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Creating Energy Efficient

Main Streets Guide

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MARKS, THOMAS ARCHITECTS

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Contents

Acknowledgements

Main Street Iowa, a program housed within the Iowa Economic Development Authority (IEDA), works to improve the social and economic well-being of Iowa's communities by capitalizing on their unique identity, assets and character of their historic commercial districts. Main Street is a comprehensive historic preservation-based economic development approach to revitalizing traditional commercial districts developed by the National Trust for Historic Preservation.

IEDA's Green Streets Initiative continues to position the State of Iowa to be a leader in sustainable development by providing the opportunity for Iowa communities to take advantage of emerging technologies and information as more communities and private entities emphasize "going green". This initiative includes providing training resources to local Main Street programs to better understand how sustainable practices can be implemented in historic commercial districts, including the *Creating Energy Efficient Main Streets* training project with the Lakota Group and Marks, Thomas Architects. IEDA has also created the Iowa Green Streets Criteria to apply to a variety of IEDA-funded projects, which can also serve as an informational guide on incorporating energy efficient and sustainable practices into Main Street projects.

The Lakota Group is multi-disciplinary planning firm that was contracted by the IEDA to deliver the *Creating Energy Efficient Main Streets* training program, including workshop sessions with eight Main Street communities and creation of this guide. With over 18 years of sustainable planning and urban design experience, the firm's approach is reflected in its name, "Lakota", which is a Native American word meaning "allies". Lakota professionals share a strong respect for the land and built environment, a sense of community, and a desire to bring people together to work together as allies for positive change. Lakota's professionals bring extensive expertise in planning, historic preservation and Main Street revitalization, landscape architecture, and urban design and community relations. Lakota partnered with Marks, Thomas Architects of Baltimore, Maryland to develop and deliver the training services. Marks, Thomas Architects provides specialized services in sustainable design, architecture and historic preservation with an extensive portfolio in commercial and institutional projects, including the adaptive use of historic buildings. The firm is proud of the ongoing relationships with its clients it has developed through four decades of service and its ongoing commitment to innovative design and sustainable environments.

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I. Introduction

The *Creating Energy Efficient Main Streets Guide* as been developed to provide information to local Main Street Iowa communities regarding energy efficient design approaches and techniques to historic commercial building rehabilitation. These techniques comprise leading practices in green building preservation with an aim to adapting such buildings with the latest energy efficiency technologies while preserving and maintaining their important historic features and character. Energy efficiency improvements presented in this guide focus on basic techniques, such as weatherization of a building's exterior envelope, insulation options, and foundation improvements. Proper application of these sustainable design features can help property and business owners save on energy costs while reducing a Main Street district's overall reliance on non-renewable energy sources.

In addition to energy efficiency strategies, this guide also provides recommendations on revising Main Street design guidelines, zoning codes and planning policies. Design guidelines often serve as an important educational tool for Main Street Design Committees when working with property owners and merchants and should incorporate new guidelines on how to balance energy efficiency improvements with sensitive rehabilitation of historic commercial building facades and storefronts. Zoning and planning policies often present barriers to facilitating improvements within a district and should be reviewed and revised to help achieve a community's energy efficiency goals.

The guide should be distributed, at a minimum, to all Main Street board members and Design Committee volunteers, the local city council, relevant municipal staff, property and business owners in the district, and other important stakeholders. It is also recommended that all Main Street board members and Design Committee volunteers read the guide, discuss its recommendations, and develop or adjust their current work plans accordingly to implement specific action steps and strategies related to design assistance, design guidelines, planning policies and zoning codes.

A blockface of commercial buildings.

II. Inherent Sustainable Building Design Features

Historic commercial buildings with several inherent sustainable design features visible.

Historic buildings are inherently green and their preservation and rehabilitation should be a key component to every community's sustainability efforts. In traditional historic commercial districts, buildings were designed and constructed with many environmental features in an era where such buildings had to operate on modest energy budgets. For instance, retractable awnings shaded storefronts from the summer heat while concrete floors and thick masonry walls kept cool air inside. Storefronts with large expanses of glass were not only designed to showcase an array of merchandise to shoppers and pedestrians but also allow natural light to shine through the store. Ceiling fans were common interior elements that circulated air. All such features were needed in a time during the mid 1800s to the early 1900s, when artificial illumination was expensive, daylighting was free and air conditioning had not been invented. When a property owner plans for building rehabilitation and energy efficiency improvements, consideration should be given to maintaining and enhancing such features.

Building Materials

Buildings constructed with locally quarried sandstone.

Most historic Main Street commercial buildings were constructed during the 19th and early 20th centuries with durable materials, such as stone, brick and dense hardwood, that were meant to stand in place and last for decades or even centuries. Such materials were also derived locally, from quarries and forests, or purchased from local merchants and lumber yards. They did not have to travel far from where they were bought to the site of building construction, as opposed to today where many materials are imported from other countries. Existing building materials also represent "embodied energy" — the energy that it took to manufacture the material, to transport it and what was used to construct the building itself.

Party and Masonry Walls

Thick masonry walls were common for most historic commercial buildings before the advent of air conditioning and electrically powered HVAC systems.

In Main Street districts, most commercial building dimensions ranged from 20 to 40 feet storefront widths to 100 to 150 feet building lengths that shared thick party walls with the buildings adjacent to it. Shared party walls conserve heat by limiting heat loss by conduction, which is the movement of heat through a building material. Additionally, historic commercial buildings were often designed with thick masonry walls to help in interior temperature regulation. Such walls trapped heat inside during winter months while maintaining cooler temperatures during warmer months.

Windows

Operable windows can help reduce energy bills by facilitating air circulation from the exterior to the interior.

Windows in upper façades in particular were originally designed to be operable so that both sashes could be moved to circulate air to a building's interior. For example, opening the top sash of a typical double-hung window allowed warm air to circulate outside from the interior ceiling. Opening the bottom sash of window on a shady side of room allows cooler air to circulate inside. This air circulation pattern can be aided by ceiling fans. Maintaining the operations of such windows can certainly help in lowering air conditioning bills during the summer. Skylights provide natural light into a building, which could save on lighting costs.

Retractable awnings and recessed entranceways provide several energy efficiency benefits.

Storefront Features

Original storefront features provide significant energy efficiency for Main Street commercial buildings if they are maintained. Over the decades, in some cases, transom windows were often taken out or covered over during insensitive storefront remodelings. It is recommended that transom windows be reinstalled in storefront rehabilitation projects if documentation shows that such windows existed prior to the remodeling. Transom windows allow sunlight to infiltrate a building's interior, providing heat as well as illumination. Some of the heat is absorbed in the building flooring, which may be radiated back into the interior space as the building cools in the late afternoon and evening. Retractable awnings can be rolled up above transom windows during winter months when sunlight and heat is desired into the building and rolled back down over them when shading and cooling is wanted during the summer. Recessed entranceways, where the storefront entranced is set back from the sidewalk, help to prevent cold or hot air from entering a business when the storefront door is opened.

III. Building Envelope Improvements

Improvements to a historic commercial building's envelope, including its walls, roof, doors and windows are the starting points for achieving energy efficiency. The following section discusses the "weak links", or where energy is lost in a historic commercial building, and how certain improvements can enhance energy efficiency and lower energy costs.

Basics of Energy Transfer

Energy (heat) can be transferred three ways: by conduction, convection and radiation. Conduction is the movement of heat through a material, as when heat is lost through an exterior wall in the winter. Convection is the movement of heat through air movement, as warm air rises and cold air falls in a room. Radiation is the transfer of heat without direct contact or through solids, liquids and gases, as when the summer sun hits a dark roof and one can "feel" the heat coming through into the building's upper floor.

The goal of building envelope improvements is to reduce all three types of heat transfer. Heat can be lost, or gained, through any exposed surface and that the rate of heat transfer is tied to the temperature difference between inside and outside. What this means is that one can lose or gain heat through all exterior building elements — roofs, wall, windows, doors and floors.

The entire building envelope includes building walls, roof and foundation.

Before undertaking a comprehensive building rehabilitation project it is a good idea to understand where the "weak links" in the building envelope are and how a building consumes energy, in order to prioritize where improvements should be made. Consulting a local architect, energy modeler, mechanical engineer or energy consultant is an excellent idea.

Roofs

Starting from the top down in a building, the first thing to consider and examine is the roof. In unimproved low-rise commercial buildings, roofs are frequently the largest source of heat loss. There are many variables to consider when studying a roof that are beyond the scope of this guide, such as repair versus replace, type of roofing system, life-cycle cost, etc. However, the two primary considerations from an energy efficiency perspective are insulation and color.

A "cool roof" and green roof (photo courtesy of Susan Stamats, Cedar Rapids).

When re-roofing, it is better typically to specify a light-colored or "cool roof" instead of a dark colored one, as the unwanted heat gained during the cooling season is usually greater than the desired heat gain through the roof during winter. In general, when selecting roofing materials, select light colored or highly reflective materials. New single-ply membrane low-slope roofs should be light-colored or white to reflect summer sun and reduce the urban heat island effect. Pitched roofs should be sheathed in spectrally-selective roofing that may have a color in the visible spectrum but is highly reflective in the infrared and ultra-violet portions of the electromagnetic spectrum. Green roofs, when appropriate, provide both heat load reductions and storm water control.

Example of composite shingles, which are available in different colors.

Light colored roof systems can also have a greater lifespan since the reduced temperature differential reduces thermal stresses on the roof assembly. Dark roofs can heat up to nearly 200 degrees Fahrenheit while light roofs may only heat up to 120 degrees, if the interior temperature is conditioned at 75 degrees Fahrenheit or so. In reducing the heat gain through a roof assembly, not only is one lowering the thermal stress of the roof assembly, but also the heat gain that can be radiated into the building interior, which translates directly to reduced mechanical loads. It can also translate into potentially significant financial savings for the building owner.

- *Sloped Roofs.* Sloped roofs can be composed of many materials, including wood shakes, slate, clay tile, metal, and most commonly, asphalt or composite shingles. Insulation is typically installed below the roof deck within the attic or joist space. Although insulation can be installed on top of the roof deck, or below the shingles, this can lead to odd roof profiles and terminations at eaves. When selecting an appropriate roof for a historic commercial building, one should look for physical or photographic evidence. Once a material has been selected, there are some sustainable alternatives. Metal roofs and composite shingle roofs are also available as "cool roofs". Although these roof systems have color that is visible to the eye, they are highly reflective to the infrared and ultra-violet ranges of the spectrum and therefore do not heat up as much as other systems, as most of the solar radiation is reflected rather than absorbed.

Maintaining original roofing materials, such as standing seam copper (above) should be a priority. If replacement is necessary, metal roofs can be ordered with "cool roof" reflective coatings.

Green roofs can provide energy efficiency savings. Buildings with minimal sloped roofs and adequate parapet walls and structural load capacity can be ideal candidates for green roofs. - photo courtesy of gbNYC

- *Flat Roofs.* Flat roofs will typically have either a built-up or single-ply membrane roof over rigid insulation over the roof deck. When reroofing, one can install additional polyisocyanurate or polystyrene insulation. Polyisocyanurate insulation has better thermal performance (a higher R-value per inch), but is usually more expensive than polystyrene insulation. As for material selection, a white TPO (thermoplastic olefin) or PVC single-ply roof is preferable to a black EPDM roof. Furthermore, a modified bitumen roof with a light-colored cap sheet is preferable to a dark cap sheet or hot-mopped asphalt built-up roof system.

- *Green Roofs.* In many situations green roofs are an excellent alternative. Green roofs can provide significant energy efficiency benefits including reduction in air conditioning needs and a reduction in a roof's solar heat gain. While green roofs can be installed on up to a 7:12 pitch, roofs with minimal slope are typically better candidates, both in terms of stability as well as visibility – green roofs could be viewed as altering character defining elements on an historic building. Property owners should consult with a local structural engineer if interested in pursuing a green roof to determine if a building has the necessary structural load capacity.

Walls

When contemplating how to improve a wall's energy performance, it is important to pay careful attention to building physics. Remember, it is not just conduction, but convection and radiation as well that can affect how a wall performs.

While it would appear clear that adding insulation should help the thermal performance of a structure, what may not be as apparent is the importance of reducing air infiltration as well. Air and moisture can move through an apparently solid wall, migrating through small gaps and cracks in the wall. In addition, as air moves through the wall it carries heating, or cooling, with it, forcing the building mechanical system to make up for this lost energy.

Before adding, or making any changes to the insulation in a building, it is critical to understand how much moisture moves through the wall. One way to control this movement is through the use of a vapor barrier, which is typically a plastic or foil sheet that resists the diffusion of moisture through a wall. If air movement is allowed through the wall assembly, it is possible for the condensation point for warm, moist air to fall somewhere within the wall cavity. If this happens with certain types of insulation, such as open cell foam or batt insulation, it is possible the moisture will condense within the insulation, severely compromising the materials thermal properties and setting up the potential for mold or mildew forming within the wall assembly. However, installing new vapor barriers may not be practical for historic buildings since wholesale removal of interior finishes may be necessary. A vapor retarder, in the form of latex paint, or two layers of appropriate oil-based paint, can help slow the infiltration of moisture from the building interior into the wall assembly. Spray foam and dense-pack cellulose insulation can also provide a measure of vapor retarding as well.

When planning an insulation installation, one must consider the insulation's R-value, which is the insulation's resistance to heat flow. The higher the R-value, the greater resistance there is to heat transfer. In addition, the density of the insulation can also have an impact on R-values. Higher density insulation can provide significantly up to 35 percent more insulating value than standard insulation materials discussed below, although the cost may be higher. There are a dizzying variety of insulation systems that can be incorporated into older structures.

Each type has its own positive and negative attributes; the challenge is to select the correct insulation for a specific application and budget. The selection of a specific insulation system should be based on several criteria: what is to be insulated (walls, ceilings or floors), the type of wall assembly and accessibility to the wall cavity, and budget. If existing exterior and interior finishes are to remain on an exterior wall, a series of small holes (one per stud cavity) can be drilled, spray foam or cellulose insulation injected into the wall cavity, and the holes are patched. Insulating attic spaces can be more easily accomplished with blown in or batt insulation.

- *Closed and Open-Cell Foam.* Closed-cell foam insulations tend to perform well, with an R-value >6 per inch typically. Generally, foam insulation should not be directly applied to exposed masonry walls or sprayed into wall framing built adjacent to existing walls. Foam insulation is best used for insulating typical air infiltration area, including vents, chimney joints and conduit penetrations. Such insulation tends to be denser, weighing 1.75-2.25 pounds per cubic foot, with very low vapor permeability. Closed-cell foam also tends to be more rigid and expensive than similar open-cell foams. Open-cell foam insulations have lower density than closed-cell insulation, with density hovering in the 0.4-1.2 pounds pre cubic foot range. They can provide an air barrier when installed to the depth of the wall, however these foams do have a higher vapor-permeability than closed-cell foams, therefore it is very important to study the potential condensation points in a wall assembly to confirm that water vapor will not condense within the insulation. These foams tend to be lighter, more flexible and less costly than closed-cell foams.

Closed cell (above) and open cell (below) foam insulation.

- *Fiberglass*. Fiberglass insulation comes in either batt or blown-in form. With a proven track record, fiberglass is still the first choice of many owners and contractors. With an R-value of 2.5 per inch for blown-in fiberglass to 3.5 for fiberglass batts, fiberglass has a thermal efficiency similar to that of open-cell foam or cellulose. However, there are several concerns regarding fiberglass that should be taken into consideration. Fiberglass does not provide an air barrier, and with high vapor permeability can allow moisture to condense within the insulation, compromising the thermal efficiency and creating conditions suitable for mold growth. While easy to install, batt installations can have gaps that allow for thermal bridging and a reduction in thermal efficiency. Fiberglass is best used for insulating attics, floor joists and in new wall framing built adjacent to existing walls. Fiberglass should not be used between roof rafters if the attic space is vented.

Fiberglass (above) and rock wool insulation (below)

- *Cellulose*. Blown-in cellulose is an increasingly popular type of insulation. Composed of wood fibers (frequently recycled shredded newspapers) mixed with borate as a preservative, cellulose provides an R-value of 3.5 to 4.0 and can serve as an air-barrier, especially in its dense-pack form. Cellulose is best recommended for non-occupied spaces and in new wall framing adjacent to existing walls. It should not, however, be applied directly to masonry walls.

- *Rock Wool/Mineral Slag*. Rock wool and mineral slag are produced from blast furnace slag and natural rock and comes in a variety of forms – loose, batt and rigid boards. With an R-value of 2.8-3.7 this material has insulating properties similar to open-cell foam, cellulose and fiberglass. The material is inert, does not absorb water and offers good resistance to flame spread.

Doors + Windows

It is important to view wall systems comprehensively — a wall is as efficient as its weakest element. It does not make sense to make a significant investment in the thermal performance of a wall, only to see all of the energy savings flow out through poorly maintained doors and windows.

Historic windows and doorways should be kept in good condition and not removed. All doorways and windows should be checked for air infiltration and weatherstripped and sealed accordingly.

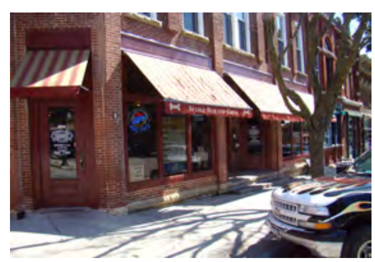
- *Doors* – one of the simplest tests for a door is to look at the door from the inside during the day. If daylight can be seen anywhere around the door's perimeter, energy is being lost and weatherstripping should be considered. If additional evidence is needed, a blower door test can be performed to study the air loss from around the door.

- *Windows* – It is critical to remember that older, historic windows do not need to be replaced to create an energy efficient building. All too often, perfectly good windows are removed in the name of energy savings, while the truth is that with a few minor adjustments and repairs to reduce the air infiltration around the window's sashes and proper sealing of the frame, old windows, combined with a storm, can be as efficient as new insulated windows — at a fraction of the cost while maintaining this charm of the historic windows.

As noted above, the first step in energy upgrades to windows and doors is to ensure that the units close tightly, all weather stripping is in place, and that the surrounding frame is sealed as well. These simple measures can dramatically reduce the air infiltration through and around windows and doors, lowering the heat loss/heat gain from the units. Storm panels can be added to the interior or exterior of windows and doors that can bring the energy performance of an existing original feature up to par with a new unit, with the added benefits of authentic material and repairability. If existing windows are missing or too badly damaged to repair, then consider replacing the windows with a similar material such as wood for wood, steel or aluminum for metal. Frames should be thermally broken to reduce direct transmission through the frame. A thermally broken window consists of a two-piece frame that is separated by an insulating material such as poured urethane. This material helps slow cold air from flowing from the outside to the inside of a frame during winter. Double or triple-paned insulated glazing or glass units can also be considered with a low-emissivity coating and filled with an inert gas such as argon, if possible. A glass unit comprises the part of the window frame that is covered by glass.

Awnings + Canopies

In the blur of new technologies, it can be easy to forget time-tested, simple measures that can help save energy. Awnings and canopies, when appropriate to the building, can all be utilized to reduce solar heat gain during the cooling season by shading the building interior from direct sun. Canopies should be sized to allow low-angle winter sun to shine into the building and heat the interior surfaces. Operable awnings can be retracted during cooler months and even be furled in the evening to provide better views into storefronts once the sun has gone down. Other simple measures can also help cut energy loads such as using blinds or shades in windows to reduce solar loading and installing ceiling fans in high-bay spaces to provide air movement during the cooling season and force warm air down to occupied zones during the winter months.



Retractable awnings are ideal since they can be rolled up during the evening to allow radiant cooling during the summer, although fixed ones are suitable. Fixed canopies should be maintained at a shallow slope to allow enough light into the storefront.

FOUNDATIONS

While it can be easy to not notice heat lost through ground, which may typically be 55 degrees Fahrenheit in the middle of a cold Iowa winter, the floor plane can still be a potential source for energy savings, especially over crawl spaces that are partially above grade. The following actions are recommended to improve energy efficiency for a building's foundations.

- *Slab on Grade.* With an existing concrete slab on-grade, there is not much that can be done to minimize some heat transference to the ground unless the entire slab is removed and replaced. There will be a continuous transfer of heat to the soil below regardless. However, the perception of cold floors can be mitigated through the selection of flooring materials that can offer some insulating properties, or at least not "feel" cold, or if a new floor is to be installed on top of the existing slab, a radiant heat system can be installed. If by chance a new slab is called for, then rigid insulation should be installed beneath the new concrete slab.

- *Crawl Space.* Crawl spaces provide a challenge — they are frequently difficult to access and with code requirements for ventilation, a significant amount of heat can be lost through a floor over a crawl space. Insulation can be installed below a floor to isolate inhabited space from the crawl space. When doing so, one should make sure that no piping or ductwork protrudes below the insulation membrane. While pipes can freeze, what is not as obvious is the amount of energy that can be lost through improperly insulated ductwork in a crawl space. As with slab on grade conditions, a radiant heat floor system can be one way to keep floors from feeling cold.

- *Basement.* When considering improvements to basement areas, one can install insulation along the perimeter walls if they are to be furred out. Rigid foam insulation can be a good choice at these locations since higher R-values per inch of insulation can allow for shallower furring studs. Rigid foam insulation is also less likely to be affected by moisture that may be present around foundation walls. What is important to recognize is the gap formed where floor joists bear on top of a foundation wall. It is important that this area receive insulation, or else a gap will be allowed for a thermal break in the building envelope with significant energy loss as a result.

IV. Energy Systems

HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

There are a variety of HVAC systems available that can dramatically reduce energy consumption in older buildings. It can be a daunting and complex process to select the appropriate mechanical system and to meet the unique size and use of a specific building. It is best to consult with a local mechanical engineer, contractor or architect who can help identify the right system for a specific project. One should also consult with the local utility to confirm if there are any incentive or rebate programs available through the utility.

When selecting a system, one should consider the initial cost of installation, the lifecycle operating costs (what is the payback), ease of retrofitting in existing buildings, access to district energy systems, and the availability of tax credits and other government incentives at the local, state and federal levels. The sizing of the heating and cooling equipment can improve efficiency and ensure adequate humidification, preventing short-cycling that can lead to excess moisture in the air, which can cause mold growth. All duct work should be sealed with a mastic or appropriate seam sealer. Insulating all supply ducts is needed for efficiency of the system. Use of a third party energy rater, separate from any project team or developer, is recommended to document that the HVAC system was installed correctly.

For smaller HVAC systems, a programmable thermostat should be installed and utilized. In larger projects over 5,000 to 10,000 square feet of floor space, one should install a Building Automation System (BAS). A BAS optimizes the performance of mechanical and electrical systems by operating systems only when needed and at their peak efficiency. Typically computer controlled, a BAS can be as simple as a programmable thermostat, or a complex system that controls temperature, fan speed, daylight dimming systems, occupancy sensors. For a very modest cost, these devices can dramatically cut heating and cooling bills by allowing temperatures within the space to vary above or below the human comfort zone when the building is unoccupied.

In addition to HVAC systems themselves, Energy Recovery Ventilators are an easy way to save energy while improving the indoor air quality of an older building. Older buildings were constructed under the assumption that a reasonable amount of air leakage through the building envelope would allow for some replenishment of stale indoor air and moisture to migrate out of the building. If one seals up a structure tightly to dramatically reduce air infiltration this can lead to "stale air" and in certain circumstances, sick building syndrome. For larger commercial buildings, Energy Recovery Ventilators recover the heating or cooling (depending on the season) and transfers the energy and humidity from the exhaust air to the outside air ducts, pre-treating the incoming air and reducing the amount of energy required to temper the make-up air. In smaller buildings, such ventilators can take the place of traditional bathroom exhaust fans, pulling air out where needed and tempering the relief air in a unit that can run continuously.

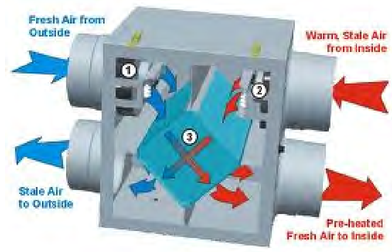


Diagram of a Energy Recovery Ventilator (image courtesy of Dpont Technologies)

<u>Electrical + Lighting</u>

One of the simplest ways to reduce electrical consumption in Main Street building rehabilitations is to replace lighting systems as appropriate to the building's historic character. Perhaps the easiest improvement is to replace standard incandescent light bulbs with compact fluorescent bulbs. This may not be appropriate where a bulb is exposed and is a decorative element in a light fixture, but even so, there are compact fluorescent bulbs that have a shroud around them making them appear as an incandescent bulb. One caveat with compact fluorescent bulbs is that specialty fixtures and/or dimmers may be needed if dimming capability is required.

LED lights will become more standard for retail stores as the purchase price comes down.

New electronic ballasts with T-8 fluorescent lights (image courtesy of Sylvania)

Light Emitting Diodes (LEDs) are also becoming very popular. These lights consume less power than fluorescent fixtures, generate less heat and have very long lamp lifes, making them good candidates for remote or difficult to reach locations. The color rendition index (CRI) of LEDs has also greatly improved over the past decade. Currently much more expensive than incandescent or fluorescent fixtures, LED prices have been dropping rapidly in recent years and may soon become viable alternatives for Main Street property owners and merchants. Automatic timers can also be installed to shut off storefront lighting when needed as well as sensor lighting for washrooms and storage areas.

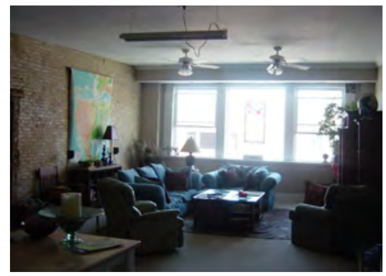
If a historic commercial building uses T-12 fluorescent lamps with magnetic ballasts, these elements should be considered for replacement. In fact many utility companies have incentive programs to help encourage building owners to make this change. It is relatively easy to change from a T-12 to a T-8 or T-5 fluorescent lamp with an electronic ballast, providing significant energy savings and frequently a higher CRI (color rendition index) value. An effective way to upgrade lighting in areas with T-12 lamps is to keep the existing fixtures, but replace the T-12 lamps and magnetic ballasts with T-8 lamps and electronic ballasts.

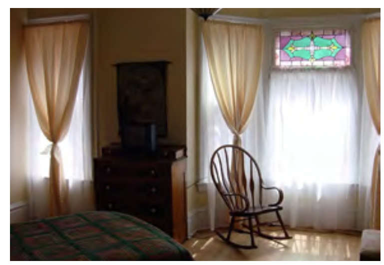
Appliances

In the greater scheme of a building rehabilitation, it may not seem to be that big of a deal, but simply specifying and installing Energy Star rated appliances can significantly cut down on a building's energy consumption. Energy Star ratings can be found for clothes washers, dehumidifiers, dishwashers, freezers, refrigerators, room air cleaners and purifiers, and water coolers.

V. Upper-Floor Development

When converting an upper story space into new offices or residential use, a property owner should follow the same strategies and recommendations for building envelope improvements and energy system upgrades as described in previous sections. Air infiltration from walls, attic, and windows and doors should be addressed and new roof systems considered in reducing heat gain and transfer to the converted space below. Existing historic windows should be repaired and rehabilitated so that sashes can be operable, broken glass panes replaced, and air leaks minimized and sealed. Storm windows should also be installed on the exterior preferably with a small weep hole, which allows any condensation and moisture to escape the space between the storm and the interior window. Ceiling fans should also be installed to cool interior spaces, especially if the resident or office tenant opens the window sashes to circulate air from the outside. For the interior upper floor space, consideration should also be given to installing Energy Star rated appliances to reduce monthly energy bills.





Upper story residential conversions are opportunities for implementing energy efficiency improvements.

When considering a rehabilitation project to create ground-level storefront retail with office and/or residential uses above, it is important to remember that different types of occupancy may or may not call for similar design solutions. Before assuming a "one size fits all" solution, study the unique demands of each type of occupancy to ascertain whether larger integrated systems make sense, or smaller independent systems are a more appropriate solution. For example, larger mechanical systems tend to be more efficient, but a single, central system might then require sub-metering if each tenant is responsible for their utility costs. Furthermore, if occupancy patterns are similar then it may make sense to consider a central system. However, if the different occupancies have significantly different operating hours then it may not make sense to have a common system as it would frequently be operating under a partial load, which is less efficient and may offset any efficiency produced by the larger central system.

VI. Design Guidelines

Many Main Street Iowa communities develop design guidelines to set the stage for the type and quality of building improvements and new development that should take place in the Main Street district. Design guidelines are used by Main Street Design Committees to manage design change and to help promote and protect the district's sense of authenticity. Effective design guidelines provide information and detailed instruction on proper building rehabilitation and preservation techniques related to façade and storefront maintenance and improvements. Specific design guidelines focus areas and topics may include building material maintenance and repair, doors and windows, cornices, transoms, awnings, signage, lighting, paint selection, alterations from the recent past, rear entries, alleys and visual merchandising. Some design guidelines may include energy efficiency improvements but they most often focus on weatherization. In addition to building rehabilitation, design guidelines also address additions, infill development and new construction to ensure that new buildings are compatible in style and form with the existing architecture and built environment.

To encourage additional energy efficiency improvements to historic commercial buildings, design guideline documents should be revised and updated to incorporate the latest information related to green and energy efficiency enhancements. Such information may include the installation of new HVAC and energy systems, such as solar panels and geothermal, green roofs, new "green" building materials, comprehensive weatherization techniques, and lighting and interior storefront improvements. Information could be organized as a separate chapter of an existing set of design guidelines or incorporated within other existing chapters related to building materials and maintenance, and façade and storefront improvements. New incentives to encourage such improvements and additional information resources should also be included within the guidelines document.

Existing Main Street Building Design Guidelines

When developing an energy efficiency chapter or elements within a set of Main Street guidelines, consider the following:

- *Conservation of Existing Materials.* Most Main Street design guidelines should already stress the maintenance and rehabilitation of existing building materials, as expressed in Standards 2 of the *Secretary of the Interior's Standards for Rehabilitation*. Additional language could be added as part of an energy efficiency chapter that reinforces the need to maintain original materials not only for their importance to the overall architecture and character of the building but also for their environmental value as "embodied" energy.

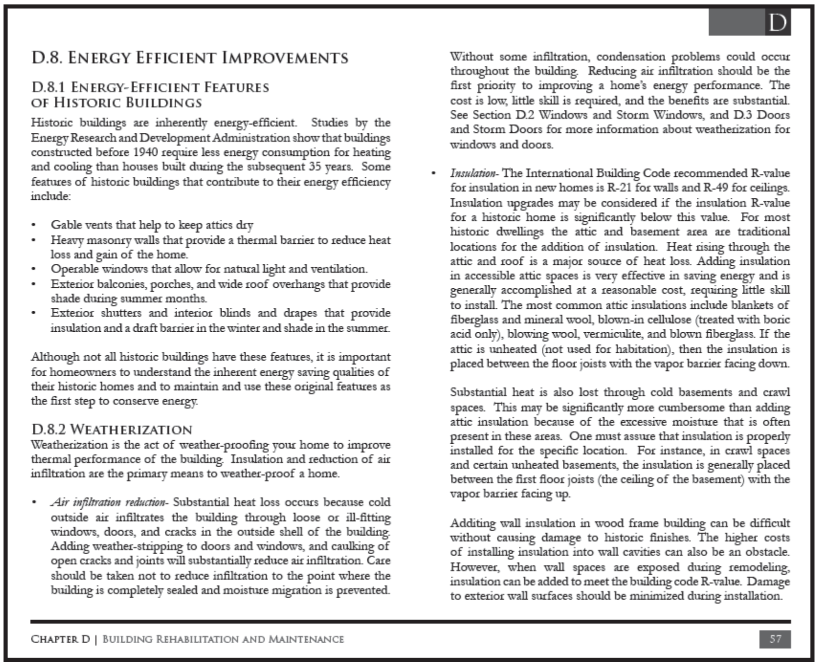
- *Inherent "Green" Building Features.* Develop a brief section describing the inherent "green" features of historic commercial buildings. These include shared party walls that conserve heat between buildings, operable awnings that can reduce heat gain within a storefront, tall ceilings and ceiling fans that moderate temperatures inside and the embodied energy represented in the construction of the building and its materials. This section can help reinforce to property and business owners that existing historic building features should be maintained to enhance a building's energy efficiency.

- *Weatherization.* If a weatherization section is not included within an existing set of guidelines, one should be developed focusing on reducing air infiltration. Clearly, doors and windows should receive priority attention for weatherstripping and caulking. Attics, basements and crawl spaces should be adequately insulated. Specific language should be added to ensure that the caulking used should be clear in color or match the color of the existing building materials.

- *Inappropriate Alterations.* Over the years, building facades and storefronts in many Main Street districts were significantly altered and lost many of their inherent green features mentioned above. Uncovering storefront transom windows and removing dropped ceilings are typical actions that could be undertaken to reverse alterations and improve energy efficiency. These actions may already be addressed in other areas of the design guidelines, such as sections on façade and storefront rehabilitation procedures, but their energy efficiency dimensions should be emphasized where needed.

- *Windows.* Maintaining or replacing windows in historic commercial buildings can be significant issues often faced by Design Committees when working with building owners. Design guidelines should emphasize the maintenance and repair of existing windows, with the installation of appropriate storms, as methods for preserving historic windows and promoting energy efficiency. These actions may already be addressed in other areas of the design guidelines, such as sections on façade and building material rehabilitation, but their energy efficiency dimensions should again be emphasized where needed.

- *Energy Generating Equipment.* There are many options today for building owners to install new heating, ventilating and air conditioning equipment to save on energy costs. Newer gas-fired energy efficient roof units are available as well as traditional boiler systems that are smaller and take up less space. Design guidelines should provide general recommendations on the types of new energy efficient HVAC systems that may be available locally from contractors rather than recommending one type of system over another, since each Main Street building is different in its size, building materials and street orientation. Main Street Design Committees should consult with local contractors about the availability and appropriateness of certain systems over others. In regards to roof-mounted systems, specific recommendations should be made to ensure that such systems are installed behind roof parapets or to rear elevations.



D

D.8. Energy Efficient Improvements

D.8.1 Energy-Efficient Features of Historic Buildings

Historic buildings are inherently energy-efficient. Studies by the Energy Research and Development Administration show that buildings constructed before 1940 require less energy consumption for heating and cooling than houses built during the subsequent 35 years. Some features of historic buildings that contribute to their energy efficiency include:

- Gable vents that help to keep attics dry
- Heavy masonry walls that provide a thermal barrier to reduce heat loss and gain of the home.
- Operable windows that allow for natural light and ventilation.
- Exterior balconies, porches, and wide roof overhangs that provide shade during summer months.
- Exterior shutters and interior blinds and drapes that provide insulation and a draft barrier in the winter and shade in the summer.

Although not all historic buildings have these features, it is important for homeowners to understand the inherent energy saving qualities of their historic homes and to maintain and use these original features as the first step to conserve energy.

D.8.2 Weatherization

Weatherization is the act of weather-proofing your home to improve thermal performance of the building. Insulation and reduction of air infiltration are the primary means to weather-proof a home.

- *Air infiltration reduction-* Substantial heat loss occurs because cold outside air infiltrates the building through loose or ill-fitting windows, doors, and cracks in the outside shell of the building. Adding weather-stripping to doors and windows, and caulking of open cracks and joints will substantially reduce air infiltration. Care should be taken not to reduce infiltration to the point where the building is completely sealed and moisture migration is prevented. Without some infiltration, condensation problems could occur throughout the building. Reducing air infiltration should be the first priority to improving a home's energy performance. The cost is low, little skill is required, and the benefits are substantial. See Section D.2 Windows and Storm Windows, and D.3 Doors and Storm Doors for more information about weatherization for windows and doors.

- *Insulation-* The International Building Code recommended R-value for insulation in new homes is R-21 for walls and R-49 for ceilings. Insulation upgrades may be considered if the insulation R-value for a historic home is significantly below this value. For most historic dwellings the attic and basement area are traditional locations for the addition of insulation. Heat rising through the attic and roof is a major source of heat loss. Adding insulation in accessible attic spaces is very effective in saving energy and is generally accomplished at a reasonable cost, requiring little skill to install. The most common attic insulations include blankets of fiberglass and mineral wool, blown-in cellulose (treated with boric acid only), blowing wool, vermiculite, and blown fiberglass. If the attic is unheated (not used for habitation), then the insulation is placed between the floor joists with the vapor barrier facing down.

  Substantial heat is also lost through cold basements and crawl spaces. This may be significantly more cumbersome than adding attic insulation because of the excessive moisture that is often present in these areas. One must assure that insulation is properly installed for the specific location. For instance, in crawl spaces and certain unheated basements, the insulation is generally placed between the first floor joists (the ceiling of the basement) with the vapor barrier facing up.

  Additing wall insulation in wood frame building can be difficult without causing damage to historic finishes. The higher costs of installing insulation into wall cavities can also be an obstacle. However, when wall spaces are exposed during remodeling, insulation can be added to meet the building code R-value. Damage to exterior wall surfaces should be minimized during installation.

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A section on energy efficiency methods and techniques for historic commercial buildings can be added to existing design guidelines (sample guidelines - The Lakota Group and Bailey Edward Architecture).

- *Solar Panels.* Solar panels and wind turbines are the two most common on-site renewable energy systems, although solar panels are more appropriate than wind turbines in Main Street districts. Since most historic commercial buildings have flat roofs, solar panels can be placed flat behind cornices and parapets, and thus not visible and ground view. These panels can also be very visible, as the panels need to face in a southern direction. This visibility can create problems in historic districts as they sometimes do not blend in with the existing architecture and disrupt viewsheds. Design guideline language should specify that solar panels be placed behind parapets and/or to the building's rear elevation. In the case the roof is not flat and has a shed of hipped form, solar panels should be placed on the rear roof elevation that is not in public view.

Design guidelines can address where solar panels should be placed on a historic commercial building. In this instance, panels should have been placed to rear where they cannot be seen at street level.

- *Green Roofs.* Much like solar panels, green roofs can lie flat and behind roof cornices and parapets. Guidelines should recommend that green roofs, especially those installed as planter boxes, be installed behind parapets so they are not visible from public view.

- *Rain Barrels.* Found more frequently in residential districts than historic commercial districts, rain barrels could be mentioned in design guidelines by specifying where they should be placed. For example, rain barrels should be placed to the rear or alley-side of a building rather than along the front and sidewalk. Rain barrels save on energy use by reducing water use for landscaping.

Expanded Design Guidelines

Many existing Main Street design guidelines focus entirely on the rehabilitation and preservation of existing buildings. However, a more comprehensive set of guidelines could also focus on other sustainable, green features related to new construction, streetscape, landscape and open space, wayfinding and signage and other green amenities. These topics can be added to existing design guidelines based on local need and Main Street design improvement objectives. Expanding design guidelines to cover topics other than buildings can help retain historic character and advance other sustainability and commercial district design practices. This can also help retain and reinforce inherent sustainable building features that also improve energy efficiency. For example, guidelines can set standards for solar shading for new buildings through awnings and canopies, including operable awnings that can be adjusted dependant on the time of year and climate.

VII. Zoning and Planning Policies

Over time, as sustainable and green technologies continue to develop and advance, design guidelines will need to be revised and updated on an ongoing basis by local Main Street programs. However, one tool that is often overlooked in promoting sustainability in Main Street districts is the local zoning code. There are several things that can be addressed to achieve sustainability and energy efficiency through the zoning code. At a basic level, zoning should be reviewed and revised to remove obstacles or unintended barriers that prevent implementation of desired commercial district sustainability goals. Zoning can also incorporate incentives to facilitate, encourage or require sustainable design improvements and initiatives on part of the private sector. The following are key items that can be more easily incorporated within a typical zoning code.


SECTION 3 NORTHEAST NEIGHBORHOOD DESIGN GUIDELINES
Design Guidelines

OPEN SPACE

Overview

A common, unifying element of the Northeast Neighborhood is its unique area open spaces. Many of these open spaces lend a sense of place, culture and history to the area.

The Northeast Neighborhood's existing open spaces range in size and activity level, from the large and active Perley School and Coquillard Park to smaller, but active, Robinson Community Learning Center and neighborhood playgrounds.

Good traditional neighborhood planning and design for new development in the Northeast Neighborhood should ensure adequate active and passive open space opportunities for its residents.

While the character, size, and detail of open space differs between residential and mixed-use/commercial areas of the Northeast Neighborhood, the following open space guidelines apply to all areas regardless of size. In many instances, the open space system helps link or create an appropriate transition between the neighborhood's predominantly single-family character and the future mixed-use/commercial and multi-family residential character of the Five Points Intersection and Eddy Street Corridor.

Convenient access and opportunities for a variety of open space components should be programmed and designed as part of new mixed-use/commercial developments at the Five Points Intersection.

A simple hierarchy of strategically placed open space elements should be implemented as new commercial or mixed-use development occurs. This hierarchy of elements may include open space elements such as:

- Pocket parks or plazas.
- Central Greens or "Commons".
- Enhanced parking area landscape islands/bioswales.
- Greenways, pedestrian linkages, or bicycle trails.
- Environmental or natural areas.
- Commercial/mixed-use area streetscapes.

While not all of these open space opportunities can occur at any one development, their collective use and integration should be ensured within the Five Points commercial mixed-use area, and the surrounding Northeast Neighborhood.

Open space elements in commercial/mixed-use areas may take numerous forms such as a pocket park or plaza.

When little or no open space opportunities can occur within any mixed-use/commercial development, these guidelines will ensure that architectural treatments of the development include unique, high-quality place making elements such as clocks, fountains, tower elements, or the like. In general, all open space elements should ensure the following characteristics:

- Promote safe and effective linkages for pedestrians, bicyclists, and motorists.
- Be pedestrian-oriented and accessible/barrier-free.
- Be highly-visible, well lit, and easy to use or maintain.
- Be "focal points, activity nodes, or landmarks" for the neighborhood.
- Be located, when feasible, within central areas of the Five Points commercial/mixed-use area or at key intersections.
- Link existing open space systems within the district and neighborhood.
- Provide elements of landscape plant material or "green space."
- Provide an appropriate balance of hardscape and softscape features.
- Be designed with low-maintenance natural or native landscape plant materials.
- Provide for functional seating and bicycle parking
- Assist in reducing the "urban heat island" effect and storm water runoff.

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An expanded set of design guidelines can cover topics such as new construction and streetscape and landscape standards to encourage additional commercial district green improvements (sample guidelines - The Lakota Group).

ENERGY

- *Solar Collectors.* Zoning should be revised to allow solar collectors and panels, but as mentioned previously in the design guidelines section, ensure that they are not visible from a building's front elevation. Ideally, they should be installed at the building's rear elevation or as part of an accessory structure, such as a garage. Solar access should also be addressed in the zoning code so that owners know their solar collector investment is protected from future development that may block solar access.

- *Exterior Insulation.* There may be barriers within the zoning that make it challenging to add additional insulation, especially exterior to existing walls. If it is the community's desire to allow or encourage exterior insulation, the ordinance should be reviewed to make sure that setbacks and floor area ratio calculations do not create a barrier to increased insulation.

- *Lighting.* It has been recognized that light pollution and light spillover, light that extends beyond its original target, wastes energy to more than $2.2 billion a year (International Dark Sky Association). Lighting ordinances can be adopted to encourage more energy efficient lighting systems and to regulate exterior lighting fixtures and light spillover from buildings and parking lots to adjacent areas where lighting is not needed. In some parts of the country, communities have adopted "dark sky" ordinances to preserve night time views by regulating light spillover upwards into the sky.

New lighting standards today can be fitted with fixtures that point light downward to minimize spillage.

LAND-USE

- *Mixed-use.* A Main Street district zoning code should allow for a variety of uses to diversify its economic base and encourage the reuse of historic commercial buildings and their upper floors. In many Main Street communities across the country, zoning codes may prohibit upper floor residential use. Upper story conversions may be opportunities for property owners to plan and implement energy efficiency improvements as well as encourage new office tenants and residents to walk, rather than drive, to commercial district stores, institutions and other attractions.

Traditional commercial districts have always been mixed-use centers although zoning codes tend to disallow some economic uses over others.

- *Rainwater Harvesting.* Ensure that rain barrels and cisterns are allowed as accessory uses in Main Street districts and regulate their on-site placement and installation to maintain desired historic character.

- *Irrigation.* Consider requiring high-efficiency irrigation systems that feature enhancements like root zone or drip heads and weather stations to improve performance and reduce demands on potable water.

- *Parking Requirements.* Additionally, some zoning codes require excessive amounts of parking for upper floor conversions to occur. Reduce parking requirements and consider shared parking allowances or maximum parking requirements to encourage more walking and bicycling or increases density where appropriate.

Building Reuse

- *Parking/Loading Requirements.* Consider allowing existing parking quantities to satisfy parking requirements if an existing building is adapted for a different use.

- *Reuse Variances.* Consider removing any existing barriers to reuse created by required zoning variances.

Others

- *Composting.* Expressly allow or encourage small scale on-site composting practices and programs, which will reduce the amount of organic materials sent to landfills.

- *Local Food Production.* Consider expressly allowing urban agriculture and/or community gardens as a land use, reducing the energy needed to transport food.

VIII. Resources

Incentives

The following incentive programs should be promoted as a way to encourage energy efficiency improvements.

- *Federal Historic Preservation Tax Credits.* Commercial or income-producing properties that are eligible or individually listed in the National Register of Historic Places, or a contributing commercial property in a National Register Historic District, are eligible to receive a 20 percent Historic Preservation Tax Credit for qualified rehabilitation expenditures including energy efficiency improvements. A 10 percent tax credit is available for non-historic buildings built before 1936. Consult the State Historical Society of Iowa for additional information.

- *Iowa State Historic Preservation Tax Credits.* The State of Iowa also provides a 25 percent Historic Preservation Tax Credit for eligible commercial properties. Consult the State Historical Society of Iowa for additional information.

- *Local Incentives.* Local governments and non-profit organizations can develop new incentives to encourage energy efficiency improvements in their traditional commercial districts. Existing facade and building improvement grant programs can be retooled to encourage specific energy efficiency improvements in addition to typical facade and storefront rehabilitation activities. A new revolving loan fund, developed by local financial institutions, can also be developed to facilitate other improvements including the purchase of new interior lighting and energy saving appliances.

Preservation Briefs

Developed by the National Park Service, *Preservation Briefs* provide technical information and guidance on appropriate methods for preserving and rehabilitating historic buildings. All 47 *Preservation Briefs* are available for download from the **National Park Service** or in hard copy from the **U.S. Government Printing Office.** Of interest to commercial building owners is Brief #3: Conserving Energy in Historic Buildings, by Baird M. Smith, AIA (currently under revision with new version available in late 2011) and *Brief #44: The Use of Awnings on Historic Buildings: Repair, Replacement & New Design* by Chad Randl.

Publications

Iowa Green Streets Criteria, Iowa Economic Development Authority, iowaeconomicdevelopment.com/community/green_initiatives.aspx

The Secretary of Interior's Standard for Rehabilitation and Illustrated Guidelines On Sustainability for Rehabilitating Historic Buildings. Anne E. Grimmer with Jo Ellen Hensley, Liz Petrella and Audrey T. Tepper. National Park Services, 2011

Sustainable Design and Historic Preservation. Sharon C. Park, AIA. Cultural Resource Management. National Park Service, 1998.

Sustainable Preservation: Greening Existing Buildings. Jean Caroon, AIA, LEED AP. New York, Wily Press, 2010.

Organizations

Main Street Iowa/Iowa Economic Development Authority
Des Moines, Iowa
515.725.3000
iowaeconomicdevelopment.com/community/mainstreetiowa/

State Historical Society of Iowa
Des Moines, Iowa
515.281.5111
www.iowahistory.org/historic-preservation

National Park Service, Technical Preservation Services
Washington, D.C.
202.343.9573
www.nps.gov/history/hps/tps/index.htm

Association for Preservation Technology International
Springfield, Illinois
217.529.9039
www.apti.org

The National Trust for Historic Preservation
Washington, D.C.
202.673.4000
www.preservationnation.org

The National Trust Chicago Field Office
Chicago, Illinois
312.939.5547
www.preservationnation.org/contacts/field-offices/chicago.html

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