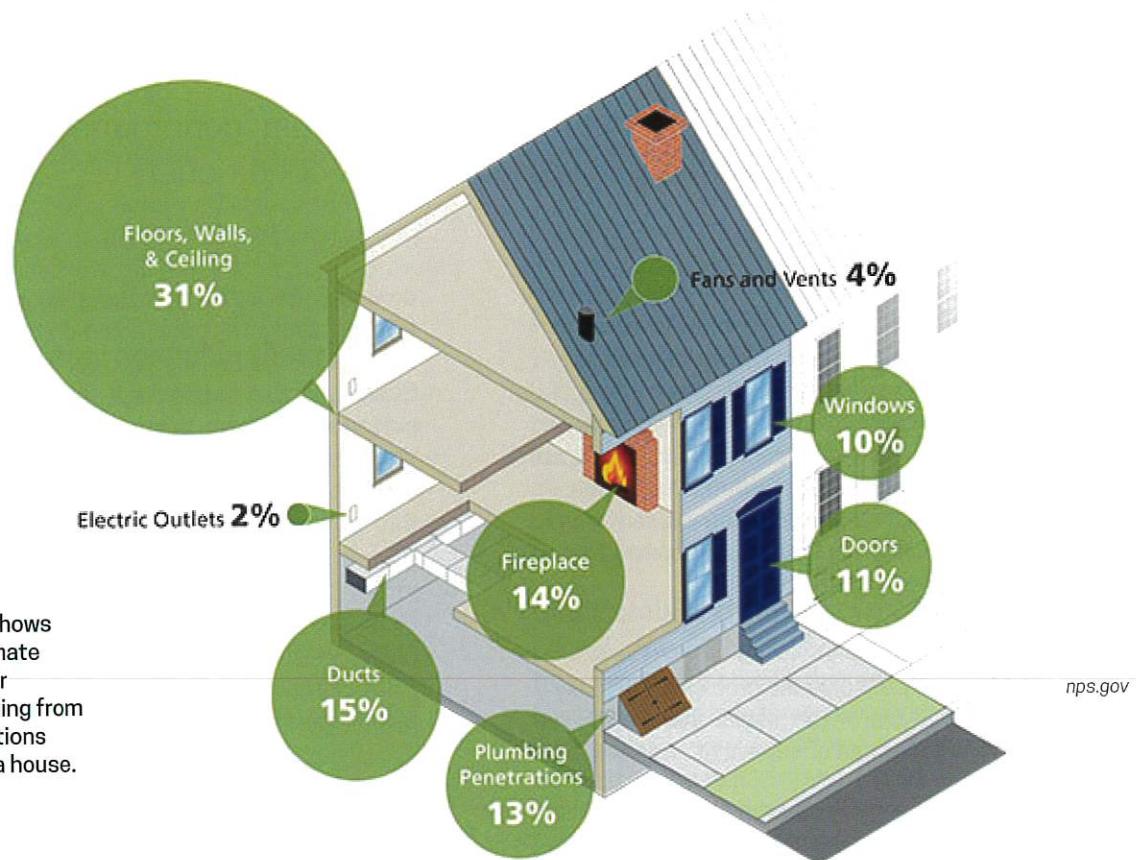
- Large openings in the attic along the outside walls
- Chimney through the attic (be sure to use appropriate materials on heated surfaces like chimneys)
- Attic hatch or entrance
- Can lights open to the attic
- Ductwork and piping penetrations in both the attic and basement
- Area along the top of outside basement walls (called sill plates)
- Outlets and switches
- Windows and doors

STACK EFFECT



INFILTRATION





This image shows the approximate amount of air leakage coming from various locations throughout a house.

Insulation

Insulation is also critical for heat loss, of course. It just isn't as effective if air is zipping around it through holes that need to be sealed. You can tell this is happening in areas where you see dirty insulation (it's working like a filter to catch the dirt while the air is just moving through it). Once the air leaks have been sealed, it's time to focus on improving the insulation levels.

Most historic homes were not originally insulated, so if there is currently insulation it was added much later. The current code requirement for attic insulation in new homes in a cold climate is R-49. This is most easily achieved by blowing in 15-18 inches of cellulose or fiberglass insulation. Insulation in a basement can be a little trickier, and if you have moisture concerns, you may only be able to insulate the areas that are above ground level. Insulating walls can also be difficult or not possible if there is knob and tube wiring still in the walls. The most common method is to drill holes and blow in "dense-packed" cellulose. One of the advantages of this method is the added air-sealing qualities of dense-pack cellulose. Newer technologies such as

spray-foam insulation have become popular in new construction, but are not recommended in historic homes, as they can create moisture issues.

It is also important to insulate pipes and ductwork. If there is ductwork running through an attic it should be wrapped with a minimum of R-5 insulation. Hot water pipes in a basement should be insulated (all pipes should be insulated if there's any chance of freezing) and the water heater tank should also be wrapped in insulation.

The following table lists some insulation R-values per inch for popular insulation materials:

INSULATION TYPE	R/INCH
Fiberglass batts, blown, board	2.4 - 4.4
Cellulose blown	3.0 - 3.6
Mineral wool batts, blown, board	2.4 - 4.4
Vermiculite or perlite	2.3 - 2.7
Expanded polystyrene (white)	3.6 - 4.2
Expanded polystyrene (blue/pink)	5.0
Polyisocyanurate board	5.6 - 7.6



Window Restoration

Original wood windows are the soul of a historic home. They are often the most important character-defining elements of a home. Typically made of old-growth lumber that is rot resistant, historic wood windows were built to last hundreds of years. Unfortunately, historic wood windows are often the first casualties of a poorly planned historic home rehabilitation project. As a result, historic character is irretrievably lost for little or no economic savings.

REPLACE HISTORIC WOOD WINDOWS ONLY AS A LAST RESORT

Homeowners often believe that just replacing their original single pane windows with new double pane windows will result in significant energy savings. However, studies have shown that only about 10-15% of a home's energy loss is through its windows. The U.S. Department of Energy estimates that windows are responsible for only 25% of a home's heating bills. Window replacement is one of the more expensive home renovation projects. Depending on the cost of a window replacement project, the National Trust for Historic Preservation estimates that the average payback period for replacement windows is 40 to 250 years. The average lifespan of a replacement window is about 20 years, far shorter than the payback period. Window replacement is usually a bad investment for a historic homeowner.

The greenest windows are the historic home's original windows. A good storm window combined with a restored single pane window is very close to the insulation value of a new double pane window.



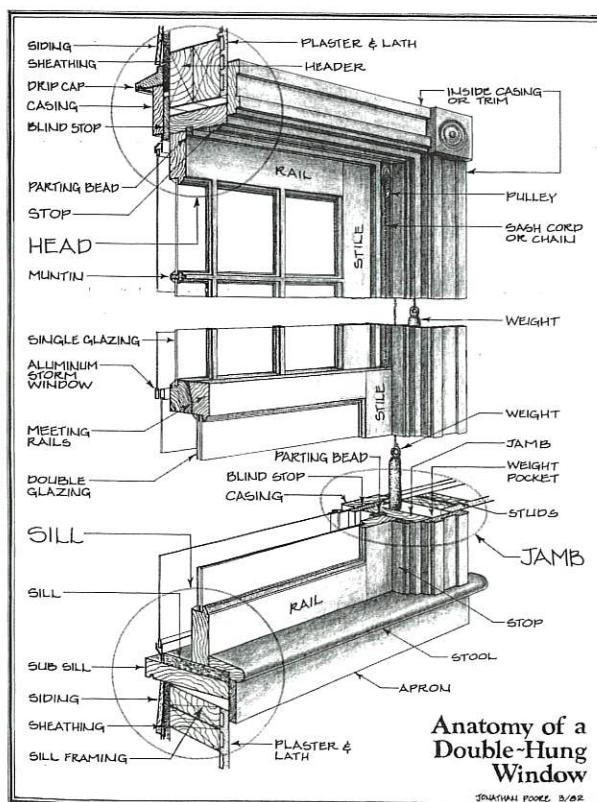
Windows are often the most important character defining feature of a historic home. A restored window with properly installed storm can be just as energy efficient as a new window.

What's more important for windows is that they are working properly and sealed to prevent drafts and moisture. Saving historic windows keeps their materials out of the landfill and saves the embodied energy both in the original window and that expended in the construction and transport of the replacement window.

When considering what to do with historic windows, all owners of historic homes should first consider restoring their original windows. There are many advantages to restoring instead of replacing your original wood windows:

- The original wood is much higher quality and long-lasting than wood used to manufacture windows today.
- Wood windows were constructed to be repaired. If one component fails, it can be repaired or replaced. If a component of a replacement window fails, the entire window must be replaced.
- Wood windows can be retrofitted with weather stripping, which increases the energy efficiency of the window.
- The cost of properly restoring original wood windows is usually less than the cost of new windows.
- The historic character of the home will be preserved.

When original windows MUST be replaced, be sure to choose a style and material that complements the home's original design.





UPGRADE!

Once you've sealed the envelope, it's time to consider upgrading the other energy consuming systems in your home.

Furnace

Especially in a cold climate like Dubuque, the furnace is the most important system to address. Forced-air, natural gas furnaces are the most popular and cost effective heating systems in this area. If your furnace is older than 12 years and not a high-efficiency (sealed combustion) furnace, you should consider replacing it. You should also make sure to consider improvements to the ductwork which can result in both significant energy savings and more consistent temperatures throughout the house. A professional energy consultant can help recommend the best improvements in this area.



A high-efficiency furnace includes a sealed combustion area that uses PVC piping for air intake and exhaust as shown in this photo.

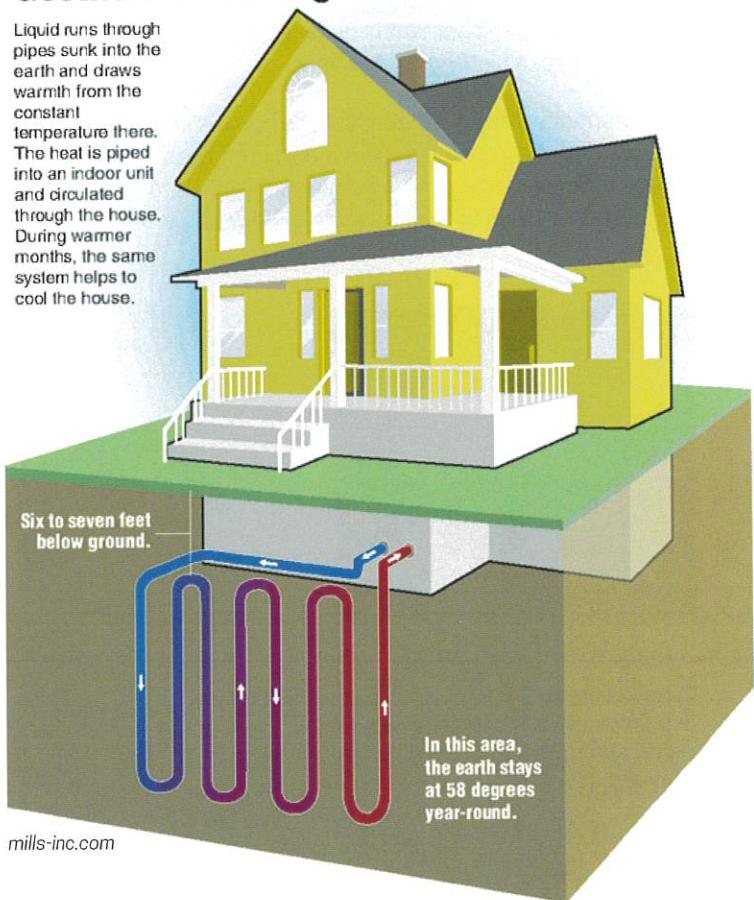
Geothermal

Another highly energy efficient heating source to consider is a geothermal system. These systems are all-electric and provide both heating and cooling. Some important factors when evaluating a geothermal system:

- Must have a tight, well-insulated house for it to be effective
- Must have a good area on property to drill the wells (not too rocky)
- Current air conditioning system is near end-of-life in addition to furnace
- Convert all gas-fired appliances to electric to eliminate gas bill completely

Geothermal heating

Liquid runs through pipes sunk into the earth and draws warmth from the constant temperature there. The heat is piped into an indoor unit and circulated through the house. During warmer months, the same system helps to cool the house.





Water Heater

Water heaters are another significant source of energy use. Like furnaces, natural gas is the most popular and cost effective fuel for water heaters in the Dubuque area. On-demand (or tankless) water heaters are more efficient than standard tank water heaters. One reason for this is that there are no "standby losses" from hot water sitting in a tank for long periods of time before it's used. If you were trying to go all-electric, a high efficiency option is a heat pump water heater that transfers energy from the surrounding air to the water in the storage tank.

Lighting

Compact Fluorescent Lights (CFLs) were a popular energy saving choice for many years, but LEDs are now the preferred type of energy efficient lightbulb. If your house is still filled with incandescent bulbs you will see a dramatic savings from converting to LEDs. An equivalent 60 watt bulb uses only 10 watts which means a savings of over 80%. LEDs also last much longer, with estimated life-spans up to 20 years. In recent years, the cost to purchase these blubs has decreased significantly, and there are many more options to choose from.

Appliances

The main appliances you should consider for energy savings potential are your refrigerator, clothes washer, and dishwasher. Always look for ENERGY STAR rated appliances and for even better savings consider products listed as "ENERGY STAR Most Efficient 2016." You can search for products at the www.energystar.gov website.

Solar

Once you've completed all the possible energy efficient upgrades on your house, consider if adding a solar system might make sense. State and Federal tax credits make solar a very attractive option right now. Some important factors when evaluating a solar system:

- Roof was recently replaced or needs to be replaced.
- Good area of nearly south-facing roof.
- Able to be set back far enough from front of house (as described in the City of Dubuque's Architectural Guidelines).

REDUCED UTILITY COST BREAKDOWN

The following table shows a 25% overall reduction in annual utility costs compared to the pre-retrofit table shown on page 9.:

ELECTRICITY USE

Air conditioning	\$180
Lighting	\$80
Clothes washer	\$140
Refrigeration/freezer	\$120
Television/cable/DVR	\$120
Computers	\$80
Dishwasher	\$80
Other electronics, etc.	\$100
Annual Electricity Cost:	\$900

NATURAL GAS USE

Furnace	\$450
Water heater	\$200
Stove, dryer, etc.	\$100
Annual Natural Gas Cost:	\$750

TOTAL ANNUAL UTILITY COST: \$1,650



The experience of living in a historic home can be greatly enhanced when the homeowner makes energy efficiency improvements. Assessment of the home's historic character, its already existing energy efficient features and the home's existing energy use prior to completing any energy efficiency improvements will assure that the home's historic character is minimally impacted and that the homeowner's money is spent wisely.

The Energy Efficiency in Historic Homes: Guidelines For Increasing Comfort, Saving Money and Preserving Historic Character provides a framework for owners of historic homes when contemplating energy efficiency enhancements. These guidelines are not intended to be a thorough manual of practice for complete energy upgrades of historic buildings.

For more information, visit www.heritageworksdbq.com, or contact us at info@heritageworksdbq.com.



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